

# The risk of incidence and persistence of obesity among Brazilian adults according to their nutritional status at the end of adolescence

*O risco de incidência e persistência da obesidade entre adultos brasileiros segundo seu estado nutricional ao final da adolescência*

**Wolney Lisboa Conde**<sup>I</sup>

**Camila Borges**<sup>II</sup>

<sup>I</sup> Department of Nutrition of the School of Public Health at *Universidade de São Paulo* (USP); Department of Epidemiological Research on Nutrition and Health at USP – São Paulo (SP), Brazil

<sup>II</sup> Department of Nutrition of the School of Public Health at *Universidade de São Paulo* (USP) – São Paulo (SP), Brazil

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**Correspondence to:** Wolney Lisboa Conde Faculdade de Saúde Pública – Departamento de Nutrição – Avenida Doutor Arnaldo, 715 – CEP: 01246-904 – E-mail: wolneyconde@gmail.com.

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## **Abstract**

**Introduction:** The prevalence of obesity has increased among adults living in developed or developing countries. In Brazil, obesity among adults affected at least 10% of population from 2008 to 2009. **Objectives:** Based on data from VIGITEL, we will estimate the incidence and persistence of obesity among Brazilian adults from 2006 to 2009. **Methods:** We used complete cases with demographic, socioeconomic, and anthropometric data of samples from 2006 to 2009. All estimates were adapted for the Brazilian population in 2007. The relative risk (RR) for incidence and persistence of overweight or obesity was estimated by the Poisson multiple regression. All estimates were adjusted for smoking behavior, age, and practice of physical activity. **Results:** The incidence of overweight among individuals with low or normal weight at the age of 20 is estimated in 40% for males and 30% for females. The persistence of obesity, in turn, is estimated in 65% for males and 47% for females. The gradient of obesity as a function of schooling is virtually inexistent in males. Among females, the gradient is negative, with linear and statistically significant associations. **Conclusion:** These characteristics, combined with the increase of obesity among young adults found in other studies, show the urgent need to use more effective public policies, which reduce public exposure to foods of poor nutritional quality and develop initiatives to promote physical activity.

**Keywords:** risk; incidence; persistence; obesity; adult.

## Resumo

**Introdução:** A prevalência da obesidade vem aumentando entre adultos nos países desenvolvidos e em desenvolvimento. No Brasil, a obesidade entre adultos atingiu entre 2008 a 2009 pelo menos 10% da população. **Objetivo:** Com base nos dados do VIGITEL, neste trabalho, serão estimadas a incidência e a persistência da obesidade entre brasileiros adultos no período de 2006 a 2009. **Métodos:** Nas amostras de 2006 a 2009, foram utilizados casos com registros demográficos, socioeconômicos e antropométricos completos. As estimativas foram expandidas para a população brasileira em 2007. A estimativa do risco relativo (RR) para incidência e persistência da obesidade ou excesso de peso entre homens e mulheres foi feita com regressão múltipla de Poisson, e ajustada para hábito de fumar, idade e atividade física. **Resultados:** A incidência do excesso de peso entre indivíduos com peso baixo ou normal, aos 20 anos, é estimada em 40%, no sexo masculino, e em 30%, no feminino. A persistência da obesidade, por sua vez, é estimada em 65%, no sexo masculino, e em 47%, no feminino. O gradiente da obesidade como função da escolarização é virtualmente nulo no sexo masculino. Entre mulheres, o gradiente é negativo, com associações lineares e estatisticamente significantes. **Conclusão:** Essas características, associadas à forte expansão da obesidade entre adultos jovens detectada em outros estudos, apontam a urgência da utilização de políticas públicas mais incisivas e efetivas, que reduzam a exposição da população à alimentação com má qualidade nutricional e desenvolvam ações voltadas à promoção da atividade física.

**Palavras-chave:** risco; incidência; persistência; obesidade; adulto.

## Introduction

The prevalence of obesity has increased among adults in developing and developed countries<sup>1</sup>. The World Health Organization (WHO) estimates that at least 1 billion people are overweight, out of which 300 million are obese<sup>2</sup>. Projections based on national surveys performed in the past decades estimate that by the year 2025 obesity may affect 40% of the population of the United States, 30% of the population in England and 20% of the Brazilian population<sup>3</sup>.

