Research note

Temporal trend of overweight and obesity prevalence among Brazilian adults, according to sociodemographic characteristics, 2006-2019

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Abstract

Objetivo: To analyze the temporal trend of overweight and obesity prevalence rates among adults in the Brazilian state capitals and Federal District between 2006 and 2019. **Methods:** This was a time series study using data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey, 2006-2019 (n=730,309). Prevalence of overweight and obesity for each of the years was analyzed, according to combined sex, age, and schooling. Temporal variation trend was analyzed using Prais-Winsten regression. **Results:** Variations in overweight prevalence were observed, mainly among males 18-24 years old with up to 8 years of schooling (3.17%/year) and among women between 18-24 years old with more than 12 or more years of schooling (6.81% /year). Variations in obesity prevalence were found mainly among women 18-24 years old with more than 12 years of schooling (10.79%/year). **Conclusion:** There was an increase in overweight and obesity in most of the socio-demographic strata studied, especially among more educated young people.

Keywords: Body Mass Index; Obesity; Health Surveys; Health Status Disparities.

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Introduction

Overweight and obesity are among the principal factors affecting the global morbidity burden.[1] In 2016, global data showed that 39% of adults were overweight and 13% were obese.[1] In the period between 1975 and 2016, body mass index (BMI) trends worldwide highlighted the growing evolution of these conditions among adults.[2] Initially a problem only in high-income countries, since the 2000s overweigth and obesity have been growing faster in low- and middle-income countries.[2,3]

National studies conducted between 2006 and 2017 found an increase in the proportion of overweight and obesity according to sex, age and schooling strata.[4-7] Similar obesity prevalence rates can be seen between males and females, as well as inverse association with schooling and increased prevalence as age increases.[4-7] However, these characteristics were assessed separately.

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Given the need to identify groups at greater risk of developing these conditions and in view of the co-existence of these characteristics, the objective of this study was to analyze the temporal trend of overweight and obesity prevalence rates in the Brazilian state capitals and Federal District between 2006 and 2019.

Methods

This was a time series study using data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), gathered between 2006 and 2019 (n=730,309). Every year VIGITEL carries out over 50,000 landline telephone interviews with adults (≥18 years old) living in private households in the 26 Brazilian state capitals and Federal District, collecting self-reported information about sociodemographic and behavioral characteristics, weight and height, among others.[8]

The VIGITEL sampling process takes place in two stages: (i) systematized random selection of 5,000 landline telephones per city, based on telephone records provided by the country's main telephone companies; and (ii) random selection of an individual in each household who is requested to answer the questionnaire.[8]

The data on respondent weight and height were used to calculate BMI and were classified according to two categories: (i) overweight (BMI ≥25kg/m^2); and (ii) obesity (BMI ≥30kg/m2).[8] Missing data on weight and height were imputed using the hot deck procedure.[8] Further information on the methodology can be found in the annual VIGITEL report.[8]

The sociodemographic variables of interest to the study were sex (male; female), age group (in years: 18-24; 25-34; 35-44; 45-54; 55-64; 65 or over) and level of schooling (in years of study: 0-8; 9-11; 12 or more), which, when combined, generated 36 categories for stratifying the analyses (Supplementary Table 1).

In order to investigate the temporal variation of the indicators studied, first of all the prevalence rates were calculated for each of the strata, year by year. Following this, Prais-Winsten regression models were used to control autocorrelation of the regression residues between the years analyzed;[9] significant regression coefficient values ($p<0.05$) indicated an increase or decrease in prevalence.

The prevalence rates estimated by VIGITEL used post-stratification weighting, which took into consideration the sex, age group and level of schooling strata, with the aim of extrapolating the sociodemographic structure of the adult population studied to the structure of the total adult population in each place studied.[8]

The statistical analyses were performed using Stata version 14.1. Secondary data available for public access and use on the Ministry of Health's website were used. The VIGITEL study was authorized by the Ministry of Health's National Human Research Ethics Committee: Opinion No. 2.006.31, issued on June 6th 2017; Certificate of Submission for Ethical Appraisal No. 65610017.1.0000.0008. Free and informed consent was obtained verbally during each telephone interview.

Results

Overweight prevalence increased from 42.6% in 2006 to 55.4% in 2019 (2.05% per annum) (Supplementary Table 2). Among males aged over 25, prevalence rates were in excess of 40.0%; with effect from 35 years of age,

higher prevalence rates were found among those with higher levels of schooling. The highest mean increases occurred among younger males (18-24 years) with up to 8 years of schooling (from 21.0% in 2006 to 35.8% in 2019; 3.17% per annum) and with 12 or more years of schooling (from 32.6% in 2006 to 41.5% in 2019; 2.24% per annum). Among males with higher levels of schooling (≥12 years), smaller increases occurred with effect from 45 years of age, compared to younger males (18-24 years) in this group (Table 1; Figure 1).

