



# Physical inactivity and elevated TV-viewing reported changes during the COVID-19 pandemic are associated with mental health: A survey with 43,995 Brazilian adults

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## ABSTRACT

**Objective:** To analyze the associations of physical activity and TV-viewing reported changes during the COVID-19 pandemic quarantine with mental health among Brazilian adults with and without depression.

**Methods:** Data of 43,995 Brazilian adults from a cross-sectional, nationwide behavior research were used. Participants reported the frequency on loneliness, sadness (feel sad, crestfallen or depressed) and anxiety (feel worried, anxious or nervous) feelings during the pandemic period. Frequency and duration of physical activity as well as duration of TV-viewing before and during the pandemic period were also reported. We created four categories of reported changes in physical activity (1-consistently active, 2-become active, 3-become inactive or 4-consistently inactive) and TV-viewing (1-consistently high, 2-become low, 3-become high or 4-consistently high). Participants also reported previous diagnoses of depression [yes (PD) or no (nPD)]. Logistic regression models separating people with and without depression were created.

**Results:** Compared to consistently active participants, to become inactive during the pandemic was associated with a higher odds for loneliness [nPD:OR:1.32 (95%CI,1.02–1.70); PD:2.22 (1.21–4.06)], sadness [nPD:1.34 (1.01–1.77); PD:2.88 (1.54–5.36)], and anxiety [nPD:1.71 (1.30–2.25); PD:2.55 (1.20–5.42)]. Also, people with depression and consistently physically inactive presented higher odds for loneliness and sadness. Compared to consistently low TV-viewing, participants that become with high TV-viewing showed higher odds for loneliness [nPD:1.59 (1.37–1.86)], sadness [nPD:1.68 (1.44–1.96); PD:1.61 (1.21 to 2.15)] and anxiety [nPD:1.73 (1.48–2.02); PD:1.58 (1.12–2.23)].

**Conclusions:** Reported increases in physical inactivity and TV-viewing during the COVID-19 pandemic were associated with poorer mental health indicators. People with depression and consistently physically inactivity were more likely to present loneliness and sadness.

## 1. Introduction

The new coronavirus (COVID-19) presented a fast spread worldwide, with an increasing number of cases and deaths. Since 11 March 2020, the World Health Organization declared the COVID-19 epidemic as a pandemic and social distancing has been recommended as a strategy to reduce the rate of new cases and was adopted by several countries [1].

Considering previous experiences with quarantines due other epidemics and pandemics as Severe Acute Respiratory Syndrome (SARS), Middle East Respiratory Syndrome (MERS), Ebola and H1N1 influenza, there are several stressors during the social distancing period, including the length of the quarantine, fears of infection, frustration, lack of supplies, lack of information and financial problems, which can be associated with lower mental health [2]. Within the context of social distancing

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measures, alexithymia can also be closely associated with mental health problems during the quarantine [3], also related with loneliness feelings. Before the COVID-19 pandemic period, alexithymia already had a role in suicide risk among people with psychiatric disorders [4]. In this sense, there is a call for action for mental health science during the COVID-19 pandemics [5].

Studies reported that the COVID-19 pandemic affected mental health [6–11]. Indicators as social support, education, type of occupation, COVID-19 relative diagnosis, and psychological factors as loneliness feelings, discrimination, and well-being were associated with higher anxiety and depressive symptoms [6,7]. Unhealthy behaviors, such as physical inactivity (<150 min/week of moderate intensity physical activity) and mentally-passive sedentary behaviors (i.e. TV viewing) are highlighted as contributor for adverse mental health outcomes [12–15]. In this sense, it is noted that the increases in physical inactivity and sedentary behaviors during the social distancing period can be associated with depressive and anxiety symptoms.

