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Ethical aspects: The VIGITEL survey was approved by the National Ethics Committee for Human Research of the Ministry of Health (CAAE: 65610017.1.0000.0008). Free and informed consent was obtained from the interviewees orally during telephone contact.

Trends of overweight and obesity prevalence among Brazilian adults: Analysis of 2006-2019 VIGITEL by capitals and Federal District

Tendência das prevalências de excesso de peso e obesidade em adultos brasileiros: análise do VIGITEL 2006-2019 por capitais e Distrito Federal

Abstract

Aim: To evaluate the trends in the prevalence of overweight and obesity among Brazilian adults in the 26 state capitals and the Federal District, obtained from national telephone surveys. ***Methods***: The prevalence of overweight and obesity was obtained from the Surveillance of Risk and Protection Factors for Chronic Diseases Through Telephone Surveys (VIGITEL) from 2006 to 2019. The prevalence for each capital and the Federal District were stratified by sex and adjusted for age. The Prais-Winsten generalized linear regression method was used. ***Results***: The overall prevalence of overweight among men increased from 47.5% in 2006 to 55.9% in 2019, and among women from 37.1% to 49.4% with an annual percent change of 2.5% and 5.1%, respectively. The prevalence of obesity in the 26 capitals and Federal District increased among men from 11.1% in 2006 to 18.5% in 2019, with an annual percent change of 7.3%, and from 11.3% to 18, 3% among women, with an annual percent change of 7.1%. The highest annual change for the prevalence of overweight was observed for women from Belém, Recife and São Paulo and the lowest for men from Macapá, Rio de Janeiro, and São Paulo. For prevalence of obesity, the highest annual change was observed among men in the Federal District, and lowest among men from São Paulo and women from Fortaleza. ***Conclusion***: Increasing trends in overweight and obesity were identified in Brazilian adults of both sexes.

Keywords: Epidemiological Surveys. Overweight. Obesity. Adults.

Resumo

Objetivo: Avaliar a tendência das prevalências de excesso de peso e obesidade em adultos brasileiros nas 26 capitais estaduais e no Distrito Federal, obtidas por meio de inquéritos telefônicos nacionais. ***Métodos***: As prevalências de excesso de peso e obesidade foram obtidas a partir dos dados do Sistema de Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico (VIGITEL) de 2006 a 2019. As prevalências para cada capital e Distrito Federal foram estratificadas por sexo e ajustadas para idade. Foi utilizado o método de regressão linear generalizada de Prais-Winsten. ***Resultados***: A prevalência geral de excesso de peso entre homens aumentou de 47,5% em 2006 para 55,9% em 2019 e entre mulheres de 37,1% para 49,4% com variação percentual anual de 2,5% e 5,1%, respectivamente. A prevalência de obesidade nas 26 capitais e no Distrito Federal aumentou entre homens de 11,1% em 2006 para 18,5% em 2019, com variação percentual anual de 7,3%, e de 11,3% para 18,3% entre mulheres, com variação percentual anual de 7,1%. A maior variação

percentual anual para a prevalência de excesso de peso foi observada para mulheres de Belém, Recife e São Paulo, e a menor para homens de Macapá, Rio de Janeiro e São Paulo. Para prevalência de obesidade, a maior variação percentual anual foi observada entre homens do Distrito Federal, e a menor entre homens de São Paulo e mulheres de Fortaleza. *Conclusão*: Tendências crescentes de excesso de peso e obesidade foram identificadas em adultos brasileiros de ambos os sexos.

Palavras-chave: Inquéritos epidemiológicos. Excesso de peso. Obesidade. Adultos.

INTRODUCTION

The evolution of nutritional problems, such as overweight and obesity, can be assessed from population-based surveys carried out over the years, which identify population groups at greatest risk, assess the performance of food and nutrition programs and (re)orientate public policies.

In Brazil, population-based surveys assessing anthropometric indicators have been carried out since the 1970s,[1] with an important contribution to the development and improvement of public policies that focus on controlling risk factors for nutritional problems and follow the trends of evolution of these problems.

