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.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Public Health 204 (2022) 14–20

Contents lists available at ScienceDirect

Public Health

journal homepage: www.elsevier.com/locate/puhe

Original Research

Depression and anxiety symptoms remained elevated after 10 months of the COVID-19 pandemic in southern Brazil: findings from the PAMPA cohort

N. Feter [a, b, *], E.L. Caputo [a, b], J.S. Leite [c], E.C. Smith [d], I.R. Doring [b], J. Cassuriaga [a], F.M. Delpino [e], C.M. Huckembeck [a], R. Alt [f], F.F. Reichert [a, b], M.C. da Silva [a, b], J.S. Coombes [d], A.J. Rombaldi [a, b]

[a] Postgraduate Program of Physical Education, Federal University of Pelotas, Pelotas, Brazil
[b] Study Group of Physical Activity Epidemiology, Federal University of Pelotas, Pelotas, Brazil
[c] Postgraduate Program of Health Sciences, Federal University of Rio Grande Do Sul, Porto Alegre, Brazil
[d] School of Human Movement and Nutritional Sciences, The University of Queensland, Brisbane, Australia
[e] Postgraduate Program of Nursing, Federal University of Pelotas, Pelotas, Brazil
[f] Postgraduate Program of Epidemiology, Federal University of Pelotas, Pelotas, Brazil

ARTICLE INFO

Article history:
Received 14 September 2021
Received in revised form
17 December 2021
Accepted 21 December 2021
Available online 30 December 2021

Keywords:
COVID-19
Depression
Anxiety
Brazil
Longitudinal studies

ABSTRACT

Objectives: This study aimed to examine the changes in depression and anxiety symptoms among Brazilian adults over 10 months of the COVID-19 pandemic.

Study design/Methods: The present study used data from wave 1 (June/July 2020) and wave 2 (December 2020/January 2021) of the Prospective Study About Mental and Physical Health (PAMPA) Cohort, a state-level, ambispective longitudinal study with adults from southern Brazil. The frequency of anxiety and depressive symptoms was assessed using the Hospital Anxiety and Depression Scale. Anxiety and depressive symptoms before social distancing were retrospectively assessed during wave 1.

Results: Most of the 674 participants were classified as non-symptomatic for depressive (85.0%) and anxiety symptoms (73.2%) before the COVID-19 pandemic. At wave 1, there were increases in symptoms of depression (7.6% [95% confidence interval [CI]: 7.2%, 8.1%]) and anxiety (9.1% [95% CI: 8.6%, 9.5%]). These decreased at wave 2 (depression: 6.9% [95% CI: 6.5%, 7.2%]; anxiety: 7.4% [95% CI: 7.1%, 7.8%]) although they were still elevated compared with pre-COVID (depression: 4.5% [95% CI: 4.2%, 4.8%]; anxiety: 5.8% [95% CI: 5.5%, 6.1%]). Adults living alone (b = 0.44 [95% CI: 0.07, 0.82]) had a faster trajectory in anxiety symptoms than their counterparts. Cohort members who were living alone (b = 0.24 [95% CI: 0.06, 0.42]) and with diagnosed chronic disease (0.32 [95% CI: 0.18, 0.46]) had a faster increase in depressive symptoms than their respective counterparts. Participants aged ≥60 years showed a slower trajectory of depressive (b = −0.46 [95% CI: −0.73, −0.18]) and anxiety (b = −0.61 [95% CI: −1.20, −0.02) symptoms.

Conclusions: During 10 months of COVID-19, anxiety and depression symptoms improved but were still higher than before COVID-19.

© 2022 The Royal Society for Public Health. Published by Elsevier Ltd. All rights reserved.

Introduction

The new COVID-19 had the first case reported in late December 2019 in China. Since then, more than 154 million cases had been recorded worldwide, with the United States and Brazil accounting for roughly one-third of the number of people diagnosed with COVID-19.[1] Also, millions of people had lost their lives due to this disease in the world. Furthermore, robust healthcare systems have

* Corresponding author. School of Human Movement and Nutrition Sciences, The University of Queensland, Brisbane, Queensland 4067, Australia. Tel.: +61 0406 260 878.
E-mail address: n.feter@uq.edu.au (N. Feter).

https://doi.org/10.1016/j.puhe.2021.12.019
0033-3506/© 2022 The Royal Society for Public Health. Published by Elsevier Ltd. All rights reserved.

been disrupted due to the sharp and rapid increase in hospitalizations due to COVID-19.[2]

