Evolution of obesity and noncommunicable diseases in populations in the capitals of Brazil between 2006 and 2018

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ABSTRACT

Study design: Cross-sectional descriptive study. **Objective:** The aim of this study was to analyze the evolution of the prevalence of overweight, obesity and NCD, and they relationship with age and studying years, in Brazilian capitals. **Method:** Data from the VIGITEL Surveys, primarily for 2006 and 2018, were analyzed for 12 variables, using descriptive statistical procedures, frequency analysis and dispersion diagrams with insertion of trend curves and determination coefficients. **Results:** The results show a significant increase in the average BMI and the prevalence of NCD in the populations of the capitals of Brazil, although the self-perception of the general state of health presents an inexpressive change. The average BMI of the population is higher in the age group between 45 and 65 years old, and the prevalence of diabetes, high blood pressure and dyslipidemia has increased sharply since the age of 40, reaching its peak in the age group between 70 and 80 years. The more years of studies the population has, the lower the prevalence of obesity and NCD. **Conclusions:** Initiatives, both public and private, to reduce the risk factors that enhance the increase in obesity and NCD are necessary. Furthermore, the increase in the educational level of a population has the potential to promote significant improvement in the public health situation, reducing health expenditures and improving the quality of life of the population.

KEYWORDS: Obesity; Noncommunicable diseases; Diabetes; Cardiovascular Diseases; Public health.

INTRODUCTION

Obesity is a multifactorial, chronic and progressive disease that affects considerable portion of populations of the world, as well as the Brazilian's population [1–4]. According to the World Health Organization (WHO), more than 1.9 billion adults (people over 18 years) were overweight (39%) in 2014, and more than 600 million were considered obese (13%) [5]. In Brazil, the high levels of prevalence of obesity observed in the population is a critical factor, since, according to data published by the Brazilian Ministry of Health, in 2013 about 30% of the country's children were overweight or obese. More up-to-date data made available through VIGITEL 2017, a comprehensive surveillance study of risk and protective factors for chronic diseases conducted by telephone survey carried out annually by the Brazilian Ministry of Health, revealed that about 18.9% of the population was diagnosed as obese and 54% was overweight [6].

Collective obesity and obesogenic environments, a societal phenomenon observed in several populations around the world, has serious implications for public health, having social, economic and environmental implications. Considering aspects associated with the individual's health and public health, previous studies have shown that the prevalence of obesity has the potential to increase the risk of morbidity and mortality due to several NCDs (Noncommunicable Diseases), such as diabetes mellitus, cardiovascular disease, chronic respiratory diseases, depression and cancer [7–9], resulting in a potential increase in public health expenditures [10–12]. In the United States, a previous study showed that medical costs associated with obesity reach US$ 209.7 billion and that the effective reduction of the population's weight could generate a cost reduction of US$ 610 billion in 20 years [13]. In Brazil, a previous study showed that in 2017 10,840 gastroplasty procedures were financed by SUS, totaling approximately R$ 69 million[14].

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NCDs represent a serious public health problem worldwide and in Brazil. In fact, NCDs are the most responsible for deaths in the world, with cardiovascular diseases being the main among them[15]. The main NCDs (cardiovascular, cancer, diabetes, chronic respiratory diseases and neuropsychiatric diseases) were associated with some about 74 % of deaths in Brazil in 2016, and the risk rate for premature death from NCD for people aged between 30 and 70 years is estimated at 17%. In addition to premature death, NCDs also imply a great loss of quality of life and economic and social costs [16].

Considering the urgency of the topic, this study aimed to analyze the evolution of the prevalence of overweight, obesity (levels I, II and III) and NCDs (diabetes, high blood pressure, dyslipidemia and cardiovascular diseases), and its relationship with age and studying years, in Brazilian's populations resident at capital cities.

METHOD

This study analyzes data from the VIGITEL survey (Risk Factor Surveillance System for NCDs) published by the Brazilian Ministry of Health, carried out from 2006 to 2018. This systematic survey conducted by the Ministry of Health was initiated in 2006 and is carried out annually by the Brazilian government, generating annual data on adult populations (≥ 18 years old) residing in the 26 Brazilian capitals and the Federal District. The method adopted by the VIGITEL system is quite robust, being established that the minimum sample size in each of the capitals must be at least 2,000 telephone interviews, to estimate the frequency of the investigated variables with a 95% confidence coefficient and 2% sample error[17].

