

## **Associated factors for post-partum weight retention in adolescent mothers: a prospective study**

**Fatores associados a retenção de peso pós-parto em mães adolescentes: um estudo prospectivo**

**Factores asociados a la retención de peso posparto en madres adolescentes: un estudio prospectivo**

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### **Abstract**

**Objective:** To assess weight retention in adolescent mothers at the fourth postpartum month and its association with sociodemographic, reproductive, anthropometric and behavioral factors. **Methods:** Prospective longitudinal study. The survey was conducted in all public and private maternity hospitals in a city in the east of Minas Gerais State. All adolescent mothers (age <20 years) with childbirth at gestational age  $\geq 37$  weeks, without chronic disease, living in the municipality, whose delivery occurred between October/2018 and October/2019 participated. The first one took place 48-hours postpartum and the second, four months later. Four months postpartum the interview took place at the home of the mothers. Associations between variables were verified using Simple and Multiple Linear Regression. **Results:** Of the 367 interviewed adolescent mothers at the maternity hospitals, the predominant characteristics were age between 18-19 years, non-white skin color and education above nine years of study. Four months postpartum, 317 mothers were evaluated and the incidence of weight retention was 79.4% (n=247) with an average of 6.86 kg  $\pm$  5.34. Higher means of weight retention were observed in mothers with less school years, greater number of children, higher daily consumption of ultra-processed food during pregnancy, without nutritional guidance during pregnancy, higher pre-gestational Body Mass Index and greater gestational weight gain (p<0.05). **Conclusions:** The incidence of weight retention was considered high, a fact that highlights the importance of prenatal care quality, including nutritional education strategies, especially for this age group, highly vulnerable.

**Keywords:** Pregnancy in adolescence; Postpartum period; Nutritional status; Gestational weight gain.

### Resumo

**Objetivo:** Avaliar a retenção de peso em mães adolescentes no quarto mês pós-parto e sua associação a fatores sociodemográficos, reprodutivos, antropométricos e comportamentais. **Metodologia:** Estudo longitudinal prospectivo, realizado em todas as maternidades públicas e privadas de Governador Valadares, Minas Gerais. A amostra foi composta por todas as mães adolescentes (idade <20 anos) com parto em idade gestacional  $\geq 37$  semanas, sem doença crônica e/ou infecciosa, residentes no município, cujo parto ocorreu entre outubro/2018 e outubro/2019. Os dados foram coletados através de duas entrevistas. A primeira em até 48 horas pós-parto e a segunda quatro meses depois, por meio de entrevista domiciliar. As associações foram verificadas através de Regressão Linear Simples e Múltipla. **Resultados:** Das 367 mães adolescentes entrevistadas nas maternidades, as características predominantes foram: idade entre 18 e 19 anos, raça/cor parda e escolaridade acima de nove anos de estudo. Quatro meses pós-parto, 317 mães foram avaliadas e a incidência de retenção de peso foi de 79,4% (n=247) com média de 6,86 kg  $\pm$  5,34. Maiores médias de retenção de peso foram observadas em mães com menor escolaridade, maior número de filhos, consumo diário de ultraprocessado(s) na gestação, maior Índice de Massa Corporal pré-gestacional e maior ganho de peso gestacional (p<0,05). **Conclusão:** Conclusões: A incidência de retenção de peso foi elevada, fato este que ressalta a importância de um cuidado pré-natal de qualidade e que inclua estratégias de educação nutricional, em especial a este grupo etário de alta vulnerabilidade.

**Palavras-chave:** Gravidez na adolescência; Período pós-parto; Estado nutricional; Ganho de peso na gestação.

### Resumen

**Objetivo:** Evaluar la retención de peso en madres adolescentes en el cuarto mes de vida y su asociación con factores sociodemográficos, reproductivos, antropométricos y de comportamiento. **Metodología:** Estudio prospectivo longitudinal realizado en todas las maternidades públicas y privadas de Governador Valadares, Minas Gerais, Brasil. La muestra estuvo compuesta por todas las madres adolescentes (edad <20 años) con parto en edad gestacional  $\geq 37$  semanas, sin enfermedad crónica y/o infecciosa, residentes en el municipio, cuyo parto se produjo entre octubre/2018 y octubre/2019. Los datos se recogieron mediante dos entrevistas. La primera en las 48 horas posteriores al parto y la segunda cuatro meses después, mediante una entrevista a domicilio. Las asociaciones se verificaron mediante regresión lineal simple y múltiple. **Resultados:** De las 367 madres adolescentes entrevistadas en las maternidades, las características predominantes fueron: edad entre 18 y 19 años, raza/color marrón y educación superior a nueve años de estudio. Cuatro meses después del parto, se evaluaron 317 madres y la incidencia de la retención de peso fue del 79,4% (n=247) con una media de 6,86 kg  $\pm$  5,34. Se observó una mayor retención media de peso en las madres con menor nivel educativo, mayor número de hijos, consumo diario de alimentos ultraprocessados durante el embarazo, mayor índice de masa corporal previo al embarazo y mayor ganancia de peso gestacional (p<0,05). **Conclusión:** La incidencia de la retención de peso fue elevada, lo que resalta la importancia de un cuidado prenatal de calidad que incluya estrategias de educación nutricional, especialmente para este grupo étnico de alta vulnerabilidad.

