Gestational Weight Gain and Prepregnancy Weight Influence Postpartum Weight Retention in a Cohort of Brazilian Women[1]

Gilberto Kac,[2] Maria H.D.A. Benício,* Gustavo Velásquez-Meléndez,† Joaquim G. Valente,**‡ and Cláudio J. Struchiner‡††

*Department of Social and Applied Nutrition, Institute of Nutrition, Universidade Federal do Rio de Janeiro, Rio de Janeiro, RJ, Brazil; *Department of Nutrition, School of Public Health, Universidade de São Paulo, São Paulo, SP, Brazil; †Department of Maternal and Pediatric Nursing and Public Health, School of Nursing, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil; **Department of Epidemiology and Quantitative Methods in Health, National School of Public Health, Fundação Oswaldo Cruz, Rio de Janeiro, RJ, Brazil; ‡Institute of Social Medicine, Universidade Estadual do Rio de Janeiro, Rio de Janeiro, RJ, Brazil; and ††Program for Scientific Computation, Fundação Oswaldo Cruz, Rio de Janeiro, RJ, Brazil*

ABSTRACT The objective of the study was to test the association between gestational weight gain, reproductive factors, and postpartum weight retention based on a cohort conducted with 405 women aged 18–45 y with follow-up waves at 0.5, 2, 6, and 9 mo postpartum. The outcome variable, postpartum weight retention, was calculated as the difference between the measured weight at each visit minus the prepregnancy weight. We estimated the statistical associations between the outcome variable and potential explanatory covariates of interest by fitting a longitudinal mixed-effects model. Women with gestational weight gain above the recommendations of the Institute of Medicine (IOM) retained significantly more weight than women with weight gain within or below the recommendations, independently of prepregnancy BMI [weight (kg)/height (m^2)] or body fat at baseline. Women with the highest gestational weight gain and with body fat ≥30 g/100 g at baseline had the highest likelihood of developing maternal obesity. The final longitudinal model showed that 35% of each kilogram of weight gained during pregnancy was retained 9 mo postpartum, even after adjustment for age, prepregnancy BMI, body fat at baseline, and years since first parturition. Each unit of increase in prepregnancy BMI was associated with a decrease of −0.51 kg in postpartum weight retention. In conclusion, gestational weight gain was one of the most important predictors for postpartum weight retention and must be monitored systematically with the aim of preventing postpartum obesity and the diseases that follow. J. Nutr. 134: 661–666, 2004.

KEY WORDS: • *postpartum weight retention* • *obesity* • *gestational weight gain* • *women of childbearing age* • *follow-up study*

Postpartum weight retention represents an important nutritional problem for women of childbearing age. Estimates from several studies demonstrated that women retain between 1.5 and 3.0 kg 1 y after parturition (1). In a previous study (2) it was observed that 19.2% of the mothers retained ≥7.5 kg 9 mo postpartum, whereas in a Swedish study (3), a mean weight retention of 1.5 kg was found after 12 mo of follow-up.

Among several of the factors determining postpartum weight retention, gestational weight gain is considered by far the most important. The literature strongly agrees that there is a clear association between gestational weight gain and postpartum weight retention (3–9). According to an American study (8), for example, women with pregnancy weight gain above the upper limit recommended by the Institute of Medicine (IOM), had twice the likelihood of retaining >9 kg postpartum compared with women with gestational weight gains within the recommendations of the IOM (10). Similar results were also found elsewhere (5).

Studies in Brazil that evaluated gestational weight gain from longitudinal data are still scarce. Based on data from >5000 pregnant women researched in 6 Brazilian capitals, the authors (11) noted the high frequency (28%) of preobesity and prepregnancy obesity in this group of Brazilian women, and the high (29%) prevalence of women with gestational weight gains above the IOM recommendations.

We present data on gestational weight gain and the effect of reproductive variables on postpartum weight retention for a group of Brazilian women of childbearing age followed for 9 mo. The results are then used to consider what strategies could be implemented to prevent this outcome.

SUBJECTS AND METHODS

Recruitment and selection of participants. We followed for 9 mo a cohort of Brazilian women aged 15–45 y, residing in the city of

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[2] To whom correspondence and reprint requests should be addressed. E-mail: gkac@gbl.com.br.