A previous study conducted during COVID-19 pandemic found that higher physical inactivity and sedentary behavior were associated with higher depressive and anxiety symptoms [16]. However, the association between negative reported changes in these behaviors during the quarantine and mental health is not clear. In this sense, a recent editorial highlighted the need for investigations on how changing health behaviors can be associated with psychological and mental health in the context of COVID-19 quarantine [17]. Also, considering that people with affective disorders, as depression, present difficulties in the sensory input processing and consequently, have higher psychological vulnerability for stressors during the COVID-19 pandemic [18,19], the association of changes in healthy behaviors can be different among people with or without previous diagnoses of depression [20]. Therefore, our aim was to analyze the associations of physical activity and TV-viewing reported patterns during the COVID-19 pandemic quarantine with mental health among Brazilian adults with and without depression. Having in mind the benefits of physical activity practice and lower sedentary behavior as well as the risk of high TV-viewing for mental health, we hypothesize that participants that reported physical inactivity and/or high TV-viewing were more likely to present worst mental health indicators, especially those with previous depression diagnosis.

## 2. Methods

### 2.1. Design and sample

The “Brazilian behavioral research during the COVID-19 pandemic” was a cross-sectional nationwide health survey, using a virtual questionnaire to assess the lifestyle characteristics in the lives of Brazilians after the arrival of the coronavirus pandemic in the country, related to social restriction initiatives for the protection of people, including quarantine. Data collection was conducted between April 24th and May 24th, 2020. The collection of data was virtual due to the faster application process and the impossibility of face-to-face interviews due to the COVID-19 social distancing measures.

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 500 people chosen. The people chosen in the first stage were called as influencers. These 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 education level (incomplete high school or less; education complete medium or more). In addition, information about the study was disseminated 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) and participants provided consent before

answering the questionnaire. Initially, 45,160 participants completed the questionnaire. The sample was weighted according to characteristics from the National Household Sample Survey (conducted annually), considering the population in each state, education, age, sex, and prevalence of chronic diseases, aiming to let the sample nationally representative.

### 2.2. Mental health indicators

As mental health indicators, we adopted three questions regarding feelings of loneliness, sadness and anxiety. For loneliness, participants were asked: “During the pandemic period, how often did you feel isolated or alone?”, for sadness was asked: “During the pandemic period, how often did you feel sad, crestfallen or depressed?” and for anxiety, participants were asked “In the period of the pandemic, how often did you feel worried, anxious or nervous?”. Possible answers for each question were: 1) “Never”, 2) “Few times”, 3) “Often” or 4) “Always”. We classified participants as positive for loneliness, sadness and anxiety those who answered “often” or “always”. These questions were previously used in the World Health Survey - Brazil (2003) [21] and we adopted in our study because of its short format and content that addressed issues that can be directly related to the COVID-19 pandemic problem for mental health, such as social isolation, sadness and anxiety.

### 2.3. Physical activity and TV-viewing

For physical activity before COVID-19 pandemic, participants were asked “Before the COVID-19 pandemic, how many days a week did you practice any type of physical exercise or sport? (do not consider physical therapy)”. Possible answers were: 1) less than 1 day/week; 2) 1–2 days/week; 3) 3–4 days/week or 4) 5 or more days/week. For those reporting physical activity practice, we also asked: “How long did this activity last?”. Possible answers were: 1) less than 30 min; 2) 30–45 min; 3) 46–60 min or 4) more than one hour. Also, for physical activity during the COVID-19 pandemic was asked: “During the COVID-19 pandemic how many days a week did you practice any type of physical exercise or sport? (do not consider physical therapy)”. Possible answers were: 1) less than 1 day/week; 2) 1–2 days/week; 3) 3–4 days/week or 4) 5 or more days/week. For those reporting physical activity practice, we also asked: “How long did this activity last?”. Possible answers were: 1) less than 30 min; 2) 30–45 min; 3) 46–60 min or 4) more than one hour. We classified activities using the recommendation of 150 min/week [22], which was calculated using the median point of frequency and duration in each category. According the World Health Organization cut-off points, we created physical activity practice patterns using four patterns: 1) Consistently active; 2) Become active (inactive to active); 3) Become inactive (active to inactive) or 4) Consistently inactive.

