

Association between Prenatal Care and Gestational Weight Gain: Cross-Sectional Study in a Low-Income Area of Rio de Janeiro

Gigante, D. S., R Amorim Adegboye, A., de Aquino Lacerda, E. M., Saunders, C., Padilha, P. C. & de Castro, M. B. T.

Published PDF deposited in Coventry University's Repository

Original citation:

Gigante, DS, R Amorim Adegboye, A, de Aquino Lacerda, EM, Saunders, C, Padilha, PC & de Castro, MBT 2021, 'Association between Prenatal Care and Gestational Weight Gain: Cross-Sectional Study in a Low-Income Area of Rio de Janeiro', DEMETRA: Alimentação, Nutrição & Saúde, vol. 16.







<https://dx.doi.org/10.12957/demetra.2021.58362>

DOI 10.12957/demetra.2021.58362

ESSN 2238-913X

Publisher: Josely Correa Koury, Brazil

Licensed under a Creative Commons Attribution 4.0 International License.

-  Débora Souza Gigante¹
 Amanda Rodrigues Amorim Adegboye²
 Elisa Maria de Aquino Lacerda³
 Cláudia Saunders⁴
 Patrícia Carvalho Padilha⁴
 Maria Beatriz Trindade de Castro¹

¹ Universidade Federal do Rio de Janeiro, Instituto de Nutrição Josué de Castro, Departamento de Nutrição Social e Aplicada. Rio de Janeiro, RJ, Brasil.

² Coventry University, Faculty of Health and Life Sciences, School of Nursing, Midwifery and Health. Coventry, CV1 5FB, UK.

³ Universidade Federal do Rio de Janeiro, Instituto de Nutrição Josué de Castro, Departamento de Nutrição Social e Dietética. Rio de Janeiro, RJ, Brasil.

⁴ Universidade Federal do Rio de Janeiro, Instituto de Nutrição Josué de Castro, Departamento de Nutrição Social e Dietética, Grupo de Pesquisa em Saúde Materno-Infantil. Rio de Janeiro, RJ, Brasil.

Correspondence

Maria Beatriz Trindade de Castro
mbtcastro@nutricao.ufrj.br

Financial support: This study was supported by Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro Grant from FAPERJ/SESDEC/MS/CNPq - 18/2009). Grant number: E-26/110.766/2010).

Association between Prenatal Care and Gestational Weight Gain: Cross-Sectional Study in a Low-Income Area of Rio de Janeiro

Associação entre a Assistência Pré-Natal e o Ganho de Peso Gestacional: Estudo Seccional em uma Área de Baixa Renda do Rio de Janeiro

Abstract

Aim: To investigate the association between the adequacy of prenatal care and gestational weight gain (GWG) among low-income Brazilian postpartum women.

Methods: Cross-sectional study in the city of Mesquita, Rio de Janeiro state, including 281 low-income adult Brazilian postpartum women. GWG was categorized as adequate, insufficient and excessive according to the Institute of Medicine (IOM) recommendations. The number of prenatal visits was categorized (1: no visit; 2: 1-3 visits; 3: 4-6 visits; 4: 7 or more visits) and gestational week (GW) at the onset of prenatal care (prenatal initiation) was used as a continuous variable. Prenatal care (PC) evaluated both grouped dimensions of the Kotelchuck's Index: adequate (adequate + adequate plus) or inadequate (intermediate and inadequate). Multinomial logistic regression models were performed to estimate the associations between inadequate prenatal care and GWG. **Results:** PC started at 12.6 (\pm 6.9) GW; 8.2% of women (n=23) had \leq 4 prenatal visits and 38.4% (n=108) had inadequate PC. On average, GWG was 12.9 kg (\pm 6.2) and 36.5%, 31.0% and 32.5% of women presented adequate, insufficient and excessive GWG, respectively. After adjustment, the inadequacy of PC (OR=2.01; CI 95%=1.03-3.90) was associated with an increased likelihood of gaining weight below IOM recommendations. **Conclusion:** This study found a significant association between the inadequacy of prenatal care and insufficient GWG, which reinforces the relevance of having adequate PC to provide the opportunity for identification of inadequate GWG and early intervention at pregnancy.

