

Factors associated with the adequacy of gestational weight gain among Brazilian teenagers

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Abstract *The scope of this article is to evaluate the adequacy of total gestational weight gain (GWG) according to maternal characteristics of Brazilian adolescents. It involved a cross-sectional, hospital-based study. A total of 3,904 teenagers with a single fetus gestation and gestational age (GA) at birth ≥ 37 weeks were included. A hierarchical model was built to analyze the dependent and independent variables adequacy of GWG: sociodemographic, care, obstetric and behavioral characteristics. The chances of insufficient GWG were higher for adolescents from the North (OR = 1.50, 95%CI: 1.07-2.10) and Northeast (OR = 1.68, 95%CI: 1.27-2.21). Paid work increased the chances of insufficient (95%CI: 1.15-2.39) and excessive (95%CI: 1.01-1.86) GWG. The pre-pregnancy body mass index of overweight or obese adolescents was associated with excessive GWG (OR = 1.86, 95%CI: 1.19-2.92 and OR = 3.06, 95%CI: 2.10-4.45, respectively), as well as GA ≥ 42 weeks (OR = 2.23, 95%CI: 1.03-4.81). Living in the North and Northeast regions increases the chances of adolescents having insufficient GWG. Having paid work was associated with a greater chance of excessive and insufficient GWG. Furthermore, pre-pregnancy excess weight or obesity and GA ≥ 42 weeks increased the chances of excessive GWG.*

Key words *Weight gain, Pregnancy in adolescence, Nutritional status*

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Introduction

Teenage pregnancy is considered to be a public health problem in Brazil and worldwide. Among the reasons that justify this affirmation are the possible negative repercussions to maternal and infant health, such as the occurrence of anemia, preeclampsia, postpartum hemorrhage, among other adverse clinical outcomes¹⁻⁵. The main causes of mortality among girls, aged 15 to 19 years, is related to the pregnancy and birth conditions. In these situations, teenage mothers run a five-fold greater chance of dying than do adult mothers⁶.

Add to this dilemma the possible social and economic impact resulting from the difficulty to return to one's studies after giving birth, in turn diminishing one's chances of insertion in the work market and social ascension^{7,8}. In this light, maternity in this stage of life has been the object of study of many fields of knowledge⁹.

In the field of nutrition, the joining of these two moments – pregnancy and adolescence – is quite delicate, as they are periods of major physical and metabolic transformation. In this context, the total Gestational Weight Gain (GWG) is a widely debated variable in the literature, as it configures as one of the determinants or the maternal and perinatal outcomes^{10,11}. It is well-known that insufficient or excessive GWG is associated with gestational results that are unfavorable to the health of the mother or the infant, causing both short-term and long-term repercussions¹⁴. Among the complications that can occur during pregnancy and birth in adolescence are the slow fetal growth, low birth weight, preeclampsia, premature birth, among others⁶. The variations referent to GWG can be caused by many factors, including socioeconomic, behavioral, and care factors¹⁵.

Despite the relevance of this theme and of its possible repercussions on maternal and infant health¹⁻⁵, the majority of studies that investigate the factors associated with the adequacy of GWG are limited to adult pregnant women, with no population studies having been conducted with adolescents in Brazil. Thus, further efforts are necessary to achieve a greater understanding of GWG in this population, especially in the countries of Latin America and the Caribbean¹, which have the second highest global rate of newborns among teenage mothers.

Therefore, the present study aims to evaluate the adequacy of GWG, according to the maternal characteristics of Brazilian adolescents.

Methods

This is a cross-sectional, nationwide hospital-based study, conducted by means of the data from the study, “Nascer no Brasil: Pesquisa Nacional sobre Parto e Nascimento” (“Born in Brazil: National Study on Delivery and Birth”), conducted from February 2011 to October 2012, approved by the Research Ethics Committee from the National School of Public Health/Oswaldo Cruz Foundation (logged under protocol number CAAE: 0096.0.031.000-10).

The selection of the postpartum women for the study, “Born in Brazil”, was conducted in three stages, through a complex representative probabilistic sample. The first stage consisted of hospitals with 500 or more annual births, stratified by the types of hospital (public, private, or mixed), geographic macroregions in Brazil (South, Southeast, Midwest, North, and Northeast) and location (capital or non-capital). In the second stage, the period necessary to cover all of the 90 postpartum women (minimum of seven days for each hospital) was selected, while the third stage consisted of the number of postpartum women (90 per hospital). In this manner, 266 hospitals from 191 Brazilian municipalities were selected, with 84 (31.6%) of these located in capital cities and 182 (68.4%) located in the countryside of Brazil, totaling 23,894 postpartum women who were interviewed.