As disease-modifying treatments have not been developed before 2021, non-pharmacological strategies to mitigate virus transmission such as social distancing have been used.[3] Social distancing has been proven to be an efficient approach at the population level to lessen the number of cases, deaths, and hospitalizations attributed to COVID-19.[4] However, it also has been associated with other effects such as aggravated symptoms of anxiety and depression.[5,6] To identify the effects of social distancing on mental and physical health in adults from southern Brazil, the PAMPA (**P**rospective Study **A**bout **M**ental and **P**hysical He**a**lth) Cohort was created.[7] Using data from wave 1 carried out between June and July 2020, we observed that cases of moderate-to-severe anxiety and depressive symptoms had increased by 7.4- and 6.6-fold, respectively.[8] These increases were even higher than those observed in countries where more restrictive strategies (e.g. lockdown) were adopted.[9–11]

Sociodemographic and health-related factors, including female sex, age (≤45 years), presence of a chronic disease, and physical inactivity, have been identified as risk factors for higher levels of depressive and anxiety symptoms during the pandemic.[5,6,9,10,12,13] However, individual repeated-measures data to quantify the longitudinal changes on anxiety and depressive symptoms since the beginning of social distancing are scarce.[14] This gap limits our knowledge as to whether these symptoms are still elevated, have increased even more, or have diminished after several months into the COVID-19 pandemic. For example, data from the United Kingdom[15] and Germany[16] showed that the rapid increase in depressive and anxiety symptoms observed in March 2020 was followed by a decline up to 5 months later. Thus, we aimed to examine the changes in depression and anxiety symptoms among Brazilian adults over 10 months of the COVID-19 pandemic. Based on previous longitudinal studies with shorter follow-up,[15,16] we hypothesized that the frequency of anxiety and depressive symptoms would remain elevated although stable in our cohort in the second half of 2020.

Methods

The present study used data from the first two waves of the PAMPA Cohort, a state-level, ambispective longitudinal study with adults from southern Brazil. A full description of the PAMPA cohort can be found elsewhere.[7] 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).

Recruitment phase

Adults living in the Rio Grande do Sul state were recruited via personal networks and social and local media.[7,17] Data were collected using an online-based, self-reported questionnaire. In wave 1, recruitment lasted 4 weeks (June 22, 2020, to July 23, 2020), whereas in wave 2, it was over 7 weeks because it included the holiday period (December 1, 2020, to January 15, 2021). Both sets of data collection were performed exclusively online.

The Rio Grande do Sul state is divided into regions by the government, and each region is weekly classified into one of the four flag colors (i.e. yellow, orange, red, and black) based on the current number of COVID-19 cases and the rate of contamination as well as the capacity of the health system to attend to the population of the region. The yellow flag indicates a region that has low risk of transmission and hospital occupancy rate and a high availability of intensive care units (ICU), whereas the black flag indicates a region with high risk of transmission and hospital occupancy rate and a low ICU availability. Regions rated with a black flag have the most restrictive measures to limit virus spread. Up to 73.5% and 95.2% of the state's population were rated with red flag during waves 1 and 2, respectively, as defined by the State government's social distancing policies. During this level of restrictions, social clubs, gyms, theaters, religious temples, commercial activities, and malls were allowed to open, but with maximal capacity reduced by up to 75% to prevent gatherings.

Sample

The required sample size calculated before wave 1 was based on the prevalence of depression in the Rio Grande do Sul state in 2013 (13.2%; 95% confidence interval [CI]: 11.8%–15.0%]). Considering the state's population according to the latest census (10,693,929 inhabitants),[18] a 95% CI with 1.8 percentage points of margins of error, and a possible lost-to-follow-up of up to 30%, the required sample size was set at 1767 participants. Furthermore, the Rio Grande do Sul state is divided into seven macroregions of health, as follows (names are in Portuguese): *Serra, Norte, Nordeste, Centro-Oeste, Vales, Metropolitana, and Sul.* Using the latest national census, we divided the required sample size proportionally to the number of people living in each region. Participants aged ≥18 years, who provided contact information (e.g. phone number, social media), and were living in the Rio Grande do Sul State were included in wave 1. From this initial sample, participants who were still living in the State were contacted in wave 2, as shown in Fig. 1.

