

## TEMPORAL EVOLUTION OF UNDERWEIGHT AND OVERWEIGHT AMONG BRAZILIAN PREGNANT ADOLESCENT AND ADULT WOMEN

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### Highlights:

1. Underweight has decreased, but the prevalence is still high among pregnant adolescent women.
2. Overweight has increased in recent years among pregnant adolescent and adult women.
3. Pregnant women in primary care have a double burden of nutritional deviations.

PRE-PROOF

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As a service to our readers, we are publishing this preliminary version of the manuscript, as accepted. The article will be reviewed, formatted, and approved by the authors before its final version is published.

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### ABSTRACT

**Objective:** Evaluate the evolution of the prevalence of underweight and overweight among pregnant adolescent and adult women from all regions of Brazil monitored by the Food and Nutrition Surveillance System (SISVAN) between 2010 and 2019. **Method:** This is an ecological study including all pregnant women treated in primary health care in all regions (North, Northeast, Central West, Southeast, and South) of Brazil. Trends in the prevalence of underweight and overweight among pregnant adult and adolescent women between 2010 and 2019 were assessed using joinpoint regression analysis. **Results:** The prevalence of underweight in pregnant adolescent women has decreased over the years in Brazil ( $p=0.040$ ), but less in the Central West region ( $p=0.164$ ). Underweight in pregnant adult women has decreased in Brazil ( $p<0.001$ ) and in all macro-regions over the years. The prevalence of overweight and obesity increased among pregnant adolescent and adult women in Brazil ( $p<0.001$ ) and in all macro-regions. **Conclusion:** Brazilian pregnant women treated in primary health care are affected by a double burden of nutritional deviations, which increase the risk of unfavorable outcomes for the mother and the baby.

**Keywords:** Nutritional status; Pregnant women; Maternal health; Nutritional surveillance.

### INTRODUCTION

Worldwide, the maternal-child group is at higher risk of mortality, especially pregnant women. In this sense, one of the US Sustainable Development Goals set for 2030 is the health and well-being of the population, and one of the targets is to reduce the global maternal mortality rate to 70 deaths per 100,000 live births<sup>1</sup>.

The Brazilian population has undergone social changes that affect health and food consumption patterns. These changes have led to a gradual reduction in malnutrition and an increase in overweight, characterizing the process of nutrition transition<sup>2</sup>. According to the most recent data from the Surveillance of Risk and Protective Factors for Chronic Diseases by Telephone Survey (Vigitel Brazil) conducted in 2021, overweight accounted for 57.2% and obese adults, 22.4%. Among the female population, the national prevalence of overweight was 55% and among obese women, 22.6%<sup>3</sup>.

During pregnancy, changes in diet, such as low consumption of fruits, greens, and vegetables, and increased consumption of foods of low nutritional value, can contribute to

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underweight or overweight among pregnant women, which negatively affects pregnancy progression and maternal and child health<sup>4</sup>.

Pregnant women who are underweight are at higher risk of impaired fetal growth and development, premature birth, and anemia. Overweight during pregnancy can be associated with a higher risk of gestational diabetes mellitus, hypertensive disorders of pregnancy, prolonged labor, cesarean delivery, birth asphyxia, preterm birth, and increased maternal and fetal morbidity<sup>5-6</sup>.

In this sense, in addition to medical monitoring during prenatal care, it is important for pregnant women to have nutritional monitoring during pregnancy, as it helps diagnose nutrition status and needs in order to prevent underweight and overweight, as well as other unfavorable pregnancy outcomes<sup>7-8</sup>.

So far, there is no nutrition survey in Brazil to monitor the nutrition risk status of pregnant women, which is necessary given that Brazil has more and less developed macro-regions and populations in poorer regions are more susceptible to health problems. Through the Food and Nutrition Surveillance System (SISVAN), it is possible to monitor the nutrition status of individuals at different stages of life treated in primary care. These data are available in the system and can be extracted and analyzed to support the creation and management of public health programs to improve the nutrition status of pregnant women and women of reproductive age.