Current literature indicates that young adults are prone to obesity, or even to being overweight in the transition of infancy or adolescence to adulthood<sup>4-7</sup>. The most critical periods for the development of obesity happen in early childhood, during the strong oscillation and transition of body adiposity, which takes place between the ages of five, seven and adolescence<sup>8</sup>. From the age of six, approximately, one out of two obese children becomes an obese adult, while only one out of ten non-obese children has the same future<sup>9</sup>.

The incidence or persistence of obesity among adults is associated with chronic diseases and the increased risk of early mortality<sup>10</sup>. Some data point out that the period at risk for obesity is the transition from adolescence to the early stages of adulthood, for both genders and different ethnicities<sup>4</sup>. Factors such as the habit of smoking or serum cholesterol levels are risky or may predict the development of obesity in young adults<sup>7</sup>.

In Brazil, a secular trend analysis indicates that obesity among adults is increasing, and affected at least 10% of the population in all the regions of the country<sup>11</sup> from 2008 to 2009. The increase in obesity rates in Brazil is less intense among women<sup>12</sup>, socioeconomic groups with higher income and those with more years of schooling<sup>13</sup>, as well as the most developed regions of the country. It is estimated that chronic diseases might have been responsible for approximately 70% of the mortality in Brazil in the decade of 2000<sup>15</sup>.

The increase and dispersion of obesity and its associated factors in Brazil – and other countries – originated the development of monitoring and surveillance systems that allow to follow-up the evolution of such problems and their main branches.

In Brazil, there is a system called Telephone-based Surveillance of Risk and Protective Factors for Chronic Diseases (VIGITEL) that aims at generating continuous information on the frequency and distribution of the main risk or protective factors for chronic diseases in the country<sup>16</sup>.

Brazil does not have studies to describe the incidence or persistence of obesity in the transition phase from adolescence to early adulthood.

Based on VIGITEL, the analysis of incidence and persistence of obesity among Brazilian adults from 2006 to 2009 will be presented in this study. The evolution description will be performed according to age and socioeconomic strata. This study focuses particularly on the gradient between changes on nutritional status and on adult life and schooling.

## Methods

VIGITEL is a system that was established by the Ministry of Health in 2006 to annually monitor the frequency and distribution of the main risk factors associated with chronic non-communicable diseases in the Brazilian population. The basic sample of VIGITEL consists of at least 2,000 individuals aged 18 years or more in the Federal District and each state capital. The adjustment of the sample to the total Brazilian population happens in two phases: first, the weighting factor is the function of the probability of being selected and having a landline telephone line in the universe of each analyzed city; in the second phase, the adjustment is given by the relation between the frequencies of gender, age and schooling categories from VIGITEL and Census, by the Brazilian Institute of Geography and Statistics (IBGE). The detailed sampling procedures of VIGITEL were described in a different publication<sup>16</sup>.

For this analysis, samples from 2006 to 2009 were selected, more specifically those related to individuals aged between 21 and 39 years; with body mass index (BMI) inferior to 35 kg/m<sup>2</sup> at the age of 20, with simultaneous record of demographic, socioeconomic and anthropometric information. In 2006, 14,767 cases (6,803 men and 7,964 women) were selected; in 2007, the selection consisted of 15,744 participants (6,634 men and 9,110 women); in 2008, 16,026 cases (6,709 men and 9,317 women) and, in 2009, 15,448 cases (6,560 men and 8,888 women). Data concerning pregnant women (or those who suspected being pregnant) were previously excluded from the samples.

The selection as to age and BMI at the age of 20 was performed with the objective to: reduce the potential memory bias of the interviewees; enable that the estimates regarding persistence of obesity is not affected by cases that are difficult to change without medicine therapy, and indirectly exclude cases of high risk of obesity associated with other chronic diseases. Also, this selection allows the comparison of data from VIGITEL with information from other national surveys.

