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## Food consumption pattern and health risk factors in the Brazilian population from 2008 to 2017

### *Padrão de consumo alimentar e fatores de risco à saúde na população brasileira de 2008 a 2017*

#### Abstract

**Objective:** This study aimed to analyze the changes in food consumption patterns and indicators regarding health risk factors in the Brazilian population. **Method:** The study analyzed data obtained from VIGITEL surveys in years 2008, 2011, 2014 and 2017. The study selected variables related to eating habits and health perception indicators, in addition to weight and height, to calculate the BMI (Body Mass Index), as well as age and years of schooling of respondents. Data were analyzed using frequency tables and specific statistical procedures as the Student's *t* test, Pearson's correlation and the linear regression slope. **Results:** The results suggest that the average BMI of the Brazilian population is increasing, reaching an average value of 26.32 in 2017. It is also observed that Brazilians evaluate their health as good, although the prevalence of diagnoses of high blood pressure, diabetes and dyslipidemia has increased considerably in recent years. Individuals diagnosed with high blood pressure, diabetes or dyslipidemia have a significantly lower frequency of consumption of beans, vegetables, soft drinks, and alcohol; and a significantly higher frequency of fruits consumption. The results also revealed that the number of years of schooling is positively and significantly associated with the frequency of consumption of vegetables, fruits, alcohol, and the habit of replacing dinner for snacks. **Conclusion:** Although nutritional habits of Brazilians have improved, the increased number of diagnoses of non-communicable diseases is worrying and requires the proper design of public healthcare policies.

**Keywords:** Eating. Obesity. Noncommunicable diseases. Public health. Food and Nutrition Security.

#### Resumo

**Objetivo:** Este estudo teve como objetivo analisar as mudanças na frequência de consumo de certos alimentos e indicadores relacionados aos fatores de risco à saúde na população brasileira. **Método:** Foram utilizados dados obtidos em pesquisas da VIGITEL dos anos de 2008, 2011, 2014 e 2017. O estudo selecionou variáveis relacionadas aos hábitos alimentares e indicadores de percepção de saúde, além de peso e altura, para o cálculo do IMC (Índice de Massa Corporal), idade e anos de estudo dos entrevistados. Os dados foram analisados por meio de tabelas de frequências e procedimentos estatísticos específicos, como o teste *t* de Student, correlação de Pearson e a inclinação da regressão linear. **Resultados:** Os resultados sugerem que o IMC médio da população brasileira está aumentando, atingindo um valor médio de 26,32 em 2017. Observa-se também que os brasileiros avaliam sua saúde como

positiva, embora a prevalência de diagnósticos de pressão alta, diabetes e dislipidemia tenha aumentado consideravelmente nos últimos anos. Indivíduos diagnosticados com pressão alta, diabetes ou dislipidemia apresentam frequência significativamente menor de consumo de feijão, vegetais, refrigerantes e álcool; e frequência significativamente maior de consumo de frutas. Os resultados também revelaram que o número de anos de estudo está associado positiva e significativamente com a frequência de consumo de vegetais, frutas, álcool e o hábito de trocar o jantar por lanches. **Conclusão:** Embora os hábitos alimentares dos brasileiros tenham melhorado, o aumento do número de diagnósticos de doenças não transmissíveis é preocupante e requer a adoção de políticas públicas de saúde.

**Palavras-chave:** Ingestão de alimentos. Obesidade. Doenças não transmissíveis. Saúde pública. Segurança Alimentar e Nutricional.

## INTRODUÇÃO

The obesity pandemic is plaguing humanity since considerable portion of the world's population are diagnosed with overweight or obesity.<sup>1-3</sup> Indeed, according to the World Health Organization regarding world's population, in 2016 about 39% of adults aged 18 years and over were overweight and 13% were obese.<sup>4</sup> Brazil also faces the problem of obesity, since the prevalence of obesity in the population increased from 11.8% in 2006 to 19.8% in 2018.<sup>5</sup> Thus, according to data from the 2013 National Health Survey, a study conducted by the Brazilian Institute of Geography and Statistics (IBGE) that assesses the health situation of the population of Brazil, about 37% of diabetics and 36.3% of hypertensive patients were obese, and about 75.2% of diabetics and 74.4% of hypertensive patients were overweight.<sup>6</sup>

Changes in food consumption patterns are somehow responsible for the obesity pandemic worldwide.<sup>2,7</sup> Increasing levels of processed and ultra-processed food supply and consumption are drastically impacting on dietary patterns and health issues worldwide.<sup>8,9</sup> Ultra-processed foods include those food products strongly based on refined substances, usually ready-to-consume, and entirely or mostly made from industrial ingredients and additives.<sup>10,11</sup> Higher dietary share of ultra-processed foods undermines the nutritional quality of diets,<sup>12</sup> increases obesity and other risk factors for non-communicable diseases (NCDs),<sup>13</sup> and rises public health costs and expenditures.<sup>14</sup>