Keywords: Nutritional Status. Pregnancy. Public Health. Weight Gain. Prenatal Care

Resumo

Objetivo: Verificar a associação entre a adequação da assistência pré-natal e o ganho de peso gestacional (GPG) em puérperas brasileiras de baixa renda. **Métodos:** Estudo transversal no município de Mesquita-RJ, incluindo 281 mulheres no pós-parto imediato. O GPG foi classificado como adequado, insuficiente e excessivo de acordo com as recomendações do Institute of Medicine (IOM). O número de consultas do pré-natal foi categorizado (1: nenhuma consulta; 2: 1-3 consultas; 3: 4-6 consultas; 4: 7 ou mais consultas) e o início do pré-natal, segundo as semanas gestacionais (SG), foi utilizado como variável contínua. A assistência pré-natal (AP) avaliou as duas dimensões agrupadas do Índice de Kotelchuck: adequado (adequado + mais adequado) ou inadequado (intermediário e inadequado). Modelos de regressão logística multinomial foram utilizados para estimar as associações entre assistência pré-natal inadequada e GPG. **Resultados:** AP foi iniciada em média com 12,6 (\pm 6,9) SG; 8,2% das mulheres (n = 23) fizeram \leq 4 consultas de pré-natal e 38,4% (n = 108) foram

classificadas com AP inadequada. Em média, o GPG foi de 12,9 kg (\pm 6,2) e 36,5%, 31,0% e 32,5% das mulheres apresentaram GPG adequado, insuficiente e excessivo, respectivamente. Após o ajuste, a inadequação da AP (OR = 2,01; IC 95% = 1,03-3,90) foi associada a uma maior probabilidade de GPG abaixo das recomendações do IOM.

Conclusão: Observou-se uma associação significativa entre a inadequação da assistência pré-natal e o GPG insuficiente, o que reforça a relevância da adequada AP para monitorar o adequado GPG e intervir precocemente na gestação.

Palavras-chave: Estado Nutricional. Gravidez. Saúde Pública. Ganho de Peso na Gestação. Cuidado Pré-Natal.

INTRODUCTION

During prenatal care, it is expected that pregnant women receive orientation about nutrition and adequate weight gain to avoid the risk of adverse maternal and infant health outcome. Excessive weight gain during pregnancy increases the risk for the development of hypertensive syndromes, gestational diabetes *mellitus* and fetal macrosomia, while insufficient weight gain is related to low birth weight and restricted intrauterine growth.¹⁻³ Socioeconomic factors such as education, parity, maternal lifestyle and prenatal care are associated with gestational weight gain (GWG).^{4,6}

The Institute of Medicine (IOM)⁷ suggests that women of normal body mass index (BMI) before pregnancy should aim for a weight gain between 11.5 and 16 kg. A slightly higher and lower target range is recommended for underweight and overweight women, respectively. It is also recommended the initiation of prenatal care in the first gestational trimester to promote adequate weight gain and positive effects on maternal and child health.^{7,8} However, the record of prenatal weight and weight management during pregnancy by health professionals are not always possible in primary care settings,⁹ and some women start prenatal care too late and do not achieve the target weight gain.^{9,10}

According to Kotelchuck,¹¹ prenatal care should be initiated before the 16th gestational week and there ought to be six visits during the period from the first prenatal care visit until childbirth. In this perspective, the "Adequacy of Prenatal Care Utilization Index" (APCU) is evaluated by combining the information on the adequacy of gestational age at the beginning of prenatal care and the total number of visits during pregnancy.¹¹

There are controversies in the literature regarding the association of the adequacy of the prenatal care process to prevent excessive GWG.^{12,13} A study in Romania on determinants of GWG found that 23% of pregnant women had inadequate APCU and 42.9% of them gained weight below the IOM recommendations.¹² Among adequate APCU, 38.3% of the women presented excessive GWG. A study in the United States conducted with 197,354 pregnant women showed that adequate prenatal care was not associated with a reduced risk for excessive gestational weight gain, but it was effective for preventing insufficient weight gain.¹³

The Brazilian Ministry of Health recommends that pregnant women should start prenatal care in the first gestational trimester, have at least six consultations during gestation and one puerperal visit.¹⁴ However, it is estimated that 75.8% of women start prenatal care before the 13th week of gestation and 73.1% attend at least the six visits recommended by the government guideline.¹⁵ The proportion of inadequate onset of prenatal care varies greatly across Brazilian regions and they are affected by sociodemographic determinants.^{16,17} A study conducted by Tsunehiro et al.¹⁸ evaluated the Brazilian indicators of the Prenatal and Birth Humanization Programme among 2,404 pregnant women assisted in 12 primary care centres in São Paulo. Authors found that 65.7% of pregnant women started prenatal care up to the 16th gestational week and attended at least six prenatal care visits. Only 13.1% of the pregnant women were considered to have an adequate prenatal onset, number of consultations, all routine exams, and puerperal visit.

Although the weighing and recording practices as a sole intervention might not be enough to guarantee the complex adequacy of all the prenatal care process, the effective adherence to weight monitoring could avoid insufficient and excessive weight gains that are the main predictors of adverse gestational outcomes. To the best of our knowledge, there is no previous study on the impact of the adequacy of prenatal care index on GWG among pregnant Brazilian women. Thus, this study aimed to describe the adequacy of prenatal care among low-income Brazilian postpartum women and gestational weight gain.

