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Gestational Weight Gain, Body Mass Index, and Risk of Hypertensive Disorders of Pregnancy in a Predominantly Puerto Rican Population

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Abstract

Objectives—To prospectively evaluate the association between gestational weight gain (GWG), prepregnancy body mass index (BMI), and hypertensive disorders of pregnancy using the revised Institute of Medicine (IOM) Guidelines.

Methods—We examined these associations among 1359 participants in Proyecto Buena Salud, a prospective cohort study conducted from 2006 to 2011 among women from the Caribbean Islands. Information on prepregnancy BMI, GWG, and incident diagnoses of hypertension in pregnancy were based on medical record abstraction.

Results—Four percent ($n = 54$) of women were diagnosed with hypertension in pregnancy, including 2.6 % ($n = 36$) with preeclampsia. As compared to women who gained within IOM GWG guidelines (22.8 %), those who gained above guidelines (52.5 %) had an odds ratio of 3.82 for hypertensive disorders (95 % CI 1.46–10.00; $p_{\text{trend}} = 0.003$) and an odds ratio of 2.94 for preeclampsia (95 % CI 1.00–8.71, $p_{\text{trend}} = 0.03$) after adjusting for important risk factors. Each one standard deviation (0.45 lbs/week) increase in rate of GWG was associated with a 1.74 odds of total hypertensive disorders (95 % CI 1.34–2.27) and 1.86 odds of preeclampsia (95 % CI 1.37–2.52).

Conclusions for Practice—Findings from this prospective study suggest that excessive GWG is associated with hypertension in pregnancy and could be a potentially modifiable risk factor in this high-risk ethnic group.

Keywords

Body mass index; Gestational hypertension; Gestational weight gain; Preeclampsia; Latina

Introduction

Hypertensive disorders of pregnancy affect approximately 1–8 % of pregnancies in the United States depending upon the population studied [1, 2] and include gestational hypertension and preeclampsia. Preeclampsia is one of the leading causes of maternal and perinatal morbidity and mortality worldwide [3] and is associated with an increased risk of preterm delivery, neonatal intensive-care unit admission, and fetal death [4]. Women with gestational hypertension are at risk for subsequent hypertension and stroke later in life [5].

Latina women have higher rates of risk factors for preeclampsia such as insulin resistance, type 2 diabetes mellitus, and gestational diabetes mellitus compared with non-Latina white women and are therefore at increased risk for hypertensive disorders of pregnancy [6]. Prevention of preeclampsia among Latina women is critically important as Latinas are the largest minority group in the U.S., with the highest birth rates of any minority group [7].

There are few known modifiable risk factors for pregnancy hypertensive disorders, but recent evidence suggests that excessive gestational weight gain (GWG) and elevated prepregnancy body mass index (BMI) may be important factors. While prior research has suggested an increased risk of hypertensive disorders of pregnancy for overweight or obese women, studies have been limited to predominantly non-Latina white populations. However, Latina women are more likely to begin their pregnancies overweight or obese as compared to non-Latina white women with almost half entering pregnancy in these categories [8–10]. In addition, the number of Latina women with both elevated BMI and excessive GWG has been increasing over time [11, 12].

In 2009, the Institute of Medicine updated its 1990 recommendations for GWG in light of the changing racial/ethnic, sociodemographic, and weight composition of pregnant women over the past decades [13]. However, few studies have examined the association between the current Institute of Medicine guidelines and risk of hypertensive disorders of pregnancy.

Therefore, we prospectively examined the relationship between GWG, prepregnancy BMI, and hypertensive disorders of pregnancy in a cohort of Latina prenatal care patients from the Caribbean Islands.

Methods and Procedures

Setting

Proyecto Buena Salud was a prospective cohort study based in the obstetrical practices of Baystate Health, an integrated health system in Western Massachusetts from 2006 to 2011.