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Rio de Janeiro, Brazil and collected data on postpartum weight retention, body composition, and obesity. The data collection process lasted 24 mo (15 for recruitment and 9 for follow-up), from May 1999 to April 2001. A total of 479 women were enrolled in the cohort, with a longitudinal design including 4 measurements waves, at ~0.5, 2, 6, and 9 mo postpartum.

The participants were women of childbearing age who volunteered for the study; they were recruited at three different time points at different sites: *1*) at the central maternity hospital in the study area, in the immediate postpartum period; 2) during prenatal consultations; and 3) during routine Bacillus Calmette-Guerin immunization (items 2 and 3 at the Municipal Health Centre). Of the recruited women, 97% had received prenatal care. Recruitment during prenatal care and routine Bacillus Calmette-Guerin immunization was conducted by the principal researcher (G.K.), whereas in the Praça XV Maternity Hospital, the recruitment was done by three interns, trained according to a standardized protocol.

The study was approved by the appropriate research ethics committees (Federal University of Rio de Janeiro and São Paulo University), and signed consent was obtained from each study participant.

Eligibility criteria. Eligibility criteria for entering the cohort were as follows: aged 15–45 y, <30 d elapsed postpartum on the date of the first interview, absence of chronic diseases, gestational age at delivery ≥35 wk, no history of multiple gestation, and residence in the study area.

Women <18 y (n = 47) were excluded from the final sample. Other exclusion criteria were lack of information on prepregnancy weight (n = 13) and postpartum weight retentions values outside the −10.0 to +16.0 kg range (n = 14), which were considered biologically improbable. A total of 74 women were thus excluded from the study.

Information on reproductive variables was collected at the third follow-up wave, and participants lost to follow-up between the first and third appointments (n = 107) could not be included in the analysis. Sixty-five women were also excluded from the analysis due to unreported gestational weight gain, restricting the final sample size to 233 women. The analysis always used maximum information whenever possible; however, the number of available observations varied according to the variables and analytic procedure used to fit each model.

Losses to follow-up. The pattern of losses to follow-up was described earlier (2,12) and was considered noninformative (random). For the present analysis, women with complete data at the final follow-up visit (n = 208) were compared with those lost to follow up (n = 132 losses between first and fourth visit + 65 women without gestational weight gain data = 187). The comparisons were made using the final follow-up rate, which was calculated as the ratio of the number of observations actually followed to the end of study period to the initial number of observations. This rate was calculated for several variables including age, marital status, skin color, total family income, prepregnancy BMI, and body fat at baseline. The χ^2 test for proportions was used to assess patterns of nonrandom losses to follow-up.

Anthropometric and body composition measurements. Anthropometric measurements were performed by a trained observer and obtained according to standard recommendations (13). The women were weighed on a digital electronic scale (Filizzola PL 150, Filizzola Ltda) and measured on a Harpenden portable stadiometer.

We measured body fat by impedance at all interviews with BIA 101Q following the manufacturer's guidelines (RJL). However, in the present study, we assessed the explanatory power of the information only at the beginning of the follow-up period, i.e., 0.5 mo after delivery.

Statistical analyses

Outcome variable and time-varying covariates. Some variables were defined here as time-varying because the values differed at each time point, e.g., postpartum weight retention, or time after parturition (in months).

The outcome variable, postpartum weight retention, was calculated as the absolute difference between the weight measured at each interview and the prepregnancy weight stated by the mother. Postpartum weight retention is a continuous variable, with approximately normal distribution. The linear regression mixed effects longitudinal model assumes that this variable is a linear function of the explanatory variables. Time after parturition was calculated in months, taking into consideration the difference between the interview and delivery dates.

Time-invariant covariates. Time-invariant covariates do not vary across the study time. The socioeconomic variables included in the present analysis are marital status (single, married, with partner), skin color (white, mixed, black), and total level of income (tertiles). Prepregnancy BMI was stratified using 26 kg/m^2 as a cut-off point, and body fat at baseline was stratified using 30 g/100 g as a cut-off value.

