Int J Public Health (2012) 57:127–133
DOI 10.1007/s00038-011-0262-8

ORIGINAL ARTICLE

Estimates of obesity trends in Brazil, 2006–2009

Erly Catarina Moura · Rafael Moreira Claro

Received: 17 January 2011 / Revised: 2 May 2011 / Accepted: 16 May 2011 / Published online: 26 May 2011

Abstract
Objective This study investigates the prevalence and trends of obesity among Brazilian adults, from 2006 to 2009, according to socio-demographic variables.
Methods Data from the Surveillance System of Risk and Protective Factors for Chronic Non-Communicable Diseases through Telephone Interviews (VIGITEL) from a sample of adults living in all state capitals were used. Approximately, 41,500 individuals were interviewed each year. Obesity prevalence and recent trends were estimated in the total population and according to socio-demographic variables.
Results In 2006, the obesity level reached 10.8% of adults, increasing to 13.5% in 2009. The increase in obesity was higher among women than men. For women, low levels of education and unemployment are also important factors. For men, higher obesity rate is seen among those who are young, resident of southeast region, higher educated and employed individuals.
Conclusion Despite obesity rates in Brazil not being among the highest in the world, the rapid increase in these rates, greater in women than men, demand immediate care. These findings will help to formulate strategies needed to reduce and prevent obesity.

Keywords Obesity · Adults · Epidemiology · Brazil

E. C. Moura (✉) · R. M. Claro
Center for Epidemiological Studies in Health and Nutrition, University of São Paulo (NUPENS-USP),
Av Dr Arnaldo, 715, São Paulo, SP CEP 01246-904, Brazil
e-mail: erlycm@usp.br

R. M. Claro
e-mail: rclaro@usp.br

Introduction

Obesity has reached epidemic levels in many countries worldwide and has been considered as one of the most important topics related to chronic non-communicable diseases (WHO 2004). In the last two to three decades, the prevalence of obesity has increased dramatically in developed countries such as Canada, England and the USA (Tremblay et al. 2002). A similar situation has also been experienced by developing countries. In Brazil, while data from the 1970s showed undernutrition as the main nutritional problem, obesity was still considered a minor issue (Monteiro et al. 2002). Over time, this scenario has changed dramatically, with strong reduction in undernutrition and obesity prevalence constantly growing in the Brazilian population: from 5.7% in 1974/1975 to 9.6% in 1989; and then to 11.1% in 2002/2003 (Monteiro et al. 2000; IBGE 2004).

Obesity has a great impact on health, leading to hypertension, diabetes, heart diseases and stroke (WHO 2004). Other chronic non-communicable diseases related to obesity are: certain types of cancer, liver and gallbladder diseases, sleep apnea and respiratory problems, gout, osteoarthritis and gynecological problems (abnormal menses and infertility), besides psychological and social conditions (WHO 2004). In Brazil, chronic non-communicable diseases contribute to 40% of total morbidity and 60% of total mortality (Malta et al. 2006).

Obesity is the result of a long-term exposure to a positive energy balance (WHO 2004). Epidemiological studies indicate its association with several socio-demographic factors, such as sex (female), age (oldest adults), ethnicity (immigrants), schooling (low education), income (lowest levels) and marital status (stable) (Seidell and Flegal 1997). Though these factors are not directly linked to excessive

weight gain, they may indicate populations' high risk groups, enabling effective measures to prevent and fight obesity. Thus, this detailed presentation of Brazilian data on prevalence of obesity and its trend, and the relationships studied in this paper should also be helpful for better understanding of the global growth of obesity and other risk factors for non-communicable diseases.

This article shows the recent trends (from 2006 to 2009) in obesity among Brazilian adults, living in 26 state capitals and the federal district, addressing the following questions: What is the prevalence of obesity in those years? What socio-demographic factors are associated with obesity? Is there any difference in the prevalence, trends or associations of obesity between men and women? These findings will help to identify the most susceptible groups to offer current baseline information to plan public health strategies aiming to reduce and prevent obesity in Brazil.