METHODS

Design and study population

This cross-sectional study is an offshoot of a cohort study entitled “Effect of Nutritional, Socio-Demographic and Reproductive Determinants in Postpartum Weight Variation and Comorbidities Development”. This study included 338 adult Brazilian women who gave birth at Municipal Hospital Leonel de Moura Brizola, in Rio de Janeiro, Brazil, between February 2009 and February 2011. Participants were postpartum women aged between 18-45 years, with no history of previous chronic diseases (as diabetes mellitus and hypertension), except obesity, and who gave birth to a singleton infant.

Of the 338 women, 334 agreed to participate in the study. The recruitment occurred from Monday to Friday in the first postpartum week. In total, 21 women were excluded for presenting preterm labour (< 37 gestational weeks). Of the 313 (100%) eligible women, 32 (10.2%) of them were considered losses due to lack of prenatal and GWG information. The final sample used in the analysis consisted of 281 (89.8%) women. This study was approved by the Ethics Committee under CAAE protocol number 353A/2010 and the Resolution nº 196/1996, of the National Health Council, was followed. Participation was voluntary and all women received information about the procedures and objectives of the study and signed an informed consent prior to data collection.

Data Collection

A trained group of nutritionists collected information on sociodemographic factors, prenatal care, reproductive history and lifestyle via a validated structured questionnaire. On this occasion, anthropometric data were also collected using a standardized technique.¹⁹ Pre-pregnancy BMI [PPBMI = weight (kg)/ height (m²)] was calculated using self-reported pre-pregnancy weight (PPW) or bodyweight measured up to the 13th week of gestation. Self-reported pre-pregnancy weight was validated by the literature and showed good agreement with the objective measurement of weight at early pregnancy.²⁰ Height was measured using a stadiometer with a precision of 0.1 cm (Alturaexata, Brazil).

Outcome variables

Total gestational weight gain (GWG) was defined as the difference between the weight on the day of delivery (or in the last prenatal visit after the 38th gestational age) and self-reported weight before pregnancy (or weight in the first prenatal visit during the first gestational trimester until the 13th gestational age). GWG was categorized as adequate, insufficient or excessive according to the IOM⁷ guidelines, which are based on PPBMI (kg/m²). PPBMI < 18.5 kg/m² was considered as underweight (adequate GWG= 12.5–18 kg); PPBMI from 18.5 to 24.9 kg/m² was considered as normal weight (adequate GWG = 11.5–16 kg); PPBMI from 25 to 29.9 kg/m² was considered overweight (adequate GWG= 7–11.5 kg); and PPBMI > 30 kg/m² was considered as obese (adequate GWG= 5–9 kg).

Independent variables

The main independent variables to classify the prenatal care quality were: i) the number of prenatal visits (1: no visit; 2: 1-3 visits; 3: 4-6 visits; 4: 7 or more visits), ii) prenatal initiation defined as gestational age in weeks at the onset of prenatal care (continuous variable); and iii) Prenatal Care (PC) which combines the two dimensions of the prenatal care inadequacy (timing and frequency of prenatal care). The PC was a binary variable that was created using four categories of the Kotelchuck's Index.¹¹ For the purposes of analyses, the PC categories were grouped as adequate (adequate + adequate plus) or inadequate (intermediate and inadequate).

Covariates

Information on maternal age (years), household income (dollars), parity (number of deliveries), maternal education (years of schooling), marital status (single vs. married/living with a partner, self-reported skin colour (black or brown vs. white), gestational age in weeks at delivery taken from the medical records, PPBMI (underweight, normal weight, overweight/obesity), previous history of health problems (yes/no) and complications during pregnancy (yes/no) were collected via standardized questionnaire.

Data analysis

Differences in maternal characteristics according to PC groups were assessed using Student's *t*-test and chi-square test for continuous and binary variables, respectively. Multinomial logistic regression models, adjusted for confounders, were used to estimate the associations between the number of prenatal visits, initiation of prenatal care and PC, with GWG as a categorical variable. The associations were considered significant when *p*-values were ≤ 0.05 in the final models.

The hierarchical models were applied considering the complexity of dependence of the covariates in the analysis.²¹ This model accounts for nested levels of hierarchical variables that could be associated with the outcome from a more distal to proximal effect on GWG. It also establishes the level of closeness of association of variables with the outcome, where the distal level is associated with proximal levels, these being linked directly to the outcome.²¹ Therefore, all covariables based on a theoretical causal model were included in the models according to three hierarchical blocks: 1) distal block with socioeconomic and demographic variables (age, civil status, parity, education, household income, skin colour); 2) intermediary block with the mother's anthropometric variable (pre-pregnancy BMI); and 3) proximal block with clinic and reproductive factors (gestational age at delivery, complications during pregnancy and previous history of health problems). These covariables remained in the model when the associations were statistically significant (*p*-value ≤ 0.05).