Among females, in most years those aged over 45 had overweight prevalence rates above 50.0%. Higher prevalence rates were found in all age groups in females with less schooling. Females aged 18-24 with 12 or more years of schooling showed the largest increase in the period (from 9.0% in 2006 to 27.5% in 2019; 6.81% per annum), compared to females with the same level of schooling aged 35 or more (Table 1; Figure 1).

Prevalence of obesity increased from 11.8% in 2006 to 20.3% in 2019: an increase of 3.8% per annum (Supplementary Table 2). Among males, lower obesity prevalence rates were found among younger males aged 18-24. When comparing all the strata, no differences were found in the average increases (Table 2; Figure 1).

Females had the lowest obesity prevalence rates in the youngest age group, i.e. 18-24 years. A significant increase in obesity was found in all the strata analyzed. When comparing age groups within the highest level of schooling, the largest increases were found among females aged 18-24 (from 2.5% in 2006 to 10.5% in 2019; 10.79% per annum), in relation to females aged over 45 years old (Table 2; Figure 1).

Discussion

An increase in the proportion of overweight and obese adults was found between 2006 and 2019 in the majority of the strata studied. Higher mean increases were found above all among young people with high levels of schooling, both for overweight, and for obesity.

A population's living and health situations and their relationship with income directly influence their food intake pattern and their physical activity, these being the main risk factors for obesity. A population that is in an economically vulnerable situation with regard to its choice of food, reduced to more affordable food items, generally having high energy density, or furthermore, a population living in regions that are unsafe due to urban violence, unable to voluntarily undertake physical activities, is a population that is related to rising growth in obesity.[10,11] Within this scenario, increased prevalence of overweight and obesity has been attributed, above all in middle-income countries such as Brazil, to behavior changes over the years, such as inadequate food intake, increased sedentary habits and low levels of physical activity.[12]

The sociodemographic characteristics studied appear to influence the increase in overweight and obesity, especially among the younger. Greater variations in the female sex may be related to gender issues, with notable impact on their health.[13,14] Although, in general, higher prevalence rates are found among individuals with lower levels of schooling, mean increases of greater magnitude can be seen among those with higher levels of schooling. These findings may be related to factors such as financial independence, occupations in which less energy is burned and little time for taking care of one's health, particularly among females.[15,16]

With the objective of curbing the growth in obesity, Brazil committed to United Nations Organization targets aimed at preventing increased obesity among adults, reducing regular consumption of sugar-sweetened drinks and promoting intake of fruit and vegetables by 2019.[17] In addition, one of the targets of the National Plan to Address Chronic Noncommunicable Diseases consists of controlling growth in obesity among the adult population.[18] In order to achieve these targets, Brazil needs to develop intersectoral response strategies, such as environmental measures that influence healthier choices, including restricting advertising of unhealthy foods,[19] fiscal measures such as subsidies and taxation,[20,21] and reformulation of urban spaces, making them more accessible for practicing physical activities, prioritizing public security and revitalizing areas and equipment in squares and parks, as well as encouraging people to walk rather than using transport. These interventions form part of public policies intended to promote greater gender equity and equality.[22]

Collecting self-reported data and possible resulting inaccuracies in BMI calculation, when such data are compared with data measured directly, limit the validity of this study. However, self-reported information is

