

Prevalence of fear of COVID-19, depression, and anxiety among undergraduate students during remote classes


Original Article

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Abstract

Background: During the coronavirus disease 2019 (COVID-19) pandemic, undergraduate students were exposed to symptoms of psychological suffering during remote classes. Therefore, it is important to investigate the factors that may be generated and be related to such outcomes. **Objective:** To investigate the association between fear of COVID-19, depression, anxiety, and related factors in undergraduate students during remote classes. **Methods:** This cross-sectional study included 218 undergraduate students (60.6% women and 39.4% men). Students answered a self-administered online questionnaire designed to gather personal information, pandemic exposure, physical activity level, fear of COVID-19 using the 'Fear of COVID-19 Scale', symptoms of depression using the Patient Health Questionnaire-9, and anxiety using General Anxiety Disorder-7. **Results:** Undergraduate students had a high prevalence of depression and anxiety (83.0% and 76.1%, respectively) but a low prevalence of fear of COVID-19 (28.9%) during remote classes. Multivariate analysis revealed that women who reported health status as neither good nor bad and who had lost a family member from COVID-19 had the highest levels of fear. For depression and anxiety, the main related factors found were female gender, bad health status, insufficiently active, and complete adherence to the restriction measures. **Conclusion:** These findings may be used to develop actions to manage symptoms of anxiety and depression among students, with interventions through physical activity programmes to improve mental health.

Significant outcomes

- Students during remote classes showed a high prevalence of anxiety and depression;
- Complete social restriction is associated with symptoms of anxiety and depression;
- Anxiety and depression symptoms manifested more in physically inactive students.

Limitations

- The nature of the cross-section study does not allow an analysis of the cause–effect that would enable us to assess the impacts over time;
- Our sample is not representative of the undergraduate Brazilian population;
- The use of self-reported questionnaires.

Introduction

Although epidemics and pandemics are common occurrences, coronavirus disease 2019 (COVID-19) stands out owing to its scope, magnitude, and rapid spread (Giordani *et al.*, 2022). Over 635 million people have been infected, and more than 6 million have died. In Brazil, more than 35 million people have been infected, and more than 689,341 have died, by November 28, 2022 (World Health Organization, 2022). Due to the severity of the

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COVID-19 pandemic, governments and health authorities worldwide have implemented public policies to slow the spread and minimise the impact of the disease (CDC, 2021b). These public policies included encouraging social distancing, imposing home quarantine, requiring face masks, and ceasing activities considered non-essential, such as some commercial activities, fitness centres, and educational institutions (CDC, 2021b). In Brazil, since the beginning of the COVID-19 pandemic, face-to-face classes were suspended, and the undergraduate students were asked to remote classes (Seffrin *et al.*, 2022). Although these measures were crucial for protecting physical health and slowing the progression of COVID-19, they have subsequently had an opposite effect on physical well-being, with reduced physical activity and an impact on mental health (Puccinelli *et al.*, 2021; Togni *et al.*, 2021; Barbosa Junior *et al.*, 2022; Wang *et al.*, 2022).

The intense emotional reaction and response of people affected by events, such as the recent pandemic, have been a topic of interest to the scientific community for decades (Son *et al.*, 2020; Wathelet *et al.*, 2020; Varma *et al.*, 2021). According to studies conducted during previous pandemics, stress, anxiety, depression, and fear are common in pandemic situations. Fear is one of the most prevalent psychological responses during pandemic situations (Salari *et al.*, 2020; Su *et al.*, 2021; Şimşir *et al.*, 2022). When fear is not calibrated to a real threat, it can present itself as maladaptive (Mertens *et al.*, 2020). Furthermore, excessive fear can have negative effects on both the individual level (mental health problems, phobia, and social anxiety) and the social level (e.g. xenophobia) (Coelho *et al.*, 2020). On the other hand, a lack of fear can also result in negative effects, such as people ignoring government measures to stop the COVID-19 virus from spreading or reckless governmental policies that ignore the risks (Mertens *et al.*, 2020).

During COVID-19, fear revealed itself in different ways, including the fear of getting infected and spreading it to family and friends, the fear of coming into contact with contaminated objects and surfaces, and most importantly, the fear of the future and the long-term effects of COVID-19 (Brooks *et al.*, 2020; Pakpour and Griffiths, 2020). Notably, fear can be modulated according to gender, socio-economic status, occupation, and current health status (Andrade *et al.*, 2022). Therefore, further investigation into these correlated factors is necessary. In addition to fear, a significant increase in anxiety and depression symptoms has been noticed in the population due to COVID-19 (CDC, 2021a; Schafer *et al.*, 2022). According to a study by the COVID-19 Mental Disorders Collaborators, in 2020, the pandemic led to a 27.6% increase in cases of major depressive disorder and a 25.6% increase in cases of anxiety disorders worldwide (COVID-19 Mental Disorders Collaborators, 2021).

Undergraduate students are more vulnerable to sudden changes caused by the COVID-19 pandemic compared with the general population (Zhu, *et al.*, 2020). Presenting increasing levels of psychosomatic problems, anxiety, and depression (Browning *et al.*, 2021; Seffrin *et al.*, 2022), related to the uncertainties of academic success, future career, social life in faced with adopting social distance and the abrupt change from face-to-face classes to remote online classes. Indeed, many studies have shown that the prevalence of anxiety and depression in college students was high for those studying online at home during the COVID-19 pandemic (Ahorsu *et al.*, 2020; Chang *et al.*, 2021; Lim *et al.*, 2022; Wang *et al.*, 2022).

Previous studies about anxiety and depression or about fear with Brazilian students have been published, but not the set of the three outcomes (Lopes & Nihei, 2021; Andrade *et al.*, 2022).

In addition, the presence of risk factors, such as physical inactivity (Modena *et al.*, 2021), was not considered, and all studies published with Brazilian undergraduate students presented focused on the peak of the evolution of COVID-19 in 2020, which restricts the exposure factors to the real situation through all the uncertainties of information and decision-making present at the beginning of the pandemic. Considering that previous studies have shown that mental health repercussions in periods of public health crises can last longer and be more prevalent than the disease/pandemic itself (Ornell *et al.*, 2020; Pakpour and Griffiths, 2020). This study aimed to investigate the association between fear of COVID-19, depression, anxiety, and related factors in undergraduate students during the period of remote classes.

Materials and methods

Design study and participants

This study is cross-sectional, analytical, and descriptive, which is part of a longitudinal study that assesses the presence of fear of COVID-19, depression, and anxiety symptoms during remote classes. This data collection was performed from 11/26/2021 to 03/12/2022. During this period, Brazilian universities adopted online remote classes.