For the specific purposes of this research, this study compiled data from four VIGITEL editions (2006, 2008, 2016 and 2018), regarding 12 key variables described in the Table 1. It is important to highlight that the answers for the main questions were self-reported.

From the database built for the study, BMI was calculated for each of the records, using the standard formula of BMI = [weight] / [height]^2. Then, the BMI values obtained were classified according to the categoriesprovided by the World Health Organization (WHO), being: (1) normal [BMI<25]; (2) overweight [BMI≥25]; (3) obesity I [BMI≥30]; (4) obesity II [BMI≥35]; and (5) obesity III [BMI≥40][18].

Table 1
VIGITEL variables analyzed in the study

Code	Variable	Description of the issue	Years analyzed
City	Capital of BR	City / State	2006 and 2018
q6	Age (years)	How old are you? (Only accepts ≥18 years and <150 years)	2006 and 2018
q7	Gender	Gender [1 = male; 2 = female]	2006 and 2018
anoescol	Studying Years	Calculated based on question q8 (Up to which grade did you study?).	2006 and 2018
q9	Weight (kg)	Do you know your weight (even if it is an approximate value)? (Only accepts ≥ 30 kg and <300 kg)	2006 and 2018
q11	Height (cm)	Do you know your height? (Only accepts ≥ 1.20 m and <2.20 m)	2006 and 2018
q14	Pregnancy	Are you pregnant at the moment? [1 = yes; 2 = no]	2006 and 2018
q74	Perception of Health Status	You would rate your health status as: [1 = very good; 2 = good; 3 = regular; 4 = bad; 5 = very bad; 777 = does not know; 888 = did not want to inform]	2006 and 2018
q75	High pressure	Has any doctor ever told you that you have high blood pressure? [1 = yes; 2 = no]	2006 and 2018
q76	Diabetes	Has any doctor ever told you that you have diabetes? [1 = yes; 2 = no]	2006 and 2018
q77	Heart attack, stroke	Has a doctor ever told you that you have had a heart attack or stroke? [1 = yes; 2 = no]	2008
q78	Dyslipidemia	Has any doctor ever told you that you have high cholesterol or triglycerides? [1 = yes; 2 = no]	2006 and 2016

Data were analyzed using descriptive statistics and frequency analysis procedures. Specifically for examining the relationship between age, studying years and prevalence of obesity and self-reported NCD, the study uses scatter diagrams with the inclusion of regression equations and their respective coefficients of determination (R^2). The following variables were considered as dependent variables, impacted by age and the number of studying years: (1) Average BMI; (2) prevalence of obesity I; (3) prevalence of obesity II; (4) prevalence of diabetes; (5) prevalence of high blood pressure; (6) prevalence of dyslipidemia; (7) prevalence of heart attack and stroke; and (8) self-assessment of general health status.

The study proceeded with a comparative analysis of VIGITEL data for the years 2006 and 2018. Specifically, for dyslipidemia, the comparison is made between the years 2006 and 2016 since this was the last year with available data for this variable. For the calculation of the average BMI, women who manifested a pregnancy situation at the time of data collection were disregarded.

It is worth mentioning that the VIGITEL system was approved by the National Committee for Ethics in Research with Human Beings (CONEP) of the Brazilian Ministry of Health and, because it is a telephone interview, verbal consent was obtained, instead of the free consent and enlightened term.

RESULTS AND DISCUSSION

Table 1 shows the analysis of the evolution of the average BMI, general perception of health status, prevalence of high blood pressure, diabetes and dyslipidemia.