Methods

Data from the Surveillance System of Risk and Protective Factors for Chronic Non-Communicable Diseases through Telephone Interviews (VIGITEL) were used for this article. The VIGITEL—a population-based cross-sectional study—interviews, annually since 2006, adults aged 18 years old and over, living in residences with landline telephones in all 26 state capitals and the Federal District of Brazil. The sample size of at least 2,000 interviews in each study site was chosen to estimate with a maximum error of 2% and a 95% confidence interval any surveyed factor in each sex (Moura et al. 2009).

This study involved only adults (individual aged 18–59 years old), who were interviewed in the years 2006, 2007, 2008 and 2009. Subjects aged above 60 years old were not included to assure better reliability of the data (Luca and Moura, 2010). Pregnant women and adults who did not provide weight and/or height information were excluded. Women are more likely than men to not provide weight and height information (especially height). Lastly, the analyses were conducted based on 166,072 individuals (41,897 individuals in 2006, 41,833 in 2007, 41,631 in 2008 and 40,711 in 2009), representing more than 92% of the total number of concluded interviews.

An individual's body mass index (BMI) or the ratio of an individual's weight to height squared was used to identify obesity, based on the recommendations of the World Health Organization for adults (BMI $\geq$ 30 kg/m^2) (WHO 1995).

The co-variables used were: age (five categories according to quintiles of the population distribution: 18–24, 25–32, 33–40, 41–48 and 49–59), race (not white and white), region of residence (north, northeast, middle-west, southeast and south), level of education (three categories: 0–8, 9–11 and $\geq$12 years of study), current employment status (employed and unemployed) and conjugal status (unstable and stable).

Post-stratification weights were applied on the original data to assure representativeness of the entire adult population of each study site (aged 18–59 years old). For each sex, 15 strata representing combinations of age (18–24, 25–32, 33–40, 41–48 and 49–59 years old) and schooling (0–8, 9–11 and $\geq$12 years of study) were built. Post-stratification weights were obtained, simply by dividing the percentage of each stratum—of sex and schooling in each study site—in the reference population (obtained in the last national census, dated from 2000; no forecast of population growth, with sufficient details, was available by the time this study was concluded) by the corresponding percentage in the studied population. Additionally, a ratio of the actual number of adults living in each study site by the adults studied through VIGITEL was constructed, taking into account differences in the size of the population in the different cities. Lastly, a final component was included in the weighting factors, taking in account differences in the number of adults and landline phones in each household.

The prevalence of obesity was estimated for total population and for men and women separately, in each one of the 4 years with a confidence interval of 95%. To identify variables associated with obesity and evaluate time trends, prevalence and prevalence ratios (ratio of the prevalence of obesity in subsequent years in the 4-year series compared to that of the baseline year of 2006) were estimated according to sex for each category of each possible associated variable (independent variable). One Poisson regression model was used to estimate the prevalence ratio (with a significance level of 5%) in each of the above-mentioned situations (according to sex for each category of each possible associated variable). No further adjustment was used. Data analysis was carried out with Stata version 9.2 (StataCorp, College Station, TX, USA), considering survey's weighting factors.

The VIGITEL study was approved by the National Human Research Ethics Committee of the Brazilian Ministry of Health.

Results

Obesity reached to 10.8% in adults (11.4% among men and 10.3% among women) in 2006 rising to 13.5% in 2009 (13.9% among men and 13.2% among women) with women experiencing greater increase in the prevalence of obesity (28%) than men (22%) during this period.

For men, obesity increased with age and among those with stable conjugal status in all periods of study. There

was no difference based on race, region, schooling and employment status. From 2006 to 2009, obesity increased 1.85 times among the youngest people (18–24 years old) despite a lower initial prevalence, 1.48 times among the southeast residents, 1.25–1.29 times in those with more schooling (≥9 years of study), 1.24 times among employed individuals and 1.63 times among those with unstable conjugal status (Table 1).

For women, obesity was more common among the oldest, lowest educated, unemployed (except in 2008) and those with stable conjugal status. There was no difference based on race and region. From 2006 to 2009, obesity increased 1.40 times among women aged 25–32 years and 1.62 times among 33–40 year olds, 1.28 times among non-white women and 1.26 times among whites, 1.20 times and 1.48 times among those living in the north and northeast regions, respectively, 1.29–1.34 times in those with less schooling (≤11 years of study and quite the contrary for men), 1.23 times among unemployed women, 1.31 times among employed women, 1.34 times among those with unstable conjugal status and 1.25 times among those with a stable conjugal status (Table 2).