The basic information used in this study come from questions number Q6, Q7, Q8, Q9, Q11, Q12 and Q13, Q14, Q42 to Q46, Q60 to Q64 of the standard questionnaire used for VIGITEL in 2009, being similar to previous years. The questionnaires from 2006 to 2009 may be fully accessed at: <http://portal.saude.gov.br/portal/saude/profissional>.

The recorded height and weight are those informed by the participant. BMI was calculated by dividing the weight (kg) by the height (m<sup>2</sup>). At the age of 20, BMI was estimated by replacing the current weight with the value at that age, and by maintaining the current height, once it is assumed that linear growth is over by this time. Nutritional status was classified into low weight (BMI < 18.5 kg/m<sup>2</sup>), normal weight (BMI of 18.5 to 24.9 kg/m<sup>2</sup>), pre-obese (BMI of 25 to 29.9 kg/m<sup>2</sup>), obese (BMI ≥ 30 kg/m<sup>2</sup>) and overweight, when

BMI is higher than 25 kg/m<sup>2</sup>, according to nomenclature and critical values adopted by WHO for adults<sup>17</sup>.

Estimates considered the final weighting factor, which expands the sample to the Brazilian population in 2007 according to values demonstrated by IBGE. The relative risk (RR) of being currently obese at the age of 20, according to nutritional status, by schooling was estimated by Poisson regression for each gender.

The model was adjusted for the temporal difference between current age and the age of 20, frequency of physical activity, current or former use of tobacco and number of cigarettes smoked per day. The linear trend as to current schooling was tested by introducing the variable in the continuous form of the model. All analyses were done with Stata®, version 11.

## Results

The incidence of overweight in this study among individuals with low or normal weight at the age of 20 is estimated in 40% for males and 30% for females. With the same comparison, the incidence of obesity is estimated in 7% for men and women. The incidence of obesity in individuals who are pre-obese at the age of 20 is approximately 40% for both genders (Table 1).

Data in Table 2 indicate the incidence of obesity among pre-obese men aged 20 is 5.4 times higher than that observed among men with normal weight at the same age. The age group clearly influences the incidence of obesity. In the group of men currently aged 21 to 39 years, the same comparison shows the incidence of obesity is 11.6 times more frequent for those who were pre-obese at the age of 20. In the group of men aged 30 to 39 years, the incidence is 4.1 times more frequent in relation to the same comparison.

As to females, the incidence of obesity among the women who were pre-obese at the age of 20 is 4.7 times higher than among those with normal weight at the same age. For women, the difference in the incidence of obesity is less prevalent among the following age groups: for women currently aged 21 to 39 years, the incidence of obesity is 6.1 times more frequent than for those who were pre-obese at the age of 20. In the group aged 30 to 39 years, the incidence is 4.3 times higher as to the same comparison.

The persistence of overweight, that is, being overweight by the age of 20 and currently, is estimated in 91% for males and 81% for females. The persistence of obesity is estimated in 65% for males and 47% for females.

**Table 1.** Current nutritional status according to the World Health Organization nutritional classification and age by nutritional status at 20 years-old, among Brazilians men aged 21 to 39 years, VIGITEL, 2006 to 2009

**Tabela 1.** Estado nutricional atual segundo classificação nutricional da Organização Mundial de Saúde e faixa etária por estado nutricional aos 20 anos, entre homens brasileiros de 21 a 39 anos. VIGITEL, 2006 a 2009

Current nutritional status	Nutritional classification at the age of 20			
	Low weight (10-18.4 kg/m <sup>2</sup> )	Normal weight (18.5- 24.9 kg/m <sup>2</sup> )	Pre-obese (25-29.9 kg/m <sup>2</sup> )	Obese (30-34.9 kg/m <sup>2</sup> )
21 to 29 years old				
Low weight (10-18.4 kg/m <sup>2</sup> )	20.6	0.4	0.1	0.0
Normal weight (18.5-24.9 kg/m <sup>2</sup> )	73.6	69.4	8.2	5.0
Pre-obese (25-29.9 kg/m <sup>2</sup> )	5.1	27.3	58.2	26.8
Obese (30-34.9 kg/m <sup>2</sup> )	0.8	2.9	33.5	68.2
30 to 39 years old				
Low weight (10-18.4 kg/m <sup>2</sup> )	7.8	0.8	0.0	0.0
Normal weight (18.5-24.9 kg/m <sup>2</sup> )	73.6	44.1	8.6	17.2
Pre-obese (25-29.9 kg/m <sup>2</sup> )	16.6	43.1	42.2	22.3
Obese (30-34.9 kg/m <sup>2</sup> )	1.9	12.0	49.3	60.5