Interviews with the postpartum women were conducted face-to-face while they were hospitalized in the health service through the application of a standardized electronic questionnaire. Their pre-natal cards were digitalized for the storage and extraction of data. Information from the medical records of the postpartum women and the newborns referent to the current gestation was also collected. More details about the sample design can be found in Vasconcelos *et al.*¹⁶, and information related to the method can be found in Leal *et al.*¹⁷

For the present study, all postpartum adolescents, aged 10 to 19 years (complete), with the pregnancy of a single fetus and a gestational age (GA) at birth ≥ 37 weeks, were selected. Excluded were those whose information was not available or feasible for the calculation of the pre-pregnancy body mass index (BMI) and total GWG in kilograms (KG) – Figure 1.

The outcome variable (dependent) was the adequacy of the total GWG. The recommendations from the Institute of Medicine (IOM, 2009)¹⁸ were considered in order to evaluate

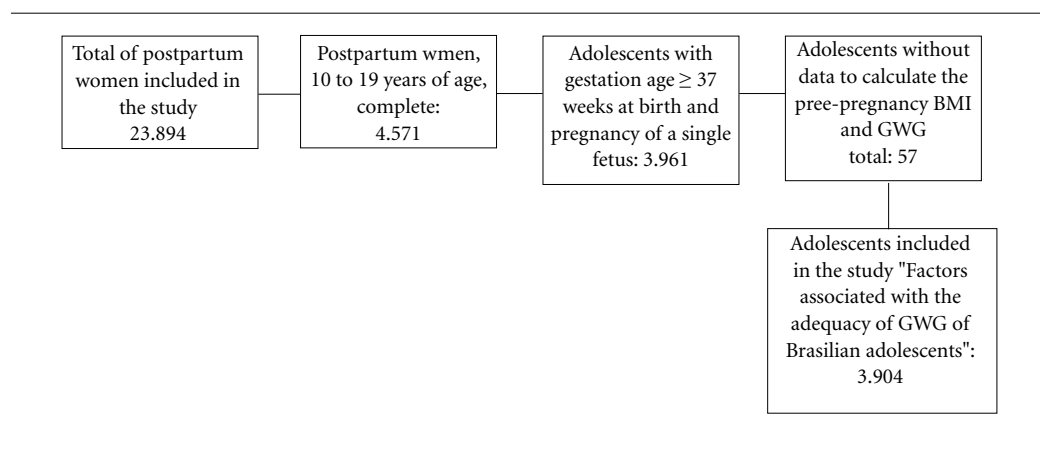


Figure 1. Flow chart of the selection of postpartum teenagers from the study, “Nascer no Brasil: Pesquisa Nacional sobre Parto e Nascimento”, Brazil 2011-2012.

Source: Authors.

the adequacy of GWG, according to the range of weight gain in accordance with the pre-pregnancy nutritional state (BMI – kg/m²). To classify the pre-pregnancy BMI, this study used the BMI/age curves for girls, aged 15 to 19 years, as established by the World Health Organization (OMS, 2007)¹⁹, with its classification in z-score, according to that proposed by the Food and Nutrition Surveillance System in Brazil for adolescents²⁰. Classified as “adequate” was the GWG that fell within the recommended ranges for each pre-pregnancy BMI, that is: low weight (z-score < -2) = 12.5-18 kg; eutrophy (z-score ≥ -2 and ≤ 1) = 11.5 -16.0 kg; overweight (z-score > 1 and < 2) = 7.0 to 11.5 kg, and obesity (z-score ≥ 2) = 5.0 to 9.0 kg. GWG values below those recommended were classified as “insufficient” and above as “excessive”. The GWG variable was calculated by the difference between the last record of weight, so long as it was up to 6 days before delivery, and the pre-pregnancy weight (kg), recorded on the pre-natal card, or the beginning weight (up to the 13th complete gestational week), or that reported by the postpartum woman. More details about the formulation of this variable can be found in Brandão et al. (2020)²¹ and about the validity of the anthropometric information in Araújo et al. (2017)²².

A structured theoretical model was formulated, in which the maternal characteristics were placed in ranked levels according to their relationship with the adequacy of GWG, based on the model proposed by Stulbach et al. (2007)²³

with modifications. For each level, the following variables were included, obtained by means of an interview with the postpartum woman, appointments registered in the medical records, and the maternal health card, defined as follows:

Distal level – socioeconomic characteristics: self-declared skin color (white or non-white); number of people per room in the household (≤ 4 or > 4); household’s geographic region (North, Northeast, Southeast, South, or Midwest); education level (incomplete elementary education, complete elementary education, or complete high school/higher); marital status (without partner or with partner); economic classification (A/B, C, or D/E); paid work (yes or no) – if yes, what is the work situation (signed working papers/employer/public servant or without signed working papers/self-employed/cooperative/other); postpartum woman, head of the family (yes or no);

Intermediate level – reproductive and obstetric history, comorbidities and care variables: primiparous (yes and no); gestational hypertensive syndrome (yes and no); gestational or chronic diabetes mellitus (yes and no); diagnosis of infection by Human Immunodeficiency Virus (HIV) during pregnancy (yes or no); number of pre-natal appointments (< 3, 4 to 5 or ≥ 6); location where most of the pre-natal appointments were conducted (public, private, or mixed service); professional who provided care in most of the pre-natal appointments (doctor or nurse); follow-up by the same professional during the

entire pre-natal period (yes – all the time, yes – in most appointments; no); high-risk gestation (yes or no); hospitalization during gestation (yes or no); adequate pre-natal care (yes or no); dissatisfaction regarding pregnancy (yes, somewhat, or no); attempt to interrupt pregnancy (yes or no); has health insurance (yes or no);