Discussion

The large sample of adults annually surveyed by VIGITEL during the past few years allowed a precise description of the recent trends in obesity prevalence in Brazil. Important aspects of these trends, involving its relation with socio-demographic variables of the population, are also described in detail.

The prevalence of obesity in Brazilian adults was 13.5% in 2009, less than the overall prevalence reported in Europe (17.2%) in 2008 by the International Association for the Study of Obesity, IASO (IASO 2010) and approximately half of the prevalence in the USA (approximately 26% in the years 2006, 2007 and 2008), according to data from the Behavioral Risk Factor Surveillance System (BRFSS) (NCCDPHP 2010). According to the IASO (IASO 2008), the prevalence of obesity was higher than 20% in several countries worldwide in the period from 1987 and 2008, regardless of their level of development. The countries surveyed include: Albania, Australia, Austria, Bahamas, Bahrain, Canada, Croatia, Cyprus, Czech Republic, England, French Polynesia, Germany, Greece, Israel, Kuwait, Liberia, Lithuania, Marshall Islands, Mexico, Nauru, New Zealand, Palestine, Panama, Qatar, Samoa, Saudi Arabia, Scotland, Tonga, Turkey, UK, Wales, and the Latin American countries of Chile, Guyana, Paraguay and Venezuela. In Latin America, Argentina (18.5% in 2003), Bolivia (15.0% among female in 2003), Peru (16.0% among male and 23.0% among female in 1998–2002) and Uruguay (17.0% in 1998) presented higher obesity prevalence than Brazil. In Latin America, only data from Colombia (12.3% among female in 2003) were similar to those of Brazil. Brazilian data were also similar to those of the Czech Republic, Denmark, Estonia, Finland, Guatemala, Kazakhstan, Mauritius, Portugal, Spain and Tunisia (IASO 2010).

Our data show no statistically significant difference in the prevalence of obesity between men (95% CI 12.3–15.4) and women (95% CI 12.1–14.3), representing, in 2009, 13.5% of the total adult population. This result differs from the majority of the countries listed by IASO (IASO 2010), which demonstrates a higher prevalence among women, but corroborates data from the 2003–2004 National Health Examination Survey conducted in the USA (Ogden et al. 2007) and from the 2004 Canadian Community Health Survey (Tjepkema 2007).

Brazilian data reflect the literature in terms of the association between obesity and age in adults. Recent studies have shown higher obesity prevalence among the older populations of Canada (Tjepkema 2007), England (NHS 2007), Scotland (NHS 2007) and the USA (Ogden et al. 2007). For both sexes, the prevalence of obesity becomes higher with age, affecting those between the ages of 49 and 59 years, 3.8 and 4.0 (men and women, respectively) times more than those between the ages of 18 and 24 years in 2006, and 2.4 and 3.6 times in 2009. This increase in the prevalence of obesity in the last 4 years among young men and middle-aged women explains the ratio reduction from 2006 to 2009, particularly among men.

Race does not correlate with obesity for either sex. This may be due to the high level of miscegenation in Brazil, resulting in an unclear definition of ethnicity (self-reported in VIGITEL). This differs from the USA, where race is well established and immigrants are more likely to be obese than white Americans (Ogden et al. 2007). The region of residence also does not correlate with obesity, meaning that obesity is equally spread across country.

Education and employment play a different role in each sex: for men, there is no association, while for women, greater education is negatively correlated with obesity (a 50% reduction at the highest education levels), as is employment which results in a reduction of 30%. In Canada, people with higher education were less likely to be obese than others, regardless of sex (Tjepkema 2007). Finally, a stable conjugal status is directly associated with obesity for men (2.2 times in 2006 and 1.4 in 2009) and women (1.7 and 1.6, respectively, for 2006 and 2009).