Outcome

The frequency of anxiety and depressive symptoms was assessed using the Hospital Anxiety and Depression Scale (HADS). This instrument was previously validated in both primary care and community settings.[19–22] The scale is composed by two domains (anxiety and depression), with seven items, each scoring from 0 to 3. Thus, each domain has a maximum score of 21 points, with higher scores indicating higher frequency of symptoms. Participants who scored seven or less were classified as non-symptomatic for that domain. Scores between 8 and 10 were considered as mild risk, scores between 11 and 14 were considered as moderate risk, and scores higher than 15 were considered as severe risk of anxiety or depression.[20]

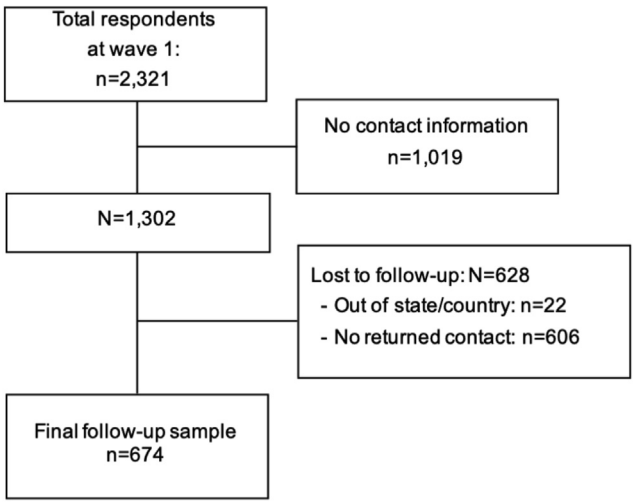

Fig. 1. Flow chart describing sampling process.

In wave 1, participants were asked to rate the frequency of depressive and anxiety symptoms twice. First, we explored depression and anxiety retrospectively by asking the participant to answer the HADS as if they were 2 months before (i.e. before the COVID-19 pandemic). Second, they responded to that same questionnaire but referred to the last 2 weeks. In wave 2, these symptoms were assessed using the HADS with the last two weeks as the reference period.

Exposures

Sociodemographic characteristics, including age, gender, skin color, conjugal situation, and educational level, were assessed in wave 1. We also asked participants in wave 1 how social distancing affected their monthly income (i.e. decreased, unchanged, increased). Self-reported weight and height were reported to calculate body mass index (BMI). BMI was further categorized into normal (BMI <25 kg/m^2), overweight (BMI ≥25 and <30 kg/m^2), and obese (BMI ≥30 kg/m^2). Chronic diseases diagnosed by a physician were also reported during wave 1 using the question previously used in the Brazilian Telephone-based Surveillance System for Noncommunicable Diseases.[23]

In wave 1, physical activity before social distancing and during the current week was determined. In wave 2, the reference period for physical activity was the current week. The following validated question was used:[24] "(*Before social distancing restrictions OR During the current week*), *were you engaged in physical activity regularly?*" If participants indicated a positive answer (i.e. "yes"), then the number of days and minutes were asked. Participants were further categorized according to the latest guidelines of physical activity provided by the World Health Organization.[25] Respondents with less than 150 min of physical activity per week were classified as inactive, and those with 150 min or more were considered physically active. We also asked participants about the use of online services to practice home-based physical activity during wave 2.

Data analyses

Due to the overrepresentation of respondents from one macroregion in the state (*Sul*, N = 436, 64.6%), all analyses were weighted by the respondents' proportion in each macroregion. Normality of data distribution and homoscedasticity were tested using Shapiro–Wilk and Bartlett tests, respectively. Continuous data were reported as mean and 95% CI, whereas categorical variables were shown as proportions and 95% CI. Differences between excluded and included participants were tested using the Chi-squared test. Two-way analysis of covariance with repeated measures was used to compare HADS scores among the three periods, with *P* values adjusted for multiple comparisons using the Bonferroni's post-hoc.

We further used structural equation modeling with maximum likelihood method to identify the velocity of change on depressive and anxiety symptoms over 10 months of the COVID-19 pandemic. The slope and intercept of the model for each domain (i.e. anxiety and depression) were integrated into multivariate linear regression models. A significant intercept indicates between-group differences before COVID-19 social distancing. Positive and negative slope coefficients indicated the trajectory of the symptoms was faster or slower, respectively, than the reference groups. 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. All analyzes were performed using STATA/MP 14.2 (Stata Corp, College Station, TX).

Results

From the participants included in wave 1 (n = 2321), 1302 were available for wave 2, as shown in Fig. 1. A total of 674 (51.8% of the available sample) individuals participated in both waves and were included in this analysis. Eligible participants who were lost-to-follow-up in wave 2 were more likely to be older than 30 years ($P = 0.005$), as shown in Supplementary Table 1. Most of included participants were women (80.7%), aged between 31 and 59 years (52.4%), White (91.9%), and lived with a partner (57.0%). Also, participants were more likely to have a university degree (67.3%) and classified as overweight/obesity (53.9%) and have a medical diagnosis of some chronic disease (57.3%). Roughly half of the participants were active before social distancing, whereas 38.9% used online services to assist with home-based physical activity during wave 2. Most respondents were classified as non-symptomatic for depressive (85.0%) and anxiety (73.2%) symptoms before the COVID-19 pandemic.