**Palabras clave:** Embarazo en adolescencia; Periodo posparto; Estado nutricional; Ganancia de peso gestacional.

## 1. Introduction

Adolescent pregnancy is associated with greater complication risks for the conceptus and for the maternal health (Haeri et al., 2010). Conditions associated with teenage pregnancy, in recent decades, such as insufficient gestational weight gain, prematurity and low birth weight (Goonewardene & Deeyagaha Waduge, 2005), are currently less prevalent (Campos et al., 2013; Lima et al., 2011) due to the nutritional transition process.

Changes in the population eating and lifestyle habits have affected the health status of pregnant adolescents, contributing to an inadequate nutrient intake (Campos et al., 2013; Constancio et al., 2019; Herrera-Suárez et al., 2008), excessive gestational weight gain (Danilack et al., 2018; Groth et al., 2013; Guimarães et al., 2018) and consequent postpartum weight retention.

Weight retention is defined by the difference between weight at a postpartum moment and pre-pregnancy weight. Although there is no cut-off point to classify the risk of retained weight, it is known that women have a postpartum weight increase (Danilack et al., 2018; Nogueira, et al., 2015). Studies have shown that the average weight retention at six and twelve months postpartum can vary between 3.0kg and 8.5kg (Endres et al., 2015; Fadzil et al., 2018; Nast et al., 2013) and among adolescents between 7.4 $\pm$ 6.1kg and 8.5 $\pm$ 6.8kg respectively (Nast et al., 2013). The associated factors for weight retention is younger age, less schooling years, being multiparous, not breastfeeding, higher pre-gestational Body Mass Index (BMI) and

gestational weight gain (Celik & Atan, 2018; Danilack et al., 2018; das Chagas et al., 2017; Nartea et al., 2019; Nast et al., 2013; Nogueira et al., 2015; Siega-Riz et al., 2010).

Postpartum weight retention has been considered a contributing factor for obesity development in women of childbearing age (Forte et al., 2015; Nartea et al., 2019; Rasmussen & Yaktine, 2009) and knowledge about it, as well as its predictive factors are scarce in the population of adolescent mothers (Nogueira et al., 2015). Thus, the present study aimed to assess weight retention four months postpartum and associated sociodemographic, reproductive, anthropometric and behavioral factors in adolescent mothers living in the city of Governador Valadares - Minas Gerais State, Brazil.

## **2. Methodology**

### ***Population and experimental design***

This is a longitudinal prospective study, involving adolescent mothers (<20 years of age), with childbirth at gestational age  $\geq 37$  weeks, without chronic and/or infectious disease, living in the city of Governador Valadares, Minas Gerais State and whose delivery occurred between October/2018 and October/2019.

### ***Logistics***

It was carried out a consecutive sampling of all adolescent mothers, up to 48 hours postpartum, admitted to the three maternity hospitals in the city, within a year.

The survey consisted of two follow-ups with a total duration of 16 months (12 months of recruitment and four months of follow-up), from October/2018 to February/2020. The first follow-up was led at the maternity hospital, within a period of up to 48 hours after childbirth, and the second was performed through home visits in the fourth postpartum month.

The interviewers visited the maternity wards in the municipality on a daily basis to identify adolescent mothers, and an interview was performed using a pre-coded and standardized questionnaire. The interviewers underwent a previous training in order to standardize the interview and complete the questionnaire. The data collection instrument contained variables related to sociodemographic, gestation, anthropometric and lifestyle characteristics of adolescent mothers. The number of prenatal consultations and the weight at the first and last prenatal consultations were filled out based on the information from the hospital record and/or pregnant woman's card. The second segment questionnaire was applied four months postpartum and consisted of anthropometric measurements (weight and height measured at the time of the interview) and information regarding breastfeeding and lifestyle habits such as regular physical activity and food intake.