A 2004 study developed in Selangor, a prosperous state of Malaysia, which examined 891 women between the ages of 20 and 59 found 16.7% of the women to be obese, slightly more than that in our data (13.6%, 95% CI 12.2–14.4). Obesity was also associated with older age, low

Table 1 Prevalence (%) of obesity (body mass index ≥ 30 kg/m^2) among men (18–59 years old) and prevalence ratio by year of the study according to socio-demographic variables, Brazil, 2006-2009

Variables	Sample size				Prevalence (95% CI)				Prevalence ratio				*p* value
	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009	
Age (years)													
18–24	3,720	3,697	3,540	3,465	4.3 (3.1–5.5)	4.4 (3.0–5.8)	5.6 (3.5–7.7)	8.0 (4.9–11.1)	1	1.02	1.30	1.85	0.010
25–32	3,598	3,612	3,540	3,450	10.9 (8.3–13.6)	12.5 (9.9–15.1)	11.8 (8.9–14.7)	14.6 (10.3–18.9)	1	1.15	1.08	1.34	0.189
33–40	3,788	3,717	3,495	3,456	14.9 (12.7–17.1)	18.2 (15.6–20.8)	15.4 (13.0–17.9)	16.2 (13.4–18.9)	1	1.22	1.04	1.09	0.860
41–48	3,492	3,466	3,465	3,373	14.1 (12.0–16.3)	17.3 (14.7–19.9)	17.3 (14.7–20.0)	14.3 (12.1–16.5)	1	1.22	1.23	1.02	0.908
49–59	3,164	3,469	3,643	3,620	16.5 (13.9–19.2)	19.8 (16.8–22.8)	19.9 (16.8–22.9)	19.3 (16.5–22.0)	1	1.20	1.20	1.16	0.195
Race													
Non-white	10,859	11,134	11,102	11,017	11.6 (10.4–12.8)	13.2 (11.8–14.6)	12.6 (11.0–14.3)	13.8 (11.8–15.7)	1	1.14	1.09	1.19	0.105
White	6,903	6,827	6,581	6,347	11.0 (9.3–12.8)	13.9 (12.1–15.7)	13.7 (12.0–15.5)	14.1 (11.5–16.7)	1	1.26	1.25	1.28	0.062
Region													
North	5,079	5,051	5,041	4,949	14.7 (12.7–16.7)	14.4 (12.6–16.3)	12.7 (10.9–14.4)	14.9 (12.6–17.3)	1	0.98	0.86	1.02	0.928
Northeast	5,693	5,749	5,650	5,599	12.3 (10.8–13.8)	12.3 (10.8–13.8)	12.1 (10.6–13.6)	13.1 (11.2–15.1)	1	1.00	0.99	1.07	0.547
Middle-west	2,609	2,715	2,620	2,571	10.6 (8.4–12.9)	11.9 (9.8–14.1)	11.1 (9.2–12.9)	10.1 (8.4–11.9)	1	1.12	1.04	0.95	0.600
Southeast	2,472	2,547	2,455	2,408	10.3 (8.4-12.2)	14.4 (12.2-16.6)	13.9 (11.4-16.5)	15.2 (12.0-18.4)	1	1.40	1.35	1.48	0.014
South	1,909	1,899	1,917	1,837	11.3 (9.4–13.2)	12.6 (10.6–14.6)	13.9 (11.7–16.1)	12.1 (9.3–14.9)	1	1.12	1.23	1.07	0.501
Schooling (years)													
0–8	4,438	4,205	3,963	3,619	12.3 (10.5–14.0)	13.8 (11.9–15.6)	13.2 (11.0–15.3)	14.4 (11.6–17.3)	1	1.12	1.07	1.18	0.258
9–11	7,506	7,706	7,668	7,446	9.8 (8.7–10.9)	12.0 (10.7–13.4)	11.9 (10.6–13.2)	12.2 (10.8–13.7)	1	1.23	1.22	1.25	0.012
≥12	5,818	6,050	6,052	6,299	11.7 (10.0–13.3)	15.0 (13.1–16.9)	14.4 (12.4–16.4)	15.1 (13.1–17.0)	1	1.29	1.24	1.29	0.021
Job													
No	2,632	2,676	2,635	2,781	12.9 (9.4–16.4)	10.7 (8.3–13.1)	10.8 (8.4–13.2)	14.1 (10.1–18.0)	1	0.83	0.83	1.09	0.645
Yes	15,130	15,285	15,048	14,583	11.1 (10.1–12.1)	14.0 (12.8–15.2)	13.4 (12.0–14.8)	13.8 (12.1–15.5)	1	1.26	1.21	1.24	0.015
Conjugal status													
Not stable	7,638	7,758	7,893	7,728	7.1 (5.7–8.5)	9.3 (7.8–10.8)	9.0 (7.2–10.7)	11.5 (9.2–13.9)	1	1.31	1.27	1.63	0.002
Stable	10,124	10,203	9,790	9,636	15.3 (13.8–16.7)	17.1 (15.5–18.7)	16.7 (14.9–18.5)	16.0 (13.8–18.1)	1	1.12	1.09	1.05	0.674
Total	17,762	17,961	17,683	17,364	11.4	13.4	13.0	13.9	1	1.18	1.14	1.22	0.017