As in other countries, in addition to population-based surveys of the household type, telephone surveys, such as the *Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico* (VIGITEL,[2] Surveillance of Risk and Protection Factors for Chronic Diseases Through Telephone Surveys) are carried out in Brazil. This survey is a population-based study that has been annually assessing the adult population aged 18 years or older who reside in the capitals of the 26 Brazilian states and in the Federal District, through telephone interviews, since 2006. Based on this survey, Flores-Ortiz *et al*. [3] assessed the trend in weight indicators between 2006 and 2016 and found an increase in the prevalence of overweight and obesity among men and women in Brazil. More recently, Silva *et al*.[4] evaluated the temporal trend of overweight and obesity, between 2006 and 2019, and observed an increase in these weight indicators among Brazilian adults in most of the socio-demographic strata studied, mainly among more educated young Brazilians.

Considering that temporal trend of overweight and obesity prevalence may show disparities among the country's capitals, this study aimed to evaluate the temporal trends of the prevalence of overweight and obesity among Brazilian adults using data from VIGITEL from 2006 to 2019 from each one of the 26 capitals and the Federal District

METHODS

The prevalence of overweight and obesity was compiled from national telephone surveys carried out from 2006 to 2019, analyzing the temporal trend among the 14 years of research (n=730,309).

VIGITEL is a survey that is part of the risk factor surveillance system for chronic noncommunicable diseases run by the Ministry of Health. It has been conducted annually since 2006 and the aim is to monitor, through telephone interviews, the frequency and distribution of the main determinants for chronic noncommunicable diseases. The anthropometric information is one of these determinants that provides data on the prevalence of overweight and obesity. Detailed information about VIGITEL including questionnaire, survey design, and datasets can be found in the previous publication.[2]

In the VIGITEL surveys, the interviewee is asked the following questions about weight and height: "Do you know your weight (even if it is an estimate)?" and "Do you know your height?".[2]

The body mass index is calculated (BMI=kg/m^2) and the prevalence of overweight (BMI≥25 kg/m^2) and obesity (BMI≥30 kg/m^2) is estimated, in accordance with the recommendations of the World Health Organization for adults,[5] considering the complex sample design.

The analyses were stratified by sex. The prevalence of obesity and overweight were age-adjusted and estimated for all the capitals and then separately. For the trend analysis, the Prais-Winsten generalized linear regression method was used, which allows the correction of first-order autocorrelation.[6] To adjust the regression, the logarithm of the prevalence of obesity and overweight was considered as the dependent variable, and the calendar year as the independent variable. The logarithmic transformation aimed to reduce the heterogeneity of residuals variance.[7] For each year "i" included in the study period, we have: $\log Y_{(i)} = a + b_i$ and $\log Y_{(i+1)} = a + b_{(i+1)}$. The value of "a" corresponds to intersection between line and vertical axis and the value of "b" corresponds to slope of line, estimated by linear regression analysis ($\log Y_{(i+1)} - \log Y_{(i)} = b_{(i+1-i)} = b$). Thus, it was possible to calculate the value of the coefficient "b" and standard error (SE) of the regression analysis and calculate the annual percent change (APC= $[-1 + 10^b]*100\%$) and 95% confidence interval (95%CI= $[-1 + 10^{(b \pm$

t*SE)]*100%), where "t" is the tabulated value of Student's t distribution. If APC is positive, the time series is increasing; if it is negative it is decreasing, and it will be stationary if there is no significant difference between its value and zero. The trend analysis was performed using the Stata program, version 12.

The VIGITEL survey was approved by the National Ethics Committee for Human Research of the Ministry of Health. Free and informed consent was obtained from the interviewees orally during telephone contact.

RESULTS

The overall prevalence of overweight among men increased from 47.5% in 2006 to 55.9% in 2019 and among women from 37.1% to 49.4% with an annual percent change of 2.5% (95%CI: 1.2; 3.8%) and 5.1% (95%CI: 3.9; 6.4%), respectively. Regarding the prevalence of obesity in the 26 capitals and the Federal District, there was an increase among men from 11.1% in 2006 to 18.5% in 2019, with an annual percent change of 7.3% (95%CI: 5.6; 9.0%), and from 11.3% to 18.3% among women, with an annual percent change of 7.1% (95%CI: 4.5; 9.7%) (data not shown).

In general, there was an increase in the prevalence of overweight and obesity between 2006 and 2019 among men (Figure 1a and Figure 2a, respectively) and women (Figure 1b and Figure 2b, respectively) for all capitals and the Federal District.

Figure 1. Prevalence of overweight (%), standardized by age, among men (A) and women (B) from Brazilian capitals from 2006 to 2019.