Details of the study have been published [9]. Briefly, the overall goals were to evaluate the association between psychosocial stress, physical activity, and risk of gestational diabetes mellitus among Latina women. Bilingual interviewers recruited patients at a prenatal care visit early in pregnancy (up to 20 weeks gestation), informed them of the aims and procedures of the study, and obtained written informed consent. The research was conducted in accord with prevailing ethical principles and reviewed and approved by the Institutional Review Boards of the University of Massachusetts-Amherst and Baystate Health. Interviews were conducted in Spanish or English based on patient preference in order to eliminate potential language or literacy barriers.

At the time of enrollment (mean = 12.4 weeks gestation), interviewers collected information on socio-demographic, acculturation, and behavioral factors. After delivery, medical records were abstracted for medical and obstetric history and clinical characteristics of the current pregnancy.

Eligibility

Eligibility was restricted to women of Puerto Rican or Dominican Republic heritage (Caribbean Islanders). Exclusion criteria included: (1) current medications thought to adversely influence glucose tolerance, (2) multiple gestation, (3) history of diagnosis of diabetes, hypertension, heart disease or chronic renal disease, and (4) aged younger than 16 years or older than 40 years.

A total of 1626 prenatal care patients were enrolled. For the purposes of the current analysis, we excluded 68 (4 %) participants who experienced a miscarriage, 138 (8 %) participants who did not deliver at Baystate Health, 44 (3 %) participants missing information on gestational age at the time of interview, and 1 (0.1 %) participant missing information on pregnancy hypertension. From the remaining group of 1375 participants, we then excluded 13 women missing prepregnancy height or weight and 3 women missing covariate information from the analysis for a final sample size of 1359 for analyses with prepregnancy BMI as the primary exposure variable. For analyses with GWG as the primary exposure variable, we excluded 79 women missing information on weight closest to delivery and 3 women missing covariate information, for a final sample size of 1293 for these analyses.

Assessment of Prepregnancy BMI

Prepregnancy weight was either self-reported to the interviewer at the time of recruitment (86.3 %) or self-reported to the practitioner at the time of the first prenatal care visit and recorded in the medical record (13.2 %). If prepregnancy weight was not available from either of these sources, it was based upon measured weight at the first prenatal care visit (0.5 %). The validity of self-reported prepregnancy weight has been shown to be high, especially if collected early in pregnancy [14–16]. A recent validation study found a strong correlation ($r = 0.95$, $p = 0.0001$) between self-reported prepregnancy weight and physician measured weight from the year before pregnancy with a mean discrepancy of 0.5 ± 3.0 kg and no significant ($p = 0.64$) differences between normal weight and overweight/obese subjects [17].

Prepregnancy BMI was classified using the Institute of Medicine classifications: underweight (BMI < 18.5 kg/m²), normal weight (18.5 kg/m² ≤ BMI < 25 kg/m²), overweight (25 kg/m² ≤ BMI < 30 kg/m²) and obese (BMI ≥ 30 kg/m²) [13]. We also created a dichotomous prepregnancy BMI variable (i.e., obese vs. non-obese).

Assessment of Gestational Weight Gain

Weight at delivery was abstracted from the medical record. Total GWG was defined as the difference between maternal weight closest to delivery and maternal prepregnancy weight. GWG was considered as a continuous variable and also categorized as ‘below guidelines’, ‘within guidelines’, or ‘above guidelines’ based on the IOM’s 2009 prepregnancy BMI-specific GWG guidelines [13]. Specifically, underweight women are advised to gain 28–40 lbs., normal weight women are advised to gain 25–35 lbs., overweight women are advised to gain 15–25 lbs., and obese women are advised to gain 11–20 lbs.

To account for gestational age at delivery, we also calculated rate of GWG as the difference between weight at delivery and maternal prepregnancy weight divided by the gestational age at delivery. In addition, rate of GWG was categorized according to the 2009 IOM guidelines as ‘below guidelines’, ‘within guidelines’, or ‘above guidelines’. Specifically, after the first trimester, underweight women are advised to gain 1.0–1.3 lbs per week, normal weight women are advised to gain 0.8–1.0 lbs per week, overweight women are advised to gain 0.5–0.7 lbs per week, and obese women are advised to gain 0.4–0.6 lbs per week [13].

