# Trends in Overweight Among Adolescents Living in the Poorest and Richest Regions of Brazil

Gloria Valeria da Veiga, PhD, Adriana Simone da Cunha, MPH, and Rosely Sichieri, MD, PhD

*Objectives.* We assessed changes in body mass index (BMI) among Brazilian adolescents.

*Methods.* In 1975, 1989, and 1997, we conducted household surveys of the weights and statures of a probabilistic sample of about 50 000 Brazilian adolescents aged 10 to 19 years. Weighted prevalences were calculated and an analysis was performed with the sample design taken into account.

*Results.* Adolescents of rich (southeast) and poor (northeast) regions showed a substantial increase in BMI. In the southeast, the prevalence of overweight, defined by international age- and gender-specific BMI cutoffs, for both genders reached 17% in 1997, whereas in the northeast, the prevalence tripled, reaching 5% among boys and 12% among girls. Older girls living in urban areas in the southeast showed a decrease in prevalence from 16% to 13% in the latter 2 surveys. For all boys and for young girls, the BMI values for the 85th percentile in 1997 were much higher than the 95th percentile values in 1975.

*Conclusions.* BMI increased dramatically in Brazilian adolescents, mainly among boys; among older girls from the richest region, the prevalence of overweight is decreasing. (*Am J Public Health.* 2004;94:1544–1548)

Obesity has been increasing in prevalence in Brazil.[1] Population-based data show that obesity almost doubled among adults during the 15-year period between 1975 and 1989[2] and tripled among older children and adolescents from 1975 to 1997.[3]

Obesity acquired during adolescence tends to persist into adulthood,[4] and it is associated with risk factors for chronic diseases in later life in both developed[5,6] and developing[7] countries. There is an urgent need for a better understanding of factors associated with this emergent worldwide epidemic.[8]

Although an increase in the prevalence of overweight/obesity in adults is seen for all regions of Brazil, a more complex picture appears when trends are compared according to socioeconomic indicators and rural versus urban settings. Among adults in the more developed areas of Brazil, and among the richest women, prevalences of overweight and obesity are decreasing. Among adults, trends of increasing obesity are stronger in men than in women and in rural than in urban settings.[1] The aim of this study was to evaluate whether these differential trends of overweight by gender and socioeconomic level among adults would also be present among adolescents. Specifically, we compared changes in body mass index (BMI; defined as weight in kilograms divided by height in meters squared) and changes in prevalence of overweight during the past 20 years among Brazilian adolescents aged 10 to 19 years living in the northeast and southeast regions, which are the poorest and richest regions, respectively, in Brazil.

## METHODS

### Study Population

Three Brazilian surveys were conducted to evaluate BMI among adolescents. The earliest of these was conducted in 1974–1975 (Estudo Nacional da Despesa Familiar [ENDEF]), and the other 2 were conducted in 1989 (Pesquisa Nacional sobre Saúde e Nutrição [PNSN]) and in 1996–1997 (Pesquisa sobre Padrões de Vida [PPV]). Similar designs were used by the 3 surveys including stratification by region, random sampling of primary sample units, and systematic sampling of households within the primary sample units.[9]

The northeast and southeast regions of Brazil have different levels of development: lower and higher, respectively. They are at opposite poles as far as the production of goods and services, salary levels, income per capita, infant mortality rate, and education level, reflected in Human Development Indexes of 0.517 and 0.775, respectively.[1,10] More than two thirds of the Brazilian population live in these 2 regions.

The study population included adolescents aged 10 to 19 years from the northeast and southeast regions. Pregnant girls and those with missing anthropometric data (2386 in 1974–1975, 307 in 1989, and 418 in 1996–1997) were excluded, leaving 40 493 in ENDEF, 6469 in PNSN, and 3934 in PPV.

Weight and stature were measured in the households by trained interviewers, with the interviewee wearing light clothing and no shoes. In the 2 most recent surveys, microelectronic scales accurate to ± 100 g were used. Height was measured by means of a platform with an attached measuring bar, accurate to within 0.1 cm. Measurements were taken twice for each person. Less precise equipment was used in the first survey (mechanical scales accurate to ± 500 g and metal measuring tapes with a precision of ± 0.5 cm).

