



Published in final edited form as:

Matern Child Health J. 2015 November ; 19(11): 2453–2461. doi:10.1007/s10995-015-1764-4.

Diet, Pre-pregnancy BMI, and Gestational Weight Gain in Puerto Rican Women

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Abstract

Objectives—To describe the dietary patterns in pregnant woman and determine the association between diet factors, pre-pregnancy Body Mass Index (BMI) and socio-demographic characteristics with gestational weight gain (GWG).

Methods—This is a secondary analysis of a longitudinal cohort study of pregnant women exploring the risk factors for preterm birth, the Puerto Rico Testsite for Exploring Contamination Threats program. Recruitment was conducted during 2011–2014. Data was collected from multiple sources. GWG was calculated using maternal weight recorded in the medical records at the first and last prenatal visits and classified according to the Institute of Medicine guidelines. Sociodemographic characteristics were obtained at baseline using an interviewed-based questionnaire. Participants completed a self-administered food frequency questionnaire at 20–28 weeks to assess dietary patterns. Analysis of associations between variables was conducted using Chi Square tests.

Results—A total of 160 women with term pregnancies were included in this analysis. Mean pre-pregnancy BMI was 25.4 ± 5.48 kg/m², with 44.4 % classified as overweight/obese. Excessive GWG was observed in 24.4 % of the participants. Socio-demographic characteristics were not associated with GWG. Being overweight/obese at the start of pregnancy was significantly associated with excessive GWG ($p < 0.05$). In addition, women consuming one or more fruit drinks per day were more likely to have an excessive GWG while those consuming less than one fruit drink per day were more likely to have an adequate GWG ($p < 0.05$).

Conclusions for Practice—Being obese before pregnancy and frequently consuming fruit drinks were important determinants of excessive GWG in this group.

Keywords

Pregnancy; Gestational weight gain; Diet; BMI; Puerto Rico

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Conflict of interest The authors have no conflict of interest to disclose.

Introduction

The main components for the promotion of healthy lifestyles during pregnancy include adequate gestational weight gain (GWG) and adequate nutrition [1]. An adequate GWG is important as this has strong short-term and long-term implications in the health of the infants. Adequate nutrition is important in all life stages, but in pregnancy, it takes a special emphasis [2]. Nutritional requirements increase during pregnancy and an adequate nutrition is necessary for the mother and baby's health and for an adequate GWG [3]. Studies have found that the main determinants of GWG are pre-pregnancy weight status and dietary patterns [4].

In the past few decades, there has been a significant increase in obesity worldwide, affecting all age groups, including women in reproductive age [5, 6]. Obesity, as a global epidemic, has led to a greater focus on pregnancy, because in this period women are more vulnerable to excessive GWG [7]. Therefore, pregnancy has been identified as a critical period for the development of overweight and/or obesity [8]. Obesity in pregnancy increases the risk not only for complications on the mother during pregnancy, but also represents a risk to the baby's health, impacting the health of the next generation [9].

Pre-gestational weight status is associated with GWG outcomes, insufficient or excessive, [10] and is considered the strongest predictor of GWG [11, 12]. In 2009, the Institute of Medicine (IOM) published new target GWG recommendations [13]. These guidelines recommend an optimal maternal weight gain range for women based on their pre-pregnancy body mass index (BMI); which has been found to be associated with optimal birth weight and obstetric outcomes [1]. Women with high pre-pregnancy BMI are more likely to gain weight during pregnancy above the IOM guidelines and duplicate their risk for developing many adverse outcomes, such as diabetes, hypertension, and pre-term births [6].

In the US, as in Puerto Rico, overweight and obesity are major public health issues, particularly in women of reproductive age. According to the National Health and Nutrition Examination Survey (NHANES) in 2011–2012, the prevalence of overweight and obesity among US women aged 20 years and older was 65.5 and 35.8 %, respectively [14]. The Pregnancy and Nutrition Surveillance System (PNSS) reported in 2010 that during pregnancy, the prevalence of overweight and obesity in US women has been estimated to be 53 % and in Puerto Rican women, it has been estimated to be 45 % [15].

