

Income-Specific Trends in Obesity in Brazil: 1975–2003

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A landmark review of cross-sectional studies on socioeconomic status (SES) and obesity that had been published before 1989 concluded that obesity was essentially a disease of the socioeconomic elite in developing societies, in contrast to the situation in developed societies, where obesity was more common among the poor than among the rich.¹ However, a review of recent studies revealed a much more complex picture of the relationship between SES and obesity in the developing world.² Most new studies still indicate a positive association between high SES and obesity among males from developing countries, although there are indications that as a country's gross national product increases, lower-SES groups tend to lose their protection against obesity.

Among women, the predominant feature of the newer studies conducted in developing countries is an inverse relationship between high SES and obesity, with indications that the relative excess of obesity among lower SES groups tends to increase with increases in a country's gross national product. In conjunction with this finding, a joint analysis of national cross-sectional data gathered on women of reproductive ages from 37 developing countries showed that the association between obesity and SES is substantially modified by a country's gross national product. A gross national product of \$2500 per capita has been shown to be the trigger level at which obesity begins to be more common among the poor than among the rich.³ Although recent studies indicate that in the developing world the burden of obesity could be shifting toward the poor, this hypothesis can be directly tested only through comparisons of time trends in obesity in different socioeconomic groups of a single population.

Brazil is one of the few developing countries that has conducted repeated cross-sectional, population-based surveys enabling comparisons of secular changes in obesity

Objectives. We sought to update income-specific secular trends in obesity in Brazil to assess the hypothesis that the disease burden is shifting toward the poor.

Methods. We compared overall and income-specific obesity prevalence rates estimated for Brazilian men and women from national surveys conducted in 1975, 1989, and 2003. We calculated age-adjusted prevalence ratios to assess time trends.

Results. In the first 14-year period examined (1975–1989), obesity rates among men and women increased by 92% and 63%, respectively, and increases were relatively higher among individuals in lower income groups. In the second 14-year period (1989–2003), there were further increases in obesity among men, and again increases were larger among the poor. In this second period, the obesity rate remained virtually stable in the overall female population, but it increased by 26% among women in the 2 lower income quintiles and decreased by 10% among women in the 3 higher income quintiles.

Conclusions. The burden of obesity is shifting toward the poor and can no longer be considered a disease of the socioeconomic elite. Policymakers need to design policy and programs that reach all members of society, but especially the poor. (*Am J Public Health.* 2007;97:1808–1812. doi:10.2105/AJPH.2006.099630)

patterns among different socioeconomic groups. An earlier study focusing on national anthropometric surveys conducted in Brazil in 1974–1975 and 1989 revealed increasing obesity prevalence rates among both men and women in all income groups, with relatively higher increases among women in low-income groups.⁴

A subsequent study that included data from a subnational survey conducted in 1996–1997 identified a clear shift in obesity from high-income women toward low-income women living in urban areas. This shift resulted from continuous increases in obesity among the urban poor and unprecedented declines among high-income groups.^{5,6} The existence of a third national anthropometric survey, conducted in 2002–2003 with a random sample of more than 48 000 Brazilian households, allows secular trends in obesity to be updated with a particular emphasis on differences between low- and high-income families. Our primary goal in this study was to update income-specific trends in obesity in Brazil.

METHODS

Study Populations and Sampling

The data analyzed in this study were derived from 3 national surveys undertaken in

Brazil from (1) August 1974 to August 1975 (“Estudo Nacional sobre Despesa Familiar” [National Study on Family Expenditures]), (2) June to September 1989 (“Pesquisa Nacional sobre Saúde e Nutrição” [National Survey on Health and Nutrition]), and (3) July 2002 to June 2003 (“Pesquisa de Orçamentos Familiares” [National Household Budget Survey]). The Instituto Brasileiro de Geografia e Estatística, the federal agency in charge of national statistics in Brazil, used similar multistage, stratified clustering sampling procedures in conducting the 3 surveys.^{5,7}

The 3 surveys (hereafter referred as the 1975, 1989, and 2003 surveys) sampled 53 311, 14 458, and 48 470 households, respectively. Although anthropometric data were collected for all household members in each of the surveys, we restricted our analyses to the samples of adults aged 20 years or older. The numbers of individuals sampled in this age group, which excluded pregnant women, were 124 274 in 1975, 32 651 in 1989, and 106 809 in 2003.