Hypertensive Disorders of Pregnancy

A trained medical record abstractor conducted detailed reviews of prenatal records including delivery logs to ascertain hypertension status. Diagnoses were then confirmed by the study obstetrician who reviewed the medical records of each suspected case.

The diagnosis of gestational hypertension was based on the American College of Obstetricians and Gynecologists task force on hypertension in pregnancy [18]. Specifically, gestational hypertension was defined as two blood pressure measurements greater than 140/90 after 20 weeks gestation in a previously normotensive woman, with no lab evidence or symptoms of preeclampsia [18]. Preeclampsia was defined as the new onset of hypertension (BP ≥ 140/90 mmHg) after 20 weeks of gestation in association with proteinuria, either 1+ by dipstick or ≥ 300 mg/24 h in the absence of urinary infection [18]. Finally, consistent with recent studies [19–21], total hypertensive disorders of pregnancy was defined as both preeclampsia and gestational hypertension combined.

Covariates

At the time of enrollment, interviewers collected information on sociodemographic factors, birth place, and language preference for speaking/reading (English, Spanish). Acculturation was assessed using the Psychological Acculturation Scale (PAS) [22]. Prepregnancy smoking was assessed using questions designed by the Pregnancy Risk Assessment Monitoring System (PRAMS) [23]. Parity was abstracted from medical records and classified as 0, 1, or 2+.

Data Analyses

Multivariable logistic regression was used to model the relationship between each of the exposures of interest (i.e., prepregnancy BMI, total GWG, rate of GWG, meeting IOM guidelines for total GWG and for rate of GWG) and risk of overall hypertensive disorders of pregnancy. Similarly multivariable logistic regression was used to model the relationship between each of the exposures and risk of preeclampsia. Odds ratios (ORs) and 95 % confidence intervals (CI) were calculated. Models adjusted for factors associated with hypertensive disorders of pregnancy in the prior literature (i.e., age and parity). Confounding by additional variables was assessed by evaluating changes in the ORs for prepregnancy BMI or GWG when each covariate was included in the regression model. A change of 10 % or greater was used as an indicator of confounding. Based on this technique, prepregnancy smoking, number of children in the household, and acculturation status were found to be additional confounders. Due to the low incidence of gestational hypertension without preeclampsia ($n = 18$; 1.3 %), we were unable to evaluate this outcome separately.

Tests for trend across ordered categories were performed by modeling the categorical BMI and GWG variables as continuous variables (i.e., 1, 2, 3, 4 corresponding to underweight, normal weight, overweight, and obese BMI; and 1, 2, 3 corresponding to below, within, and above IOM GWG guidelines, respectively). Finally we compared participants who were missing information on our exposures of interest to those not missing information on covariates. Statistical analysis was conducted using SAS (Version 9.3, SAS Institute Inc., Cary, North Carolina).

Results

Among the 1359 study participants, 4 % ($n = 54$) of women were diagnosed with a hypertensive disorder of pregnancy including 2.6 % ($n = 36$) with preeclampsia. A total of 310 (22.8 %) women were categorized as obese, 324 (23.8 %) were overweight, 644 (47.3 %) were normal weight, and 84 (6.2 %) were underweight prior to pregnancy. Approximately one-fifth of women (261, 20.2 %) gained below guidelines for GWG, 353 (27.3 %) gained within guidelines, and more than half (679, 52.5 %) gained above guidelines.

Women who gained above IOM GWG guidelines were more likely to be overweight and obese, have higher education levels, and be born in the continental US as compared to women who gained below or within guidelines (Table 1). Age, annual household income, marital status, acculturation, smoking prior to pregnancy and other sociodemographic factors were not associated with compliance with IOM GWG guidelines. All study participants had gestational ages less than or equal to 42.1 weeks, within normal delivery limits.

We then examined the association between total GWG and hypertensive disorders of pregnancy (Table 2). In unadjusted analyses, as compared to women who gained within IOM GWG guidelines, those who gained above guidelines had an odds ratio of 4.13 for hypertensive disorders (95 % CI 1.61–10.58; $p_{\text{trend}} = 0.002$). This finding was slightly attenuated after adjustment for age, prepregnancy BMI, parity, and prepregnancy smoking

but remained statistically significant (OR 3.82, 95 % CI 1.46–10.00; $p_{\text{trend}} = 0.003$). Every 5-pound increase in GWG was associated with a 14 % increase in odds (95 % CI 1.05–1.23).