### ***Monitoring and losses***

Between October/2018 and October/2019, 372 adolescent mothers eligible for the research were identified in the three maternity hospitals in the city. Of these, four losses (1.1%) and one refusal (0.3%) were recorded, totaling 367 (98.6%) participants in the baseline of this study.

At the follow-up visit, four months postpartum, 317 mothers were interviewed in their respective homes, representing 86.4% of the original cohort. Among the others, there were 45 losses (12.6%) due to changes in the home address and contact; two refusals (0.5%); and three exclusions (0.8%) due to neonatal or maternal death.

### ***Dependent variable***

The outcome variable, weight retention four months postpartum, was calculated from the subtraction of the pre-gestational weight present in the pregnant woman's hospital record or referred by the puerperal woman in the interview up to 48 hours postpartum and the weight measured four months postpartum (Rasmussen & Yaktine, 2009). The mothers were weighed barefoot and dressed in light clothing, on a digital scale (Panasonic®), accurate to 100 grams. The height was also

measured using a measuring tape, fixed on a smooth wall, with the participant in an upright position, with the heels pressed against the wall.

In order for the assessment to be plausible, mothers who did not show a positive difference between pre-pregnancy weight and weight four months postpartum were excluded from analyzes related to weight retention.

### ***Independent variables***

The analyzed independent variables were: age (years); skin color (white; black; and brown); lives with a partner (yes or no); family income (R\$); age of menarche (years); parity (primiparous or multiparous); minimum of six prenatal consultations (yes or no); receiving nutritional guidance during pregnancy (yes or no); self-perception of food consumption during pregnancy (adequate; insufficient; and excessive); consumption of ultra-processed food during pregnancy at least 1 time a day (yes or no); consumption of fruits and vegetables during pregnancy at least 2-3 times a day (yes or no); regular physical exercise during pregnancy (yes or no); type of delivery (normal or cesarean); being breastfeeding in the fourth postpartum month (yes or no) and breastfeeding status in the fourth postpartum month (yes or no).

The pre-gestational and four months postpartum nutritional status were calculated using the Body Mass Index (BMI) and classified according to the mother's age into: low weight, adequate, overweight and obesity (World Health Organization, 2021). The gestational BMI was obtained from the data from the last prenatal visit and classified according to the Atalah criteria: low weight ( $\leq 25 \text{ kg/m}^2$ ), adequate ( $>25$  to  $<29 \text{ kg/m}^2$ ), overweight ( $\geq 29.50$  to  $<33.5 \text{ kg/m}^2$ ) or obesity ( $\geq 33.5 \text{ kg/m}^2$ ).

The gestational weight gain (GWG) was obtained by the difference between the weight before delivery (registered in the pregnant woman's record) and the pre-pregnancy weight (referred by participant). It was classified according to the recommendations of the Institute of Medicine (IOM) (Rasmussen & Yaktine, 2009).

### ***Data consistency and quality control***

The collected data were entered twice in the EpiData program, version 3.1, by trained and distinct typists. Data validation was also performed in the same program. Quality control was carried out concurrently with data collection, by applying a questionnaire reduced to 10.6% of the sample ( $n=39$ ). A Kappa index of 0.97 was obtained (Landis & Koch, 1977).

### ***Statistical analysis***

The statistical analysis was performed via Stata® 16.0 software, where, initially, the description of sociodemographic and health characteristics was carried out through absolute, relative and average frequencies with their respective standard deviations (SD). To verify the differences between the outcome and each independent variable, Pearson's chi-square and Fisher's exact tests were used for categorical variables and Student's t-test and analysis of variance (ANOVA) for continuous variables.

Following this step, in order to obtain the effect of each independent variable on postpartum weight retention, gross and adjusted regression coefficients using Simple and Multiple Linear Regression models were employed.

For the adjusted model, a causality hierarchical model was followed in three levels (1st) age, skin color, education, income; (2nd) parity, receiving nutritional guidance during pregnancy, regular physical exercise during pregnancy, self-perception of food consumption during pregnancy, consumption of ultra-processed food during pregnancy at least once a day, fruit, vegetables or greens consumption during pregnancy at least 2-3 times a day, pre-gestational BMI and gestational weight gain; (3rd) breastfeeding status in the fourth postpartum month.

The variables were selected for the final model using the backward method, in which only those with  $p \leq 0.20$  were maintained. A significance level of 5% was considered.