Table 1

Evaluation of health and NCD indicators in the Capitals of Brazil

	Average BMI [a]		Severity of Health Status [b]		High Blood Pressure [c]		Diabetes [c]		Dyslipidemia [c]	
	2006	2018	2006	2018	2006	2018	2006	2018	2006	2016[d]
BRAZIL [e]	**24.40**	**26.41**	**2.25**	**2.25**	**23.83%**	**34.98%**	**5.57%**	**11.26%**	**20.35%**	**30.47%**
1- Aracaju	24.32	26.33	2.28	2.29	24.37%	36.23%	5.47%	11.59%	27.16%	37.57%
2- Belém	24.39	26.47	2.35	2.27	20.79%	29.30%	5.40%	9.85%	22.29%	33.28%
3- Belo Horizonte	23.84	26.24	2.10	2.14	25.69%	40.01%	4.67%	12.36%	19.14%	29.49%
4- Boa Vista	24.50	26.35	2.34	2.26	21.18%	26.17%	4.86%	8.33%	15.70%	23.64%
5- Campo Grande	24.66	26.88	2.15	2.20	26.22%	39.85%	5.16%	12.80%	17.94%	31.33%
6- Cuiabá	24.83	27.01	2.22	2.23	23.88%	33.53%	5.36%	10.55%	14.17%	24.95%
7- Curitiba	24.91	26.35	2.13	2.17	24.44%	35.96%	6.36%	12.39%	20.29%	33.37%
8- Florianópolis	24.30	26.28	2.08	2.11	20.72%	32.07%	5.17%	11.02%	22.29%	31.02%
9- Fortaleza	24.20	26.73	2.22	2.28	22.51%	33.25%	5.72%	14.94%	18.44%	30.09%
10- Goiânia	24.20	26.19	2.23	2.24	24.70%	37.57%	6.18%	11.33%	20.08%	29.72%
11- João Pessoa	24.50	26.28	2.28	2.29	27.80%	36.31%	6.37%	11.79%	24.21%	34.13%
12- Macapá	24.85	26.51	2.37	2.27	21.99%	34.58%	4.92%	8.93%	17.82%	29.47%
13- Maceió	24.09	26.15	2.37	2.36	26.27%	38.57%	7.19%	13.75%	22.93%	34.56%
14- Manaus	24.96	26.97	2.32	2.29	21.73%	30.36%	5.20%	9.06%	20.49%	31.58%
15- Natal	24.72	26.33	2.28	2.27	25.51%	35.64%	5.77%	11.57%	25.14%	34.89%
16- Palmas	23.97	25.97	2.18	2.14	15.29%	25.07%	3.50%	7.23%	16.92%	27.19%
17- Porto Alegre	24.98	26.60	2.09	2.14	25.31%	39.56%	5.12%	13.43%	22.90%	29.88%
18- Porto Velho	24.64	26.63	2.27	2.25	21.53%	29.79%	4.95%	9.57%	18.07%	25.62%
19- Recife	24.61	26.45	2.31	2.38	29.31%	39.25%	6.13%	11.67%	21.53%	31.17%
20- Rio Branco	24.65	26.86	2.40	2.29	24.78%	35.80%	4.35%	9.17%	17.84%	25.75%
21- Rio de Janeiro	24.68	26.70	2.26	2.31	29.93%	44.13%	7.03%	14.21%	22.79%	28.34%
22- Salvador	24.06	26.29	2.31	2.36	27.25%	36.65%	5.84%	10.59%	22.23%	34.50%
23- São Luis	23.27	25.73	2.37	2.31	20.08%	28.99%	6.03%	9.73%	19.13%	29.27%
24- São Paulo	24.78	26.69	2.21	2.21	24.77%	35.38%	7.50%	11.84%	16.68%	26.11%
25- Teresina	23.59	25.95	2.37	2.30	20.41%	32.72%	4.78%	8.73%	18.96%	30.68%
26- Vitória	24.03	26.15	2.19	2.13	26.10%	37.61%	5.79%	12.19%	22.24%	32.45%
27- Distrito Federal	24.46	26.13	2.10	2.23	21.19%	35.18%	5.69%	12.09%	21.75%	31.74%

Note: [a] women who manifested pregnancy status at the time of the interviews were disregarded to calculate the average BMI; [b] Variable based on self-rated health assessed using a 5-point scale ranging from 1 (very good) to 5 (very poor); [c] variable measured using a dichotomous scale (1 = yes; 2 = no); [d] The year 2016 was used as this was the last year available with data for this variable; [e] General Average considering the capitals of Brazil

The results show a significant increase in the average BMI in the population residing in the capitals of Brazil, going from 24.4 in 2006 to 26.41 in 2018. It is also observed that the average BMI increased by 2 points in all capital cities of the country, and that Cuiabá, Manaus and Campo Grande are the capitals with the highest average BMI values in the population in 2018, with 27.01, 26.97 and 26.88 respectively. It is also observed that the prevalence of high blood pressure, diabetes and dyslipidemia increased significantly in the capitals of Brazil in the analyzed period. The population of Brazilian capitals with high blood pressure rose from 23.83% in 2006 to 34.98% in 2018, the prevalence of diabetes rose from 5.57% in 2006 to 11.26% in 2018, and the population share with dyslipidemia rose from 20.35% in 2006 to 30.47 % in 2016. Although the prevalence of high blood pressure, diabetes and dyslipidemia has increased significantly in the capitals of Brazil, the self-perception of the health status of the population has shown no significant change, suggesting that although the NCD self-reported are increasing dramatically in recent years, Brazilian people do not evaluate this increase as a worsening in their general health.