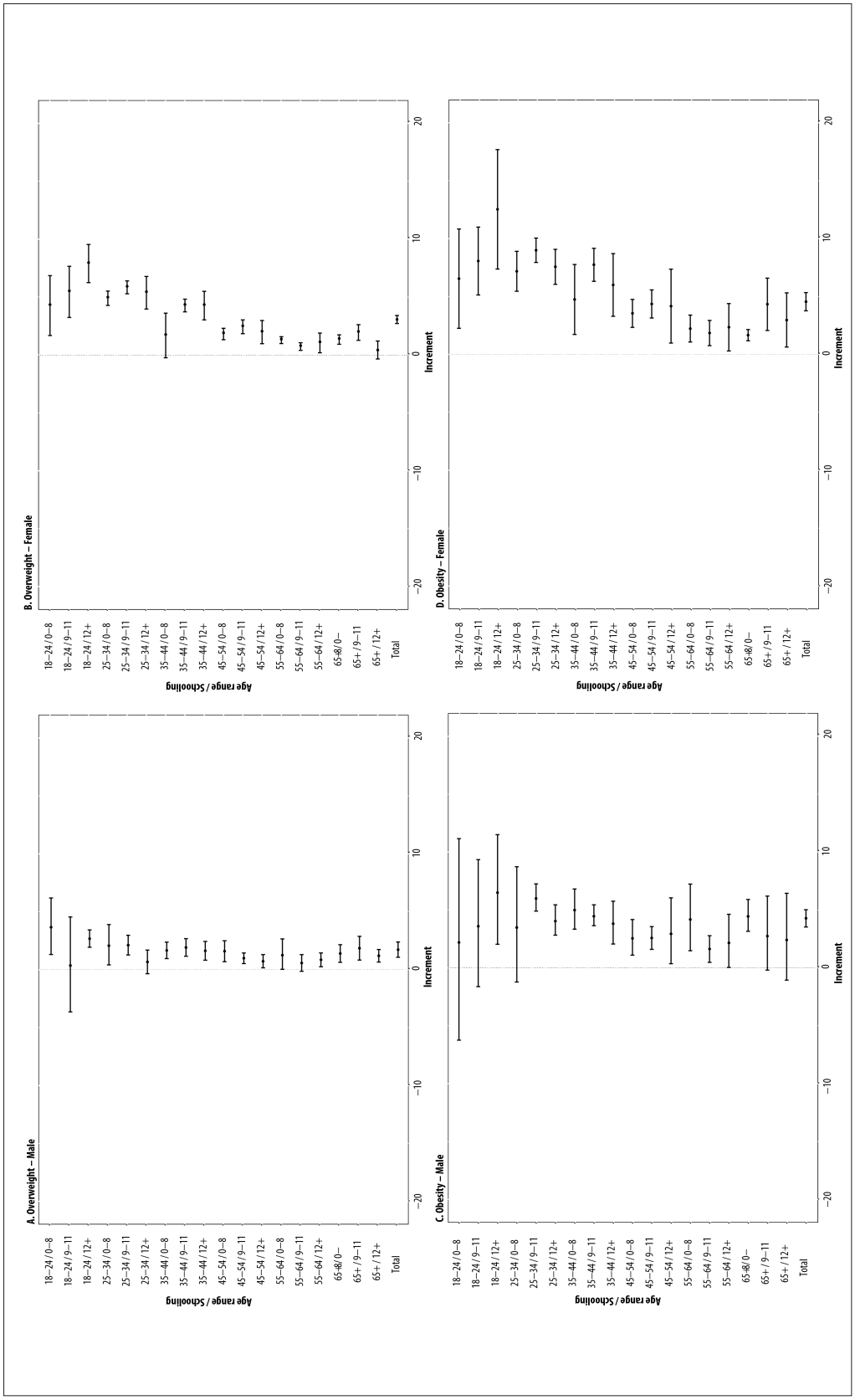

Figure 1 – Average increment and respective confidence intervals (95%CI) for overweight and obesity among the adult population in the capital cities of the Brazilian States and in the Federal District, by sociodemographic strata, based on data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Table 1 – Percentage[a] (%) of overweight adult population in the capital cities of the Brazilian States and in the Federal District, by sociodemographic strata, based on data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Variables																			
Age (years)	Schooling (years)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average increment	95%CI[b]	p-value[c]
Male																		
	0-8	21.0	30.4	23.0	40.8	32.6	30.5	33.1	28.9	24.6	48.5	35.8	32.6	47.0	35.8	3.17	1.06;5.28	**0.007**
18-24	9-11	25.8	23.5	26.9	26.0	28.7	30.7	31.0	34.4	37.9	34.3	30.8	33.0	28.6	24.9	0.31	-3.23;3.86	0.850
	≥12	32.6	33.9	30.9	32.3	35.3	30.5	37.8	38.0	36.1	38.4	37.5	44.3	39.3	41.5	2.24	1.60;2.89	**<0.001**
	0-8	47.6	46.4	42.5	45.9	45.7	50.9	59.2	56.3	57.1	59.1	45.0	56.0	55.2	57.8	1.79	0.28;3.29	0.024
25-34	9-11	47.1	48.8	50.7	47.7	49.8	53.3	50.8	49.4	55.8	56.8	63.0	56.0	58.5	56.4	1.75	1.02;2.49	<0.001
	≥12	49.5	52.1	58.5	57.8	54.7	61.7	59.1	54.5	55.9	54.4	59.0	57.6	55.8	57.2	0.50	-0.38;1.39	0.241
	0-8	53.9	52.8	54.5	51.8	53.4	60.1	58.7	59.4	59.9	60.4	66.9	56.8	62.0	60.7	1.36	0.75;1.98	**<0.001**
35-44	9-11	59.9	56.1	57.3	61.8	61.4	63.8	59.2	63.9	72.1	69.6	64.9	71.6	67.6	68.4	1.58	0.93;2.24	**<0.001**
	≥12	57.4	66.7	62.2	60.3	65.1	68.0	71.4	71.4	67.8	65.5	69.9	71.1	72.8	71.9	1.33	0.63;2.03	**0.001**
	0-8	55.2	58.3	55.8	54.5	60.6	54.8	60.5	67.3	61.8	66.5	65.6	66.1	61.7	62.6	1.30	0.52;2.08	**0.003**
45-54	9-11	59.1	61.7	67.9	60.5	65.3	64.5	63.6	63.9	67.6	66.7	71.8	64.8	70.0	63.8	0.78	0.38;1.17	**0.001**
	≥12	65.8	65.5	69.2	66.2	72.0	71.3	72.0	65.3	68.1	69.1	70.7	69.9	73.9	71.7	0.55	0.06;1.05	**0.032**
	0-8	50.3	55.5	57.9	59.1	60.7	59.7	57.6	60.6	64.2	67.2	60.8	57.5	59.4	61.6	1.08	-0.05;2.22	0.059