Proximal level – pre-pregnancy BMI classification (low weight, eutrophy, overweight, or obesity); suspicion of inappropriate use of alcohol (no suspicion of inappropriate use of alcohol, suspicion of inappropriate use of alcohol, or did not ingest alcoholic beverages during gestation); smoked at some point during pregnancy (yes or no); age in years (10 to 16 years; 17 to 19 years); gestational age at birth (≥ 37 and < 42 weeks or ≥ 42 weeks).

The postpartum women considered the head of the family was the reference person for decision-making in the family. The economic class was based on the criteria established by the Brazilian Association of Research Companies (ABEP/2010)²⁴. The variable of hypertensive syndrome during gestation refers to the diagnosis of chronic hypertension, preeclampsia, or eclampsia²⁵. This study defined as adequate the pre-natal care that was begun up to the 12th gestational week, having attended at least six appointments (corrected for the gestational age at birth), registration of the pre-natal card of at least one result of each of the routine pre-natal exams, and receipt of medical advice regarding the reference maternity clinic²⁶. For the suspicion of the use of alcohol, the TWEAK: Tolerance Worry Eye-opener Annoyed Cut-down was used, considering as positive those postpartum women who answered yes to three or more questions of the questionnaire regarding the consumption of alcohol²⁷. The classification of the maternal age in two groups (10 to 16 years; 17 to 19 years) is justified by the fact that some studies indicate a greater difference in the pre-pregnancy BMI classification in younger adolescents (< 16 years) and that adolescents over 16 years of age have characteristics of pregnancy that are similar to those of adults²⁸⁻³⁰.

The pre-pregnancy BMI was imputed by the Chained Equations (MICE)³¹, since for 17.5% of the participating postpartum women in this study, there were no data about stature (15.5%) and 4.4% about pre-pregnancy or beginning weight. The prediction model of multiple imputation for pre-pregnancy BMI included the following maternal variables: geographic region of the country, source of payment for the delivery, schooling, skin color, age, parity and presence of

diabetes or hypertension (chronic or gestational), pre-pregnancy weight, weight at the end of the gestation and stature. This study used the Fully Conditional Specification (FCS) method in the Statistical Package for the Social Sciences (SPSS, version 22) to obtain ten groups of imputed data. Next, the models were formulated, based on these multiple groups of imputed data, using the Rubin rules to combine estimates of effect and estimates of standard errors^{31,32}.

All of the statistical analyses were carried out in the SPSS, version 22, and R, version 4.0.1, software, using procedures for complex samples that include the sample weight of the postpartum women and the effect of the design. In the bivariate analysis, Pearson's chi-squared test were used in the evaluation of the association between the maternal characteristics and the outcome. Initially, the variables that presented a p-value ≤ 0.20 in the bivariate analysis were selected for the construction of a model of multinomial hierarchical regression. At each level, the variables were selected by the "backward" method, with the criteria of $p < 0.05$, in order to remain in the model. The odds ratio (OR), adjusted with the respective 95% confidence interval (95%CI), were estimated, and were considered with a statistically significant association with the outcome of the variables, whose p-value was ≤ 0.05 . At each level, the variables were controlled for the others at the same level and for those at a higher level. Thus, the estimates obtained at each ranked level refer to the effects of the variable already adjusted for the possible confounding factors.

Results

This study excluded 57 adolescents, leaving a total sample of 3,904 adolescents (Figure 1). The majority were non-white (72.4%), lived with a partner (68.0%), had no paid work (87.9%), and belonged to economic class "C" (54.5%) (Table 1).

It was observed that the major concentration of adolescents with insufficient weight gain occurred in the North (44.2%) and Northeast (42.2%) as compared to other regions of the country. Only 26.0% of the adolescents living in the Northeast, and 30.1% in the North, presented an adequate GWG (Table 1).

Regarding the exercise of paid work, it was found that the adolescents that did not work presented a higher percentage of adequacy of GWG (30.9%), while those that worked had a higher level of insufficiency (42.6%) and excess (34.0%)

Table 1. Adequacy of total GWG of adolescents, according to maternal characteristics of the distal level of ranking, Brazil, 2011-2012.

