Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original Research

Sharp increase in depression and anxiety among Brazilian adults during the COVID-19 pandemic: findings from the PAMPA cohort

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ABSTRACT

Objectives: We aimed to compare the prevalence of depression and anxiety symptoms before and during the pandemic and identify factors associated with aggravated mental health symptoms.
Study design: Retrospective cohort study.
Methods: We identified the proportion of normal, mild, moderate, and severe symptoms of depression and anxiety before and during the social distancing restrictions in adults from southern Brazil. An online, self-administered questionnaire was delivered for residents within the state of Rio Grande do Sul. Depressive and anxiety symptoms were examined by the Hospital Anxiety and Depression Scale.
Results: Most of the participants (n = 2314) aged between 31 and 59 years (54.2%), were women (76.6%), White (90.6%) with a university degree (66.6%). Moderate-to-severe symptoms of depression and anxiety were reported in 3.9% and 4.5% of participants, respectively, before COVID-19. During the pandemic (June–July, 2020), these proportions increased to 29.1% (6.6-fold increase) and 37.8% (7.4-fold increase), respectively. Higher rates of depressive and anxiety symptoms were observed among women, those aged 18–30 years, diagnosed with chronic disease and participants who had their income negatively affected by social restrictions. Remaining active or becoming physically active during social distancing restrictions reduced the probability of aggravated mental health disorders.
Conclusions: Depressive and anxiety symptoms had a 6.6- and 7.4-fold increase since the COVID-19 pandemic. Public policies such as physical activity promotion and strategies to reduce the economic strain caused by this pandemic are urgently needed to mitigate the impact of the pandemic on mental health.

Introduction

Since it was declared a pandemic on March 11, 2020, the novel coronavirus disease (COVID-19) has elevated the attention toward mental health disorders, including anxiety and depression.[1] However, in many countries they were public health concerns even before COVID-19. The total number of people living with depressive or anxiety disorders in the world was 322 and 264 million in 2015, respectively.[2] Brazil ranked fifth and first for the prevalence of depressive and anxiety disorders, respectively, with the highest proportion of cases reported in the south region of the country.[3]

As neither vaccines or treatment have been developed at this time, nonpharmacological strategies such as good personal hygiene and social distancing are the best approaches available to reduce virus transmission and associated mortality.[4–6] Social distancing actions have required interrupting all nonessential activities and services, such as commercial services, industries, malls, and schools.[5] Although effective in combating the spread of the virus,[5,6] these approaches are likely to lead to mental distress due to acute financial strain and changes in household dynamics. Further, lifestyle changes such as increased physical inactivity[7] might heighten the incidence of mental disorders such as anxiety and depression.[8,9]

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Other determinants for worse mental health during the COVID-19 pandemic have been proposed such as underlying health conditions and young age groups.[10,11] However, most studies were carried out in high-income countries such as the United States,[12] United Kingdom,[10] and Austria.[11] Also, compliance with social distancing (e.g., stay at home, personal distancing) seems to increase depressive and anxiety symptoms.[12] Given the unprecedented situation caused by the COVID-19 pandemic, more studies are warranted to clarify the impact of preventive strategies such as social distancing in depressive and anxiety symptoms at the population level.[13]

Social disparities in Brazil have led to further uneven health and economic consequences across the population during the COVID-19 pandemic.[14] In May 2020, the World Health Organization launched the "COVID-19 and the Need for Action on Mental Health" aiming to mitigate the mental health problems caused by COVID-19 around the world.[1] One of the recommended actions is to comprehend the extent of mental health consequences of COVID-19 and the subsequent social and economic effects. Using data from a retrospective longitudinal study in the Rio Grande do Sul state in Brazil, we aimed to (1) compare the prevalence of depression and anxiety symptoms before and during the pandemic and (2) identify factors associated with aggravated depressive and anxiety symptoms.

Methods

Study design

The PAMPA cohort (Prospective Study About Mental and Physical Health) is an ambispective longitudinal observational study that aimed to identify the effects of the COVID-19 pandemic in adults from southern Brazil. An online questionnaire was used to gather data on mental and physical health from before and during COVID-19 social distancing. The study protocol was approved by the institutional research ethics board of the Superior School of Physical Education of the Federal University of Pelotas, Brazil (protocol: 4.093.170), and can be found elsewhere.[15] In this study, we analyzed data from the baseline of the PAMPA cohort, with fieldwork being conducted between June 22 and July 23, 2020.