We then examined the association between rate of GWG and hypertensive disorders of pregnancy. In fully adjusted models, as compared to women who gained within IOM guidelines for rate of GWG, those who gained at a rate above guidelines did not have a statistically significant increase in odds of hypertensive disorders (OR 1.93, 95 % CI 0.85–4.36) although the test across categories of compliance (below to above) was statistically significant ($p = 0.04$) (Table 2). Similarly, every one standard deviation (SD = 0.45) increase in rate of GWG was associated with a 1.74 odds of total hypertensive disorders (95 % CI 1.34–2.27).

Findings for the association between GWG and preeclampsia were similar (Table 2). In unadjusted analyses, as compared to women who gained within IOM GWG guidelines, those who gained above guidelines had an odds ratio of 3.33 for preeclampsia (95 % CI 1.15–9.65; $p_{\text{trend}} = 0.02$) which was slightly attenuated but remained statistically significant in multivariable models (OR 2.94, 95 % CI 1.00–8.71, $p_{\text{trend}} = 0.03$). Every 5-pound increase in GWG associated with a 15 % increase in odds of preeclampsia (95 % CI 1.05–1.27).

In terms of rate of GWG, in fully adjusted models, as compared to women who gained within IOM guidelines for rate of GWG, those who gained at a rate above guidelines did not have a statistically significant increase in odds of preeclampsia (OR 1.65, 95 % CI 0.64–4.25), nor was there a statistically significant trend across categories of compliance ($p_{\text{trend}} = 0.14$) (Table 2). Every one standard deviation increase in rate of GWG was associated with a 1.86 odds of preeclampsia (95 % CI 1.37–2.52).

We then examined the association between prepregnancy BMI and hypertensive disorders of pregnancy (Table 3). In unadjusted analyses, as compared to normal weight women, obese women had an odds ratio of 1.23 for hypertensive disorders of pregnancy (95 % CI 0.63–2.41), however this finding was not statistically significant. After further adjustment for age, parity, smoking prior to pregnancy, number of children in the household, and acculturation status, the odds ratio was 1.37 (95 % CI 0.68–2.77, $p_{\text{trend}} = 0.20$). When we evaluated prepregnancy BMI as a continuous variable, we observed a 4 % increased odds of hypertensive disorders for every unit increase in BMI (95 % CI 0.99–1.08), however this was not statistically significant.

Findings were similar when we evaluated prepregnancy BMI as a dichotomous variable (OR 1.25, 95 % CI 0.65–2.38 for obese vs. nonobese).

Findings for the association between prepregnancy BMI and preeclampsia were similar (Table 3). In unadjusted analyses, as compared to normal weight women, obese women had an odds ratio of 1.18 for preeclampsia (95 % CI 0.52–2.70) which was strengthened, but remained non-significant in multivariable models (OR 1.36, 95 % CI 0.57–3.20, $p_{\text{trend}} = 0.24$). Findings were again similar when we evaluated prepregnancy BMI as a dichotomous variable (OR 1.21, 95 % CI 0.55–2.67 for obese vs. nonobese).

A total of 79 participants (6 %) were missing GWG data. We observed no significant differences between women with weight gain data and those missing weight gain data in regards to age, marital status, number of children and adults in the household, generation in the US, language preference, acculturation status, and parity. However, women missing weight gain data were more likely to have less than a high school education (67.4 vs. 47.6 %, $p = 0.01$) and not know/refuse to report their annual household income (75.9 vs. 52.9 %, $p = 0.0007$). A total of 13 participants (0.9 %) were missing prepregnancy BMI data. We observed no significant differences between women with BMI data and those missing BMI data in regards to education, annual household income, marital status, number of children and adults in the household, generation in the US, language preference, acculturation status, and parity. However, women missing BMI data were more likely to be 30 years or older (38.5 vs. 11.7 %, $p = 0.03$).

