

The burden of hospitalization due to overweight and obesity in Brazil

Importância e custo das hospitalizações associadas ao sobrepeso e obesidade no Brasil

Rosely Sichieri ¹
Sileia do Nascimento ¹
Walmir Coutinho ²

¹ Instituto de Medicina Social, Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brasil.
² Instituto Estadual de Diabetes e Endocrinologia Luiz Capriglione, Rio de Janeiro, Brasil.

Correspondence

R. Sichieri
Instituto de Medicina Social, Universidade do Estado do Rio de Janeiro.
Rua São Francisco Xavier 524, 7^a andar, Bloco E, sala 7002, Rio de Janeiro, RJ 20550-900, Brasil.
sichieri@ims.uerj.br

Abstract

This article estimates the burden of hospitalization associated with overweight and obesity in Brazil. The analysis of all hospitalizations for men and women from 20 to 60 years of age was based on the National Healthcare Expenditure Database (SIH-SUS), covering more than 70% of all hospital admissions. Data were for the year 2001. Attributable fraction of hospitalizations associated with diseases related to obesity and overweight was based on the combined risks of United States and European cohorts. The population-attributable fraction for each disease studied was multiplied by values reimbursed to the hospitals and summed to obtain total direct costs. Overall costs of overweight and obesity represent 3.02% of total hospitalization costs for men and 5.83% for women, corresponding to 6.8 and 9.3% of all hospitalization (excluding pregnancy). Diseases associated with overweight and obesity had a significant impact on hospitalizations and economic costs in Brazil, and overall percentages were similar to those from developed countries. Since the nutritional transition is still under way in Brazil, overweight had a higher impact than obesity on disease prevalence and costs.

Obesity; Overweight; Hospitalization; Health Expenditures

Introduction

The increasing prevalence of obesity in three nationwide Brazilian surveys over the last 20 years ¹ and the high prevalence of chronic diseases associated with obesity, such as stroke ², diabetes ³, and cardiovascular diseases ⁴ suggest a significant burden of disease from overweight in the country. Monteiro et al. ⁵ identified clear changes from undernutrition to overnutrition between 1975 and 1996 in Brazil, but few studies have evaluated the implications of overweight for the national health systems of Latin America countries. A population-based survey conducted in the South of Brazil among individuals aged 20-69 years estimated that treatment for hypertension consumes approximately 23% of per capita income for hypertensive individuals ⁶. The total estimated annual cost associated with diabetes in Latin America in 2000 was US\$65,216 million ⁷, but there are no overall figures for the burden of overweight.

Economic studies on the costs of obesity in developed countries suggest that preventing weight gain may help contain the rapidly rising healthcare costs ⁸. Reviews of cost-of-illness studies on obesity indicate that the annual burden represented 5.5 to 7.8% of healthcare expenditure in the 1990s ⁹, and a more recent analysis of 10 studies reported that the burden of obesity for national health systems accounts for 5.5-7.0% of national health expenditures in

the United States and 2.0-3.5% in other developed countries¹⁰. Indeed, Sturm & Wells¹¹ and Sturm¹² reported that obesity-related morbidity is greater than that associated with smoking, drinking, or poverty in the United States.

Although the burden of obesity and associated medical conditions varies across studies, the direct monetary implications of obesity for healthcare expenditures are based on the fact that overweight and obesity are known risk factors for highly prevalent conditions such as cardiovascular diseases, hypertension, and type 2 diabetes. Indirect costs of obesity to society come from losses in productivity due to morbidity and mortality, while intangible costs include poorer health-related quality of life such as social rejection, commuting difficulties, and psychological problems.

Brazil's National Healthcare Expenditure System (SIH-SUS)¹³ covers more than 70% of all hospitalizations, but there are no longitudinal data on the risk of hospitalization or overall illness associated with obesity in the country. We thus estimated the burden of hospitalization associated with overweight and obesity, assuming that the relative risk of developing medical conditions associated with obesity and overweight in large cohorts of developed countries was similar to the risk of being hospitalized for these conditions in Brazil.

