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Changes in chronic diseases and risk and protective factors before and after the third wave of COVID-19 in Brazil

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Abstract *The present study aimed to compare changes in risk and protective behaviors for non-communicable diseases (NCDs), self-reported morbidity, and preventive cancer tests prior to and at the end of the third wave of the COVID-19 pandemic in Brazil. This study analyzes a historical series from the Surveillance System of Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL) for the years 2006 and 2021. Trends were analyzed using linear regression, and the Student's t test was used to calculate differences between years. A decline in the prevalence of leisure-time physical activity (PA) and PA while commuting; and increased prevalence of adults with insufficient PA practice, sedentary behavior, and physical inactivity were observed. A worsening of the indicators of overweight, obesity, and diabetes was also observed during the pandemic. Hypertension was stable during the period from 2009 to 2019 and increased during the years of the pandemic. There was a reduction in the coverage of preventive mammograms and cervical cytology exams, differing from the previous trend. In conclusion, the findings point to the worsening of NCD indicators. Therefore, health promotion actions are a priority in this context.*

Key words *Risk factors, Chronic disease, Pandemics, Health surveys, Cross-sectional studies, Brazil*

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Introduction

The COVID-19 pandemic was declared by the World Health Organization (WHO) on March 11, 2020[1]. In Brazil, the first case was confirmed on February 26th[2]. By March 28, 2022, more than 30.9 million cases and more than 666,000 deaths were registered in the country[3]. The excess mortality rate due to COVID-19 in Brazil reached levels above the global average in 2020 and 2021[4].

Socioeconomic inequalities and vulnerability shape the spread and impacts of COVID-19 in Brazil[5]. However, there is evidence that the tragic political actions taken by the federal government influenced morbimortality caused by the disease in the country due to the lack of national guidelines to fight the disease, to the delay in obtaining vaccines, to denial of the pandemic and of science, and to the lack of coordination and national handling of the problem[6-8]. All of this resulted in unnecessary and avoidable casualties. Moreover, it is a well-known fact that good governmental action is a fundamental aspect in the fight against a pandemic[9].

Pandemics have damaging and multidimensional effects on the health of a population, which go beyond statistics of morbimortality[10]. Studies have indicated that the social isolation measures adopted in the fight against the pandemic also resulted in changes in the behavior and health of the Brazilian people, including the feelings of loneliness, sadness, stress, and anxiety[11]; worse lifestyles (less physical activity (PA) and an increase in the consumption of alcoholic beverages, cigarettes, and unhealthy food)[12-14]; as well as less healthcare follow-up[15], especially among adults with non-communicable diseases (NCD)[16], a decline in the hospitalization of patients with cardiovascular diseases (CVD)[17]; and an increase in mortality caused by CVD[18,19].

Taking this into account, measuring of one's state of health, self-referred morbidity, and the performance of preventative exams before and after the COVID-19 pandemic, are essential in order to subsidize the elaboration and reformulation of public policies, to plan measures to reduce social inequalities and evidence-based health measures, as well as to contribute in the planning and organization of health services and programs after the pandemic. Therefore, this study aims to compare changes that occurred in risk and protective behaviors against NCD, reported morbidity, and the performance of preventative exams for cancer, before and after the third wave of the COVID-19 pandemic in Brazil.

Methodology

Study design

This is an epidemiological study analyzing the data banks from the Surveillance System for Risk and Protective Factors for Chronic Diseases by Telephone Survey (VIGITEL, in Portuguese) from 2006 to 2021. Data was collected from September 21, 2021, to February 2022, which corresponded to the final months of 2021 and the third wave of the COVID-19 pandemic in 2022.

Context

VIGITEL was created by the Brazilian Ministry of Health (MH) in 2006. It is an annual population-based survey that monitors NCDs and their risk and protection factors by telephone surveys, with adults (≥18 years of age) residing in homes with at least one telephone landline.

Sampling

The sampling procedures, for each state capital of the 26 Brazilian States, sought to obtain probabilistic samples from the adult population residing in homes with at least one telephone landline.

Adults (≥ 18 years of age) who resided in the capitals of the 26 Brazilian states and the Federal District, who had a telephone landline, were interviewed. Between 2006 and 2019, approximately 54,000 individuals were interviewed, and all the estimates were pondered so that they were representative of the entire adult population of each town. To estimate the frequency of the indicators, a 95% confidence interval (95%CI) was considered, with a maximum error of approximately three percentage points. In 2020 and 2021, the minimum sample size of 1,000 individuals per town was established, with nearly 27,000 interviews in total. Such a sample allows us to estimate, with a 95%CI and a maximum error of four percentage points, the frequency of any risk or protective factor within the adult population. A maximum error of five percentage points is to be expected in specific estimates according to sex, assuming that women and men appear in similar proportions in the sample.