The reproductive variables were extracted from a data set collected mainly at the time of the third interview. Gestational weight gain is considered a central covariate in this analysis and was reported by the mother answering the following question: How much weight did you gain during the last pregnancy? Sixty-five women did not answer this question and were excluded from the final model analysis. Other analyzed variables are mother's age at menarche (<13, ≥13 y), mother's age at first parturition (<21, ≥21 y), years after menarche (<10, 10–19, ≥20 y), years after first parturition (<1, 1–5, ≥6 y), parity (1, 2, ≥3 children), type of delivery (normal, cesarean), previous abortion (yes, no), tube ligation (yes, no), gender of the head of the family (female, male), and interpregnancy interval (<21, ≥21 mo). Primiparae were considered to have no interval and received zero as a value. Controlling variables were age and prepregnancy BMI.

Statistical analyses were performed in phases. First, means and 95% CI were calculated for gestational weight gain and for years since first parturition stratified by prepregnancy BMI and by body fat at baseline. Finally and most importantly, the second phase consisted in the development of a longitudinal mixed-effects linear regression model (14).

Longitudinal models. Data analysis involved fitting longitudinal mixed effects linear regression models to investigate the effect reproductive factors may have had on postpartum weight retention during the 9 mo after delivery. The longitudinal aspect of the study design allowed us to describe patterns of change along time.

We developed longitudinal mixed-effect models (S-PLUS 2000 linear mixed effects) that had postpartum weight retention as the outcome variable, and a linear function of the main explanatory variables. The pattern of evolution of weight retention along time was modeled as a linear function of variable time after parturition. All longitudinal models fitted had this term. In addition, our models also allowed for within-subject differences (random effects) in intercept and slope. For the actual analyses, we ran all models with and without random effects, and the differences observed in the parameter estimates guided the inclusion or exclusion of random effects in the final models.

Correlation structure. Postpartum weight retention was measured at irregular time intervals (0.5, 2, 6 and 9 mo); thus, an exponential correlation structure was used to control for autocorrelation and irregular time intervals.

Statistical modeling. With postpartum weight retention as the outcome variable, we first fit a bivariate longitudinal linear regression model using the variables time after parturition and prepregnancy weight, along with their interaction term. After that, we fit multivariate longitudinal models to assess important predictors of postpartum weight retention over time. Variables eligible to inclusion in the model were as follows: age, prepregnancy weight, prepregnancy BMI, body fat at baseline, height, mother's place of birth, residential stratum, total family income, skin color, marital status, schooling, and the reproductive variables described above.

The model was constructed step by step. At first, a model with only main effects was built. Only variables that had $P < 0.20$ under bivariate modeling and no interaction were included. After that, biologically plausible effect modifications were considered, one at a time, to be included in the main effect model. Interaction terms significant at $P < 0.15$ were considered candidates for the final model. Finally, interaction terms considered candidates for the final model were all simultaneously included in the main effect model.

The final model was obtained after backward elimination of main

TABLE 1

Frequency distribution for selected variables between loss and complete follow-up and final follow-up rate for Brazilian women aged 18–45 y in Rio de Janeiro, 1999–2001

Variable[1]	Initial observations	Losses to follow-up	Complete follow-up	Final follow-up rate	*P*-value[2]
	n			%	
Age category, *y*					
18–19	60	33	27	45.0	
20–24	136	68	68	50.0	
25–29	114	52	62	54.4	
30–45	95	44	51	53.7	0.6379
Marital status					
Single	74	29	45	60.8	
With partner	230	113	117	50.9	
Married	101	55	46	45.5	0.1329
Skin color					
White	154	70	84	54.5	
Mixed	179	88	91	50.8	
Black	72	39	33	45.8	0.4664
Total family income, *reais*					
Tertile 1	195	107	88	45.1	
Tertile 2	96	40	56	58.3	
Tertile 3	114	50	64	56.1	0.0512
Prepregnancy BMI, *kg/m²*					
≤29	381	186	195	51.2	
>29	24	11	13	54.2	0.7765
Body fat, *g/100 g*					
<30	195	88	107	54.9	
≥30	210	109	101	48.1	0.1727

[1] Other variables tested include height (>159, ≤159 cm), residential stratum (rural, urban), smoking status (yes, no), schooling (>4, ≤4), breast-feeding initiation (yes, no), and working status during pregnancy (yes, no).
[2] *P*-value for χ^2 test for proportions.

effects and interaction terms from the saturated model. The presence of an interaction term implied keeping all related main effects (hierarchy). Discrimination among competing models and choice of the best model were based on global criteria, such as the Akayke Information Criterion and Log Likelihood. For all modeling steps, three kinds of diagnostic graphics were produced: scatter plot of residuals between observed and predicted values; q-q plots to check normality of the residuals; and plots to check the autocorrelation structure. The objective was always to try to identify the best functional form for each variable included in the model. All analysis were performed using S-PLUS 2000 (MathSoft).