In addition to the worsening of obesity, there is also an increased prevalence of NCDs, such as diabetes and diseases of the circulatory system, that can be caused mainly by the increased incidence of obesity.<sup>15</sup> It is also observed that aspects of people's daily living and lifestyle (e.g. greater sedentary, smoking and high stress levels) may potentially increase NCDs diagnoses.<sup>16,17</sup> In fact, studies show that levels of diabetes and cardiovascular diseases are increasing severely in Brazil and worldwide.<sup>18,19</sup> Also, previous study estimated that the total cost for the Brazilian Unified Health System (SUS) associated with diagnoses of hypertension, diabetes and obesity reached R\$ 3.45 billion (about US\$ 890 million) in 2018.<sup>20</sup>

Studies have argued that increased production and sales of ultra-processed foods in low-income and middle-income countries may be associated with the rising severity of NCDs.<sup>11</sup> In Brazil, there is evidence that the household consumption of ultra-processed ready-to-eat or ready-to-heat food products, richer in added sugar, saturated fat, sodium, energy density, has highly increased in last decades.<sup>21</sup> Furthermore, the obesity epidemic in Brazil is strongly associated with high consumption of ultra-processed foods.<sup>22,23</sup>

This study aims to analyze the changing in food consumption patterns and health indicators in the Brazilian population, using data obtained from VIGITEL from 2008 to 2017. In this context of changing eating habits and growth trends in rates of obesity, this study supports public policy decisions, helps a greater theoretical and information basis for the academy and, finally, is valued in the field of practice for public and private hospital administration.

## METHOD

This study analyzes data from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL) carried out in the years 2008, 2011, 2014 and 2017. This systematic survey started in 2006 and is conducted annually by the Brazilian government, generating annual data on adult populations ( $\geq 18$  years old) in the 26 Brazilian state 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, in order to estimate the frequency of the investigated variables with a 95% confidence coefficient and sample error of 2%.<sup>24</sup>

For the specific purposes of this investigation, we selected 13 standardized questions of the VIGITEL survey that are relevant for the research objectives. Table 1 shows the details about the analyzed questions. Also, the following demographic variables that characterized the study population were analyzed: (1) gender; (2) age; (3) schooling years; (4) height; and (5) weight. Height and weight enabled the calculation of BMI (Body Mass Index) used as an indicator of health risk factor.

**Table 1.** Standardized VIGITEL research questions analyzed in the study in years 2008, 2011, 2014 and 2017. Brazil.

Code	Question	Answers
Q15	How many days a week do you usually eat beans?	(1) never; (2) almost never; (3) 1-2 days a week; (4) 3-4 days a week; (5) 5-6 days a week; and (6) every day.
Q17	How many days a week do you usually eat lettuce and tomato salad or any other raw vegetables?	
Q27	How many days a week do you usually eat fruit?	
Q29	How many days a week do you usually drink soda or artificial juice?	
R144a	How many days a week do you usually replace lunch food for sandwiches, pizza or other snacks?	
R144b	How many days a week do you usually replace dinner food for sandwiches, pizza or other snacks?	
Q35	Do you usually drink alcohol?	(1) does not usually consume alcoholic beverages; (2) less than 1 day per month; (3) less than 1 day a week; (4) 1-2 days a week; (5) 3-4 days a week; (6) 5-6 days a week; and (7) every day (including Saturday and Sunday).
Q36	How often do you consume an alcoholic beverage?	
Q74	Would you rate your health status as...	(5) very good; (4) good; (3) regular; (2) bad; and (1) very bad.
Q75	Has any doctor ever told you that you have high blood pressure?	(1) yes; (2) no.
Q76	Has any doctor ever told you that you have diabetes?	
Q78	Has any doctor ever told you that you have high cholesterol or triglycerides?	
Q60	Do you smoke?	(1) yes, daily; (2) yes, but not daily; (3) no.

It is worth noting that a 3-year interval was defined between each VIGITEL survey to be analyzed and compiled in the study database. This investigation analyzes data from VIGITEL surveys in years 2008, 2011, 2014 and 2017. We consider that this selection is adequate and enough to analyze the evolution of the variables investigated in the 10-year period. Considering the four years selected from the VIGITEL survey analyzed, it should be noted that questions R144a and R144b have data only for years 2014 and 2017; and question Q78 has data only for years 2008 and 2014.