55-64	9-11	62.9	59.4	64.6	59.7	65.9	64.6	62.1	59.9	65.4	66.9	71.0	62.5	65.0	62.0	0.42	-0.20;1.05	0.168
	≥12	57.0	64.8	63.2	64.4	67.2	59.7	63.2	70.3	61.5	64.4	64.2	67.8	66.4	69.7	0.66	0.14;1.17	**0.017**
	0-8	50.8	49.0	49.7	55.9	58.5	49.2	57.8	52.7	56.7	55.8	52.6	56.5	60.2	60.0	1.13	0.47;1.79	**0.003**
≥65	9-11	44.9	48.2	56.2	53.0	56.5	52.2	55.0	55.0	60.6	60.3	58.1	53.3	60.4	59.7	1.52	0.64;2.41	**0.003**
	≥12	53.8	62.5	57.8	54.5	57.0	60.8	58.6	63.1	56.8	62.3	63.2	61.5	64.7	64.3	0.96	0.49;1.43	**0.001**
Female																		
	0-8	25.8	19.2	35.7	28.0	41.0	36.3	34.8	31.1	41.2	52.0	33.0	34.6	49.8	37.3	3.67	1.44;5.91	**0.004**
18-24	9-11	14.4	14.9	16.0	22.0	24.9	20.0	22.8	25.1	28.7	26.7	28.4	26.7	27.1	28.6	4.70	2.79;6.61	**<0.001**
	≥12	9.0	13.1	16.9	15.2	14.4	15.5	22.7	21.3	20.6	22.7	22.8	26.4	29.6	27.5	6.81	5.39;8.24	**<0.001**
	0-8	34.8	41.1	38.3	42.4	47.0	47.0	48.3	46.8	53.5	59.3	56.0	58.8	64.2	61.1	4.23	3.69;4.76	**<0.001**
25-34	9-11	26.8	29.5	34.7	34.9	38.7	39.8	41.7	40.8	45.2	48.6	49.8	49.2	56.1	56.2	5.04	4.56;5.52	**<0.001**
	≥12	20.8	23.0	23.1	24.6	33.0	29.2	35.7	31.3	30.9	32.8	35.4	36.4	40.2	42.1	4.64	3.42;5.85	**<0.001**
	0-8	48.8	48.0	49.5	50.6	52.3	52.7	55.5	60.1	62.1	66.1	61.2	62.2	60.5	57.0	1.44	-0.22;3.11	0.082
35-44	9-11	41.0	37.7	42.6	45.6	44.4	48.1	50.5	48.9	53.2	57.2	57.8	61.5	61.6	58.8	3.68	3.21;4.16	**<0.001**
	≥12	32.0	31.5	31.6	34.2	38.3	41.6	45.1	41.9	39.5	42.8	50.2	45.3	48.1	51.5	3.67	2.61;4.74	**<0.001**
	0-8	55.9	54.2	55.0	57.0	58.4	59.8	61.9	61.2	64.3	63.7	63.0	61.2	66.6	68.0	1.56	1.13;1.98	**<0.001**
45-54	9-11	50.9	48.0	46.4	53.4	50.6	54.6	56.0	55.1	57.8	58.0	56.2	58.6	63.0	65.3	2.09	1.58;2.61	**<0.001**
	≥12	42.1	44.3	43.9	41.1	44.6	45.3	55.5	49.3	49.3	49.9	49.4	51.2	51.9	52.1	1.69	0.83;2.56	**0.001**
	0-8	60.2	58.0	59.8	59.7	60.4	61.9	62.7	65.7	64.3	66.4	64.0	64.8	69.2	64.4	1.10	0.84;1.35	**<0.001**
55-64	9-11	54.4	58.7	55.5	62.7	56.5	60.7	57.7	63.2	59.9	58.8	59.6	61.9	60.2	64.2	0.61	0.33;0.90	**<0.001**
	≥12	52.9	48.1	48.8	49.2	54.2	51.5	58.7	54.3	48.5	53.9	56.0	52.4	55.8	57.8	0.89	0.15;1.62	**0.022**