Post-stratification weights, calculated by the rake method, are attributed to the interviews, considering the variables of sex, age group, and education level, so that the samples are representative of the adult population from each town.

Further detail on the sampling process and data collection are provided by VIGITEL[20,21].

Variables

The following indicators were analyzed, and remained similar throughout the entire period of data collection. As shown below, not every indicator was available in each edition:

- *Smokers:* individuals with the habit of smoking, regardless of the number of cigarettes, the frequency, and the duration of the smoking habit. Collected from 2006 to 2021.

- *Second hand smokers at home:* non-smokers who report having at least one of the residents of their home who smokes indoors. Collected from 2009 to 2021.

- *Second-hand smokers in the workplace:* non-smokers who report that at least one person smokes inside the working environment. Collected from 2009 to 2021.

- *Abusive consumption of alcoholic beverages*: consumption of five or more shots (men) and four or more shots (women) of alcoholic beverages at one single occasion, at least once in the previous 30 days. Collected from 2006 to 2021.

- *Regular consumption of fruits and vegetables:* consumption of fruits and vegetables five or more days in a week. Collected from 2008 to 2021.

- *Recommended consumption of fruits and vegetables:* consumption of fruits and vegetables, at least five days per week and when the sum of the daily portions of those foods totals at least five. Collected from 2008 to 2021.

- *Regular consumption of beans:* consumption of beans at least five days per week. Collected from 2006 to 2021, except 2018.

- *Regular consumption of softdrinks:* consumption of soft drinks (or artificial juices/beverages) five or more days per week. Collected from 2007 to 2021.

- *Consumption of five or more foods from the "protective foods" group:* consumption of five or more groups of foods that are minimally or unprocessed, which are protective factors for chronic diseases, on the day prior to the interview. The survey considered lettuce, sweet potato or okra, papaya, mango, yellow melon, tomato, cucumber, eggplant, squash or beat, orange, banana, apple or pineapple, beans, peas, lentils or chickpeas, peanuts, cashews or Brazil nuts. Collected from 2018 to 2021.

- *Consumption of five or more of ultra-processed foods groups:* consumption of five or more groups of ultra-processed foods during the day prior to the interview/number of individuals interviewed. The following foods were considered to be ultra-processed: Soft drinks, fruit juice in boxes or cans, chocolate mix, flavored yogurt, packaged snacks or chips, biscuits or crackers, biscuits with a filling or package cake, chocolate, ice cream, jello, flan or other industrialized desserts, sausage, hot dogs, bologna or ham, sandwich bread, hot dog buns or hamburger buns, mayonnaise, ketchup or mustard, margarine, instant noodles, package soup, frozen lasagna or any other ready-to-eat frozen food. Collected from 2018 to 2021.

- *Recommended practice of leisure-time physical activity:* practice of at least 150 weekly minutes of moderate intensity physical activity or at least 75 weekly minutes of vigorous physical activity. Physical activity lasting less than 10 minutes was not considered in the calculation of the daily sum of minutes spent with physical activities[22]. Collected from 2009 to 2021.

- *Practice of physical activity while commuting:* at least 30 daily minutes spent (five or more days of the week) when going to and coming from work or school, riding a bicycle or walking. Collected from 2006 to 2021.

- *Physically inactive:* not doing any leisure-time physical activity in the three months prior to the interview and not making physical effort at work, not going to work or school by bicycle or walking (for at least 20 minutes on the way to or from), and did not make an effort to do heavy cleaning at home. Collected from 2006 to 2021.

- *Insufficient physical activity:* doing less than 150 minutes of physical activities per week, in at least three domains: leisure time, while commuting, work. Collected from 2014 to 2021.

- *Sedentary behavior:* habit of watching TV, computer, tablet or cell phone three or more hours per day. Collected from 2016 to 2021.

- *Overweight:* individual with body mass (BMI) ≥ 25 kg/m2[23], calculated by dividing the weight in kilos by the square height in meters, both measures self-reported. Collected from 2006 to 2021.

- *Obesity:* individuals with BMI ≥ 30 kg/m2[23], calculated by dividing the weight in kilos by the square height in meters, both measures self-reported. Collected from 2006 to 2021.

- *Arterial hypertension:* self-reported medical diagnosis of hypertension. Collected from 2006 to 2021.

- *Diabetes:* self-reported medical diagnosis of diabetes. Collected from 2006 to 2021.

- *Mammogram in the last two years:* women between 50 and 69 years of age who had a mammogram in the last two years. Collected from 2007 to 2021.

- *Oncotic cytology exam in the last three years:* women between 25 and 64 years of age who had an oncotic cervical cytology exam in the last three years. Collected from 2007 to 2021.

The prevalence of the indicators was estimated using the total number of interviewed adults as a denominator, not including the indicators for cancer detection, which were specific for females in certain age groups.