Item nonresponse rates for weight or height measurements (or both) were 2.7% in 1975, 3.1% in 1989, and 7.9% in 2003; there were no major differences in nonresponse across socioeconomic groups. Another

0.4% of individuals in 1975, 0.3% in 1989, and 0.4% in 2003 were excluded from our analyses because their weight or height measurements were too low or too high (below or above 5 *z* scores from the gender-specific Centers for Disease Control and Prevention 2000 reference distribution at age 20 years).⁸ Fewer than 3% of individuals were missing data for family income in all of the surveys; no individuals were missing data on gender or age.

Data Collection

The 3 surveys used similar processes to collect the data (i.e., age, gender, weight, height, and family income) analyzed in this study. Trained teams used calibrated portable scales (mechanical in 1975 and microelectronic in 1989 and 2003) to obtain weight measurements with respondents wearing light clothes and no shoes. During height measurements, respondents did not wear shoes, and their heads were held in the Frankfort plane (the imaginary line passing through the external ear canal and across the top of the lower bone of the eye socket, immediately under the eye). Data on family income were obtained using a standardized questionnaire that covered all possible sources of income; total family income was divided by number of residents in the household to calculate data on per capita income.

Data Analysis

We first computed gender-specific estimates of mean body mass index (BMI; weight in kilograms divided by height in meters squared), prevalence rates of obesity (defined as BMI \geq 30 kg/m²), and prevalence rates of overweight and obesity in combination (defined as BMI = 25–29.9 kg/m²) for each survey. We then calculated gender-specific estimates of obesity prevalence rates for 5 socioeconomic groups within each survey. These 5 groups corresponded to quintiles of the per capita family income distribution.

As a means of assessing the direction, intensity, and statistical significance of trends in obesity in the 2 overall 14-year periods covered by the 3 surveys (1975–1989 and 1989–2003), we used Poisson regression with robust variance to calculate age-adjusted prevalence ratios.⁹ We calculated the Mantel–Haenszel χ^2 test for homogeneity to

TABLE 1—Sample Characteristics and Body Mass Index Distributions Among Adults Aged 20 Years or Older: Brazil, 1975, 1989, and 2003

Characteristic	Men			Women		
	1975	1989	2003	1975	1989	2003
Total sample, no.	57 179	15 435	44 097	62 709	15 827	49 232
Age, y, mean (SE)	40.0 (0.14)	40.3 (0.23)	41.0 (0.16)	40.0 (0.11)	41.2 (0.27)	42.0 (0.16)
BMI, kg/m ² , mean (SE)	22.4 (0.08)	23.5 (0.07)	24.6 (0.04)	23.0 (0.08)	24.5 (0.07)	24.7 (0.04)
BMI \geq 25 kg/m ² , % (SE)	18.0 (0.81)	29.1 (0.83)	41.0 (0.50)	27.3 (0.67)	39.9 (0.76)	39.8 (0.42)
BMI \geq 30 kg/m ² , % (SE)	2.7 (0.16)	5.1 (0.33)	8.8 (0.27)	7.4 (0.26)	12.4 (0.47)	13.0 (0.28)

Note. BMI = body mass index. BMI was calculated as weight in kilograms divided by height in meters squared.

assess statistical differences in obesity trends for each period across categories of income.¹⁰

We ran gender-specific Poisson regression models on obesity status when we found statistically significant heterogeneity across income categories. Explanatory variables included in these models were age (20–24, 25–29, 30–34, 35–44, 45–54, 55–64, \geq 65 years), SES (income quintiles), survey year (1975, 1989, 2003), and an interaction term between SES and survey year. From these models we generated predicted obesity prevalence rates, with the age distribution set to the gender-specific age distribution in the 2003 survey. We used Stata¹¹ to conduct all statistical analyses and analyses that accounted for sampling weights and design effects on standard errors (and confidence intervals [CIs]) resulting from the complex sampling methods employed in each survey.