Scores of both depressive and anxiety-specific domains increased in wave 1 and decreased in wave 2, as shown in Fig. 2. However, those values remained elevated compared with before COVID-19 period. Supplementary Table 2 illustrates the scores from the HADS depression-specific domain. Significant time × group interactions were observed based on age groups ($P < 0.001$), conjugal situation ($P = 0.003$), and depressive ($P < 0.001$) and anxiety ($P = 0.014$) symptoms before the pandemic. People aged <60 years reported an increased and sustained frequency of depressive symptoms over 10 months of the COVID-19 pandemic. On the other hand, no significant changes were observed among people aged ≥60 years and those with moderate-to-severe depressive symptoms. During social distancing, participants who lived with a partner showed a lower score on depressive symptoms than those who lived alone. Participants who were non-symptomatic for depressive symptoms before social distancing reported a higher score on the depression-specific HADS domain during wave 1 followed by a reduction in wave 2. However, scores in wave 2 remained elevated compared with before the pandemic. Participants with a mild risk of depression showed elevated scores in waves 1 and 2 with no significant difference between these two time points. No interaction effect was observed for other variables.

Changes on anxiety symptoms over 10 months of the COVID-19 pandemic are reported in Supplementary Table 3. Younger participants (i.e. aged <60 years) had higher scores of anxiety-specific

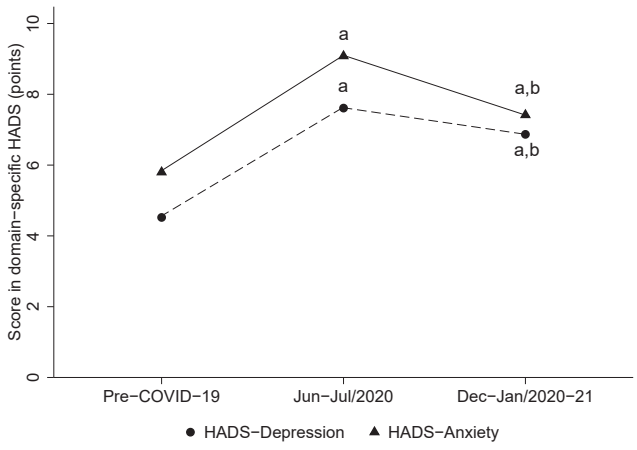

Fig. 2. Mean score at depression and anxiety domains of the Hospital Anxiety and Depression Scale (HADS) throughout the follow-up period. (a) $P < 0.05$ compared with the pre-COVID-19 period. (b) $P < 0.05$ compared with the Jun–July 2020 period.

HADS in wave 1 followed by a significant reduction in wave 2 although still higher than before the pandemic. A similar pattern was observed among participants non-symptomatic for anxiety levels before the pandemic. Those with a mild risk for anxiety showed increased scores in wave 1 with no reduction in wave 2, whereas those with moderate-to-severe risk remained with elevated scores throughout the follow-up. No interaction effect was observed for other variables.

Younger adults and people with chronic diseases reported higher level of anxiety symptoms before the pandemic, as shown in Table 1. Age, conjugal status, and anxiety level before the pandemic were associated with the velocity of changes in such domain. Participants aged ≥60 years (b = −0.61 [95% CI: −1.20 to −0.02]) as well as those with mild (b = −0.41 [95% CI: −0.75 to −0.08]) and moderate-to-severe risk of anxiety before the pandemic (b = −1.80 [95% CI: −2.46 to −1.13]) reported slower aggravation during social distancing. However, adults living alone had a faster increase in anxiety symptoms than those who lived with a partner (b = 0.44 [95% CI: 0.07–0.82]).

Women, younger adults, and people with chronic diseases reported higher levels of depressive symptoms before the pandemic, as shown in Table 2. Some participants reported faster worsening of depressive and anxiety symptoms since social distancing began. Cohort members who were living alone (b = 0.23 [95% CI: 0.09–0.37]) and had an diagnosed chronic disease (0.32 [95% CI: 0.18–0.46]) had a faster increase in depressive symptoms than their respective counterparts. A similar pattern was observed for those with a mild-to-moderate risk of depression and anxiety before the COVID-19 pandemic. On the other hand, participants aged ≥60 years (b = −0.45 [95% CI: −0.71 to −0.18]) showed a slower trajectory of depressive symptoms.

Discussion

This is the first longitudinal state-level study addressing the frequency of depressive and anxiety symptoms over 10 months of the COVID-19 pandemic in Brazil. The country is the current epicenter of the pandemic, with a total of 422,340 deaths by May 9,

Table 1
Association between sociodemographic, behavioral, and health-related factors with anxiety trajectory evaluated by latent growth curve model, Rio Grande do Sul, Brazil (N = 674).