Weighted to represent distribution of population aged ≥18 years according to Brazil's national census for the year 2000

Table 2 Prevalence (%) of obesity (body mass index ≥ 30 kg/m^2) among women (18–59 years old) and prevalence ratio according to year of the study, Brazil, 2006–2009

Variables	Sample size				Prevalence (95% CI)				Prevalence ratio				*p* value
	2006	2007	2008	2009	2006	2007	2008	2009	2006	2007	2008	2009	
Age (years)													
18–24	4,326	4,025	3,874	3,632	4.8 (3.1–6.6)	4.4 (1.9–6.8)	4.2 (2.8–5.6)	6.0 (3.8–8.3)	1	0.90	0.87	1.25	0.447
25–32	4,919	4,752	4,714	4,531	8.3 (6.5–10.0)	9.8 (7.6–12.1)	10.7 (8.6–12.8)	11.6 (8.8–14.3)	1	1.19	1.30	1.40	0.035
33–40	5,452	5,296	5,158	4,905	9.7 (8.2–11.1)	11.0 (9.2–12.9)	13.3 (11.5–15.1)	15.7 (13.4–17.9)	1	1.14	1.37	1.62	<0.001
41–48	4,671	4,690	4,853	4,701	14.2 (11.9–16.4)	16.3 (13.8–18.8)	15.5 (13.1–17.9)	15.3 (13.1–17.4)	1	1.15	1.09	1.08	0.647
49–59	4,767	5,109	5,349	5,578	19.0 (16.5–21.4)	19.4 (17.2–21.5)	21.1 (18.7–23.4)	21.4 (19.1–23.7)	1	1.02	1.11	1.13	0.092
Race													
Non-white	13,713	13,769	14,183	13,832	10.8 (9.7–12.0)	12.4 (10.8–13.9)	11.8 (10.6–13.0)	13.8 (12.4–15.3)	1	1.14	1.09	1.28	0.005
White	10,422	10,103	9,765	9,515	9.6 (8.4–10.8)	9.7 (8.5–10.9)	12.4 (11.0–13.9)	12.1 (10.4–13.8)	1	1.01	1.30	1.26	0.002
Region													
North	6,391	6,368	6,453	6,353	10.3 (8.8–11.8)	10.4 (8.9–12.0)	13.1 (11.0–15.1)	12.3 (10.5–14.2)	1	1.01	1.27	1.20	0.023
Northeast	7,904	7,976	7,861	7,760	10.2 (9.1–11.3)	11.4 (10.2–12.7)	12.6 (11.1–14.0)	15.1 (13.2–16.9)	1	1.12	1.23	1.48	<0.001
Middle-west	3,684	3,521	3,673	3,485	9.7 (8.1–11.3)	10.6 (8.9–12.2)	12.1 (10.4–13.9)	11.8 (8.6–15.0)	1	1.09	1.25	1.22	0.146
Southeast	3,430	3,359	3,385	3,263	10.3 (8.6–12.0)	11.3 (9.2–13.4)	11.2 (9.5–12.9)	12.6 (10.6–14.5)	1	1.10	1.08	1.22	0.116
South	2,726	2,648	2,576	2,486	11.6 (9.8–13.5)	12.6 (10.1–15.0)	13.7 (11.3–16.1)	13.0 (10.9–15.1)	1	1.08	1.18	1.11	0.267
Schooling (years)													
0–8	5,367	4,876	4,768	4,284	13.4 (11.8–15.0)	14.7 (12.7–16.6)	15.8 (14.0–17.5)	17.2 (15.0–19.4)	1	1.10	1.18	1.29	0.003
9–11	10,146	10,297	10,199	9,943	7.5 (6.6–8.5)	8.6 (7.6–9.6)	8.8 (7.8–9.7)	10.1 (9.0–11.1)	1	1.14	1.17	1.34	<0.001
≥12	8,622	8,699	8,981	9,120	7.2 (6.0–8.5)	7.1 (5.9–8.2)	8.0 (6.7–9.3)	8.0 (6.9–9.1)	1	0.98	1.11	1.11	0.210
Job													
No	8,679	8,393	8,308	8,411	12.5 (11.0–14.0)	13.9 (11.9–15.9)	13.6 (11.9–15.2)	15.5 (13.5–17.5)	1	1.11	1.08	1.23	0.037
Yes	15,456	15,479	15,640	14,936	8.9 (7.8–9.9)	9.5 (8.5–10.6)	11.0 (9.9–12.1)	11.6 (10.4–12.9)	1	1.08	1.25	1.31	<0.001
Conjugal status													
Not stable	12,327	11,994	12,461	11,883	7.6 (6.7–8.6)	8.2 (7.2–9.2)	9.2 (8.1–10.2)	10.2 (8.9–11.6)	1	1.07	1.20	1.34	0.001
Stable	11,808	11,878	11,487	11,464	12.9 (11.5–14.3)	14.3 (12.5–16.0)	15.1 (13.6–16.7)	16.1 (14.4–17.8)	1	1.11	1.17	1.25	0.004
Total	24,135	23,872	23,948	23,347	12.5	14.4	13.6	15.5	1	1.09	1.17	1.28	<0.001