### Ethical approval

Human Research Ethics Committee of the Universidade Federal do Rio Grande (FURG, opinion 75/2019).

### 3. Results

Of the 367 adolescent mothers who constituted the baseline of the study, most were between 18 and 19 years old (58.0%), non-white skin color (77.8%) and had more than nine years of schooling (58.6%). The average family income of the participants in the lowest income tertile was R\$699.00 and in the highest R\$3,368.00 (Table 1).

**Table 1.** Characteristics description of the pregnant adolescent women living in Governador Valadares, Minas Gerais State, and average weight retention four months postpartum, from 2018 to 2020.

General characteristics	Sample	Weight retention (Kg)	
	(n = 367)	(n = 247)	
	n (%)	Average ± SD	p value
<i>Pre-gestational variables</i>			
Age range (years)			
< 15	15 (4.1)	7.51 ± 4.99	0.8040*
15 a 17	139 (37.9)	7.32 ± 6.41	
18 a 19	213 (58.0)	6.51 ± 4.51	
Skin color			
White	20 (5.5)	9.33 ± 6.87	0.2442
Black	58 (16.0)	7.07 ± 6.01	
Brown	284 (78.5)	6.68 ± 5.09	
Lives with a partner			
No	149 (40.6)	6.44 ± 5.06	0.3140
Yes	218 (59.4)	7.14 ± 5.51	
Education (Schooling years)			
≤ 9 years	152 (42.4)	7.79 ± 6.15	<b>0.0282</b>
> 9 years	215 (58.6)	6.26 ± 4.66	
Family income (tertile)			
Lowest ( $\bar{X}$ = 699 R\$)	142 (38.7)	6.56 ± 6.54	<b>0.0498*</b>
Intermediate ( $\bar{X}$ = 1392 R\$)	103 (28.1)	7.20 ± 4.43	
Highest ( $\bar{X}$ = 3368 R\$)	122 (33.2)	6.91 ± 4.39	
Age of menarche (years)			
8 a 12	182 (56.4)	7.14 ± 5.75	0.5026
13 a 18	141 (43.7)	6.63 ± 5.10	
BMI(Kg/m <sup>2</sup> )			
Low weight	25 (8.1)	6.69 ± 5.42	0.9187
Adequate	220 (70.7)	6.74 ± 5.24	
Overweight	47 (15.1)	7.26 ± 6.18	
Obesity	19 (6.1)	7.52 ± 3.83	
<i>Gestational variables</i>			
Parity			
Primiparous	302 (82.3)	6.57 ± 5.30	0.0869

Multiparous	65 (17.7)	8.03 ± 5.35	
Minimum of 6 prenatal consultations			
No	104 (28.4)	7.68 ± 5.88	0.1340
Yes	262 (71.6)	6.52 ± 5.09	
Regular physical exercise			
No	327 (89.1)	7.08 ± 5.43	0.0599
Yes	40 (10.9)	4.96 ± 4.03	
Receiving nutritional guidance			
No	118 (32.2)	7.33 ± 5.61	0.3428
Yes	248 (67.8)	6.63 ± 5.20	
Self-perception of food consumption			
Insufficient	41 (11.2)	6.96 ± 4.35	<b>0.006</b>
Adequate	197 (53.7)	5.94 ± 4.84	
Excessive	129 (35.2)	8.24 ± 5.97	
Daily consumption of ultra-processed food			
No	70 (19.1)	5.36 ± 3.73	<b>0.0271</b>
Yes	297 (80.9)	7.24 ± 5.61	
Consumption of fruits and vegetables at least 2 to 3 times a day			
No	211 (57.5)	6.60 ± 5.30	0.3646
Yes	156 (42.5)	7.22 ± 5.39	
Type of delivery			
Normal	242 (65.9)	6.47 ± 5.06	0.1306
Cesarean	125 (34.1)	7.54 ± 5.75	
Weight gain (Kg)			
Insufficient	91 (29.26)	3.10 ± 2.88	<b>0.001*</b>
Adequate	92 (29.58)	5.08 ± 3.19	
Excessive	128 (41.16)	9.45 ± 5.85	
BMI (Kg/m <sup>2</sup> )			
Low weight	123 (39.3)	4.69 ± 3.64	<b>0.0001*</b>
Adequate	104 (33.2)	6.69 ± 4.62	
Overweight	55 (17.6)	9.52 ± 6.36	
Obesity	31 (9.9)	10.0 ± 6.75	
<i>Variables four months postpartum</i>		<b>(n = 317)</b>	
Breastfeeding status			
No	75 (23.7)	8.67 ± 6.05	<b>0.0097*</b>
Partial/Predominant	174 (54.9)	6.26 ± 5.14	
Exclusive	68 (21.5)	6.21 ± 4.45	
BMI (Kg/m <sup>2</sup> )			
Low weight	12 (3.8)	1.54 ± 1.37	<b>0.0001*</b>
Adequate	190 (59.9)	5.20 ± 3.67	
Overweight	69 (21.8)	7.76 ± 4.95	
Obesity	46 (14.5)	12.50 ± 6.91	

\* Kruskal-Wallis p value. BMI: Body Mass Index. Source: Authors.