Among men with overweight at the age of 20, 92% also were overweight afterwards, between the age of 21 and 29 years, and 90% are overweight at the age of 30 to 39 years. In relation to females, 81% of the women who were overweight at the age of 20 also presented this feature at the current age, at any age group.

Schooling shapes the gradient of incidence of obesity differently for each gender. For males, the association between obesity and years of schooling has a decreasing form, even if non-linear. For females, the association between obesity and years of schooling is inverse and linear.

The association standard between obesity and schooling is shaped by the nutritional status at the age of 20 and, again, differs as to gender. For males, the association between obesity and years of schooling is inversely linear only among individuals with healthy weight at the age of 20, and presents a non-linear form among those who were obese at the age of 20.

For females, the association between obesity and schooling is inversely linear, regardless of the nutritional status at the age of 20. However, women who have a bachelor's degree, in relation to those who have had up to three years of schooling, present a risk of obesity of 0.72 when they were obese at the age of 20; 0.49, when they were

pre-obese; and 0.22 when they presented normal weight at that time.

Data from Table 3 suggest the interaction between schooling and previous nutritional status to determine current obesity. However, the interaction of these variables did not show statistical significance after the adjustment for other factors, such as: current age, habit of smoking in adulthood and practice of physical activity.

Table 4 presents the RR of becoming obese, remaining obese or overweight in adulthood as a function of the nutritional status at the age of 20 and schooling adjusted by current age, habit of smoking and practice of physical activity. In relation to men, women have more years of schooling (0.5 year), are older (0.5 year) and have an inferior BMI at the age of 20 (1.8 kg/m<sup>2</sup>).

As to males, the association between schooling and incidence or persistence of nutritional conditions that present risk to health is always positive, even if it is non-linear in the case of incidence or persistence of obesity. For females, however, the association between schooling and the incidence or persistence of nutritional conditions that present risk to health is always negative and, in cases of incidence or persistence of overweight, associations are linear and statistically significant.

**Table 2.** Current nutritional status according to the World Health Organization nutritional classification and age by nutritional status at 20 years-old, among Brazilians women aged from 21 to 39 years-old, VIGITEL, 2006 to 2009

**Tabela 2.** Estado nutricional atual segundo classificação nutricional da Organização Mundial de Saúde e faixa etária por estado nutricional aos 20 anos, entre mulheres brasileiras de 21 a 39 anos. VIGITEL, 2006 a 2009

Current nutritional status	Nutritional classification at the age of 20			
	Low weight (10-18.4 kg/m <sup>2</sup> )	Normal weight (18.5-24.9 kg/m <sup>2</sup> )	Pre-obese (25-29.9 kg/m <sup>2</sup> )	Obese (30-34.9 kg/m <sup>2</sup> )
21 to 29 years old				
Low weight (10-18.4 kg/m <sup>2</sup> )	36.9	2.3	0.1	0.0
Normal weight (18.5-24.9 kg/m <sup>2</sup> )	59.4	73.1	22.7	8.6
Pre-obese (25-29.9 kg/m <sup>2</sup> )	3.3	19.9	49.3	44.8
Obese (30-34.9 kg/m <sup>2</sup> )	0.4	4.6	27.9	46.6
30 to 39 years old				
Low weight (10-18.4 kg/m <sup>2</sup> )	15.3	0.9	0.2	0.0
Normal weight (18.5-24.9 kg/m <sup>2</sup> )	68.2	56.7	19.0	21.2
Pre-obese (25-29.9 kg/m <sup>2</sup> )	14.1	30.0	27.0	30.0
Obese (30-34.9 kg/m <sup>2</sup> )	2.3	12.4	53.8	48.8