Finally, we compared gestational age at delivery in women who developed preeclampsia as compared to those who were free of hypertensive disorders of pregnancy. The preeclamptic group delivered slightly earlier (mean, 36.5 weeks; SD = 3.9) as compared to the normotensive group (mean, 39 weeks; SD = 2.5; $p < .0001$).

Discussion

In this prospective cohort of Latina women of predominantly Puerto Rican descent, we found that women who gained above IOM GWG guidelines had nearly a fourfold odds for hypertensive disorders and a threefold odds of preeclampsia relative to women who gained within the guidelines. Each additional five pounds of total GWG were associated with 14–15 % higher odds of hypertensive disorders of pregnancy and preeclampsia. Similarly, each additional 0.4 lbs/week increase in rate of GWG was associated with a 74–86 % higher odds of hypertensive disorders and preeclampsia. We did not observe statistically significant associations between prepregnancy BMI and risk of hypertensive disorders of pregnancy or preeclampsia.

Studies of GWG and hypertension in pregnancy are sparse and conflicting [13]. In one of the only studies to use the revised 2009 Institute of Medicine gestational weight guidelines, de la Torre et al. [19] conducted an analysis using a large database containing clinical data collected prospectively from high-risk pregnant women throughout the US. The authors found that women who exceeded weight gain guidelines had 1.75 times the odds of hypertension in pregnancy (a combined variable of both gestational hypertension and preeclampsia) as compared to women who met recommendations (95 % CI 1.1–2.16). In the only prior study limited to Latina women [24], Fortner et al. evaluated this association among 1231 women from the Caribbean Islands in the prospective Latina Gestational Diabetes Mellitus Study. Using the 1990 IOM guidelines, the authors similarly found that women with excessive GWG had a threefold increased risk of a hypertensive disorder of pregnancy (95 % CI 1.1–7.2) and a fourfold risk of preeclampsia (95 % CI 1.2–14.5) compared with women who gained within guidelines. In the current study, we found that those with excessive weight gain had a fourfold increase in risk of a hypertensive disorder and a threefold increased risk of preeclampsia after controlling for pregravid BMI.

While we did not observe significant associations between prepregnancy BMI and odds of hypertensive disorders of pregnancy, our findings were in the same direction of those reported in previous studies in predominantly non-Latina white populations suggesting an increased risk of hypertensive disorders of pregnancy for overweight or obese women [13]. Few studies have examined this association in Latina women [1, 24]. For example, Wolf et al. conducted a prospective cohort study of 3244 women, 863 (27 %) of whom were from Central and South America and Puerto Rico. While findings were not stratified by ethnicity, the relative risk was 1.04 (95 % CI 1.01–1.07) for gestational hypertension and 1.07 (95 % CI 1.04–1.10) for preeclampsia for each unit increase in BMI (kg/m^2) [1]. Similarly, we found that each unit increase in BMI was associated with a 1.04 (95 % CI 0.99–1.08) increased odds of total hypertensive disorders and 1.03 (95 % CI 0.98–1.09) odds of preeclampsia.

In their cohort of women from the Caribbean Islands, Fortner et al. [24] found stronger associations. In multivariable analyses, obese women ($\text{BMI} > 29 \text{ kg}/\text{m}^2$) had 2.5 times the risk of hypertensive pregnancy (95 % CI 1.3–4.8) and 2.7 times the risk of preeclampsia (95 % CI 1.2–5.8) compared to normal weight women (19.8–26.0 kg/m^2). However, the authors' findings for a one unit increase in BMI were similar to the current study (1.09 for hypertensive disorders and 1.07 for preeclampsia) [24]. Differences in findings could be due, in part, to the use of the older 1990 IOM cut points for prepregnancy BMI [25].