We used BMI to define *overweight* on the basis of the standard proposed by the Childhood Obesity Working Group of the International Obesity Task Force.[11] This definition is based on age- and gender-specific curves that pass through 25 kg/m$^2$ (overweight) and 30 kg/m$^2$ (obesity) at age 18. Overweight and obesity were combined because the prevalence of obesity was small.

### Statistical Analysis

All analyses were performed separately for boys and girls. Prevalences (percentages) of overweight by region (northeast or southeast) and residence area (urban or rural) were derived by individual sample weighting to accurately represent the Brazilian populations from which the samples were taken. Weighted

**TABLE 1—Weighted Prevalences of Overweight[a] Among Brazilian Adolescents Aged 10 to 19 Years, by Region (Northeast [Poorest] vs Southeast [Richest]) and Area (Rural vs Urban): Survey Data From 1975, 1989, and 1997**

| | Boys, % (SE) | | | Girls, % (SE) | | |
|---|---|---|---|---|---|---|
| | 1975 (n = 19 812) | 1989 (n = 3296) | 1997 (n = 1986) | 1975 (n = 20 681) | 1989 (n = 3173) | 1997 (n = 1948) |
| Northeast | 1.7 (0.15) | 2.6 (0.38) | 5.4 (0.82) | 4.3 (0.24) | 7.7 (0.64) | 12.4 (1.33) |
| Rural, no. | 3833 | 1004 | 353 | 3780 | 967 | 306 |
| Age group, y | | | | | | |
| 10–13 | 1.5 (0.30) | 0.8 (0.40) | 1.6 (0.96) | 2.2 (0.36) | 3.7 (0.89) | 7.2 (2.39) |
| 14–16 | 1.0 (0.31) | 3.0 (0.94) | 1.9 (1.17) | 6.9 (0.87) | 8.1 (1.65) | 10.5 (3.19) |
| 17–19 | 1.2 (0.35) | 1.8 (0.94) | 5.1 (2.36) | 6.2 (0.82) | 8.1 (1.86) | 11.4 (4.31) |
| All age groups | 1.3 (0.19) | 1.7 (0.41) | 2.6 (0.83) | 4.5 (0.37) | 6.0 (0.78) | 9.1 (1.77) |
| Urban, no. | 5167 | 805 | 754 | 5776 | 896 | 774 |
| Age group, y | | | | | | |
| 10–13 | 2.6 (0.41) | 3.4 (0.91) | 9.6 (2.29) | 3.0 (0.40) | 8.1 (1.40) | 12.5 (2.46) |
| 14–16 | 1.6 (0.41) | 2.6 (0.99) | 7.5 (2.34) | 5.3 (0.66) | 9.1 (1.79) | 12.9 (3.25) |
| 17–19 | 2.0 (0.45) | 4.2 (1.33) | 3.8 (1.47) | 4.4 (0.59) | 10.3 (1.90) | 19.2 (4.14) |
| All age groups | 2.1 (0.25) | 3.4 (0.61) | 7.4 (1.28) | 4.1 (0.31) | 9.0 (0.96) | 14.5 (1.85) |
| Southeast | 3.2 (0.20) | 7.2 (0.87) | 16.9 (1.61) | 6.8 (0.27) | 14.7 (1.26) | 17.3 (1.62) |
| Rural, no. | 2988 | 857 | 235 | 2763 | 690 | 217 |
| Age group, y | | | | | | |
| 10–13 | 1.7 (0.35) | 4.9 (1.13) | 8.0 (2.66) | 4.3 (0.62) | 12.3 (1.84) | 12.2 (3.83) |
| 14–16 | 1.2 (0.59) | 3.4 (1.14) | 16.5 (4.63) | 7.2 (1.06) | 12.0 (2.37) | 12.0 (4.09) |
| 17–19 | 2.1 (0.54) | 5.0 (1.47) | 3.1 (2.16) | 7.9 (1.10) | 15.4 (2.81) | 19.2 (5.18) |
| All age groups | 1.9 (0.27) | 4.5 (0.71) | 9.2 (1.92) | 6.0 (0.50) | 13.0 (1.30) | 14.1 (2.49) |
| Urban, no. | 7824 | 630 | 644 | 8362 | 620 | 651 |
| Age group, y | | | | | | |
| 10–13 | 4.4 (0.40) | 9.1 (1.66) | 21.0 (3.06) | 6.7 (0.50) | 13.7 (2.05) | 24.9 (3.36) |
| 14–16 | 3.7 (0.50) | 7.3 (1.93) | 14.6 (3.03) | 7.9 (0.61) | 16.1 (2.84) | 12.3 (2.67) |
| 17–19 | 3.0 (0.43) | 5.7 (1.73) | 17.1 (3.30) | 6.9 (0.56) | 16.4 (3.01) | 14.5 (2.90) |
| All age groups | 3.8 (0.26) | 7.7 (1.04) | 17.9 (1.82) | 7.1 (0.32) | 15.1 (1.46) | 17.8 (1.79) |
| Overall | 2.6 (0.13) | 5.2 (0.53) | 11.8 (0.98) | 5.8 (0.19) | 11.7 (0.76) | 15.3 (1.09) |

