

Association between lowering restriction levels during the coronavirus outbreak and physical activity among adults: a longitudinal observational study in Brazil

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Abstract. – OBJECTIVE: The COVID-19 pandemic has had significant consequences on public health and lifestyle and has negatively affected mental health and the level of physical activity worldwide. This study examined the impact of reopening fitness centers and nonessential services and introducing flexible measures to ensure social distancing on physical activity and mental health.

MATERIALS AND METHODS: This was a longitudinal study. A self-administered questionnaire, including personal, behavioral, physical activity, perception of health, and mood state disorder information, was answered by 128 Brazilians in June 2020 (during severe restrictive measures) and again in April 2021 (after fitness centers and nonessential services were reopened).

RESULTS: The restriction level adopted in April 2021 was significantly lower than that in June 2020 ($p < 0.001$). The level of physical activity ($p < 0.001$) and health status perception ($p < 0.001$) decreased from June 2020 to April 2021. The median values for depression and anxiety did not differ across the study period.

CONCLUSIONS: The level of physical activity was reduced during the COVID-19 pandemic, and anxiety and depression were not improved following less restrictive social distancing measures and the reopening of fitness centers. Thus, the return to a prepandemic level of physical activity and mental health status may not be automatic. The results presented here suggest that the decrease in physical activity observed in the population may be challenging in the postpandemic period.

Key Words:

COVID-19, Coronavirus, Physical activity, Mental health, Pandemic.

Introduction

Coronavirus disease (COVID-19) is an infectious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first case was reported in December 2019 in Wuhan, China. COVID-19 spread throughout Europe and America and eventually the rest of the world^{1,2}. In Brazil, the first case was reported in February 2020, and on March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic³.

The mode of transmission of SARS-CoV-2 is predominantly person-to-person, and the virus can be spread from an infected person by droplets and aerosols during coughing, talking, or breathing. To contain the spread of the virus, several countries have adopted measures of social distancing and personal hygiene (use of masks and hand hygiene). Social distancing in Brazil and several other countries worldwide was achieved through lockdown. In Brazil, lockdown measures were implemented in mid-March 2020, with the closing of nonessential services such as stores, parks, clubs, gyms, and

schools⁴. These measures had significant consequences on public health, economy, and politics. Regarding public health, a negative impact on mental health (with a consequent increase in depression and anxiety) and on the level of physical activity has been observed^{5,6}.

Physical inactivity has been considered a pandemic since 2012. Evidence suggests that 6% to 10% of all deaths from noncommunicable diseases can be attributed to a sedentary lifestyle⁷. Moreover, physical inactivity is an important risk factor for the development and progression of cardiovascular diseases, obesity, depression, anxiety, arterial hypertension, diabetes, and premature death⁸. Furthermore, physical inactivity, hypertension, obesity, and diabetes are also considered risk factors for the development of severe COVID-19, with increased hospitalization and mortality in the population. Therefore, the current world scenario is worrisome because the pandemic had led to an increase in a sedentary lifestyle. Physical inactivity is an important risk factor for the negative outcome of COVID-19, but it can be modified⁹.

In addition to the decreasing level of physical activity, damage to the mental health of the population is also a concern; several studies show that the COVID-19 pandemic and an extended period of quarantine due to the pandemic were associated with higher levels of depression and anxiety^{10,11}. Furthermore, a recent publication¹² calls the attention on an additional psychiatric epidemic, which occurs alongside the COVID-19 pandemic, and necessitates the attention of the global health community.

After the initial rules for social distancing in Brazil, which were introduced in mid-March, the São Paulo Plan was implemented in the state of São Paulo, a strategy to safely resume the State's economy during the pandemic that began in June, 2020¹³. Based on the average occupancy rate of intensive care unit beds exclusively for patients with COVID-19, the number of new admissions in the same period, and the number of deaths, each region of the State was placed under one of five alert levels that ranged from severe restrictions to more flexible ones according to the data, giving therefore autonomy to each municipality and region. Exercise facilities and fitness centers could be reopened for regions in phase 3 and above (with a limited capacity of people and prior scheduling), which began in some regions¹⁴ on July 6, 2020. Since Brazil is an extensive country with different local reali-

ties, it was advised by the Ministry of Health to use this type of assessment in other States and municipalities¹⁵.