After selecting the VIGITEL survey questions (variables) relevant to the study, data from the four selected years was compiled into a single database. Some adjustments were also made to allow data analysis using some statistical

techniques. Occasionally, the response scales were recategorized in scalar logic to allow the analysis of trend and dispersion statistics of the responses. Thus, questions Q15, Q17, Q27, Q29, R144a and R144b were re-categorized, and the original answer alternatives [(1) 1-2 days a week; (2) 3-4 days a week; (3) 5-6 days a week; (4) every day; (5) almost never; and (6) never] moved to the recategorized scale in order to assume an ordinal logic [(1) never; (2) almost never; (3) 1-2 days a week; (4) 3-4 days a week; (5) 5-6 days a week; and (6) every day].

Two questions about the consumption of alcoholic beverages (Q35 and Q36) were combined into only one variable to assess the degree of alcohol consumption, with a recategorization of the response alternatives as follows: (1) do not usually consume alcoholic beverages; (2) less than 1 day per month; (3) less than 1 day a week; (4) 1-2 days a week; (5) 3-4 days a week; (6) 5-6 days a week; and (7) every day (including Saturday and Sunday). Descriptive analysis was conducted by calculating measures of central tendency (arithmetic mean), and frequency distribution.

The results were analyzed in an interpretative perspective allowing the investigation of the evolution of the variables investigated in the study. The study also included the analysis of the Student's *t* test for comparison between groups, with the presence / absence of diagnosis of high blood pressure, diabetes and dyslipidemia among the respondents participating in the VIGITEL studies as grouping variables. Furthermore, the study used Pearson's correlation analysis, estimation of the linear regression slope and the regression determination coefficient ( $R^2$ ), and the F statistic obtained through the ANOVA test, so as to assess the degree of association between the average frequency of consumption of certain foods, and the age and schooling years of respondents in the 2017 VIGITEL survey. For using the ANOVA test, estimating the regression slope and calculating Pearson's linear correlation coefficient, the variables "age" and "years of schooling" were treated as categorical variables.

It is worth mentioning that the VIGITEL system was approved by the National Research Ethics Committee for Human Beings of the Brazilian Ministry of Health. Considering that this is a telephone interview, verbal consent was obtained, instead of the written free and informed consent term.

## RESULTS

To describe the sample profile and findings of some health issues for the Brazilian population, table 2 presents the frequency distribution and average value for specific questions addressed in the VIGITEL surveys.

**Table 2.** Profile and answers for questions about health issues for participants of VIGITEL surveys, study in the years 2008, 2011, 2014 and 2017. Brazil.

Variable	2008	2011	2014	2017
<b>N (sample)</b>	54 353	54 144	40 853	53 034
<b>Gender distribution</b>	Male = 39.44% Female = 60.56%	Male = 39.57% Female = 60.43%	Male = 37.99% Female = 62.01%	Male = 36.78% Female = 63.22%
<b>Average age in years</b> (standard dev.)	43.15 (16.48)	45.06 (16.94)	48.28 (17.63)	52.60 (18.22)
<b>Average schooling years</b> (standard dev.)	10.90 (4.98)	10.86 (4.95)	11.08 (5.10)	11.18 (4.96)
<b>Average BMI</b> (standard dev.)	24.82 (5.59)	25.81 (4.87)	26.18 (4.98)	26.32(4.89)

**Table 2.** Profile and answers for questions about health issues for participants of VIGITEL surveys, study in the years 2008, 2011, 2014 and 2017. Brazil. (Continues)

Variable	2008	2011	2014	2017
<b>N (sample)</b>	54 353	54 144	40 853	53 034
<b>arithmetic mean (1-5)</b>	3.82	3.79	3.72	3.78
<b>Q74</b> Health status				
[1] very poor	1.00% (545)	1.17% (635)	1.14% (467)	1.10% (585)
[2] poor	3.34% (1,814)	3.62% (1,958)	3.83% (1,563)	3.28% (1,739)
[3] regular	28.36% (15,414)	28.68% (15,526)	31.31% (12,793)	29.02% (15,388)
[4] good	47.24% (25,677)	47.44% (25,685)	47.49% (19,401)	48.26% (25,594)
[5] very good	19.82% (10,773)	18.51% (10,022)	14.71% (6,009)	17.43% (9,244)
do not know	0.21% (113)	0.55% (297)	1.45% (594)	0.77% (411)
no answer	0.03% (17)	0.04% (21)	0.06% (26)	0.14% (73)
<b>Q75</b> High blood pressure				
yes	26.02% (14,142)	27.86% (15,083)	31.72% (12,958)	35.16% (18,648)
no	73.89% (40,161)	72.05% (39,012)	68.07% (27,810)	64.72% (34,321)
does not know	0.09% (50)	0.09% (49)	0.21% (85)	0.12% (65)
<b>Q76</b> Diabetes				
yes	6.17% (3,353)	7.56% (4,091)	9.99% (4,081)	11.23% (5,956)
no	93.76% (50,964)	92.37% (50,013)	89.76% (36,670)	88.64% (47,007)
does not know	0.07% (36)	0.07% (40)	0.25% (102)	0.13% (71)
<b>Q78</b> Dyslipidemia				
yes	21.77% (11,830)	-	25.99% (10,618)	-
no	77.93% (42,359)	-	72.65% (29,681)	-
does not know	0.30% (164)	-	1.36% (554)	-
<b>Q60</b> Smoker				
yes. daily,	9.95% (5,408)	8.60% (4,658)	6.92% (2,825)	5.68% (3,010)
yes. but not daily	1.90% (1,031)	1.75% (946)	1.17% (479)	1.29% (684)
no	88.15% (47,914)	89.65% (48,539)	91.91% (37,549)	93.03% (49,340)