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 1 h/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. TV-viewing was classified using the cut-off point of 4 h/day [23] in both moments for high TV-viewing. TV-viewing patterns were created using four patterns: 1) Consistently low; 2) Become low (high to low); 3) Become high (low to high) or 4) Consistently high.

### 2.4. Diagnosis of depression

Previous diagnosis of depression was assessed through a question regarding the lifetime diagnosis of depression by a physician. The response options were either yes or no. This question was previously used in different national health studies, including the last Brazilian National Health Survey [24].

## 2.5. Covariates

We used sex, age group, highest academic achievement, working status during the pandemic, skin color, alcohol use, tobacco smoking, 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 no academic achievement or elementary school, high school and higher education or more. 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.

Diagnoses of COVID-19 on a close friend, co-worker or relative was assessed through the question “*Did any family member or close friend, or co-worker, have had a serious case of COVID-19 or died?*” with “yes” or “not” as potential answers. The adherence to the quarantine was assessed through the question “*During the Coronavirus pandemic, to what extent did you (or are you still) restricting contact with people?*”. Possible answers: “*I did nothing, I led a normal life*”; “*I tried to take care, stay away from people, reduce contact a little, not visit the elderly, but I kept working and leaving*”; “*I stayed at home just going shopping at the supermarket and pharmacy*” or “*stayed strictly at home, leaving only for health care needs*”. We classified as positive for quarantine adherence the answers “*I stayed at home just going shopping at the supermarket and pharmacy*” or “*stayed strictly at home, leaving only for health care needs*” and negative adherence the answers “*I did nothing, I led a normal life*” or “*I tried to take care, stay away from people, reduce contact a little, not visit the elderly, but I kept working and leaving*”.

## 2.6. Statistical procedures

Weighted frequencies and 95% confidence intervals were used to describe the sample. After this, crude and adjusted models (for sex, age group, working status during the quarantine, skin color, diagnoses of COVID-19 on a relative or close friend and quarantine adherence) were created to analyze the associations of physical activity and TV-viewing patterns with mental health among people with and without diagnoses of depression. Also, we inserted an interaction term of behavior reported changes and previous diagnoses of depression to investigate whether previous diagnoses of depression can change the association between patterns of behaviors and mental health indicators. All analyzes were conducted using the software Stata 15.1.

## 3. Results

From the initial sample ( $n = 45,160$ ), 1165 presented missing data in at least one variable and were excluded from the present analyses. Therefore, the final sample was composed by 43,995 adults with a mean age of 43.0 (95%CI: 42.5 to 43.5 years). Characteristics of the sample are presented in Table 1. The prevalence of frequent loneliness feelings was 57.1%, frequent sadness was 40.3% and frequent anxiety was 53.1%. 21.3% of the participants become inactive and 28.0% passed to present elevated TV-viewing during the quarantine period.

Table 2 presents the associations of physical activity and TV-viewing reported change patterns with mental health indicators. After the adjustments, participants that become inactive during quarantine presented higher odds for loneliness, sadness and anxiety when compared with consistently active participants, regardless previous diagnoses of depression. Higher odds for all three mental health outcomes (with previous depression) and for sadness and anxiety (without previous depression) were observed among consistently inactive participants (compared to consistently active group). Among participants with previous depression, only those who become with high TV-viewing during quarantine presented higher odds for sadness and anxiety. While among participants without previous depression, higher odds for negative mental health were observed among those who passed to present high TV viewing (all three outcomes). Both compared to consistently low TV

**Table 1**

Characteristics of the sample ( $n = 43,995$ ).