Statistical analysis

The prevalence of the indicators is shown in proportions (%), and their 95%CI. The trend analysis was conducted using the linear regression method for two periods: 2006 to 2019 and 2006 to 2021.

This study also compared the years prior to the pandemic (2019) and the year after the third wave of the pandemic (2021) by means of annual variation (Δ) during the period, expressed as percentages, according to sex. To test the differences between the two editions of the survey, the Student's t Test was applied, considering H0 : $\Delta = 0$ and H1 : $\Delta \neq 0$, and a significance level (α) equal to 0.05. The variation is significant when the 95%CI does not contain zero.

Processing and data analysis were conducted using the Statistical Software for Data Science (Stata Corp LP, College Station, Texas, United States), version 16.0, considering the post-stratification weights.

Ethical considerations

Free and informed consent was obtained orally upon telephone contact with the interviewees. VIGITEL was approved by the National Ethics Committee for Research with Human Beings from the Ministry of Health (CAAE: 65610017.1.0000.0008).

Results

Approximately 54,000 interviews were conducted each year, and nearly 27,000 in 2020 and 2021.

Table 1 shows the tendencies of the indicators in two periods, 2006 to 2019 and 2006 to 2021. Between 2006 and 2019, a significant decrease can be seen in the prevalence of smokers ($p < 0.001$), second-hand smokers at home ($p < 0.001$), second-hand smokers in the workplace ($p < 0.001$), consumption of soft drinks ($p < 0.001$), consumption of beans ($p < 0.001$), and insufficient practice of physical activities ($p = 0.022$). By contrast, an increase was found in the prevalence of the abusive consumption of alcoholic beverages ($p = 0.032$), recommended consumption of fruits and vegetables ($p = 0.006$), practice of leisure-time physical activities (PA) ($p < 0.001$), overweight ($p = 0.001$), obesity ($p < 0.001$), diabetes ($p < 0.001$), and having a mammogram among women ($p = 0.001$). The prevalence of the regular consumption of fruits and vegetables, the practice of PA while commuting, physical inactivity, sedentary behavior, hypertension, and having an oncotic cytology exam in women, all remained stable (Table 1).

When comparing the entire period (2006-2021), some indicators changed tendency during the pandemic: "insufficient practice of PA", which had previously shown a decline in prevalence, increased after 2019, reaching the same prevalence of 2014; "sedentary behavior", stable until 2019, showed an increase (1.144 per year) in 2020 and 2021; "practice of leisure -time PA" showed a progressive increase (0.942 per year) until 2019 and declined in the following years; "PA while commuting" dropped in 2020 and 2021 ($p = 0.019$); "self-reported diabetes", although with an increasing trend throughout the entire period, showed an increase in 2020 and 2021 (reaching 9.1% in 2021). Mammogram and oncotic cytology dropped in 2020 and 2021, given that mammograms were less often covered by healthcare insurance in 2009, whereas oncotic cytology – which previously showed stability – declines significantly in the last two years ($p = 0.013$), when the two last years of the series were included. Obesity and overweight also worsened over the last two years. The remaining indicators showed no changes in their trend in the final years of the series (Table 1).

Comparing the pre-pandemic year (2019) and after the third wave (2021) (Tables 2, 3 and 4), the practice of leisure-time PA dropped from 39.0% (95%CI: 38.0; 39.9) in 2019 to 36.7% (95%CI: 35.3; 38.2) for the total population and 46.7% (95%CI: 45.2; 48.3) to 43.1% (95%CI: 40.8; 45.5) for the male sex. The prevalence of PA for while commuting went from 14.2% (95%CI: 13.4; 14.9) in 2019 to 10.4% (95%CI: 9.4; 11.4) in 2021for the total population; 14.5% (95%CI: 13.4; 15.7) to 10.8% (95%CI: 9.4; 12.4) in men; and 13.8% (95%CI: 13.0; 14.7) to 10.0% (95%CI: 8.8;

Table 1. Historical series of risk factor indicators for NCDs, related to morbidity and early cancer detection exams in women considering the periods from 2006 to 2019 and 2006 to 2021. Vigitel, Brazil, 2016-2021.