Material and methods

Design and subjects

The SIH-SUS covers 75.5% of all hospitalizations in the country according to the *National Household Sample Survey* (PNAD 1998)¹⁴. Individual records in the SIH-SUS include the main cause of hospitalization, length of stay, age, and sex. The database also includes the values reimbursed to the hospital for each cause of hospitalization or procedures. Throughout the paper these will be referred to jointly as cost of hospitalization.

Diseases used in our analysis were those with well-established epidemiological associations with obesity^{1,2,3,4}. For the year 2001 we counted all hospitalizations and all days of hospitalization with the following main three-digits diagnoses¹⁵: obesity (E66), diabetes (includes 1 and 2 as in the database) (E10 and E11), hypertension (I10), cholelithiasis (K80) and cholecystitis (K81), myocardial infarction (I21), other ischemic heart diseases (I24), stroke (I64), and colon cancer (C18), for both men and women 20 to 60 years of age. Three-digit diagnoses have greater reliability than those with four digits¹⁶.

Individuals more than 60 years of age were excluded from the analysis for three reasons: (1) Calculation of relative risk was based on middle-aged individuals from large cohorts^{17,18,19}; (2) Since obesity is a recent public health problem in Brazil, older people may still not have suffered the chronic consequences of obesity¹; and (3) With aging, overweight tends to become relatively less important as a cause of mortality²⁰.

Prevalence of obesity and overweight

Data on prevalence of obesity and overweight were based on the World Health Organization (WHO)²¹ definition and obtained from a Brazilian nationwide survey on living standards (PPV) in 1996-1997²². Body mass index (BMI) of 25-29.9kg/m² was classified as overweight and ≥ 30 kg/m² was classified as obese. The PPV is a probabilistic multistage household survey that was based on the World Bank design for the international survey on living standards. Weight and height were measured at the subject's home using standard methods.

Analytical procedures

The attributable fraction of hospitalization associated with obesity and overweight-related diseases was based on the incidence observed in large cohorts from the United States and Europe, which presented data broken down by BMI. The nurses' cohort and health professional cohort¹⁸ estimated risks were chosen preferentially when they were not far from other cohorts, because the reports from these two cohorts show a 10-year risk of developing all of the diseases we were investigating. Also, for both cohorts, risk values were presented by sex and BMI category, which allowed weighted calculations of the sex-specific relative risk of illness associated with BMI, further explained in this section. Gallstone relative risk was estimated based on NHANES I follow-up data, which is a population-based cohort from the United States¹⁷; for hypertension, the relative risks of two large studies were combined^{19,23}.

The odds ratio of the nurses' cohort and health professional cohort for diabetes, cholelithiasis and cholecystitis, colon cancer, heart disease, and stroke for both cohorts were adjusted for age, smoking, and race¹⁸, and our study transformed them into relative risks²⁴. Weighted sex-specific relative risks were averaged to estimate the overall RR for BMI ≥ 30 , using the RR for BMI 30-34.9 and BMI ≥ 35 . Weighted RR was chosen because the prevalence and relative risks showed large differences with increasing BMI. Obesity and overweight prevalence rates (P) were

obtained from the latest Brazilian survey (PPV)²². The population-attributable fraction (PAF) for obesity was computed for each disease condition, using the formula: $(P) (RR - 1) / [P (RR - 1) + 1]$ (Table 1). The PAF for each disease studied was multiplied by the total cost of the disease.

Results

Overweight prevalence was approximately 30% in both sexes, and obesity was twice as frequent in women (13%) than in men (7%). Diabetes showed the greatest population-attributable risk (PAR): 38% for overweight and 28% for obesity among men, and about 40% for both BMI categories among women. For cholelithiasis and cholecystitis, PAR was more than twice as great

for women than for men, and for both sexes the attributable risks for most diseases were greater for overweight than for obesity (Table 1).