RESULTS

Sample characteristics and BMI distributions for the 1975, 1989, and 2003 surveys are shown in Table 1. The mean BMIs of Brazilian men and women increased by 1.1 and 1.5 kg/m², respectively, from the beginning to the end of the first 14-year period assessed (i.e., the period encompassing the first 2 surveys), and obesity prevalence rates almost doubled in both genders. Also during this period, prevalence rates of overweight and obesity in combination increased by 60% among men and 50% among women. In the second 14-year period assessed (i.e., the period encompassing the second and third surveys), both mean BMIs and obesity prevalence rates continued to increase considerably

among men but only slightly among women. Prevalence rates of overweight and obesity in combination increased by 40% among men but remained unchanged among women.

Tables 2 and 3 show gender-specific obesity prevalence rates for the overall populations and for income quintiles within each of the surveys, as well as age-adjusted prevalence ratios assessing the direction, intensity, and statistical significance of trends in obesity between the beginning and end of the 2 periods (1975–1989 and 1989–2003) covered by the surveys. Obesity among men increased significantly in both periods: by 92% during 1975 to 1989 and by 70% during 1989 to 2003. Among women, obesity also increased significantly (by 63%) in the earlier period, whereas there was virtually no change in the more recent period (prevalence ratio = 1.03; 95% CI = 0.95, 1.12).

Trends in obesity risk differed according to family income in both periods assessed and among both men and women ($P < .001$ for the null hypothesis of homogeneity of trends across income categories). Among men, obesity risk increased more among those from lower-income quintiles than among those from higher-income quintiles, with prevalence ratios of 3.19 versus 1.53 in the first period and 2.50 versus 1.45 in the second period. Obesity also tended to increase more among women in lower-income quintile than among women in higher-income quintiles during the earlier period. In the more recent period, increases in obesity prevalence rates were restricted to women from the 2 lower-income quintiles (for these quintiles combined, prevalence ratio = 1.26; 95% CI = 1.11, 1.43), whereas slight declines in obesity rates were

TABLE 2—Changes Over Time in Obesity Prevalence Rates Among Men, by Income Level: Brazil, 1975, 1989, and 2003

Family Income Quintile	Obesity Prevalence Rate, %			Age-Adjusted Prevalence Ratio (95% CI)	
	1975	1989	2003	1975-1989	1989-2003
First (lowest)	0.5	1.7	4.1	3.19* (1.98, 5.15)	2.50* (1.68, 3.72)
Second	1.4	3.3	8.0	2.37 (1.64, 3.42)	2.45 (1.76, 3.42)
Third	2.2	4.6	8.6	2.10 (1.55, 2.84)	1.83 (1.36, 2.45)
Fourth	3.7	7.7	10.5	2.10 (1.70, 2.56)	1.31 (1.06, 1.62)
Fifth (highest)	5.5	8.5	12.8	1.53 (1.28, 1.82)	1.45 (1.21, 1.74)
Total	2.7	5.1	8.8	1.92 (1.62, 2.27)	1.70 (1.48, 1.95)

Note. CI = confidence interval.

* $P < .001$, for homogeneity of prevalence ratios across income quintiles.