RESULTS

The final follow-up rate was 51.4% (208/405). Losses to follow-up were noninformative for all variables compared (**Table 1**). Lower income, black, younger, and married women had a smaller final follow-up rate ($P > 0.05$).

The study population was relatively young, with a mean age of 26 y and a mean of 2 children. Mean gestational weight gain was almost 13 kg and the mean age at menarche 12.6 (**Table 2**).

Women with gestational weight gains above the recommendations of the IOM had greater weight retention ($P < 0.05$), independently of the stratification by prepregnancy BMI, or body fat at baseline. However, women with a longer interval since first parturition had higher postpartum weight retentions only for groups with prepregnancy BMI < 26 kg/m^2 and body fat < 30 g/100g. For the other subgroups, this pattern was present only for the 3rd and 4th follow-up visits (**Tables 3** and **4**).

TABLE 2

Means and 95% CI for selected variables for Brazilian women aged 18–45 y in Rio de Janeiro, 1999–2001

Variable	*n*	Mean	95% CI	Min	Max
Age, *y*	405	26.2	25.6–26.8	18.1	45.1
Pre-pregnancy weight, *kg*	405	57.2	56.2–58.3	34.0	100.0
Pre-pregnancy BMI, *kg/m²*	405	22.7	22.4–23.1	14.5	38.4
Height, *cm*	405	158.6	157.9–159.2	140.1	180.2
Mother's age at first parturition, *y*	301	21.1	20.6–21.6	12.0	40.0
Parity, *n*	301	2.1	1.9–2.3	1.0	13.0
Time after first parturition, *y*	301	5.4	4.7–6.0	0.0	26.4
Interpregnancy interval, *mo*	300	35.6	30.5–40.7	0.0	204.0
Mother's age at menarche, *y*	299	12.6	12.4–12.8	9.0	17.0
Time after menarche, *y*	299	13.8	13.1–14.5	2.2	32.8
Gestational weight gain, *kg*	233	12.9	12.1–13.6	−6.0	33.0

TABLE 3

Postpartum weight retention evolution stratified by prepregnancy BMI for Brazilian women aged 18–45 y in Rio de Janeiro, 1999–2001

	Time after parturition, *mo*											
	0.5			2			6			9		
Variable	*n*	Mean	95% CI	*n*	Mean	95% CI	*n*	Mean	95% CI	*n*	Mean	95% CI
Weight, *kg*	405	62.0	60.9–63.1	359	61.8	60.6–63.0	298	61.2	59.7–62.6	271	60.8	59.2–62.4
Time after parturition, *d*	405	16.9	16.2–17.6	359	65.9	65.0–66.9	298	190.5	189.2–191.8	271	280.7	279.1–282.3
Prepregnancy BMI < 26 kg/m^2												
Gestational weight gain, *kg*												
Below IOM recommendations	81	2.6	2.1–3.2	81	2.0	1.3–2.6	78	1.1	0.2–1.9	72	0.9	−0.1–1.8
Within IOM recommendations	63	5.6	4.7–6.4	63	4.6	3.7–5.6	61	3.5	2.4–4.6	56	2.9	1.7–4.2
Above IOM recommendations	47	9.8	8.8–10.7	45	8.1	7.0–9.1	45	6.3	5.1–7.6	41	5.5	3.9–7.0
Time after first parturition, *y*												
<1.0	98	4.7	3.8–5.6	96	3.2	2.3–4.0	94	2.0	1.0–2.9	84	1.3	0.3–2.3
1.0–5.9	65	5.1	4.1–6.1	68	4.8	3.6–5.9	60	3.0	1.9–4.0	55	2.8	1.5–4.1
≥6.0	80	6.1	5.2–7.1	79	5.4	4.6–6.3	78	4.8	3.7–5.9	74	4.3	3.2–5.4
Prepregnancy BMI ≥ 26 kg/m^2												
Gestational weight gain, *kg*												
Below IOM recommendations[1]												
Within IOM recommendations	16	1.5	−1.6–4.6	15	2.7	0.9–4.4	16	4.1	1.5–6.6	16	3.8	1.0–6.7
Above IOM recommendations	18	5.2	3.4–6.9	19	6.1	4.6–7.5	19	6.4	4.5–8.3	17	6.2	4.1–8.2
Time after first parturition, *y*												
<1.0	18	3.1	0.8–5.5	19	2.9	1.1–4.6	18	3.5	1.5–5.5	15	4.0	1.4–6.6
1.0–5.9	12	1.5	−2.3–5.2	12	4.4	1.2–7.7	13	3.8	0.0–7.6	11	2.9	−1.0–6.8
≥6.0	26	3.3	1.6–4.9	27	3.3	1.8–4.9	27	5.3	3.5–7.1	25	5.5	3.5–7.5