Therefore, this study aimed to evaluate the evolution of the prevalence of underweight and overweight among pregnant adolescent and adult women in the different regions of Brazil monitored by SISVAN between 2010 and 2019.

### METHODS

This is an ecological study with secondary data from pregnant women registered on the SISVAN digital platform and treated in primary health care of the Brazilian National Health System (SUS) between 2010 and 2019. Data were accessed and extracted in December 2022 through public reports generated on the SISVAN digital platform.

The SISVAN public reports accessed for this study were those containing nutrition status data and then filters were defined to obtain data spreadsheets of pregnant women. The filters used to access the public reports were: reference year (2010, 2011, 2012, 2013, 2014,

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2015, 2016, 2017, 2018, and 2019), reference month (all), geographic region (all states), life stage (pregnant woman), and age (adolescent and adult). The variables analyzed in the study were: year of data collection; regions and states of Brazil; age; prevalence of underweight, overweight, and obesity among pregnant women.

Pregnant adolescent women were aged between  $\geq 10$  and  $< 20$  years and pregnant adult women were aged between  $\geq 20$  and  $< 60$  years. The current nutrition status of pregnant women was classified according to their body mass index (BMI) for the gestational age, based on the Atalah Curve, which classifies pregnant women as underweight, adequate weight, overweight and obesity, as recommended by the Ministry of Health<sup>9</sup>.

First, the database was imported from Excel software (version 365®) into open-access statistical software Joinpoint Regression Program, version 4.9.0.0, March 2021 (National Cancer Institute, Bethesda, MD, USA), available at <https://surveillance.cancer.gov/joinpoint/>.

The trend analysis was conducted using joinpoint regression analysis, which identifies the occurrence of points that indicate significant changes during the assessed period. The number of points used in the analysis was defined a posteriori in order to allow the best representation of the trend, with the fewest inflection points. In addition, the 3-month percentage changes (TPC) was calculated, with a 95% confidence interval, as well as the change over the entire period by the average 3-month percentage change (ATPC). An upward trend (increase) was considered in cases where the TPC/ATPC were higher than zero (plus), with the lower limits of the 95%CI greater than zero. A downward trend (decrease) was accepted when the TPC/ATPC were less than zero (minus) and the upper limits of the 95%CI were less than zero. The TPC/ATPC were considered stationary when they were equal to zero and/or with a 95%CI containing zero and a non-significant p-value. Statistical significance was set at  $p < 0.05$ .

This study did not require approval from the Research Ethics Committee as it used secondary data on the nutrition status of pregnant women treated in primary health care.

## RESULTS

### *Underweight among pregnant adolescent and adult women*

The prevalence of underweight among Brazilian pregnant adolescent women decreased over the years from 2010 to 2019 in Brazil ( $p=0.040$ ). Among the macro-regions,

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Central West ( $p=0.164$ ) was the only region that did not show a downward trend in the prevalence of underweight (Table 1).

The prevalence of underweight in Brazilian pregnant adult women decreased in Brazil ( $p<0.001$ ) and in all macro-regions between 2010 and 2019 (Table 1).

**Table 1.** Trends, 3-month percentage changes (TPC), and 95% confidence intervals (95%CI) of underweight in Brazilian pregnant adolescent and adult women registered in the National Food and Nutrition Surveillance System. Brazil, 2010-2019.