Maternal characteristics	Total N (%)	Average weight gain (kg)	Adequacy of total gestation weight gain ¹			p-value**
			Insufficient N (%)	Adequate N (%)	Excessive N (%)	
Skin color						
White	1079 (27.6)	12.6	373 (34.6)	303 (28.1)	402 (37.3)	0.092
Non-White	2826 (72.4)	12	1074 (38.0)	867 (30.7)	885 (31.3)	
Number of people per room per household	3828 (98.2)	12.2	1412 (36.9)	1142 (29.8)	1274 (33.3)	0.138
≤ 4	71 (1.8)	10.7	32 (45.5)	25 (36.1)	13 (18.3)	
> 4						
Region in the country						0.002
North	513 (13.1)	11.5	227 (44.2)	155 (30.1)	132 (25.7)	
Northeast	1228 (31.5)	11.8	518 (42.2)	320 (26.0)	390 (31.8)	
Southeast	1479 (37.9)	12.5	481 (32.5)	483 (32.6)	516 (34.9)	
South	418 (10.7)	12.5	135 (32.3)	133 (31.9)	149 (35.8)	
Midwest	266 (6.8)	12.9	86 (32.5)	79 (29.8)	100 (37.8)	
Schooling (level of education)						0.467
Incomplete elementary	1525 (39.2)	12.1	566 (37.1)	436 (28.6)	522 (34.2)	
Complete elementary	1680 (42.2)	12.3	624 (37.1)	501 (29.8)	555 (33.0)	
Complete high school or higher	685 (17.6)	12	253 (36.9)	229 (33.5)	203 (29.6)	
Marital status		12				0.414
Without partner	1251 (32)	12.3	491 (39.3)	356 (28.5)	403 (32.3)	
With partner	2652 (68)		955 (36)	814 (30.7)	883 (33.3)	
Paid work						0.036
No	3431 (87.9)	12.2	1245 (36.3)	1059 (30.9)	1127 (32.9)	
Yes	472 (12.1)	11.8	201 (42.6)	111 (23.4)	160 (34.0)	
Work situation						0.220
Signed working papers or employer or public servant	219 (46.3)	12.1	81 (37.1)	53 (24.5)	84 (38.5)	
without Signed working papers or self-employed or cooperative or other	253 (53.7)	11.7	120 (47.4)	57 (22.5)	76 (30.1)	
Head of the family						0.147
Yes	124 (3.2)	12.8	38 (31)	25 (20.5)	60 (48.5)	
No	3745 (96.8)	12.1	1394 (37.2)	1134 (30.3)	1217 (32.5)	
Socioeconomic class						0.064
D + E	1335 (34.4)	11.6	542 (40.6)	378 (28.3)	415 (31.1)	
C	2114 (54.5)	12.6	716 (33.9)	646 (30.5)	752 (35.6)	
A + B	431 (11.1)	11.6	176 (40.9)	137 (31.9)	117 (27.2)	

¹ According to recommendations from the Institute of Medicine (2009) for each pre-pregnancy BMI range, this classified according to the z-score of BMI/Growth Curve Age for girls of 5 to 19 years from the World Health Organization (2007). The total weight gain was considered adequate, insufficient, or excessive when within the recommended margins, above or below, respectively. ² Pearson chi-squared test.

Source: Authors.

in weight gain (Table 1). When the paid work was analyzed by region (data not presented in the tables), a higher concentration of adolescents who exercised paid work was observed in the Southeast (44.0%), given that 50.3% of these presented an insufficient (OR = 3.36, 95%CI: 1.86-6.07) and 31.9% excessive (OR = 1.78, 95%CI: 1.08-2.95) GWG.

At the distal level, the variable of skin color, number of people per room per household, head of the family, economic class, paid work, and region of the country proved to be associated with the outcome (Table 1). The same occurred with the hypertensive syndromes and the professional who provided medical care in most pre-natal appointments, at the intermediate level (Table 2).

Table 2. Adequacy of total GWG of adolescents, according to maternal characteristics of the intermediate level of the ranking. Brazil, 2011-2012.