Regarding the prevalence of diabetes, a disease responsible for numerous health complications and high costs, the results show that Fortaleza, Rio de Janeiro and Maceió presented quite expressive portions in 2018 of this NCD, being 14.94%, 14.21% and 13,75% of the population respectively. Rio de Janeiro, Belo Horizonte, Campo Grande, Porto Alegre and Recife also present significant portions of the population with high blood pressure in 2018. It is also observed that Aracajú, Natal and Maceió present high portions of the population with dyslipidemia in 2016.

Next, Table 2 shows the evolution of the prevalence of overweight and the 3 levels of obesity observed in the populations of the capitals of Brazil for the years 2006 and 2018. It should be noted that diagnoses based on higher BMI are also accounted for in lower BMI diagnoses. For example, the population with obesity III is also counted in the population with levels II, I and overweight obesity.

The prevalence of overweight and obesity, in its three levels, showed a significant increase in the period considered in the study. In fact, the proportion of the population residing in the capitals of Brazil that is overweight increased from 39.06% in 2006 to 51.93% in 2018, which indicates that more than half of the population in the Brazilian capitals is overweight. The prevalence of the three levels of obesity also show a high increase, since the prevalence of obesity I changed from 10.73% in 2006 to 17.87% in 2018, whereas the prevalence of obesity II changed from 2.63% in 2006 to 4.66% in 2018, and the prevalence of obesity III increased from 0.73% in 2006 to 1.24% in 2018, suggesting that collective obesity is increasing alarmingly in Brazil.

Table 2

Prevalence of overweight and types of obesity in the capitals of Brazil (2006 and 2018)

	% Overweight (BMI ≥ 25) [a]		% Obesity I (BMI ≥ 30) [a]		% Obesity II (BMI ≥ 35) [a]		% Obesity III (BMI ≥ 40) [a]	
	2006	**2018**	**2006**	**2018**	**2006**	**2018**	**2006**	**2018**
BRAZIL [b]	39.06%	51.93%	10.73%	17.87%	2.63%	4.66%	0.73%	1.24%
1- Aracaju	36.78%	49.75%	11.33%	16.90%	2.63%	4.82%	0.75%	0.89%
2- Belém	38.90%	50.97%	11.23%	16.74%	2.78%	5.07%	0.89%	1.19%
3- Belo Horizonte	34.97%	52.83%	8.30%	17.46%	1.95%	4.05%	0.50%	1.45%
4- Boa Vista	38.64%	31.66%	10.99%	10.94%	3.01%	3.16%	0.85%	0.80%
5- Campo Grande	42.64%	59.53%	10.97%	22.27%	2.99%	6.08%	0.38%	1.58%
6- Cuiabá	42.73%	63.85%	11.55%	24.27%	3.04%	6.30%	0.77%	1.71%
7- Curitiba	43.27%	54.97%	12.35%	18.22%	3.16%	3.77%	1.05%	1.05%
8- Florianópolis	38.49%	57.82%	9.58%	19.06%	1.79%	4.71%	0.65%	0.92%
9- Fortaleza	38.90%	55.40%	10.05%	19.30%	2.40%	5.15%	0.85%	1.65%
10- Goiânia	36.54%	51.43%	10.23%	17.59%	2.66%	4.66%	0.80%	1.55%
11- João Pessoa	39.13%	50.82%	12.59%	17.34%	3.05%	4.20%	0.80%	1.00%
12- Macapá	41.27%	38.52%	12.41%	13.59%	3.43%	4.44%	1.01%	1.07%

(Continues)

(Continuation)