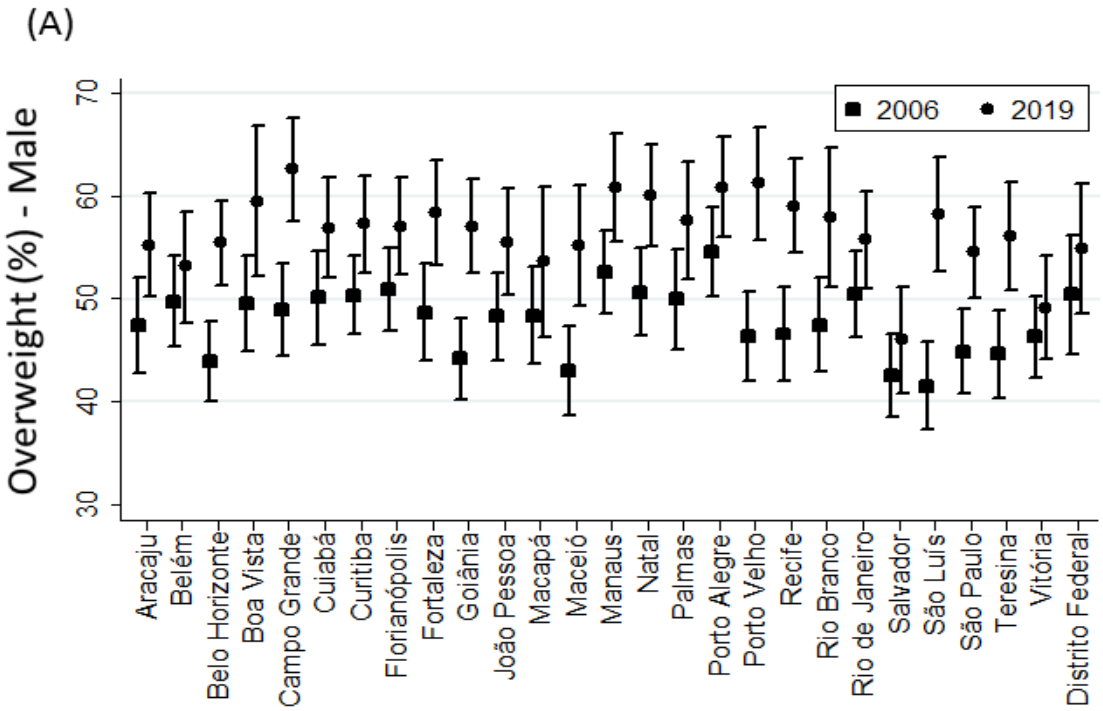


Figure 1. Prevalence of overweight (%), standardized by age, among men (A) and women (B) from Brazilian capitals from 2006 to 2019. (Continues.)