The all-cause hospitalization rate was 4.1% in men and 4.2% in women. These values were lower than the overall hospitalization rate found in a population-based survey in the city of Rio de Janeiro in 1996²⁵ (5% for men and 5.8% for women). The main causes of hospitalization in Brazil were respiratory tract (32%), all cardiovascular (20%), digestive tract (18%), and infectious diseases (16%) (data not shown).

The estimated hospitalization rate attributable to overweight (per 100,000) was 60.7 for men and 107.2 for women; for obesity, the figures were 37.5 for men and 130.8 for women (Table 2). Total hospitalizations in Table 2 correspond to 6.8% of all admissions for men and 9.3% for women. An-

Table 1

Frequency of body mass index (BMI) (%), relative risk (RR), and weighted relative risk (WRR) for BMI categories, and population-attributable risk (PAR) for diseases associated with overweight (BMI = 25-29.9kg/m²) and obesity (BMI > 30kg/m²).

	BMI (kg/m ²)	%	Men			Women			
			RR	WRR	PAR	%	RR	WRR	PAR
Diabetes	25.0-29.9	31.88	2.9		37.85	26.19	3.9		43.08
	30.0-34.9	5.76	6.2	-	-	8.74	6.9	-	
	> 35	1.38	8.4	-	-	3.48	9.4	-	
	> 30	7.14	-	6.60	28.56	12.22		7.6	44.64
Cholelithiasis and cholecystitis	25.0-29.9	31.88	2.6	-	33.78	26.19	3.4	-	38.59
	30.0-34.9	5.76	3.0	-	-	8.74	6.9	-	-
	> 35	1.38	3.4	-	-	3.48	10.9	-	-
	> 30	7.14	-	3.08	12.93	12.22	-	8.04	46.24
Hypertension	25.0-29.9	31.88	1.9		22.29	26.19	2.0		20.75
	30.0-34.9	5.76	3.0	-	-	8.74	4.0	-	-
	> 35	1.38	7.0	-	-	3.48	9.0	-	-
	> 30	7.14	-	3.77	16.51	12.22	-	5.42	35.07
Colon cancer	25.0-29.9	31.88	1.19	-	5.71	26.19	1.19	-	4.74
	30.0-34.9	5.76	1.69	-	-	8.74	1.29	-	-
	> 35	1.38	1.29	-	-	3.48	1.8	-	-
	> 30	7.14	-	1.60	4.11	12.22	-	1.43	4.99
Myocardial infarction/ Other ischemic heart disease	25.0-29.9	31.88	1.47	-	13.03	26.19	1.4	-	9.48
	30.0-34.9	5.76	1.9	-	-	8.74	1.5	-	-
	> 35	1.38	2.1	-	-	3.48	1.5	-	-
	> 30	7.14	-	1.94	6.29	12.22	-	1.5	5.76
Stroke	25.0-29.9	31.88	1.19	-	5.71	26.19	1.19		4.74
	30.0-34.9	5.76	1.98	-		8.74	1.0		
	> 35	1.38	2.27	-		3.48	1.09		
	> 30	7.14	-	1.54	3.71	12.22	-	1.02	0.24

PAR = prevalence * (WRR - 1)/prevalence * (WRR - 1) + 1.

Table 2

Number of hospital discharges, average length of stay, and estimated rate of hospitalization attributable to overweight and obesity-related diseases in Brazil. National Healthcare Expenditure Database (SIH-SUS) ¹³.