The variables retained in the models were: education (distal block - model 1); education and pre-pregnancy BMI (distal block *plus* intermediary block - model 2); education, pre-pregnancy BMI and gestational age at delivery (distal, intermediary and proximal blocks - model 3). Gestational age in weeks was forced into the models regardless of *p*-value due to the fact that GWG is related to the length of gestation. All analyses were performed in STATA 12.²²

RESULTS

On average, prenatal care started at 12.6 (± 6.9) weeks of gestation. In total, 8.2% of women (*n*=23) had < 4 prenatal visits, 38.4% (*n*=108) had inadequate prenatal initiation and 38.4% (*n*=108) had inadequate PC. On average, GWG was 12.9 kg (± 4.4). Women categorized with underweight based on PPBMI weight gained 16.1 kg (± 7.1) and obese ones gained 11.9 kg (± 7.0). The prevalence of adequate, insufficient and excessive GWG was 36.5%, 31.0% e 32.5%, respectively.

The general characteristics of the study population according to PC are shown in Table 1. Women who had inadequate PC were less educated, had more deliveries (parity), were more likely to have a normal PPBMI and present GWG below recommendations. No significant differences were found regarding age, household income, civil status, skin colour, health history and complications during pregnancy between those with inadequate and adequate PC (*p*-value > 0.05).

Table 1. Characteristics of the study population according to Prenatal Care from 281 postpartum women. Mesquita city, Rio de Janeiro, 2011

Characteristics	Prenatal Care			p-value
	Total N=281	Adequate N=173	Inadequate N=108	
	Mean (\pm SD)			
Age (years)	24.8 (5.3)	25.0 (5.3)	24.5 (5.4)	0.466
Household income (dollars)	339 (211)	349 (213)	324 (208)	0.549
Parity (number of deliveries)	2.2 (1.3)	2.0 (1.1)	2.5 (1.5)	<0.001
Education (total years)	7.9 (2.7)	8.1 (2.7)	7.4 (2.7)	0.040
Gestational age at delivery (weeks)	39.6 (1.1)	39.6 (1.2)	39.5 (1.0)	0.380
Gestational weight gain (kg)	12.9 (6.2)	13.4 (6.2)	12.1 (6.1)	0.083
Pre-gestational BMI (kg/m ²)	23.6 (4.4)	23.4 (4.6)	23.0 (4.0)	0.066
	N (%)			
Civil Status				
Single	68 (24.4)	41 (24.0)	27 (25.0)	0.846
Married/ partner	211 (75.6)	130 (76.0)	81 (75.0)	
Skin Colour				
White	52 (18.5)	31 (18.0)	21 (19.4)	0.749
Brown and Black	229 (81.5)	142 (82.1)	87 (80.6)	
Previous health problems				
Yes	20 (7.1)	12 (7.0)	8 (7.4)	0.881
No	261 (92.3)	161 (93.1)	100 (92.6)	
Complications (pregnancy)				
Yes	60 (21.4)	41 (23.7)	19 (17.6)	0.224
No	221 (78.7)	132 (76.3)	89 (82.4)	
Prepregnancy BMI				
Underweight	21 (7.5)	11 (6.4)	10 (9.3)	0.029
Normal weight	166 (59.1)	94 (54.3)	72 (66.7)	
Excessive	94 (33.5)	68 (39.3)	26 (24.1)	
Gestational weight gain				
Adequate	100 (36.5)	65 (37.6)	35 (32.4)	0.001
Insufficient	85 (31.0)	39 (22.5)	46 (42.6)	
Excessive	89 (32.5)	69 (39.9)	27 (25.0)	

SD – standard deviation; BMI – body mass index

Table 2 shows the association between inadequacy of prenatal care and GWG as a categorical variable. After adjustment for confounders in Model 3, the results showed that inadequate PC was significantly associated with insufficient GWG (OR=2.01; p-value=0.041; CI 95%=1.03-3.90). Initiation of prenatal care (OR=1.05; p-value=0.056; CI 95%=0.99-1.10) and number of prenatal visits (OR=0.59; p-value=0.051; CI 95%=0.34-1.00) were not associated with insufficient GWG.

Table 2 Multinomial Logistic Regression Models[‡] of inadequacy of prenatal care and gestational weight gain from 281 postpartum women. Mesquita city, Rio de Janeiro, 2011.

Models	Gestational weight gain					
	Excessive			Insufficient		
Prenatal care	OR	CI 95%	p-value	OR	CI 95%	p-value
Crude	0.65	0.34-1.21	0.174	2.19	1.21-3.96	0.009
Model 1	0.64	0.33-1.27	0.201	2.08	1.10-3.91	0.024
Model 2	0.69	0.35-1.39	0.301	2.05	1.09-3.87	0.027
Model 3	0.69	0.34-1.41	0.309	2.01	1.03-3.90	0.041
Initiation of prenatal (weeks)	OR	CI 95%	p-value	OR	CI 95%	p-value
Crude	0.98	0.94-1.03	0.491	1.06	1.01-1.10	0.013
Model 1	0.98	0.93-1.03	0.354	1.04	0.99-1.10	0.054
Model 2	0.98	0.94-1.03	0.516	1.04	0.99-1.10	0.059
Model 3	0.98	0.93-1.03	0.484	1.05	0.99-1.10	0.056
Prenatal visits (number)	OR	CI 95%	p-value	OR	CI 95%	p-value
Crude	1.32	0.83-2.12	0.242	0.73	0.46-1.14	0.166
Model 1	1.33	0.78-2.24	0.291	0.67	0.41-1.10	0.111
Model 2	1.25	0.73-2.14	0.414	0.68	0.41-1.11	0.123
Model 3	1.15	0.66-2.03	0.622	0.59	0.34-1.00	0.051