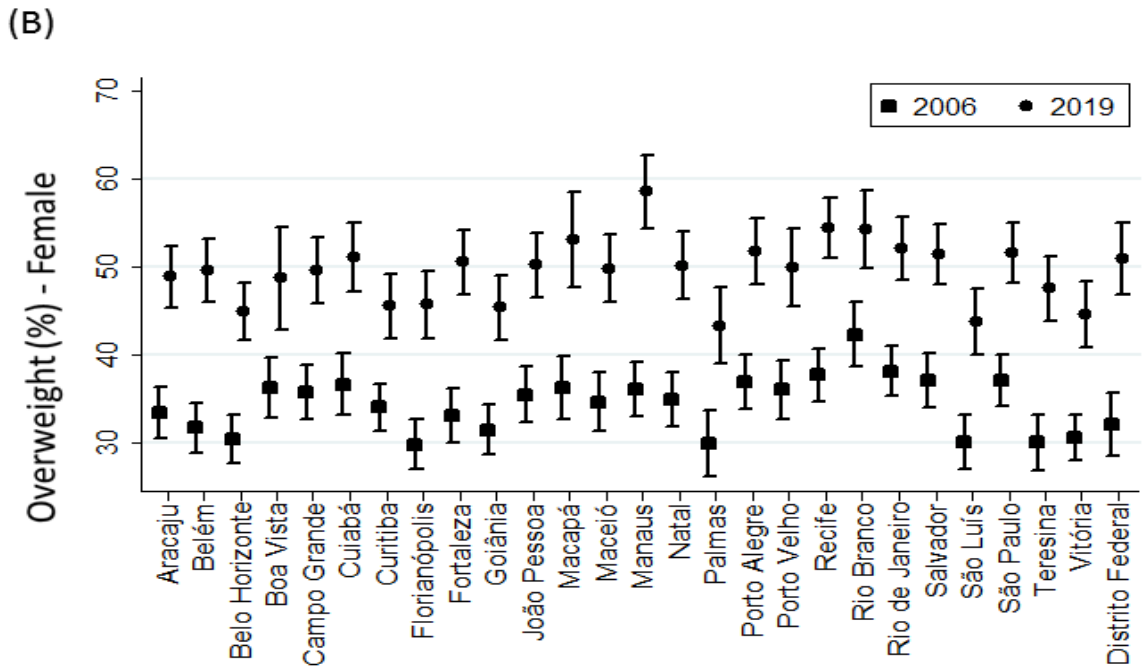


Figure 2. Prevalence of obesity (%), standardized by age, among men (A) and women (B) from Brazilian capitals from 2006 to 2019.

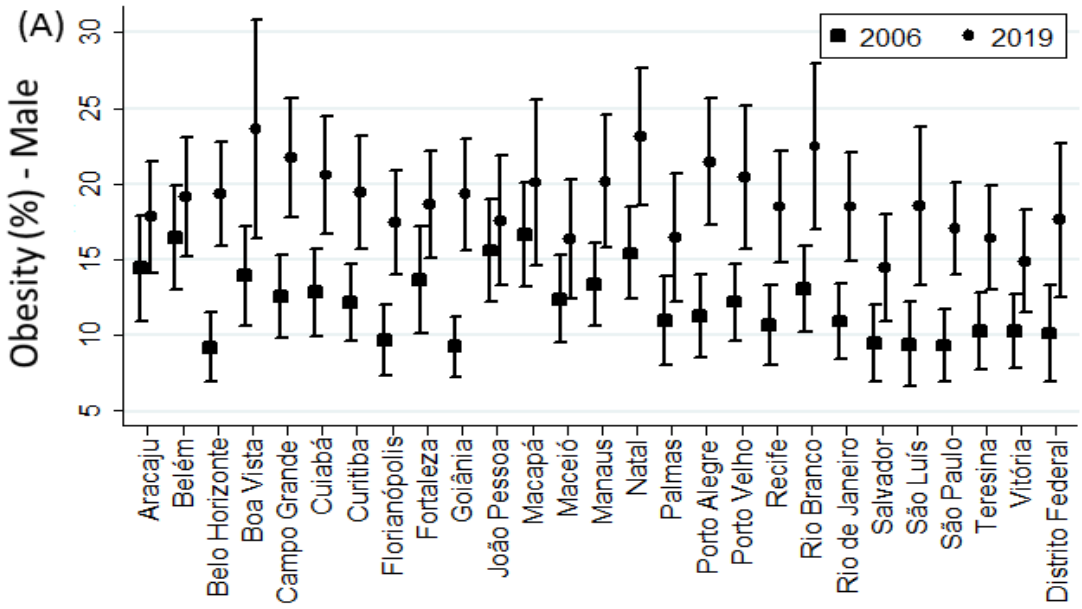
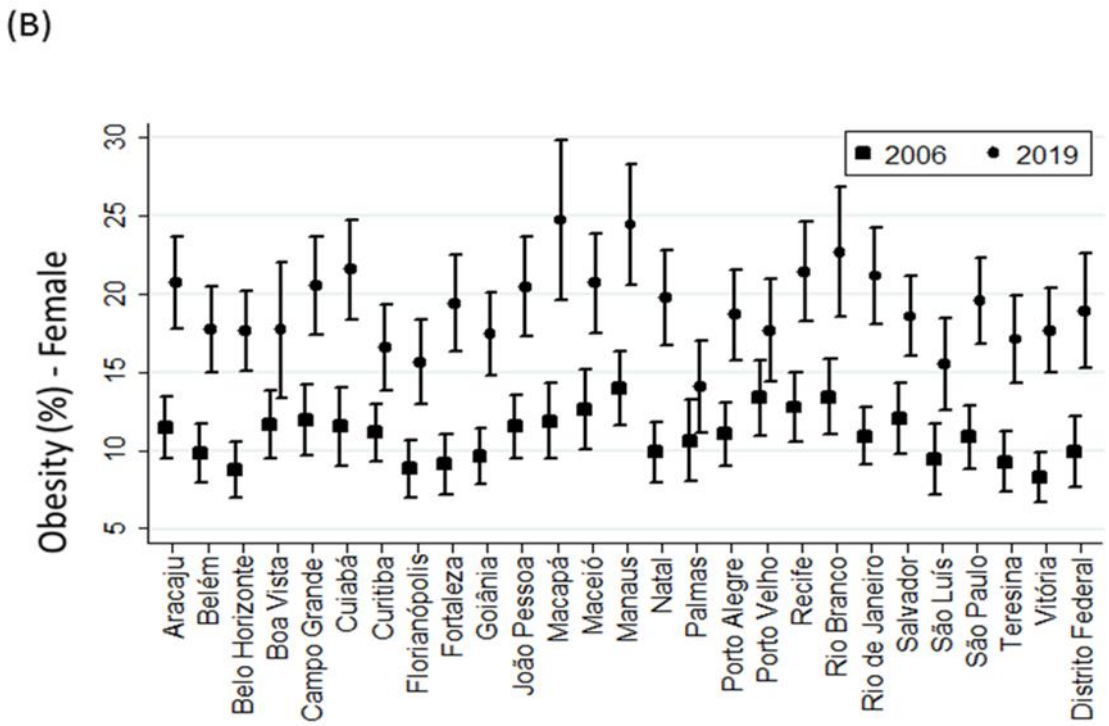