Os resultados apresentados na tabela 2 mostram que a proporção entre homens e mulheres nas amostras das edições da pesquisa VIGITEL analisadas no presente estudo manteve-se equilibrada, com maior participação das mulheres (cerca de 60%). Observa-se também que a idade média nas amostras permaneceu entre 43 e 53 anos, sendo que na pesquisa de 2017 a idade média foi a maior observada (52,6 anos). Além disso, a média de anos de estudo manteve-se na faixa de 11 anos nas edições analisadas do VIGITEL.

Os resultados sugerem que o IMC médio da população brasileira aumentou nos últimos anos, e que em 2011 já era assumido como um diagnóstico de excesso de peso (maior que 25). Essa evidência corrobora os achados de estudo anterior que sugeriu que entre 2006 e 2013 as populações de todas as regiões do Brasil tendiam à obesidade.<sup>25</sup> Essa evidência é particularmente importante, uma vez que a obesidade coletiva pode aumentar e

agravar os custos ambientais, uma vez que os hábitos de consumo alimentar têm implicações no meio ambiente e nos sistemas públicos de saúde.<sup>26</sup>

Uma das perguntas da pesquisa VIGITEL visa identificar as percepções dos respondentes sobre sua situação geral de saúde, em uma escala de 5 pontos que varia de “muito ruim” a “muito boa”. Em 2008 os resultados mostraram que a avaliação média do estado de saúde dos entrevistados foi de 3,82 pontos, com 47,24% dos entrevistados afirmando que consideravam seu estado geral de saúde bom, e 28,36% consideraram que apresentavam um estado de saúde regular. A percepção geral dos entrevistados para o ano de 2017 mudou muito pouco, com a avaliação média do estado de saúde dos entrevistados sendo 3,78 pontos, com 48,26% dos entrevistados dizendo que consideravam seu estado geral de saúde como bom, e 29% consideraram que apresentavam estado geral de saúde regular. Assim, em geral, os brasileiros consideram seu estado geral de saúde bom.

A avaliação geral de saúde e a inexpressiva mudança nessa percepção geral observada entre os anos de 2008 e 2017 contradiz os resultados obtidos para o número de entrevistados que afirmaram ter sido diagnosticados com hipertensão, diabetes e níveis elevados de colesterol e triglicérides. Em 2008, 26% dos entrevistados disseram ter sido diagnosticados com hipertensão e 6,17% dos entrevistados disseram que tinham sido diagnosticados com diabetes. Em 2017, 35,16% dos entrevistados disseram ter sido diagnosticados com hipertensão, e 11,23% disseram ter sido diagnosticados com diabetes. Essas evidências sugerem uma mudança considerável no estado de saúde da população brasileira.

Embora a frequência de diagnósticos de hipertensão, diabetes e colesterol / triglicérides elevados tenha aumentado, a frequência de tabagismo na população brasileira diminuiu nos últimos anos. Os dados mostram que, em 2008, 9,95% dos entrevistados afirmaram fumar diariamente, enquanto em 2017 essa proporção caiu para 5,68%.

A seguir, a tabela 3 apresenta os resultados obtidos para as questões que descrevem alguns hábitos alimentares dos inquiridos VIGITEL.

**Tabela 3.** Respostas das questões sobre hábitos de consumo da pesquisa VIGITEL, estudo nos anos 2008, 2011, 2014 e 2017. Brasil.