Variables	Intercept		Slope	
	β (95% CI)	*P* value	β (95% CI)	*P* value
Sex		0.063		0.531
Male	1.00		1.00	
Female	0.29 (−0.01–0.59)		0.13 (−0.28–0.55)	
Age (years)		0.007		0.003
18–30	1.00		1.00	
31–59	−0.22 (−0.47–0.04)		0.34 (−0.07–0.76)	
60+	−0.65 (−1.13–−0.17)		−0.61 (−1.20–−0.02)	
Ethnicity		0.896		0.572
White	1.00		1.00	
Black	0.01 (−0.64–0.66)		0.43 (−0.42–1.28)	
Mixed	0.16 (−0.42–0.74)		−0.37 (−1.26–0.52)	
Other	−0.87 (−4.02–2.27)		1.18 (0.89–1.48)	
Living situation		0.283		0.021
Living with a partner	1.00		1.00	
Living alone	0.14 (−0.12–0.40)		0.44 (0.07–0.82)	
Highest education level		0.816		0.077
High school or lower	1.00		1.00	
University degree	−0.10 (−0.43–0.23)		−0.02 (−0.53–0.50)	
Specialized, Masters, PhD	−0.08 (−0.39–0.22)		−0.42 (−0.85–0.02)	
Decreased monthly income		0.316		0.453
No	1.00		1.00	
Yes	0.13 (−0.12–0.37)		0.14 (−0.22–0.50)	
Self-reported body mass index		0.307		0.361
Normal	1.00		1.00	
Overweight	0.22 (−0.06–0.50)		−0.04 (−0.43–0.35)	
Obese	0.11 (−0.22–0.44)		−0.32 (−0.79–0.14)	
Chronic diseases		0.006		0.224
No	1.00		1.00	
Yes	0.36 (0.10–0.61)		0.23 (−0.14–0.59)	
Physical activity before COVID-19 pandemic		0.519		0.658
Inactive	1.00		1.00	
Active	−0.08 (−0.33–0.17)		0.08 (−0.29–0.46)	
Online services to practice home-based physical activity		0.948		0.830
No	1.00		1.00	
Yes	0.02 (−0.52–0.55)		0.04 (−0.33–0.41)	
Depressive symptoms		<0.001		0.528
Non-symptomatic	1.00		1.00	
Mild	0.58 (0.19–0.98)		0.28 (−0.28–0.84)	
Moderate-to-severe	1.01 (0.38–1.65)		0.36 (−0.65–1.37)	
Anxiety symptoms		<0.001		0.001
Non-symptomatic	1.00		1.00	
Mild	3.89 (3.59–4.19)		−0.50 (−0.99–−0.02)	
Moderate-to-severe	6.65 (6.07–7.24)		−1.70 (−2.78–−0.63)	

Adjusted for sex, age, skin color, living situation, highest education level, decreased monthly income, self-reported body mass index, chronic diseases, physical activity, and depressive and anxiety symptoms pre-COVID-19.

Table 2
Association between sociodemographic, behavioral, and health-related factors with depression trajectory evaluated by latent growth curve model, Rio Grande do Sul, Brazil (N = 674).

Variables	Intercept		Slope	
	β(95% CI)	*P* value	β (95% CI)	*P* value
Sex		0.025		0.084
Male	1.00		1.00	
Female	0.25 (0.03–0.47)		0.16 (−0.02–0.35)	
Age (years)		0.002		0.001
18–30	1.00		1.00	
31–59	0.07 (−0.13–0.27)		0.03 (−0.16–0.23)	
60+	−0.63 (−0.97–−0.28)		−0.46 (−0.73–−0.18)	
Ethnicity		0.778		0.275
White	1.00		1.00	
Black	0.14 (−0.33–0.61)		0.22 (−0.14–0.59)	
Mixed	−0.18 (−0.60–0.24)		−0.20 (−0.58–0.18)	
Other	−0.10 (−2.39–2.18)		−0.13 (−0.33–0.07)	
Living situation		0.051		0.011
Living with a partner	1.00		1.00	
Living alone	0.25 (−0.01–0.50)		0.24 (0.06–0.42)	
Highest education level		0.430		0.231
High school or lower	1.00		1.00	
University degree	−0.15 (−0.39–0.09)		−0.19 (−0.40–0.03)	
Specialized, Masters, PhD	−0.04 (−0.26–0.18)		−0.13 (−0.33–0.07)	
Decreased monthly income		0.149		0.113
No	1.00		1.00	
Yes	0.17 (−0.06–0.41)		0.13 (−0.04–0.29)	
Self-reported body mass index		0.399		0.718
Normal	1.00		1.00	
Overweight	0.12 (−0.08–0.33)		0.06 (−0.13–0.24)	
Obese	−0.02 (−0.26–0.22)		−0.03 (−0.24–0.18)	
Chronic diseases		<0.001		<0.001
No	1.00		1.00	
Yes	0.33 (0.15–0.52)		0.32 (0.18–0.46)	
Physical activity before COVID-19 pandemic		0.540		0.462
Inactive	1.00		1.00	
Active	−0.06 (−0.24–0.12)		−0.27 (−0.44–−0.09)	
Online services to practice home-based physical activity		0.821		0.821
No	1.00		1.00	
Yes	0.03 (−0.25–0.31)		0.02 (−0.17–0.22)	
Depressive symptoms		<0.001		<0.001
Non-symptomatic	1.00		1.00	
Mild	0.97 (0.69–1.25)		0.85 (0.60–1.11)	
Moderate-to-severe	1.80 (1.35–2.25)		1.24 (0.84–1.65)	
Anxiety symptoms		<0.001		0.003
Non-symptomatic	1.00		1.00	
Mild	0.58 (0.36–0.80)		0.36 (0.15–0.57)	
Moderate-to-severe	0.36 (−0.07–0.79)		0.30 (−0.06–0.66)	

