

**Brief communication**

**Associations of sedentary behaviors and incidence of unhealthy diet during the COVID-19 quarantine in Brazil**

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## **Abstract**

*Objective:* Our aim was to analyze the association of change patterns on TV-viewing and computer/tablet use and incidence of elevated consumption of ultra-processed food consumption and lower consumption of fruits and vegetables during the COVID-19 pandemic.

*Design:* Data of 39,208 Brazilian adults from the Behavior Web Survey were used. Unhealthy nutrition habits were eating fruits or vegetables (< 5 day/week) and ultra-processed food (sugary foods, snacks, ready-to-eat frozen foods and embedded foods) (≥5 days/week). For incidence indicators, we only considered participants without the unhealthy behavior before the quarantine. We created four categories of change in TV-viewing and computer/tablet use, considering a cut-off point of 4h/d for each behavior (1-consistently low, 2-become low during the quarantine, 3-become high during the quarantine or 4-consistently high). Analyses were adjusted for sex, age group, highest academic achievement, per capita income, working status during the quarantine, skin color and adherence to the quarantine.

*Setting:* Brazil

*Participants:* Brazilian adults (nationally representative).

*Results:* Logistic regression models revealed that high TV-viewing and computer/tablet use incidence were associated with higher odds for elevated frequency of ultra-processed food consumption (TV-viewing: OR: 1.70; 95%CI: 1.37 to 2.12; computer/tablet: 1.73; 1.31 to 2.27) and low consumption of fruit and vegetables (TV-viewing: 1.70; 1.29 to 2.23; computer/tablet: 1.53; 1.08 to 2.17) incidence. Consistent high computer/tablet use also presented higher odds for incidence of elevated frequency of ultra-processed food consumption.

*Conclusions:* Participants with incidence of sedentary behaviors were more likely to also present incidence of unhealthy diet during the COVID-19 pandemic quarantine.

**Key words:** sedentary behavior, feeding behavior, health behavior, social distancing.

## **Introduction**

The pandemic of the new coronavirus disease (COVID-19) presented a fast spread worldwide and reached Brazil in last February (2020) <sup>(1)</sup>. The World Health Organization has been recommending social distancing measures as quarantines aiming to reduce the velocity of transmission <sup>(1)</sup>. In this sense, the state health departments, are strongly recommending social distancing, with a “stay at home” message and restriction measures as closing schools and universities as well as non-essential commercial establishments since early March (2020).

Despite the benefits for the COVID-19 spread, the quarantine measures can be associated with the adoption of unhealthy behaviors, such as increasing sedentary behavior and reduced diet quality, with increases in ultra-processed food consumption <sup>(2,3)</sup>. Sedentary behavior, especially TV-viewing is associated with increased energy intake <sup>(4)</sup>, which can be through different mechanisms as the higher consumption of ultra-processed foods while watching TV, as well as higher exposure to ultra-processed advertises <sup>(5-7)</sup>. In addition, other types of sedentary behaviors that become more frequent with social restriction measures (e.g. computer, tablet, smartphone) can also be associated to poor dietary habits given the new routine found during the quarantine.

However, the association between changes in sedentary/screen behaviors and incidence of poor dietary habits during the COVID-19 pandemic is unclear. In this study, we aimed at analyzing the association of change patterns on TV-viewing and computer/tablet use and the incidence of elevated consumption of ultra-processed food consumption and lower consumption of fruits and vegetables during the COVID-19 pandemic. We hypothesize those participants that increased TV-viewing and computer/tablet use are more likely to also increase the frequency of ultra-processed food consumption and reduce the consumption of fruits and vegetables.

## **Methods**

### **Sample**

This was a national cross-sectional health survey, with retrospective information. Data collection was conducted between April 24th and May 24th, 2020. The invitation of participants was through a chain sampling procedure. In the first stage, the 15 researchers involved in the study chose a total of 200 other researchers from different states in Brazil. Also, each researcher in the study chose 20 people from their social network, making a total of 400 people chosen. The people chosen in the first stage were called as seeds of the chain recruitment. These seeds sent the survey link to at least 12 people from their social networks, obeying a stratification by sex, age range (18-39; 40-59; 60+) and educational level

(incomplete high school or less; complete high school or more). In addition, information about the Behavior Survey was circulated through press releases, social communications from participating research institutions, state health departments, and social media. All procedures were approved by the National Research Ethics Commission (CONEP) (process: 30598320.1.0000.5241). The total sample was composed of 45,160 participants. The sample was weighted (through the use of sampling weights) according to characteristics from the National Household Sample Survey (2019), considering the population in each state, education, age, sex, and prevalence of chronic diseases, aiming to let the sample nationally representative.