VIGITEL Year		2008	2011	2014	2017
N (sample size)		54,353	54,144	40,853	53,034
	<b>arithmetic mean (1-6)</b>	4.70	4.79	4.76	4.60
Q15 Frequency of beans consumption	[1] never	1.80% (980)	1.36% (739)	1.88% (769)	1.57% (833)
	[2] almost never	4.17% (2,269)	2.85% (1,541)	2.72% (1,113)	3.11% (1,649)
	[3] 1-2 days a week	15.68% (8,523)	15.25% (8,257)	15.46% (6,317)	17.77% (9,424)
	[4] 3-4 days a week	19.32% (10,502)	18.86% (10,213)	19.48% (7,959)	23.89% (12,672)
	[5] 5-6 days a week	18.83% (10,237)	19.28% (10,440)	17.89% (7,308)	18.15% (9,625)
	[6] every day	40.19% (21,842)	42.39% (22,954)	42.56% (17,387)	35.51% (18,831)
	<b>Q17 arithmetic mean (1-6)</b>	4.22	4.32	4.37	4.28
Frequency of lettuce and tomato salad or any other raw vegetables consumption	[1] never	2.71% (1,471)	2.13% (1,155)	2.98% (1,217)	2.28% (1,210)
	[2] almost never	5.18% (2,815)	3.88% (2,099)	3.63% (1,485)	3.91% (2,073)
	[3] 1-2 days a week	24.01% (13,052)	23.13% (12,523)	20.73% (8,468)	22.56% (11,966)
	[4] 3-4 days a week	23.12% (12,564)	23.49% (12,718)	24.04% (9,821)	26.82% (14,222)
	[5] 5-6 days a week	12.16% (6,608)	14.50% (7,851)	13.89% (5,673)	14.61% (7,746)
	[6] every day	25.45% (13,833)	26.29% (14,232)	28.77% (11,753)	24.80% (13,151)
	no answer	7.38% (4,010)	6.59% (3,566)	5.96% (2,436)	5.03% (2,666)

**Tabela 3.** Respostas das questões sobre hábitos de consumo da pesquisa VIGITEL, estudo nos anos 2008, 2011, 2014 e 2017. Brasil. (Continues)

VIGITEL Year		2008	2011	2014	2017
N (sample size)		54,353	54,144	40,853	53,034
<b>arithmetic mean (1-6)</b>		4.42	4.52	4.66	4.74
<b>Q27</b> Frequency of fruit consumption	[1] never	1.60% (867)	1.67% (905)	1.97% (805)	1.20% (638)
	[2] almost never	9.76% (5,305)	7.06% (3,820)	6.13% (2,505)	4.30% (2,282)
	[3] 1-2 days a week	19.61% (10,660)	19.49% (10,552)	16.49% (6,738)	16.21% (8,597)
	[4] 3-4 days a week	20.97% (11,397)	21.26% (11,510)	19.96% (8,154)	21.38% (11,340)
	[5] 5-6 days a week	10.04% (5,457)	10.85% (5,874)	10.30% (4,208)	11.37% (6,031)
	[6] every day	38.02% (20,667)	39.68% (21,483)	45.14% (18,443)	45.53% (24,146)
<b>arithmetic mean (1-6)</b>		3.32	3.3	2.86	2.55
<b>Q29</b> Frequency of soft drinks or artificial juice consumption	[1] never	11.04% (6,002)	12.28% (6,648)	22.51% (9,194)	26.06% (13,823)
	[2] almost never	18.72% (10,176)	16.74% (9,064)	19.72% (8,055)	25.77% (13,668)
	[3] 1-2 days a week	33.67% (18,301)	34.82% (18,855)	31.48% (12,861)	30.06% (15,941)
	[4] 3-4 days a week	14.64% (7,958)	14.88% (8,056)	11.36% (4,640)	9.18% (4,866)
	[5] 5-6 days a week	7.16% (3,891)	7.47% (4,047)	5.22% (2,133)	3.55% (1,881)
	[6] every day	14.76% (8,025)	13.80% (7,474)	9.72% (3,970)	5.38% (2,855)
<b>arithmetic mean (1-6)</b>		-	-	1.6	1.54
<b>R144a</b> Replace lunch food for snacks	[1] never	-	-	62.90% (25,695)	63.22% (33,529)
	[2] almost never	-	-	18.97% (7,749)	22.47% (11,916)
	[3] 1-2 days a week	-	-	14.60% (5,965)	12.07% (6,400)
	[4] 3-4 days a week	-	-	2.50% (1,023)	1.68% (892)
	[5] 5-6 days a week	-	-	0.47% (194)	0.34% (178)
	[6] every day	-	-	0.56% (227)	0.22% (119)
<b>arithmetic mean (1-6)</b>		-	-	2.95	2.85
<b>R144b</b> Replace dinner food for snacks	[1] never	-	-	29.83% (12,186)	28.65% (15,194)
	[2] almost never	-	-	14.30% (5,841)	16.81% (8,915)
	[3] 1-2 days a week	-	-	24.09% (9,843)	25.51% (13,528)
	[4] 3-4 days a week	-	-	10.95% (4,474)	11.39% (6,041)
	[5] 5-6 days a week	-	-	4.43% (1,809)	4.75% (2,518)
	[6] every day	-	-	16.40% (6,700)	12.89% (6,838)
<b>arithmetic mean (1-7)</b>		1.97	1.93	1.87	1.97
<b>Q35 and Q36</b> Alcohol consumption	[1] never	64.52% (35,066)	66.43% (35,968)	68.69% (28,062)	64.71% (34,317)
	[2] less than 1 day a month	6.30% (3,423)	5.12% (2,770)	5.12% (2,093)	5.71% (3,026)
	[3] less than 1 day a week	4.52% (2,455)	4.44% (2,406)	3.86% (1,578)	5.99% (3,179)
	[4] 1-2 days a week	19.88% (10,805)	19.63% (10,629)	17.84% (7,288)	18.10% (9,600)
	[5] 3-4 days a week	2.92% (1,585)	2.74% (1,482)	2.77% (1,133)	3.37% (1,785)
	[6] 5-6 days a week	0.51% (278)	0.51% (276)	0.45% (183)	0.65% (347)
	[7] every day	1.36% (741)	1.13% (613)	1.25% (511)	1.41% (746)