Variables	% (95%CI)
Sex (women)	53.3 (51.8 to 54.8)
Age group	
18–39	46.7 (45.2 to 48.1)
40–59	33.9 (32.5 to 35.2)
60 +	19.4 (18.2 to 20.7)
Highest academic achievement	
No academic achievement or elementary school	10.3 (9.4 to 11.3)
High school	72.8 (71.7 to 73.9)
More than high school	16.9 (16.3 to 17.4)
Working status during the quarantine	
No	54.2 (52.7 to 55.6)
Normal routine	20.9 (19.7 to 22.2)
Home office	25.0 (23.8 to 26.2)
Skin color (non-white)	54.3 (52.9 to 55.7)
Diagnoses of COVID-19 on a relative or close friend	16.7 (15.7 to 17.7)
Adherence to the quarantine (yes)	74.1 (72.8 to 75.4)
Previous diagnoses of depression (yes)	15.0 (14.0 to 16.0)
Loneliness (frequently)	57.1 (55.6 to 58.5)
Sadness (frequently)	40.3 (38.9 to 41.8)
Anxiety (frequently)	53.1 (51.6 to 54.6)
Physical activity	
Consistently active	8.8 (8.1 to 9.7)
Become active	3.3 (2.9 to 3.8)
Become inactive	21.3 (20.2 to 22.5)
Consistently inactive	66.6 (65.2 to 67.9)
TV-viewing	
Consistently low	61.5 (60.0 to 62.9)
Become low	0.8 (0.6 to 1.0)
Become high	28.0 (26.8 to 29.3)
Consistently high	9.7 (8.8 to 10.7)

Note. Values are weighted according the National Household Sample Survey (2019). CI, confidence interval. Physical activity patterns were created using the cut-off point of 150 min/week. TV-viewing patterns were created using the cut-off point of 4 h/day.

viewing group. People with previous diagnoses of depression were consistently inactive presented higher odds of loneliness and sadness when compared with consistently active and without depression participants.

## 4. Discussion

Our main findings were that reported incidence of physical inactivity and TV viewing were associated with higher odds for negative mental health outcomes, regardless of previous diagnoses of depression. In addition, consistently inactivity was associated to higher negative mental health outcomes during the pandemic specially among participants with previous diagnosis of depression. We highlight that the analyzes were adjusted for important potential confounders, including the adherence to the quarantine and diagnoses of COVID-19 on a relative or close friend.

The social distancing during quarantine period can be associated with several indicators of mental health [2,9,10]. In our study, we found an elevated prevalence of loneliness, sadness and anxiety, which are higher than normally found. For example, it was estimated that the prevalence of loneliness is about 10% to 20% [25,26]. Considering the Patient Health Questionnaire (PHQ-9) about sadness from the last Brazilian National Health Survey, the prevalence was about 8%, consistently lower than the present prevalence [27]. Our findings are in line with previous studies that found elevated levels of adverse mental health indicators on other countries during COVID-19 pandemic [7,9–11].

Also, the social distancing measures during the COVID-19 pandemic can reduce health behaviors that are associated with mental health indicators such as physical activity and low sedentary behavior [12–15]. However, participants that become physically inactive were at similar risk of participants consistently inactive, which can indicate that the actual physical activity was the most associated with poorer mental

**Table 2**

Association of physical activity and TV-viewing patterns during the COVID-19 quarantine with mental health indicators.