During the COVID-19 pandemic, cities and states in Brazil had independent legislature to delineate their own regulatory strategies to control the virus spreading. In the Rio Grande do Sul state, a controlled social distancing system was adopted, according to which each macroregion in the state was evaluated according the availability of intensive care unit (ICU) beds, incidence rates, and spreading velocity. When these indicators indicated a worse scenario in a region (e.g., faster virus spreading and less ICU beds available), social distancing restrictions were more severe. During the recruitment phase, up to 73.4% of state population were in the second highest level of social distancing restriction, in which social clubs, gyms, theaters, religious temples, commercial centers, and malls were closed to prevent gatherings.

Sample

According to the latest Brazilian National Health Survey,[3] Rio Grande do Sul state has the highest prevalence of depression among all states in Brazil (13.2%; 95% confidence interval (CI): 11.8%–15.0%). The 2010 population census in Brazil reported 10,693,929 people living in the state.[16] To ensure a 95% confidence interval and 1.8 percentage points of margin of error, a required sample size of 1359 participants was calculated. Also, we accounted for a possible lost-to-follow-up of up to 30%. Therefore, our final sample size target was 1767 adults.

The state is divided in seven macroregions of health, as follows (names are in Portuguese): Serra, Norte, Nordeste, Centro-oeste, Vales, Metropolitana, and Sul. Using data from the latest national demographic census, we divided the target sample size proportionally to the number of inhabitants in each region. Full description of sampling process can be found elsewhere.[15]

Participant recruitment

We used a four-arm approach, as described elsewhere.[15] Briefly, we first contacted public and private universities within the state. A standardized email about the survey objectives and a link to access the questionnaire were sent to contacts in these institutions. Secondly, social media campaigns (i.e., Facebook® and Instagram®) were used to make the questionnaire's link available in different regions within the state. These campaigns were adjusted weekly to achieve a higher number of people in different regions, as necessary. Third, local media (e.g., local newspapers, TV, radio) were contacted by email and through social media to inform the local population about the present study. Finally, each researcher involved in this survey shared the link with the questionnaire access to personal contacts spread across the state. The recruitment phase lasted four weeks (June 22 to July 23, 2020).

Questionnaire

We developed an online-based, self-administered questionnaire to evaluate the effects of the COVID-19 pandemic on physical and mental health, as well as other health outcomes. The questionnaire was developed using the Google® Forms platform. A preliminary analysis showed that the average time to complete the survey was around 10 min, ranging from 7 to 12 min. Questions about mental health were assessed twice so it could be accessed based on different periods (before and during social distancing).

Primary outcomes

Mental health

Mental health was assessed by the Hospital Anxiety and Depression Scale (HADS) to identify symptoms of depression and anxiety both before and during social distancing. This 14-item scale is a simple and reliable tool valid in both community settings and primary care medical practice.[17–19] Each domain (depression and anxiety) contains seven items, which are scored between 0 and 3. Therefore, each domain has a maximum score of 21. Participants who scored less than 7 were classified as nonsymptomatic for that domain (i.e., anxiety or depression). Scores between 8 and 10 were considered as mild risk, between 11 and 14 as moderate risk, and between 15 and 21 as severe risk of depression and/or anxiety.[20] To assess the frequency of depressive and anxiety symptoms retrospectively, we asked the participants to answer all the HADS questions using the period before the COVID-19 pandemic as reference. Later, the current frequency of such symptoms was assessed considering the last week as the reference period.

Exposures

Sociodemographic characteristics

Questions on age, gender (male, female, other/prefer not to mention), city of residence, ethnicity (White, Black, Yellow, Mixed, Indigenous, other), conjugal situation (with or without partner), and the highest educational level achieved were assessed.

Health-related questions

We also asked participants about the diagnosis of any chronic disease based on the question used in the Brazilian Telephone-based Surveillance System for Noncommunicable Diseases.[21]

Table 1
Sociodemographic and health-related characteristics from surveyed adults in southern Brazil (Rio Grande do Sul). N = 2321.