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Table 1 – Percentage[a] (%) of overweight adult population in the capital cities of the Brazilian States and in the Federal District, by sociodemographic strata, based on data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Variables																		
Age (years)	Schooling (years)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average increment	95%CI[b]	p-value[c]
	0-8	53.5	52.6	54.5	53.9	56.9	57.4	59.0	58.5	58.7	57.3	58.9	63.2	60.9	60.4	1.14	0.79;1.49	**<0.001**
≥65	9-11	54.2	43.9	57.5	52.5	53.6	53.0	63.8	54.6	58.0	60.6	62.6	60.6	60.8	59.6	1.67	1.08;2.25	**<0.001**
	≥12	46.6	57.9	54.2	51.3	47.2	52.5	52.6	51.8	55.5	52.1	54.8	52.3	55.2	53.5	0.36	-0.31;1.03	0.267

Notes: a) Values adjusted to match the total estimated population of each capital city with each of the years of study; b) 95%CI: 95% confidence interval; c) Prais-Winsten regression.

Table 2 – Percentage[a] (%) of obese adult population in the capital cities of the Brazilian States and in the Federal District, by sociodemographic strata, based on data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Variables																		
Age (years)	Schooling (years)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average increment	95%CI[b]	p-value[c]
Male																		
	0-8	5.7	4.6	6.7	11.1	8.3	6.8	9.7	5.8	7.4	13.7	13.2	13.8	8.9	3.8	2.09	-5.44;9.61	0.557
18-24	9-11	3.8	4.3	5.6	6.9	5.5	5.6	6.0	7.6	10.6	7.8	7.3	6.2	5.6	6.9	3.30	-1.44;8.04	0.155
	≥12	5.3	5.0	4.6	7.0	5.5	6.9	11.6	10.2	8.0	7.2	8.3	16.5	8.2	9.0	5.81	1.72;9.91	**0.009**
	0-8	14.0	13.4	12.4	15.8	11.9	19.3	22.3	20.9	24.6	26.0	17.8	17.5	15.8	21.3	3.20	-1.10;7.51	0.131
25-34	9-11	9.3	14.1	11.7	10.9	13.3	14.1	15.9	14.5	16.2	18.0	20.3	18.2	21.7	19.3	5.22	4.20;6.23	**<0.001**
	≥12	11.2	10.1	14.7	12.9	10.9	15.7	14.6	16.2	13.4	15.4	17.9	18.0	15.3	19.0	3.53	2.40;4.67	**<0.001**
	0-8	12.7	17.6	15.7	15.2	13.0	21.3	20.1	21.7	22.8	24.0	22.1	22.4	27.2	20.8	4.35	2.85;5.85	**<0.001**
35-44	9-11	16.2	14.6	17.4	18.1	18.4	20.4	20.9	22.4	23.9	24.8	22.0	25.6	23.2	26.4	3.89	3.11;4.67	**<0.001**
	≥12	12.5	22.4	15.6	15.6	24.5	22.4	19.9	22.8	18.9	23.0	21.8	27.1	27.9	22.7	3.34	1.74;4.94	**0.001**
	0-8	18.1	20.4	19.8	14.0	23.3	16.1	19.3	22.0	20.8	18.1	23.2	25.7	22.6	24.0	2.24	0.91;3.57	**0.003**
45-54	9-11	14.4	18.8	19.1	18.9	21.8	21.0	20.6	21.9	20.3	22.4	22.9	21.5	23.9	22.4	2.19	1.34;3.04	**<0.001**
	≥12	13.4	19.3	17.4	22.0	24.1	24.3	23.0	21.5	18.2	20.2	23.9	23.7	22.3	25.4	2.73	0.27;5.19	**0.032**
	0-8	12.1	16.9	18.1	21.9	14.4	17.3	19.0	23.3	26.5	23.8	19.9	21.8	20.8	26.5	3.73	1.24;6.22	**0.007**
55-64	9-11	15.2	23.0	16.5	17.8	21.3	19.6	21.7	19.0	21.4	17.4	21.3	24.1	20.3	22.6	1.37	0.37;2.36	**0.011**
	≥12	14.1	17.8	18.8	20.6	14.3	14.6	21.8	23.3	16.9	24.4	18.8	18.8	19.7	22.8	1.98	-0.01;3.96	**0.051**
	0-8	10.6	11.5	10.9	13.2	16.2	12.5	12.7	16.0	14.8	15.5	15.3	16.6	18.9	18.5	3.88	2.69;5.07	**<0.001**
≥65	9-11	11.0	9.0	14.5	11.6	20.9	11.1	13.2	15.1	20.1	14.0	12.8	12.4	19.3	16.7	2.56	-0.21;5.32	0.067
	≥12	11.8	14.2	13.9	15.3	12.9	11.5	11.4	21.0	19.9	17.0	16.5	13.8	15.1	17.7	2.28	-0.96;5.53	0.151