Figure 2. Prevalence of obesity (%), standardized by age, among men (A) and women (B) from Brazilian capitals from 2006 to 2019. (Continues.)



An increasing trend was observed for the prevalence of overweight in all Brazilian capitals and the Federal District, except for men from Curitiba, João Pessoa, Maceió and Vitória, which showed stability. The highest annual change was observed for women from Belém, Recife and São Paulo (7.0%), and the lowest for men from Macapá, Rio de Janeiro and São Paulo (2.4%). Similarly, there was an increasing trend in the prevalence of obesity in the period analyzed, except for women from Campo Grande, Florianópolis, and Porto Velho, and men from Florianópolis, Fortaleza, Maceió, and Vitória, for whom there was no significant trend in the period. The highest annual change was observed among men in the Federal District (13.0%), and the lowest among men from São Paulo and women from Fortaleza (5.4%) (Table 1).

Table 1.. Linear regression coefficient (β) of Prais-Winsten generalised linear regression method, annual percent change (APC) and 95% confidence interval (95%CI) of overweight (BMI ≥ 25 kg / m²) and obesity (BMI ≥ 30 kg / m²) in the capitals and the Federal District according to sex between 2006 and 2019

Capitals	Sex	Overweight			Obesity		
		β	APC	95%CI	β	APC	95%CI
Aracajú	M	0.019*	4.5	2.6; 6.3	0.033*	7.9	1.7; 14.4
	W	0.023*	5.5	3.2; 7.9	0.031*	7.4	3.1; 11.9
Belém	M	0.012*	2.9	1.0; 4.8	0.032*	7.7	3.3; 12.3
	W	0.029*	7.0	5.4; 8.7	0.036*	8.5	5.4; 11.8
Belo Horizonte	M	0.016*	3.7	2.8; 4.6	0.049*	11.8	10.2; 13.5
	W	0.022*	5.2	3.5; 6.9	0.037*	8.9	5.5;12.5
Boa Vista	M	0.018*	4.2	1.9; 6.5	0.045*	10.9	3.4; 18.9
	W	0.018*	4.3	2.1; 6.6	0.033*	7.9	5.0; 10.8
Campo Grande	M	0.017*	3.9	2.7; 5.1	0.039*	9.5	6.1; 12.9
	W	0.024*	5.8	2.9; 8.7	0.025	5.9	-1.9; 14.3

Table 1.. Linear regression coefficient (β) of Prais-Winsten generalised linear regression method, annual percent change (APC) and 95% confidence interval (95%CI) of overweight (BMI ≥ 25 kg / m²) and obesity (BMI ≥ 30 kg / m²) in the capitals and the Federal District according to sex between 2006 and 2019.