The incidence of weight retention four months postpartum was 79.4% (n=247) with an average of 6.86kg±5.34. Table 1 shows that the average weight retention was higher among adolescents belonging to the intermediate tertile of family income (7.79kg±6.15), among those who perceived their food consumption as excessive during pregnancy (8.24kg±5.97) and those who reported consuming ultra-processed food daily during pregnancy (7.24kg±5.61). Higher values of weight retention were also identified among mothers with excessive gestational weight gain (9.45±5.85) and with the classification of gestational BMI in overweight or obesity (9.52kg±6.36 and 10.0±6.75, respectively). In addition, those who were not breastfeeding in the child's fourth month of life (8.67±6.05) and with a BMI four months postpartum classified as overweight or obese (7.76kg±4.95 and 12.50±6.91, respectively), were also the ones that had higher values of postpartum weight retention, in comparison to the other categories of each variable (p<0.05) (Table 1).

In the gross analysis (Table 2), it was observed that increasing the study time reduced on average 0.38 kg of weight retained in the fourth postpartum month (p=0.028).

**Table 2.** Linear regression coefficient of weight retention four months postpartum, according to sociodemographic, obstetric and anthropometric characteristics of adolescent mothers living in Governador Valadares, Minas Gerais State, from 2018 to 2020 (n = 247).

Variables	$\beta$	IC95%	p
<i>Pre-gestational</i>			
Age (years)	-0.30	-0.75 – 0,15	0.194
Skin color <sup>a</sup>			
Black	-2.25	-5.72 – 1.21	0.203
Brown	-2.64	-5.77 – 0.48	0.097
Education (Schooling years)	-0.38	-0.71 – -0.04	<b>0.028</b>
Income (R\$)	-0.00006	-0.0005 – 0.0004	0.802
BMI (Kg/m <sup>2</sup> )	0.11	-0.33 – 0.26	0.130
<i>Gestational</i>			
Parity <sup>b</sup>			
Multiparous	1.45	-0.21 – 3.12	0.087
Receiving nutritional guidance	-0.69	-2.12 – 0.79	0.343
Regular physical exercise	-2.12	-4.32 – 0.09	0.060
Self-perception of food intake <sup>c</sup>			
Insufficient	1.02	-1.46 – 3.49	0.419
Excessive	2.30	0.90 – 3.70	<b>0.001</b>
Daily consumption of ultra-processed food	1.88	0.21 – 3.54	<b>0.027</b>
Consumption of fruits and vegetables at least 2 to 3 times a day	0.62	-0.73 – 1.97	0.365
Type of delivery <sup>d</sup>			
Cesarean	1.07	-0.39 – 2.45	0.131
Weight gain (Kg)	0.62	0.52 – 0.71	<b>0.000</b>
<i>4 months postpartum</i>			
Breastfeeding status <sup>e</sup>			
Partial/predominant	-2.39	-3.98 – -0.80	<b>0.003</b>
Exclusive	- 2.45	-24.39 – 0.51	<b>0.013</b>

<sup>a</sup> Reference category = white; <sup>b</sup> Reference category = primiparous; <sup>c</sup> Reference category = adequate; <sup>d</sup> Reference category = normal; <sup>e</sup> Reference category= no. BMI: Body Mass Index. Source: Authors.

As for food intake, adolescents who perceived their consumption during pregnancy as excessive, presented an average increase of 2.30kg in weight retention in comparison to those who reported an adequate intake ( $p=0.001$ ). As well, daily intake of ultra-processed food, increased on average 2.0kg of retained weight in comparison to mothers who did not consume this daily ( $p=0.027$ ). Being breastfeeding partially/predominantly or exclusively in the fourth postpartum month reduced weight retention by an average of 2.39kg ( $p=0.003$ ) and 2.45kg ( $p=0.013$ ), respectively, in comparison to mothers who were not breastfeeding at that time. On the other hand, the gain of 1.0kg of weight during pregnancy increased by an average of 620g ( $p<0.0001$ ) in postpartum weight retention.