TABLE 3—Changes Over Time in Obesity Prevalence Rates Among Women, by Income Level: Brazil, 1975, 1989, and 2003

Family Income Quintile	Obesity Prevalence Rate, %			Age-Adjusted Prevalence Ratio (95% CI)	
	1975	1989	2003	1975-1989	1989-2003 ^a
First (lowest)	2.6	8.9	11.2	3.27* (2.64, 4.06)	1.36* (1.14, 1.62)
Second	5.7	11.7	13.5	1.97 (1.65, 2.34)	1.17 (0.99, 1.39)
Third	8.8	14.8	13.5	1.65 (1.40, 1.94)	0.87 (0.73, 1.03)
Fourth	11.0	14.3	14.1	1.30 (1.10, 1.52)	0.92 (0.77, 1.10)
Fifth (highest)	8.6	12.7	11.5	1.42 (1.23, 1.65)	0.90 (0.76, 1.07)
Total	7.4	12.4	13.0	1.63 (1.47, 1.80)	1.03 (0.95, 1.12)

Note. CI = confidence interval.

^aAmong women in the 2 lowest quintiles, the age-adjusted obesity prevalence ratio between 1989 and 2003 was 1.26 (95% CI = 1.11, 1.43); among women in the 3 highest quintiles, the ratio was 0.90 (95% CI = 0.81, 0.99).

* $P < .001$, for homogeneity of prevalence ratios across income quintiles.

observed in the 3 higher-income quintiles (for these quintiles combined, prevalence ratio = 0.90; 95% CI = 0.81, 0.99).

Overall, the shifting obesity patterns in different income groups across time led to substantial changes in obesity risks among both men and women in these groups. In the case of men, the 10-times greater difference in obesity prevalence rates from the highest to the lowest income quintile that existed in 1975 (obesity rates for the 5 quintiles from lowest to highest were 0.5%, 1.4%, 2.2%, 3.7%, and 5.5%, respectively) decreased to a 3-times greater difference in 2003 (corresponding rates of 4.1%, 8.0%, 8.6%, 10.5%, and 12.8%). Among women, the “relative protection” against obesity that existed for the lowest income quintile in 1975 (only 2.6% of women vs 8.6% in the highest income quintile) was eliminated in 2003; in that year,

approximately 11% of women in both the lowest and highest income quintiles were obese.

Figure 1 displays gender-specific, age-adjusted time trends in obesity predicted by regression models taking into account significant interaction terms ($P < .001$) between income quintiles and survey years. These time trends confirm the finding that obesity among both men and women is shifting toward the poor. Analyses focusing on predicted time trends in prevalence rates of overweight and obesity in combination indicated the same results (data not shown).

DISCUSSION

Our comparison of rigorously designed national probabilistic surveys conducted with Brazil's adult population in 1975, 1989, and 2003 showed that trends in the risk of obesity

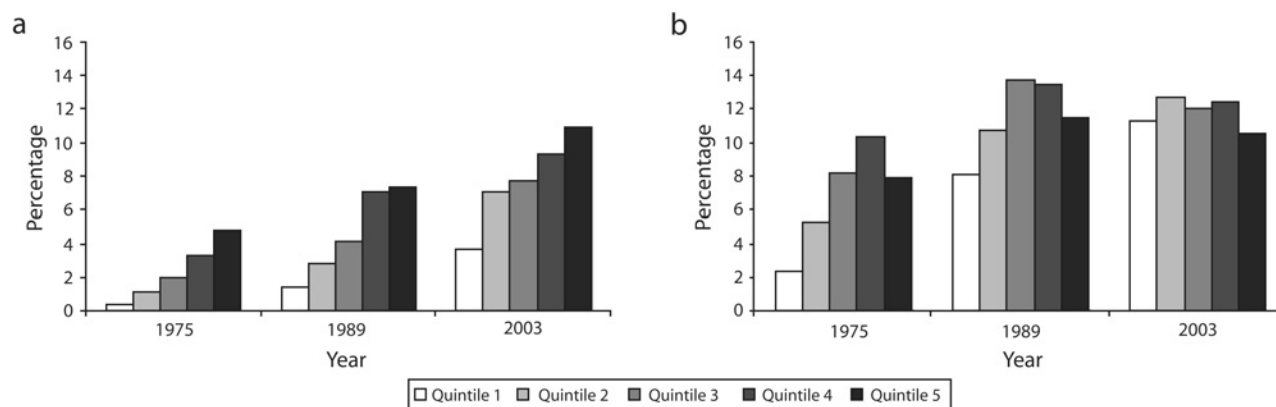
varied according to gender and SES during the periods assessed. Age-adjusted results from the 14-year period covered by the first 2 surveys (1975–1989) showed that obesity prevalence rates increased by 92% among men and 63% among women, with higher relative increases seen among individuals in lower income groups (219% increase among men and 227% increase among women).