PC: prenatal care. OR: odds ratio. CI: confidence interval

Adequate gestational weight gain was used as reference. PC and number of visits were used as categorical variables and initiation of prenatal as a continuous variable.

[‡]Models: Model 1 were adjusted for education; Model 2 was adjusted for education and PPBMI; and Model 3 was adjusted for education, PPBMI and gestational age at delivery.

DISCUSSION

The findings of this study revealed that inadequate prenatal care including the inadequacy of initiation of prenatal care, number of prenatal visits and PC were significantly associated with insufficient GWG, after adjustment for confounders, such as education, pre-pregnancy BMI and gestational age at delivery. To the best of our knowledge, no previous study has investigated the association between adequacy of prenatal care and gestational weight gain in Brazil, and there are only a few previous studies in other populations.^{12,13} Although comparisons among studies and the interpretation of research findings are problematic due to the variety of indicators applied to express maternal weight gain during pregnancy and definitions of adequacy or inadequacy of prenatal care,²³ our findings seem consistent with previous international studies^{12,13,24-26} and confirm the hypothesis that variation in GWG might be partially explained by the adequacy of prenatal care index, mainly with relation to the insufficient weight gain.

A cross-sectional study in Romania with 400 pregnant women¹² divided the adequacy of prenatal care index into "inappropriate", "intermediate", "adequate" and "adequate plus". This classification was based on the American College of Obstetricians and Gynecologists recommendations. Results found that 42.9% of pregnant women who had an inappropriate index showed a weight gain below the recommendations, while 14.6% classified as having adequate care had insufficient GWG. According to Yeo et al.,¹³ in a sectional analysis with 197,354 singleton full-term births to American mother residents in North Carolina, women that were classified with inadequate or intermediary levels of prenatal care index had a higher risk of insufficient GWG, whereas the adequate prenatal was associated with recommended weight gain during pregnancy.

Regarding the number of visits and the initiation of prenatal care, previous studies^{5,6,26} suggested an association of these indicators with the insufficient GWG. Drehmer et al.⁵ found that pregnant women with less than six prenatal consultations had a 52% of risk of inadequacy in weight gain. In Fraga and Theme Filha cross-sectional

study⁶ with 1,079 pregnant women in Rio de Janeiro city, the number of visits was associated with insufficient gestational weight gain. Research conducted by Yan²⁶ showed the increased risk of insufficient gestational weight gain among those with late prenatal care (second and third-trimester care onset).

However, the relationship between adequate prenatal care and excessive GWG seem to remain uncertain in the scientific literature.^{12,27} Consistent with our results, Popa and collaborators¹² did not find an increased risk of excessive weight gain among pregnant women with inadequate antenatal care. Krukowski et al.²⁷ studied 4,619 postpartum women and did not find a significant association between gestational age of beginning of prenatal care and exceed weight gain guidelines. Further research should be conducted to investigate the potential protective effect of adequate prenatal care on excessive weight gain. Possibly, other factors than a weight management routine should be evaluated to improve the prenatal care routine of women with excess body weight.^{28,29}

Obese and overweight pregnant women tend to exceed the early GWG at early pregnancy³⁰ and they are at increased risk of gaining weight above the recommendations^{13,31} particularly those living in lower-income areas. Magalhães et al.³² studied potential predictors of GWG in 328 pregnant women in Bahia and observed that 41.18% of women with excessive weight gain began prenatal care after the first trimester.

Regarding the beginning of prenatal care, in this study, 38.4% of women presented initiation of the prenatal care after the 13th week of gestation. This prevalence is higher than what was observed in other Brazilian studies. Domingues et al.³³ studied 2,353 pregnant women assisted by public health units of Rio de Janeiro city and found that 25.6% of women began prenatal care after the first trimester. Despite the improvements in prenatal care access, low adequacy and inequalities of care persist in Brazil.^{16,17} Although women are entitled to prenatal care in the first gestational trimester, late prenatal care is common among vulnerable populations.^{15,16} A study conducted in Brazil using the adequacy of prenatal care index to evaluate the quality of prenatal care categorized in "very adequate", "adequate", "intermediate" and "inappropriate". The results suggested that 15.9% of pregnant women showed intermediate and inadequacy of prenatal care.³⁴ This frequency of inadequate prenatal care was lower than the frequency of 38.4% observed in this study. Leal et al.³⁵ found that 38.5% of 9,920 postpartum women in Rio de Janeiro were evaluated as having adequate or intensive prenatal care. According to Tsunehiro et al.,¹⁸ approximately 35.0% of pregnant women had inadequacy of prenatal. However, the index used by the authors included the beginning of the prenatal and the number of visits until the routine of blood exams to classify the adequacy of the prenatal care. Frequencies of inadequate or intermediate prenatal care index in a non-Brazilian population vary from 10.5% to 36.0% among developed and developing countries.^{36,37}