Weighted to represent distribution of population aged ≥18 years according to Brazil's national census for the year 2000

education and a stable conjugal status, as in this study, but not with employment status (Sidik and Rampal 2009).

In the Netherlands, the prevalence of obesity grew from 4 to 10% among men and 6 to 12% among women from 1981 to 2004 (Schokker et al. 2006). In Portugal (Santana et al. 2009), the obesity level rose from 10.3% among men and 11.4% among women to 16.0 and 16.9%, respectively, in a period of 10 years (1996–2006), an increment similar to Brazilian men, considering a smaller period of 4 years. In Canada, the prevalence of obesity increased from 13.8% (1978–1979) to 23.1% (2004), being worst among adults aged 25–34 years (Tjepkema 2007). In England, the obesity rate rose from 19% among men and 14% among women in 1994 to 29 and 25% in 2006 (Heartstats 2010). In Scotland, obesity rose from 17.5% in 1995 to 25.5% in 2003, affecting men aged 55–64 years and women 35–44 years to a greater degree (NHS 2007). In the USA (Ogden et al. 2007), obesity rose from 13.3% in 1960–1962 to 23.2% in 1988–1994 to 32.9% in 2003–2004, a clear demonstration of the severity of the obesity epidemic. This situation should be taken as a warning to countries such as Brazil, which currently has an obesity rate of 13.5%. Major increases have also been observed in Australia, an average raise of 10.1% per year from 1989 to 1999; Scotland 5.7%, Luxembourg, Finland and France over 4%, Italy over 3% and UK 2.4% (NHS 2007).