Several months after the implementation of the São Paulo Plan, and the initiation of vaccination in Brazil, in January 2021, nonessential services, shopping malls, gyms, clubs, and parks were progressively reopened, and the strict recommendations to avoid leaving home were made flexible. However, it is not known if this new scenario, i.e. the flexibility of rules for social distancing that culminated in a reduction in physical activity¹⁶ and increased levels of anxiety and depression¹⁰, will be able to positively impact the population's level of physical activity and mental health.

Thus, the primary aim of the present study was to compare the levels of physical activity, depression, and anxiety in the population between two periods – June 2020 (severe regulations for social distancing and no nonessential services), and April 2021 (flexible regulations for social distancing and reopening of nonessential services). It had been hypothesized that after the introduction of flexible regulations for social distancing, the level of physical activity in the population would have increased, while that of depression and anxiety would have decreased.

Materials and Methods

Study Design

This was a longitudinal study. Data collection was carried out in two different times using an online structured questionnaire. The questionnaire was shared by Google Forms (digital platform). The same participants answered the same questionnaire in two different times – between June 2 and June 12, 2020, and between April 22 and April 25, 2021. At the time of the first questionnaire, WHO data indicated that Brazil had 180,000 new cases per day and 7,148 deaths per day (June 1, 2020). In the second moment of data collection, WHO data indicated that Brazil presented 463,000 new cases per day and 21,094 deaths per day (April 22, 2021)¹⁷. In the second half of March, the Brazilian government had introduced emergency restrictions across the country with the closing of schools, universities, parks, and nonessential services and in June 2020 these measurements were still in place. When the questionnaire was repeated (in April 2021), the Brazilian government had already adopted a flexible approach to the measures, reopening

nonessential services while maintaining some restrictions, such as reduced work hours and a limited number of people in functional areas such as gyms, clubs, and parks.

Questionnaire

The questionnaire was self-reported in Brazilian Portuguese and contained five sections. In the first section, general data were collected from the participants, such as sex (male or female), open-ended questions about age (in years), body mass (in kg), and height (in cm).

In the second section, behavioral data during the quarantine period were collected. The first question was a multichoice question about the level of restriction, specifically for routine activities (completely adhered to the social distancing recommendations; maintained partial restriction, leaving only for essential non-work activities; maintained partial restriction, leaving only for essential activities including work activities; and did not adhere to the social distancing recommendations). For data analysis, a score from 1 to 4 was proposed, where 1 referred to the strictest level of restrictions and 4 referred to the lowest level of restrictions.

The third section was a self-assessment of the participant's health during the quarantine period. This section started with a self-assessment of their current health status, which was classified as excellent, very good, good, fair, bad, or very bad. For analysis, a score of from 0 to 5 was proposed, with 0 being very bad and 5 being excellent.

The fourth section assessed the physical activity levels using the International Physical Activity Questionnaire (IPAQ). The IPAQ is an instrument recommended by the WHO since 1998, with its result internationally validated and accepted, validated for Brazilian Portuguese in 2001¹⁸. Based on the data obtained by the participants' responses, the level of physical activity was classified into 5 categories¹⁸. 1) Very active: those who engaged in vigorous activity 5 days/week, ≥ 30 min per session or ≥ 3 days/week and ≥ 20 min per session + moderate activity ≥ 5 days/week and ≥ 30 min per session. 2) Active: those who practice vigorous activity ≥ 3 days/week and ≥ 20 min per session or moderate activity ≥ 5 days/week and ≥ 30 min per session or a combination of ≥ 5 days/week and ≥ 150 min/week between moderate + vigorous activity. 3) Irregularly active: those who practice physical activity but the frequency or duration is insufficient to be classified as active. 4) Irregularly active B: those who practice physical

activity but the frequency and duration are insufficient to be classified as active. 5) Not active: those who do not practice any physical activity for more than 10 continuous minutes during the week. For data analysis, a score from 0 to 4 was proposed, where 0 referred to the lowest level of activity (not active) and 4 to the highest level of activity (very active).