[a]International age- and gender-specific body mass index cutoffs.[11]

prevalences were calculated with SAS (SAS Institute Inc, Cary, NC) and SUDAAN (Research Triangle Institute, Research Triangle Park, NC). Secular trends in BMI were estimated with percentiles for each 2-year age group to lessen the effect of value fluctuations in each percentile owing to the small sample size in the last survey. Also, a smooth nonparametric trajectory was obtained with the procedure "smooth curves" in Excel (Microsoft Corporation, Redmond, WA). All statistical analyses were conducted with the individual sample weights and accounted for the effect of the sample design. The SAS procedure PROC SURVEYREG was used to evaluate trends in BMI. To account for the difference in the lag between surveys we coded the 1975 survey as 0, the 1989 survey as 14, and the 1997 survey as 22 in the modeling. We specifically tested an effect modification in the trend by age group by including in the model an interaction of survey (trend) and age. The interaction term was kept in the model when there was a significant improvement in the likelihood ratio at $P<.05$.

## RESULTS

The overall prevalence of overweight more than tripled in boys (from 2.6% to 11.8%) and more than doubled in girls (from 5.8% to 15.3%) during the period 1975 to 1997 (Table 1). Prevalences were generally higher in the southeast region, among girls, and among adolescents from urban areas. Between 1975 and 1989, a 100% increase in overweight occurred among boys and girls; between 1989 and 1997, the prevalence rose dramatically among boys (126%) and less dramatically among girls (30%). From 1975 to 1997, the prevalence of overweight increased by a factor of 3.2 in boys from the northeast and by 5.2 in boys from the southeast; corresponding factors among girls were 2.9 and 2.5 in northeast and southeast, respectively (Table 1).

From 1989 to 1997, an important reduction in the prevalence of overweight was observed among older girls residing in the urban southeast region (Table 1). A similar change was observed in BMI among these girls, as shown by a statistically significant interaction between survey (trend) and age

**TABLE 2—Regression Coefficients for Body Mass Index (kg/m$^2$) Trends Among Brazilian Adolescents Aged 10 to 19 Years, by Region (Northeast [Poorest] vs Southeast [Richest]) and Area (Rural vs Urban): Survey Data From 1975 Through 1997**

| | Northeast | | | Southeast | | |
|---|---|---|---|---|---|---|
| | β | *P* | $R^2$ | β | *P* | $R^2$ |
| **Boys** | | | | | | |
| Rural | | | | | | |
| Age group | 1.99 | <.0001 | 0.41 | 1.95 | <.0001 | 0.34 |
| Trend from 1975 to 1997 | 0.02 | <.0001 | | 0.06 | <.0001 | |
| Age group × trend | –0.12 | .065 | | 0.02 | .880 | |
| Urban | | | | | | |
| Age group | 1.46 | <.0001 | 0.30 | 1.78 | <.0001 | 0.24 |
| Trend from 1975 to 1997 | 0.08 | <.0001 | | 0.09 | <.0001 | |
| Age group × trend | 0.17 | .039 | | –0.14 | .150 | |
| **Girls** | | | | | | |
| Rural | | | | | | |
| Age group | 2.27 | <.0001 | 0.33 | 2.22 | <.0001 | 0.30 |
| Trend from 1975 to 1997 | 0.03 | .0001 | | 0.050 | <.0001 | |
| Age group × trend | 0.01 | .913 | | 0.12 | .325 | |
| Urban | | | | | | |
| Age group | 1.950 | <.0001 | 0.25 | 0.97 | <.0001 | 0.17 |
| Trend from 1975 to 1997 | 0.058 | <.0001 | | 0.12 | <.0001 | |
| Age group × trend | –0.03 | .738 | | 0.34 | .001 | |