Adjusted for sex, age, skin color, living situation, highest education level, decreased monthly income, self-reported body mass index, chronic diseases, physical activity, depressive and anxiety symptoms pre-COVID-19.

2021, and 53% of them occurred in 2021. We observed that the prevalence of moderate-to-severe symptoms of anxiety and depression did not change significantly compared with wave 1, supporting our initial hypothesis. However, some groups had different trajectories of symptoms in the follow-up period.

We identified that depression and anxiety scores remained elevated compared with before the COVID-19 pandemic, despite a reduction from wave 1 to 2. This decreased burden in anxiety and depressive symptoms suggests a populational adaptation to the COVID-19 pandemic situation.[15,26] The government of the Rio Grande do Sul started with state-level social distancing policies in March 2020. Since then, a plethora of online and home-based leisure activities such as physical exercise classes, the amplified use of virtual communication tools, and the increased availability of psychological services via telemedicine might have contributed to lessen the aggravation in anxiety and depressive symptoms in our population.[27] For example, 38.9% of the included sample reported using online-based services to practice physical activity during wave 2 although this strategy was not associated with changes in anxiety and depressive symptoms. Furthermore, although most macroregions were classified with the red and black flags by the state government throughout the fieldwork, some restrictions were eased during the December holidays. For example, restaurants and pubs were allowed to open with reduced capacity and opening hours. A misleading perception of normality in social life also encouraged by the federal government might have contributed to the reduced frequency of anxiety and depressive symptoms. Also, the news that a vaccine could be soon available might have induced a feeling of safety, reducing the burden on mental health.

Those aged ≥60 years reported lower levels of anxiety and depression symptoms before the pandemic, followed by lower variation in the scores of such mental health domains. On the other hand, the frequency of anxiety symptoms was reduced between waves 1 and 2, whereas depressive symptoms were persistently high during wave 2 among adults <60 years. Previous studies have indicated that people aged up to 45 years were at higher risk for

worse depressive and anxiety symptoms during the COVID-19 pandemic.[5,8] Adults from this age group might have been more affected by schools closing and interrupted commercial activities such as business centers. Although these approaches are important to reduce virus transmission, they represent, in most cases, reduced monthly income and uncertainty about the near future. Appropriated financial and psychological support followed by timely interventions to reduce anxiety and depressive symptoms among young and middle-aged adults is urgently needed, mainly in populations from developing countries such as Brazil, which have both a large number of COVID-19 cases and economically frail individuals.

Depressive symptoms increased in wave 1 but decreased in the subsequent period in some groups. However, in those living alone, the scores from depressive-specific HADS remained elevated compared with before the pandemic, with no significant difference before social distancing (i.e. intercept) and between waves 1 and 2. Social isolation, sometimes wrongly confounded as social distancing, is a leading cause of depression and suicide.[28] While social distancing requires people to keep a safe distance (i.e. 2 m) from each other and stay at home when possible, social isolation is a lack of social connections. Social isolation might contribute to the risk of future neurological diseases such as dementia.[29] Although the population must stay at home whenever is possible, strategies to improve social activities must be promoted, especially for the vulnerable population such as those living in areas with no internet access.[30]