In addition to weight status, certain dietary patterns have been associated with GWG. Studies have found that consumption of dairy products, meats, sweets, artificially or sugar sweetened beverages is related to excessive GWG, while consumption of whole grains, fruits and vegetables is related to adequate GWG [11, 16, 17]. However, there is scarce data among Hispanic pregnant women, which may have different dietary patterns.

The objective of this study was to describe the dietary patterns in a sample of Hispanic pregnant women living in Puerto Rico and to determine the association between diet factors, pre-pregnancy BMI and socio-demographic characteristics with GWG. Results from this study could help formulate public health recommendations specifically directed for Hispanic pregnant women in Puerto Rico and in the US. In addition, this study adds to the body of

literature available, regarding dietary patterns and pregnancy outcomes in this unstudied group.

Materials and Methods

Design

This is a secondary analysis from data collected in the study “Puerto Rico Testsite for Exploring Contamination Threats (PROTECT)”. PROTECT is a prospective longitudinal cohort study that aims to recruit a convenience sample of 1200 pregnant women living in the northern karst area of Puerto Rico and explore biological and environmental risk factors contributing to preterm birth. This project is funded under the Superfund Research Program [18]. The study was approved by the Institutional Review Board of the Medical Sciences Campus, University of Puerto Rico; participants provided written consent before participating in the study.

Study Population

The recruitment for this cohort is ongoing. For this analysis, data were collected from February 2011 to March 2014, for which a total of 505 women had been recruited. Inclusion criteria of the main study are: (a) healthy pregnant woman, age 18–40 years; (b) living in the northern karst region of Puerto Rico; (c) planning to give birth in one of the three participating hospitals; (d) having less than 20 weeks of gestation and; (e) not having pregnancy complications. For this secondary analysis, we only included those participants that had completed the Food Frequency Questionnaire (FFQ). Exclusion criteria were: (a) pre-pregnancy use of birth control pills; (b) pregnancy conceived by use of assistive reproductive technology and; (c) conditions or complication such as diabetes, hypertension, or heart disease.

Data Collection

Data was collected in the main study through questionnaires at specific gestational windows and through medical record data abstraction performed by research nurse as:

- Screening visit (<16 weeks): a questionnaire was used to assess eligibility and age of participants, which was classified as 18–29 and 30–40 years.
- First visit (16–20 weeks): a questionnaire was used to assess education and income. Education was classified as less or equal to high school and greater than high school. Family Annual Income was classified as <\$20,000 and \$20,000, which was based on poverty thresholds for 2012 in Puerto Rico [19]. Initial weight and height were recorded from the first prenatal visit, as specified in the medical record. These measurements were performed at the clinics following the standard routine guidelines.
- Second visit (20–24 weeks): a semi-quantitative FFQ was provided to the participants to be completed at home and to bring back on the third visit.
- Third visit (24–28 weeks): the FFQ was collected and verified.

- Delivery and Postpartum: the last weight from prenatal visits before delivery was recorded from the medical record to calculate GWG.

The questions were derived from previously field-tested surveys, the National Health Interview Survey, the National Health and Nutrition Examination Survey, and the Birth Defects Prevention Study [20–22]. All three had field-test Spanish versions.

Pre-pregnancy BMI

Initial weight and height were used to calculate pre-pregnancy BMI using the following formula: weight (kg)/height (m)². Participants were classified as: underweight (BMI <18.5 kg/m²), healthy weight (BMI 18.5–24.9 kg/m²), overweight (BMI 25–29.9 kg/m²), and obese (BMI >30 kg/m²), according to the IOM guidelines for GWG [13, 23].

Gestational Weight Gain (GWG)

GWG was calculated from the difference between the last and initial weight recorded in the medical record [13, 23]. IOM guidelines (2009) recommend the following weight gain in women during pregnancy: underweight 12.5–18 kg, healthy weight 11.5–16 kg, overweight 7–11.5 kg, and obese 5–9 kg [1]. Participants were classified as “inadequate GWG” if weight gain was below, “appropriate GWG” if weight gain was according, and “excessive GWG” if weight gain was above the IOM guidelines [23].

Food Frequency Questionnaire (FFQ)

A valid semi-quantitative FFQ was used to assess dietary patterns [24, 25]. This FFQ had 193 items, in which participants were asked to estimate the frequency of consumption (at home and away from home) of each item daily, weekly, monthly or never. The reference period was the preceding 12 months, an accurate amount of time in which participants can report usual dietary patterns [26].