	Without depression (n = 36,796)			With depression (n = 7199)		
	Loneliness OR (95%CI)	Sadness OR (95%CI)	Anxiety OR (95%CI)	Loneliness OR (95%CI)	Sadness OR (95%CI)	Anxiety OR (95%CI)
<b>Crude model</b>						
<b>Physical activity</b>						
Consistently active	REF	REF	REF	REF	REF	REF
Become active	1.24 (0.85 to 1.80)	1.28 (0.87 to 1.89)	1.37 (0.94 to 2.01)	1.30 (0.61 to 2.76)	1.83 (0.86 to 3.88)	1.78 (0.83 to 3.82)
Become inactive	1.43 (1.12 to 1.83)	1.59 (1.22 to 2.07)	2.03 (1.58 to 2.62)	2.38 (1.31 to 4.32)	2.86 (1.60 to 5.13)	2.45 (1.27 to 4.75)
Consistently inactive	1.26 (1.01 to 1.57)	1.65 (1.30 to 2.10)	1.85 (1.47 to 2.32)	2.38 (1.38 to 4.08)	3.45 (2.03 to 5.86)	2.49 (1.39 to 4.46)
<b>TV-viewing</b>						
Consistently low	REF	REF	REF	REF	REF	REF
Become low	0.70 (0.39 to 1.29)	1.13 (0.61 to 2.08)	0.74 (0.41 to 1.33)	1.98 (0.69 to 5.72)	1.25 (0.37 to 4.31)	0.85 (0.22 to 3.28)
Become high	1.66 (1.42 to 1.92)	1.70 (1.47 to 1.97)	1.69 (1.46 to 1.95)	1.51 (1.06 to 2.14)	1.73 (1.28 to 2.32)	1.62 (1.17 to 2.26)
Consistently high	1.07 (0.84 to 1.36)	0.94 (0.73 to 1.22)	0.86 (0.67 to 1.09)	0.93 (0.60 to 1.46)	0.91 (0.59 to 1.42)	0.64 (0.40 to 1.03)
<b>Adjusted model</b>						
<b>Physical activity</b>						
Consistently active	REF	REF	REF	REF	REF	REF
Become active	1.14 (0.77 to 1.69)	1.07 (0.72 to 1.61)	1.16 (0.76 to 1.76)	1.03 (0.49 to 2.21)	1.57 (0.72 to 3.43)	1.47 (0.65 to 3.31)
Become inactive	1.32 (1.02 to 1.70)	1.34 (1.01 to 1.77)	1.71 (1.30 to 2.25)	2.22 (1.21 to 4.06)	2.88 (1.54 to 5.36)	2.55 (1.20 to 5.42)
Consistently inactive	1.17 (0.93 to 1.47)	1.40 (1.08 to 1.81)	1.62 (1.26 to 2.07)	2.16 (1.26 to 3.71)	3.35 (1.92 to 5.85)	2.58 (1.33 to 5.01)
<b>TV-viewing</b>						
Consistently low	REF	REF	REF	REF	REF	REF
Become low	0.74 (0.42 to 1.30)	1.26 (0.69 to 2.30)	0.94 (0.55 to 1.63)	1.76 (0.60 to 5.18)	1.28 (0.40 to 4.10)	1.03 (0.31 to 3.40)
Become high	1.59 (1.37 to 1.86)	1.68 (1.44 to 1.96)	1.73 (1.48 to 2.02)	1.37 (0.96 to 1.96)	1.61 (1.21 to 2.15)	1.58 (1.12 to 2.23)
Consistently high	1.15 (0.90 to 1.47)	1.12 (0.86 to 1.45)	1.13 (0.87 to 1.48)	0.84 (0.53 to 1.33)	0.87 (0.54 to 1.41)	0.79 (0.46 to 1.36)

Note. Adjusted model: adjusted for sex, age group, highest academic achievement, working status during the quarantine, skin color, diagnoses of COVID-19 on a relative or close friend and adherence to the quarantine. OR, odds ratio. CI, confidence interval. Physical activity interactions (reference group: consistently active and without depression): Loneliness: Become active x with depression: OR:0.86 (95%CI:0.37 to 1.99); Become inactive x with depression: 1.66 (0.86 to 3.20); Consistently inactive x with depression: 1.86 (1.04 to 3.33). Sadness: Become active x with depression: OR:1.13 (95%CI:0.45 to 2.79); Become inactive x with depression: 2.04 (0.99 to 4.19); Consistently inactive x with depression: 2.33 (1.25 to 4.37). Anxiety: Become active x with depression: OR:0.98 (95%CI:0.37 to 2.55); Become inactive x with depression: 1.40 (0.59 to 3.36); Consistently inactive x with depression: 1.50 (0.71 to 3.18). TV-viewing interactions (reference group: consistently low and without depression): Loneliness: Become low x with depression: OR:2.51 (95%CI:0.75 to 8.39); Become high x with depression: 0.86 (0.58 to 1.28); Consistently high x with depression: 0.81 (0.49 to 1.35). Sadness: Become low x with depression: OR:0.93 (95%CI:0.25 to 3.39); Become high x with depression: 0.90 (0.63 to 1.29); Consistently high x with depression: 0.92 (0.52 to 1.62). Anxiety: Become low x with depression: OR:0.99 (95%CI:0.25 to 3.81); Become high x with depression: 0.85 (0.58 to 1.26); Consistently high x with depression: 0.76 (0.42 to 1.38).