### ***Ultra-processed food and fruit and vegetable consumption***

Ultra-processed food and fruit and vegetable consumption were assessed asking about the frequency of eating fruits, vegetables, sugary foods, snacks, ready-to-eat frozen foods and embedded foods. We classified as risk behavior those reporting less than five per week eating fruits or vegetables as well as eating five or more days per week at least one ultra-processed food (sugary foods, snacks, ready-to-eat frozen foods and embedded foods), which were classified according to the NOVA classification <sup>(8)</sup>. For the purposes of this study, for ultra-processed food analysis, we only classified those without elevated frequency of ultra-processed food consumption before the quarantine, and for fruit and vegetable analysis, those without low frequency of fruit and vegetable consumption before the quarantine.

### ***TV-viewing and computer/tablet use***

For TV-viewing, participants were asked: “Usually, before the pandemic, how many hours a day did you used to spend watching television?” and “During the pandemic, how many hours a day have you been watching television?”. Possible answers for both 1) none; 2) less than 1h/day; 3) between 1 and less than 2 h/day; 4) between 2 and less than 3 h/day; 5) between 3 and less than 4 h/day; 6) between 4 and less than 5 h/day; 7) between 5 and less than 6 h/day; 8) 6 h/day or more. Also, computer/tablet use was assessed using two questions “Usually, before the pandemic, how many hours a day did you used to spend using a computer or tablet?” and “During the pandemic, how many hours a day did you used to spend using a computer or tablet?” with open answer. TV-viewing and computer/tablet use were classified using the cut-off point of 4h/day in both moments (before and during the quarantine), especially considering the elevation in the incidence of cardiovascular disease and mortality risk <sup>(9–11)</sup>. TV-viewing and computer/tablet use patterns were created using four change patterns: 1) Consistently low; 2) Become low (High to low); 3) Become high (Low to high) or 4) Consistently high.

### ***Covariates***

We used sex, age group, highest academic achievement, working status during the quarantine, skin color, diagnoses of COVID-19 on a close friend, co-worker or relative and adherence to the quarantine as covariates. The highest academic achievement was classified as incomplete high school, complete high school, and college education or more. Per capita income before the pandemic was estimated through the total income of all members of the household divided by the number of members and classified as lower than one minimum wage (approximately 200 dollars), one to two minimum wages and three or more minimum wages. Working status during the quarantine was classified as currently not working, working on a normal routine and home office. Skin color was classified as white or other. The adherence to the quarantine was classified as positive for those just going grocery stores and pharmacies or stayed strictly at home, leaving only for health care needs; and negative for adherence for those reporting that continued a normal life or tried to stay away from people, reducing contacts a little, not visiting the elderly, but kept working and leaving home as usual.

### ***Statistics***

For the ultra-processed food and fruits and vegetable consumption analyses, proportion estimates and 95% confidence intervals of all sample characteristics were calculated. Crude and adjusted models (Adjusted for sex, age group, highest academic achievement, per capita income, working status, skin color and adherence to the quarantine) were used to analyze the associations of TV-viewing and computer/tablet use patterns with incidence of elevated ultra-processed food consumption and low consumption of fruit and vegetables. All analyzes were conducted using the software Stata 15.1.

### **Results**

The final sample was composed of 39,208 adults due to missing data. However, 5307 (weighted prevalence: 14.3%) presented elevated frequency of ultra-processed food consumption and 26,572 (weighted frequency: 78.0%) presented low consumption of fruit and vegetable before the pandemic and were excluded from the specific analyses. Therefore, the final sample was composed of 33,901 adults for ultra-processed food consumption and 12,636 adults for the low consumption of fruits and vegetables analysis. The samples for both analyses were similar, except for age group (sample of fruit and vegetable consumption analysis was slightly younger) and Highest academic achievement (sample of fruit and vegetable consumption analysis presented slightly higher frequency of more than high school) (Table 1). The prevalence of participants that started consuming elevated ultra-

processed food during the quarantine was 10.4% (95%CI: 9.6 to 11.3), while 17.6% (95%CI: 15.9 to 19.4) of participants that started to have low consumption of fruit and vegetables during the quarantine (Table 1).