For this analysis we used the frequency of consumption of the summary questions included in the original FFQ for the following food groups: fruits, vegetables, breakfast cereals (ready to eat cereals, hot cereals and cereal bars), starchy vegetables and beans, rice (prepared in any way), meats, fish, milk, 100 % fruit juices, fruit drinks and soft drinks. The frequency of consumption was categorized as “<1 per day or 1 per day”. For meats and fish, frequency of consumption was categorized as “<2 per week or 2 per week”, as these food items are recommended about 2 times per week. More details are provided elsewhere [24, 25].

Statistical Analysis

Means and standard deviations were used to describe continuous variables and frequency distributions were used for categorical variables. Chi Square test was used to explore the association between socio-demographics, pre-pregnancy BMI and diet factors with GWG (categorized using IOM recommendations) with SPSS, version 17.0.

Results

A total of 180 women completed the FFQ from the 505 participants recruited at the moment of this analysis (36 %). From this, 20 participants were excluded because they had delivered

prematurely. Therefore, the total sample for this analysis consisted of 160 participants. General characteristics are shown in Table 1. Overall, most women were between the ages 18–29 years (63.9 %), had higher education (83.8 %) and reported an income \leq \$20,000 (59.9 %). With respect to pre-pregnancy BMI, 44.4 % were classified as overweight/obese. Women who completed the FFQ were likely to be younger, with higher education and income compared to those who did not completed the FFQ ($p < 0.01$).

Figure 1 shows the frequency of foods and beverages consumption in the sample. The frequency of consumption of fruits, vegetables, starchy vegetables and beans, fish and milk was very low, while the frequency of consumption of 100 % fruit juices and fruit drinks was high in most participants.

Table 2 shows the association between socio-demographics and pre-pregnancy BMI with GWG. No significant associations were observed between age, education and income with GWG. Women who were overweight or obese before pregnancy were most likely to have excessive GWG (38.8 and 31.2 %, respectively) compared to underweight and normal weight women, while those underweight before pregnancy were most likely to have an inadequate GWG (45.5 %; $p = 0.021$).

Table 3 shows the associations between the frequency of consumption of certain food groups with GWG. No significant associations were observed when stratified by pre-pregnancy BMI. However, there was a trend in the frequency of consumption of breakfast cereals and GWG among under or health weight pregnant women, whereas women consuming less than one breakfast cereals per day were more likely to have inadequate GWG.

Table 4 shows the associations between the frequency of consumption of certain beverages with GWG. No significant associations were observed when stratified by pre-pregnancy BMI. However, there was a trend in the frequency of consumption of coffee and GWG among overweight and obese pregnant women, whereas women consuming less than one coffee per day were more likely to have excess GWG. When considering the total sample, we found that women consuming one or more fruit drinks per day were more likely to have excessive GWG while those consuming less than one fruit drink per day were more likely to have adequate GWG.

Discussion

The results of this study show that being obese before or at the start of pregnancy is significantly associated with excessive GWG among participants of the PROTECT study, a population of Hispanic pregnant women in Puerto Rico. In addition, consuming one or more fruit drinks per day is significantly associated with excess GWG in this sample.

Consistent with other studies, we showed that pre-pregnancy weight is an important determinant of GWG. Obese women before pregnancy were most likely to gain weight above the IOM recommendations at the end of pregnancy. Similar results were found in non-Hispanic white, Hispanic and Asian populations [8, 12, 27–29]. The weight recommendations during pregnancy established by the IOM were based on data to achieve

appropriate GWG for a healthy pregnancy and baby. Women with excessive GWG have more complications during pregnancy such as gestational diabetes, preeclampsia, prematurity and birth defects [2, 30] which increases the risk of obesity, diabetes and metabolic syndrome (obesity, hypertension, dyslipidemia and glucose intolerance) in their babies later in life [9]. Therefore, it is important that health care providers encourage pregnant women to gain weight within the IOM recommended ranges.

Another important determinant of GWG in this sample was the frequency of fruit drinks consumption. These beverages are very common in Puerto Rico and often individuals perceived them as healthy beverages. In deed, these beverages are commercially marketed as beverages containing fruits. However, the fruit content of these beverages is very low, while the sugar content is very high.