Indicators	Year																2006-2019		2006-2021	
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	p-value	Inclination	p-value	Inclination
Smokers	15.6	15.7	14.8	14.3	14.1	13.4	12.1	11.3	10.8	10.4	10.2	10.1	9.3	9.8	9.5	9.1	< **0.001**	-0.536	< **0.001**	-0.483
Passive smokers at work				12.1	10.5	11.2	10.4	9.8	8.9	8.0	7.0	6.7	6.8	6.6	6.3	5.4	< **0.001**	-0.585	< **0.001**	-0.540
Passive smokers at home				12.7	11.5	11.3	10.2	10.2	9.4	9.1	7.3	7.9	7.6	6.8	7.0	7.0	< **0.001**	-0.565	< **0.001**	-0.491
Abusive consumption of alcoholic beverages	15.6	16.6	17.2	18.5	18.1	16.5	18.4	16.4	16.5	17.2	19.1	19.1	17.9	18.8	20.9	18.4	**0.032**	0.156	**0.006**	0.185
Regular consumption of fruits and vegetables			33.0	32.2	32.0	33.7	34.1	36.0	36.5	37.6	35.2	34.6	33.9	34.3	32.7	34.2	0.101	0.232	0.389	0.097
Recommended consumption of fruits and vegetables			20.1	20.2	19.5	22.0	22.7	23.6	24.1	25.2	24.4	23.8	23.1	22.9	22.5	22.1	**0.006**	0.375	**0.05**	0.216
Regular consumption of beans	71.0	66.8	65.6	64.9	65.6	67.6	67.5	66.9	66.2	64.8	61.3	59.5		59.7	58.3	60.4	**0.001**	-0.650	**<0.001**	-0.661
Regular consumption of soda		30.9	26.4	26.0	26.8	27.5	26.0	23.3	20.8	19.0	16.5	14.6	14.4	15.1	15.2	14.0	< **0.001**	-1.392	< **0.001**	-1.256
Consumption of five or more protective food groups													31.0	29.8	31.4	30.9			0.755	0.130
Consumption of five or more ultra-processed food groups													17.8	18.2	18.5	18.2			0.326	0.150
Practice of physical activity in the recommended free time				30.3	30.1	31.6	33.5	33.8	35.3	37.6	37.6	37.0	38.1	39.0	36.8	36.7	< **0.001**	0.942	< **0.001**	0.682
Practice physical activity while commuting	10.9	10.7	11.3	17.0	17.9	14.8	14.2	12.1	12.3	11.9	14.4	13.5	14.4	14.2	13.3	10.4	0.52	0.097	0.943	-0.009
Physically inactive	14.1	14.2	18.0	15.9	15.3	14.9	14.9	16.3	15.4	16.0	13.7	13.9	13.7	13.9	14.9	15.8	0.154	-0.118	0.33	-0.064
Insufficient physical activity									48.7	47.5	45.1	46.0	44.1	44.8	47.2	48.2	**0.022**	-0.823	0.740	-0.0969
Sedentary behavior											61.7	61.0	63.3	62.7	67.4	66.0	0.332	0.530	**0.030**	1.144
Overweight	42.7	43.3	44.9	46.0	48.2	48.8	51.0	50.8	52.5	53.9	53.8	54.0	55.7	55.4	57.5	57.3	< **0.001**	1.049	< **0.001**	1.001
Obesity	11.9	13.3	13.7	14.3	15.1	16.0	17.4	17.5	17.9	19.0	18.9	18.9	19.8	20.3	21.6	22.4	< **0.001**	0.625	< **0.001**	0.635
Arterial hypertension	22.5	23.5	25.3	25.4	24.3	24.3	24.3	24.1	24.8	24.9	25.7	24.3	24.8	24.5	25.2	26.3	0.139	0.080	**0.019**	0.1086
Diabetes	5.7	5.7	6.2	6.3	6.8	6.3	7.4	6.9	8.0	7.4	8.9	7.6	7.7	7.5	8.2	9.1	< **0.001**	0.1850	< **0.001**	0.193
Mammography women, aged 50 to 69 years, 2 years		71.1	71.7	72.4	73.4	74.4	77.4	78.0	77.8	78.1	78.2	78.5	78.0	76.9	78.0	72.8	< **0.001**	0.620	**0.017**	0.374
Oncotic cytology in the last three years		82.0	83.3	82.2	82.2	81.8	82.3	82.9	81.4	81.0	82.0	82.8	81.7	81.5	80.1	77.2	0.22	-0.061	**0.013**	-0.204

Source: Authors.

11.5) in women. By contrast, the prevalence of adults with insufficient practice of PA increased in the total population (44.8%; 95%CI: 43.9; 45.7 to 48.2%; 95%CI: 46.7; 49.7), among men (36.1%; 95%CI: 34.7; 37.6 to 39.3%; 95%CI: 37.0; 41.6) and among women (52.2%; 95%CI: 51.0; 53.4 to 55.7%; 95%CI: 53.7; 57.7). The lack of physical activity increased in the total population (13.9%; 95%CI: 13.3; 14.5 to 15.8%); 95%CI: 14.7; 16.9) and among women (14.0%; 95%CI: 13.3; 14.7 to 16.0; 95%CI: 14.5; 17.6). Sedentary behavior also increased, rising from 62.7% (95%CI: 61.8; 63.6) to 66.0% (95%CI: 64.6; 67.4) in the total population, 63.9% (62.4; 65.3) to 66.7% (64.4; 68.8) among men and 61.7% (95%CI: 60.5; 62.8) to 65.4% (95%CI: 63.6; 67.2) among women (Table 2).