Our study faces several limitations. Although the incidence of total hypertensive disorders of pregnancy in our cohort of predominantly Puerto Rican women was 4 %, the incidence of preeclampsia was lower (2.6 %), limiting the statistical power to detect associations for this outcome. However, our rates were comparable to those observed among similar Latina subgroups. For example, Wolf et al. [1] observed rates of preeclampsia and gestational hypertension of 3.8 and 1.6 %, respectively, among Central and South American participants in the Massachusetts General Hospital Obstetric Maternal Study. In a predominantly Puerto Rican population in New York State, Tanaka et al. observed rates of preeclampsia and gestational hypertension of 3.0 and 1.2 %, respectively [26].

A second limitation is the possibility of misclassification between gestational hypertension and preeclampsia. However, because the diagnosis of preeclampsia required documentation of proteinuria, it is most likely that women with preeclampsia would be misclassified as having gestational hypertension [1]. This could result in greater similarity in our observed findings for gestational hypertension and preeclampsia than truly exist for these disorders [1].

Given the typically shorter duration of pregnancy in preeclamptic women, and thus shorter opportunity for weight gain, it is possible that the impact of excessive GWG on odds of preeclampsia was actually underestimated in this study. We found that women with preeclampsia had, on average, 2.5 week lower gestational age as compared to normotensive women, suggesting this underestimation was not extensive.

Insufficient statistical power may be a potential explanation for the lack of statistically significant findings for prepregnancy BMI and risk of hypertensive disorders. However,

while the majority of confidence intervals do not provide statistically significant evidence, they do not rule out an increase in risk for obese and overweight women. It is also reassuring to note that we did observe statistically significant findings for gestational weight gain and risk of hypertensive disorders, reducing this concern for the gestational weight gain analysis.

In summary, in this prospective study among a predominantly Puerto Rican population, we observed a strong, significant relationship between excessive GWG and hypertensive disorders of pregnancy. Our observations are consistent with the findings of prior prospective studies conducted among predominantly non-Latina white populations and extend these findings to a Latina population. Given that gestational weight gain is a potentially modifiable risk factor, women should be encouraged and supported to avoid excessive weight gain during pregnancy regardless of their prepregnancy BMI. This is particularly critical in light of the association between excessive GWG and postpartum weight retention which, in turn, is a significant contributor to the US obesity epidemic and has been implicated in the intergenerational cycle of obesity. The results of the current study yield important implications for prenatal counseling which, if adopted by pregnant women, could modify their risk of hypertensive disorders of pregnancy.

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Significance**What Is Already Known on This Subject**

1. Latina women are at increased risk for hypertensive disorders of pregnancy as compared to non-Latina white women.
2. Prior studies have been limited to predominantly non-Latina whites and few utilized current 2009 Institute of Medicine recommendations for gestational weight gain.

What This Study Adds

1. Excessive gestational weight gain is associated with hypertension in pregnancy in Latina women from the Caribbean Islands.
2. Women who gained above guidelines had a threefold odds of preeclampsia.
3. Gestational weight gain could be a potentially modifiable risk factor in this high-risk ethnic group.

Table 1
Participant characteristics according to compliance with gestational weight gain (GWG) guidelines (n = 1359)

	Total sample (n = 1359)	Compliance with gestational weight gain guidelines		p value
		Below guidelines (n = 261, 20.2 %)	Within guidelines (n = 353, 27.3 %)	Above guidelines (n = 679, 52.5 %)
	%	%	%	%
Prepregnancy BMI (kg/m ²)				
Underweight (<18.5)	6.2	10.0	9.9	2.8
Normal weight (18.5 to <25.0)	47.3	52.9	55.0	43.6
Overweight (25.0 to <30)	23.8	13.8	18.1	30.0
Obese (30+)	22.7	23.4	17.0	23.6
Age (years)				
Less than 19	31.4	32.2	31.2	31.2
19–23	39.2	41.8	39.1	38.6
24–29	17.6	15.7	19.0	17.8
30 and Above	11.8	10.3	10.8	12.4
Educational status				
Less than high school	43.3	51.7	43.6	40.1
High school graduate	29.5	29.5	28.6	32.0
Some college/graduate	16.9	11.9	16.2	19.7
Annual household income				
<\$15,000	26.8	29.5	27.5	26.2
>\$15,000–\$30,000	13.5	9.6	14.2	15.6
>\$30,000	5.7	5.0	6.2	6.0
Don't know/refused/missing	54.1	55.9	52.1	52.1
Marital status				
Single/divorced/separated/widowed	77.4	81.2	75.9	78.8
Married	9.7	9.2	10.2	10.0
Live with spouse/partner				
No	43.4	46.4	42.8	43.7
				0.82