These results have important public health implications. As stated in the Center for Disease Control Pre-conceptional Care Guidelines, emphasis should be made for reaching high risk women, such as obese women, before conceiving to prevent many complications [31]. Once pregnant, there is a need to counsel women to reduce or eliminate fruit drinks and other sugary beverages to prevent excessive GWG. This could be particularly relevant to health professionals in the Women, Infant and Children program (WIC) in Puerto Rico, one of the locations with the highest participation in the US. In Puerto Rico, participants enroll early in pregnancy in WIC to obtain the benefits. Therefore, this is a great opportunity for encouraging healthy beverages during pregnancy and an adequate weight gain. However, other programs could reach at risk women before becoming pregnant, such as Nutritional Assistance Program, NAP (in Puerto Rico this program is in lieu of the Supplemental Nutrition Assistance Program) and the Expanded Food and Nutrition Education Program (EFNEP). NAP covers about 35 % of the population, providing monetary support for low income participants to purchase foods and beverages, which does not alcoholic beverages but it includes fruit drinks [32]. Therefore, policies are needed to modify the use of NAP to allow only the purchase of healthy foods and beverages. The EFNEP is another great opportunity to reach women in Puerto Rico as this program provides low-income families with the knowledge, skills, and desire to adopt and maintain a nutritious diet. Other strategies are needed at the population level to help reduce overall obesity in women of reproductive age, such as improving access to healthy foods in local markets, increasing farmers market, among other strategies. In addition, strategies are needed for increasing physical activity, which is very low in Puerto Rico [33]. Some strategies that could be implemented are improving access to parks and facilities for engaging in physical activity, implementing walking groups and other physical activity programs for pregnant women.

Our results should be considered in light of its limitations. The FFQ was self-administered, which could have led to errors when reporting the frequency of consumption of the different foods and beverages. We had a low response rate for completing and returning the FFQ, which was related to the length of the FFQ. In addition, women who completed the FFQ were younger and with higher education and income; therefore, these results may be biased. In addition, the use of a convenience sample and the cross-sectional design of our study do not allow us to infer causality or to generalize our findings to other groups of pregnant

women. Therefore, longitudinal studies are needed to confirm the impact of dietary patterns on GWG.

In conclusion, the present study found that being obese before pregnancy and frequently consuming fruit drinks were important determinants of excessive GWG in this group. Although there are some limitations related to the design of our study, results from this study could help formulate public health recommendations for helping women lose weight before pregnancy and reducing the frequency of fruit drinks during pregnancy.

Acknowledgments

This project is supported by award P42ES017198-01A1 (Superfund Research for the National Institute of Environmental Health Sciences) and in part by awards G12RR03051 (RCMI Clinical Research Center), 5G12-MD007600 (Center for Collaborative Research in Health Disparities), and U54MD007587 (Puerto Rico Clinical and Translational Research Consortium) from the Institute on Minority Health and Health Disparities, National Institutes of Health. We gratefully acknowledge PROTECT research staff and collaborators: study nurses (Abigail Figueroa and Janisse Cabrera); trainees (Esteban Romero, Carlos Vergara, Claudia Pérez, Carolina Pérez, Suely Román, Krizia Santos, Andrea González and Brenda Castro) and the medical faculty, nursing, laboratory and administrative staff of the affiliated prenatal health clinics.

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Significance

Adequate gestational weight gain (GWG) during pregnancy is important for short- and long-term health implications in the infants. Among the main determinants of GWG are pre-pregnancy weight status and dietary patterns. This is particularly important in Puerto Rico, as the prevalence of overweight and obesity is the highest compared to other states or US territories. In this study among Hispanic pregnant women living in Puerto Rico, being obese before pregnancy and frequently consuming fruit drinks were important determinants of excessive GWG in this group. Results from this study could help formulate public health recommendations for helping women loose weight before pregnancy and reducing the frequency of fruit drinks during pregnancy.