**Table 3.** Current frequency (%) of obesity according to gender and years of schooling according to the nutritional status at the age of 20, among Brazilian adults aged 21 to 39 years. VIGITEL, 2006 to 2009

**Tabela 3.** Frequência (%) atual da obesidade segundo sexo e anos de estudo por estado nutricional aos 20 anos, entre adultos brasileiros de 21 a 39 anos. VIGITEL, 2006 a 2009

Gender and years of schooling	Nutritional classification at the age of 20				
	Total (10-34.9 kg/m <sup>2</sup> )	Low weight (10-18.4 kg/m <sup>2</sup> )	Normal weight (18.5-24.9 kg/m <sup>2</sup> )	Pre-obese (25-29.9 kg/m <sup>2</sup> )	Obese (30-34.9 kg/m <sup>2</sup> )
Male					
0 to 3 years	13.3	0.0	10.7	42.2	49.2
4 to 7 years	14.0	1.6	8.9	43.8	65.5
8 to 10 years	13.7	3.5	8.3	42.1	76.7
11 years	11.6	2.2	6.5	37.2	70.9
12 years or more	12.0	1.4	5.3	35.5	65.1
Female					
0 to 3 years	19.7	9.1	17.3	59.5	69.1
4 to 7 years	14.7	2.1	13.6	50.8	64.5
8 to 10 years	11.5	2.3	9.9	41.6	51.7
11 years	7.7	0.7	6.6	35.5	60.7
12 years or more	5.1	0.6	3.8	29.4	50.0

**Table 4.** Relative risk (RR)<sup>1</sup> of incidence and persistence of obesity and overweight by gender and years of schooling among Brazilian adults from 21 to 39 years-old. VIGITEL, 2006 to 2009

**Tabela 4.** Risco relativo (RR)<sup>1</sup> de incidência da obesidade e persistência da obesidade e do excesso de peso, segundo sexo e anos de estudo de adultos brasileiros de 21 a 39 anos. VIGITEL, 2006 a 2009

Gender and years of schooling	Relative risk		
	Incidence of obesity (BMI 20 a <30; BMI atual ≥30)	Obesity persistence (BMI 20 a ≥30; BMI atual ≥30)	Overweight persistence (BMI 20 a ≥25; BMI atual ≥25)
Male (n=25,941)			
0 to 3 years	1	1*	1*
4 to 7 years	1.15 (0.67-1.95)	1.28 (0.28-4.30)	1.18 (0.89-1.57)
8 to 10 years	1.31 (0.79-2.17)	1.50 (0.46-4.90)	1.19 (0.90-1.56)
11 years	1.15 (0.72-1.83)	2.35 (0.78-7.07)	1.18 (0.90-1.54)
12 or more years	1.14 (0.71-1.85)	1.94 (0.64-5.90)	1.21 (0.93-1.60)
Female (n=34,309)			
0 to 3 years	1*	1	1*
4 to 7 years	0.93 (0.60-1.45)	0.70 (0.26-1.86)	0.96 (0.81-1.15)
8 a to 10 years	0.72 (0.46-1.13)	0.51 (0.19-1.33)	0.97 (0.82-1.15)
11 years	0.47 (0.31-0.71)	1.17 (0.56-2.42)	0.89 (0.76-1.05)
12 or more years	0.32 (0.21-0.49)	0.69 (0.29-1.64)	0.82 (0.69-0.97)

<sup>1</sup> The sample was adjusted for temporal difference between current age and the age of 20, frequency of physical activity, smoking and number of cigarettes a day. RR estimates (95%CI); \* linear trend test with p<0.05.

<sup>1</sup> O modelo foi ajustado para a diferença temporal entre a idade atual e 20 anos, frequência de atividade física, uso atual ou passado de tabaco e número de cigarros ao dia. Estimativas são RR (IC 95%); \* teste da tendência linear com valor p<0,05.

## Discussion

The analysis of incidence and persistence of obesity among the Brazilian adult population in the second half of this decade shows that: the incidence of obesity is higher for males, especially those who were

pre-obese at the age of 20; the persistence of obesity is also more common among men, especially the younger ones; for females, more years of schooling functions in relation to the group of fewer years of schooling, as a protective factor as to the incidence and persistence of obesity.