	Men				Women			
	Number	Average length of stay (days)	Rate per 100,000 * attributable to BMI (kg/m ²)		Number	Average length (days)	Rate per 100,000 * attributable to BMI (kg/m ²)	
			25-30	> 30			25-30	> 30
Obesity	136	7.9	0.0014		516	6.8	0.0052	
Hypertension	25,841	3.9	12.51	9.26	40,925	3.6	17.21	29.09
Stroke	14,279	7.4	1.76	1.14	12,869	6.8	1.23	0.052
Myocardial infarction	12,790	7.6	3.61	1.75	5,927	7.8	0.56	0.69
Other ischemic heart disease	31,518	6.0	8.90	4.31	23,587	5.7	2.26	2.75
Diabetes	25,841	7.2	21.20	16.05	33,072	6.4	28.89	29.92
Colon cancer	1,694	10.3	0.20	0.15	1,668	9.9	0.16	0.17
Cholelithiasis and cholecystitis	17,122	4.6	12.56	4.81	72,704	4.0	56.87	68.14
Total (%) **	129,221 (6.8)	289,625	60.7	37.5	191,265 (9.3)	795,323	107.2	130.8

* Estimated population 20-60 years in 2001: men = 46,036,833; women = 49,333,157;

** All-cause hospitalization, excluding pregnancy: men = 1,902,031; women = 2,060,115.

nual workdays lost due to hospitalization attributable to overweight/obesity was estimated by multiplying average length of stay by the number of cases of disease attributable to overweight/obesity. The greatest loss was due to diabetes, and the workdays lost in 2001 totaled 289,625 for men and 795,324 for women (Table 2).

More than half of hospitalization costs were due to myocardial infarction and other ischemic heart diseases (Table 3). The largest proportion of costs was attributable to overweight for both men and women, and costs for women were greater than for men. Overall costs of overweight and obesity accounted for 3.02% (1.94 + 1.08) of total hospitalization costs in men 20-60 years of age and 5.83 % in women (Table 3).

Discussion

Although obesity is now recognized as a major public health problem in developing countries, the impact of overweight and obesity on health-care costs has not been evaluated.

Our attempt to quantify the burden of overweight/obesity in Brazil used national data on hospitalizations. Other studies have used hospitalization rates to estimate disease burden. For example, the United States National Hospital Discharge Survey data (1979-1999) were used to analyze changes in obesity-associated diseases and economic costs in youth. Diabetes, obesity,

sleep apnea, and gallbladder disease were examined to explore the trend in burden of the disease listed as primary or secondary diagnosis. During this period, the percentage of discharges with diabetes nearly doubled, obesity and gallbladder diseases tripled, and sleep apnea increased five-fold, with annual hospital costs increasing more than threefold ²⁶.

Hospitalizations were also analyzed in a population-based study in the United States, where five classifications of overweight, based on BMI, were compared for their ability to predict subsequent all-cause hospitalization and mortality. In this analysis, the WHO classification of overweight was a better predictor of 12-year hospitalization than a death predictor, with a population-attributable risk of hospitalization of 3.4% in men and 3.9% in women ²⁷.

The present study used a prevalence-based burden-of-obesity approach, assuming relative risks associated with overweight/obesity from secondary sources. A similar but hypothetical analysis for a large managed care plan in the Pacific Northwest region of the United States estimated the economic burden of diseases for which obesity is an established risk factor, such as coronary heart disease, hypertension, hypercholesterolemia, gallbladder disease, stroke, type 2 diabetes, osteoarthritis of the knee, and endometrial cancer. Results of the study, which included individuals 35 to 84 years of age, showed that obesity accounted for ap-

Table 3

Direct costs (US\$) of hospitalizations and estimated percentages attributable to overweight and obesity among adults 20 to 60 years of age in Brazil. National Healthcare Expenditure Database (SIH-SUS) ¹³.