Capitals	Sex	Overweight			Obesity		
		β	APC	95%CI	β	APC	95%CI
Cuiabá	M	0.014*	3.4	1.9; 4.9	0.038*	9.1	4.6; 13.8
	W	0.020*	4.8	3.5; 6.1	0.034*	8.1	1.5; 15.0
Curitiba	M	0.008	1.9	-0.8; 4.7	0.027*	6.5	2.7; 10.4
	W	0.013*	3.1	0.2; 6.0	0.024*	5.7	0.3; 11.5
Florianópolis	M	0.014*	3.2	1.9; 4.5	0.023	5.4	-1.7; 13.1
	W	0.021*	5.0	2.4; 7.6	0.020	4.8	-0.6; 10.5
Fortaleza	M	0.014*	3.4	1.0; 5.8	0.010*	2.3	-4.3; 9.4
	W	0.020*	4.7	1.9; 7.5	0.023*	5.4	1.0; 10.1
Goiânia	M	0.012*	2.8	1.1; 4.6	0.046*	11.2	8.4; 14.1
	W	0.022*	5.2	2.3; 8.2	0.037*	8.8	5.5; 12.3
João Pessoa	M	0.010	2.4	-0.3; 5.2	0.033*	7.8	1.8; 14.1
	W	0.023*	5.4	3.1; 7.8	0.038*	9.0	4.0; 14.3
Macapá	M	0.010*	2.4	0.3; 4.6	0.024*	5.8	2.2; 9.4
	W	0.017*	4.1	1.9; 6.2	0.032*	7.7	4.1; 11.4
Maceió	M	0.012	2.8	-0.2; 5.8	0.013	3.0	-4.1; 10.6
	W	0.026*	6.2	3.5; 9.0	0.044*	10.7	5.4; 16.2
Manaus	M	0.022*	5.3	2.9; 7.7	0.046*	11.2	7.0; 15.5
	W	0.023*	5.3	2.3; 8.5	0.037*	8.9	5.9; 12.1
Natal	M	0.016*	3.8	2.4; 5.1	0.036*	8.7	4.6; 12.9
	W	0.015*	3.4	1.0; 6.0	0.034*	8.2	1.3; 15.6
Palmas	M	0.019*	4.5	2.5; 6.5	0.033*	8.0	0.5; 16.0
	W	0.021*	5.1	1.0; 9.2	0.040*	9.5	0.8; 19.0
Porto Alegre	M	0.019*	4.5	2.6; 6.4	0.044*	10.6	3.8; 18.0
	W	0.022*	5.2	1.6; 9.0	0.036*	8.7	4.5; 13.0
Porto Velho	M	0.018*	4.1	2.6; 5.7	0.039*	9.4	6.2; 12.7
	W	0.019*	4.6	2.3; 6.9	0.017	3.9	-0.3; 8.3
Recife	M	0.014*	3.2	1.2; 5.2	0.028*	6.7	2.1; 11.6
	W	0.030*	7.0	5.3; 8.8	0.052*	12.8	8.4; 17.4
Rio Branco	M	0.018*	4.2	2.4; 6.0	0.036*	8.7	3.8; 13.9
	W	0.023*	5.4	3.6; 7.3	0.033*	8.0	3.2; 12.9
Rio de Janeiro	M	0.010*	2.4	0.7; 4.2	0.034*	8.0	3.7; 12.5
	W	0.029*	6.9	5.9; 7.9	0.043*	10.4	6.8; 14.2
Salvador	M	0.016*	3.8	0.6; 7.2	0.049*	11.8	6.5; 17.4
	W	0.026*	6.2	5.3; 7.2	0.034*	8.2	3.2; 13.4
São Luís	M	0.016*	3.8	2.2; 5.4	0.044*	10.6	7.8; 13.4
	W	0.028*	6.6	4.4; 8.9	0.042*	10.1	6.7; 13.6
São Paulo	M	0.010*	2.4	1.1; 3.8	0.023*	5.4	1.8; 9.0
	W	0.029*	7.0	6.0; 8.1	0.046*	11.3	6.9; 15.8
Teresina	M	0.017*	4.0	0.3; 7.9	0.037*	8.9	5.1; 12.9
	W	0.026*	6.3	4.1; 8.5	0.036*	8.6	5.9; 11.3
Vitoria	M	0.005	1.2	-0.3; 2.8	0.021	4.8	-0.5; 10.4
	W	0.024*	5.6	3.1; 8.2	0.041*	9.8	5.1; 14.6
Federal District	M	0.016*	3.7	1.6; 5.9	0.053*	13.0	7.7; 18.5
	W	0.024*	5.7	2.8; 8.8	0.045*	11.0	6.1; 16.1