The data show that beans are a very common vegetable in the daily life of the Brazilian population; however, analyzing the trend of the data presented, there was a change in the habit of the population in the item on the consumption of beans every day of the week, from 40.19% in 2008 to 35.51% in 2017. This might be due to the fact that people have less time to prepare food with longer cooking times, such as beans, so the tendency is to decrease household consumption and increase expenses with snacks and food for fast consumption.<sup>27</sup>

In addition, Brazil stands out for being the third largest fruit producer in the world.<sup>28</sup> Fruit consumption in Brazil is considered high when compared to average consumption per capita in other countries. Furthermore, the results



suggest that the level of fruit consumption in Brazil is increasing. In fact, the 2008 results showed that 38% of respondents declared they consume fruits every day, while in 2017 that number increased to 45.5%. The results also demonstrate that the habit of consuming soft drinks and artificial juices is decreasing over time, which is considered positive in terms of health. Alcohol consumption, on the other hand, showed little change over time, and the results show that a large portion of the Brazilian population surveyed (about 64%) does not usually consume alcohol.

In surveys of years 2014 and 2017, VIGITEL began to ask about replacing conventional lunch and dinner with snacks. Results point that 62.90% of the respondents in 2014, and 63.22% of the respondents in 2017 say that they never replace a conventional lunch for snacks. However, it is observed that the habit of exchanging dinner for snacks is more frequent, suggesting that Brazilians tend to consume snacks instead of dinner about 1-2 days a week.

Table 4 presents the results for the comparative analysis between groups, with the diagnosis of high blood pressure, diabetes, and dyslipidemia as the grouping variables (1 = yes; 2 = no).

**Table 4.** Comparison between NCDs groups (Yes or No) regarding Age, Schooling years, BMI, and food consumption (Student's *t*-test). Brazil, 2017.

Grouping Variables	Dependent Variables	Mean (1 = yes)	Mean (2 = no)	<i>t</i> -test	Valid N (1 = yes)	Valid N (2 = no)	Std.Dev. (1 = yes)	Std.Dev. (2 = no)
High Blood Pressure	Age (in years)	58.847	42.143	216.078 ***	60,831	141,304	14.755	16.426
	Schooling years	9.414	11.686	-95.793 ***	60,568	140,933	5.387	4.648
	BMI	27.693	24.941	108.280 ***	54,325	131,573	5.493	4.759
	BEANS	4.659	4.734	-11.892 ***	60,831	141,304	1.350	1.293
	VEGETABLES	4.250	4.313	-9.316 ***	57,204	132,297	1.389	1.341
	FRUITS	4.772	4.496	39.934 ***	60,831	141,304	1.412	1.429
	SOFT DRINKS	2.723	3.148	-58.832 ***	60,831	141,304	1.458	1.505
	ALCOHOL	1.806	2.000	-27.300 ***	60,831	141,304	1.438	1.467
	Replace LUNCH	1.470	1.618	-24.828 ***	31,606	62,131	0.806	0.893
	Replace DINNER	2.861	2.916	-4.669 ***	31,606	62,131	1.822	1.642
Diabetes	Age (in years)	62.077	45.756	120.737 ***	17,481	184,654	13.138	17.409
	Schooling years	8.757	11.216	-62.727 ***	17,406	184,095	5.436	4.895
	BMI	28.027	25.538	58.016 ***	15,365	170,525	5.645	5.041
	BEANS	4.686	4.714	-2.733 **	17,481	184,654	1.361	1.306
	VEGETABLES	4.249	4.298	-4.411 ***	16,443	173,050	1.414	1.350
	FRUITS	4.942	4.544	35.251 ***	17,481	184,654	1.355	1.432
	SOFT DRINKS	2.473	3.072	-50.697 ***	17,481	184,654	1.434	1.500
	ALCOHOL	1.622	1.972	-30.356 ***	17,481	184,654	1.303	1.472
	Replace LUNCH	1.433	1.585	-16.577 ***	10,037	83,677	0.776	0.876
	Replace DINNER	2.714	2.919	-11.425 ***	10,037	83,677	1.814	1.690
Dyslipidemia	Age (in years)	53.608	42.740	86.023 ***	22,448	72,040	15.151	16.935
	Schooling years	10.340	11.192	-22.192 ***	22,395	71,889	5.455	4.875
	BMI	26.852	24.932	45.319 ***	20,595	67,201	5.474	5.271
	BEANS	4.611	4.763	-14.946 ***	22,448	72,040	1.364	1.316
	VEGETABLES	4.269	4.293	-2.108 *	21,084	67,042	1.401	1.379
	FRUITS	4.729	4.463	23.868 ***	22,448	72,040	1.428	1.466
	SOFT DRINKS	2.859	3.210	-30.269 ***	22,448	72,040	1.474	1.533
	ALCOHOL	1.844	1.957	-10.115 ***	22,448	72,040	1.434	1.463
	Replace LUNCH	1.536	1.628	-8.844 ***	10,618	29,681	0.878	0.935
	Replace DINNER	2.985	2.944	2.056 *	10,618	29,681	1.843	1.729