An increase in the prevalence of overweight was also observed, which in 2019 was 55.4% (95%CI: 54.4; 56.3) and rose to 57.2%; (95%CI: 55.7; 58.8) in 2021. The prevalence of obesity also increased, from 20.3% (95%CI: 19.5; 21.0) in 2019 and to 22.4% (95%CI: 21.1; 23.6) in 2021. Obesity also increased among men, rising from 19.5% (95%CI: 18.3; 20.7) to 22.0% (95%CI: 20.0; 24.0) (Table 2).

In terms of self-reported morbidity, an increase in the prevalence of self-reported hypertension was observed in the total population (24.5%; 95%CI: 23.8; 25.3 to 26.3%; 95%CI: 25.1; 27.6)**,** and among men (21.2%; 95%CI: 20.0; 22.4 to 25.4%; 95%CI: 23.4; 27.4). The prevalence of self-reported diabetes increased from 7.5% (95%CI: 7.0; 7.9) to 9.1% (95%CI: 8.5; 9.8) in the total population, from 7.8% (95%CI: 7.3; 8.3) to 9.6% (95%CI: 8.8; 10.5) among women, and from 7.1% (95%CI: 6.4; 7.8) to 8.6% (95%CI: 7.6; 9.7) among men (Table 3).

In terms of having early detection cancer exams among women, a decline was observed in the coverage of mammograms in the last two years, dropping from 76.9% (95%CI: 75.4; 78.3) in 2019 to 72.8% (95%CI: 70.7; 75.0) in 2021/2022. There was also a decrease in the coverage of cervical cytology exams in the last three years, dropping from 81.5% (95%CI: 80.4; 82.6) in 2019 to 77.2% (95%CI: 75.2; 79.1) in 2021. A decline was found in the prevalence of second-hand smokers at the workplace (6.6%; 95%CI: 6.0; 7.1 in 2019 to 5.4%; 95%CI: 4.6; 6.3 in 2021), as well as for males (10.0%; 95%CI: 9.0; 11.0 in 2019 and 8.1%; 95%CI: 6.7; 9.7 in 2021) (Table 2).

The remainder of the indicators remained stable: prevalence of smokers, second-hand smokers at home; abusive consumption of alcoholic beverages; food consumption, with stability for a regular and recommended consumption of fruits and vegetables; the consumption of beans, soft drinks, five or more groups of protection foods, and five or more groups of ultra-processed foods.

Discussion

Between 2006 (start of the VIGITEL system) and 2019 (pre-pandemic), positive changes occurred, including the decrease in the prevalence of smokers and of physical inactivity, and increase in the consumption of fruits and vegetables, coverage by mammograms, and practice of leisure-time PA. During the period, the indicators for alcohol consumption, obesity, and diabetes worsened, whereas a stability was observed in such indicators as hypertension and most PA. After the pandemic period of 2020, a rapid change took place in the NCD indicators, which had previously been in either positive evolution or stable. The prevalence of adults with insufficient PA practice, sedentary behavior and physical inactivity increased; a decline in PA for while commuting was also observed. The Coverage of preventive breast cancer screenings, which had previously shown an increasing trend, and cervical cytology, which had been stable, both decreased. A decrease in the indicators of overweight, obesity, and self-reported prevalence of diabetes was also observed. Hypertension, which had previously been stable, showed an increase in the prevalence.

The present study showed that all of the PA indicators were affected during the pandemic, making it more difficult to attain the goals of the NCD plan established by the WHO, which made a commitment to reduce physical inactivity by 10%, or practice PA for at least 150 minutes per week in different contexts (leisure, while commuting, at work)[24]. The findings show unprecedented evidence that there has been a decline in active while commuting of nearly 30%. In other words, two years after the beginning of the pandemic, the levels of active while commuting still remain low, possibly due to the persistence of remote work, in home office, but also due to the increase in unemployment[25]. Previous studies have indicated that the COVID-19 pandemic resulted in a decrease in the practice of leisure-time PA among Brazilian adults[12,26].

The increase in sedentary behavior during the COVID-19 pandemic has been explained as a direct effect of the social distancing measures. Therefore, social distance provoked a decline in

Table 2. Prevalence (confidence interval) and percentage of variation in indicators of risk factors for NCDs among adults by sex. Vigitel, Brazil, 2019-2021.