group (Table 2). For boys living in northeast urban areas, this interaction between surveys and age group was also statistically significant but the magnitudes of prevalence and changes in BMI were much lower (Table 2).

Comparisons of trends in BMI during 1975–1997 are plotted in Figure 1. We observed a slight difference in the lowest percentiles for both regions and both genders. Among boys, differences in the 5th percentile varied from 0.40 kg/m$^2$ for those aged 10 to 13 years to around 0.80 kg/m$^2$ for those aged 14 years and older in the northeast. The difference was smaller in the southeast region and among girls. The largest change was observed in the percentiles above median values both boys and girls. In the southeast region, differences in the median varied from 0.95 kg/m$^2$ at 11 years to 2.64 kg/m$^2$ at 12 years for boys and from 1.99 kg/m$^2$ at 10 years to 0.24 kg/m$^2$ at 14 years for girls. In this region, young girls showed a higher increase in BMI than did older girls. Among boys, the BMI values for the 85th percentile in 1997 were higher than the 95th percentile BMI values in 1975; the same was true for young girls. Among girls, the differences in the 95th percentile between the 2 surveys were about 5 units for those aged 10 to 12 years and about 3 units for those aged 13 years and older. These differences in the 95th percentile were smaller in the northeast, where the 1997 BMI was found to be about 3 units higher than the 1975 BMI for all age groups.