Participants non-symptomatic for anxiety and depression before the pandemic reported an increased frequency of these symptoms during wave 1 followed by a reduction in wave 2. However, the scores in the latest wave remained significantly higher than those observed in the pre-COVID-19 period, suggesting an inverted J-shaped curve in the frequency of symptoms for this group. Based on previous findings,[15,26] this decrease could be attributable to the development of coping strategies by participants. A similar process was seen in other types of isolation such as incarcerations where a remarkable increase in depressive symptoms is followed by a steady decline.[26] Nevertheless, the prevalence of moderate-to-severe symptoms of anxiety and depression in wave 2 persisted remarkably higher than the period before the COVID-19 pandemic. As previously noted, the easing of some restrictions might also have stimulated this reduction. However, transmission rate in Brazil was high during wave 2. The weekly switching from less to more severe restrictions (and vice-verse, depending on the situation) might have limited the decrease in the frequency of anxiety and depressive symptoms. It is well-known that this pandemic can trigger an unpredictable increase in the prevalence of depression and anxiety, especially in low- and middle-income countries.[31] Until a large proportion of the population get vaccinated, strategies to protect people's mental health need to be promoted by federal, state, and local governments.

Some methodological limitations of our study must be acknowledged. First, our retention rate was lower than expected (52% vs 70%[7]). However, large, population-based cohort studies found similar or even lower (e.g. 28%) response rates using online-based questionnaires.[32] Second, we used self-reported measurements to evaluate anxiety and depressive symptoms, physical activity, and other variables. In-person interviews or assessments were not allowed by the local research ethics committee. Third, the retrospective design used during wave 1 may have led to recall bias. Nevertheless, as stated previously, there were no data from large, state-level prospective studies in south Brazil.[8] Fourth, the proportion of participants with an academic degree was overexpressed. Although 17% of adults aged ≥25 years had at least one academic degree, this proportion reached 42.4% (95% CI: 37.6% to 47.3%) in our sample. As data collection was online, we expected this sampling bias as less educated people might have limited internet access. However, the COVID-19 has a deeper impact in lower economic groups, so sampling bias is likely to underestimate our occurrence measurements.

In summary, we report the changes on anxiety and depressive symptoms in adults from southern Brazil over 10 months of the COVID-19 pandemic. The frequency of these symptoms decreased from June/July 2020 to December 2020/January 2021 yet remained elevated compared with the pre-COVID-19 period. Long-lasting strategies to control the burden of social distancing on mental health at a population level are warranted as the COVID-19 pandemic in Brazil is likely to last longer, be more aggressive, and continuously increase the health disparities in the country.

Author statements

Ethical approval

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

Funding

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

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.2021.12.019.

References

1. Dong E, Du H, Gardner L. An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect Dis* 2020;**20**(5):533–4.
2. World Health Organization (WHO). *Pulse survey on continuity of essential health services during the COVID-19 pandemic: interim report, 27 August 2020*. World Health Organization; 2020.
3. Bo Y, Guo C, Lin C, Zeng Y, Li HB, Zhang Y, et al. Effectiveness of non-pharmaceutical interventions on COVID-19 transmission in 190 countries from 23 January to 13 April 2020. *Int J Infect Dis* 2021;**102**:247–53.
4. Islam N, Sharp SJ, Chowell G, Shabnam S, Kawachi I, Lacey B, et al. *Physical distancing interventions and incidence of coronavirus disease 2019 : natural experiment in 149 countries*. 2020. p. 1–10.
5. Vindegaard N, Benros ME. COVID-19 pandemic and mental health consequences: systematic review of the current evidence. *Brain Behav Immun* 2020;**89**:531–42. https://doi.org/10.1016/j.bbi.2020.05.048.
6. Salari N, Hosseinian-Far A, Jalali R, Vaisi-Raygani A, Rasoulpoor S, Mohammadi M, et al. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Glob Health* 2020;**16**(1):1–11.
7. Feter N, Caputo EL, Doring IR, Leite JS, Cassuriaga J, Reichert FF, et al. *Longitudinal study about low back pain, mental health, and access to healthcare system during COVID-19 pandemic: protocol of an ambispective cohort*. medRxiv; 2020 Jul. Short title: PAMPA cohort: study protocol. Cold Spring Harbor Laboratory Press.
8. Feter N, Caputo EL, Doring IR, Leite JS, Cassuriaga J, Reichert FF, et al. Sharp increase in depression and anxiety among Brazilian adults during the COVID-19 pandemic: findings from the PAMPA cohort. *Publ Health* 2021;**190**:101–7.
9. Pierce M, Hope H, Ford T, Hatch S, Hotopf M, John A, et al. Mental health before and during the COVID-19 pandemic : a longitudinal probability sample survey of the UK population. *Lancet Psychiatr* 2020:1–10. https://doi.org/10.1016/S2215-0366(20)30308-4 [Internet];0366(20). Available from:.
10. Pieh C, Budimir S, Probst T. The effect of age, gender, income, work, and physical activity on mental health during coronavirus disease (COVID-19) lockdown in Austria. *J Psychosom Res* 2020:110186.