Revert the lack of quality of prenatal care and improve adequate weight gain should be a strategy to prevent negative gestational outcomes. GWG is an important modifiable predictor of birth weight and perinatal morbidity and mortality.^{1,38} A case-control study conducted in São Paulo with secondary data from a national public surveillance system showed that inadequate antenatal care was associated with low birth weight.³⁹ According to Vítolo et al.,⁴⁰ prenatal care can assist in the control of GWG. It is assumed that the more visits the women have, the higher the chances of receiving advice on a healthy lifestyle, weight gain, and nutrition status. Early identification of insufficient weight gain may allow intervention to improve nutrition and potentially prevent some negative gestational outcomes including low birth weight, preterm birth and fetal growth restriction.⁴⁰

In this study, the mean GWG was 12.9 kg and it varied according to pre-pregnancy BMI. Underweight women gained on average 16.1 kg, while overweight ones gained 11.9 kg, and the prevalence of excessive GWG was higher among overweight pre-gestational women. The average total GWG in Brazilian and international studies range from 11 to 15 kg.^{12,31,41} It was also observed that 36.5%, 31.0% and 32.5% of women gained adequate, insufficient, and excessive weight, respectively. This estimate is consistent with both previous studies in Brazil and international studies.¹⁰ However, it worth nothing there is a large variation in the prevalence of inadequate and excessive GWG across different studies and populations.^{2,31}

Furthermore, the literature suggests that pre-pregnancy BMI is positively associated with GWG and overweight and obese women are more likely to gain excess weight during pregnancy.^{13,30} Cheney et al.³⁰ found that overweight and obese pregnant women had a higher chance of gain excessive weight compared to normal-weight women. These findings are also confirmed in the present study. We found that overweight women presented a higher prevalence of adequate prenatal care than underweight women. Similar results were found in a large study (n = 7,094 women) conducted in New York, USA, using similar criteria for adequate PC.⁴²

Although our results are consistent with previous publications, some limitations should be noted. This is a cross-sectional study and it is not possible to infer causality from these associations. The utilization of self-reported pre-pregnancy weight may impose bias, but it was adequately validated by literature and information was deemed of good quality.^{20,43} Although gestational age at the last prenatal visit can be less than gestational age at delivery, the weight was measured within two weeks immediately preceding childbirth to minimize a potential error of estimation.⁴⁴

The variables tested in this study included the term “inadequate”, but they do not refer to the quality of prenatal consultations and there is no data available regarding weight monitoring during prenatal care. This study also has some strengths which should be considered. First of all, it is the first study that investigated the association of the adequacy of prenatal care index and GWG among low-risk pregnant women from a low-income area. Additionally, questionnaires were previously validated and it was possible to test a wide range of potential confounders in the hierarchical analysis. The study was conducted within the first week after childbirth and data collection was performed before discharge from the maternity hospital. Thus, it is expected that information on reproductive history, complication during pregnancy and other important confounders were not severely affected by memory bias. Women are usually more motivated to participate in studies in the reproductive period,⁴⁵ and this fact could increase women’s willingness to answer the questions accurately.

Because the late onset of prenatal care among low-income populations is frequent and health information could not be easily accessed, the simple register of weight gain on prenatal routine could be a possible strategy to achieve the adequate GWG.^{30,46}

CONCLUSION

In summary, the study found significant associations between the inadequacy of prenatal care and insufficient GWG, which reinforces the importance of adequate prenatal care as a window of opportunity to monitoring weight gain trends during pregnancy and early intervention since both insufficient and excessive GWGs are associated with negative pregnancy outcomes. However, more studies are warranted to contribute to the literature about the quality of prenatal care and should confirm the associations found in this paper.