Telephone health and nutrition surveys, like VIGITEL, are always prone to information bias. However, evidence points that bias is low, when existent<sup>18,19</sup>, and may be adjusted<sup>20</sup>. Information gain to anticipate trends and surveillance of associated factors compensate for the possible uncertainties of this method.

Another aspect that presents potential bias as to the results is the estimated incidence of nutritional aspects over the information of reported weight at the age of 20. In VIGITEL, values of height, weight and obesity of the years 2008 and 2009 were compared with equivalent data obtained by the Brazilian household budget survey (POF) for people aged 20 to 23 years, and there were no differences as to the obesity average of both samples. Then anthropometric data from VIGITEL differ from their equivalents from POF, the difference is symmetric in relation to weight and height, which barely impacts estimates of obesity. In this comparison, the estimates of obesity for men was 5.8% against 4.5% for VIGITEL and POF, respectively; among women, it was 4.5% against 4.4%, respectively. The comparison between reported weight at the age of 20 by VIGITEL and the one measured in respective cohorts, analyzed in other surveys, projects a mean difference of 0.4 kg/m<sup>2</sup> to calculate BMI and 1.5% to estimate obesity. All data were estimated by the authors.

The analysis of nutritional status evolution among adults may start at different stages of life. Generally, when the stage of life to be compared is early, the analytical rigor and the quality of information are higher. In a recent systematic review of literature on the follow-up of overweight children until adulthood, Singh et al. identified 25 publications that met their minimum quality criteria; out of these, 13 could be considered as high quality. This review clearly shows that overweight children and adolescents are more prone to becoming obese adults, or remaining overweight<sup>21</sup>.

In this analysis, we chose to separate the category "overweight" in two BMI groups in order to describe the risk of obesity in

adulthood more properly. Thus, it is possible to observe that the average incidence of obesity among individuals who were obese at the age of 20 is approximately five times higher than that observed for individuals with normal BMI. Also, such incidence is more intense among younger adults. This vigorous development of the incidence of obesity also takes place in other countries: in the United States, obesity doubles from adolescence to early adulthood, and doubles again until the early 30s<sup>5</sup>. In Greece, the five year follow-up of individuals aged 18 years pointed to incidence of obesity in 22% of the men and 12% of the women who were analyzed; among individuals with normal initial BMI, the incidence was 10 and 7%, respectively<sup>7</sup>.

One of the impediments to the expansion of obesity has been the socioeconomic condition of the exposed individual, even if the income or schooling strata are more effective for females than males<sup>22,23</sup>. In this study, the gradient of obesity in relation to schooling is virtually insignificant among men and well established among women. The new information resulting from VIGITEL is the reduction in the incidence and persistence of obesity or overweight among females, especially those with more years of schooling. Thus, even women who start adulthood overweight have good chances of returning to a normal BMI.

Another relevant aspect in the analysis of VIGITEL is the information regarding the increase from relatively moderate frequencies of obesity at the end of adolescence to high frequencies in less than two decades of adult life. This information is harder to interpret and compare with trends and data from other countries. One hypothesis is that this population group has been excluded from academic studies and the focus of public policies due to its historically low frequency of obesity.

The main trends indicate that, so far, the expansion of obesity in the populations affect adults and youngsters, and one of the characteristics of countries with higher frequencies of obesity is that the increase in obesity is similar for adults and children<sup>24</sup>.

Thus, the assessment of individuals aged 15 to 29 years is relevant for the analysis of the increasing incidence and persistence of obesity in Brazil, due to their biological and social characteristics.

## Conclusion

The main trends observed in this study indicate that the incidence of obesity is more prevalent among men and young adults. Among women, schooling blocks the incidence or persistence of obesity.

When these characteristics are associated with the increased obesity among young adults, the urgency to establish more effective public policies is detected, in order to reduce the exposure of the population to an unbalanced or nutritionally poor diet, and to increase actions or programs directed to the encouragement of physical activity. Also, it is important that body weight evolution be monitored in younger individuals as they go to social apparatus such as schools and health care units.

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