The participants answered a questionnaire shared using a digital platform, Google Forms (Alphabet, Mountain View CA, USA). The participants were invited to participate through e-mail and social media (WhatsApp, Instagram, Facebook, and Twitter) via convenience and nonprobability snowball sampling strategy. Due to the current pandemic situation, this procedure was adopted because it is a more economical and practical way to recruit people from different states, besides presenting a good response rate compared with other strategies (Kennedy-Shaffer, *et al.*, 2021). The questionnaire included questions about socio-economic and general health, physical activity levels, exposure to the COVID-19 pandemic, and the assessment of anxiety, depression, and fear of COVID-19.

The following inclusion criteria were adopted: (a) having been regularly enrolled in an undergraduate course; (b) not having returned to in-person classes; and (c) being aged ≥ 18 years. Participants, who did not complete the questionnaire or who had graduated, were excluded from the survey. Two hundred forty-nine participants answered the online questionnaire. Of these, two refused to participate, 27 had returned to face-to-face classes, and two were not undergraduate students. Therefore, the final sample was composed of 218 participants.

Ethics approval

The study was approved by the Human Research Ethics Committee of the Federal University of Goiás (approval number 5.104.304) on 11/13/2021 and conformed to the principles outlined in the Declaration of Helsinki. All participants, after being informed of the aims of the study, provided their consent on a voluntary basis (online). Participants who chose not to consent to participation did not have access to the research questions.

Measures

Fear of COVID-19 (FCV-19S)

The Fear of COVID-19 Scale (FCV-19S) (Ahorsu *et al.*, 2020) was used to evaluate fear levels related to COVID-19. A version translated and validated for the Brazilian population was used.

FCV-19S's psychometric properties showed good reliability evidence ($\alpha = 0.88$), and confirmatory factor analysis (factor loads from 0.57 to 0.86) confirmed the unidimensional structure (Cavalheiro and Sticca, 2022). The Likert scale consists of seven items, each with a response ranging from 1 (totally disagree) to 5 (totally agree). The total score is calculated by adding the score of each item (ranging from 7 to 35 points). The higher the score, the greater the fear of COVID-19. The classification was made based on the weighted average of the final score, categorised based on the 75th percentile (Schimmenti *et al.*, 2020). As a result, due to the lack of adequate standardisation for the Brazilian population, an absence of fear (<22 points) and a presence of fear of COVID-19 (≥ 22 points) are classified.

Depression

The Patient Health Questionnaire-9 (PHQ-9) was used to evaluate individuals at risk of depression. The translated and validated version for the Brazilian population was used. PHQ-9 presented psychometric properties with sensitivity (77.5%; 95% CI 61.5–89.2) and specificity (86.7%; 95% CI 83.0–89.9) (Santos *et al.*, 2013). The scale consists of nine items. The items in the inventory assess attitudes and symptoms of sadness, pessimism, feeling of failure, dissatisfaction, feeling of guilt, and punishment. The frequency of each symptom is evaluated using a Likert scale of 0 (none), 1 (several days), 2 (more than half of the days), and 3 (almost every day). The questionnaire provides a final score from 0 to 27 points. For the analyses, the cut-off point >9 points for classification in the absence and presence of depression was used (Santos *et al.*, 2013).

Anxiety

The General Anxiety Disorder (GAD-7) was used to assess possible generalised anxiety disorders (Spitzer *et al.*, 2006). The translated and validated version for the Brazilian population was used. GAD-7 psychometric properties showed good reliability evidence, Cronbach's alpha coefficient ($\alpha = 0.916$), and rho composite reliability coefficient ($p = 0.909$) (Moreno *et al.*, 2016). The scale consists of seven items with possible responses on a Likert scale of 4 points: 0 (none), 1 (several days), 2 (more than half of the days), and 3 (almost every day). The questionnaire provides a score ranging from 0 to 21 points. For analysis, it was classified into presence and absence of anxiety by the cut-off point ≥ 10 points (Spitzer *et al.*, 2006).

Socio-economic factors

The following general information and characteristics of the participants were gathered: sex (female and male), age (years), race/ethnicity (white, black, brown, indigenous, and asian), household condition (alone, friends/spouse, family/parents), and total family income calculated in the multiplex of the Brazilian minimum wage of USD 220 per month according to the exchange rate of May 2022 (less than minimum wage, 1 and 2 minimum wages, 3 and 6 minimum wages, and 7 minimum wages or more).

Health status and physical activity level

The general health status was self-reported (extremely good/very good, neither good nor bad, good, and extremely/very bad). The short version of International Physical Activity Questionnaire (IPAQ) was used to assess the current physical activity level. The translated and validated version for the Brazilian population was used (Matsudo *et al.*, 2001). IPAQ psychometric properties showed good reliability evidence, rho composite reliability coefficient of 0.69–0.71 ($p < .001$), and validity of 0.75 for the short form. The level of physical activity was determined from activities of

Table 1. Description of physical activity level ratings according to the IPAQ

Very active	Vigorous activities 5 days/week and ≥ 30 min per session or vigorous activities ≥ 3 days/week and ≥ 20 min per session + moderate activities ≥ 5 days/week and ≥ 30 min per session.
Active	Vigorous activities ≥ 3 days/week and ≥ 20 min per session; or moderate activities ≥ 5 days/week and ≥ 30 min per session, or any combined activity: ≥ 5 days/week and ≥ 150 min/week, such as walking + moderate + vigorous.
Irregularly active	Irregular physical activities that are insufficient to be classified as active because it does not comply with the recommendations regarding frequency or duration and not comply with either frequency or duration recommendations.
Not active	No physical activity for at least 10 continuous minutes during the week.

moderate to vigorous intensity. It was composed of six questions that determined the number of days and minutes per day practised. The results allow the classification of the participants into four categories (Matsudo *et al.*, 2001) as described in Table 1.

Factors of exposure to the COVID-19 pandemic

Exposure to the pandemic was assessed by the level of isolation adopted by the participants. This was done on a scale from 0 (strictly adhering to the distance measures) to 3 (not adhering to the restrictions). The questions included the following: 'Have you sought extra information about the COVID-19 outbreak?' (yes or no), 'Has your family income been negatively impacted by the COVID-19 pandemic?' (yes or no), 'Have you been infected by COVID-19? (Yes, More than once, and No) and 'Has anyone in your family had COVID-19?' (yes or no). Finally, questions included whether any family members died because of COVID-19 (yes or no) (Puccinelli *et al.*, 2021).

Statistical analysis

Statistical analysis was performed using the IBM SPSS software (version 26.0, USA). The Kolmogorov–Smirnov test was used to verify data normality. The data were described using absolute and relative frequency, median, and interquartile range (IQR). A simple and multiple analyses of the factors associated with the fear of COVID-19 (presence/absence), depression (presence/absence), and anxiety disorder (presence/absence) were used to estimate the prevalence ratios (PR). Poisson regression was used through the generalised linear models with a robust estimator. The crude models were constructed containing the following independent variables: socio-economic factors (sex, race/ethnicity/family income, and household condition), health factors (health status and physical activity level), and exposure to the COVID-19 pandemic (immunisation, infected with COVID-19, restriction level, family infected and died, and negative impact in family income during the pandemic). The variables for which $p \leq 0.20$ (Wald test) were obtained and candidates for multivariate models (Backward), with age adjusted. For calculating adjusted PR, a significance level of 5% and a confidence interval (CI) of 95% were considered.