BMI= Body Mass Index; M= Men; W= Women; *p-value < 0.05

DISCUSSION

Based on telephone surveys from 2006 to 2019, there has been an increase in the prevalence of overweight and obesity among Brazilian adults for almost all capitals and the Federal District, with a high annual percent change, approximately 7%, for obesity in both sexes, and the highest annual percent change for overweight was observed among women. For men from four capitals, stability in the prevalence of overweight was observed. For obesity, there was no significant trend in the period for women in three capitals and men in four capitals. Thus, despite the national prevalence of overweight and obesity following the global scenario between 2006 and 2019, local characteristics of the 26 Brazilian capitals and the Federal District deserve to be considered in the planning of public policies for managing the nutritional conditions in the Brazilian population.

This increasing trend in the prevalence of overweight and obesity does not only occur in Brazil, but in other countries as well. The GBD 2015 Obesity Collaborators,[8] which analyzed data from 195 countries between 1990 and 2015, observed that the prevalence of obesity has doubled in more than 70 countries and increased steadily in most other countries. Finucane *et al*.,[9] systematically evaluated health surveys and epidemiological studies from 960 country-years that included 9.1 million participants (adults ≥ 20 years old) between 1980 and 2008 and found that the BMI has increased approximately 0.4 kg/m^2 per decade worldwide. In this context, controlling the increase in obesity is one of the goals of the Global NCD Plan (2013-2020)[10] and the Strategic Action Plan to Tackle NCD in Brazil 2011-2022.[11] National health surveys, such as VIGITEL, are important tools to monitor the occurrence and distribution of the main determinants and risk factors for NCDs, including overweight and obesity.

In Brazil, national studies using data between 1975 and 2019 found an increase in overweight and obesity prevalence among Brazilian adults with differences according to sex, age, and education level.[3,4,12,13] These studies analyzed data from nationally representative surveys, such as Household Budget Survey, National Health Survey, and VIGITEL. The present study is similar to the analysis by Flores-Ortiz *et al*.,[3] when evaluating the temporal trend of overweight and obesity, describing the results by Brazilian capitals and the Federal District from 2006 to 2016. However, we update the analyzed historical series, incorporating the VIGITEL surveys carried out from 2017 to 2019.

When the Brazilian capitals and the Federal District are analyzed, the significant annual percent change in the prevalence of overweight (2.4% to 7.0%) and obesity (5.4% to 13.0%) is outstanding. No disparities in this change were observed in Brazilian capitals in regions considered to have higher or lower economic development, as those observed for obesity change in Porto Alegre (in the South Region) and Rio Branco (in the Northeast Region). These two capitals presented a great difference in GDP per capita of the estimated population in 2018 (R$ 52,149.00 and R$ 22,287.70 reais, respectively).[14]

Although the increase in the prevalence of obesity is directly associated with socioeconomic status in low-income countries and inversely in high-income countries,[15,16] it remains uncertain in middle-income countries,[17,18] such as Brazil.[13] In the early 2000s, Monteiro *et al*.[12] compared Brazilian national surveys with an interval of 14 years (1989-2003) and found that obesity was no longer a health problem in more economically advantaged social classes, but it increased among men and women with less purchasing power.

Data collection through telephone interviews can be considered a limitation of the present study, as it can generate potential information biases. The classification of weight was performed by means of self-reported weight and height measurements, which, in turn, are useful for population surveys and prove to be valid among Brazilian adults.[19]

The temporal trends were observed and the increasing trends in overweight and obesity in Brazilian adults were identified among residents from Brazilian capitals from different regions of the country. The apparent lack of an established pattern of economic development referring to the cities evaluated is outstanding. Thus, further studies are required to assess the association between the temporal evolution of overweight and obesity using

indicators of quality of life, health, education, and per capita income distribution of the individuals assessed in different capitals

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Contributors

Rodrigues PRM, Moreira NF and Muraro AP participated in the design of the study, collection, and interpretation of data, in addition to writing the article. Andrade ACS and Ferreira MG contributed to the data analysis and discussion of the results, with relevant intellectual contribution in the critical review of the article. All authors approved the final version of the article and are responsible for all aspects of the work.

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