The fifth section was used to screen for possible mood disorders. Two tools were applied for this analysis: the Patient Health Questionnaire-9 and the General Anxiety Disorder-7 questionnaire.

The Patient Health Questionnaire-9 was validated for the Brazilian Portuguese language and used to identify the risk of depression¹⁹. The questionnaire had a score ranging from 0 to 27. A score of ≤ 4 suggested minimal depression, scores from 5 to 9 suggested mild depression, scores from 10 to 14 suggested moderate depression, scores from 15 to 19 suggested moderate-to-severe depression, and scores from 20 to 27 suggested severe depression. For data analysis, a score from 0 to 4 was used, where 0 corresponded to minimal depression and 4 corresponded to severe depression.

The General Anxiety Disorder-7 questionnaire was validated for the Brazilian Portuguese language and used to identify possible generalized anxiety disorders²⁰. The questionnaire had scores ranging from 0 to 21. A score of ≤ 4 suggested no anxiety disorder, scores from 5 to 9 suggested mild anxiety, scores from 10 to 14 suggested moderate anxiety, and scores from 15 to 21 suggested severe anxiety. For data analysis, a score from 0 to 3 was used, where 0 represented the lowest score, suggesting the absence of an anxiety disorder, while 3 represented the highest score, suggesting a severe anxiety disorder.

Participants

Participants of both sexes were invited to participate in the study through e-mail, websites and social networks (Instagram, Facebook, and WhatsApp), shared by researchers and also by institutions involved in the research. It was a convenience sample. The invitation contained a link to access the questionnaire shared on the Google Forms digital platform. The access link for the second questionnaire was directly sent by email to those who answered the first questionnaire.

The inclusion criteria for the study were an age ≥ 18 years and the Brazilian citizenship. The exclusion criteria were incomplete questionnaires and the inability to complete both the question-

naires (June 2020 and April 2021). Individuals from 16 Brazilian States and the Federal District answered the questionnaire. The first questionnaire (June 2020) had 2,140 responses; 287 were excluded for being incomplete or duplicated; thus, there were 1,853 participants. The second questionnaire (April 2021) had 574 responses, of which 130 respondents had also answered the first questionnaire. The 130 participants who had answered both the questionnaires were included in the analysis during our study. Of these 130 responses, 1 was excluded for being incomplete, resulting in a total of 129 participants (average age 38.9 ± 13.0 years, average weight 70.2 ± 13.5 kg, and average height 168.2 ± 8.8 cm) being enrolled in the study.

Ethics Approval and Consent to Participate

The study was approved by the Human Research Ethics Committee of the Federal University of São Paulo (approval number: 4.073.442) and conformed to the principles outlined in the Declaration of Helsinki. Before responding to the questionnaire, participants were required to read and sign an informed written consent. If they agreed to participate in the study, the participants provided an e-mail, which served to verify the duplicity of the answers. Informed consent was obtained from all individual participants included in the study.

Statistical Analysis

According to the Kolmogorov-Smirnov test, none of the variables presented a normal distribution. For this reason, variables were expressed as medians and interquartile ranges. The Wilcoxon signed-rank test was used to compare measures collected in the first (June 2020) and in the second (April 2021) questionnaire. The McNemar test was employed to compare the frequency of each answer regarding the adopted restriction

level, physical activity level, health perception, depression, and anxiety level. Statistical analysis was performed using SPSS v 21.0 (IBM Corp., Armonk, NY, USA). In all comparisons, p -values $< 5\%$ were considered statistically significant.