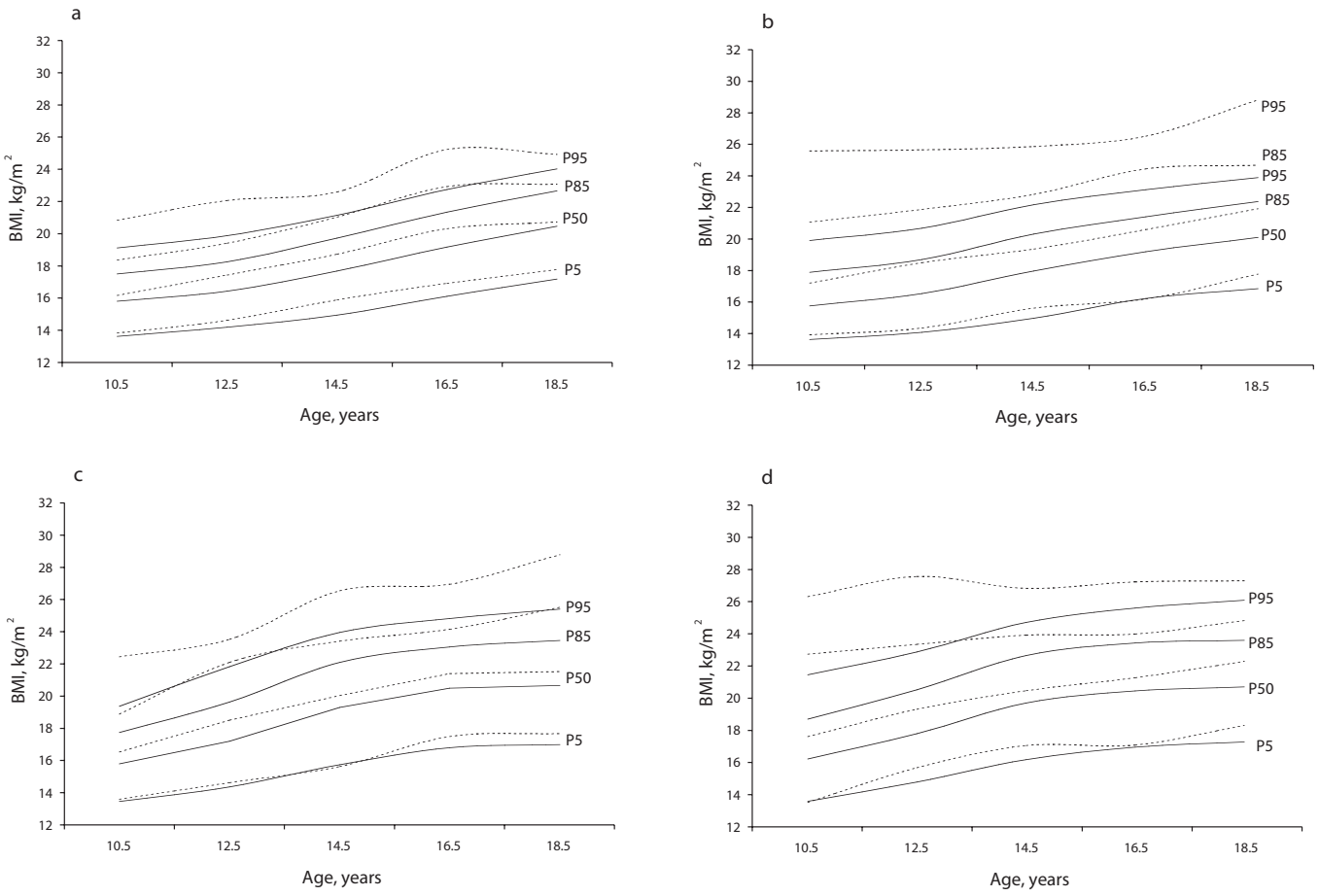
## DISCUSSION

With data from surveys conducted in Brazil during the past 3 decades, we compared trends in overweight among adolescents living in regions with opposite levels of development[1–10] that together contain more than three quarters of the Brazilian population. The nationwide prevalence rate of overweight in adolescents in the 1989 survey (7.7%)[10] was quite similar to the prevalence in our study (7.1%), which included only the southeast and northeast regions. During the period between 1974 and 1989, the significant rise in prevalence of overweight among adolescents followed trends previously identified among adults[1] and elderly persons[12]; however, the 100% increase among adolescents was higher than that observed among adults (approximately 80%) and much higher than that observed among elderly persons approximately 60%).[1,12]

The greater increase in overweight among boys compared with that among girls observed in the present study is in line with results found in Finland[13] and Canada.[14] The prevalence of overweight observed in the 1997 survey was lower than the prevalences reported in the 1990s for Spain (18.1%),[15] the United States (25%),[16] and Canada (26.7%–33%).[14] Prevalence rates for Brazilian girls were similar to those reported for Australian girls (15.8%)[17] and higher than those reported for Finnish girls (9.8%)[13] in a report using the same overweight classification criteria we used. The increase in obesity rates in both developed and developing countries has been attributed to lack of physical activity and dietary changes.[18] The traditional Brazilian diet, characterized by rice and beans, was associated with a lower risk of overweight/obesity in adults living in Rio de Janeiro,[19] but lately consumption of beans has decreased, as shown by comparing surveys in 1975 and 1989.[19] Also, population-based data on physical activity among Brazilian youths indicate that they spend long periods watching television,[20] with less than 20% of adolescents reporting weekly leisure-time physical activity.[21,22]

We found a downward trend in prevalence of overweight among older female adolescents living in the urban southeast, in agreement with findings for obesity among Brazilian women in the high-income quartile from the southeast.[1] Between 1992 and 1998, a downward trend in BMI among adolescents also occurred in Russia at all levels of per capita household income, but whereas in Russia the decrease in overweight was followed by an increase in the prevalence of underweight, the prevalence of underweight in Brazil is very low and is declining.[3]

The higher level of industrial development and better life conditions in the southeast region of Brazil allow greater access to obesogenic foods but also permit greater access to information, frequently through the media, on how to protect against obesity.[1] Indeed, an adequate level of schooling among Brazilian youths appears to protect them against obesity.[10]




*Note*. Solid lines indicate 1975; dotted lines indicate 1997. Percentiles indicated with "P."