Note: \*  $p < 0,05$ ; \*\*  $p < 0,01$ ; \*\*\*  $p < 0,001$ .

The objective of the analysis of the Student's *t*-test was to identify the possible presence of a significant difference in terms of age, schooling years, BMI, and food consumption patterns in groups of individuals who testify to being diagnosed with high blood pressure, diabetes, and dyslipidemia. The results suggest that elderly individuals, with less education and higher BMI tend to be diagnosed with high blood pressure, diabetes, and dyslipidemia. A finding that draws attention is that individuals with more years of schooling tend to have a better level of health, which suggests that the educational level is associated with a greater concern for health and, possibly, healthier habits.

Results also suggest that there are significant differences in the average frequency of consumption of beans, vegetables, fruits, soft drinks, alcohol, and the habit of exchanging main meals for snacks when compared with groups that self-declare to have NCDs and those that do not have such comorbidities. Among these results, emphasis is given to the finding that individuals diagnosed with high blood pressure, diabetes or dyslipidemia have a significantly lower frequency of consumption of beans, vegetables, soft drinks, alcohol, and higher frequency of consumption of fruits. In addition, individuals who declare high blood pressure or diabetes tend to exchange their lunch less for snacks.

Table 5 presents the results for the analysis of the relationship between nutritional habits, and the age and schooling years of participants in the 2017 VIGITEL study.

**Table 5.** Relationships between food consumption, age and schooling years using data from VIGITEL 2017. Brazil.

Dependent Variables	Categorical Variables	Slope	R <sup>2</sup>	Pearson's Correlation	ANOVA F-test
Average BEANS consumption	Age [18-90] (in years)	-0.003	0.441	-0.664 ***	2.077 ***
	Schooling years [0-20]	-0.035	0.882	-0.939 ***	64.393 ***
Average VEGETABLES consumption	Age [18-90] (in years)	0.000	0.002	0.049	1.936 ***
	Schooling years [0-20]	0.040	0.913	0.956 ***	75.365 ***
Average FRUIT consumption	Age [18-90] (in years)	0.017	0.954	0.977 ***	48.028 ***
	Schooling years [0-20]	0.023	0.450	0.671 **	43.014 ***
Average SOFT DRINKS consumption	Age [18-90] (in years)	-0.015	0.858	-0.926 ***	44.3 ***
	Schooling years [0-20]	0.008	0.066	0.258	29.398 ***
Average ALCOHOL consumption	Age [18-90] (in years)	-0.010	0.739	-0.860 ***	12.647 ***
	Schooling years [0-20]	0.051	0.933	0.966 ***	86.181 ***
Average replace LUNCH for snacks	Age [18-90] (in years)	-0.008	0.864	-0.929 ***	35.404 ***
	Schooling years [0-20]	0.013	0.418	0.647 **	31.177 ***
Average replace DINNER for snacks	Age [18-90] (in years)	0.001	0.008	0.088	5.114 ***
	Schooling years [0-20]	0.041	0.880	0.938 ***	44.125 ***

Note: \* p <0,05; \*\* p <0,01; \*\*\* p <0,001.