[1] Three observations only.

TABLE 4

Postpartum weight retention evolution stratified by body fat at baseline for Brazilian women aged 18–45 y in Rio de Janeiro, 1999–2001

	Time after parturition, *mo*											
	0.5			2			6			9		
Variable	*n*	Mean	95% CI	*n*	Mean	95% CI	*n*	Mean	95% CI	*n*	Mean	95% CI
Body fat at baseline < 30 g/100 g												
Gestational weight gain, *kg*												
Below IOM recommendations	61	2.4	1.7–3.1	61	1.7	0.9–2.4	59	0.5	−0.5–1.4	55	0.4	−0.5–1.4
Within IOM recommendations	34	4.4	3.2–5.7	34	3.3	2.1–4.5	33	1.8	0.5–3.1	32	0.9	−0.4–2.3
Above IOM recommendations	16	8.1	6.3–9.9	16	7.9	4.4–7.9	16	4.9	0.5–3.1	44	3.8	1.8–5.8
Time after first parturition, *y*												
<1.0	55	3.1	2.0–4.1	55	1.7	0.6–2.7	53	0.1	−1.0–1.1	49	−0.5	−1.5–0.6
1.0–5.9	34	2.8	1.7–3.9	34	2.2	1.1–3.2	34	1.2	0.1–2.3	32	0.7	−0.5–2.0
≥6.0	54	4.8	3.7–5.9	54	2.3	0.8–3.9	53	3.5	2.3–4.7	52	3.2	2.1–4.2
Body fat at baseline ≥ 30 g/100 g												
Gestational weight gain, *kg*												
Below IOM recommendations	23	3.0	2.0–4.0	23	2.6	1.6–3.7	22	2.7	0.9–4.6	20	2.4	0.2–4.5
Within IOM recommendations	45	4.9	3.5–6.4	44	5.0	3.9–6.1	44	5.0	3.7–6.3	40	4.9	3.4–6.4
Above IOM recommendations	49	8.6	7.5–9.8	47	7.9	6.8–8.9	46	6.8	5.5–8.0	40	6.3	4.8–7.8
Time after first parturition, *y*												
<1.0	61	5.7	4.5–6.9	59	4.6	3.6–5.5	59	4.2	3.0–5.3	49	3.9	2.6–5.2
1.0–5.9	43	5.8	4.3–7.4	41	6.7	5.2–8.2	38	4.8	3.2–6.3	33	4.8	2.9–6.7
≥6.0	52	6.1	4.8–7.4	51	5.9	4.8–7.0	50	6.4	5.1–7.2	45	6.3	4.7–7.8

Women with gestational weight gain ≥ 16 kg and with body fat at baseline ≥ 30 g/100g had higher postpartum weight retention throughout the study, with a decreasing trend over time (**Fig. 1**).

The final longitudinal regression model showed that the following variables remained significantly associated with weight retention: second-order polynomial for time after parturition (coefficient = 0.0211), prepregnancy BMI (coefficient = −0.5154), gestational weight gain (coefficient = 0.3506), body fat at baseline (coefficient = 0.3988), and time after first parturition (coefficient = 0.1852) (**Table 5**).

