

High Temporal, Geographic, and Income Variation in Body Mass Index among Adults in Brazil

ABSTRACT

Objectives. Population-based data on body mass index for developing countries are scarce. Body mass index data from two Brazilian surveys were examined to determine regional and temporal variations in the prevalences of underweight, overweight, and obesity.

Methods. Nationwide surveys in 1974/75 and 1989 collected anthropometric data in Brazil from 55 000 and 14 455 households, respectively. Trained interviewers used the same methods to measure weight and stature in both surveys, and survey designs were identical. Prevalences of underweight, overweight, and obesity were determined for persons 18 years of age and older.

Results. In the 1989 survey, body mass index varied greatly according to region of the country, urbanization, and income. In the wealthier South, the prevalence of overweight/obesity was the highest and the prevalence of underweight was the lowest; in the poorer rural Northeast, these patterns were reversed. For both surveys, overweight/obesity was more common among women than among men and peaked at age 45 to 64 years in both sexes. Over the 15 years between surveys, the prevalence of both overweight and obesity increased strikingly.

Conclusions. In contrast to findings in developed countries, obesity in Brazil was positively associated with income and was much more prevalent among women than among men. For Brazilian women, the overall prevalence of overweight was nearly as high as that among women in the United States. (*Am J Public Health.* 1994;84:793-798)

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Introduction

Obesity is recognized as a condition characteristic of high-income societies.¹⁻³ Little is known, however, about the pattern of weight change within populations of developing countries. Increased mortality rates owing to obesity-related chronic diseases indicate that obesity may be an important risk factor in these countries,^{4,5} but population-based data are scarce. In 1974/75 and 1989, the Brazilian Institute of Geography and Statistics conducted national representative surveys that measured the weight and stature of the participants. The purpose of this report is to describe demographic variations in the prevalence of underweight, overweight, and obesity based on body mass index and to compare the increased prevalence of overweight and obesity over the 15 years between surveys with such prevalences in developed countries.

Population and Methods

Study Population

Stature and weight have been measured in two nationwide nutritional surveys in Brazil: the Estudo Nacional da Despesa Familiar,⁶ conducted in 1974/75, and the Pesquisa Nacional de Saúde e Nutrição,⁷ conducted in 1989. The first was based on a national probability sample of 55 000 Brazilian households; the second was based on a representative population sample of 14 455 households. For both surveys, samples were selected from the urban and rural districts of the five major geographical regions of the country; the only area not included was the sparsely populated rural North. For both surveys, participants' households

were selected using two-stage probability sampling. In the first stage, primary sampling units were selected from the nine major urban/rural regions of the country. In the second stage, households were sampled from the primary sampling units. Probability of selection of primary sampling units and households was proportional to the population in the nine areas. Household nonresponse for the 1989 survey was 10.8%, of which 99% was owing to failure to locate household occupants for interview and examination.

Measurement of the Variables

Stature and weight were collected in the households by two trained interviewers, with the interviewee wearing light clothes and no shoes. The scales were calibrated at each household, and for each person the measurements were taken twice. Scales were precise to 100 g. Height was measured using a platform with an attached measuring bar, precision was within 0.1 cm.

Per capita income was calculated as the preceding month's family income divided by the number of persons living on

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TABLE 1—Sample Size and Prevalence for Underweight, Overweight, and Obesity^a among Brazilian Adults Aged 18 and Older in Two National Surveys, by Sex

	Pesquisa Nacional de Saúde e Nutrição, 1989				Estudo Nacional da Despesa Familiar, 1974/75			
	Sample Size		Prevalence, %		Sample Size		Prevalence, %	
	No.	%	Men (n = 16 783)	Women (n = 17 168)	No.	%	Men (n = 63 138)	Women (n = 65 169)
Underweight (BMI < 20)	5 432	16.0	15.4	16.8	32 318	25.2	24.1	26.3
Normal weight (BMI 20–24)	17 383	51.2	57.1	45.7	68 546	53.4	58.9	47.9
Overweight (BMI 25–29)	8 318	24.5	22.5	26.4	21 416	16.7	14.4	18.9
Obesity (BMI > 30)	2 818	8.3	4.8	11.7	6 027	4.7	2.5	6.9

^aBased on body mass index (BMI), which is defined as weight in kilograms divided by height in square meters (kg/m²).