Age-adjusted results from the 14-year period covered by the second pair of surveys (1989–2003) showed a further increase in obesity among men (70%), and again there was a larger increase (150%) among those in lower income groups. In this second period, obesity rates remained virtually stable in the adult female population as a whole. However, rates increased by 26% among women in the 2 lowest income quintiles and decreased by 10% among women in the 3 highest income quintiles. As a consequence, the relative excess of obesity that initially existed among the more affluent was attenuated among men and virtually eliminated among women during the 28-year period covered by the 3 surveys.

Relevance

The trends in obesity prevalence rates we describe are relevant for several reasons. First, our findings provide, for the first time in a developing country, solid national-level evidence that the burden of obesity is shifting toward the poor. Previous studies hypothesized that such a shift was occurring, given recent cross-sectional evidence showing a direct association between SES and obesity in lower per capita income countries and an inverse association in higher per capita income ones.^{2,3} Second, our results show that shifts in obesity toward the poor, although more accentuated among women, occur in both genders. Most previous studies examining SES and obesity in developing countries have been based on demographic health surveys, which usually do not include anthropometric measurements from male respondents.^{2,3,12,13}

Third, our findings demonstrate that, in the case of women, the shift in obesity toward the poor during 1989 to 2003 was because of both an increase in obesity among those in lower income groups and a decline among those in higher income groups. To date, with



Note. Quintile 1 was the lowest income quintile; quintile 5, the highest.

FIGURE 1—Secular trends in age-adjusted obesity prevalence rates, by income quintiles, among (a) men and (b) women: Brazil, 1975–2003.

the exception of the well-known decline in obesity among women with high levels of education from 2 provinces in Finland—a decline that was the consequence of an unprecedented comprehensive, multisectoral effort to control chronic diseases—there have been no reports of declining trends in obesity in any country.¹⁴ Furthermore, no countries have shown any ability to even slow down the rapid increases in obesity.

Underlying Determinants

In both developed and developing countries, the trend toward increased obesity has been attributed to a growing “obesogenic” environment that essentially facilitates the intake of energy-dense foods while restricting or inhibiting all activities demanding high energy expenditures.^{15,16} In Brazil, as in most developing countries, there have been—and continue to be—marked increases in urbanization and integration of the economy to global markets coupled with increased penetration of the so-called Western culture; such factors are important in determining unfavorable shifts in diet and physical activity as well as increases in the risk of obesity and other nutrition-related chronic diseases.^{17,18}

The specific determinants responsible for the higher increases in obesity among Brazilians from lower income groups are not easy to identify. Unfortunately, the country does not have reliable data to assess SES-specific secular trends in patterns of food intake and physical activity. A national household

budget survey conducted in parallel to the anthropometric survey of 2002–2003 indicated substantial differences between the dietary habits of low and high income families.¹⁹ However, these differences generally pointed to a more obesogenic diet among high income families. For instance, energy from fat represented 34% of total energy consumed in the highest income quintile, compared with 19% in the lowest income quintile; consumption of soft drinks was almost negligible among low-income families (0.41% of total calories) but represented 2.5% of the total energy intake among high-income families.¹⁹

In any case, only individual food-intake surveys repeated through time and representative of different socioeconomic groups will be able to clarify the role of diet in determining the different obesity trajectories observed among Brazilian men and women from low- and high-income groups. Patterns of leisure-time physical activity were investigated for the first time in Brazil in a study conducted in 1996–1997; the results of that study revealed that low-income individuals, both men and women, reported less physical exercise than their high-income counterparts.²⁰ However, that investigation did not consider other forms of physical activity, particularly labor-related activities, thus precluding a definitive assessment of the association between SES and physical inactivity.