	% (95% CI)
Age group, years (n = 2300)	
18–30	37.3 (34.8, 39.8)
31–59	54.2 (51.7, 56.8)
60+	8.5 (7.2, 10.1)
Sex (n = 2319)	
Male	23.3 (21.3, 25.6)
Female	76.6 (74.4, 78.7)
Ethnicity (n = 2318)	
White	90.6 (89.0, 92.0)
Mixed	9.4 (8.0, 11.0)
Conjugal situation	
Living with a partner	61.6 (59.1, 64.1)
Living alone	38.4 (35.9, 40.9)
Highest educational level	
High school or lower	33.3 (31.0, 35.8)
University degree	26.4 (24.2, 28.7)
Specialized, Masters, PhD	40.2 (37.8, 42.8)
Self-reported body mass index (n = 2315)	
Normal	46.7 (44.2, 49.3)
Overweight	33.1 (30.8, 35.6)
Obese	20.1 (18.1, 22.3)
Physical activity status before social distancing (n = 2314)	
Inactive	56.8 (54.3, 59.3)
Active	43.2 (40.7, 45.7)
Chronic disease	
No	43.1 (40.6, 45.7)
Yes	56.9 (54.3, 59.4)
Anxiety symptoms before social distancing (n = 2314)	
Normal	74.8 (72.5, 76.9)
Mild	20.7 (18.8, 22.9)
Moderate	4.5 (3.5, 5.7)
Severe	None
Depressive symptoms before social distancing (n = 2314)	
Normal	83.8 (81.8, 85.6)
Mild	11.8 (10.2, 13.5)
Moderate	3.9 (3.1, 5.1)
Severe	0.01 (0.00, 0.10)
Economic impact of social distancing	
No change	48.1 (45.6, 50.7)
Decreased	45.3 (42.7, 47.8)
Increased	6.6 (5.4, 8.0)

CI, confidence interval.

Next, respondents provided an estimated current weight and height. These measures were used to calculate the body mass index (BMI) and classify the sample into the following BMI-based categories[22]: normal (<25 kg/m^2), overweight (25–29.9 kg/m^2), and obese (≥30 kg/m^2).

Economic impact of the COVID-19 pandemic

The impact of COVID-19 pandemic in work-related activities and economic situation were examined with the following question: "*Did social distancing affect your monthly income*?" In case of an affirmative response, participants reported whether income decreased or increased during the COVID-19 pandemic.

COVID-19: Knowledge and attitudes

Self-rated knowledge about the COVID-19 was accessed by the following question: "How do you evaluate your knowledge about the new coronavirus (SARS-CoV-2)?" Participants could rate it as "bad," "regular," "good," "very good/excellent." Attitudes toward social distancing were assessed by the following question: "*How has your daily routine at home been*?" Answering options were: "staying at home all the time," "go out only for essential things" (e.g., buying food, go out sometimes for shopping and stretching my legs), "go out every day for some activity," or "go out every day to work or another regular activity." The two latest alternatives were merged for analysis purposes.

Physical activity

Changes in physical activity were established from similar questions. First, we asked participants about the weekly volume of physical activity before the social distancing period using the following question: "Before social distancing restrictions, were you engaged in physical activity regularly?" If the participant indicated a positive answer (i.e., "Yes"), then the total days and duration (minutes) of physical activity were asked.[23] Further, we asked about practice of physical activity in the current week (i.e., during social distancing). Participants were categorized into two groups according to the World Health Organization's recommendation: physically inactive (less than 150 min per week) or active (150 min or more per week).[24]

Data analyses

Data were exported from Google® Sheets to Stata 13.1 (StataCorp, College Station, Texas). Due to a higher number of respondents from one macroregion in the state (South, N = 1247 [53.7%]), all analyses were weighted for the number of respondents in each region. Continuous data were reported as mean and standard deviation while proportions were presented as mean and 95% confidence interval (CI). The chi-squared test was used to compare the proportion of participants in each level of anxiety and depression symptoms. Scores from both domains of HADS between pre- and during the COVID-19 social distancing were compared using two-way ANOVA with repeated measures, and Bonferroni's post hoc was used as required. Univariate and multivariate Poisson regression were performed to identify the determinants of declining mental health risk during COVID-19 pandemic. All variables from univariate analyses were added in the multivariate model, and a *P*-value≤0.20 was set to determine whether variables were maintained in the model. We adopted a *P*-value lower than 0.05 as the level of significance.