Results

Two hundred eighteen participants took part in this study. The median age of participants was 24.0 (IQR 6.0) years. The characteristics of the sample are described in Table 2.

Table 2. Characterisation of undergraduate students according to sociodemographic variables, health status, factors related to COVID-19, and physical activity level during online remote classes

Variables	<i>n</i> (%)
Sex	
Male	86 (39.4)
Female	132 (60.6)
Race/ethnicity	
White	106 (48.6)
Black	39 (17.9)
Brown	66 (30.3)
Indigenous	1 (0.5)
Asian	6 (2.8)
Family income	
Less than minimum wage	35 (16.1)
1 and 2 minimum wages	60 (27.5)
3 and 6 minimum wages	88 (40.4)
7 minimum wages or more	35 (16.1)
Household condition	
Alone	18 (8.3)
Friends/spouse	25 (11.5)
Family/parents	175 (80.3)
Health status	
Extremely/reasonably good	74 (33.9)
Good	48 (22.0)
Neither good nor bad	44 (20.2)
Extremely/reasonably bad	52 (23.9)
Physical activity level	
Not active	14 (6.4)
Irregularly active	50 (22.9)
Active	101 (46.3)
Very active	53 (24.3)
Immunisation of COVID-19	
No/incomplete coverage (first shot)	11 (5.0)
Complete coverage (second shot)	172 (78.9)
Booster shot (third shot)	35 (16.1)
You were infected with COVID-19	
Yes	52 (23.9)
More than once	6 (2.8)
No	160 (73.4)
Restriction level	
Completely adhered	3 (1.4)
Maintained partial restriction (essential non-work activities)	72 (33.0)

(Continued)

Table 2. (Continued)

Variables	<i>n</i> (%)
Maintained partial restriction (essential activities including work)	89 (40.8)
No restriction	54 (24.8)
Someone in your family had COVID-19	
Yes	146 (67.0)
No	72 (33.0)
Someone in your family died from COVID-19	
Yes	34 (15.6)
No	184 (84.4)
Negative impact on family income during the COVID-19 pandemic	
Yes	151 (69.3)
No	67 (30.7)
Sought extra information about the COVID-19 outbreak	
Yes	191 (87.6)
No	27 (12.4)

n: absolute frequency; %: relative frequency.

The median score of FCV-19S, GAD-7, and PHQ-9 was 18.0 (IQR 8.0), 9.0 (IQR 9.0), and 11.0 (IQR 11.0), respectively. According to the criteria adopted in the current study, the prevalence of fear of COVID-19 was 28.9%, depression was 83.0%, and 76.1% anxiety disorder in the general population. When stratified by sex, 38.6% of women and 14.0% of men presented fear of COVID-19. For depression, the prevalence was 69.8% and 61.6, and anxiety was 91.7% and 69.8% for female and male participants, respectively.

Table 3 presents the crude and multivariate PR for the independent variables in relation to fear in undergraduate students during remote virtual classes.

Table 4 presents the crude and multivariate PR for the independent variables in relation to depression in undergraduate students during remote virtual classes.

Table 5 presents the crude and multivariate PR for the independent variables in relation to anxiety disorder in undergraduate students during remote virtual classes.

Discussion

This study aimed to investigate the association between fear of COVID-19 and the level of depression, anxiety, and related factors, such as gender, family arrangement, current health, physical activity practice, and pandemic exposure in undergraduate students during remote classes. The main findings of the study indicate that most students showed no fear of COVID-19, but had a high prevalence of anxiety and depression. Furthermore, our results indicate a higher PR of fear, anxiety, and depression for women. There was a higher PR of depression and anxiety for those that reported health status extremely and reasonably bad and a higher PR of fear, anxiety, and depression for those that reported health status as neither good nor bad observed. A higher

Table 3. Multivariate analysis of factors associated with fear of COVID-19 during remote classes in the COVID-19 pandemic, 2022.

Variables	Fear of COVID-19 (FCV-19S)			
	Crude*	<i>p</i>	Multivariate**	
	PR (95% CI)		PR (95% CI)	<i>p</i>
Sex				
Female	2.76 (1.57–4.88)	<i><0.001</i>	2.60 (1.48–4.57)	<i>0.001</i>
Male	1		1	
Household condition				
Alone	1.18 (1.02–1.37)	<i>0.025</i>		
Friends/spouse	1.03 (0.86–1.24)	<i>0.693</i>		
Family/parents	1			
Health status				
Extremely/reasonably bad	1.18 (0.66–2.13)	<i>0.569</i>	0.98 (0.87–1.11)	<i>0.811</i>
Neither good nor bad	2.05 (1.24–3.38)	<i>0.005</i>	1.66 (1.01–2.75)	<i>0.048</i>
Good	0.68 (0.32–1.45)	<i>0.323</i>	0.90 (0.80–1.01)	<i>0.075</i>
Extremely/reasonably good	1		1	
Someone in your family had COVID-19				
Yes	1.89 (1.10–3.25)	<i>0.020</i>		
No	1			
Someone in your family died from COVID-19				
Yes	1.18 (1.04–1.34)	<i>0.007</i>	1.62 (1.02–2.57)	<i>0.037</i>
No	1		1	
Restriction level				
Completely adhered	3.60 (1.35–9.55)	<i>0.044</i>		
Maintained partial restriction (essential non-work activities)	2.17 (1.16–4.06)	<i>0.015</i>		
Maintained partial restriction (essential activities including work)	1.05 (0.94–1.17)	<i>0.396</i>		
No restriction/partial restriction	1			
Negative impact on family income during the COVID-19 pandemic				
Yes	1.55 (0.92–2.61)	<i>0.097</i>		
No	1			

PR: prevalence ratio; CI: confidence interval.

p < 0.05 values are highlighted in italics*Wald test *p* ≤ 0.20.

**Backward method and age.

PR of fear among those who lost relatives due to COVID-19, high PR of depression among those who were insufficiently active and who remained in total social isolation among those who were infected by COVID-19 was reported.

In the present study, the prevalence of participants infected by COVID-19 was 26.7%. This prevalence is higher than that found for the general Brazilian population, which is 14.3% (data from 05/19/2022) (Instituto Brasileiro de Geografia e Estatística, 2022; Ministério da Saúde, 2022). These data are alarming and call into question the effectiveness of adopting remote classes as a strategy to avoid the spread of COVID-19 among students. When looking at the level of social isolation/distancing adopted by the students, only 1.4% of the students fully complied with the Brazilian health authorities' guidelines regarding the adoption of social isolation. This result can probably be attributed to the milder symptoms of COVID-19 in young people without comorbidities (Liao

et al., 2020; Gómez-Belda *et al.*, 2021). Immunisation with the COVID-19 vaccine is another factor that may have contributed to the lower perception of fear. Even if it was not complete (second dose), it may have influenced a greater feeling of protection because an immunised individual is at lower risk of getting sick from COVID-19 (Mertens *et al.*, 2022). Moreover, this fact may explain the low prevalence of fear of COVID-19 among the participants of the present study.