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Table 2 – Percentage[a] (%) of obese adult population in the capital cities of the Brazilian States and in the Federal District, by sociodemographic strata, based on data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Variables																		
Age (years)	Schooling (years)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average increment	95%CI[b]	p-value[c]
Female																		
18-24	0-8	6.8	6.4	9.1	7.6	11.7	11.8	8.5	4.9	17.0	12.9	19.9	10.7	13.3	13.1	5.61	1.90;9.32	**0.006**
	9-11	4.1	3.4	3.3	6.3	5.4	5.0	5.4	5.2	8.0	8.8	8.5	7.3	7.5	9.8	6.93	4.39;9.46	**<0.001**
	≥12	2.5	2.4	3.2	2.8	2.5	3.3	8.6	3.2	3.9	5.0	6.9	8.7	8.1	10.5	10.79	6.33;15.25	**<0.001**
25-34	0-8	12.6	15.0	13.4	16.9	17.5	14.2	19.9	20.3	19.8	30.2	24.8	25.6	27.3	26.6	6.16	4.67;7.65	**<0.001**
	9-11	7.2	9.3	9.3	10.5	11.0	14.0	13.3	14.0	14.6	18.9	18.6	17.6	22.3	22.2	7.73	6.82;8.64	**<0.001**
	≥12	4.6	6.0	6.9	7.0	10.0	7.5	10.6	10.6	10.5	11.4	11.4	10.8	12.4	15.5	6.50	5.19;7.80	**<0.001**
35-44	0-8	14.4	16.4	18.7	20.0	20.5	21.2	24.2	24.1	28.6	29.3	31.0	24.2	25.4	25.9	4.06	1.44;6.67	**0.005**
	9-11	10.0	11.4	13.1	12.9	13.8	17.2	18.9	16.5	22.6	22.9	24.6	22.2	24.4	24.0	6.65	5.41;7.88	**<0.001**
	≥12	10.2	6.8	7.7	9.0	12.6	15.2	13.1	13.7	11.8	16.7	14.9	14.3	14.9	17.8	5.14	2.80;7.48	**<0.001**
45-54	0-8	18.8	22.2	21.5	22.3	24.9	26.9	28.6	25.6	25.1	28.1	27.8	27.9	29.7	30.8	3.02	1.97;4.06	**<0.001**
	9-11	14.4	15.9	15.8	18.4	18.2	20.7	22.3	21.0	22.4	21.7	21.1	23.0	24.8	24.9	3.72	2.67;4.77	**<0.001**
	≥12	8.6	14.2	11.2	11.4	13.7	17.3	17.2	20.8	14.9	15.8	15.1	15.2	17.8	18.3	3.56	0.80;6.32	**0.016**
55-64	0-8	23.0	21.9	25.7	23.6	24.8	26.8	29.2	30.3	26.4	25.8	28.6	26.3	33.1	27.1	1.88	0.88;2.89	**0.002**
	9-11	17.2	21.1	17.7	21.7	23.4	22.6	21.8	22.6	22.6	21.1	22.5	22.7	22.9	24.7	1.55	0.61;2.49	**0.004**
	≥12	16.0	11.7	18.0	16.1	14.9	15.7	20.5	16.7	11.7	17.8	18.7	17.5	22.1	17.0	1.98	0.21;3.75	**0.031**
≥65	0-8	20.8	19.8	22.4	21.6	23.4	22.6	22.9	24.1	23.3	22.9	24.0	25.2	25.1	24.0	1.39	0.97;1.81	**<0.001**
	9-11	14.3	13.7	15.2	18.5	15.2	18.2	24.3	20.5	21.2	23.2	23.6	18.9	20.8	24.6	3.70	1.74;5.65	**0.001**
	≥12	13.7	13.5	12.1	13.4	12.5	15.4	20.9	13.0	15.6	14.9	19.0	19.1	18.7	13.9	2.52	0.50;4.55	**0.019**

Notes: a) Values adjusted to match the total estimated population of each capital city with each of the years of study; b) 95%CI: 95% confidence interval; c) Prais-Winsten regression.

widely used in health surveys and is recommended for risk factor investigation.[23,24] The VIGITEL sample is restricted to individuals who have landlines and live in the Brazilian state capitals and Federal District. This may mean that the BMI information reported by individuals with landlines could be biased as it may possibly be different to information relating to individuals who do not have a landline telephone. Although the method used to collect data may perhaps influence the prevalence estimates for each of the years, under or overestimation of those estimates is deemed to be consistent over the course of the years. Finally, the combination of the sociodemographic characteristics studied may have influenced the accuracy of the estimates for some of the strata.