REFERENCES

1. Goldstein RF, Abell SK, Ranasinha S, et al. Association of gestational weight gain with maternal and infant outcomes: a systematic review and meta-analysis. *JAMA* 2017; 317:2207.
2. Wu Y, Wan S, Gu S, et al. Gestational weight gain and adverse pregnancy outcomes: a prospective cohort study. *BMJ Open* 2020;10:e038187. doi:10.1136/ bmjopen-2020-038187

3. Mamun AA, Callaway LK, O'Callaghan MJ, et al. Associations of maternal pre-pregnancy obesity and excess pregnancy weight gains with adverse pregnancy outcomes and length of hospital stay. *BMC Pregnancy Childbirth* 2011;11:2-9.
4. Lana TC, Oliveira LVA, Martins EF, Santos NCP, Matozinhos FP, Felisbino-Mendes MS. Prevalence, associated factors and reproductive outcomes related to excessive gestational weight gain. *UERJ Nursing Journal*. 2020; 28:e53127 DOI: <http://dx.doi.org/10.12957/reuerj.2020.53127>
5. Drehmer M, Camey S, Schmidt MI, et al. Socioeconomic, demographic and nutritional factors associated with maternal weight gain in general practices in Southern Brazil. *Cad Saúde Pública* 2010;26:1024-34.
6. Fraga AC, Theme Filha MM. Factors associated with gestational weight gain in pregnant women in Rio de Janeiro, Brazil, 2008. *Cad Saúde Pública* 2014;30:633-44.
7. Institute of Medicine. *Weight Gain during Pregnancy: Reexamining the Guidelines*. National Academies Press, Washington, DC: Committee to Reexamine IOM Pregnancy Weight Guidelines; 2009.
8. World Health Organization. *WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience*. Geneva, Switzerland: World Health Organization; 2016.
9. Wilkinson S, Beckmann M, Donaldson E, et al. Implementation of gestational weight gain guidelines - what's more effective for ensuring weight recording in pregnancy? *BMC Pregnancy Childbirth* 2019;19:19.
10. Castro MBT, Kac G, Sichieri R. Determinantes nutricionais e sociodemográficos da variação de peso no pós-parto: uma revisão da literatura. *Rev Bras Saúde Matern Infant* 2009;9:125-37.
11. Kotelchuck M. An evaluation of the Kessner Adequacy of Prenatal Care Index and a proposed Adequacy of Prenatal Care Utilization Index. *Am J Public Health* 1994;84:1414-20.
12. Popa AD, Popescu RM, Botnariu GE. Adequate weight gain in pregnancy: an analysis of its determinants in a cross-sectional study. *Srp Arh Celok Lek* 2014;142:695-702.
13. Yeo S, Crandell JL, Jones-Vessey K. Adequacy of Prenatal Care and Gestational Weight Gain. *J Womens Health (Larchmt)* 2016;25:117-23.
14. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. *Cadernos de Atenção Básica, nº 32. Atenção ao pré-natal de baixo risco*. Brasília; 2012
15. Viellas EF, Domingues RM, Dias MA, et al. Prenatal care in Brazil. *Cad Saúde Pública* 2014;30:S1-15.
16. Mario DN, Rigo L, Boclin KLS, et al. Quality of Prenatal Care in Brazil: National Health Research 2013. *Cien Saude Colet* 2019;24:1223-1232.

17. Cunha AC, Lacerda JT, Alcauza MTR, et al. Evaluation of prenatal care in Primary Health Care in Brazil. *Rev Bras Saúde Mater Infant* 2019;19:447-458.
18. Tsunehiro MA, Lima MOP, Bonadio IC, et al. Prenatal care assessment according to the Prenatal and Birth Humanization Program. *Rev Bras Saúde Mater Infant* 2018;18:771-780.
19. Lohman TG, Roche AF, Martorell R. Anthropometric standardization reference manual. Champaign, IL: Human Kinetics Books; 1988.
20. Carrilho TRB, Rasmussen KM, Farias DR, et al. Agreement between self-reported pre-pregnancy weight and measured first-trimester weight in Brazilian women. *BMC Pregnancy Childbirth* 2020;20:734. <https://doi.org/10.1186/s12884-020-03354-4>
21. Victora CG, Huttly SR, Fuchs SC, et al. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. *Int J Epidemiol* 1997;26:224-7.
22. Statacorp. Stata statistical software: release 12. College Station (TX): StataCorp LP; 2011.
23. Rowe S, Karkhaneh Z, MacDonalld I, et al. Systematic review of the measurement properties of indices of prenatal care utilization. *BMC Pregnancy and Childbirth* (2020); 20; 171. <https://doi.org/10.1186/s12884-020-2822-5>
24. Stotland N, Tsoh JY, Gerbert B. Prenatal weight gain: who is counseled? *J Womens Health* 2012;21:695-701.
25. Cohen TR, Koski KG. Limiting excess weight gain in healthy pregnant women: importance of energy intakes, physical activity, and adherence to gestational weight gain guidelines. *J Pregnancy* 2013;2013787032.
26. Yan J. The effects of prenatal care utilization on maternal health and health behaviors. *Health Economics* 2017;26:1001-1018.
27. Krukowski RA, Bursac Z, McGehee MA, et al. Exploring potential health disparities in excessive gestational weight gain. *J Women's Health* 2013;22:494-499.
28. Fealy SM, Taylor RM, Foureur M, et al. Weighing as a stand-alone intervention does not reduce excessive gestational weight gain compared to routine antenatal care: a systematic review and meta-analysis of randomised controlled trials. *BMC Pregnancy and Childbirth* 2017;17:36.
29. Siega-Riz AM, Bodnar LM, Stotland NE, et al. The current understanding of gestational weight gain among women with obesity and the need for future research. *NAM Perspectives. Discussion Paper, National Academy of Medicine, Washington, DC; 2020.*
30. Cheney K, Berkemeier S, Gordon A, et al. Prevalence and predictors of early gestational weight gain associated with obesity risk in a diverse Australian antenatal population: a cross-sectional study. *BMC Pregnancy and Childbirth* 2017;17:296.