Results

From June 2020 to April 2021, the participants showed no significant changes in body mass ($p=0.351$). The median of the restrictions level adopted in June 2020 was 2, corresponding to partial restrictions (leaving only for essential non-work activities) and in April 2021 it was 3, thus still corresponding to partial restrictions (leaving only for essential and work activities). The restrictions level was significantly higher in June 2020 than in April 2021 ($p<0.001$). Physical activity level ($p<0.001$) and health status perception ($p<0.001$) decreased significantly from June 2020 to April 2021. The median physical activity level was “active” (score 4) in June 2020, and irregularly active A (score 3) in April 2021. The median health status perception was good (score 4), but the interquartile interval decreased. The median values for depression and anxiety levels did not significantly differ between the two groups (Table I).

The number of respondents and the percentage values of each answer for each question (restrictions level, physical activity level, perception of health, and depression and anxiety level) in June 2020 and April 2021 are shown in Table II.

The proportion of participants who answered that there was a significant reduction in the restrictions level in April 2021, as compared to June 2020, were those who initially responded that they were completely restricted ($p=0.002$) or allowed for essential activities ($p=0.001$). As a result of the reduction in the level of social restrictions, we found a significant increase in the

Table I. Comparison of the levels of restriction, physical activity, health perception, depression, and anxiety levels during the two periods of data collection during the pandemic (June 2020 vs. April 2021).

	June 2020	April 2021	p -value
Restriction level	2 (2-3)	3 (2-3)	$< 0.001^*$
Physical activity level	4 (3-4)	3 (3-4)	$< 0.001^*$
Health perception level	4 (4-5)	4 (3-4)	$< 0.001^*$
Depression level	1 (0-2)	1 (0-2)	0.458
Anxiety level	1 (0-2)	1 (0-1)	0.108

* $p < 0.05$ (comparison between June 2020 and April 2021). Data are presented as median (interquartile interval).

Table II. Percentage values for the sample population between June 2020 and April 2021.

Variables	June/2020 (n = 128)	April/2021 (n = 128)	p-value
Restriction level			
Completely adhered to the social distancing recommendations	12 (9.3%)	2 (1.6%)*	0.002*
Maintained partial restriction, leaving only for essential non-work activities	71 (55.0%)	51 (39.8%)*	< 0.01*
Maintained partial restriction, leaving only for essential activities including work activities	38 (8.9%)	61 (47.7%)*	< 0.01*
Did not adhere to the social distancing recommendations	8 (6.2%)	14 (10.9%)	0.180
IPAQ level			
Not active	0 (0%)	6 (4.7%)	–
Irregularly active B	8 (6.2%)	13 (10.1%)	0.320
Irregularly active A	5 (3.9%)	7 (5.4%)	0.754
Active	39 (30.2%)	45 (34.9%)	0.430
Very active	77 (59.7%)	58 (45.0%)	0.003*
Health perception level			
Very bad	0 (0%)	0 (0%)	–
Bad	0 (0%)	8 (6.2%)	–
Regular	8 (6.2%)	16 (12.4%)	0.096
Good	16 (12.4%)	40 (31.0%)	< 0.001*
Very good	60 (46.5%)	40 (31.0%)	0.008*
Excellent	45 (34.9%)	25 (19.4%)	0.004*
Anxiety (GAD-7)			
No disorder	49 (38.0%)	60 (46.5%)	0.04*
Mild	39 (30.2%)	38 (29.5%)	1.00
Moderate	29 (22.5%)	14 (10.9%)	0.006*
Severe	12 (9.3%)	17 (13.2%)	0.359
Depression (PHQ-9)			
Minimal	37 (28.7%)	50 (38.8%)	0.01*
Mild	48 (37.2%)	37 (28.7%)	0.126
Moderate	25 (19.4%)	22 (17.1%)	0.728
Moderately severe	14 (10.9%)	9 (7.0%)	0.302
Severe	5 (3.9%)	11 (8.5%)	0.07

* $p < 0.05$ (comparison between June/2020 and April/2021); IPAQ (International Physical Activity Questionnaire); GAD-7 (General Anxiety Disorder-7); PHQ-9 (Patient Health Questionnaire-9).

number of participants who reported a partial restriction, leaving for essential activities and work activities ($p < 0.001$). We did not find a significant difference among the participants who reported that they were not adhering to the social distancing recommendations between the evaluated periods ($p = 0.180$) (Table II).