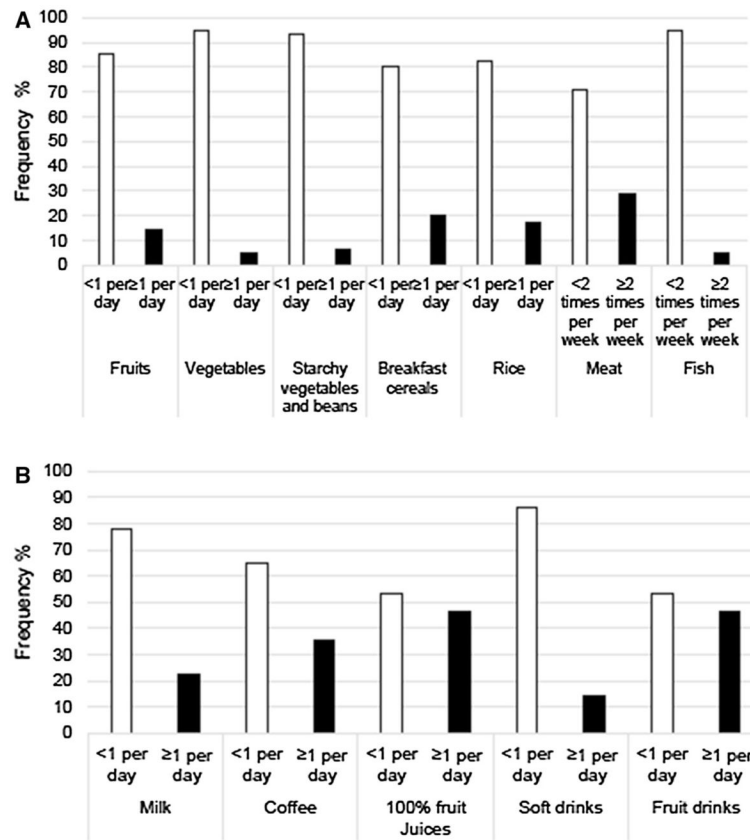


Fig. 1. Frequency of food groups and beverages consumption in the sample. **a** Foods consumption. **b** beverages consumption

Table 1

Characteristics of study participants (n = 160)

Characteristics	Mean \pm SD or % (N)
<i>Age (year)</i>	27.4 \pm 5.29
18–29	63.9 % (n = 101)
30–40	35.1 % (n = 57)
<i>Education</i>	
High School	16.3 % (n = 26)
> High School	83.8 % (n = 134)
<i>Income (\$)</i>	
< 20,000	40.1 % (n = 55)
20,000	59.9 % (n = 82)
<i>Pre-pregnancy BMI (kg/m²)</i>	
Underweight	5.60 % (n = 9)
Normal weight	50.0 % (n = 80)
Overweight	25.0 % (n = 40)
Obese	19.4 % (n = 31)
<i>Gestational weight gain</i>	
Inadequate	25.0 % (n = 40)
Appropriate	50.6 % (n = 81)
Excessive	24.4 % (n = 39)

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Table 2

Association between socio-demographic characteristics with GWG

Characteristics	Gestational weight gain			Total	p value
	Inadequate	Appropriate	Excessive		
<i>Age (year)</i>					
18–29	22.8 % (n = 23)	52.5 % (n = 53)	24.8 % (n = 25)	100 % (n = 101)	0.54
30–40	29.8 % (n = 17)	45.6 % (n = 26)	24.6 % (n = 14)	100 % (n = 57)	
<i>Education</i>					
High School	34.6 % (n = 9)	46.2 % (n = 12)	19.2 % (n = 5)	100 % (n = 26)	0.24
> High School	23.1 % (n = 31)	51.5 % (n = 69)	25.4 % (n = 34)	100 % (n = 134)	
<i>Income (\$)</i>					
< 20,000	30.9 % (n = 17)	45.5 % (n = 25)	23.6 % (n = 13)	100 % (n = 55)	0.42
20,000	20.7 % (n = 17)	56.1 % (n = 46)	23.2 % (n = 19)	100 % (n = 82)	
<i>Pre-pregnancy BMI (kg/m²)</i>					
Underweight	44.4 % (n = 4)	44.4 % (n = 4)	11.1 % (n = 1)	100 % (n = 9)	0.01
Normal weight	28.8 % (n = 23)	58.8 % (n = 47)	12.5 % (n = 10)	100 % (n = 80)	
Overweight	15.0 % (n = 6)	40.0 % (n = 16)	45.0 % (n = 18)	100 % (n = 40)	
Obese	22.6 % (n = 7)	45.2 % (n = 14)	32.3 % (n = 10)	100 % (n = 31)	