Only participants that presented high TV-viewing incidence were at risk for elevated frequency of ultra-processed food consumption incidence (OR: 1.70; 95%CI: 1.37 to 2.12) and low consumption of fruit and vegetables incidence (OR: 1.70; 95%CI: 1.29 to 2.23) (Table 2). Participants with consistently high computer/tablet use (OR: 1.58; 95%CI: 1.24 to 2.01) and those becoming high computer/tablet use (OR: 1.73; 95%CI: 1.31 to 2.27) were at risk for elevated frequency of ultra-processed food consumption incidence, while only those that become high computer/tablet use were at risk for low consumption of fruit and vegetables incidence when comparing with the consistently low computer/tablet use group (OR: 1.53; 95%CI: 1.08 to 2.17).

## Discussion

Our main findings were that participants that started to present elevated TV-viewing were more likely to present incidence of elevated frequency of ultra-processed food consumption and low fruit and vegetable consumption. However, this association was not clear considering the computer/tablet use patterns, in which participants that started to have computer/tablet high use and those with consistently high computer/tablet use presented higher odds for incidence of poor dietary habits.

The COVID-19 pandemic promoted several changes in health behaviors as the reduction of physical activity, an increase in sedentary behavior, and an increase in the consumption of unhealthy foods <sup>(3)</sup>. However, our findings highlighted that people with high TV-viewing incidence were more likely to present incidence of unhealthy diet behaviors. The difference between computer/tablet use and TV-viewing can be in the co-occurrence of unhealthy foods such as snacks while watching TV <sup>(5,6)</sup>. Also, 14.2% of the advertises of free-to-air TV channels from Brazil were food-related and approximately 90% of the food related advertises were of ultra-processed food <sup>(12)</sup>, which can also lead to higher consumption of ultra-processed food as well as lower consumption of fruits and vegetables <sup>(7)</sup>. Given the negative effects of the sedentary behaviors and unhealthy diet for health, these findings highlight the need to identify and to intervene on population groups that presented higher incidence of more than one unhealthy behavior during the COVID-19 pandemic, especially groups at risk for non-communicable diseases.

Our findings should be inferred in light of some limitations. Even with the weighting of our sample according to the National Household Sample Survey, the research had a low

representativity of individuals with low socioeconomic conditions, illiterate as well as people without access to the internet. Also, the retrospective design and self-reported questionnaires can be associated with recall bias. We were only able to analyze few types of ultra-processed food and only the frequency of consumption, without information on daily serving and specific calorie contribution of each food, and we were not able to estimate the specific contribution of ultra-processed food on daily energy consumption. Moreover, the present research was conducted probably before the peak of COVID-19 cases and deaths in Brazil, which should be considered in the interpretation of our findings. On the other hand, we presented data of a large nationwide sample, which was weighted for being nationally representative assessing the associations between change in sedentary/screen behaviors and incidence of elevated frequency of ultra-processed food consumption and low consumption of fruit and vegetables during the COVID-19 pandemic quarantine and we consider this as a strength.

Thus, participants that started to present high TV-viewing and computer/tablet use during the COVID-19 pandemic quarantine were more likely to present incidence of elevated frequency of ultra-processed food consumption and low consumption of fruit and vegetables. Our study highlights that policies for the promotion of health behaviors during the COVID-19 pandemic should focus on multiple behaviors.



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**Table 1.** Characteristics of the sample.