Maternal characteristics	Total N (%)	Average weight gain (kg)	Adequacy of total gestation weight gain ¹			p-value**
			Insufficient N (%)	Adequate N (%)	Excessive N (%)	
Previous gestations						
No	2940 (75.4)	12.2	1088 (37.0)	866 (29.4)	986 (33.5)	0.532
Yes	961 (24.6)	12.2	356 (37.1)	304 (31.7)	300 (31.3)	
Hypertensive disease						
No	3628 (92.9)	12	1354 (37.3)	1096 (30.2)	1177 (32.5)	0.129
Yes	276 (7.1)	13.8	92 (33.4)	74 (26.7)	110 (39.8)	
Gestational or chronic diabetes mellitus						
No	3718 (95.2)	12.1	1386 (37.3)	1113 (29.9)	1219 (32.8)	0.543
Yes	186 (4.8)	13.5	60 (32.5)	57 (30.7)	68 (36.8)	
Positive diagnosis for Human Immunodeficiency Virus during gestation	3899 (99.9)	12.2	1443 (37)	1169 (30)	1287 (33)	0.332
No	5 (0.1)	9.1	3 (65.4)	1 (22.3)	1 (12.2)	
Yes						
Number of pre-natal appointments						
< 3	460 (12.1)	11	197 (42.8)	114 (24.8)	149 (32.4)	0.323
4-5	867 (22.9)	12	326 (37.7)	279 (32.2)	261 (30.1)	
> 6	2466 (65)	12.4	896 (36.3)	749 (30.4)	821 (33.3)	
Location where most of the pre-natal appointment took place						
Public service	3466 (90.1)	12.2	1293 (37.3)	1034 (29.8)	1139 (32.9)	0.431
Private service	290 (7.6)	11.05	96 (33)	86 (29.5)	109 (37.5)	
Public and private service	90 (2.3)	12	34 (37.9)	32 (35.4)	24 (26.7)	
Professional who provided medical care in most of the pre-natal care appointments						
Doctor	2422 (64.3)	12.3	816 (33.7)	734 (30.3)	871 (36)	<0.001
Nurse	1344 (35.7)	11.8	590 (43.9)	375 (27.9)	378 (28.2)	
Follow-up by the same professional during the entire pre-natal care period						
No	526 (13.7)	12.8	177 (33.3)	148 (28.1)	203 (38.6)	0.247
Yes, most of the time	1519 (39.6)	11.3	552 (36.3)	456 (30)	511 (33.6)	
Yes, the entire time	1789 (46.7)	11.8	689 (38.5)	545 (30.5)	555 (31)	
High-risk gestation						
No	2081 (81.8)	12.2	778 (37.4)	602 (28.9)	701 (33.7)	0.293
Yes	464 (18.2)	12.4	153 (33.1)	138 (29.8)	172 (37.1)	
Hospitalization during gestation						
No	329 (84.4)	12.1	1235 (37.5)	984 (29.9)	1073 (32.6)	0.653
Yes	608 (15.6)	12.6	210 (34.6)	184 (30.3)	213 (35.1)	
Adequate pre-natal care						
No	1861 (47.7)	12	693 (37.2)	537 (28.8)	63 (33.9)	0.518
Yes	2043 (52.3)	12.3	754 (36.9)	633 (31)	656 (32.1)	
Has health insurance						
No	3432 (88)	12.1	1290 (37.6)	1010 (29.4)	1132 (33)	0.277
Yes	468 (12)	12.3	155 (33.2)	158 (33.9)	154 (33)	
Dissatisfaction wth pregnancy						
No	2435 (62.7)	12.3	896 (36.8)	738 (30.3)	800 (32.9)	0.977
Somewhat	1071 (27.6)	12	402 (37.5)	311 (29)	358 (33.5)	
Yes	375 (9.7)	12.2	143 (38.2)	112 (29.9)	120 (31.9)	
Attempt to interrupt pregnancy						
No	3768 (96.6)	12.1	1396 (37.1)	1124 (29.8)	1247 (33.1)	0.727
Yes	133 (3.4)	12.5	51 (38)	44 (32.9)	39 (29.1)	

¹ According to recommendations from the Institute of Medicine (2009) for each pre-pregnancy BMI range, this classified according to the z score of BMI/Growth Curve Age for girls of 5 to 19 years from the World Health Organization (2007). The total weight gain was considered adequate, insufficient, or excessive when within the recommended margins, above or below, respectively. ² Pearson chi-squared test.

In relation to the pre-pregnancy BMI, it was found that 65.4% of the participants began their pregnancies as eutrophic, 22.6% overweight, 10.6% obese, and 1.3% with low weight (Table 3). As regards the maternal habits, the majority (85.4%) reported not having ingested alcoholic beverages during gestation. There was a suspicion of the inappropriate use of alcohol for 8.4% of the adolescents (Table 3).

It was observed that the majority of the adolescents (46.1%) suspected of the inappropriate use of alcohol presented insufficient weight gain when compared to those that did not present this suspicion (31.0%) or that did not ingest alcoholic beverages (36.6%) (Table 3). When this variable was evaluated by geographic region, a statistically significant difference was found in the Northeast, given that the adolescents suspected of an inappropriate use of alcohol presented a significantly higher chance of excessive weight gain in relation

to those who did not ingest alcoholic beverages (OR = 0.42, 95%CI: 0.21-0.84). More than half (58.4%) of the adolescents of this region suspected of the inappropriate use of alcohol presented an insufficient weight gain, as compared to 27.0% adequate and only 15.0% excessive weight gain (data not presented in the tables).

After the adjustment of the multiple hierarchical model, among the variables of the distal level, it was found that the chances of presenting an insufficient weight gain were higher for adolescents from the North (OR = 1.50, 95%CI: 1.07-2.10) and Northeast (OR = 1.68, 95%CI: 1.27-2.21) regions when compared to those from the Southeast of the country. The paid work was associated with a 66% greater chance of insufficient (95%CI: 1.15-2.39) and 37% of excessive (95%CI: 1.01-1.86) GWG. None of the variables of the intermediate level (Table 2) remained associated with the outcome ($p < 0.05$). At the

Table 3. Adequacy of the total GWG of adolescents, according to maternal characteristics of the proximal level of the ranking. Brazil, 2011-2012.