<b>Region</b>	<b>Trends</b>	<b>TPC</b>	<b>95%CI</b>	<b>p</b>
<b>Adolescent women</b>				
Central West	2010.1 to 2019.4	-0.1	-0.3; 0.1	0.164
Northeast	2010.1 to 2019.4	-0.4	-0.5; -0.3	< <b>0.001</b>
North	2010.1 to 2019.4	-0.6	-0.7; -0.5	< <b>0.001</b>
Southeast	2010.1 to 2019.4	-0.2	-0.3; -0.1	<b>0.001</b>
South	2010.1 to 2019.4	-0.2	-0.4; -0.1	<b>0.011</b>
Brazil	2010.1 to 2019.4	-0.1	-0.2; -0.0	<b>0.040</b>
<b>Adult women</b>				
Central West	2010.1 to 2019.4	-0.9	-1.1; -0.8	< <b>0.001</b>
Northeast	2010.1 to 2019.4	-1.2	-1.3; -1.1	< <b>0.001</b>
North	2010.1 to 2019.4	-1.5	-1.6; -1.3	< <b>0.001</b>
Southeast	2010.1 to 2019.4	-0.9	-1.7; -0.0	<b>0.046</b>
South	2010.1 to 2019.4	-0.9	-1.2; -0.7	< <b>0.001</b>
Brazil	2010.1 to 2019.4	-0.9	-1.0; -0.8	< <b>0.001</b>

Source: Study data.

### ***Overweight among pregnant adolescent and adult women***

#### ***Overweight***

The prevalence of overweight among Brazilian pregnant adolescent and adult women showed an upward trend in Brazil ( $p<0.001$ ) and in all macro-regions over the period evaluated (Table 2).

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**Table 2.** Trends, 3-month percentage changes (TPC), and 95% confidence intervals (95%CI) of overweight in Brazilian pregnant adolescent and adult women registered in the National Food and Nutrition Surveillance System. Brazil, 2010-2019.

<b>Regions</b>	<b>Trends</b>	<b>TPC</b>	<b>95%CI</b>	<b>p</b>
<b>Adolescent women</b>				
Central West	2010.1 to 2019.4	0.3	0.1; 0.5	< <b>0.001</b>
Northeast	2010.1 to 2019.4	0.9	0.8; 1.0	< <b>0.001</b>
North	2010.1 to 2019.4	1.1	1.0; 1.3	< <b>0.001</b>
Southeast	2010.1 to 2019.4	0.6	0.5; 0.7	< <b>0.001</b>
South	2010.1 to 2010.3	6.6	-4.0; 18.3	0.224
	2010.3 to 2019.4	0.4	0.3; 0.5	< <b>0.001</b>
	2010.1 to 2019.4	0.7	0.2; 1.2	<b>0.009</b>
Brazil	2010.1 to 2011.3	1.9	0.3; 3.6	<b>0.025</b>
	2011.3 to 2016.2	0.2	0.0; 0.3	<b>0.035</b>
	2016.2 to 2019.4	1.0	0.7; 1.3	< <b>0.001</b>
	2010.1 to 2019.4	0.7	0.4; 1.0	< <b>0.001</b>
<b>Adult women</b>				
Central West	2010.1 to 2019.4	0.3	0.1; 0.5	<b>0.001</b>
Northeast	2010.1 to 2019.4	0.5	0.4; 0.6	< <b>0.001</b>
North	2010.1 to 2019.4	0.8	0.7; 0.9	< <b>0.001</b>
Southeast	2010.1 to 2019.4	0.4	-0.4; 1.2	0.295
South	2010.1 to 2019.4	0.3	0.1; 0.5	<b>0.001</b>
Brazil	2010.1 to 2019.4	0.4	0.4; 0.4	< <b>0.001</b>

Source: Study data.

### **Obesity**

The prevalence of obesity among Brazilian pregnant adolescent and adult women has also increased over the years in Brazil ( $p < 0.001$ ) and in all geographic macro-regions of Brazil. However, it is important to highlight that adolescent pregnant women presented a downward trend of obesity in the Central West region from 2015.3 to 2017.2 and in the South region from 2011.2 to 2012.1 (Table 3).

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**Table 3.** Trends, 3-month percentage changes (TPC), and 95% confidence intervals (95%CI) of obesity in Brazilian pregnant adolescent and adult women registered in the National Food and Nutrition Surveillance System. Brazil, 2010-2019.