Indicators	Total				Masculino				Feminino			
	% (95%CI)		% of variation (95%CI)	p-value	% (95%CI)		% of variation (95%CI)	p-value	% (95%CI)		% of variation (95%CI)	p-value
	2019	2021-2022			2019	2021-2022			2019	2021		
Smokers	9,8 (9,2; 10,5)	9,1 (8,3; 10,0)	-0,8 (-1,8; 0,3)	0,158	12,3 (11,2; 13,5)	11,8 (10,4; 13,4)	-0,5 (-2,4; 1,4)	0,606	7,7 (7,1; 8,4)	6,7 (5,9; 7,7)	-0,1 (-2,1; 0,1)	0,084
Passive smokers at home	6,8 (6,3; 7,3)	7,0 (6,0; 8,0)	+0,1 (-1,0; 1,2)	0,806	6,6 (5,9; 7,4)	7,6 (6,1; 9,2)	1,0 (-0,7; 2,8)	0,235	7,0 (6,4-7,7)	6,4 (5,2; 7,8)	-0,6 (-2,1; 0,8)	0,383
Passive smokers in the workplace	6,6 (6,1; 7,1)	5,4 (4,6; 6,3)	-1,1 (-2,1; -0,1)	0,025	10,0 (9,0; 11,0)	8,1 (6,7; 9,7)	-1,9 (-3,7; -0,1)	0,038	3,7 (3,2; 4,2)	3,2 (2,5; 4,2)	-0,5 (-1,4; 0,5)	0,342
Abusive consumption of alcoholic beverages	18,8 (18,0; 19,6)	18,4 (17,1-19,6)	-0,5 (-1,9; 1,0)	0,537	25,4 (24,0; 26,7)	25,0 (23,0; 27,1)	-0,4 (-2,9; 2,1)	0,762	13,3 (12,4; 14,2)	12,7 (11,3; 14,2)	-0,5 (-2,2; 1,2)	0,540
Regular consumption of fruits and vegetables	34,3 (33,4; 35,2)	34,2 (32,8; 35,6)	-0,1 (-1,8; 1,6)	0,902	27,9 (26,5; 29,3)	26,2 (24,3; 28,3)	-1,6 (-4,1; -0,8)	0,183	39,8 (38,7; 40,9)	41,0 (39,1; 42,9)	+1,2 (-1,0; 3,4)	0,289
Recommended consumption of fruits and vegetables	22,9 (22,1; 23,7)	22,1 (20,9; 23,3)	-0,8 (-2,3; 0,6)	0,255	18,4 (17,3; 19,6)	16,9 (15,3; 18,7)	-1,4 (-3,5; 0,6)	0,163	26,8 (25,8; 27,8)	26,4 (24,7; 28,2)	-0,3 (-2,4; 1,7)	0,748
Regular consumption of beans	59,7 (58,8; 60,6)	60,4 (59,0-61,9)	0,7 (-1,0; 2,4)	0,422	66,5 (65,1; 67,9)	65,9 (63,8; 68,0)	-0,6 (-3,1; 1,9)	0,637	53,9 (52,8; 55,1)	55,8 (53,8; 57,7)	+1,8 (-0,5; 4,1)	0,118
Regular consumption of soda	15,1 (14,3; 15,9)	14,0 (12,9; 15,3)	-1,0 (-2,5; 0,4)	0,166	18,3 (17,0; 19,7)	17,2 (15,3; 19,4)	-1,0 (-3,5; 1,4)	0,412	12,3 (11,4; 13,2)	11,3 (10,0; 12,7)	-1,0 (-2,6; 0,6)	0,223
Consumption of five or more protective food groups	29,8 (29,0; 30,6)	30,9 (29,5; 32,2)	1,1 (-0,4; 2,7)	0,158	26,9 (25,6; 28,2)	27,7 (25,8; 29,6)	+0,8 (-1,6; 3,1)	0,508	32,3 (31,2; 33,3)	33,7 (31,6; 35,5)	+1,4 (-0,7; 3,5)	0,184
Consumption of five or more ultra-processed food groups	18,2 (17,4; 19,0)	18,2 (16,9; 19,5)	0,0 (-1,5; 1,5)	0,958	21,8 (20,5; 23,2)	21,7 (19,7; 23,9)	-0,1 (-2,6; 2,3)	0,905	15,1 (14,2; 16,1)	15,2 (13,7; 16,8)	+0,1 (-1,8; 1,9)	0,954
Practice of physical activity in the recommended free time	39,0 (38,1; 39,9)	36,7 (35,3; 38,2)	-2,3 (-4,0; -0,5)	0,010	46,7 (45,2; 48,3)	43,1 (40,8; 45,5)	-3,6 (-6,4; -0,8)	0,011	32,4 (31,3; 33,5)	31,3 (29,5; 33,1)	-1,1 (-3,2; 1,0)	0,292

it continues

Table 2. Prevalence (confidence interval) and percentage of variation in indicators of risk factors for NCDs among adults by sex. Vigitel, Brazil, 2019-2021.