	Total costs	Attributable to BMI (25-30kg/m ²)	%	Attributable to BMI (≥ 30kg/m ²)	%
Men					
Obesity	133,798			133,798	0.029
Hypertension	1,882,858	419,689	0.091	310,860	0.067
Stroke	3,702,265	211,399	0.045	137,354	0.030
Myocardial infarction	6,620,678	862,674	0.19	416,441	0.089
Other ischemic heart disease	35,950,673	4,684,372	1.01	2,261,297	0.49
Diabetes	4,496,611	1,701,967	0.37	1,284,232	0.28
Colon cancer	1,110,673	63,419	0.013	45,649	0.0098
Cholelithiasis and cholecystitis	3,015,804	1,018,738	0.22	389,943	0.084
All hospitalizations, excluding pregnancy	462,918,784	8,962,258	1.94	4,979,574	1.08
Women					
Obesity	442,635			442,635	0.12
Hypertension	3,127,672	648,992	0.17	1,096,874	0.29
Stroke	3,136,510	148,670	0.041	7,528	0.002
Myocardial infarction	2,869,827	272,059	0.072	165,302	0.044
Other ischemic heart disease	17,342,557	1,644,074	0.43	998,931	0.26
Diabetes	5,099,888	2,197,032	0.58	2,276,590	0.60
Colon cancer	1,021,405	48,415	0.013	50,968	0.013
Cholelithiasis and cholecystitis	14,226,119	5,489,859	1.45	6,578,157	1.74
All hospitalizations, excluding pregnancy	378,354,397	10,449,101	2.76	11,616,985	3.07

proximately 45% of all cases of hypertension, 85% of type 2 diabetes, 18% of hypercholesterolemia, and 35% of coronary heart disease, with costs attributable to obesity reaching 41% of total healthcare costs ²⁸. Our results are less striking than the estimated burden of obesity in this managed care setting, but are still substantial considering that the nutritional transition in Brazil is still under way. Obesity prevalence in Brazil is less than one-fourth that of the United States, but Brazilian surveys have shown a greater and increasing prevalence of overweight and increasing prevalence of obesity ¹. Our results thus indicate that the burden and costs associated with overweight are greater than the burden of obesity, mainly for men. Among women, costs associated with obesity and overweight were nearly the same.

Hospitalization was used as a proxy for morbidity in the present analysis, because it has the advantage of using an inclusive national database in Brazil, although also displaying important limitations. First, as shown by data on over-

all hospitalization in Rio de Janeiro, men were at lower risk than women ²⁵, but overall mortality and obesity-related mortality were higher among men ²⁹. Therefore, hospitalization rates associated with overweight/obesity among men may underestimate the burden of overweight/obesity.

Other possible limitations of the study involve the quality of the SIH-SUS data due to: (1) incorrect information registered on medical records; (2) incomplete data; (3) lack of training and unfamiliarity with coding rules among hospital employees; and (4) the fact that principal diagnoses may have been picked based on the amount of reimbursement for them ^{16,30,31}. In addition, since no data are available on relative risks based on Brazilian cohorts, attributable risks may not reflect the burden of the diseases in the country. We chose the relative risk associated with overweight and obesity from United States cohorts ¹⁸, and these values are quite similar to the Europe figures ^{19,23}. However, in the United States, obesity is less associated with mortality among blacks ²⁰ as compared to whites, an im-

portant consideration given the extensive racial admixture in Brazil.

Additionally, for several reasons, this study represents a conservative estimate of the burden associated with obesity. First, some important obesity-related diseases were not included in the database search, including several types of cancer other than colon cancer. Second, if the age range were extended beyond 60 years, a significant increase in hospitalization would be expected.

Despite these methodological limitations, our study indicates that overweight and obesity have an important impact on hospitalization in Brazil, representing a major share of total health-care costs and more than a million workdays lost in 2001.

The percentage of costs, as previously discussed, tends to be underestimated, but the Brazilian costs are still within the range observed in other studies⁸. The estimated direct cost attributable to obesity (BMI \geq 30kg/m²) in a French

national survey was 0.7 to 1.5% of total health expenditures³², and data from developed countries other than the United States indicate expenditure in the 2.0-3.5% range¹⁰, while our hospitalization data indicated that obesity-related costs accounted for at least 3% of total hospitalization costs in men and 5% in women.