After adjusting the coefficients (Table 3), the variables education, daily consumption of ultra-processed food and gestational weight gain remained associated, while the self-perception of food consumption during pregnancy and being of breastfeeding in the fourth month lost their effect on weight retention. On the other hand, parity ( $\beta=1.41\text{kg}$ ;  $p=0.025$ ), pre-pregnancy BMI ( $\beta=0.18\text{kg}$ ;  $p=0.001$ ) and receiving nutritional guidance ( $\beta=-1.25\text{kg}$ ;  $p=0.019$ ) were associated with an increase in postpartum weight retention.

**Table 3.** Adjusted final multiple linear regression model for weight retention four months postpartum of adolescent mothers residing in Governador Valadares, Minas Gerais State, from 2018 to 2020 (n 247)<sup>a</sup>.

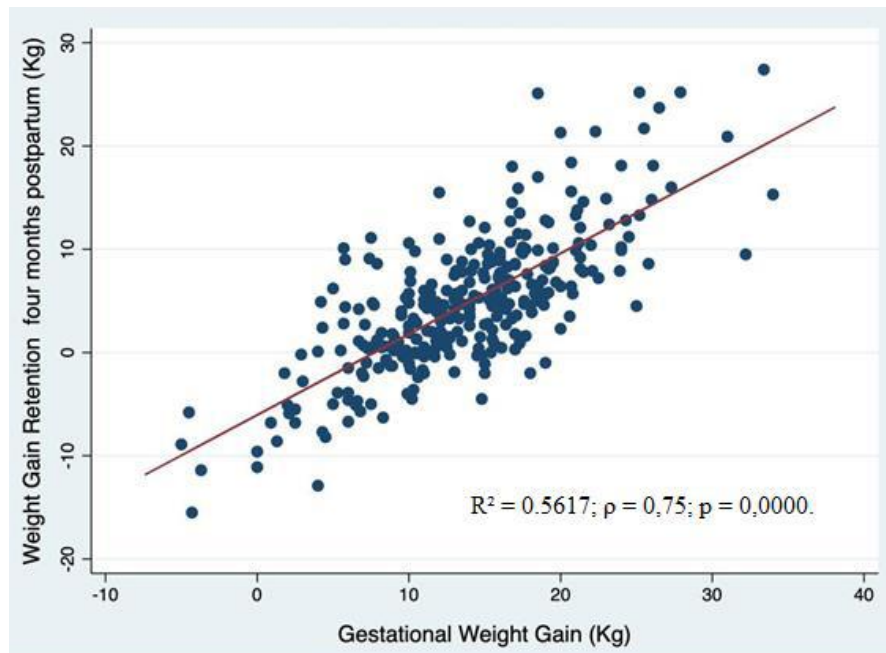
Variables	$\beta$	$p$
<i>Pre-gestational</i>		
Education (Schooling years)	-0.38	0.028
BMI (Kg/m <sup>2</sup> )	0.18	0.001
<i>Gestational</i>		
Parity	1.62	0.012
Multiparous	1.41	0.025
Receiving nutritional guidance during pregnancy	-1.25	0.019
Daily consumption of ultra-processed food during pregnancy	1.38	0.025
Gestational weight gain (Kg)	0.64	<0.001

<sup>a</sup>Adjusted analysis according to a causality hierarchical model of three levels: age, skin color, schooling years, income; parity, receiving nutritional guidance during pregnancy, regular physical exercise during pregnancy, self-perception of food consumption during pregnancy, daily consumption of ultra-processed food during pregnancy, consumption of fruits and vegetables during pregnancy at least 2 to 3 times a day, pre-gestational BMI, gestational weight gain; breastfeeding status in the fourth postpartum month. BMI: Body Mass Index. Source: Authors.

Figure 1 shows the gross relation between gestational weight gain and postpartum weight retention. The variables have a moderate to high correlation ( $r=0.75$ ;  $p<0.0001$ )<sup>23</sup>, and 56% ( $R^2=0.5617$ ) of the variability in weight retention four months postpartum was explained by the maternal weight gain during pregnancy.



**Figure 1.** Relation between total gestational weight gain and weight retention at four months postpartum, Governador Valadares, Minas Gerais State, from 2018 to 2020.



Fonte: Authors (2021).