An increase in the proportion of overweight and obese adults was found in the majority of the strata studied, above all among young people with higher levels of schooling. Addressing the complex challenges that obesity represents for society goes beyond the health sector. Using public policies to boost a set of intersectoral actions that encourage healthy lifestyles is essential for controlling the growth of these conditions in Brazil.

Authors' contributions

Silva LES, Oliveira MM and Stopa SR contributed to the study concept and design and drafting the first version of the manuscript. Gouvea ECDP, Ferreira

KRD, Santos RO, Neto PFV, Macário EM and Sardinha LMV contributed to data interpretation, drafting and critically reviewing the manuscript. All the authors have approved the final version of the manuscript and declare themselves to be responsible for all aspects thereof, including the guarantee of its accuracy and integrity.

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Supplementary Table 1 – Distribution of the interviewed population and overweight and obese adults in the capital cities of the Brazilian States and in the Federal District, by sociodemographic strata, based on data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Variables		Total (n=730,309)	Overweight (n=375,468)	Obesity (n=124.394)
Age (years)	Schooling (years)	n (%)	n	n
Male				
18-24	0-8	3,536 (0.5)	1,115	312
	9-11	22,614 (3.1)	6,912	1,545
	≥12	14,640 (2.0)	5,570	1,220
25-34	0-8	6,136 (0.8)	3,103	984
	9-11	20,865 (2.9)	11,379	3,264
	≥12	22,163 (3.0)	12,817	3,442
35-44	0-8	11,702 (1.6)	6,896	2,288
	9-11	20,951 (2.9)	13,524	4,346
	≥12	18,887 (2.6)	12,787	4,005
45-54	0-8	14,517 (2.0)	8,844	3,065
	9-11	18,543 (2.5)	12,295	3,998
	≥12	17,039 (2.3)	11,649	3,618
55-64	0-8	14,892 (2.0)	9,046	3,069
	9-11	13,587 (1.9)	8,858	2,851
	≥12	13,426 (1.8)	9,132	2,747
≥65	0-8	21,912 (3.0)	11,954	3,334
	9-11	10,791 (1.5)	6,158	1,701
	≥12	12,321 (1.7)	7,483	1,956
Total		**278,522 (38.1)**	**159,522**	**47,745**
Female				
18-24	0-8	3,266 (0.5)	1,028	341
	9-11	23,623 (3.2)	4,982	1.322
	≥12	18,444 (2.5)	3,383	841
25-34	0-8	8,069 (1.1)	3,727	1.466
	9-11	28,674 (3.9)	11,426	3.641
	≥12	32,675 (4.5)	9,913	2.815
35-44	0-8	15,537 (2.1)	8,310	3.347
	9-11	32,303 (4.4)	15,521	5.271
	≥12	32,108 (4.4)	12,940	3.893
45-54	0-8	22,751 (3.1)	13,668	5.875
	9-11	30,346 (4.2)	16,564	5.843
	≥12	28,695 (3.9)	13,711	4.220

To be continue

Continuation

Supplementary Table 1 – Distribution of the interviewed population and overweight and obese adults in the capital cities of the Brazilian States and in the Federal District, by sociodemographic strata, based on data from theSurveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Variables		Total (n=730,309)	Overweight (n=375,468)	Obesity (n=124.394)
Age (years)	Schooling (years)	n (%)	n	n
55-64	0-8	29,281 (4.4)	18,298	7.846
	9-11	24,704 (3.4)	14,555	5.289
	≥12	23,029 (3.2)	12,344	3.878
≥65	0-8	56,597 (7.8)	32,573	13.214
	9-11	23,271 (3.2)	13,106	4.507
	≥12	18,414 (2.5)	9,897	3.040
Total	**451,309 (61.9)**	**215,946**	**76,649**	**76.649**