TABLE 5

Final longitudinal regression model for postpartum weight retention for Brazilian women aged 18–45 y in Rio de Janeiro, 1999–2001[1]

Variable	Regression coefficient	SE	*P*-value
Main effects			
Time after parturition, *mo*	−0.4251	1.3340	<0.0001
Time after parturition,[2] *mo*	0.0211	0.0059	0.0004
Pre-pregnancy BMI, *kg/m*[2]	−0.5154	0.0554	<0.0001
Age, *y*	−0.0390	0.0393	0.3228
Body fat at baseline, *g/100 g*	0.3988	0.0448	<0.0001
Gestational weight gain, *kg*	0.3506	0.0343	<0.0001
Time after first parturition, *y*	0.1852	0.0389	0.0001
Intercept	0.7019	1.3340	0.5990
Akayke Information Criterion	4014.9		
Log likelihood	−1994.5		
Autocorrelation structure: Exponential	270.3[2]		

[1] *n* = 233.
[2] Parameter estimate for the autocorrelation function.

DISCUSSION

The present results suggest that women with greater gestational weight gain had higher postpartum weight retentions throughout the follow-up period. We inferred this from the means and 95% CI for postpartum weight retention stratified by gestational weight gain, and also according to the final longitudinal regression model. Prepregnancy BMI was negatively associated with postpartum weight retention, whereas body fat at baseline and time after first parturition presented positive associations.

Several studies have systematically observed that the higher the gestational weight gain, the higher the postpartum weight retention (3–8,15). A study conducted with a group of 274 low-income Canadian women (6), for example, showed that gestational weight gain > 12 kg explained 65% of the postpartum weight retention, whereas it was shown for a sample of 7116 American women that the gestational weight gain independent effect for the first pregnancy explained 21% of the weight variation between subsequent pregnancies (16).

From an epidemiologic perspective, excessive gestational weight gain is one of the most relevant health problems. In this study, 55% of the women gained ≥12 kg and 27.6% gained ≥16 kg, independently of the prepregnancy BMI. According to another Brazilian investigation (11), 29.2% of all women studied gained more weight than the IOM recommendations (10). Prepregnancy overweight women exceeded the recommendations with a frequency of 49.5%. These values are virtually identical to ours, where 28.8% in general and 50% of the overweight group had gestational weight gains above the IOM recommendation. Another way of showing this variable effect is the final longitudinal model in which each kilogram of gestational weight gain corresponded to a positive weight retention of 0.35 kg. If we compare women with gains > 16 kg with women with gains of ∼10 kg, the final difference in postpartum weight retention attributable exclusively to gestational weight gain could be 2 kg less in the lower gestational weight gain group.

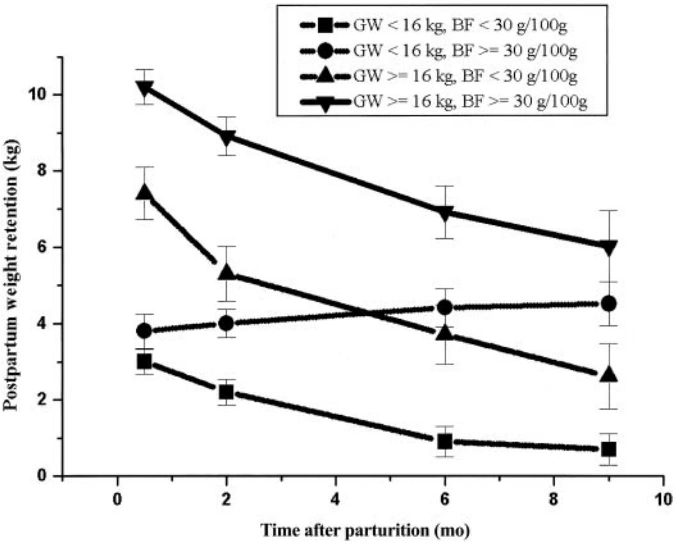

FIGURE 1 Postpartum weight retention according to combined categories of gestational weight gain (GW) and body fat at baseline (BF) for Brazilian women 18–45 y in Rio de Janeiro, 1999–2001. Values are means ± SEM, *n* = 21–92.