Results

Table 1 summarizes the sociodemographic characteristics of the final sample (n = 2321). Most of participants were middle-aged (31–59 years old [54.3%]), female (76.6%), White (90.6%), and had an university-level degree (66.6%). More than half were overweight or obese (53.2%) and had at least one chronic disease (56.9%).

Table 2
Impact of social distancing restrictions on symptoms of anxiety and depression, physical activity, and monthly income in southern Brazil (Rio Grande do Sul). N = 2321.

	% (95% CI)
Anxiety symptoms (n = 2314)	
No change	44.9 (42.3, 47.4)
Worsening	51.3 (48.8, 53.9)
Improvement	3.8 (3.0, 4.9)
Depressive symptoms (n = 2314)	
No change	60.3 (57.5, 63.0)
Worsening	35.0 (32.3, 37.7)
Improvement	4.7 (3.7, 6.0)
Physical activity (n = 2314)	
Sustained inactive	46.9 (44.4, 49.6)
Became inactive	26.6 (24.4, 28.9)
Became active	8.3 (6.9, 9.8)
Economic impact (n = 2321)	
No change	48.1 (45.6, 50.7)
Decreased	45.3 (42.7, 47.8)
Increased	6.6 (5.4, 8.0)

CI, confidence interval.

Table 2 described the impact of social distancing restrictions on depression and anxiety symptoms, physical activity, and economic situation. Most of the respondents reported worse anxiety symptoms since the beginning of social distancing (51.3%) while one in three had aggravated depressive symptoms in the same period. Roughly half of the participants indicated a decrease in monthly income (45.3%) and remained physically inactive (46.9%) since social distancing restrictions came into place.

The effects of the COVID-19 pandemic are also presented on the severity of anxiety (Supplementary Table S1) and depression (Supplementary Table S2). The proportion of people reporting moderate-to-severe anxiety and depression increased by 7.4 and 6.6 times since social distancing restrictions. Participants who were more likely to report worse anxiety symptoms during this period were female, aged between 18 and 30 years, had low educational achievement, and decreased monthly income since social distancing was implemented. In participants who completed secondary education or less the proportion of moderate-to-severe anxiety symptoms increased from 9.7% to 51.4%, with one quarter being classified with severe symptoms.

Aggravated depression symptoms were more frequent during the COVID-19 pandemic in females, younger age groups, and participants with chronic disease, as shown in Supplementary Table S2. Among participants with low educational achievement (i.e., up to secondary school), two out of five were classified with moderate-to-severe depression, representing a 4.6-fold increase from the pre-COVID-9 period. The negative impact of COVID-19 on monthly income was associated with higher scores of depression. Also, respondents who became physically inactive during social distancing restrictions reported higher increase in moderate-to-severe symptoms of depression (13.3x) than those who became active in the same period (5.1x).

Table 3 summarizes the continuous scores from HADS both on anxiety and depression symptoms. Notwithstanding the remarkable impact of COVID-19 pandemic among all subgroups, participants with low educational level, normal BMI classification, and reduced monthly income since social distancing restrictions revealed a higher impact on anxiety symptoms than their counterparts. Similarly, females and participants with a BMI lower than 24.9 kg/m^2 were the most affected by COVID-19 regarding depressive symptoms. On the other hand, those who were classified as physically active either before or during the pandemic had better mental health indicators.

Table 4 describes the determinants of aggravated mental health symptoms during the COVID-19 pandemic. Female sex (prevalence ratio (PR): 1.27; 95% CI: 1.11 to 1.45), presence of chronic disease (PR: 1.17; 95% CI: 1.05 to 1.29), and decreased monthly income (PR: 1.15; 95% CI: 1.04 to 1.28) were associated with a higher likelihood of more severe anxiety symptoms during social distancing. However, age and physical active practice (i.e., $\geq$150 min per week) were associated with less anxiety symptoms. This protective effect of physical activity was observed among those respondents who were active at both times (PR: 0.72; 95% CI: 0.57 to 0.91) and also among those who became physically active (PR: 0.59; 95% CI: 0.41 to 0.85) during social distancing restrictions.

Determinants for worse depressive symptoms were similar to those observed for anxiety. However, those who were physically active had fewer depressive symptoms regardless of the status before the COVID-19 pandemic.