Maternal characteristics	Total N (%)	Average weight gain (kg)	Adequacy of total gestation weight gain ¹			p-value**
			Insufficient N (%)	Adequate N (%)	Excessive N (%)	
Age						
10 to 16 years	1138 (29.2)	12.4	389 (34.2)	344 (30.2)	405 (35.6)	0.164
17 to 19 years	2766 (70.8)	12.1	1058 (38.2)	825 (29.9)	883 (31.9)	
Classification of the pre-pregnancy body mass index ³						
Low weight (< -2)	52 (1.3)	15.5	21 (40.5)	18 (34)	13 (25.6)	< 0.001
Overweight (> +1 e < +2)	882 (22.6)	11.2	180 (20.5)	285 (32.3)	417 (47.3)	
Obesity (≥ +2)	415 (10.6)	8.6	115 (27.8)	87 (21)	213 (51.3)	
Eutrophy (≥ -2 e ≤ +1)	2555 (65.4)	13	1130 (44.2)	780 (30.5)	644 (25.2)	
Suspicion of the inappropriate use of use of alcohol during gestation						
No suspicion of the inappropriate use of alcohol during gestation	235 (6.2)	12.8	73 (31)	88 (37.2)	75 (31.8)	0.046
Suspicion of the inappropriate use of alcohol during gestation	318 (8.4)	11.1	146 (46.1)	90 (28.3)	81 (25.6)	
Did not ingest alcoholic beverages during gestation	3249 (85.4)	12.2	1189 (36.6)	966 (29.7)	1094 (33.7)	
Smoked at some point during pregnancy						
No	3534 (90.7)	12.2	1305 (36.9)	1056 (29.9)	1173 (33.2)	0.784
Yes	363 (9.3)	11.9	140 (38.6)	112 (30.9)	111 (30.5)	
Gestational age at birth						
≥ 37 and < 42 weeks	3764 (96.4)	12.1	1409 (37.4)	1137 (30.2)	1218 (32.4)	0.044
≥ 42 weeks	140 (3.6)	14	38 (27.2)	32 (23.3)	69 (49.6)	

¹ According to recommendations from the Institute of Medicine (2009) for each pre-pregnancy BMI range, this classified according to the z score of BMI/Growth Curve Age for girls of 5 to 19 years from the World Health Organization (2007). The total weight gain was considered adequate, insufficient, or excessive when within the recommended margins, above or below, respectively. ² Pearson chi-squared test. ³ According to the BMI/age growth curves for girls of 5 to 19 years from the World Health Organization (2007).

proximal level, the pre-pregnancy BMI remained as an explicative variable, with the chances of excessive GWG being greater for adolescents who began their pregnancy overweight (OR = 1.86, 95%CI: 1.17-2.92) and obese (OR = 3.06, 95%CI: 2.10-4.45). The gestational age \geq 42 weeks was also associated with a greater chance (OR = 2.23, 95%CI: 1.03-4.81) of excessive gestational weight gain (Table 4).

The adolescents of the North and Northeast regions presented averages of initial gestational weight (53.1 kg and 56.5 kg, respectively) and end gestational weight (64.7kg and 68.3kg, respectively) below that of the participants of the other regions of the country (Figure 2 – A). The same occurred with the total GWG. On average, the participants from the North gained 11.5 kg; from the Northeast, 11.8 kg; followed by the Southeast, 12.5 kg; the South, 12.5 kg; and the Midwest, 12.9 kg (Figure 2 – B).

Discussion

The findings from this investigation indicate that residing in the North and Northeast regions of Brazil constitutes a greater chance of insufficient GWG for adolescents, who, in general, began and finished their pregnancies with lower weights when compared to girls from other geographic regions of Brazil. This result can be explained when one considers the social inequality that exists in the country, with the North and Northeast regions presenting the worst income and working conditions³³.

What stands out here is that the majority of adolescents from the Northeast suspected of the inappropriate use of alcohol during pregnancy presented an insufficient weight gain. This is a worrisome fact, bearing in mind that the excessive consumption of alcohol (and other drugs) can interfere in the absorption of nutrients, as

Table 4. Hierarchical model of factors associated with the adequacy of the GWG of adolescents, distal, intermediate, and proximal levels. Brazil, 2011-2012.

Variables	Adequacy of gestational weight gain			
	Insufficient		Excessive	
	OR ¹	95% CI ¹	OR ¹	95% CI [#]
Distal level				
Region of the country				
Southeast	1		1	
North	1.50	(1.07-2.10)	0.81	(0.57-1.15)
Northeast	1.68	(1.27-2.21)	1.16	(0.82-1.65)
South	1.00	(0.69-1.46)	1.04	(0.75-1.45)
Midwest	1.09	(0.79-1.52)	1.19	(0.79-1.77)
Paid work				
No	1		1	
Yes	1.66	(1.15-2.39)	1.37	(1.01-1.86)
Intermediate level*				
Proximal level**				
Pre-pregnancy body mass index				
Low weight	0.84	(0.41-1.71)	0.96	(0.45-2.06)
Eutrophy	1		1	
Overweight	0.46	(0.30-0.73)	1.86	(1.19-2.92)
Obesity	0.98	(0.68-1.41)	3.06	(2.10-4.45)
Gestational age at birth				
37-41 weeks	1		1	
\geq 42 weeks	0.84	(0.47-1.50)	2.23	(1.03-4.81)

¹Selection of variables by the “backward” method, as of those with $p < 0.20$ in the bivariate analysis. * Adjusted for the statistically significant variables of the distal level (p -value < 0.05). ** Adjusted for the statistically significant variables of the distal and intermediate levels (p -value < 0.05).