31. Godoy AC, Nascimento SL, Surita FG. A systematic review and meta-analysis of gestational weight gain recommendations and related outcomes in Brazil. *Clinics* 2015; 70:758-764.
32. Magalhães EIS, Maia DS, Bonfim CSA, et al. Prevalência e fatores associados ao ganho de peso gestacional excessivo em unidades de saúde do sudoeste da Bahia. *Rev Bras Epidemiol* 2015;18:858-69.
33. Domingues RMSM, Hartz ZMA, Dias MAB, et al. Avaliação da adequação da assistência pré-natal na rede SUS do Município do Rio de Janeiro, Brasil. *Cad Saúde Publica* 2012;28:425-37.
34. Traldi MC, Galvão P, Fonseca MRCC. Prenatal care evaluation in pregnant women in the region of Jundiá-SP, Brazil: Kotelchuck's index. *Rev Saúde* 2014;8.
35. Leal MC, Gama SGN, Ratto KMN, et al. Use of the modified Kotelchuck index in the evaluation of prenatal care and its relationship to maternal characteristics and birth weight in Rio de Janeiro, Brazil. *Cad Saúde Pública* 2004;20:S63-S72.
36. Tayebi T, Zahrani ST, Mohammadpour R. Relationship between adequacy of prenatal care utilization index and pregnancy outcomes. *Iran J Nurs Midwifery Res* 2013;18:360–366
37. Shin D, Song WO. Influence of the adequacy of the prenatal care utilization Index on Small-for-gestational-age infants and preterm births in the United States. *J Clin Med* 2019;8:838.
38. Kominiarek MA, Peaceman AM. Gestational weight gain. *Am J Obstet Gynecol* 2017;217:642-651. doi:10.1016/j.ajog.2017.05.040.
39. Fonseca CRB, Strufaldi MWL, Carvalho LR, et al. Adequacy of antenatal care and its relationship with low birth weight in Botucatu, São Paulo, Brazil: a case-control study. *BMC Pregnancy Childbirth* 2014;14:255.
40. Vítole MR, Bueno MS, Gama CM. Impact of a dietary counseling program on the gain weight speed of pregnant women attended in a primary care service. *Rev Bras Ginecol Obstet* 2011;33:58-9.
41. Kac G, Carilho TRB, Rasmussen KM and Brazilian Maternal and Child Nutrition Consortium. Gestational weight gain charts: results from the Brazilian Maternal and Child Nutrition Consortium. *Am J Clin Nutr* 2021;113:1351-1360.
42. Zozzaro-smith PE, Bacak S, Conway C, et al. Association between obesity during pregnancy and the adequacy of prenatal care. *Matern child health J* 2015; 20:158-63.
43. Bannon AL, Waring ME, Leung K, et al. Comparison of Self-reported and Measured Pre-pregnancy Weight: Implications for Gestational Weight Gain Counseling. *Matern Child Health J* 2017;21:1469–78.
44. Scholl TO, Hediger ML, Schall JI, et al. Gestational weight gain, pregnancy outcome, and postpartum weight retention. *Obstet Gynecol* 1995;86:423-7.

45. Soliman FES. Satisfaction of rural pregnant women as quality indicator of provided antenatal care. *IJSRP* 2015;5:1-9.
46. Olson CM, Strawderman MS, Reed RG. Efficacy of an intervention to prevent excessive gestational weight gain. *Am J Obstet Gynecol* 2004;191:530-6.

Contributors

Gigante DS drafted the first version of the manuscript, performed the statistical analysis and contributed to the interpretation of the results; Adegboye ARA conceptualized the study, performed the statistical analysis, contributed to the interpretation of the results and reviewed the discussion of the manuscript; Lacerda EMA contributed to the proposal of statistical analysis, interpretation of the results and reviewed the discussion of the manuscript; Padilha CP drafted the first version of the manuscript, performed the statistical analysis, contributed to the interpretation of the results and reviewed the discussion of the manuscript; Saunders C contributed to the interpretation of the results and reviewed the discussion of the manuscript; Castro MBT collected the data, conceptualized the study, performed the statistical analysis and the interpretation of the data, draft de manuscript and contributed to the discussion of the results. The authors have approved the final version of the submitted manuscript.

Conflict of Interest: The authors declare no conflict of interest

Received: March 11, 2021

Accepted: June 16, 2021