Discussion

To date and to the best of our knowledge, this is the first study that examined the effect of COVID-19 pandemic on mental health issues in Brazil using a longitudinal design. We found that the prevalence of moderate-to-severe anxiety and depressive symptoms increased 7.4x and 6.6x, respectively, after the implementation of social distancing restrictions. Female sex, age 30 or less, diagnosed chronic disease, and acute economic strain due to the COVID-19 pandemic were identified as determinants for worse anxiety and depressive symptoms. Aggravated depressive symptoms were less likely in participants who were physically active during the social distancing restrictions, independent of physical activity status before them.

Although we did not analyze specific income data, we asked participants about the impact of the COVID-19 crisis on their monthly income. A negative economic impact was reported by 45.3% (95% CI: 42.7%, 47.8%) of the respondents, who were more likely to have aggravated anxiety and depressive symptoms during the pandemic. We also found that participants aged between 18 and 30 years were more likely to have heightened anxiety and depressive symptoms than older age groups, corroborating previous findings.[11,25] This subgroup is working age and less likely to be in an established position in their jobs. Therefore, the fear of unemployment and uncertainty about the future after COVID-19 may be responsible for the aggravated mental health.[10,26,27] This is similar to what was documented in previous outbreaks (i.e., Ebola and SARS).[26,28] Further, the COVID-19 pandemic has heightened the social inequalities seen for so many years in Brazil and in other countries[29] especially regarding the access of mental health services.[30] If no action is made to mitigate mental health issues in the most vulnerable groups, the burden of mental health disorders is expected to lead to an unprecedented health crisis.[1]

Some countries have estimated the prevalence of depression and other mental health disorders during COVID-19. Nevertheless, information from longitudinal studies is scarce. In Ethiopia, since the beginning of the pandemic, the number of people with depression had a threefold increase compared to the pre-COVID-19 period.[1] A recent prospective longitudinal study in the United Kingdom reported that the prevalence of clinically significant levels of mental distress rose 44% from 2018/19 to April 2020 (i.e., after 1 month of government-imposed lockdown), affecting more young and female participants.[10] In China, a study surveyed 333 people between the initial outbreak and 4 weeks after the epidemic's peak, with no difference in the prevalence of moderate-to-severe depression, anxiety, and stress.[31] We revealed that in Brazil, the number of people reporting moderate-to-severe depressive and anxiety symptoms increased 6.6x and 7.4x, respectively. This “above average” increase in mental distress compared to other countries may reveal the triple burden caused by health, economic, and political crises in the country. Besides, no federal agencies in Brazil imposed a lockdown or any more rigorous social distancing strategies to obligate people to stay at home. However, this was seen in the abovementioned countries,[32] where lower burden of mental health attributable to the COVID-19 pandemic was reported.

We revealed that physically active participants were less likely to report mental health issues during the COVID-19 crisis, consistent with previous findings.[33] We further observed that this protective effect was independent of physical activity status before the pandemic. However, those who became inactive during this period had the same likelihood of aggravated symptoms compared to respondents who were inactive before the pandemic and sustained this behavior during it. Although social distancing restrictions may include closing gyms and sports clubs, physical activity needs to be promoted and encouraged.[34] Previous studies have reported that engaging in physical activity reduces the risk of depression and anxiety disorders during the COVID-19 pandemic.[11,35,36] These protective effects may be associated with the increased synthesis and release of neurotransmitters[37] and neurotrophic factors[38]

Table 3
Effect of COVID-19 pandemic on HADS scores in subgroup analyses. N = 2314.