Another study, restricted to the metropolitan area of Sao Paulo, investigated both

leisure-time and labor-related physical activities and showed an association between poverty and physical inactivity among women but not among men.²¹ Additional studies investigating the effects of changes in dietary and physical activity patterns on SES-specific trends in obesity are clearly needed in Brazil, as well as in other developing countries.

Trends in the educational levels of the poorer and richer segments of the Brazilian population from 1975 to 2003 could represent one explanation for the differing obesity patterns observed among the different income groups. When we analyzed education data from the 3 national surveys, we found that Brazilian adults in the lowest income quintile had completed, on average, 1.1 years of schooling in 1975, 2.0 years in 1989, and 3.6 years in 2003, whereas their counterparts in the highest income quintile had completed 6.9, 9.2, and 10.4 years of schooling, respectively.

Although the absolute increments in years of schooling were only slightly larger for the highest income quintile than for the lowest income quintile (and trends were similar for men and women), the meaning of the changes was quite different for the 2 groups. In the case of the highest income quintile, the increment in schooling showed that two thirds of individuals had completed a high school or university education in 2003, compared with one third in 1975; in the lowest income quintile, the increment in schooling essentially resulted in semiliteracy replacing

illiteracy. In a previous Brazilian study, we conducted multivariate regression analyses of income and education on obesity status and found that a higher level of formal education was a potent protector against obesity, particularly among women.²²

The education argument gains more strength if we take into account that in Brazil, as in most countries, initiatives aimed at controlling obesity are mostly based on providing information at the individual level. As reported elsewhere, since the early 1990s, the Brazilian commercial mass media has been very active in delivering messages focused on combating sedentary lifestyles and promoting better dietary habits.⁵ In addition, although poor dietary habits and physical inactivity have been the object of several pioneering governmental initiatives in Brazil, most of these initiatives still focus on motivating and informing the population, with little attention devoted to obesogenic environments.^{23,24} It is reasonable to assume that the higher-income, more educated segments of the population are in a better position to take advantage of educational initiatives provided by both nongovernmental and governmental sources than their lower-income, less educated counterparts.

Policy Implications

Regardless of its causes, the shifting of the burden of obesity toward the poor in Brazil (and presumably in other low- to middle-income and middle- to upper-income developing countries^{2,3}) has important policy implications. First, obesity can no longer be considered a disease of the socioeconomic elite. On the contrary, it must be considered a potential or real factor that reinforces the numerous health disadvantages faced by the poor, including nutritional deficiencies, infectious diseases, and maternal and perinatal conditions. Moreover, it should be noted that obesity, in addition to being a disease in its own right, substantially increases the risk of several other diseases, particularly cardiovascular diseases, type 2 diabetes, endocrine and metabolic disturbances, sleep apnea, osteoarthritis, certain types of cancer, and psychological disorders.¹⁵

Second, whereas policies and programs aiming to control the epidemic of obesity

should be designed to effectively reach members of all social classes, they should focus particularly on the poor. Finally, the slight decline in obesity prevalence rates documented here among Brazilian women in high-income groups is a positive sign that the worldwide epidemic of obesity does not have to be viewed as intractable. ■

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This article was accepted November 5, 2006.

Contributors

C.A. Monteiro led the planning of the study and the writing of the article. W.L. Conde assisted with data handling and the statistical analyses and critically reviewed all parts of the article. B.M. Popkin contributed to interpretation of results and to the writing of the article.

Acknowledgments

This research was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico-CNPq (grant 401965/2005-8) and the National Institutes of Health (grant R01-HD30880/R01-HD38700).

We thank Regina Rodrigues for administrative assistance and Bill Shapbell for editorial assistance.

Human Participation Protection

No protocol approval was needed for this study.

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