health and not necessarily the reported change itself. The association between reduced physical activity with sadness and anxiety can be through different mechanisms, including an increase of inflammation, changes in the regulation of neuroendocrine responses and lower neuroplasticity [28]. Also, physical activity practice (especially through the practice of group physical activity) can be associated with psychological and social mechanisms, including a higher social inclusion, self-efficacy and self-esteem [28,29]. The findings of a higher odds for negative mental health outcomes among participants with consistently physical inactivity and with previous diagnosis of depression also points for the higher vulnerability of people with mental disorders during the pandemics, which already present a higher number of unhealthy behaviors [3,18,20].

On the other hand, only participants that passed to present elevated TV-viewing presented higher odds for loneliness, sadness and anxiety, indicating that the potential change during the quarantine of COVID-19 pandemic was determinant for the higher odds. Our findings considering the elevated TV-viewing during the COVID-19 quarantine are in line with previous clinical studies which found that experimentally induced sedentary behavior was associated with higher anxiety, anxiety and poorer mood [30,31]. Potential mechanisms linking TV-viewing and mental health can also be through the lower social contact [32], poorer sleep quality [33] and also blood markers as reduced insulin sensitivity and inflammation [34,35], which could be associated directly and indirectly associated with sadness and anxiety.

Our findings highlight that policies on the promotion of health behaviors should also be stimulated during the quarantine period aiming to protect mental health. During the COVID-19 social distancing periods, exercise at home or outdoor individual activities should be stimulated [36]. Also, groups that most increased physical inactivity and high sedentary behavior levels (e.g. young adults and people that reduced or

lost their income) should be prioritized [37]. In another perspective, the post COVID-19 scenario is also challenging to return to pre-pandemic physical activity and sedentary behavior levels, which highlights the role of institutional policies, including the national health system ("Sistema Único de Saúde", in portuguese) to achieve this goal.

Our findings should be inferred in the light of potential limitations. The research had a low representativity of individuals with low socio-economic status and without access to internet and electronic devices as a computer or cellphone. In addition, the retrospective design is prone to recall bias. Similarly, all questions were self-reported and prone to recall bias and the causality inference is not possible. We also presented only one question for each indicator (sadness, anxiety and loneliness). We highlight that data was collection before the peak of COVID-19 cases in Brazil. This timing should be considered to the interpretation of these results, as well as further studies are needed in order to surveillance mental health with increases cases and measures of COVID-19 in the country. On the other hand, we presented data of more than 43,000 Brazilian adults, weighted for nationally representative population distribution, during the initial phase of the COVID-19 pandemic on the association of movement behaviors with mental health.

Thus, both reported physical inactivity and TV-viewing during the COVID-19 pandemic quarantine were associated with poorer mental health indicators, regardless previous diagnoses of depression. Consistently physical inactivity (before and during the COVID-19 pandemic) was also associated with negative mental health outcomes, especially among participants with previous diagnosis of depression. Interventions for physical activity promotion and sedentary behavior reduction should be stimulated during the COVID-19 social distancing period.

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## Declaration of Competing Interest

The authors declare no conflict of interest.

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