#### 4. Discussion

Current studies on postpartum weight retention with samples constituted exclusively of adolescent mothers are rare (Nogueira et al., 2015). However, existing studies with this population or mixed samples (adolescents and adults) demonstrated that being a mother during this stage of life has been a contributing factor to the presence of postpartum weight retention and a consequent change in the nutritional status of these young mothers (de Azeredo et al., 2011; Gigante et al., 2005; Nast et al., 2013; Sámano et al., 2013; Severi T, Alonso, & Atalah S, 2009), persisting throughout adult life (Danilack et al., 2018; Forte et al., 2015; Groth et al., 2013).

In the present study, there was a high incidence of weight retention four months postpartum (79.4%), being higher among less educated, multiparous women, who during pregnancy consumed ultra-processed food daily, among those without nutritional guidance during pregnancy, with higher pre-gestational BMI and greater gestational weight gain.

Almost 80% of the participants had weight retention four months postpartum. Despite being high, other national and international surveys found similar weight retention rates of 78% (Celik & Atan, 2018; Nast et al., 2013; Siega-Riz et al., 2010) and 81% (Bogaerts et al., 2017). The average weight retention identified in this study was  $6.86\text{kg} \pm 5.34$ , similar to the value found by studies carried out on mixed samples (das Chagas et al., 2017; Nartea et al., 2019; Nast et al., 2013; Siega-Riz et al., 2010). Nartea et al. (2019) found an average weight retention of  $5.15\text{kg} \pm 5.47$  between 6 to 8 weeks postpartum, with 14% of the sample (306 puerperal women) being mothers between 14-19 years of age. De Azeredo et al. (2011) was the only Brazilian study carried out in the last ten years, which evaluated exclusively adolescent mothers ( $n=50$ ), and found an average weight retention of 6.5kg, very similar to that found in the present study.

Higher levels of education was associated with lower postpartum weight retention in this study ( $\beta=-0.38$ ;  $p=0.028$ ). In alignment, studies with adult mothers observed that weight retention decreases as the level of education increases (Kac et al., 2004; Siega-Riz et al., 2010). According to Kac et al. (2004), the effect of this factor can be understood considering that women with lower levels of education tend to have greater difficulty in perceiving the risks associated with obesity.

Approximately 80.0% of the adolescents in this study consumed ultra-processed food daily and, this unhealthy intake, proved to be associated with an average increase of 1.38kg of retained weight in comparison to mothers who did not consume these products ( $p=0.025$ ). In a study carried out with 82 pregnant women (Joseph et al., 2008), the direct influence of food during pregnancy on postpartum weight retention it was evaluated. It was shown that the higher consumption of unhealthy foods, such as processed foods and high saturated fat content, significantly influences the elevation of postpartum weight retention significantly (Joseph et al., 2008).

Furthermore, in the present study, it was identified that multiparous adolescents had higher weight retention averages ( $8.03\text{kg}\pm 5.35$ ) compared to those who had their first child ( $6.57\text{kg}\pm 5.30$ ). This result corroborates with the birth cohort starting in 1982 in a southern city in Brazil (Gigante et al., 2005), where, of 464 participants aged 15 to 19 years, 16% had a gestation in this period. It was found that both single pregnancies and two or more pregnancies were associated with a significant increase in postpartum BMI,  $0.81\text{kg}/\text{m}^2$  ( $p=0.01$ ) and  $1.58\text{kg}/\text{m}^2$  ( $p=0.02$ ), respectively, being higher among multiparous women. In another study, with a sample of 2,607 women (17.9% <20 years) from the BRISA birth cohort (2010-2013) in São Luís do Maranhão (das Chagas et al., 2017), parity demonstrated a positive direct effect on postpartum weight retention ( $\beta=0.147$ ;  $p<0.001$ ) (das Chagas et al., 2017).

The pre-gestational BMI and the gestational weight gain above the recommended are the most studied and most associated factors when it comes to postpartum weight retention (Celik & Atan, 2018; Danilack et al., 2018; das Chagas et al., 2017; Endres et al., 2015; Nartea et al., 2019; Rasmussen & Yaktine, 2009; Siega-Riz et al., 2010). In the present study, high values of pre-gestational BMI showed a positive correlation with greater postpartum weight retention ( $\beta=0.18$ ;  $p=0.001$ ) as well as greater gestational weight gain ( $\beta=0.64$ ;  $p=0.000$ ). These results are similar to those found in the literature, both in adolescents and in adult women (Celik & Atan, 2018; Joseph et al., 2008; Siega-Riz et al., 2010).