One of the limitations of this study is that weight and height information was self-reported. In this sense, a Brazilian study has shown previously good validity of obesity measurement based on self-reported data (Peixoto et al. 2006). While similar results can be found in other studies (Brunner Huber 2006; Lim et al. 2009), the general findings in validation studies of self-reported weight and height indicate that overweight participants tend to underestimate their weight, and all participants tend to overestimate their height (Rowland 1990; Palta et al. 1982; Visscher et al. 2006). A systematic review comparing direct and self-report measures use for assessing height, weight and body mass index, based on 64 studies, has also shown trends of underreporting for weight and BMI and over-reporting for height (Gorber et al. 2007), with variations in the degree of underreporting for men and women and according the characteristics of the population being examined in the original study (Gorber et al. 2007). These findings indicate that self-reported obesity prevalence might be underestimated. However, since these biases are constant across time, this type of information still allows indentifying time trends with agility, reliability and low cost. Another limitation of our study refers to the use of landline telephone interviews, since the coverage in the surveyed cities vary from 34 to 82% of total households (MS 2007). This bias is minimized with the use of post-stratification weights, as used by similar studies such as the BRFSS (NCCDPHP 2010). In this sense, it is also important to consider that the high cost, longer time needed and the territorial vastness of the country justify the use of telephone interviews instead of more traditional household surveys, especially on the investigation of short-term trends as those described by this study. It is also important to notice that the results presented in our study should be viewed with caution in the face of the fact that the narrow period of time between surveys may not have been sufficient to produce statistically detectable temporal variations.

Special attention was also taken with data analysis. Poisson regression allows robust estimations of change in prevalence over time, since it accounts both for the fluctuation across time and the variability at each time point, giving to this procedure an advantage over similar analytical approaches (such as ordinary least squares regression) that would have rendered weaker results (Rosenberg 1997).

Still, data from the Brazilian Household Budget Survey, conducted in 2008/09 by the Brazilian Institute of Geography and Statistics (IBGE), reinforce the validity of our findings. The study estimated obesity prevalence based on weight and height measurements acquired directly by trained interviewers. The results, in comparison to our study, were obtained, with obesity in 14.8% of the total adult population (age $\geq$ 20) in the country (IBGE 2010). Some level of difference was expected since our data represent only adults residing in state capitals and do not include information on the elderly population (age $\geq$ 60). Also, several of the trends verified—according to sex, schooling and age—could also be verified in our study (IBGE 2010). Once again, it is worth mentioning that previous cost comparison between face-to-face and telephone interviews in Brazil, using real survey costs, demonstrated the enormous economical advantage of the latter, which were 4.7 times cheaper per interview (Moura et al. 2008).

Our data indicate a fast increase in the prevalence of obesity in Brazil and, at this rate, in less than 10 years it may become an epidemic. Without doubt, obesity has become a significant national public health issue, exacerbating the risk for chronic non-communicable diseases and premature death and consequently increases health-care costs. Finally, our results indicate that the Brazilian government should focus their policies on men (young, from the southeast, with higher education, employed and an unstable conjugal status) and women (middle aged, from the north and northeast and with low schooling). Suggestions involve improving the environment, such as a better and cheaper access to healthier food items and to physical exercise practices, and most importantly, education campaigns about the importance of maintaining a healthy lifestyle.

Acknowledgments This work was done using secondary data from the Surveillance System of Risk and Protective Factors for Chronic Non-Communicable Diseases through Telephone Interviews (VIGITEL) of the Health Ministry, Brazil.

References

British Heart Foundation Statistics Website (Heartstats) (2010) Prevalence of overweight and obesity by sex, adults aged 16–64 years, 1986/87-2004, England, and 1995–2003, Scotland. http://www.heartstats.org. Accessed 17 December 2010

Brunner Huber LR (2006) Validity of self-reported height and weight in women of reproductive age. Matern Child Health J 11:137–144

Gorber SC, Tremblay M, Moher D, Gorber B (2007) A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. Obes Rev 8:307–326

Instituto Brasileiro de Geografia e Estatística (IBGE) (2004) Pesquisas de orçamentos familiares 2002–2003: análise da disponibilidade domiciliar de alimentos e do estado nutricional no Brasil. IBGE, Rio de Janeiro

Instituto Brasileiro de Geografia e Estatística (IBGE) (2010) Pesquisa de Orçamentos Familiares 2008/2009: Antropometria e Estado Nutricional de Crianças, Adolescentes e Adultos no Brasil. IBGE, Rio de Janeiro

International Association for the Study of Obesity (IASO) (2008) Adult overweight and obesity in the European Union (EU27). http://www.iotf.org/database/documents/AdultEU27January2010.pdf. Accessed 17 December 2010

International Association for the Study of Obesity (IASO) (2010) Global Obesity prevalence in adults. http://www.iotf.org/. Accessed 22 August 2010