	Total sample (n = 1359)	Compliance with gestational weight gain guidelines			p value
		Below guidelines (n = 261, 20.2 %)	Within guidelines (n = 353, 27.3 %)	Above guidelines (n = 679, 52.5 %)	
Yes	45.2	45.6	43.9	47.1	
Children (<18 years) in household ^a					
0	17.0	14.9	15.3	19.2	0.07
1	31.5	34.1	27.5	34.0	
2	21.9	23.8	22.4	21.5	
3+	17.0	18.4	20.7	14.7	
Adults (≥ 18 years) in household ^a					
1	23.1	23.8	22.7	23.9	0.77
2	42.7	42.9	43.6	43.7	
3+	23.2	26.4	20.4	23.6	
Born in Puerto Rico/dominican republic					
No	51.2	45.6	49.0	55.1	0.02
Yes	45.3	51.3	47.3	41.7	
Acculturation status ^b					
Low <3	67.2	71.7	64.0	69.2	0.75
High ≥ 3	17.2	18.0	18.1	17.2	
Language preference					
English	78.2	75.9	79.3	78.8	0.54
Spanish	21.9	24.1	20.7	21.2	
Pregnancy smoking					
No	60.1	67.1	59.8	58.9	0.17
Yes	29.5	26.8	28.6	32.0	
Parity					
0	41.7	38.3	40.2	44.0	0.24
1	29.9	33.0	28.6	30.5	
2	28.4	28.7	31.2	25.5	

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Proyecto Buena Salud, Western Massachusetts, 2006–2011
According to 2009 Institute of Medicine (IOM) guidelines
N may not total to 1359 due to missing data
BM/body mass index

^a Including the participant as appropriate: if <18 years, included as a child; if >18 years, included as an adult

^b Acculturation is measured by the Psychological Acculturation Scale and ranges from 1 to 5

Table 2

Hypertensive disorders of pregnancy according to total and rate of gestational weight gain (GWG) and meeting Institute of Medicine Guidelines for total and rate of GWG; Proyecto Buena Salud, Western Massachusetts, 2006–2011

	Cases		Unadjusted		Age-, BMI-, and parity-adjusted		Fully-adjusted ^b				
	n	%	OR	95 % CI	OR	95 % CI	OR	95 % CI			
<i>Hypertensive disorders of pregnancy</i>											
Total GWG											
Compliance with total GWG guidelines ^a											
Below guidelines	8	3.07	2.20	0.71	6.81	2.28	7.13	2.09	0.67	6.54	
Within guidelines	5	1.42	Referent			Referent		Referent			
Above guidelines	38	5.60	4.13	1.61	10.58	3.77	1.44	9.81	3.82	1.46	10.00
<i>p-trend</i>			0.002			0.004			0.003		
Continuous GWG (1-pound units)			1.02	1.01	1.04	1.02	1.01	1.04	1.03	1.01	1.04
Continuous GWG (5-pound units)			1.12	1.04	1.21	1.13	1.04	1.22	1.14	1.05	1.23
Rate of GWG											
Compliance with GWG rate guidelines											
Below guidelines	10	2.18	0.76	0.30	1.94	0.80	0.31	2.07	0.72	0.28	1.87
Within guidelines	8	2.87	Referent			Referent			Referent		
Above guidelines	33	5.95	2.14	0.98	4.70	1.98	0.88	4.44	1.93	0.85	4.36
<i>p-trend</i>			0.01			0.04			0.04		
Continuous rate of GWG (1 SD)			1.56	1.23	1.98	1.63	1.27	2.09	1.74	1.34	2.27
<i>Preeclampsia</i>											
Total GWG											
Compliance with total GWG guidelines ^a											
Below guidelines	5	1.92	1.70	0.45	6.40	1.75	0.46	6.63	1.61	0.42	6.12
Within guidelines	4	1.13	Referent			Referent			Referent		
Above guidelines	25	3.68	3.33	1.15	9.65	2.92	0.99	8.62	2.94	1.00	8.71
<i>p-trend</i>			0.02			0.04			0.03		
Continuous GWG (1-pound units)			1.03	1.01	1.05	1.03	1.01	1.05	1.03	1.01	1.05
Continuous GWG (5-pound units)			1.14	1.04	1.25	1.14	1.04	1.26	1.15	1.05	1.27