For the fear assessment of COVID-19, we used the FCV-19S. When comparing our data with other studies in the literature, which used the same instrument, the values of the present study (18.0; IQR 8.0 points) were higher (Konstantinov *et al.*, 2022; Yehudai *et al.*, 2022) or lower (Rodríguez-Hidalgo *et al.*, 2020; Perz, *et al.*, 2022). In studies conducted in Kazakhstan (Konstantinov *et al.*, 2022) and Israel/Russia (Yehudai *et al.*, 2022), the authors found FCV-19S scores of 22.1 ± 5.8 and

Table 4. Multivariate analysis of factors associated with depression during remote classes in the COVID-19 pandemic, 2022.

Variables	Depression (PHQ-9)			
	Crude*	<i>p</i>	Multivariate**	
	PR (95% CI)		PR (95% CI)	<i>p</i>
Sex				
Female	1.33 (1.14–1.54)	<i><0.001</i>	1.25 (1.08–1.44)	<i>0.002</i>
Male	1		1	
Health status				
Extremely/reasonably bad	1.42 (1.21–1.66)	<i><0.001</i>	1.29 (1.10–1.51)	<i>0.002</i>
Neither good nor bad	1.35 (1.13–1.60)	<i>0.001</i>	1.22 (1.02–1.45)	<i>0.024</i>
Good	1.16 (0.94–1.43)	0.148	1.08 (0.89–1.32)	0.399
Extremely/reasonably good	1		1	
Physical activity level				
Not active	1.33 (1.05–1.67)	<i>0.015</i>	1.25 (1.01–1.56)	<i>0.040</i>
Irregularly active	1.34 (1.10–1.62)	<i>0.003</i>	1.15 (0.96–1.38)	<i>0.114</i>
Active	1.20 (0.99–1.46)	0.062	1.14 (0.95–1.38)	0.152
Very active	1		1	
Immunisation of COVID-19				
No/incomplete coverage (first shot)	1.16 (1.01–1.33)	<i>0.025</i>		
Complete coverage (second shot)	0.95 (0.81–1.11)	0.545		
Booster shot (third shot)	1			
Restriction level				
Completely adhered	1.22 (1.08–1.39)	<i>0.002</i>	1.61 (1.11–2.36)	<i>0.012</i>
Maintained partial restriction (essential non-work activities)	1.05 (0.89–1.23)	0.533	0.99 (0.84–1.17)	0.415
Maintained partial restriction (essential activities including work)	1.00 (0.85–1.18)	0.935	0.98 (0.84–1.15)	0.841
No restriction/partial restriction	1		1	
Someone in your family died from COVID-19				
Yes	1.11 (0.97–1.26)	0.108		
No	1			

PR: prevalence ratio; CI: confidence interval.

p < 0.05 values are highlighted in italics*Wald test *p* ≤ 0.20.

**Backward method and age.

19.44 ± 6.0 points, which are lower than the findings of the present study. On the other hand, the values found in our study were higher compared with studies conducted in Spain (14.37 ± 5.38) (Rodríguez-Hidalgo *et al.*, 2020) and the United States (15.33 ± 5.75) (Perz, *et al.*, 2022). Possible explanations for this discrepancy may be related to economic and sociocultural factors (Luo *et al.*, 2021; Quadros *et al.*, 2021), as well as the pandemic period in which the study was conducted. Another reason for the different scores obtained between the studies may be due to the different proportion of women (60.6% of the participants in this study), but the study of Rodríguez-Hidalgo *et al.* (2020) and Perz *et al.* (2022) was 72% and 73% women, respectively. In fact, studies show that women are more sensitive than men to different displeasing stimuli (Quadros *et al.*, 2021; Andrade *et al.*, 2022).

Regarding anxiety and depression, the existing literature reports a high prevalence of mental disorders in undergraduate students during the COVID-19 pandemic (Xiong *et al.*, 2020;

Luo *et al.*, 2021). In addition, several studies conducted before the pandemic period already showed that college students have a higher prevalence of mental disorders than the general population. In the present study, the prevalence of depression and anxiety was 83.0% and 76.1%, respectively. In contrast, in the general population, the prevalence of depression and anxiety during the pandemic was 30% and 23.3%, respectively (Puccinelli *et al.*, 2021). The results are contradictory compared with the results of other studies. In studies conducted with American and Brazilian undergraduate students, the authors found a prevalence of depression of 72.0% (Son *et al.*, 2020) and 60.5% (Lopes & Nihei, 2021), respectively. Studies conducted with Ukrainian and Chinese students found a prevalence of depression of 34.8% (Pavlenko *et al.*, 2022) and 21.1% (Daly and Robinson, 2022), respectively. For anxiety, we found a prevalence of 76.1%, which was higher than that found in Indian (Faisal *et al.*, 2021) (40%) and Spanish students (González-Sanguino *et al.*, 2020) (21.6%). Son *et al.* (2020) investigated 195 students at a significant United

Table 5. Multivariate analysis of factors associated with anxiety disorder during remote classes in the COVID-19 pandemic 2022.

Variables	Anxiety disorder (GAD-7)			
	Crude*	<i>p</i>	Multivariate**	<i>p</i>
	PR (95% CI)		PR (95% CI)	
Sex				
Female	1.40 (1.17–1.69)	<0.001	1.34 (1.11–1.61)	0.002
Male	1		1	
Health status				
Extremely/reasonably bad	1.45 (1.18–1.77)	<0.001	1.29 (1.05–1.59)	0.013
Neither good nor bad	1.42 (1.15–1.75)	0.001	1.28 (1.04–1.57)	0.019
Good	1.15 (0.89–1.48)	0.269	1.06 (0.83–1.36)	0.605
Extremely/reasonably good	1		1	
Physical activity level				
Not active	1.40 (1.10–1.79)	0.006	1.32 (1.04–1.68)	0.020
Irregularly active	1.28 (1.02–1.61)	0.029	1.09 (0.87–1.37)	0.421
Active	1.13 (0.91–1.42)	0.251	1.08 (0.87–1.35)	0.456
Very active	1		1	
Restriction level				
Completely adhered	1.28 (1.11–1.48)	0.001	1.62 (1.07–2.45)	0.023
Maintained partial restriction (essential non-work activities)	0.98 (0.81–1.19)	0.899	0.93 (0.77–1.12)	0.473
Maintained partial restriction (essential activities including work)	0.95 (0.79–1.15)	0.619	0.93 (0.78–1.11)	0.444
No restriction/partial restriction	1		1	
Someone in your family died from COVID-19				
Yes	1.18 (1.01–1.38)	0.030		
No	1			

PR: prevalence ratio; CI: confidence interval.

p<0.05 values are highlighted in italics*Wald test *p* ≤ 0.20.