Lim LLY, Seubsman S, Sleigh A (2009) Validity of self-reported weight, height, and body mass index among university students in Thailand: implications for population studies of obesity in developing countries. Popul Health Metr 7:1–8

Luca A, Moura EC (2010) Validity and reliability of self-reported weight, height and body mass index from telephone interviews. Cad Saúde Pública 26(1):110–122

Malta DC, Cezário AC, Moura L et al (2006) A construção da vigilância e prevenção das doenças crônicas não transmissíveis no contexto do Sistema Único de Saúde. Epidemiol Serv Saúde 15:47–65

Ministério da Saúde (MS) (2007) VIGITEL Brasil 2006. Vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico: estimativas sobre freqüência e distribuição sócio-demográfica de fatores de risco e proteção para doenças crônicas nas capitais dos 26 estados brasileiros e no Distrito Federal em 2006. Ministério da Saúde, Brasília

Monteiro CA, Benício MAD, Conde WL et al (2000) Shifting obesity trends in Brazil. Eur J Clin Nutr 54:342–346

Monteiro CA, Conde WL, Popkin BM (2002) Is obesity replacing or adding to undernutrition? Evidence from different social classes in Brazil. Public Health Nutr 5(1A):105–112

Moura EC, Morais Neto OL, Malta DC, Moura L, Silva NN, Bernal R, Claro RM, Monteiro CA (2008) Surveillance of risk-factors for chronic diseases through telephone interviews in 27 Brazilian cities (2006). Rev Bras Epidemiol 11 (suppl 1):20–37

Moura EC, Malta DC, Morais Neto OL et al (2009) Prevalence and social distribution of risk factors for chronic noncommunicable diseases in Brazil. Rev Panam Salud Publica 26:17–22

National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP) (2010) Behavioral risk factor surveillance system. CDC. http://www.cdc.gov/brfss/. Accessed 13 January 2011

National Health Services Scotland (NHS) (2007) Obesity in Scotland: an epidemiological briefing. NHS, Edinburgh

Ogden CL, Yanovski SZ, Carrol MD et al (2007) The epidemiology of obesity. Gastroenteroly 132:2087–2102

Palta M, Prineas RJ, Berman R, Hannan P (1982) Comparison of self-reported and measured height and weight. Am J Epidemiol 115:223–230

Peixoto MRG, Benício MHDA, Jardim PCBV (2006) Validade do peso e altura referidos: o estudo de Goiânia. Rev Saúde Pub 40:1065–1072

Rosenberg D (1997) Trend analysis and interpretation. Key concepts and methods for maternal and child health professionals. US Department of Health and Human Services/Maternal and Child Health Bureau

Rowland ML (1990) Self-reported weight and height. Am J Clin Nutr 52:1125–1133

Santana P, Santos R, Nogueira H (2009) The link between local environment and obesity: a multilevel analysis in the Lisbon metropolitan area, Portugal. Soc Sci Med 68:601–609

Schokker DF, Visscher TLS, Nooyens ACJ et al (2006) Prevalence of overweight and obesity in the Netherlands. Obes Rev 8:101–107

Seidell JC, Flegal KM (1997) Assessing obesity: classification and epidemiology. Br J Nutr 53:238–252

Sidik SM, Rampal L (2009) The prevalence and factors associated with obesity among adult women in Selangor, Malaysia. Asia Pac Fam Med 8:1–6

Tjepkema M (2007) Adult obesity in Canada: measured height and weight. (Catalogue 82-620-MWE). Statistics Canada. http://www.statcan.gc.ca/pub/82-620-m/2005001/article/adults-adultes/8060-eng.htm. Accessed 13 January 2011

Tremblay MS, Katzmarzyk PT, Willms J (2002) Temporal trends in overweight and obesity in Canada, 1981–1996. Int J Obesity 26:538–543

Visscher TL, Kroesbergen IH, Seidell JC (2006) Underreporting of BMI in adults and its effect on obesity prevalence estimations in the period 1998 to 2001. Obesity 14:2054–2063

World Health Organization (WHO) (1995) Physical status: the use and interpretation of anthropometry. WHO, Geneva

World Health Organization (WHO) (2004) WHO global strategy on diet, physical activity and health. Food Nutr Bull 25:292–302