Indicators	Total				Masculino				Feminino			
	% (95%CI)		% of variation (95%CI)	p-value	% (95%CI)		% of variation (95%CI)	p-value	% (95%CI)		% of variation (95%CI)	p-value
	2019	2021-2022			2019	2021-2022			2019	2021		
Practice physical activity while commuting	14,2 (13,4; 14,9)	10,4 (9,4; 11,4)	-3,8 (-5,0; -2,5)	0,000	14,5 (13,4; 15,7)	10,8 (9,4; 12,4)	-3,8 (-5,7; -1,9)	0,000	13,8 (13,0; 14,7)	10,0 (8,8; 11,5)	-3,8 (-5,4; -2,2)	0,000
Insufficient physical activity	44,8 (43,9; 45,8)	48,2 (46,7; 49,7)	3,4 (1,6; 5,2)	0,000	36,1 (34,7; 37,6)	39,3 (37,1; 41,6)	3,2 (0,5; 5,9)	0,021	52,2 (51,0; 53,4)	55,7 (53,7; 57,7)	3,5 (1,2; 5,8)	0,003
Physically inactive	13,9 (13,3; 14,5)	15,8 (14,7; 17,0)	1,9 (0,6; 3,2)	0,003	13,9 (12,8; 14,9)	15,6 (14,0; 17,3)	1,7 (-0,2; 3,7)	0,077	14,0 (13,3; 14,7)	16,0 (14,5; 17,6)	2,1 (0,4; 3,7)	0,017
Sedentary behavior	62,7 (61,8; 63,6)	66,0 (64,6; 67,4)	3,3 (1,7; 5,0)	0,000	63,9 (62,4; 65,3)	66,7 (64,4; 68,8)	2,8 (0,2; 5,5)	0,038	61,7 (60,5; 62,8)	65,4 (63,6; 67,2)	3,8 (1,7; 5,8)	0,000
Overweight	55,4 (54,4; 56,3)	57,3 (55,7; 58,8)	1,9 (0,1; 3,7)	0,039	57,1 (55,6; 58,7)	59,9 (57,6; 62,2)	2,8 (0,0; 5,5)	0,051	53,9 (52,7; 55,0)	55,0 (53,0; 57,0)	1,1 (-1,2; 3,4)	0,336
Obesity	20,3 (19,5; 21,0)	22,4 (21,2; 23,6)	2,1 (0,6; 3,5)	0,005	19,5 (18,3; 20,7)	22,0 (20,1; 24,0)	2,6 (0,3; 4,9)	0,029	21,0 (20,0; 21,9)	22,6 (21,1; 24,2)	1,7 (0,1; 3,5)	0,069

95%CI: 95% confidence interval; %: percentagem.

Source: Authors.

Table 3. Prevalence (confidence interval) and percentage of variation of indicators related to morbidity among adults by sex. Vigitel. Brazil. 2019-2021.

Indicators	Total		% of variation (95%CI)	p-value	Masculino		% of variation (95%CI)	p-value	Feminino		% of variation (95%CI)	p-value
	% (95%CI)				% (95%CI)				% (95%CI)			
	2019	2021-2022			2019	2021-2022			2019	2021		
Medical diagnosis of high blood pressure	24.5 (23.8; 25.3)	26.3 (25.1; 27.6)	1.8 (0.3; 3.3)	0.016	21.2 (20.1; 22.4)	25.4 (23.4; 27.5)	4.2 (1.9; 6.5)	0.000	27.3 (26.4; 28.3)	27.1 (25.6; 28.8)	-0.2 (-2.1; 1.7)	0.822
Medical diagnosis of diabetes	7.5 (7.0; 7.9)	9.1 (8.5; 9.8)	1.7 (0.9; 2.5)	0.000	7.1 (6.4; 7.8)	8.6 (7.6; 9.7)	1.5 (0.3; 2.7)	0.016	7.8 (7.3; 8.3)	9.6 (8.8; 10.5)	1.8 (0.9; 2.8)	0.000

95%CI: 95% confidence interval; %: percentagem.

Source: Authors.

Table 4. Prevalence (confidence interval) and percentage of variation of early cancer detection exam indicators in women. Vigitel, Brazil, 2019-2021.

Indicators	% (95%CI)			p-value
	2019	2021	% of variation (95%CI)	
Performing a mammography in the last two years	76.9 (75.4; 78.3)	72.8 (70.6; 74.9)	-4.1 (-6.7; -1.4)	0.002
Oncotic cytology exam for cervical cancer in the last three years	81.5 (80.4; 82.6)	77.2 (75.1; 79.1)	-4.3 (-6.6; -2.1)	0.000

95%CI: 95% confidence interval; %: percentagem.

Source: Authors.

social interactions and forced the population to spend more time in front of the TV, the tablet, the computer, and the cell phone, as an alternative for leisure and for remote work[27,28]. The decrease in physical activity and subsequent increase in sedentary behavior negatively affect the quality of life and health[26], and have damaging effects for cardiovascular health[29], worsening COVID-19 cases[30] and causing subsequent repercussions on mental health[31], all resulting in higher numbers of avoidable and premature deaths[32]. Consequently, it is urgent to adopt measures that encourage the population to practice PA, especially among the most highly affected population groups, as in the case of patients with NCDs[33,34].