	% Overweight (BMI ≥ 25) [a]		% Obesity I (BMI ≥ 30) [a]		% Obesity II (BMI ≥ 35) [a]		% Obesity III (BMI ≥ 40) [a]	
	2006	**2018**	**2006**	**2018**	**2006**	**2018**	**2006**	**2018**
13- Maceió	36.47%	49.25%	10.71%	15.79%	2.67%	4.38%	0.45%	0.91%
14- Manaus	42.03%	46.52%	13.02%	17.61%	3.28%	4.64%	1.01%	1.46%
15- Natal	40.54%	52.28%	11.69%	18.72%	3.01%	3.66%	0.75%	0.80%
16- Palmas	35.45%	52.79%	8.62%	16.13%	1.72%	3.65%	0.61%	0.61%
17- Porto Alegre	45.35%	63.56%	12.05%	21.93%	3.31%	5.65%	1.09%	1.83%
18- Porto Velho	40.36%	56.56%	12.76%	21.44%	3.28%	5.30%	0.61%	1.16%
19- Recife	41.24%	54.21%	11.24%	18.87%	2.72%	4.91%	0.63%	1.41%
20- Rio Branco	39.74%	39.59%	11.62%	14.39%	2.72%	4.73%	0.86%	1.11%
21- Rio de Janeiro	45.31%	58.49%	12.16%	21.05%	3.32%	6.37%	0.91%	1.66%
22- Salvador	37.34%	49.27%	9.21%	16.96%	1.61%	4.93%	0.55%	1.51%
23- São Luis	30.41%	48.59%	7.10%	14.25%	1.71%	2.92%	0.45%	0.76%
24- São Paulo	41.68%	60.10%	10.63%	21.70%	2.90%	5.85%	1.34%	1.77%
25- Teresina	32.23%	47.90%	8.21%	15.72%	1.60%	3.95%	0.40%	1.20%
26- Vitória	37.03%	50.03%	8.97%	16.83%	2.17%	4.84%	0.30%	1.46%
27- Distrito Federal	39.50%	59.27%	10.42%	19.22%	2.35%	4.20%	0.45%	1.23%

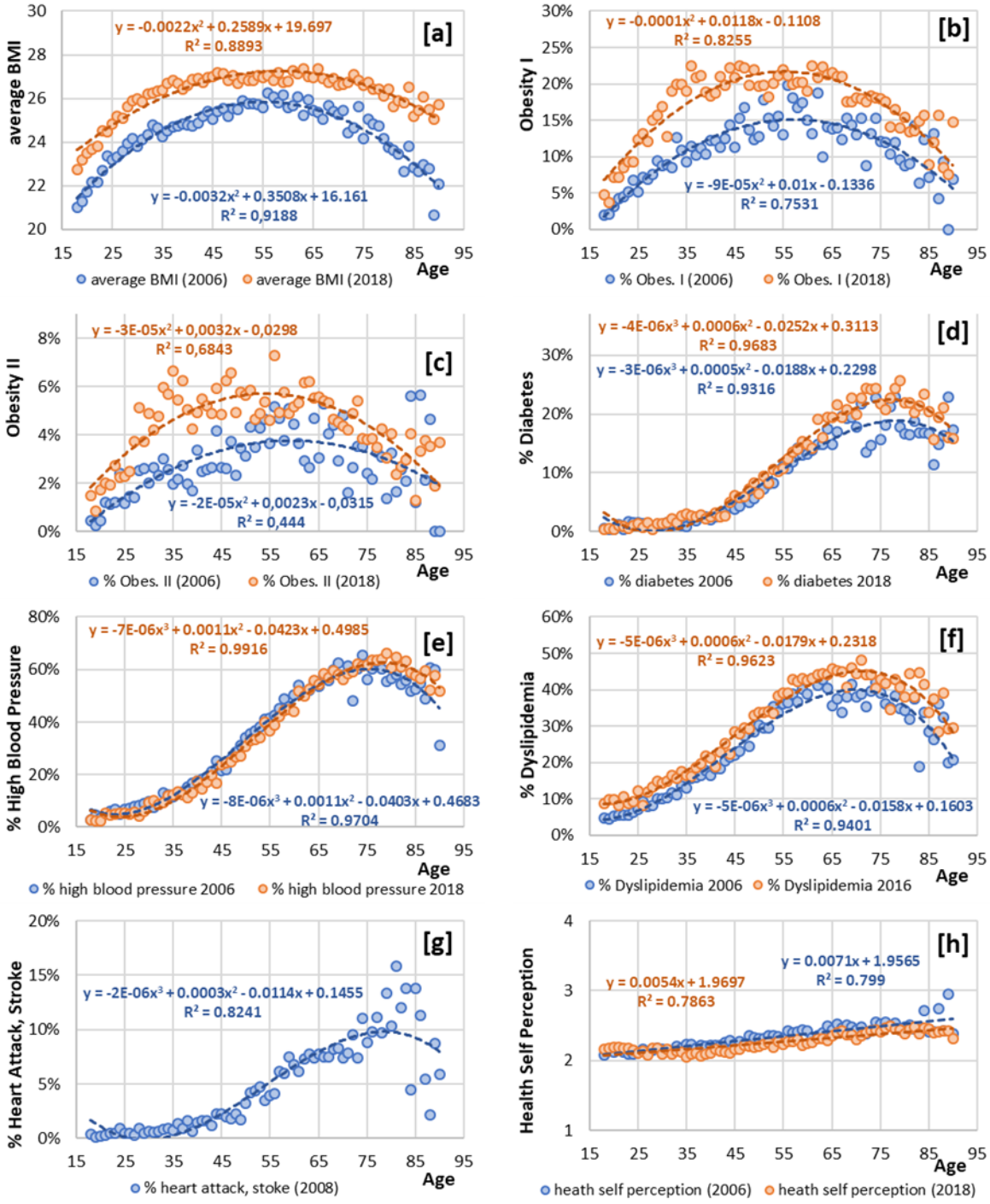
Note: [a] women who manifested pregnancy status at the time of the interviews were disregarded to calculate the mean BMI; [b] portion of the population residing in the capitals of Brazil.