**Backward method and age.

States university in order to understand the effects of the pandemic on mental health and well-being. The authors found a high prevalence of stress and anxiety (71%) due to the outbreak of COVID-19, among the stressors, fear, and concern about one's own health and that of family members was one of the options most often mentioned as a cause (91%). Again, these differences can be attributed to sociocultural and economic characteristics (Santomauro *et al.*, 2021), in addition to the security measures adopted by each country and the period of the pandemic that the collection was carried out (Esteves *et al.*, 2021; Wang *et al.*, 2022). It is known that college students are subjected to psychological pressure related to training and insertion into the labour market (Wang *et al.*, 2022). Specifically with regard to Brazilian students, in addition to the health crisis of COVID-19, Brazil has been facing an economic and political crisis (Szylovec *et al.*, 2021), which may have influenced the results presented here.

Another noteworthy result was the higher PR found for women related to anxiety. Traditionally, literature shows that women have a higher prevalence of mental disorders compared with men (Quadros *et al.*, 2021; Andrade *et al.*, 2022; Broche-Pérez *et al.*, 2022). For biological reasons, women are more likely to develop anxiety symptoms than men (Costa *et al.*, 2022). It is mainly influenced by hormonal differences, with oestrogen production,

which is critical to markers of stress and anxiety, such as the hypothalamic-pituitary-adrenal axis, and basal plasma corticosterone levels, which show higher markers in women (Marques *et al.*, 2016). In the same line, depression was also more prevalent among women, probably due to certain biological, hormonal, and social factors. The so-called genetically determined 'window of vulnerability', with hormonal fluctuations in oestrogen and progesterone, whether during the reproductive period or menopause, affects brain regions known to be involved in the modulation of mood and behaviour, such as the prefrontal cortex and the hippocampus (Faravelli *et al.*, 2013). Women also experience specific forms of depression-related illness, such as premenstrual dysphoric disorder, postpartum depression, and postmenopausal depression and anxiety (Albert, 2015). Psychosocial factors, such as stress life events, relationship issues, lack of adequate housing, and poverty, contribute directly to or interact with depression symptoms. Women are also more frequently affected by physical and sexual abuse, which will significantly influence future episodes of depression (Keita, 2007).

In some cases, the uncertainty of infection, risk of exposure to death, and/or the possibility of infecting family and friends can potentiate dysphoric mental states (Brooks *et al.*, 2020). In fact, our findings show that students who had a family member or

relative die because of COVID-19 had a 13% higher PR in manifesting fear of COVID-19 (95% CI 1.07–1.28; $p = 0.039$). In fact, the loss of a loved one is highlighted as a risk factor for a painful bereavement process, which can trigger feelings of depression, anger, and guilt. This is particularly relevant during the COVID-19 pandemic, where the spread of the virus to the deceased may have been attributed to a lack of adherence by their family members and lack of the principles of hygiene and precautions with social detachment/isolation (Mortazavi et al., 2020).

Health status was also an associated variable for anxiety and depression in the participants assessed. The health status 'extremely/reasonably bad' and 'neither good nor bad' was associated with higher PR for fear of COVID-19, depression, and anxiety. Ishida et al. (2020) evaluated depressive symptoms in undergraduate students in cohorts from France and Japan and found that those with a poor self-assessment of health in both cohorts showed an association with high depressive symptoms (OR 2.82, 95% CI 1.99–4.01 in France, OR 7.10, 95% CI 5.76–8.74 in Japan). Another study found that poor health status was associated with a three to seven times higher risk of experiencing depressive symptoms, anxiety, and post-traumatic stress, regardless of demographic status and health behaviours (Buneviciene et al., 2022). Therefore, negative or indifferent health perception should be considered a high-risk factor for adverse health outcomes. Optimising this state can potentiate resilience and coping in the pandemic period (Buneviciene et al., 2022).

Social distancing was another factor related to anxiety and depression. We found that students who followed the social distancing rules showed higher levels of depression than their peers. This result can be explained by the suspension of face-to-face classes and the adoption of the remote online system, as measures implemented in higher education institutions that ended up removing the student from his study daily environment (Esteves et al., 2021). with the loneliness present despite the adoption of social distancing (Lamprakiid et al., 2022).

During periods of indoor confinement, the population has adopted a routine with greater exposure to sedentary behaviour, which may have elevated psychosocial distress (depression and anxiety) (Esteves et al., 2021). In fact, regular physical activity is related to the prevention of mental disorders (Schuch et al., 2018, 2019), and physically active populations are less likely to develop mental disorders (Pearce et al., 2022). This may be because physical activity optimises the stress response, neurotransmitter level, and function and modulates serotonin, dopamine, and glutamate (Phillips and Fahimi, 2018). Through the release of neurotrophic factors, physical activity stimulates a cascade of cellular mechanisms that produce changes in the structure and function of several brain regions, including the hippocampus. This reflects on neuronal survival and neuroplasticity that optimises neuroendocrine and physiological responses to psychosocial stress (Kandola et al., 2019). Puccinelli et al. (2021) evaluated the levels of physical activity, anxiety, and depression in Brazilian adults during the pandemic and found that subjects who decreased their levels of physical activity had greater symptoms of mental disorders, resulting from the adoption of social isolation and closures of public and private spaces from those who retained their level of physical activity. Since the multivariate analysis showed that students with low levels of physical activity had a higher PR for depression disorders (PR 1.25; 95% CI 1.01–1.56; $p = 0.040$) and anxiety (PR 1.32; 95% CI 1.04–1.68; $p = 0.020$), this result is similar to the present study. Recent research has documented the advantages of exercise or physical activity in terms of health and psychological gains (Rebar et al., 2015; White

et al., 2017). In addition, regular physical activity can result in positive behavioural changes, improving mental health by promoting skills to cope with stressful events arising from the COVID-19 pandemic (Alsalhe et al., 2020; Puccinelli et al., 2021).

One of the study's strengths is that the data comprise more recent impacts on the fear of COVID-19, anxiety, and depression in college students as opposed to the existing literature with data referenced at the beginning of the COVID-19 pandemic, which may have behaved in a biased manner due to the outbreak of infections, false information, and uncertainty, as shown in the study's discussion. Another relevant factor is that this is the first study to be concerned with controlling access to distance education in a Brazilian multicenter sample with students from different states of the country.