Table 3

Associations between frequency of consumption of food groups and GWG

Food group	Pre-BMI		p value	Pre-BMI		p value	Total	p value				
	Underweight and Normal weight	Excessive (%)		Overweight and Obese	Excessive (%)			Inadequate (%)	Appropriate (%)	Excessive (%)		
<i>Fruits</i>												
<1/day	30.1	54.8	15.1	0.22	16.1	43.5	40.3	0.27	23.7	49.6	26.7	0.32
1/day	33.3	66.7	0.0		37.5	25.0	37.5		34.8	52.2	13.0	
<i>Vegetables</i>												
<1/day	31.3	57.5	11.3	0.33	19.1	42.6	38.2	0.16	25.7	50.7	23.6	0.51
1/day	16.7	66.7	16.7		0.0	0.0	100.0		12.5	50.0	37.5	
<i>Starchy vegetables and beans</i>												
<1/day	29.1	57.0	13.9	0.41	18.2	42.4	39.4	0.27	24.1	50.3	25.5	0.84
1/day	28.6	71.4	0.0		0.0	33.3	66.7		20.0	60.0	20.0	
<i>Breakfast cereals</i>												
<1/day	33.8	56.3	9.9	0.06	17.5	43.9	38.6	0.58	26.6	50.8	22.7	0.50
1/day	16.7	61.1	22.2		21.4	35.7	42.9		18.8	50.0	31.2	
<i>Rice</i>												
<1/day	29.0	58.0	13.0	0.51	13.8	48.3	37.9	0.34	22.0	53.5	24.4	0.63
1/day	25.0	62.5	12.5		36.4	18.2	45.5		29.6	44.4	25.9	
<i>Red meat</i>												
<2/week	33.9	55.9	10.2	0.13	17.6	43.1	39.2	0.48	26.4	50.0	23.6	0.64
2/week	23.1	57.7	19.2		15.8	42.1	42.1		20.0	51.1	28.9	
<i>Fish</i>												
<2/week	29.8	58.3	11.9	0.44	18.2	42.4	39.4	0.61	24.7	51.3	24.0	0.72
2/week	25.9	50.0	25.0		25.0	25.0	50.0		25.0	37.5	37.5	

Table 4

Association between frequency of beverages consumption and GWG

Beverages	Pre-BMI		p value		Pre-BMI		p value		Total		p value	
	Underweight and Normal weight	Excessive (%)	Appropriate (%)	Excessive (%)	Overweight and Obese	Appropriate (%)	Excessive (%)	Inadequate (%)	Appropriate (%)	Excessive (%)	Inadequate (%)	Appropriate (%)
<i>Milk</i>												
<1/day	32.8	58.2	9.0	0.10	19.6	46.4	33.9	0.09	26.8	52.8	20.3	0.06
1/day	25.0	50.0	25.0		13.3	26.7	60.0		20.0	40.0	40.0	
<i>Coffee</i>												
<1/day	29.8	56.1	14.0	0.48	12.8	41.0	46.2	0.06	22.9	50.0	27.1	0.52
1/day	30.8	57.7	11.5		30.8	38.5	30.8		30.8	48.1	21.2	
<i>100 fruit juices</i>												
<1/day	34.1	58.5	7.3	0.15	15.9	45.5	38.6	0.47	24.7	51.8	23.5	0.92
1/day	27.7	55.3	17.0		22.2	37.0	40.7		25.7	48.6	25.7	
<i>Soft drinks</i>												
<1/day	32.4	56.8	10.8	0.19	18.0	41.0	41.0	0.58	25.9	49.6	24.4	0.83
1/day	23.1	53.8	23.1		11.1	55.6	33.3		18.2	54.5	27.3	
<i>Fruit drinks</i>												
<1/day	28.8	64.4	6.8	0.51	15.3	47.5	37.3	0.34	22.0	55.9	22.0	0.047
1/day	37.0	40.7	22.2		33.3	16.7	50.0		35.9	33.3	30.8	

Bold value indicates significant association