The significant increase in the average BMI and the prevalence of obesity in the populations of the capitals of Brazil can be triggered by several factors such as increased sedentary lifestyle and changes in eating habits, such as the increase in consumption of processed and ultra-processed foods [19,20]. In this sense, like other countries, initiatives aimed at regulating the consumption of such foods by the population, and regulating the actions of companies in the food sector are strategies that may come to play a fundamental role in reducing the consumption of such foods 21–23, resulting in improved health indicators and reduced risk factors for the population of Brazil.

The increased prevalence of obesity in the Brazilian population has severe implications for public health and the economy of the country [19,24,25]. In fact, previous study estimated that the total cost of hypertension, diabetes and obesity to the public health system in Brazil in 2018 reached approximately R$ 3.45 billion, being 59% to the treatment of hypertension, 30% to the treatment of diabetes and 11% to the treatment of obesity[26]. Therefore, the prevalence of NCDs associated with obesity represents a high cost to the public health system in Brazil, and initiatives, both public and private, to reduce the risk factors that enhance the increase in such diseases are necessary.

It is observed that all capitals have alarming prevalence of overweight and obesity, but this prevalence is higher for Cuiabá, Porto Alegre, São Paulo, Distrito Federal and Rio de Janeiro, which present the largest portions of the population in situations of overweight and obesity in its 3 levels. On the other hand, Boa Vista, Macapá and Rio Branco show little or no increase in the prevalence of overweight and obesity in their populations. In fact, the share of the overweight population in Boa Vista changed from 38.64% in 2006 to 31.66% in 2018, and the share of the overweight population (at 3 levels) remained virtually unchanged, although it has a significant increase in the prevalence of diabetes and dyslipidemia was observed (Table 1).

Figure 1 is composed of 8 scatter diagrams that analyze the relationship between the age of respondents in VIGITEL surveys and the average BMI (Fig. 1a), prevalence of obesity I (Fig. 1b), prevalence of obesity II (Fig. 1c), prevalence of diabetes (Fig. 1d), the prevalence of high pressure (Fig. 1e) dyslipidemia (Fig. 1f), the prevalence of heart attack and stroke (Fig. 1g), and self-perceived general health (Fig. 1h).



Note: For charts [a], [b] and [c], women who manifested pregnancy status at the time of the interviews were excluded.

Figure 1: Relationship between age and health indicators (average BMI, prevalence of obesity levels I and II, and prevalence of diabetes, high blood pressure and dyslipidemia)

The results show that the average BMI of the population increased from 2006 to 2018 proportionally at all ages in the populations of the capitals of Brazil. In addition, results show that the average BMI is higher in the age group between 45 and 65 years. The trend curve that best fits the data is the second-degree equation with higher R^2 (Fig. 1a). A similar interpretation is