Regions	Trends	TPC	95%CI	<i>p</i>	
<b>Adolescent women</b>					
Central West	2010.1 to 2012.1	4.4	1.2; 7.7	<b>0.008</b>	
	2012.1 to 2014.3	-0.2	-2.1; 1.8	0.855	
	2014.3 to 2015.3	16.7	7.2; 27.0	<b>0.001</b>	
	2015.3 to 2017.2	-6.5	-8.5; -4.5	<b>&lt; 0.001</b>	
	2017.2 to 2019.4	0.5	-0.8; 1.8	0.460	
Northeast	2010.1 to 2019.4	1.4	0.1; 2.6	<b>0.032</b>	
	2010.1 to 2019.4	1.9	1.7; 2.0	<b>&lt; 0.001</b>	
North	2010.1 to 2014.3	2.1	0.9; 3.4	<b>0.001</b>	
	2014.3 to 2015.2	10.0	-14.9; 42.1	0.454	
	2015.2 to 2017.3	-0.5	-1.9; 0.9	0.456	
	2017.3 to 2019.5	2.5	1.4; 3.6	<b>&lt; 0.001</b>	
Southeast	2010.1 to 2019.4	2.2	0.2; 4.2	<b>0.034</b>	
	2010.1 to 2016.2	0.9	0.7; 1.2	<b>&lt; 0.001</b>	
	2016.2 to 2019.4	1.7	1.3; 2.1	<b>&lt; 0.001</b>	
South	2010.1 to 2019.4	1.2	1.0; 1.4	<b>&lt; 0.001</b>	
	2010.1 to 2011.2	42.1	37.3; 47.0	<b>&lt; 0.001</b>	
	2011.2 to 2012.1	-30.8	-39.1; -21.3	<b>&lt; 0.001</b>	
	2012.1 to 2019.4	1.5	1.3; 1.7	<b>&lt; 0.001</b>	
Brazil	2010.1 to 2019.4	2.9	1.8; 4.0	<b>&lt; 0.001</b>	
	2010.1 to 2011.4	3.5	1.4; 5.5	<b>0.002</b>	
	2011.4 to 2017.2	0.5	0.3; 0.7	<b>&lt; 0.001</b>	
	2017.2 to 2019.4	1.7	1.1; 2.2	<b>&lt; 0.001</b>	
<b>Adult women</b>	2010.1 to 2019.4	1.3	0.9; 1.7	<b>&lt; 0.001</b>	
	Central West	2010.1 to 2016.1	1.9	1.6; 2.2	<b>&lt; 0.001</b>
		2016.1 to 2017.1	-1.7	-5.8; 2.6	0.425
		2017.1 to 2019.4	0.9	0.3; 1.6	<b>0.007</b>
	Northeast	2010.1 to 2019.4	1.3	0.8; 1.7	<b>&lt; 0.001</b>
		2010.1 to 2019.4	1.5	1.4; 1.6	<b>&lt; 0.001</b>
	North	2010.1 to 2015.2	2.2	1.8; 2.5	<b>&lt; 0.001</b>
		2015.2 to 2019.4	1.3	1.2; 1.5	<b>&lt; 0.001</b>
	Southeast	2010.1 to 2019.4	1.8	1.6; 2.0	<b>&lt; 0.001</b>
		2010.1 to 2019.4	1.1	0.3; 2.0	<b>0.009</b>
South	2010.1 to 2019.4	1.1	0.9; 1.3	<b>&lt; 0.001</b>	
Brazil	2010.1 to 2019.4	1.0	0.9; 1.1	<b>&lt; 0.001</b>	

Source: Study data.