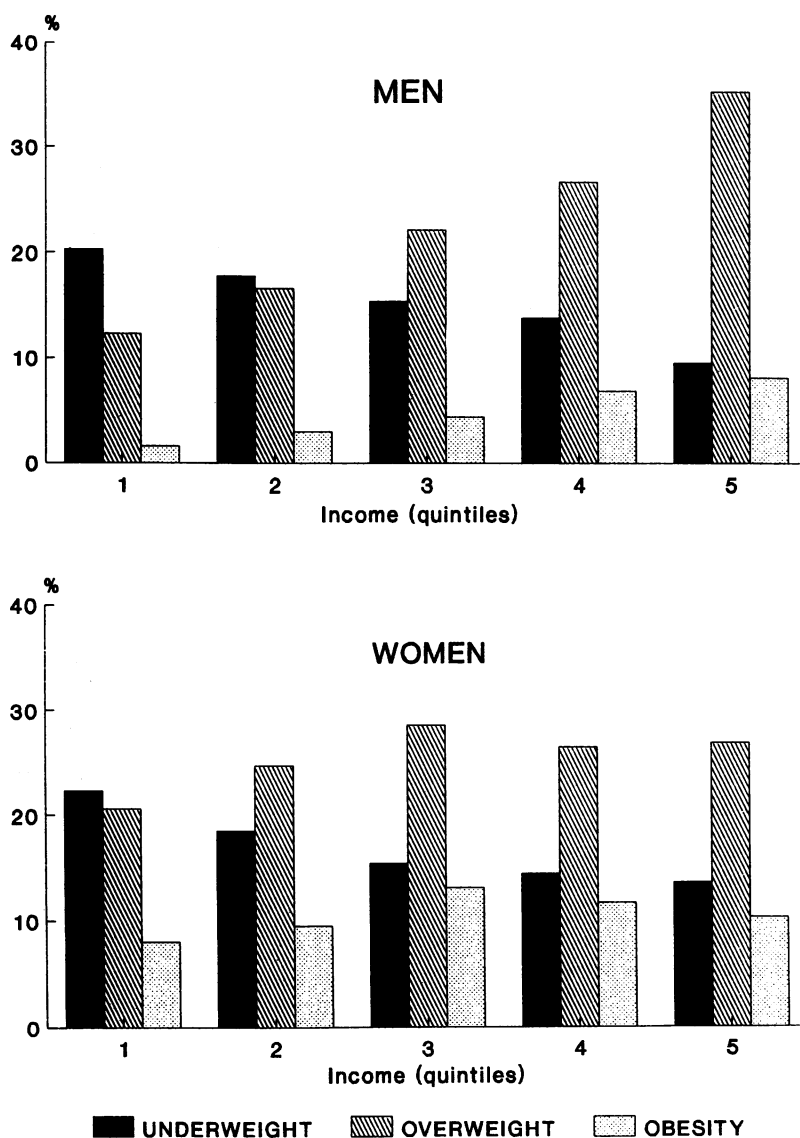


FIGURE 1—Age-adjusted prevalence (%) of underweight (body mass index [BMI] < 20 kg/m²) and overweight/obesity (BMI ≥ 25 kg/m²), by income and sex: Brazil, 1989.

that budget. Family income was categorized into quintiles and also as being above or below twice the Brazilian minimum wage per month (US \$150 in July 1989), the estimated income necessary for the survival of a family of four.

Analytical Procedures

Body mass index, defined as weight in kilograms divided by height in square meters (kg/m²), was classified according to standards of the World Health Organization (WHO)⁸ with a modification in terminology. Underweight was defined as a body mass index of less than 20 kg/m², normal weight as 20 to 24 kg/m², overweight as 25 to 30 kg/m² (WHO obesity grade 1), and obesity as above 30 kg/m² (WHO obesity grades 2 and 3). The overweight and obesity categories were combined since findings for these two categories were very similar. Persons missing data were excluded; there were 115 missing values for body mass index and 800 missing values for income in the 1989 survey.

The SUDAAN DESCRIPT procedure⁹ was used to estimate the population percentages of underweight, overweight, and obesity, age-standardized by 10-year age groups to the estimated Brazilian population in 1989. Logistic regression with RTILOGIT¹⁰ was used to examine the age, sex, and income-adjusted associations of underweight and overweight/obesity with urban or rural residence and geographic region of the country. These regions were entered in the models as four indicator variables, with the Southeast being the reference region.

Brazilian prevalence of overweight/obesity (body mass index ≥ 25 kg/m²) was compared with prevalences for Great Britain in 1980,¹¹ Canada in 1981,¹¹ and United States from 1976 to 1980.¹²

Results

Only 45.7% of women and 57.1% of men were classified as having normal weight in the 1989 survey. In the 1974/75 survey, underweight was more prevalent than overweight/obesity, but by 1989 the reverse was the case (Table 1).

Prevalence of Underweight

The overall prevalence of underweight was 16.0%, with 13 million Brazilian adults classified as underweight in 1989. Overall prevalence was slightly higher among women than among men (Table 1). For both sexes, the age-adjusted prevalence was higher in rural than in urban areas (Table 2). The highest prevalence of underweight was found in the Northeast and the lowest was in the South. For both sexes, the prevalence of underweight decreased with increasing income (Figure 1).

In the multivariate logistic regression analysis, age, income, sex, rural residence, and geographic region were significant independent risk factors for underweight (Table 3). Living in the South, living in a urban area, and being relatively affluent decreased the odds of being underweight.

Prevalence of Overweight and Obesity

The overall prevalence of overweight/obesity in 1989 was 32.8%. Women had a greater prevalence of overweight/obesity than men (Table 1). Among men, the prevalence was much higher in urban than in rural areas, whereas among women, a clearly higher urban prevalence occurred only in the Northeast and the Southeast (Table 2). Among the regions, the highest prevalence of overweight/obesity was found in the South and the lowest was in the Northeast.

Prevalence of overweight/obesity increased with income among men but did not increase beyond the third quintile of income among women (Figure 1). In the logistic regression analysis, all variables studied were significantly associated with overweight/obesity, with associations opposite to those found with underweight (Table 3). The only exception was that women were at higher risk than men of both underweight and overweight/obesity.

Trends in Body Mass Index in Brazil

The trend for the 15-year period studied was a striking reduction in the prevalence of underweight and an increase in the prevalence of overweight/obesity (Figure 2). Decrease in the preva-

TABLE 2—Age-Adjusted Prevalence (%) of Underweight and Overweight/Obesity, by Regions of the Country, Urban or Rural Residence, and Sex: Brazil, 1989

Regions	Men		Women	
	Urban (n = 9291)	Rural (n = 7492)	Urban (n = 10 595)	Rural (n = 6573)
Underweight (BMI < 20 kg/m²)^a				
North	11.9	...	16.8	...
Northeast	16.5	22.7	19.1	29.0
Southeast	14.5	21.3	14.5	17.2
South	9.1	12.0	11.4	13.8
Midwest	13.4	18.4	17.8	20.9
Overweight/obesity (BMI ≥ 25 kg/m²)^a				
North	32.0	...	37.3	...
Northeast	25.4	10.3	33.8	20.7
Southeast	31.6	16.8	41.8	34.7
South	38.2	24.7	42.3	41.9
Midwest	31.5	17.9	36.2	34.2

^aBMI = body mass index.

TABLE 3—Odds Ratios^a and 95% Confidence Intervals for Underweight and Overweight/Obesity, According to Age, Income, Sex, Urban or Rural Residence, and the Five Geographic Regions of the Country: Brazil, 1989

	Underweight (BMI < 20 kg/m ²) ^b		Overweight/Obesity (BMI ≥ 25 kg/m ²) ^b	
	Odds Ratio	95% Confidence Interval	Odds Ratio	95% Confidence Interval
Age, y ^c				
20	1.87	1.12, 3.08	0.21	0.13, 0.33
40	1.03	0.85, 1.25	0.74	0.62, 0.88
50	1.00	...	1.00	...
60	1.15	0.94, 1.42	1.08	0.89, 1.31
80	2.61	1.31, 5.19	0.65	0.34, 1.23
Income (US \$100)	0.91	0.88, 0.94	1.07	1.05, 1.09
Sex (women/men)	1.38	1.29, 1.46	1.72	1.63, 1.80
Residence (urban/rural)	0.82	0.77, 0.89	1.60	1.49, 1.71
Region				
North	0.92	0.76, 1.12	0.92	0.80, 1.07
Northeast	1.13	1.05, 1.22	0.71	0.67, 0.75
Southeast	1.00	...	1.00	...
South	0.67	0.61, 0.75	1.18	1.10, 1.27
Midwest	1.02	0.90, 1.16	0.91	0.82, 1.01

^aOdds ratio for a single variable adjusted for all the other variables in the model and calculated by multiple logistic regression.

^bBMI = body mass index.

^cModel adjusted for age and age squared.

lence of underweight was about 36% for both sexes combined. For men, overweight increased by 56.3% and obesity increased by 92.0% whereas for women, the increases were less pronounced: 39.7% for overweight and 69.6% for obesity (Table 1).

International Comparisons

The overall prevalence of overweight/obesity among men in Brazil was much lower than that in some developed countries (Figure 3). However, when the analysis was restricted to Brazilian men

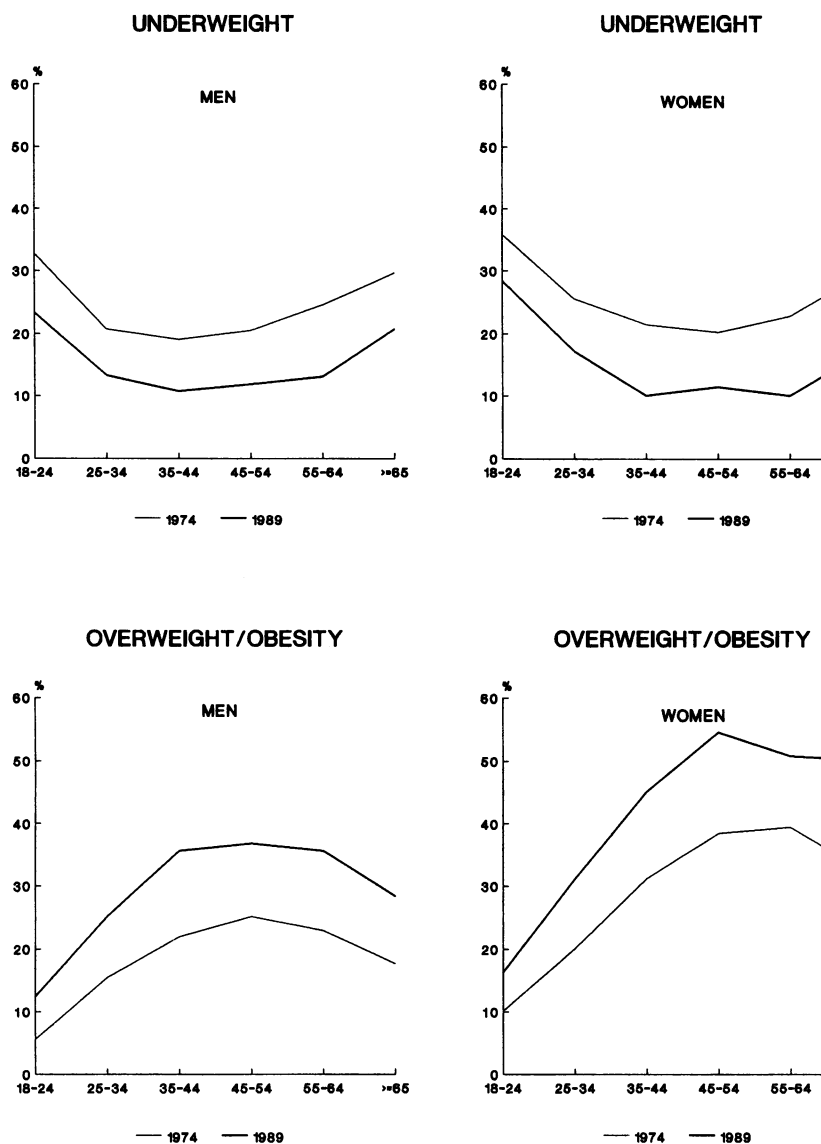


FIGURE 2—Prevalence (%) of underweight (body mass index < 20 kg/m²) and overweight/obesity (BMI ≥ 25 kg/m²) in two surveys—Estudo Nacional da Despesa Familiar, 1974/75, and Pesquisa Nacional de Saúde e Nutrição, 1989—by sex.

with family income higher than twice the Brazilian minimum wage, the prevalence of overweight/obesity was comparable to that in the other countries. Among women, the prevalence of overweight/obesity, both overall as well as among those with higher income, was comparable to that among US women and higher than that in the other countries.

Discussion

There was a striking difference in body mass index in Brazil according to sex, region, urbanization, and income.

Women were almost 2.5 times as likely as men to be obese, a degree of gender difference unobserved in developed countries (Figure 3). However, the pattern in Brazil may be changing toward that of these other countries. The prevalence of overweight/obesity increased more rapidly for men than for women between the two surveys, and the greatest increase was among young men. Also, at the highest income levels, the prevalence of overweight was more common among men than among women. These shifts toward the attributes of more developed countries raise the possibility that Brazil is

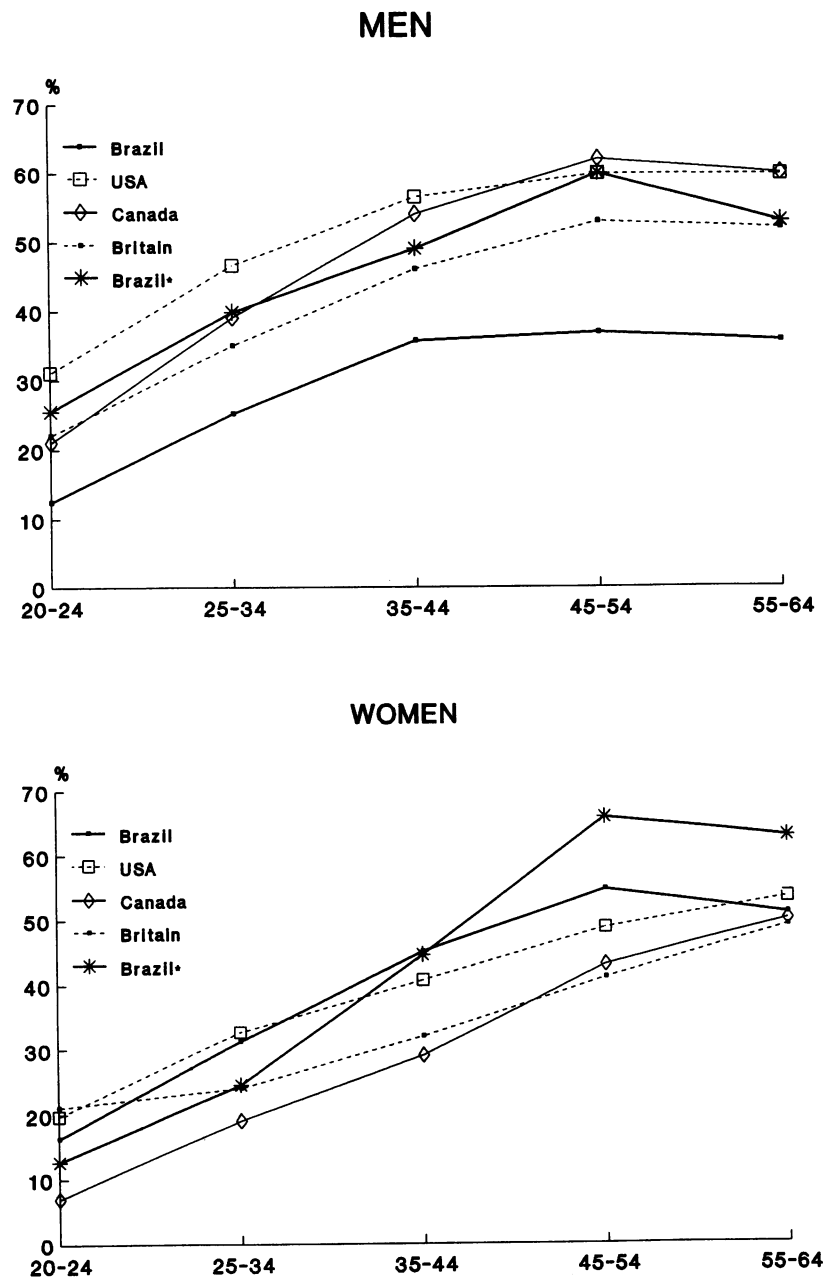
currently in the midst of changes that occurred among more economically developed countries before population-based surveys were in general use. A stepwise increase of overweight/obesity with income was observed for men, whereas other studies have found weakly positive associations.^{13,14} In contrast, a negative association between socioeconomic status and body mass index has been reported in many studies of women.¹⁵⁻¹⁷ Among Brazilian women, the prevalence of overweight/obesity was highest in the third quintile of income and slightly lower for the two higher quintiles.

Both urbanization and the more developed geographic regions in Brazil were positively associated with the prevalence of overweight/obesity and negatively associated with the prevalence of underweight, independently of income (Table 3). Additional adjustment for race did not explain these urban/rural and regional differences. Comparative data on race are not available for the 1974/75 survey.

The striking variations in body mass index by urbanization, income, and region of the country indicate that environmental factors are important determinants of obesity. Both the available supply of goods and services in urban areas and the nutritional status of the urban populations are better, as evidenced by greater mean heights among urban residents.¹⁸ Chronic malnutrition and acute diarrheal illness in areas of poorer sanitation may also have contributed to regional and urban/rural differences in underweight.

The marked increase in the prevalence of obesity in a short space of time, as shown in this study, has not been observed in developed countries.¹⁹⁻²¹ Our analysis supports the concept proposed by Price et al.²¹ in 1991 that a general improvement in environmental conditions that predisposed all individuals to obesity would shift the overall body mass index distribution to higher values. However, the recent secular trends in developed countries have shown only an increase in the overweight component of the body mass index distribution without a substantial increase in the mean or median.^{19,21}

Measures of stature and weight were carefully performed in both surveys; thus, the differences in body mass index between surveys are unlikely to be a result of inaccurate anthropometric measures. Moreover, any misclassification of body mass index would have been expected in both surveys since the measurement of weight and stature in both surveys was



Note. Brazilian curves marked with stars excluded the population below the poverty level (two minimum wages per month per family).

FIGURE 3—Prevalence (%) of overweight/obesity (body mass index ≥ 25 kg/m²) for Great Britain in 1980,¹¹ Canada in 1981,¹¹ United States from 1976 to 1980,¹² and Brazil in 1989.

very similar. Comparisons among countries also should not depend on methodological differences between surveys since all data were based on carefully measured weight and stature.

Differences in energy intake and physical activity are the obvious explanation for Brazil's rapid changes and geographic variations in the prevalence of

overweight and obesity. Dietary data collected in the 1974/75 survey show a positive relationship of mean energy intake with both body weight and income.²² Thus, part of the increase in body mass index in Brazil may be related to increased energy intake. However, even when controlling for income, a correlate of energy intake, marked urban/rural

differences in body mass index persist. Perhaps greater physical activity is a reason for the lower risk of overweight and obesity in rural areas where manual labor remains common.

The rapid increase and wide demographic variation in the prevalence of overweight/obesity in Brazil present opportunities for studying the development of this condition. Such opportunities are not available in countries with slower anthropometric changes and less distinct demographic variations. □

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Call for Abstracts for Second International Conference on Dietary Assessment Methods

The Second International Conference on Dietary Assessment Methods will be held in Boston, Mass, January 22 through 24, 1995. The conference is designed to facilitate ongoing exchange of information, stimulate national and international collaborative research, and encourage innovative approaches to improving methods for collecting and analyzing dietary data. This international exchange of knowledge and ideas will enhance our understanding of the role of diet in the etiology and prevention of disease and will facilitate the development of nutrition programs and policies leading to improved world health.

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To receive abstract submission guidelines and/or further information, please contact the Conference on Dietary Assessment Methods, Harvard School of Public Health, 677 Huntington Ave, LL 23, Boston, MA 02115-6023; tel (617) 432-1171; fax (617) 432-1969.