	Cases		Unadjusted			Age-, BMI-, and parity-adjusted			Fully-adjusted ^b		
	n	%	OR	95 % CI		OR	95 % CI		OR	95 % CI	
Rate of GWG											
Compliance with GWG rate guidelines											
Below guidelines	6	1.31	0.60	0.19	1.89	0.64	0.20	2.04	0.59	0.19	1.87
Within guidelines	6	2.15	Referent			Referent			Referent		
Above guidelines	22	3.96	1.88	0.75	4.69	1.69	0.66	4.32	1.65	0.64	4.25
<i>p-trend</i>		0.05				0.14			0.14		
Continuous rate of GWG (1 SD)			1.65	1.26	2.16	1.74	1.30	2.33	1.86	1.37	2.52

^a According to 2009 Institute of Medicine (IOM) guidelines

^b Additionally adjusted for prepregnancy smoking

Hypertensive disorders of pregnancy according to prepregnancy Body Mass Index (BMI) Proyecto Buena Salud, Western Massachusetts, 2006–2011

Table 3

	Cases		Unadjusted		Age- and parity-adjusted		Fully-adjusted				
	n	%	OR	95 % CI	OR	95 % CI	OR	95 % CI			
<i>Hypertensive disorders of pregnancy</i>											
Prepregnancy BMI (kg/m ²)											
Underweight (<18.5)	2	2.38	0.63	0.15	2.71	0.60	0.14	2.62	0.55	0.13	2.44
Normal weight (18.5 to <25.0)	24	3.73	Referent			Referent			Referent ^a		
Overweight (25.0 to <30)	14	4.32	1.17	0.59	2.28	1.30	0.65	2.58	1.27	0.63	2.54
Obese (30+)	14	4.55	1.23	0.63	2.41	1.28	0.64	2.56	1.37	0.68	2.77
<i>p-trend</i>			0.36			0.28			0.20		
Continuous BMI			1.02	0.99	1.06	1.03	0.99	1.07	1.04	0.99	1.08
Prepregnancy BMI (kg/m ²)											
Not obese (<30)	40	3.81	Referent			Referent			Referent		
Obese (30+)	14	4.55	1.20	0.65	2.24	1.21	0.64	2.29	1.25	0.65	2.38
<i>Preeclampsia</i>											
Prepregnancy BMI (kg/m ²)											
Underweight (<18.5)	1	1.19	0.47	0.06	3.61	0.44	0.06	3.41	0.42	0.05	3.30
Normal weight (18.5 to <25.0)	16	2.49	Referent			Referent			Referent ^b		
Overweight (25.0 to <30)	10	3.09	1.25	0.56	2.78	1.43	0.63	3.23	1.34	0.59	3.04
Obese (30+)	9	2.92	1.18	0.52	2.70	1.27	0.54	2.99	1.36	0.57	3.20
<i>p-trend</i>			0.42			0.29			0.24		
Continuous BMI			1.02	0.97	1.07	1.03	0.98	1.08	1.03	0.98	1.09
Prepregnancy BMI (kg/m ²)											
Not obese (<30)	27	2.57	Referent			Referent			Referent		
Obese (30+)	9	2.92	1.14	0.53	2.45	1.18	0.54	2.59	1.21	0.55	2.67

^a Hypertensive disorders of pregnancy model additionally adjusted for prepregnancy smoking, children in the household and acculturation status

^b Preeclampsia model additionally adjusted for prepregnancy smoking and acculturation status