Overweight and obesity were in continuous growth before[35,36], and those problems had important increases in annual variation during the pandemic, affecting up to 60% and 20% of the Brazilian population, respectively. Those problems can be explained by insufficient PA, but are also affected by worsening nutrition[12,26]. A study conducted during the pandemic identified an increase in nutritional insecurity, affecting 100 million Brazilians. Nearly 20 million people are starving[37]. Moreover, it is important to point out the increase in the consumption of cheap ultra-processed foods, such as instant noodles, which may have been caused by their low price and high caloric value[26]. We should also mention the absence of regulatory policies for the control of ultra-processed foods and the lack of incentives for production and access to quality nutrition. Fruits and vegetables, for example, have a high cost, thus reducing their consumption, especially among the low-income population[26,37-38]. Moreover, the serious sanitary, social and political crisis in Brazil had a damaging impact on socioeconomic indicators, highlighting the inequalities which had already reached their maximum levels due to austerity measures and reductions in social policies which had been previously adopted for the country[39-41].

There is evidence that, besides the worsening of overweight and obesity, there was also an increase in hypertension and diabetes during the COVID-19 pandemic over the short term, further exacerbating the scenario of NCD in Brazil. Arterial hypertension had remained stable up to 2019, when it started to increase significantly. Diabetes grew at a slower pace (0.181) per year, and accelerated in the two initial years of the pandemic to approximately four times the annual variation in comparison to the previous period. There is evidence that the crisis caused by the pandemic resulted in the worsening of NCD[42,43], as if it were a "fourth wave" of the pandemic, and its effects will remain for many years[44]. The worsening of NCD was caused by the systemic effects of the after-effects of COVID-19, as well as by the changes in the population's lifestyle, such as the reduction in access to preventive health services because of the interruption of the follow-up of patients in terms of primary and secondary health care, aggravating NCDs[15,16,45]. Moreover, it has been discussed that the worsening of mental health with the increase in stress levels, combined with the economic damage resulting from COVID-19, may result in a "fifth wave" of the pandemic[44].

Furthermore, the current study showed a decline in exams for the early detection of cancer in women. There was a reduction in mammograms, which had been on the rise, as well as in oncotic cytology exams, which had been stable before the pandemic. The decline in mammograms and cervical oncotic cytology can be explained by difficulties in access to health services and by a limited availability of these exams at private and public health facilities due to the pandemic[46]. The interruption or reduction in access to health services compromised the follow-up of patients,

increasing morbimortality and avoidable disability[15,16]. Studies conducted by WHO identified that 75% of the responding countries reported interruptions in NCD prevention and treatment services[47,48]. In the Americas, a study by the Pan-American Health Organization (PAHO) showed limited access to services related to NCDs in 64% of the countries, caused by cancellations of elective medical appointments (58%), the reallocation of professionals for the response to COVID-19 (50%), and the lack of attendance to health appointments (50%)[49], often motivated by fear of contracting COVID-19, especially before the introduction of mass vaccination.

Although there is evidence of an increase in the consumption of cigarettes and alcohol beverages in Brazil during the first wave of COVID-19[12,14,26], the present study did not identify changes in the prevalence of tobacco and alcoholic beverages consumption, except for a decrease in second-hand smoking in the workplace. Therefore, new studies are warranted, since they may contribute to the identification of changes in the prevalence of smoking and abusive alcoholic beverages consumption among Brazilian adults, considering that both habits are risk factors for worsening COVID-19 infections[50].

Some limitations must be taken into consideration. First, the fact that the indicators are self-reported and liable to information bias. Second, the representativeness is limited to Brazilian state capitals and with coverage connected to having a telephone landline, requiring post-stratification methodologies to minimize possible biases. Third, the period of data collection by VIGITEL, from 2021 to 2022 (September through February) was different from the period surveyed in 2019 (throughout the entire year), and may be related to bias due to seasonal influence on behaviors related to risk and protective factors. Moreover, the reduction in sample size in 2021 resulted in a reduction in terms of the precision of the estimates, and must therefore be confirmed by future editions of VIGITEL.

On the other hand, it is important to show that our findings allow us to describe a scenario of health behaviors among the Brazilian adult population during the period before and during the pandemic, which may serve as a baseline for future evaluations, and may support the fight against future post-pandemic challenges. Moreover, the results may support the monitoring of global commitments to fight against NCDs[24], especially those set forth in the 2030 Agenda[51].

In conclusion, the sanitary crisis caused by COVID-19 resulted in the worsening of indicators for PA, obesity, overweight, and morbidity by NCDs, and showed a decline in cancer prevention exams by women in Brazil, thus accentuating the economic and social inequalities in the country.

Collaborations

All of the authors worked on the conception and design of this study, on the data analysis, on the write-up and review of the article, and on the approval of the final version for publication.

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