Supplementary Table 2 – Percentage[a] (%) overweight and obesity among the adult population of the capital cities of the Brazilian States and the Federal District, by sociodemographic strata, based on data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Variables	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average increment	95%CI[b]	p-value[c]
Overweight																	
Sex																	
Male	47.5	48.8	49.8	50.1	52.4	53.4	54.5	54.7	56.5	57.6	57.7	57.3	57.8	57.1	1.42	0.85;1.99	**<0.001**
Female	38.5	38.7	40.7	42.3	44.6	44.9	48.1	47.4	49.1	50.8	50.5	51.2	53.9	53.9	2.64	2.34;2.94	**<0.001**
Age (years)																	
18-24	20.6	21.0	23.2	25.5	27.7	25.7	28.9	29.7	31.5	33.2	30.3	32.1	32.1	30.1	2.99	1.52;4.46	**0.001**
25-34	37.5	39.8	41.0	41.4	44.3	46.0	47.7	45.3	48.0	49.6	50.3	50.0	52.9	53.1	2.48	2.13;2.82	**<0.001**
35-44	48.8	48.0	49.4	50.4	51.8	55.1	55.9	56.4	58.6	60.2	61.1	60.9	61.3	61.0	1.86	1.26;2.46	**<0.001**
45-54	54.8	55.0	55.3	55.2	57.9	57.7	60.8	60.7	61.6	62.4	62.4	61.6	64.0	63.7	1.30	1.03;1.57	**<0.001**
55-64	56.6	57.2	58.6	59.4	60.4	60.3	60.3	62.7	61.8	63.8	62.4	61.0	63.1	63.1	0.79	0.48;1.01	**<0.001**
≥65	52.1	51.2	53.6	54.2	56.6	54.3	58.5	56.3	57.8	57.3	57.7	59.6	60.6	59.8	1.16	0.95;1.37	**<0.001**
Schooling (years)																	
0-8	48.9	49.7	50.3	52.0	54.2	54.4	57.3	58.1	58.9	61.7	59.2	59.7	61.8	61.0	1.82	1.33;2.30	**<0.001**
9-11	37.4	37.2	40.7	42.0	44.4	45.8	46.7	47.3	51.6	52.0	53.3	53.0	54.5	53.8	2.94	2.37;3.52	**<0.001**
≥12	37.3	40.0	40.7	40.5	43.6	44.6	48.4	45.5	45.0	46.8	48.8	49.6	51.3	52.2	2.30	1.80;2.80	**<0.001**
Total	**42.6**	**43.4**	**44.9**	**45.9**	**48.2**	**48.8**	**51.0**	**50.8**	**52.5**	**53.9**	**53.8**	**54.0**	**55.7**	**55.4**	**2.05**	**1.67;2.43**	**<0.001**

To be continue

Continuation

Supplementary Table 2 – Percentage[a] (%) overweight and obesity among the adult population of the capital cities of the Brazilian States and the Federal District, by sociodemographic strata, based on data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL), 2006-2019

Variables	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Average increment	95%CI[b]	p-value[c]
Obesity																	
Sex																	
Male	11.4	13.6	13.4	13.9	14.4	15.5	16.5	17.5	17.6	18.1	18.1	19.2	18.7	19.5	3.66	3.01;4.30	**<0.001**
Female	12.1	13.1	13.9	14.7	15.6	16.5	18.2	17.5	18.2	19.7	19.6	18.7	20.7	21.0	3.89	3.21;4.57	**<0.001**
Age (years)																	
18-24	4.4	4.1	4.8	6.5	5.7	5.7	7.5	6.3	8.5	8.3	8.5	9.2	7.4	8.7	5.36	3.83;6.88	**<0.001**
25-34	9.8	11.4	11.2	11.9	12.2	13.7	15.1	15.0	15.1	17.9	17.1	16.5	18.0	19.3	4.70	4.03;5.36	**<0.001**
35-44	12.8	14.9	15.2	15.6	16.6	19.6	19.7	20.1	22.0	23.6	22.5	22.3	23.2	22.8	4.15	2.79;5.52	**<0.001**
45-54	16.1	19.5	18.6	17.9	21.6	21.2	22.6	22.5	21.3	21.7	22.8	23.3	24.0	24.5	2.46	1.71;3.21	**<0.001**
55-64	18.0	19.5	20.8	21.6	19.8	21.1	23.4	24.4	23.1	22.7	22.9	22.6	24.6	24.3	1.91	1.02;2.80	**0.001**
≥65	16.1	15.6	17.4	17.8	19.4	17.7	19.0	20.2	19.8	19.4	20.3	20.3	21.5	20.9	2.09	1.58;2.59	**<0.001**
Schooling (years)																	
0-8	15.3	16.9	17.5	18.1	18.8	19.7	21.7	22.3	22.7	23.6	23.5	23.3	24.5	24.2	3.36	2.45;428	**<0.001**
9-11	9.0	10.7	11.0	12.2	13.1	14.2	15.2	15.1	17.2	17.8	18.3	17.8	19.4	19.9	5.46	4.86;6.07	**<0.001**
≥12	8.6	9.9	10.2	10.6	11.7	13.0	14.4	14.3	12.3	14.6	14.9	16.0	15.8	17.2	4.57	3.61;5.54	**<0.001**
Total	**11.8**	**13.3**	**13.7**	**14.3**	**15.1**	**16.0**	**17.4**	**17.5**	**17.9**	**18.9**	**18.9**	**18.9**	**19.8**	**20.3**	**3.8**	**3.15;4.49**	**<0.001**

Notes: a) Values adjusted to match the total estimated population of each capital city with each of the years of study; b) 95%CI: 95% confidence interval; c) Prais-Winsten regression.