**FIGURE 1—Trends in body mass index (BMI) for 5th, 50th, 85th, and 95th percentiles among adolescents aged 10 to 19 years living in the poorest and richest regions in 2 Brazilian surveys: (a) boys in the Northeast, (b) boys in the Southeast, (c) girls in the Northeast, and (d) girls in the Southeast.**

We have yet to explain the differences between the results for boys and girls, particularly in regard to the dramatic increase in overweight among boys from the urban southeast regions. A possible explanation for the discrepancy may be the high concern with aesthetics and the current standard of beauty that places excessive value on slimness, an ideal affecting girls more than boys, and older girls in particular.[23,24] We have shown that school-age adolescent girls restrict their dietary intake and skip meals to become slimmer.[20]

Evaluation of the increase in mean values and in the distribution of BMI over time may be an attractive alternative to comparisons of prevalence in terms of assessing changes in the nutritional situation of a population, avoiding potential short-term fluctuations in rates of overweight, because these may vary according to the criteria used to define the problem—particularly in the context of adolescence, where these criteria are controversial. The rate of increase in BMI in our study was greater than the rates observed in developed countries. For example, the median BMI increase among boys from the urban southeast between 1974 and 1997 was approximately 2.0 kg/m$^2$ (Figure 1), compared with 1.4 kg/m$^2$ among Swedish teenagers[25] and Danish young men[26] during a period of similar duration.

Comparing the BMI in the 1975 survey with that in the most recent survey (1997), we observed that the highest increase occurred at the upper limits of the distribution, with smaller differences at the lower limits. These findings were similar to findings from other countries,[13,27–30] but the large difference observed in the median values in Brazil was not observed in other countries. The differences in BMI values for the higher percentiles are much greater than the BMI differences reported for Belgian teenagers in 1969–1996, which did not exceed 2.7 kg/m$^2$ for the 95th percentile.[30]

Compared with data for youths in Belgium and the United States, for a period of about 20 years, data for Brazilian adolescents are closer to those for American teenagers;

indeed, the difference was actually a little greater for boys from the southeast, among whom the increase at the 95th percentile varied from 2.9 to 7.4 BMI units, whereas the variation for both genders among American adolescents was from 2 to 6 BMI units.[27]

The prevalence data and trends in BMI values suggest not only that the prevalence of overweight is increasing among Brazilian adolescents but also that the heaviest individuals are becoming even heavier. Boys across all age groups and the youngest girls from the southeast region seem to be most vulnerable to this process. The high rates of overweight in the northeast among both genders raise concerns about the poorest region.

In conclusion, overweight increased dramatically among Brazilian adolescents between 1974 and 1975 and between 1996 and 1997, affecting to a different extent 2 regions studied, genders, and even age groups within same gender. Changes were concentrated not only in higher BMI values, as in other countries, but also in median values, suggesting that the problem is affecting the entire population. Considering the adverse health effects of obesity both in adolescence and in adult life, the upward trend in this nutritional disorder in the 2 most populous regions of the country underlines the need to develop strategies for prevention and control. However, the trend toward a reduction in overweight among adolescents older than 14 years living in the urban southeast highlights the need for a more detailed investigation of the factors that might curb the epidemic of obesity. ■

## About the Authors

*Gloria Valeria da Veiga is with the Department of Nutrition, Federal University of Rio de Janeiro, and Andriana Simone da Cunha and Rosely Sichieri are with the Department of Epidemiology, State University of Rio de Janeiro, Rio de Janeiro, Brazil.*

*Requests for reprints should be sent to Gloria Valeria da Veiga, Instituto de Nutrição, Universidade Federal do Rio de Janeiro, Ave Brigadeiro Trompowisky, s/n CCS, Bloco J, 2 andar, Ilha do Fundão, Rio de Janeiro, RJ, Brazil, CEP 21941–590 (e-mail: gvveiga@gbl.com.br).*

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## Contributors

G.V. da Veiga originated the study, interpreted the results, and led the writing. A.S. da Cunha assisted with data management and data analyses. R. Sichieri supervised all aspects of analysis and interpretation of the data.

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## Human Participant Protection

The Brazilian national surveys analyzed were conducted before the approval of Brazilian Resolution 196, which established the requirement of informed consent for surveys. Local institutional review board approval was not sought, because this study was a secondary analysis of publicly available data sets.

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