The proportion of participants who were very active in June 2020 decreased significantly in April 2021 ($p = 0.003$). Furthermore, the proportion of participants who evaluated their health status as excellent or very good also decreased significantly between June 2020 and April 2021 ($p = 0.005$ and $p < 0.001$, respectively) (Table II). There was a significant increase in the proportion of participants who reported good health status between the two time points ($p < 0.001$). There was no significant difference between the partici-

pants who reported regular health status between the two time points (Table II). Despite the fact that the median values for depression and anxiety levels did not differ between the two periods, there was a significant decrease in the number of participants who were classified as having moderate anxiety and a significant increase in those with no anxiety in the second evaluation (April 2021). In addition, there was a significant increase in the number of participants with minimal depression in April 2021, as compared to June 2020.

Discussion

The main results found in this study were as follows: from June 2020 to April 2021 (1) there was a reduction in the number of individual

restrictive measures adopted, (2) there was a reduction in the level of physical activity, (3) the perception of individual health worsened, and (4) there was no significant difference in the median values for anxiety and depression. Therefore, our initial hypothesis was not confirmed.

The level of social distancing measurements that were adopted by those who participated in the present study reduced significantly in the second evaluation. In June 2020, 9.3% of the participants reported to be abiding by full indoor restrictions, but in April 2021, this number decreased to 1.6%. In addition, the number of participants who reported that they were partially restricted, leaving their homes only for essential nonworking activities, significantly reduced from 55.0% to 39.8%. Consequently, the number of participants leaving their homes for work-related activities increased from 28.9% to 47.7%. Data from the WHO and the Brazilian Ministry of Health showed that even in April 2021, the number of cases and deaths from COVID-19 remained high in Brazil^{17,21}. The Brazilian Institute of Geography and Statistics data from September 2020 reported a reduction in the level of strictly isolated people²². Despite a high rate of infection and death from COVID-19 in April 2021, people had decreased their level of social distancing measures. The beginning of the vaccination process, which was initiated in Brazil in January 2021, and the financial and work needs may have contributed to the reduction in the level of restrictions.

The level of physical activity significantly reduced from June 2020 to April 2021 among those who were classified as very active. In June 2020, 59.7% of the participants were classified as very active, and by April 2021, the percentage decreased to 45.0%. Several previous studies showed that at the beginning of the COVID-19 pandemic, after the adoption of measures of social distancing, there was a significant reduction in the population's physical activity level^{10,23}. The present study hypothesized that when fewer COVID-19 restrictive measures would be adopted for social distancing there would be an increase in the level of physical activity among the population. However, this hypothesis has not yet been confirmed. Instead, the present results demonstrated an additional decrease in physical activity levels during the pandemic period. The closing of gyms, clubs, and parks during the COVID-19 pandemic was identified in several studies^{5,6,24} as being one of the factors

responsible for the decrease in the population's level of physical activity, but their reopening during periods of flexibility did not positively impact the level of physical activity. Similarly, it was observed in the United Kingdom that even after relaxing social distancing restrictions and reopening nonessential services, there was a reduction in the level of physical activity, especially among young and very active people²⁵. In this study, it was not possible to establish why this pattern was observed.