	Anxiety (mean [SD])		*P*-values			Depression (mean [SD])		*P*-values		
	Before	During	Group	Time	Group x time	Before	During	Group	Time	Group x time
Sex			<0.001	<0.001	0.077			0.270	<0.001	<0.001
Male	5.3 (2.8)	8.2 (4.5)				4.8 (3.2)	7.3 (4.0)			
Female	5.8 (2.7)	9.6 (4.7)				4.6 (2.9)	8.2 (4.0)[g]			
Ethnicity			0.180	<0.001	0.939			0.024	<0.001	0.537
White	5.7 (2.7)	9.3 (4.7)				4.7 (3.0)	8.0 (4.0)			
Non-white	5.7 (2.9)	9.0 (4.8)				4.3 (2.9)	7.7 (4.1)			
Age group in years			0.173	<0.001	0.582			0.002	<0.001	0.439
18–30	5.9 (2.6)	10.0 (4.7)				4.5 (2.8)	8.5 (4.0)			
31–59	5.7 (2.7)	9.0 (4.6)				4.8 (3.1)	7.8 (3.9)			
60+	4.9 (3.1)	7.2 (4.4)				4.4 (3.0)	6.5 (3.9)			
Conjugal situation			0.006	<0.001	0.059			0.970	<0.001	0.503
With partner	5.6 (2.7)	9.0 (4.6)				4.6 (3.0)	7.7 (4.0)			
No partner	6.0 (2.8)	9.7 (4.8)				4.7 (3.0)	8.4 (4.0)			
Educational level			0.006	<0.001	0.015			0.926	<0.001	0.612
High school or less	6.1 (3.1)[a]	10.4 (5.1)[a]				5.2 (3.2)	8.7 (4.0)			
College degree	5.9 (2.6)[a]	9.4 (4.5)[a,b]				4.6 (2.9)	8.1 (3.9)			
Postgraduate	5.5 (2.7)	8.7 (4.7)				4.4 (3.0)	7.6 (4.1)			
Chronic disease			0.003	<0.001	0.656			<0.001	<0.001	0.809
No	5.3 (2.6)	8.8 (4.6)				4.2 (2.7)	7.5 (4.0)			
Yes	6.1 (2.8)	9.7 (4.7)				5.0 (3.1)	8.4 (3.9)			
Physical activity status			<0.001	<0.001	<0.001			<0.001	<0.001	<0.001
Sustained inactive	5.9 (0.1)	9.8 (0.2)				5.1 (0.1)	8.6 (0.1)			
Became inactive	5.7 (0.1)[c]	9.9 (0.2)				4.3 (0.1)[c]	8.4 (0.2)			
Became active	5.6 (0.3)	7.3 (0.4)[c,d]				4.4 (0.3)	5.9 (0.3)[c,d]			
Sustained active	5.1 (0.1)[c]	8.1 (0.3)[c,d]				4.1 (0.2)[c]	6.9 (0.3)[c,d]			
Body mass index			0.028	<0.001	0.001			0.642	<0.001	<0.001
Normal	5.7 (2.7)	9.5 (4.7)				4.4 (2.7)	8.2 (4.0)			
Overweight	5.8 (2.8)	8.9 (4.5)[e]				4.7 (3.2)[e]	7.7 (3.9)			
Obese	5.9 (2.9)	9.1 (5.0)				5.0 (3.1)[e]	7.9 (4.0)			
Economic impact of COVID-19			<0.001	<0.001	<0.001			0.252	<0.001	0.329
No change	5.9 (2.7)	9.9 (4.7)				4.6 (2.9)	8.5 (4.0)			
Decreased	5.6 (2.8)[a]	8.7 (4.5)[a]				4.6 (3.0)	7.6 (3.9)			
Increased	5.9 (2.7)	9.2 (5.1)				4.8 (3.0)	7.6 (4.4)			
Routine during COVID-19			0.066	<0.001	0.433			0.197	<0.001	0.691
Stay at home	6.1 (2.8)	10.1 (5.2)				5.2 (3.4)	8.9 (4.5)			
Go out only for essential activities	5.8 (2.8)	9.3 (4.7)				4.6 (3.0)	8.1 (4.0)			
Go out every day	5.5 (2.7)	8.9 (4.6)				4.4 (2.9)	7.4 (3.8)			
Knowledge about COVID-19			0.004	<0.001	0.850			0.020	<0.001	0.556
Bad	7.0 (2.7)	11.9 (4.3)				5.3 (3.5)	9.6 (3.6)			
Regular	6.2 (3.0)	9.6 (5.0)				5.3 (3.3)	8.6 (3.8)			
Good	5.8 (2.8)	9.1 (4.5)				4.8 (2.9)	8.0 (3.8)			
Very good/excellent	5.6 (2.7)	9.3 (4.8)				4.4 (2.9)	7.9 (4.2)			