The results suggest that age is significantly and negatively associated with the average frequency of consumption of beans, soft drinks, alcohol, and the habit of replacing lunch for snacks. On the other hand, age is significantly and positively associated with the average frequency of fruit consumption. Therefore, elderly people tend to have a less expressive habit of consuming beans and soft drinks in their daily food intake. It is also evident that elderly people also have lower frequency of alcohol consumption and less tendency to replace lunch for snacks.

Furthermore, the results also suggest that schooling years are significantly and negatively associated with the frequency of average bean consumption. However, schooling years is significantly and positively associated with the frequency of average consumption of vegetables, fruits, alcohol and the habit of exchanging main meals (lunch and mainly dinner) for snacks.

## DISCUSSION

This study brings evidence about the eating habits and general health status of the population living in the capitals of Brazil. The results suggest that, in general, Brazilians have healthy eating habits since a large part of the population frequently consumes unprocessed foods (e.g. beans, fruits and vegetables). In addition, it was highlighted that, in the analyzed time span, the average consumption rate of these unprocessed foods increased. It was also observed that a small portion of the population usually replaces the main meals for snacks.

A relevant finding in this study is that people with higher education levels have healthier behaviors in terms of food. Other previous studies have reported the relationship between instruction level and healthy eating, but with mixed results. A study conducted in the USA revealed that more educated women tend to consume more fast food, but more educated men do not follow the same trend.<sup>29</sup> Another relevant study demonstrated that educational level and parental intervention in feeding children tend to trigger healthier eating habits.<sup>30</sup> In this sense, formal education plays a fundamental role in promoting healthier habits, with the potential for long-term gain in public health issues.

Although evidence suggests that Brazilians have favorable eating habits, the average BMI of the population shows an upward trend. In fact, previous studies have already warned of the increasing prevalence of obesity in the Brazilian population, pointing out that this phenomenon has severe implications for public health and economic issues in the country.<sup>8,25,31</sup> Although studies show that obesity is strongly related to unhealthy eating habits and the strong presence of processed and ultra-processed foods in the dietary model of a population,<sup>32</sup> it is necessary to consider other factors that help increase obesity prevalence.

Another important finding of this study is that, in general terms, the respondents' perception of the general health status is considered good, showing some stabilization over the analyzed period. However, the share of individuals who claimed to have been diagnosed with high blood pressure and diabetes, as well as the average BMI calculated for the population, grew considerably from 2008 to 2017, which suggests that the general health status of the Brazilian population is getting worse. About this, a previous study suggested that weight is not associated with self-perceived health.<sup>33</sup> It is necessary to promote an improvement in the self-perception of the general health status of the Brazilian population. An inadequate self-perception in terms of health can generate new patients for a health system, implying high social and economic costs.

The high BMI index in the current Brazilian context, aggravated by its accelerated growth rate, highlights the need for attention to an eminent epidemic of population obesity. The positive self-perception of the interviewees' general health status contrasts with the expressive increase in the average BMI of the Brazilian population, which results in a public health care alert in the country .

In addition to analyzing the respondents' perception of their general health status, this study also highlights the presence of health risk factors, such as alcohol consumption and smoking. Moderate alcohol consumption and the reduction in smoking levels observed in the Brazilian population are positive indicators for the country's public health. However, the increase in the prevalence of diabetes, diagnoses of high blood pressure and dyslipidemia suggest that other factors not considered in this study are worsening the general health status of the Brazilian population. So additional studies on the population are needed to clarify the causes of the increase in the number of cases of diabetes, high blood pressure and dyslipidemia in Brazil.

## CONCLUSION

This study aimed to analyze the changes in the Brazilian population in terms of BMI as an indicator of overweight and obesity, as well as eating habits and health indicators. The results revealed that Brazilians are gaining weight acceleratedly since the average BMI of the population shows marked growth. It has been also shown that Brazilians realize that their health has improved in general, although the number of diagnoses of NCD (high blood pressure, diabetes and dyslipidemia) has increased significantly in the last 10 years.

This study has important limitations since it is based on data from surveys carried out by the Ministry of Health. In addition, the surveyed individuals live in the capital cities of the states of Brazil only, which prevents an analysis of rural populations and those living in inland municipalities.

Based on the results, it is suggested that more efficient public health measures be adopted in order to promote a significant reduction in the diagnosis of NCDs in Brazil, especially the promotion of public policies for children and adolescents. Additional studies are also suggested in order to analyze and monitor the situation of obesity and overweight in the Brazilian population living in inland municipalities and in rural areas, in addition to identifying the main factors that trigger the possible prevalence of obesity in such places.

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### Contributors

Abbade EB worked in all stages, from the conception of the study to the revision of the final version of the article; Oliveira GM and Peters GC participated in the discussion of results, writing and critical review of the article. All authors approved the final version of the article.

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