This study is not free from limitations. The cross-section does not allow the cause-and-effect analysis that can assess the impacts over time, but it presents evidence that can foster the construction of future longitudinal studies, considering not only the levels of fear of COVID-19, depression, and anxiety but also the pandemic state, with the online remote classes and the return to face-to-face classes. Another limitation is the use of self-reported measures; however, the use of questionnaires that have been validated for the Brazilian population minimises this limitation. Finally, our sample is not representative of the undergraduate Brazilian population because it is a convenience sample; therefore, caution is needed to use current data in other populations. Nevertheless, we believe that these limitations do not prevent the conclusions of the study to be drawn and can be used to manage anxiety and depression among undergraduate students.

Therefore, we conclude that the results of the present study indicate that undergraduate students have a high prevalence of depression and anxiety, but not for fear of COVID-19 during the pandemic and remote classes. Women who reported the related factors' health status, neither good nor bad, and who had a family member died from COVID-19 had the highest fear of COVID-19. While for anxiety and depression, the main related factors found were female gender, bad health status, insufficiently active, and complete adherence to the restriction measures. Such findings can be used for development actions by university managers and the academic community to manage symptoms of fear, anxiety, and depression among students, especially among women students, with interventions like physical activity promotion programmes for access to improved mental health.

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References

- Ahorsu DK, Lin CY, Imani V, Saffari M, Griffiths MD and Pakpour AH (2020) The fear of COVID-19 scale: development and initial validation. *International Journal of Mental Health and Addiction* 20(3), 1–9. doi: [10.1007/S11469-020-00270-8/TABLES/3](https://doi.org/10.1007/S11469-020-00270-8/TABLES/3).
- Albert PR (2015) Why is depression more prevalent in women? *Journal of Psychiatry and Neuroscience* 40(4), 219–221. doi: [10.1503/jpn.150205](https://doi.org/10.1503/jpn.150205).
- Alsalha TA, Aljaloud SO, Chalghaf N, Guelmami N, Alhazza DW, Azaiez F and Bragazzi NL (2020) Moderation effect of physical activity on the relationship between fear of COVID-19 and general distress: a pilot case study in Arabic countries. *Frontiers in Psychology* 11, 2381. doi: [10.3389/fpsyg.2020.570085](https://doi.org/10.3389/fpsyg.2020.570085).
- Andrade EF, Pereira LJ, de Oliveira APL, Orlando DR, Alves DAG, Guilarducci JS and Castelo PM (2022) Perceived fear of COVID-19 infection according to sex, age and occupational risk using the Brazilian version of the Fear of COVID-19 Scale. *Death Studies* 46(3), 533–542. doi: [10.1080/07481187.2020.1809786](https://doi.org/10.1080/07481187.2020.1809786).
- Barbosa Junior JG, Barbosa De Lira CA, Vancini RL, Puccinelli PJ, Seffrin A, Vivan L, Dos Anjos V, Weiss K, Knechtle B and Andrade MS (2022) Comparison of the levels of depression and anxiety during the first and fourth waves of coronavirus disease-2019 pandemic in Brazil. *European Review for Medical and Pharmacological Sciences* 26(11), 4148–4157. doi: [10.26355/EURREV_202206_28988](https://doi.org/10.26355/EURREV_202206_28988).
- Broche-Pérez Y, Fernández-Fleites Z, Jiménez-Puig E, Fernández-Castillo E and Rodríguez-Martin BC (2022) Gender and fear of COVID-19 in a Cuban population sample. *International Journal of Mental Health and Addiction* 20(1), 1–91. doi: [10.1007/S11469-020-00343-8](https://doi.org/10.1007/S11469-020-00343-8).
- Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N and Rubin GJ (2020) Rapid review. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *The Lancet* 395(10227), 912–920. doi: [10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8).
- Browning MHEM, Larson LR, Sharaievska I, Rigolon A, McAnirlin O, Mullenbach L, Cloutier S, Vu TM, Thomsen J, Reigner N, Metcalf EC, D'Antonio A, Helbich M, Bratman GN and Alvarez HO (2021) Psychological impacts from COVID-19 among university students: risk factors across seven states in the United States. *PLOS ONE* 16(1), e0245327. doi: [10.1371/JOURNAL.PONE.0245327](https://doi.org/10.1371/JOURNAL.PONE.0245327).
- Buneviciene I, Bunevicius R, Bagdonas S and Bunevicius A (2022) The impact of pre-existing conditions and perceived health status on mental health during the COVID-19 pandemic. *Journal of public health (Oxford, England)* 44(1), e88–e95. doi: [10.1093/PUBMED/FDAB248](https://doi.org/10.1093/PUBMED/FDAB248).
- Cavalheiro FRS and Sticca MG (2022) Adaptation and validation of the Brazilian version of the fear of COVID-19 scale. *International Journal of Mental Health and Addiction* 20(2), 921–929. doi: [10.1007/s11469-020-00415-9](https://doi.org/10.1007/s11469-020-00415-9).
- CDC, Centers for Disease Control and Prevention (2021a) *About Mental Health*. Available at <https://www.cdc.gov/mentalhealth/learn/index.htm> 24 April 2022.
- CDC, Centers for Disease Control and Prevention (2021b) *Social Distancing: Keep a Safe Distance to Slow the Spread*. Available at <https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/social-distancing.html>. Available at: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fprevent-getting-sick%2Fsocial-distancing.html#stay6ft 24 August 2021.