A study conducted in the United States (Joseph et al., 2008), with 102 pregnant women between 15 and 21 years old, found an association between pre-gestational BMI and GWG. It was evaluated that adolescents who exceeded the recommended weight gain retained significantly more weight one year postpartum, when compared to the ones with adequate or below recommended weight gain. The authors also found an association between postpartum weight retention and pre-gestational BMI (Joseph et al., 2008).

Prospective research (Nartea et al., 2019) with 306 puerperal women evaluated the relation between GWG and postpartum weight loss with the risk of postpartum obesity. In this study, adolescent mothers had an average gestational weight gain of  $13.98\text{kg}$  ( $\pm 5.49$ ), 1kg more than the average weight gain among adult mothers ( $12.98\text{kg}\pm 5.99$ ) (Nartea et al., 2019).

A cross-sectional study conducted in Turkey (Celik & Atan, 2018) with 239 women, investigated the factors that affect postpartum maternal weight retention, with pre-gestational BMI and gestational weight gain being significant factors for this retention ( $p<0.05$ ). The authors assessed gestational weight gain according to the IOM guidelines and found that the chance of postpartum weight retention was four times greater (Odds Ratio=4.0; 95%CI: 1.71-9.39) in mothers who gained weight according to the guidelines and five times higher (95%CI: 2.20-12.97) among those who gained above the recommended, compared with those who gained less than the suggested value (Celik & Atan, 2018).

In the current study, 21.2% of adolescents started pregnancy with overweight and more than 40% of the sample gained excessive weight during pregnancy according to the IOM guidelines (Rasmussen & Yaktine, 2009).

A study carried out in Brazil (Nast et al., 2013) with 545 women showed that the risk of retaining postpartum weight increases among adolescent mothers and those who start pregnancy with overweight or obesity. Considering the pre-gestational BMI, weight retention at six months ( $8.7\pm 7.0\text{kg}$ ;  $p=0.03$ ) and 12 months ( $9.9\pm 7.7\text{kg}$ ,  $p=0.03$ ) postpartum, it was higher in overweight women, compared to normal weighted women,  $6.9\pm 5.7\text{kg}$  and  $7.6\pm 6.2\text{kg}$  at six and 12 months postpartum, respectively (Nast et al., 2013). Das Chagas et al. (2017) reported that for each variation of a standard deviation

(SD) of GWG, there was a significant increase of 0.49 SD in postpartum weight retention ( $p < 0.001$ ), meaning that each increase of 5,88kg in GWG (SD) corresponded to an increase of 3.25kg in retention.

Postpartum weight retention in adolescents brings into light a significant public health problem, obesity. This morbidity affects about 650 million people, with overweight and obesity contributing to 4 million deaths a year (World Health Organization, 2021). Few data are available in the literature regarding the long-term health impact of weight retention after a teenage pregnancy. In the present study, the authors warn the predictive factors for weight retention, reinforcing the importance of adequate monitoring of nutritional status and, thus, being able to assist in monitoring throughout the reproductive cycle of this population. It is evident that pregnant teenagers with lower level of education should have a singled out attention regarding nutritional counseling during pregnancy. Likewise, adolescent mothers who start prenatal care with a BMI of overweight or obesity or who show a GWG higher than desired, should have nutritional monitoring during their prenatal care. The major concern is that this vulnerable group may continue to accumulate weight throughout life and, with serious consequences for general health and quality of life. Thus, health education actions, adolescent pregnancy prevention programs, control of gestational weight gain and promotion of a healthy diet and lifestyle should be encouraged with the aim of preventing possible risks to future maternal health, such as postpartum weight retention. In addition, the need for new prospective studies in this specific population is imperative, so that more scientific evidences are consolidated.

The following are the strengths of this study: its longitudinal design, which reflects a temporal sequence of facts between exposures and outcome; estimating the effects of exposures on postpartum weight retention; and low number of losses from following the sampling, maintaining reliability. The main weakness of this study is the use of some data self-reported by the mother and/or acquired in a secondary way (pregnant woman's records), such as pre-pregnancy weight. However, this type of data collection is commonly observed in other studies on postpartum weight retention (Nogueira et al., 2015).

## 5. Conclusion

The incidence of weight retention four months postpartum was high among adolescents, especially among those with lower educational level, multiparous, with the habit of consuming ultra-processed food daily during pregnancy, without nutritional guidance during pregnancy, with higher pre-gestational BMI and with greater gestational weight gain.

These data reinforce the importance of a prenatal quality care that includes nutritional education strategies, especially for this highly vulnerable age group, in order to promote a healthier lifestyle and avoid excessive weight gain during pregnancy and its postpartum retention.

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