[f] $P < 0.05$ (Bonferroni's post-hoc) compared to no change.
[a] $P < 0.05$ (Bonferroni's post-hoc) compared to postgraduate degree.
[b] $P < 0.05$ (Bonferroni's post-hoc) compared to college degree.
[c] $P < 0.05$ (Bonferroni's post-hoc) compared to sustained inactive.
[d] $P < 0.05$ (Bonferroni's post-hoc) compared to became inactive.
[e] $P < 0.05$ (Bonferroni's post-hoc) compared to normal BMI.
[g] $P < 0.001$ (Bonferroni's post-hoc) compared to male sex.

which may improve neurogenesis,[39] angiogenesis,[40] and neuroplasticity.[41,42] Previous findings revealed that breaking long-lasting sitting time could reduce depressive and anxiety symptoms.[43] Then, home-based, COVID-19-safe approaches to promote physically active behavior and decrease sitting time may be crucial to reduce the burden of COVID-19 on mental health at the population level.

Some limitations of our study need to be acknowledged. First, the retrospective longitudinal design may lead to recall bias. Nonetheless, there was no data from ongoing, population-level, prospective studies in south Brazil. Therefore, the study design used here was the only possibility. Also, the unprecedented impact of COVID-19 pandemic on daily activities may create a remarkable timepoint improving participants' ability to compare the moments before and during social distancing restrictions, thus reducing the likelihood of recall bias. Second, as face-to-face research was not permitted by the ethics board from our institution, a probabilistic sampling process was not possible. For example, the proportion of participants self-declared White (90.6% [95% CI: 89.0%–92.0%]) and aged 30 years or over (62.7% [95% CI: 60.2%–65.2%]) is similar to the observed in the general population of the Rio Grande do Sul state (Whites: 79%, adults aged 30 or over: 62.2%). Nevertheless, respondents with one or more academic degree is overexpressed. Data from the latest PNAD[44] revealed that 16.9% of adults aged 25 years or over had at least one academic degree, while in our sample, this proportion was 40.2% (95% CI: 37.8%–42.8%). This sampling bias was expected, since data collection was online and poorer/less schooled people have limited access to internet compared to richer/more schooled people in Brazil. However, one should note that the COVID-19 has a stronger impact on the lower economic groups of the population; thus our results are likely underestimated. Had our sample included a higher proportion of the less schooled people, an

Table 4
Determinants of worsened anxiety and depression symptoms in subgroup analyses. N = 2314.