In conclusion, among all hospital discharges in 2001 in Brazil, the proportion of discharges with overweight/obesity-associated diseases had a significant impact, with overweight greater than obesity. These findings may reflect the nutritional transition still under way in Latin American countries and indicate that the burden of these diseases tends to increase due to the growing prevalence and severity of obesity. Also, since the greatest increase in obesity prevalence rates has been reported among lower-income groups in the Brazilian population, the results point to an alarming scenario for the country's healthcare system in the near future.

Resumo

Os custos de hospitalização associados ao sobrepeso/obesidade e às doenças associadas no Brasil foram estimados utilizando-se os dados das hospitalizações de homens e mulheres de 20 a 60 anos do Sistema de Informações Hospitalares do Sistema Único de Saúde (SIH-SUS) para o ano de 2001. O SUS cobre mais de 70% das hospitalizações. A fração atribuível a hospitalizações associadas com obesidade/sobrepeso ou doenças relacionadas foi estimada com base na combinação dos riscos relativos de coortes americanas e européias. O custo direto total do sobrepeso/obesidade foi estimado pela soma do risco atribuível à população para cada morbidade multiplicada pelo valor de reembolso de cada morbidade. O total de custos foi equivalente a 3,02% dos custos totais de hospitalização em homens e 5,83% em mulheres, correspondendo a 6,8 e 9,3% de todas as hospitalizações (excluindo gestantes). O excesso de peso no Brasil tem um impacto nas hospitalizações e nos custos similar ao observado em países desenvolvidos. Sendo a transição nutricional um processo em andamento no Brasil, o sobrepeso teve maior impacto nos custos do que a obesidade.

Obesidade; Sobrepeso; Hospitalização; Gastos em Saúde

Contributors

R. Sichieri contributed to the project design, collecting, analyzing, and interpreting the data, and drafting the manuscript. S. Nascimento conducted the literature search and data collection, analysis, and interpretation. W. Coutinho participated in designing the project and interpreting the data.

Acknowledgments

Funding included a scholarship from the Carlos Chagas Filho Rio de Janeiro State Research Foundation and a grant from Abbott do Brazil.