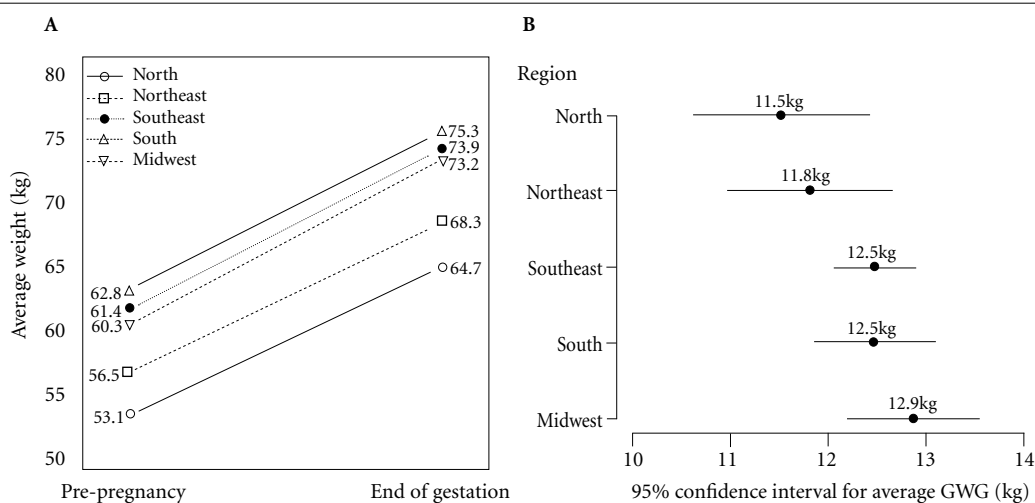


Figure 2. Curves of averages of initial and end gestational weight gain (A) and averages of total gestational weight gain (B) of adolescents according to geographic regions. Brazil, 2011-2012.

Source: Authors.

well as compromise their consumption in both adequate quantity and quality, resulting in malnutrition, especially due to the lack of micronutrients³⁴⁻³⁷. The compromising of the mother's nutritional state due to the ingestion of alcohol can harm the nutritional supply to the fetus and result in unfavorable outcomes, such as the restriction of intrauterine growth or fetal alcohol spectrum disorder (FASD)³⁷. Therefore, tracking and intervention strategies geared toward the prevention of the use of alcohol by pregnant adolescents, mainly those residing in the more underprivileged regions of the country, are necessary to prevent and combat the possible impacts of this practice in maternal and infant health.

Another variable that appeared to explain the insufficient weight gain was the exercise of paid work, especially for adolescents from the Southeast region of the country. Although insufficient weight gain has been more prevalent in the adolescents from the North and Northeast regions, when categorized by the exercise of paid work, it was more commonly observed in adolescents from the Southeast region. Half of them present insufficient GWG, as if this activity contributed to the poor results in weight gain, given that this same factor is associated with excessive weight gain. Findings from Silva et al. (2019)³⁸, carried out with pregnant women, mostly adults, identified that their insertion in the work market was

associated with excessive weight gain (71.6%), in comparison to those who were not inserted in the market (51.8%). Other studies in Brazil^{23,39} that included adult and adolescent pregnant women found no association between work and gestational weight gain, these results, which differ from our findings, should be taken with caution, since the present study deals with a specific population, including only adolescents. Thus, it is relevant to consider that the insertion in the work market, as an pregnant teenage women, can also contribute to a worse result as regards weight gain, possibly overloading these girls both physiologically and metabolically. Such a scenario can be observed primarily in the less favored social strata, with limited financial resources, with paid work being a way to contribute to the basic family needs, such as food and housing⁴⁰.

It is important to note that more than half of the adolescents who work, do so informally, and, to a great extent, present insufficient GWG. In Brazil, studies conducted with students of public schools in São Paulo⁴¹ and Ceará⁴² showed that the adolescents more often occupied positions as street vendors, aides, nannies, maids, packagers, stockers, among other activities performed without formal working contracts, with a long and exhausting weekly work schedule (reaching 60 hours/week, in some cases), and with no social protection or labor rights. Although the results

of the present study on informal work and insufficient GWG have not presented any statistically significant difference, they lead us to reflect on what the working conditions of these young mothers must be like, and suppose that they must be similar to that reported by other studies related to the theme, that is, they are exposed to work developed in a precarious manner, without the conditions to provide an adequate diet that meets the necessary nutritional demands during pregnancy.