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### DISCUSSION

This study shows an overview of the nutrition status of Brazilian pregnant women in 2010 and 2019. Analysis of data of Brazilian pregnant women monitored by SISVAN showed a decrease in the prevalence of underweight among pregnant adolescent and adult women in Brazil, but among adolescents in the Central West region, this reduction was not statistically significant. Regarding overweight and obesity, both presented an increase in the prevalence among pregnant adolescent and adult women in Brazil, in all regions. We highlight the importance of this study, given that there is no national survey to assess the health of pregnant women in Brazil. It is also important to monitor the nutrition profile of Brazilian pregnant women in order to strengthen existing prenatal care policies and promote necessary changes according to the epidemiological scenario of the prevalence of underweight and overweight among pregnant women.

The prevalence of underweight in the Brazilian population has decreased over the years, according to data from the Family Budget Survey (POF). In 2002-2003, underweight among adults was 4%, while in 2008-2009, it fell to 2.7%<sup>10-11</sup>. This is due to changes in the profile of diseases in Brazil, which used to be associated with deficiency processes such as malnutrition, anemia, and hypovitaminosis, and are currently related to advances in technology, a decline in the fertility rate, increased longevity, urbanization, and changes in the eating patterns and habits of the population<sup>12-13</sup>.

This study showed that among pregnant adult women, underweight has decreased in recent years in Brazil and in all macro-regions. However, among pregnant adolescent women – a group at risk of low birth weight – the prevalence showed a downward trend in Brazil and in the Northeast, North, Southeast, and South macro-regions.

In the study by Grillo, Slaviero and Mezadri<sup>14</sup>, the prevalence of underweight among pregnant adolescent women in Brazil was 32.09% in 2018. However, according to the study by Silva Júnior *et al.*<sup>15</sup> with pregnant adolescents from the *Bolsa Família* Program between 2008 and 2018, the trend of underweight was downward (-1.2%), and the South region showed the highest annual variation (-1.5%). In our study, the prevalence of underweight among adolescents has not decreased in the Central West region in recent years, which may suggest that public policies of the states in this region have not successfully reduced this nutritional deviation in this group. On the other hand, the Northeast and North regions showed



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the highest reduction in underweight as a result of improvements in living conditions, although these macro-regions keep offering poor access to services, and individuals from low socioeconomic class still face more challenges to fulfill their demands<sup>16</sup>.

Underweight during pregnancy is associated with a higher risk for the fetus and the mother. This risk is even higher among pregnant adolescent women, considering this stage of life demands more nutrients, and eating habits are often inadequate, with healthy meals replaced with poorly nutritious snacks and skipped meals, which can lead to lower than recommended food intake<sup>17</sup>.

Although prevalence rates are low, underweight and growth delay are still reasons for public health concern in many regions, including Latin America. In low- and middle-income countries, the most frequent form of double burden of malnutrition is an overweight mother and a child with growth delay in the same family<sup>18-19</sup>. In the study by Farias *et al.* with data from ENANI-2019, malnutrition in mother-child dyads increased considerably from 2006 to 2019, when overweight in mother-child dyads increased by 50% and the double burden of malnutrition increased by 92% – the main data of malnutrition at household level in Brazil<sup>20</sup>.

This study showed that, according to SISVAN data, Brazilian pregnant women have a double burden of nutritional deviations. The prevalence rates of overweight and obesity increased among pregnant adolescent and adult women in Brazil and in all macro-regions. The results of this study are consistent with evidence from national surveys that point to an increase in the prevalence rates of overweight and obesity in the Brazilian population<sup>3</sup>.

Overweight has become a serious public health problem. Excessive weight gain before and during pregnancy represents a risk factor. In the study by Manera and Höfelmann, almost half of the pregnant women were overweight during pregnancy (46.2%) and before conception (40.8%). The variables of being 35 years and over, having three or more children, and being overweight in the pre-gestational period were associated with higher chances of being overweight during pregnancy<sup>20</sup>.