- Chang WW, Zhang L, Wen LY, Su H and Jin YL (2021) Association between online self-directed learning ability and negative emotions among college students during the COVID-19 pandemic: a cross-sectional study in Anhui Province, East China. *Frontiers in Psychology* 12, 5204. doi: [10.3389/FPSYG.2021.720911/BIBTEX](https://doi.org/10.3389/FPSYG.2021.720911/BIBTEX).
- Coelho CM, Suttiwan P, Arato N and Zsido AN (2020) On the nature of fear and anxiety triggered by COVID-19. *Frontiers in Psychology* 11, 581314. doi: [10.3389/FPSYG.2020.581314](https://doi.org/10.3389/FPSYG.2020.581314).
- Costa TG, Duque L, do Amaral LC, Viana RB, da Silva WF, Vancini RL, Andrade MS and de Lira CAB (2022) Unpleasant pictures exposure evokes different repercussion on emotional state and heart rate response in healthy women and men. *Applied Psychophysiology Biofeedback* 47(2), 85–94. doi: [10.1007/S10484-021-09532-0/FIGURES/3](https://doi.org/10.1007/S10484-021-09532-0/FIGURES/3).
- COVID-19 Mental Disorders Collaborators (2021) Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *Lancet* 398(10312), 1700–1712. doi: [10.1016/S0140-6736\(21\)02143-7](https://doi.org/10.1016/S0140-6736(21)02143-7).
- Daly M and Robinson E (2022) Depression and anxiety during COVID-19. *The Lancet* 399(10324), 518. doi: [10.1016/S0140-6736\(22\)00187-8](https://doi.org/10.1016/S0140-6736(22)00187-8).
- Esteves CS, de Oliveira CR and de Argimon L II (2021) Social distancing: prevalence of depressive, anxiety, and stress symptoms among Brazilian students during the COVID-19 pandemic. *Frontiers in Public Health* 8, 923. doi: [10.3389/FPUH.2020.589966/BIBTEX](https://doi.org/10.3389/FPUH.2020.589966/BIBTEX).
- Faisal RA, Jobe MC, Ahmed O and Sharker T (2021) Mental health status, anxiety, and depression levels of Bangladeshi university students during the COVID-19 pandemic. *International Journal of Mental Health and Addiction* 20(3), 1500–1515. doi: [10.1007/S11469-020-00458-Y](https://doi.org/10.1007/S11469-020-00458-Y).
- Faravelli C, Alessandra Scarpato M, Castellini G and Lo Sauro C (2013) Gender differences in depression and anxiety: the role of age. *Psychiatry Research* 210(3), 1301–1303. doi: [10.1016/j.psychres.2013.09.027](https://doi.org/10.1016/j.psychres.2013.09.027).
- Giordani RCF, Zanoni da Silva M, Muhl C and Giolo SR (2022) Fear of COVID-19 scale: assessing fear of the coronavirus pandemic in Brazil. *Journal of Health Psychology* 27(4), 901–912. doi: [10.1177/1359105320982035](https://doi.org/10.1177/1359105320982035).
- Gómez-Belda AB, Fernández-Garcés M, Mateo-Sanchis E, Madrazo M, Carmona M, Piles-Roger L and Artero A (2021) COVID-19 in older adults: What are the differences with younger patients? *Geriatrics & Gerontology International* 21(1), 60–65. doi: [10.1111/GGI.14102](https://doi.org/10.1111/GGI.14102).
- González-Sanguino C, Ausín B, Castellanos MÁ., Saiz J, López-Gómez A, Ugidos C and Muñoz M (2020) Mental health consequences during the initial stage of the 2020 Coronavirus pandemic (COVID-19) in Spain. *Brain Behavior, and Immunity* 87, 172–176. doi: [10.1016/J.BBI.2020.05.040](https://doi.org/10.1016/J.BBI.2020.05.040).
- Instituto Brasileiro de Geografia e Estatística (2022) *Projeção da população*. IBGE. Available at <https://www.ibge.gov.br/apps/populacao/projecao/index.html> 31 May 2022.
- Ishida M, Montagni I, Matsuzaki K, Shimamoto T, Cariou T, Kawamura T, Tzourio C and Iwami T (2020) The association between depressive symptoms and self-rated health among university students: a cross-sectional study in France and Japan. *BMC Psychiatry* 20(1), 1–10. doi: [10.1186/S12888-020-02948-8/TABLES/3](https://doi.org/10.1186/S12888-020-02948-8/TABLES/3).
- Kandola A, Ashdown-Franks G, Hendrikse J, Sabiston CM and Stubbs B (2019) Physical activity and depression: towards understanding the antidepressant mechanisms of physical activity. *Neuroscience & Biobehavioral Reviews* 107, 525–539. doi: [10.1016/j.neubiorev.2019.09.040](https://doi.org/10.1016/j.neubiorev.2019.09.040).
- Keita GP (2007) Psychosocial and cultural contributions to depression in women: considerations for women midlife and beyond. *Journal of Managed Care Pharmacy* 13(9 Supp A), 12–15. doi: [10.18553/jmcp.2007.13.9-a.12](https://doi.org/10.18553/jmcp.2007.13.9-a.12).
- Kennedy-Shaffer L, Qiu X and Hanage WP (2021) Snowball sampling study design for serosurveys early in disease outbreaks. *American Journal of Epidemiology* 190(9), 1918–1927. doi: [10.1093/AJE/KWAB098](https://doi.org/10.1093/AJE/KWAB098).
- Konstantinov V, Berdenova S, Satkangulova G, Reznik A and Isralowitz R (2022) COVID-19 impact on Kazakhstan University student fear, mental health, and substance use. *International Journal of Mental Health and Addiction* 20(2), 888–894. doi: [10.1007/S11469-020-00412-Y](https://doi.org/10.1007/S11469-020-00412-Y).
- Lamprakiid C, Hoffman A, Lique Roquet A and Jopp DS (2022) Loneliness during COVID-19: development and influencing factors. *PLOS ONE* 17(3), e0265900. doi: [10.1371/journal.pone.0265900](https://doi.org/10.1371/journal.pone.0265900).
- Liao J, Fan S, Chen J, Wu J, Xu S, Guo Y, Li C, Zhang X, Wu C, Mou H, Song C, Li F, Wu G, Zhang J, Guo L, Liu H, Lv J, Xu L and Lang C (2020) Epidemiological and clinical characteristics of COVID-19 in adolescents and young adults. *The Innovation* 1(1), 100001. doi: [10.1016/J.XINN.2020.04.001](https://doi.org/10.1016/J.XINN.2020.04.001).
- Lim LTS, Regencia ZJG, Dela Cruz JRC, Ho FDV, Rodolfo MS, Ly-Uson J and Baja ES (2022) Assessing the effect of the COVID-19 pandemic, shift to online learning, and social media use on the mental health of college students in the Philippines: a mixed-method study protocol. *PLOS ONE* 17(5), e0267555. doi: [10.1371/JOURNAL.PONE.0267555](https://doi.org/10.1371/JOURNAL.PONE.0267555).