References

1. Monteiro CA, Benício MHD'A, Conde WL, Popkin BM. Shifting obesity trends in Brazil. *Eur J Clin Nutr* 2000; 54:342-6.
2. Guimarães AC. Hypertension in Brazil. *J Hum Hypertens* 2002; 16 Suppl 1:S7-10.
3. Barbosa RB, Barcelo A, Machado CA. National campaign to detect suspected diabetes cases in Brazil: a preliminary report. *Rev Panam Salud Pública* 2001; 10:324-7.
4. Lotufo PA. Increasing obesity in Brazil: predicting a new peak of cardiovascular mortality. *São Paulo Med J* 2000; 118:161-2.
5. Monteiro CA, Conde WL, Popkin BM. The burden of disease from undernutrition and overnutrition in countries undergoing rapid nutrition transition: a view from Brazil. *Am J Public Health* 2004; 94:433-4.
6. Costa JSD, Fuchs SC, Olinto MTA, Gigante DP, Menezes AMB, Macedo S, et al. Cost-effectiveness of hypertension treatment: a population-based study. *São Paulo Med J* 2002; 120:100-4.
7. Barceló A, Aedo C, Rajpathak S, Robles S. The cost of diabetes in Latin America and the Caribbean. *Bull World Health Organ* 2003; 81:19-27.
8. Wolf AM, Colditz GA. The cost of obesity: the US perspective. *Pharmacoeconomics* 1994; 5 Suppl 1:34-7.
9. Kortt MA, Langley PC, Cox ER. A review of cost-of-illness studies on obesity. *Clin Ther* 1998; 20:772-9.
10. Thompson D, Wolf AM. The medical-care cost burden of obesity. *Obes Rev* 2001; 2:189-97.
11. Sturm R, Wells KB. Does obesity contribute as much to morbidity as poverty or smoking? *Public Health* 2001; 115:229-35.
12. Sturm R. The effects of obesity, smoking, and drinking on medical problems and costs. *Health Aff (Millwood)* 2002; 21:245-53.
13. Departamento de Informação e Informática do SUS. Sistema de informação hospitalar. Brasília: Ministério da Saúde; 2002.
14. Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional por Amostra de Domicílios - acesso e utilização de serviços de saúde 1998. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 1998.
15. Organização Mundial da Saúde. Classificação estatística internacional de doenças e problemas relacionados à saúde, 10ª revisão. v. 1. São Paulo: Centro Colaborador da OMS para a Classificação de Doenças em Português; 1995.
16. Veras CMT, Martins MS. A confiabilidade dos dados nos formulários de Autorização de Internação Hospitalar (AIH), Rio de Janeiro, Brasil. *Cad Saúde Pública* 1994; 10:339-55.
17. Sichieri R, Everhart JE, Roth HP. Low incidence of hospitalization with gallbladder disease among blacks in the United States. *Am J Epidemiol* 1990; 131:826-35.
18. Field AE, Coakley EH, Must A, Spadano JL, Laird N, Dietz W, et al. Impact of overweight on the risk of developing common chronic diseases during a 10-year period. *Arch Intern Med* 2001; 160:1581-6.
19. Sharabi Y, Grotto I, Huerta M, Grossman E. Susceptibility of the influence of weight on blood pressure in men versus women: lessons from a large-scale study of young adults. *Am J Hypertens* 2004; 17 (5 Pt 1):404-8.
20. Fontaine KR, Redden DT, Wang C, Westfall AO, Allison DB. Years of life lost due to obesity. *JAMA* 2003; 289:187-93.
21. World Health Organization. Obesity: preventing and managing the global epidemic. Geneva: World Health Organization; 1998. (Report of a WHO Consultation on Obesity).
22. Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional por Amostra de Domicílios - pesquisa padrões de vida (PPV) 1996-1997 [CD-ROM]. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 1998.
23. Huang Z, Willett WC, Manson JE, Rosner B, Stampfer M, Speizer FE, et al. Body weight, weight change, and risk for hypertension in women. *Ann Intern Med* 1998; 128:81-8.
24. Zhang J, Yu KF. What's the relative risk? A method for correcting the odds ratio in cohort studies of common outcomes. *JAMA* 1998; 280:1690-1.
25. Afonso FM, Sichieri R. Associação do índice de massa corporal e da relação cintura/quadril com hospitalizações em adultos do município do Rio de Janeiro - RJ. *Rev Bras Epidemiol* 2002; 5:153-63.
26. Wang G, Dietz WH. Economic burden of obesity in youths aged 6 to 17 years: 1979-1999. *Pediatrics* 2002; 109:E81.
27. Sichieri R, Everhart JE, Hubbard VS. Relative weight classifications in the assessment of underweight and overweight in the United States. *Int J Obes Relat Metab Disord* 1992; 16:303-12.
28. Oster G, Edelsberg J, O'Sullivan AK, Thompson D. The clinical and economic burden of obesity in a managed care setting. *Am J Manag Care* 2000; 6:681-9.
29. Fundação Nacional de Saúde. Sistema de informações sobre mortalidade (SIM). Brasília: Ministério da Saúde; 2002.
30. Mathias TAF, Soboll MLMS. Confiabilidade de diagnósticos nos formulários de autorização de internação hospitalar. *Rev Saúde Pública* 1998; 32:526-32.
31. Bittencourt SA, Camacho LAB, Leal MC. O Sistema de Informação Hospitalar e sua aplicação na saúde coletiva. *Cad Saúde Pública* 2006; 22:19-30.
32. Detournay B, Fagnani F, Phillippo M, Pribil C, Charles MA, Sermet C, et al. Obesity morbidity and health care costs in France: an analysis of the 1991-1992 Medical Care Household Survey. *Int J Obes Relat Metab Disord* 2000; 24:151-5.

Submitted on 09/Aug/2005

Final version resubmitted on 27/Oct/2006

Approved on 09/Jan/2007