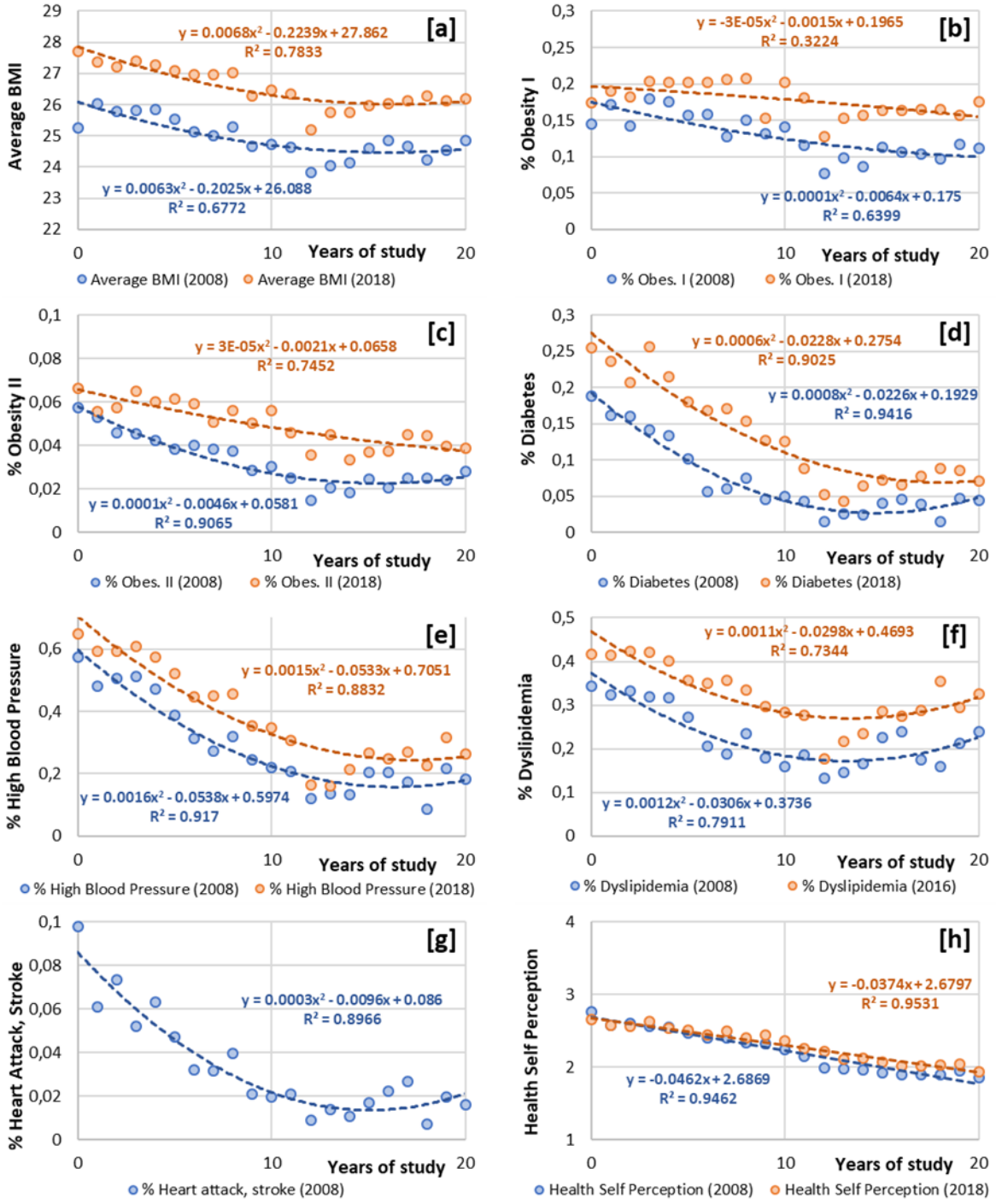
given for the analysis of the relationship between age and the population prevalence of obesity I (Fig. 1b), since the second-degree equation has a satisfactory fit to the data, and the age group with the highest proportion of obese population I is around 55 years old. The relationship between age and the prevalence of diabetes, high blood pressure and dyslipidemia shows that from the age of 40 the prevalence of such comorbidities shows a marked growth, reaching its peak in the range between 70 and 80 years, and the polynomial equation of third-degree presents better adjustment.

Aging tends to be associated with an increase in body fat, since increasing age leads to a decrease in the secretion of growth hormone, decreasing the rate of basal metabolism, decreasing lean mass and increasing the amount of body fat [27]. This can lead to a significant increase in BMI during the aging process. In addition, previous experiences associate variation and weight gain in adulthood with the increased risk of mortality and development of NCDs, also relating weight gain in adulthood with the increased incidence of some types of cancer and cardiovascular disease [28–30]. Also, previous studies demonstrate the existing significance between increasing age, in addition to other sociodemographic characteristics, with the increase in BMI, recommending that public health promotion strategies related to the prevention of weight gain at the population level should consider important sociodemographic factors [31,32].