The prevalence of eutrophy prior to pregnancy was less than that reported by studies that evaluated only adolescents^{9,43}, and higher than those that included both adolescents and adults^{44,45}. This difference is possibly due, in addition to the sociodemographic and regional cultural differences, to the distinct methods used to evaluate the pre-pregnancy BMI. To evaluate the nutritional state prior to pregnancy in the group of adolescents, some authors^{9,43} applied the WHO's growth curves (2007)¹⁹ – which establish the BMI with their own cut-off points for this group, with variations according to age, up to 19 years. Other authors^{39,44,46} evaluated the adolescents according to the BMI classes recommended by the IOM (2009)¹⁸ and the WHO (1995)⁴⁷. Although Brazilian authors⁴⁸ recommended the classification proposed by the WHO (2007)¹⁹, it is important to invest in epidemiological studies geared toward the definition of a specific method for the population of Brazilian adolescents, in such a way that there is a classification criterion that is appropriate for this group and that can be applied in clinical practice.

In the present work, the adolescents whose pre-pregnancy BMI was classified as overweight or obesity presented greater chances of excessive GWG, findings that run in line with that reported in both national and international literature. In one Brazilian study, which included 98 women with an average of 25.4 years, the participants with an excess weight before gestation also presented a higher prevalence of excessive GWG ($p = 0.001$)⁴⁹. In the same light, authors that studied the determinants of weekly GWG of 328 Brazilian pregnant women reported that the pre-pregnancy nutritional state of overweight/obesity was one of the factors associated with excessive weight gain (RP = 1.33, 95% CI: 1.01-1.75)⁵⁰.

In addition, in our results, it was found that the teenage pregnant women with excessive GWG had more post-term births, which is similar to findings from Slack (2019)⁵¹ and Heslehurst (2017)⁵², who point out that women with high

BMI (obesity) present higher risks of post-term births. As this is an avoidable risk factor, which contributes to perinatal and infant mortality⁵², our findings reinforce the importance of pre-natal care, especially for adolescents that begin their gestation overweight/obese. It is thus necessary to set up strategies that seek to promote weight gain that is as close to the recommended levels as possible, aiming to reduce gestational results that are unfavorable to maternal and infant health. It is important to mention the need for investigations that seek to clarify the association between excessive weight gain and post-term birth in adolescents.

The present study showed a higher percentage of excessive GWG in the adolescents of the younger group when compared to that of 17 to 19 years of age, and that the opposite occurred with insufficient GWG, even though these data were not significantly different. Rodrigues *et al.*⁵³, in a study conducted in Rio de Janeiro about the magnitude and determining factors of insufficient and excessive GWG, found higher chances of insufficient weight gain in older pregnant women (25 to 29 years of age and ≥ 30 years) as compared to younger women (18 to 24 years), which presented higher chances of excessive weight gain. Although these data are similar to our findings, they differ in the fact that they include adolescents and adults in their sample. When analyzing our results, it is important to consider the hypothesis of maternal-fetal competition for nutrients when the mother is still growing, which is responsible for part of the increase in weight during teenage pregnancy⁵⁴. In this stage of life, the sexual hormones of puberty and of growth are high, leading to the maturation of the sexual organs. During this process, important changes occur, such as changes in the body composition, with the increase in bone and muscle mass, as well as the consequent changes in weight and stature^{55,56}. In this context, maternal weight gain may not reflect fetal growth, since it is well-documented in the literature that low birth weight is one of the adverse outcomes associated with teenage pregnancy^{57,58}.

Some possible limitations of this investigation are the absence of maternal information related to food consumption, physical activity, current educational status, and gynecological age, as well as the cross-sectional design, in which it was not possible to indicate temporal relations between the dependent and independent variables, the non-segmentation of the GWG by gestational trimesters, as well as the data collection regard-

ing the gestation weight reported on the medical card of the pregnant women (indirect collection), which may have limited the accuracy in the analysis of the GWG.

Despite the aforementioned limitation, the present study highlighted the fact that residing in the North and Northeast regions of the country expands the chances of the Brazilian adolescents presenting insufficient GWG, indicating the existing nutritional risk in this population. The exercise of paid work was associated with inadequate weight gain (excessive and insufficient). In addition, excessive weight gain during pregnancy was more common in those who begin their pregnancy overweight or obese.

Our results reinforce the need for nutritional care for the pregnant teenager to be provided in an individualized manner, considering their region of residency, their life style, and their nutritional state prior to pregnancy. Beyond the clinical practice, the present findings lead us to reflect on the relevance of the Brazilian public policies being formulated in such a way as to reduce the social inequalities that exist in Brazil, which reflect negatively upon the health of vulnerable populations, including pregnant teenagers, and, consequently, on maternal and infant health.

The final version of the database, which contains the results presented herein, can be accessed at: <https://doi.org/10.48331/scielodata.II6KOL>.

Collaborations

SFM Santos: drafted, wrote, and interpreted the manuscript's data. SGN Gama: drafted the methodology, reviewed and interpreted the results. RGPS Araújo: reviewed the methodology section. LAT Silva: reviewed the text and interpreted the data. ACC Costa: performed statistical analysis and text revision. VM Fonseca: advised and reviewed all stages of the manuscript.

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