<b>Variables</b>	<b>Ultra-processed food analysis (n = 33,862)</b>	<b>Fruit and vegetable consumption analysis (n = 12,618)</b>
Sex (women)	52.7 (51.0 to 54.4)	61.1 (58.0 to 64.1)
<i>Age group</i>		
18-39	47.1 (45.5 to 48.8)	32.3 (29.8 to 35.0)
40-59	34.8 (33.3 to 36.4)	38.6 (35.9 to 41.4)
60 +	18.1 (16.7 to 19.5)	29.0 (26.4 to 31.8)
<i>Highest academic achievement</i>		
No academic achievement or elementary school	9.7 (8.6 to 10.9)	8.8 (7.1 to 10.9)
High school	72.8 (71.5 to 74.0)	66.7 (64.4 to 68.9)
More than high school	17.5 (16.9 to 18.2)	24.5 (23.1 to 26.0)
<i>Per capita income before the pandemic</i>		
Lower than one minimum wage	49.4 (47.7 to 51.0)	39.0 (36.1 to 42.0)
1-2 minimum wages	24.8 (23.3 to 26.4)	22.6 (20.4 to 25.0)
2 + minimum wages	25.8 (24.6 to 27.1)	38.3 (35.7 to 41.0)
<i>Working status during the quarantine</i>		
No	52.7 (51.1 to 54.4)	51.1 (48.3 to 54.0)
Normal routine	21.3 (19.9 to 22.8)	18.6 (16.4 to 21.0)
Home office	25.9 (24.6 to 27.4)	30.3 (27.7 to 33.0)
Skin color (non-white)	55.3 (53.7 to 56.9)	44.1 (41.2 to 47.1)
Adherence to the quarantine (yes)	73.3 (72.7 to 74.8)	78.7 (76.1 to 81.1)
<i>TV-viewing patterns</i>		
Consistently low	61.6 (59.9 to 63.2)	65.6 (62.8 to 68.2)

Become low	0.8 (0.5 to 1.1)	1.1 (0.5 to 2.3)
Become high	28.5 (27.1 to 30.0)	25.7 (23.4 to 28.3)
Consistently high	9.1 (8.1 to 10.3)	7.6 (6.2 to 9.2)
<i>Computer / tablet use patterns</i>		
Consistently low	33.7 (32.2 to 35.4)	33.9 (32.1 to 36.6)
Become low	4.0 (3.4 to 4.7)	3.9 (3.1 to 4.8)
Become high	21.1 (19.8 to 22.4)	19.6 (17.7 to 21.7)
Consistently high	41.2 (39.6 to 42.8)	42.7 (39.8 to 45.6)
Low consumption of fruit and vegetables during the quarantine	-	17.6 (15.9 to 19.4)
Elevated ultra-processed food consumption during the quarantine	10.4 (9.6 to 11.3)	-

Note. Data are presented using values of frequency and 95% confidence intervals.

**Table 2.** Association of TV-viewing and computer/tablet use patterns with incidence of ultra-processed food and low fruit and vegetable consumption.

	Incidence	
	Elevated frequency of ultra-processed food consumption OR (95% CI)	Low frequency of fruit and vegetable consumption OR (95% CI)
<b>Crude model</b>		
<i>TV-viewing patterns</i>		
Consistently low	REF	REF
Become low	0.41 (0.16 to 1.04)	0.70 (0.18 to 2.75)
Become high	1.66 (1.36 to 2.04)	1.73 (1.33 to 2.27)
Consistently high	0.66 (0.45 to 0.95)	0.72 (0.43 to 1.23)
<i>Computer / tablet use patterns</i>		
Consistently low	REF	REF
Become low	1.60 (1.05 to 2.44)	1.49 (0.90 to 2.47)
Become high	2.43 (1.88 to 3.13)	1.86 (1.34 to 2.58)
Consistently high	2.19 (1.74 to 2.75)	1.14 (0.84 to 1.54)
<b>Adjusted model</b>		
<i>TV-viewing patterns</i>		
Consistently low	REF	REF
Become low	0.63 (0.25 to 1.61)	0.97 (0.27 to 3.45)
Become high	1.70 (1.37 to 2.12)	1.70 (1.29 to 2.23)
Consistently high	0.98 (0.67 to 1.44)	0.90 (0.52 to 1.57)
<i>Computer / tablet use patterns</i>		
Consistently low	REF	REF
Become low	1.43 (0.93 to 2.20)	1.34 (0.79 to 2.27)
Become high	1.73 (1.31 to 2.27)	1.53 (1.08 to 2.17)
Consistently high	1.58 (1.24 to 2.01)	1.96 (0.69 to 1.33)

Note. Adjusted model: Adjusted for sex, age group, highest academic achievement, per capita income before the pandemic, working status during the quarantine, skin color and adherence to the quarantine. OR, odds ratio. CI, confidence interval