Observing the equation estimated for the prevalence of diabetes in 2018, the peak occurs at the prevalence of proximately 22% observed in the 78-year age group (Fig. 1d). For the prevalence of high blood pressure in 2018, the peak is observed at a prevalence of approximately 62% observed in the age group of 78 years (Fig. 1e). As for the prevalence of dyslipidemia in 2018, the peak found was approximately 56% observed in the 73-year-old age group (Fig. 1f). Regarding the prevalence of cardiovascular diseases (myocardial infarction, and stroke), the available data is 2008, and the peak observed in the equation estimated was approximately 10% observed in the age group of 78 years, although the observable data show registered prevalence 16% at 81 years of age (Fig. 1g). Although with the advancing age of the population the prevalence of comorbidities increases significantly, the increase in self-perceived worsening health status increases very little (Fig. 1h), suggesting that the prevalence of diabetes, high blood pressure and dyslipidemia does not impact directly in the self-perception of worsening of people's general health.

Important evidence from this study is the weak connection observed between the health indicators and the population's self-perception regarding their health, since the results observed for the variables that assess the population's health showed a significant worsening from 2006 to 2018, while the variable related to self-perceived health status showed an insignificant change, reinforcing the findings of the study that shows that people tend not to associate weight with health [33].

Figure 2 complements the previous analysis, also presenting 8 scatter diagrams that aim to analyze the relationship between the number of studying years of the respondents with the variables related to the health of the populations of the capitals of Brazil.



Note: For charts [a], [b] and [c], women who manifested pregnancy status at the time of the interviews were excluded.

Figure 2: Relationship between years of study and health indicators (average BMI, prevalence of obesity levels I and II, and prevalence of diabetes, high blood pressure and dyslipidemia)

The results show that the average BMI of the population tends to decrease, both for the 2006 and 2018 data, as the number of studying years of the population increases (Fig. 2a). It is also observed that the increase in the number of studying years of the population tends to reduce the prevalence of obesity I (Fig. 2b), obesity II (Fig. 2c), diabetes (Fig. 2d), high blood

pressure (Fig. 2e), dyslipidemia (Fig. 2f), and cardiovascular diseases (Fig. 2g). Furthermore, respondents' self-perception is of better health as the number of years of study increases (Fig. 2f).

Another important finding of this study is the relationship between the number of years of studies and health indicators, showing that formal education has the potential to improve the health of a population. This result corroborates other findings, such as a Canadian study which showed that individuals with fewer years of formal education consume more ultra-processed foods, and that such consumption is positively associated with obesity 34. Following another line of investigation, a previous study showed that the level of education and parental intervention in children's food tends to trigger healthier eating habits 35. Therefore, it is reasonable to assume that an increase in the educational level of a population has a high potential to promote improvement in the public health situation, potentially reducing health spending and improving the quality of life of the population.

CONCLUSION

This study shows that the average BMI of the Brazilian population is increasing sharply, and that the prevalence of NCDs, especially diabetes and hypertension, accompanies such growth. It is reasonable to assume that such a worsening of the health situation of the populations of the capitals of Brazil has the potential to dramatically increase the demands of the population for services in the health system in Brazil in the coming years, which triggers the need to increase capacity and allocate a greater amount financial resources to the health system, both public and private.

It was also evidenced that the average BMI of the population is higher for the age group between 45 and 65 years old, and the prevalence of diabetes, high blood pressure and dyslipidemia show a marked increase from 40 years old, reaching the peak in the age group between 70 and 80 years old. The study also showed that the level of formal education, assessed through the number of years of study, has a strong relationship with the prevalence of obesity and NCDs, whereas the more years of study the population has, the lower the prevalence of such comorbidities. Thus, initiatives, both public and private, to reduce the risk factors that enhance the increase in obesity and NCDs are necessary. In addition, the increase in the educational level of a population has the potential to promote significant improvement in the framework of public health, reducing health expenditures and improving the quality of life of the population.

This study has important limitations as it only uses data from the VIGITEL editions. Thus, the analyzed data are regarding habitants of capital cities in Brazil, which prevents an analysis of populations living in inland districts or rural area of the country, which represents a large portion of the population. Thus, it is suggested that additional studies should be carried out that aim to analyze and monitor the situation of obesity and overweight in the Brazilian population living in municipalities in the interior and rural areas, in addition to identifying the main factors that trigger the possible prevalence of obesity in these locations. It is also suggested that additional studies be conducted to analyze the repercussions of worsening obesity and NCDs on costs associated with the Brazilian public health system, as well as other costs to society, such as social and labor implications.

In due course, this study recommends that more effective public initiatives should be designed and adopted in order to promote a significant reduction in the prevalence of non-communicable diseases in Brazil, especially the promotion of public policies targeting children and adolescents.

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