- Lopes AR and Nihei OK** (2021) Depression, anxiety and stress symptoms in Brazilian university students during the COVID-19 pandemic: predictors and association with life satisfaction, psychological well-being and coping strategies. *PLOS ONE* **16**(10), e0258493. doi: [10.1371/JOURNAL.PONE.0258493](https://doi.org/10.1371/JOURNAL.PONE.0258493).
- Luo F, Ghanei Gheshlagh R, Dalvand S, Saedmoucheshi S and Li Q** (2021) Systematic review and meta-analysis of fear of COVID-19. *Frontiers in Psychology* **12**, 1311. doi: [10.3389/fpsyg.2021.661078](https://doi.org/10.3389/fpsyg.2021.661078).
- Marques AA, Bevilacqua MCDN, Da Fonseca AMP, Nardi AE, Thuret S and Dias GP** (2016) Gender differences in the neurobiology of anxiety: focus on adult hippocampal neurogenesis. *Neural Plasticity* **2016**, 5026713. doi: [10.1155/2016/5026713](https://doi.org/10.1155/2016/5026713).
- Matsudo S, Araújo T, Matsudo V, Andrade D, Andrade E, Oliveira LC and Braggion G** (2001) Questionário Internacional de Atividade Física (IPAQ): Estudo de Validade e Reprodutibilidade no Brasil. *Revista Brasileira de Atividade Física & Saúde* **6**(2), 5–18. doi: [10.12820/RBAFS.V.6N2P5-18](https://doi.org/10.12820/RBAFS.V.6N2P5-18).
- Mertens G, Gerritsen L, Duijndam S, Saleminck E and Engelhard IM** (2020) Fear of the coronavirus (COVID-19): predictors in an online study conducted in March 2020. *Journal of Anxiety Disorders* **74**, 102258. doi: [10.1016/j.janxdis.2020.102258](https://doi.org/10.1016/j.janxdis.2020.102258).
- Mertens G, Lodder P, Smeets T and Duijndam S** (2022) Fear of COVID-19 predicts vaccination willingness 14 months later. *Journal of Anxiety Disorders* **88**, 102574. doi: [10.1016/J.JANXDIS.2022.102574](https://doi.org/10.1016/J.JANXDIS.2022.102574).
- Ministério da Saúde** (2022) Coronavírus Brasil. Ministério da Saúde. Available at <https://covid.saude.gov.br/> 31 May 2022.
- Modena CF, Kogien M, Marcon SR, Demenech LM, Nascimento FCDS and Carrijo MVN** (2021) Fatores associados à percepção do medo da COVID-19 em estudantes universitários. *Revista Brasileira de Enfermagem* **75**(Suppl 1), e20210448. doi: [10.1590/0034-7167-2021-0448](https://doi.org/10.1590/0034-7167-2021-0448).
- Moreno AL, Desousa DA, De Souza AMFLP, Manfro GG, Salum GA, Koller SH, De Lima Osório F and De Souza Crippa JA** (2016) Factor structure, reliability, and item parameters of the Brazilian-Portuguese version of the GAD-7 questionnaire. *Temas em Psicologia* **24**(1), 367–376. doi: [10.9788/TP2016.1-25](https://doi.org/10.9788/TP2016.1-25).
- Mortazavi SS, Assari S, Alimohamadi A, Rafiee M and Shati M** (2020) Fear, loss, social isolation, and incomplete grief due to COVID-19: a recipe for a psychiatric pandemic. *Basic and Clinical Neuroscience* **11**(2), 225–232. doi: [10.32598/BCN.11.COVID19.2549.1](https://doi.org/10.32598/BCN.11.COVID19.2549.1).
- Ornell F, Schuch JB, Sordi AO and Kessler FHP** (2020) Pandemic fear, and COVID-19: mental health burden and strategies. *Brazilian Journal of Psychiatry* **42**(3), 232–235. doi: [10.1590/1516-4446-2020-0008](https://doi.org/10.1590/1516-4446-2020-0008).
- Pakpour AH and Griffiths MD** (2020) The fear of COVID-19 and its role in preventive behaviors. *Journal of Concurrent Disorders* **2**(1), 58–63.
- Pavlenko V, Kurapov A, Drozdov A, Korchakova N, Reznik A and Israelowitz R** (2022) COVID-19 fear association with Ukrainian help profession student mental health, substance use, and resilience. *Journal of Loss and Trauma* **27**(3), 292–295. doi: [10.1080/15325024.2021.1961408](https://doi.org/10.1080/15325024.2021.1961408).
- Pearce M, Garcia L, Abbas A, Strain T, Schuch FB, Golubic R, Kelly P, Khan S, Utukuri M, Laird Y, Mok A, Smith A, Tainio M, Brage S and Woodcock J** (2022) Association between physical activity and risk of depression: a systematic review and meta-analysis. *JAMA Psychiatry* **79**(6), 550–559. doi: [10.1001/JAMAPSYCHIATRY.2022.0609](https://doi.org/10.1001/JAMAPSYCHIATRY.2022.0609).
- Perz CA, Lang BA and Harrington R** (2022) Validation of the fear of COVID-19 scale in a US college sample. *International Journal of Mental Health and Addiction* **20**(1), 273–283. doi: [10.1007/S11469-020-00356-3](https://doi.org/10.1007/S11469-020-00356-3).
- Phillips C and Fahimi A** (2018) Immune and neuroprotective effects of physical activity on the brain in depression. *Frontiers in Neuroscience* **12**, 498. doi: [10.3389/fnins.2018.00498](https://doi.org/10.3389/fnins.2018.00498).
- Puccinelli PJ, da Costa TS, Seffrin A, de Lira CAB, Vancini RL, Nikolaidis PT, Knechtle B, Rosemann T, Hill L and Andrade MS** (2021) Reduced level of physical activity during COVID-19 pandemic is associated with depression and anxiety levels: an internet-based survey. *BMC Public Health* **21**(1), 425. doi: [10.1186/S12889-021-10470-Z](https://doi.org/10.1186/S12889-021-10470-Z).
- Quadros S, Garg S, Ranjan R, Vijayarathi G and Mamun MA** (2021) Fear of COVID 19 infection across different cohorts: a scoping review. *Frontiers in Psychiatry* **12**, 1289. doi: [10.3389/FPSYT.2021.708430/BIBTEX](https://doi.org/10.3389/FPSYT.2021.708430/BIBTEX).
- Rebar A, Stanton R, Geard D, Short C, Duncan M and Vandelanotte C** (2015) A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. *Health Psychology Review* **9**(3), 366–378. doi: [10.1080/17437199.2015.1022901](https://doi.org/10.1080/17437199.2015.1022901).
- Rodríguez-Hidalgo AJ, Pantaleón Y, Dios I and Falla D** (2020) Fear of COVID-19, stress, and anxiety in university undergraduate students: a predictive model for depression. *Frontiers in Psychology* **11**, 3041. doi: [10.3389/FPSYG.2020.591797/BIBTEX](https://doi.org/10.3389/FPSYG.2020.591797/BIBTEX).
- Salari N, Hosseinian-Far A, Jalali R, Vaisi-Raygani A, Rasoulpoor S, Mohammadi M, Rasoulpoor S and Khaledi-Paveh B** (2020) Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. *Globalization and Health* **16**(1), 57. doi: [10.1186/s12992-020-00589-w](https://doi.org/10.1186/s12992-020-00589-w).
- Santomauro DF, Mantilla Herrera AM, Shadid J, Zheng P, Ashbaugh C, Pigott DM, Abbafati C, Adolph C, Amlag JO, Aravkin AY, Bang-Jensen BL, Bertolacci GJ, Bloom SS, Castellano R, Castro E, Chakrabarti S, Chattopadhyay J, Cogen RM, Collins JK, Dai X, Dangel WJ, Dapper C, Deen A, Erickson M, Ewald SB, Flaxman AD, Frostad JJ, Fullman N, Giles JR, Giref AZ, Guo G, He J, Helak M, Hulland EN, Idrisov B, Lindstrom A, Linebarger E, Lotufo PA, Lozano R, Magistro B, Malta DC, Månsson JC, Marinho F, Mokdad AH, Monasta L, Naik P, Nomura S, O'Halloran JK, Ostroff SM, Pasovic M, Penberthy L, Reiner Jr RC, Reinke G, Ribeiro ALP, Sholokhov A, Sorensen RJ D, Varavikova E, Vo AT, