

# The Burden of Disease From Undernutrition and Overnutrition in Countries Undergoing Rapid Nutrition Transition: A View From Brazil

| Carlos A. Monteiro, MD, PhD, Wolney L. Conde, PhD, and Barry M. Popkin, PhD

On the basis of 3 comparable population-based surveys conducted in Brazil, we identified clear changes in the relative magnitude of women's undernutrition and overnutrition. In 1975, there were almost 2 cases of underweight to 1 case of obesity, whereas in 1997, there were more than 2 cases of obesity to 1 case of underweight. In 1997, Brazilian low-income women were significantly more susceptible than high-income women to both underweight and obesity.

The concept of *nutrition transition* encompasses major shifts in the nutritional profile of human populations directly related to modifications in dietary intake and nutrient expenditure patterns and is basically determined by an interplay of economic, demographic, environmental, and cultural changes occurring in the society.<sup>1,2</sup> Rapid

and broad changes have occurred over the last quarter of the 20th century in most developing countries, but the effect of these changes on the nutritional profile of their populations remains to be fully assessed.<sup>3,4</sup> This assessment is undertaken here with a specific focus on the adult female population of Brazil, a country undergoing rapid nutrition transition. It updates previous analyses of the nutrition transition in Brazil<sup>5,6</sup> and complements findings from a recent article focused on regional differences in the nutrition transition among children and adults in Brazil.<sup>7</sup>

## METHODS

We used data from 3 independent population-based household surveys conducted with similar sampling and data collection methodologies in the 2 most populous regions (the northeastern and the southeastern) of Brazil in 1975, 1989, and 1997.<sup>5-7</sup> Together, these 2 regions concentrate more than 70% of the total Brazilian population. The number of women (aged  $\geq 20$  years) sampled was 40 268 in 1975, 7160 in 1989, and 5137 in 1997. We used body mass index (BMI) to assess women's nutritional status,<sup>8</sup> and time-trend analyses detected changes in the prevalence of underweight (BMI  $< 18.5$  kg/m<sup>2</sup>) and obesity (BMI  $\geq 30.0$  kg/m<sup>2</sup>) between 1975 and 1989 and between 1989 and 1997. Analyses were performed for the whole sample and for the 25% low-income and the 25% high-income individuals in each survey. Prevalence estimates were age adjusted by direct standardization to the age distribution of the world population<sup>9</sup> and took into account the sampling weights and the sam-

pling design effects on standard errors resulting from the complex sample design used by each survey. The statistical significance of changes over time was assessed by comparing prevalence 95% confidence intervals in each survey and, when appropriate, describing *P* values of  $\chi^2$  tests for  $2 \times 2$  contingency tables.<sup>10</sup>

## RESULTS

Table 1 indicates that time trends in women's undernutrition and overnutrition were substantially different in the 2 periods delimited by the 3 surveys. In the earlier period (1975–1989), the prevalence of underweight was nearly halved, whereas obesity prevalence almost doubled. Similar significant decreases in underweight and increases in obesity were observed for the 25% low-income and the 25% high-income women. Both the relative excess of underweight in the low-income group and the relative excess of obesity in the high-income group remained unchanged in this first period. In the second and most recent period (1989–1997), underweight prevalence remained stable for the total population and for each income group. Obesity prevalence also was relatively stable in this second period for the entire population, but it changed strongly, and in opposite directions, when extreme income strata were considered: obesity increased from 7.9% to 12.6% ( $P < .001$ ) for the low-income women, but it decreased from 14.1% to 10.9% ( $P < .001$ ) for the high-income women.

These recent trends in women's obesity shifted radically the distribution of the disease by income group: low income (and pre-

**TABLE 1—Secular Trends in the Age-Adjusted Prevalence (% and 95% Confidence Intervals) of Underweight and Obesity in Adult Women: Brazil, 1975–1997**

| Stratum           | Underweight       |                 |                 | Obese           |                   |                   |
|-------------------|-------------------|-----------------|-----------------|-----------------|-------------------|-------------------|
|                   | 1975              | 1989            | 1997            | 1975            | 1989              | 1997              |
| 25% Poorest women | 17.1 (16.7, 17.4) | 9.7 (9.2, 10.3) | 9.5 (8.8, 10.2) | 4.7 (4.5, 4.9)  | 7.9 (7.5, 8.4)    | 12.6 (11.7, 13.4) |
| 25% Richest women | 7.0 (6.7, 7.2)    | 3.8 (3.3, 4.2)  | 3.9 (3.4, 4.3)  | 9.8 (9.5, 10.1) | 14.1 (13.3, 14.9) | 10.9 (10.2, 11.6) |
| All women         | 12.7 (12.1, 13.3) | 6.6 (5.7, 6.6)  | 6.0 (4.9, 7.1)  | 7.4 (6.9, 7.9)  | 12.3 (10.8, 13.7) | 12.7 (11.0, 14.4) |

viously high income) was in 1997 a significant risk factor for obesity. Actually, in 1997, Brazilian low-income women were significantly more susceptible than high-income women to both underweight (9.5% vs 3.9%;  $P < .001$ ) and obesity (12.6% vs 10.9%;  $P < .05$ ).

## DISCUSSION

The relative importance of women's underweight and women's obesity clearly changed throughout the surveys. In 1975, for the entire country, there were almost 2 cases of underweight to 1 case of obesity, whereas in 1997, there were more than 2 obese women to 1 underweight woman. Excessive underweight being replaced by excessive obesity also applies to the low-income group. For the high-income group, obesity was already more frequent than underweight in 1975, but the relative excess of obesity increased substantially throughout the surveys. Furthermore, the combined prevalence of underweight and obesity—a proxy of the total burden of nutritional diseases—appears larger for the low-income women in both the 1975 survey (21.8% vs 16.8%), when undernutrition was the main burden component, and the 1997 survey (22.1% vs 14.8%), when obesity leads the burden.

These results support the new Brazilian food and nutrition policy whose main goal is to promote, protect, and support eating practices and lifestyles conducive to optimum nutritional and health status for all.<sup>11</sup> They also provide relevant empirical arguments to include obesity prevention as a great priority for food and nutrition policies in countries undergoing rapid transition and to keep or even reinforce the focus of these policies on the less-privileged social classes. ■

## About the Authors

Carlos A. Monteiro and Wolney L. Conde are with the Department of Nutrition, School of Public Health, University of São Paulo and the Center for Epidemiological Studies in Health and Nutrition, São Paulo, Brazil. Barry M. Popkin is with the Department of Nutrition, School of Public Health, University of North Carolina at Chapel Hill and the Carolina Population Center, Chapel Hill.

Requests for reprints should be sent to Carlos A. Monteiro, Department of Nutrition, School of Public Health, University of São Paulo, Ave Dr Arnaldo 715, São Paulo 01246-904, Brazil (e-mail: carlosam@usp.br).

This brief was accepted May 15, 2003.

## Contributors

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

## Human Participant Protection

No protocol approval was needed for this study.

## References

1. Popkin BM. Nutritional patterns and transitions. *Popul Dev Rev*. 1993;19:138–157.
2. Caballero B, Popkin BM. Introduction. In: Caballero B, Popkin BM, eds. *The Nutrition Transition: Diet and Disease in the Developing World*. London, England: Academic Press; 2002:1–5.
3. Popkin BM. The nutrition transition and its health implications in lower income countries. *Public Health Nutr*. 1998;1:5–21.
4. Popkin BM. An overview on the nutrition transition and its health implications: the Bellagio meeting. *Public Health Nutr*. 2002;5:93–103.
5. Monteiro CA, Mondini L, Medeiros de Souza AL, Popkin BM. The nutrition transition in Brazil. *Eur J Clin Nutr*. 1995;49:105–113.
6. Monteiro CA, Benicio MHD'A, Conde WL, Popkin BM. Shifting obesity trends in Brazil. *Eur J Clin Nutr*. 2000;54:342–346.
7. Monteiro CA, Conde WL, Popkin BM. Is obesity replacing or adding to undernutrition? Evidence from different social classes in Brazil. *Public Health Nutr*. 2002;5(1A):105–112.
8. World Health Organization. *Physical Status: The Use and Interpretation of Anthropometry: Report of a WHO Expert Committee*. Geneva, Switzerland: World Health Organization; 1995. Technical Report Series, No. 854.
9. Waterhouse J, ed. *Cancer Incidence in Five Continents*. Vol 3. Lyon, France: International Agency for Research on Cancer; 1976:456.
10. Kirkwood BR. *Essentials of Medical Statistics*. Oxford, England: Blackwell Scientific Publications; 1988.
11. Coitinho D, Monteiro CA, Popkin BM: What Brazil is doing to promote healthy diets and active lifestyles. *Public Health Nutr*. 2002;5(1A): 263–268.