Other factors that may favor overweight in the population are changes in nutrition and food systems, how they eat and drink, how they commute to work, and how they participate in leisure activities<sup>22</sup>. Pregnant women with greater adherence to the “traditional Brazilian” pattern, which includes rice, beans, meat, greens, and vegetables, and characterized by low consumption of salty snacks, pizzas, and sandwiches, had a lower chance of obesity<sup>23</sup>.

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In agreement with the findings of this study, another study that assessed 785 pregnant women treated in the public health system in Ribeirão Preto, São Paulo, between 2011 and 2012 found a prevalence rate of 56.7% of overweight pregnant adult women<sup>24</sup>. Another study with 386 pregnant women at the Women's Hospital at the Universidade de Campinas in São Paulo, found a combined prevalence of overweight and obesity of 53.88%, with excessive gestational weight gain of 37.31% of the participants<sup>25</sup>.

A study assessing SISVAN data of 4,279 pregnant adult women from Macaé, Rio de Janeiro, between 2010 and 2018 also showed a significant upward trend in overweight, with an increase in the annual increment rate ( $\beta_1=2.35$ ;  $p\text{-value}<0.001$ )<sup>26</sup>. Similarly, another study using SISVAN data with pregnant adolescent women from the Bolsa Família Program between 2008 and 2018 showed an upward trend of the prevalence rate (2.9%) of overweight, with the North region presenting the highest annual change among the regions (4.1%) and an upward trend of the prevalence rate (7.5%) of obesity, with the Central West (10.2%) and Northeast (10.1%) regions presenting the highest annual changes<sup>15</sup>.

Overweight during pregnancy, particularly obesity, is associated with an increased risk of miscarriage, birth defects in newborns, obesity in adult offspring and, as a more serious consequence, mortality of mother and baby<sup>27</sup>.

Recently, new weight gain curves were proposed for Brazilian pregnant women according to gestational age and pre-gestational BMI and included in the new pregnancy booklet<sup>28-29</sup>. The new curves will enable better monitoring and prevention of underweight and overweight during pregnancy in primary health care. Early nutritional interventions during pregnancy can help prevent overweight and underweight, and adequate prenatal care with a multi-professional team is required to minimize potential adverse effects on maternal and child health.

Study limitations include the fact that SISVAN data are still underused in primary care, considering that providing data on pregnant women is still far below the reality of the service. However, system use has improved over the years in terms of coverage and increase in data collection<sup>30</sup>. The lack of information on some relevant variables during pregnancy, such as maternal age, pre-gestational weight, and gestational week at the time of the assessments, as well as the lack of information on food consumption, make it difficult to interpret the results. However, the aim of our study was to analyze the SISVAN public

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reports, identifying trends in the nutrition status of Brazilian pregnant women, considering the system limitations. Data comparison was difficult due to the lack of nationwide studies with pregnant women.

On the other hand, the strengths of our study should be highlighted. Rare publications reveal the national reality of the nutritional profile of Brazilian pregnant women and the SISVAN public reports allow such analysis, which is still little explored in Brazil. Our results indicate the coexistence of overweight and underweight among Brazilian pregnant women, exposing them to the risk of unfavorable outcomes during pregnancy and increased maternal and infant mortality. Also, our data allow a critical assessment of the need for improvements in prenatal care for Brazilian pregnant women, in particular the mandatory nutrition monitoring of pregnant women during prenatal care with a nutritionist, a practice that is currently uncommon.

### CONCLUSION

We conclude that Brazilian pregnant women receiving primary care present a double burden of nutritional deviations, which increase the risk of unfavorable outcomes for mother and baby. The prevalence of underweight has decreased significantly among pregnant adolescent and adult women. However, actions are required to reduce the prevalence of underweight among pregnant adolescents, given that the Central West region still has a high prevalence of this deviation. Overweight and obesity, on the other hand, has presented an upward trend over the years among pregnant adolescent and adult women, requiring improvements in nutrition during prenatal care, given the harmful effects of this nutritional deviation on the mother and the fetus.

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