	Anxiety				Depression			
	Crude (PR, 95% CI)	*P*-value	Adjusted (PR, 95% CI)	*P*-value	Crude (PR, 95% CI)	*P*-value	Adjusted (PR, 95% CI)	*P*-value
Sex		<0.001		0.001		0.016		0.006
Male	1.00		1.00		1.00		1.00	
Female	1.28 (1.12, 1.47)		1.27 (1.11, 1.45)		1.28 (1.05, 1.55)		1.33 (1.08, 1.63)	
Ethnicity		0.535		0.697		0.966		0.964
White	1.00		1.00		1.00		1.00	
Mixed	0.95 (0.79, 1.13)		0.97 (0.81, 1.15)		1.00 (0.78, 1.30)		0.99 (0.76, 1.30)	
Age group in years		<0.001		<0.001		0.010		0.002
18–30	1.00		1.00		1.00		1.00	
31–59	0.85 (0.77, 0.94)		0.82 (0.74, 0.91)		0.84 (0.72, 0.99)		0.79 (0.67, 0.93)	
60+	0.57 (0.43, 0.74)		0.57 (0.44, 0.75)		0.62 (0.44, 0.88)		0.59 (0.41, 0.85)	
Conjugal situation		0.067		0.727		0.055		0.448
With partner	1.00		1.00		1.00		1.00	
No partner	1.10 (0.99, 1.21)		1.02 (0.92, 1.13)		1.16 (1.00, 1.36)		1.07 (0.90, 1.26)	
Educational level		0.075		0.509		0.049		0.584
High school or less	1.00		1.00		1.00		1.00	
College degree	0.95 (0.82, 1.09)		0.94 (0.82, 1.09)		0.85 (0.69, 1.05)		0.90 (0.72, 1.12)	
Postgraduate	0.86 (0.74, 0.99)		0.91 (0.78, 1.06)		0.76 (0.61, 0.95)		0.89 (0.70, 1.12)	
Chronic disease		0.054		0.003		0.066		0.025
No	1.00		1.00		1.00		1.00	
Yes	1.11 (1.00, 1.22)		1.17 (1.05, 1.29)		1.16 (0.99, 1.35)		1.21 (1.02, 1.42)	
Change in physical activity status		<0.001		<0.001		<0.001		0.002
Sustained inactive	1.00		1.00		1.00		1.00	
Became inactive	1.10 (0.98, 1.22)		1.10 (0.98, 1.22)		0.97 (0.81, 1.15)		0.95 (0.79, 1.14)	
Became active	0.61 (0.47, 0.80)		0.62 (0.47, 0.81)		0.59 (0.41, 0.86)		0.59 (0.41, 0.85)	
Sustained active	0.74 (0.63, 0.87)		0.75 (0.64, 0.81)		0.70 (0.55, 0.89)		0.72 (0.57, 0.91)	
Body mass index		0.192		0.372		0.852		0.857
Normal	1.00		1.00		1.00		1.00	
Overweight	0.98 (0.87, 1.09)		1.01 (0.90, 1.13)		0.95 (0.80, 1.13)		0.98 (0.81, 1.17)	
Obese	0.88 (0.76, 1.01)		0.91 (0.79, 1.06)		0.99 (0.81, 1.22)		1.04 (0.85, 1.28)	
Economic impact of COVID-19		0.011		0.011		0.036		0.047
No change	1.00		1.00		1.00		1.00	
Decreased	1.16 (1.05, 1.29)		1.15 (1.04, 1.28)		1.23 (1.05, 1.44)		1.23 (1.04, 1.44)	
Increased	1.01 (0.81, 1.25)		0.94 (0.75, 1.18)		1.09 (0.79, 1.48)		1.07 (0.79, 1.44)	
Commitment to social distancing restrictions		0.240		0.928		0.675		0.593
Low	1.00		1.00		1.00		1.00	
Medium	0.87 (0.74, 1.04)		1.02 (0.83, 1.26)		1.11 (0.81, 1.52)		1.08 (0.78, 1.49)	
High	0.86 (0.71, 1.03)		1.03 (0.86, 1.24)		1.02 (0.77, 1.36)		0.98 (0.73, 1.31)	
Knowledge about COVID-19		0.441		0.227		0.718		0.911
Very good/excellent	1.00		1.00		1.00		1.00	
Good	0.94 (0.85, 1.05)		1.32 (0.92, 1.90)		1.00 (0.85, 1.18)		1.02 (0.40, 2.62)	
Regular	1.01 (0.85, 1.21)		1.00 (0.84, 1.19)		1.16 (0.89, 1.51)		1.11 (0.84, 1.46)	
Bad	1.25 (0.83, 1.86)		0.93 (0.84, 1.04)		0.90 (0.36, 2.24)		1.01 (0.86, 1.19)	

Values are reported as prevalence ratio (PR) and 95% confidence interval (CI).

even higher prevalence of the outcomes could be observed. Third, the questionnaire was self-administered which may be more prone to response bias. Nevertheless, as previously reported,[45] self-report scales might be useful in the current scenario, as they are usually short, easy to administer, and feasible to be used when in social distancing restrictions. Fourth, we adapted the validated HADS to assess the frequency of depressive and anxiety symptoms retrospectively. Then, although astounding, our findings need to be interpreted with caution. Lastly, although we used a retrospective design, reverse causality cannot be ruled out when interpreting our findings.

In summary, we revealed a 6.6- and 7.4-fold increase in moderate-to-severe symptoms of depression and anxiety. Women, younger age (i.e., 18–30 years), clinically diagnosed chronic diseases, and negative economic impact from social distancing restriction were associated with a higher likelihood of aggravated mental health issues. Physical activity decreased the probability of worse depressive and anxiety symptoms at the same time point. Well-designed treatment and recovery plans for these groups need to take place urgently. If not addressed, the burden associated with depression and anxiety could be worse than the health impact from the virus itself and lead to a longer, deeper, and more uneven health crisis in Brazil.

Author statements

Ethical approval

Ethical Approval was given by the Ethics Committee of the Federal University of Pelotas (31906920.7.0000.5313).

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Competing interests

None declared.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.puhe.2020.11.013.

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