11. Huang Y, Zhao N. Generalized anxiety disorder, depressive symptoms and sleep quality during COVID-19 outbreak in China: a web-based cross-sectional survey. *Psychiatr Res* 2020:112954.
12. Qiu J, Shen B, Zhao M, Wang Z, Xie B, Xu Y. A nationwide survey of psychological distress among Chinese people in the COVID-19 epidemic: implications and policy recommendations. *Gen psychiatry* 2020;**33**(2).
13. Zhang Y, Zhang H, Ma X. Mental health problems during the COVID-19 pandemics and the mitigation E ff ects of exercise : a longitudinal study of College students in China. *Int J Env Res Public Heal* 2020;**17**(10):1–16.
14. Arango C, Wykes T, Moreno C. Mental health care and COVID-19. *Lancet Psychiatr* 2020;**7**(12):1013.
15. Fancourt D, Steptoe A, Bu F. Trajectories of anxiety and depressive symptoms during enforced isolation due to COVID-19 in England: a longitudinal observational study. *Lancet Psychiatr* 2021;**8**(2):141–9.
16. Bendau A, Kunas SL, Wyka S, Petzold MB, Plag J, Asselmann E, et al. Longitudinal changes of anxiety and depressive symptoms during the COVID-19 pandemic in Germany: the role of pre-existing anxiety, depressive, and other mental disorders. *J Anxiety Disord [Internet]* 2021;**79**:102377. Available from: https://www.sciencedirect.com/science/article/pii/S0887618521000244.
17. Leite JS, Feter N, Doring IR, Cassurriaga J, Caputo EL. Using social media for research during COVID-19 pandemic in a cohort in Rio Grande do Sul state, Brazil. *Rev bras ativ fis saúde* 2020;**1**–**5**.
18. Instituto Brasileiro de Geografia e Estatística (IBGE). *Censo demográfico 2010* [Internet]. 2010 [cited 2020 Oct 3]. Available from: https://censo2010.ibge.gov.br/.
19. Djukanovic I, Carlsson J, Årestedt K. Is the Hospital Anxiety and Depression Scale (HADS) a valid measure in a general population 65–80 years old? A psychometric evaluation study. *Health Qual Life Outcome* 2017;**15**(1):193.
20. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand* 1983 Jun;**67**(6):361–70.
21. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale: an updated literature review. *J Psychosom Res* 2002;**52**(2):69–77.
22. Wu Y, Levis B, Sun Y, He C, Krishnan A, Neupane D, et al. Accuracy of the Hospital Anxiety and Depression Scale Depression subscale (HADS-D) to screen for major depression: systematic review and individual participant data meta-analysis. *BMJ* 2021:373.
23. Enes CC, Nucci LB. A telephone surveillance system for noncommunicable diseases in Brazil. *Public Health Rep* 2019:0033354919848741.
24. Milton K, Bull FC, Bauman A. Reliability and validity testing of a single-item physical activity measure. *Br J Sports Med* 2011 Mar;**45**(3):203–8.
25. Bull FC, Al-Ansari SS, Biddle S, Borodulin K, Buman MP, Cardon G, et al. World Health Organization 2020 guidelines on physical activity and sedentary behaviour [Internet] *Br J Sports Med* 2020 Dec 1;**54**(24):1451–62. Available from: http://bjsm.bmj.com/content/54/24/1451.abstract.
26. Porter LC, DeMarco LM. Beyond the dichotomy: incarceration dosage and mental health. *Criminology* 2019;**57**(1):136–56.
27. Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N, et al. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet* 2020;**395**(10227):912–20.
28. Ge L, Yap CW, Ong R, Heng BH. Social isolation, loneliness and their relationships with depressive symptoms: a population-based study. *PLoS One* 2017;**12**(8):e0182145.
29. Mukadam N, Sommerlad A, Huntley J, Livingston G. Population attributable fractions for risk factors for dementia in low-income and middle-income countries: an analysis using cross-sectional survey data. *Lancet Glob Heal* 2019;**7**(5):e596–603.
30. Navarro JG. *Internet usage in Brazil* [internet]. 2020 [cited 2021 may 9]. Available from: https://www.statista.com/topics/2045/internet-usage-in-brazil/#topicHeader__wrapper.
31. United Nations (UN). *COVID-19 and the need for action on Mental Health* [Internet]. Policy Brief; 2020. Available from: https://unsdg.un.org/resources/policy-brief-covid-19-and-need-action-mental-health.
32. Brown M, Goodman A, Peters A, Ploubidis GB, Sanchez A, Silverwood R, et al. *COVID-19 survey in five national longitudinal studies: wave 1 user guide (version 1)*. 2020. London.