Regular physical activity is associated with several health benefits; however, to obtain health benefits, the WHO recommends performing 150-300 minutes of moderate-intensity aerobic physical activity or at least 75-150 minutes of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate and vigorous activity per week plus at least 2 days of moderate-intensity muscle strengthening. For additional health benefits, the recommendation is to increase moderate-intensity aerobic activities to >300 minutes or vigorous-intensity activity to >150 minutes²⁶. A sedentary lifestyle is the fourth leading cause of death worldwide and 6% to 10% of all deaths from chronic diseases can be attributed to it. In the current COVID-19 pandemic, patients presenting chronic diseases, such as hypertension, diabetes mellitus 2, obesity, and cardiovascular diseases, are more likely to experience a severe COVID-19 outcome²⁷. Patients who were diagnosed with COVID-19 and had a sedentary lifestyle had a greater chance of hospitalization, intensive care unit admission, and death when compared to patients who followed the WHO physical activity recommendation⁹; hence, regular physical activity is an important protective factor in controlling risk factors, associated with negative outcomes in patients with COVID-19, such as hypertension, diabetes mellitus 2, obesity, cardiovascular diseases and cancer⁸. Therefore, a decrease in the level of physical activity is worrisome during the current situation.

Leaving behind a sedentary lifestyle and returning to prepandemic levels of physical activity appears to be challenging, and the present results indicate that this return is not automatic. Thus, significant efforts may be required to reduce sedentary lifestyles in the postpandemic world.

In addition to the reduction in physical activity, the perception of individual health worsened in April 2021, despite fewer social restrictions. In June 2020, 34.9% of participants reported

excellent health, and in April 2021, that number had decreased to 19.4%. Similarly, in June 2020, 46.5% reported having very good health, and this percentage decreased to 31.0% in April 2021. Although it is not possible to state whether this worsening was due to a decrease in physical activity, the health benefits of regular physical activity involve a reduction in the symptoms of anxiety and depression, improved self-esteem, improved aerobic capacity, and better control of chronic diseases^{28,29}.

Another important finding from the present study was that the anxiety and depression symptoms level did not change between June 2020 and April 2021.

A recent systematic review study³⁰ showed that the restriction level of mobility was associated with the prevalence of anxiety and depression, therefore, a reduction in these levels was expected in the population studied. However, there are other factors that are also associated with anxiety and depression in addition to a restricted level of mobility. Specifically, daily COVID-19 infection rates were also a factor that showed a significant association with anxiety and depression levels. In this direction, the number of new cases per day (463,000) and also the number of deaths per day (21,094) that occurred in April 2021 was much higher than the number of new cases per day (180,000) and the number of deaths per day (7,148) that occurred in June 2020¹⁷. Therefore, it is evident that a single cause cannot attribute the damage to the mental health of the population. In the same direction, the observed decrease in physical activity levels may also be a factor that made it difficult to improve the population's mental health, as it was previously demonstrated³¹.

The decrease in the level of physical activity, a decrease in the perception of health, and unchanged levels of anxiety and depression, even after fewer social restrictions, reinforce the need to formulate strategies to promote and encourage physical activity and to improve mental health during and after the pandemic. The present results indicate that a natural return to prepandemic levels is not possible. A previous study³¹ has demonstrated that the use of virtual platforms and the purchase of home gym equipment during the pandemic had increased the level of physical activity in the population. The use of these tools could be encouraged to increase or maintain the minimum level of physical activity required for health benefits.

Conclusions

The level of physical activity was reduced during the COVID-19 pandemic period and anxiety and depression levels had not increased, even with fewer social distancing restrictions and the reopening of gyms, parks, and clubs. These data demonstrate that despite fewer restrictive measures, it should not be assumed that the return to prepandemic levels of physical activity and mental health will be automatic and that interventions are not needed. The results obtained in this study show the need for public policies to publicize the importance of exercising and encourage physical activity during and after the pandemic, in addition to alerting the population about the importance of mental health. The use of tools such as virtual apps and home gym equipment can encourage the population to exercise. Further prospective studies should be conducted to assess the impact that lifestyle changes imposed by the pandemic will have on the population's sedentary behavior and create strategies to encourage a return to regular physical activity. Finally, the results presented herein suggest that there will be a challenging scenario in the postpandemic period regarding physical activity.

Conflict of Interest

The Authors declare that they have no conflict of interests.

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