Excessive gestational weight gains are still associated with a higher accumulation of body fat and complications during pregnancy and at delivery (7). Body fat at baseline was also an important weight retention predictor for this group. Complementary analysis showed that women at the combined categories of excessive gestational weight gain and body fat at baseline ≥30 g/100 g, had the highest postpartum weight retention across the whole study. Therefore, this group has the highest likelihood of developing maternal obesity.

An interesting finding is the positive association between time after first parturition and postpartum weight retention. There are few studies concerning time after first parturition and weight retention. Recently, it was shown that time intervals between age at menarche and age at first parturition shorter than 8 y predicted postpartum obesity development (17). Time after first parturition can be considered a proxy for early pregnancy which agrees with results reported in a previous study (2) in which women who gave birth for the first time before the age of 23 y had a 2.80 times greater risk of retaining ≥7.5 kg.

It is interesting to note that among reproductive variables, we did not observe any effect on postpartum weight retention stratified by type of delivery, previous abortion, or tubal ligation. Although we observed systematically lower means for primiparae, no significant effect of parity could be detected in the final model, which contradicts some (18–20), but not all studies (3,21).

A relevant feature of the present investigation was the use of a longitudinal approach to study the effect of reproductive variables on postpartum weight retention. With this approach, the precision and the power in detecting differences tend to be higher than in cross-sectional studies. In addition, it becomes possible to use all available information in all follow-up waves, which may not be possible with cross-sectional studies. Other advantages include the ability to model time-varying and time-invariant variables, to analyze data with different time intervals, and to define the auto-correlation structure between repeated measurements (14).

Prepregnancy BMI provided a better fit to the data as inferred from the final model statistics compared with an alternative model that included only height (results not shown). Each unit of increase in prepregnancy BMI represented a postpartum weight retention reduction of −0.51 kg. Comparing women with a prepregnancy BMI of 25 kg/m^2 with women with a prepregnancy BMI of 30 kg/m^2, we observed a final difference of almost 3 kg less in postpartum weight retention, favoring the higher prepregnancy BMI group.

Several other factors such as marital status, skin color, and breastfeeding duration have been pointed out as important postpartum weight retention predictors (8,22). The breastfeeding effect on postpartum weight retention was addressed in another publication (23).

In relation to the reliability of the reported information regarding prepregnancy weight, some studies (24), including those studies on Brazilian populations (25,26), reported a high correlation between measured and reported weight and height, thus increasing the consistency of the reported measures. Another investigation also compared measured and reported prepregnancy weights (27). These authors found a high correlation between the two measurements and concluded that reported data can replace weight measurements, especially when it is not possible to measure weight itself.

A drawback of the present study includes a potential recall bias for gestational weight gain, reported by mothers. Nevertheless, we found consistent differences among categories of gestational weight gain based on mean response values and 95% CI across the whole study period. Data available for 3082 pregnant women residents of six Brazilian capitals, between 1991 and 1995, showed a mean gestational weight gain of 12.7 kg (11). This value is similar to that in the present study (12.9 kg), which may refute the occurrence of bias for this variable.

It is important to mention that missing information due to study participants lost to follow-up is a common problem in longitudinal studies. In the present study, the analysis was performed with variables collected predominantly at the third follow-up wave, and information on 187 of 405 women was missing, disallowing them from inclusion in the final model. However, our exploratory analysis of the pattern of losses to follow-up indicated that this was strictly a random process. Based on the points raised above, we contend that the final sample of 208 women with complete information represents the original sample, providing useful and valid information.

What kind of health policy should be formulated to prevent excessive gestational weight gain and maternal obesity? Initially, it is important to improve the quality of currently implemented general prenatal care programs, at the public health centers, especially those concerning nutritional guidelines. Prenatal care policy should emphasize the control of gestational weight gain and should include the following: *1*) systematic weight surveillance throughout the entire gestational period; *2*) specific nutritional counseling, such as diets appropriate for controlling gestational weight gain; *3*) promotion of exclusive breast-feeding (23,28); and *4*) light physical activity (29,30), or at least, the promotion of an active live style (7).

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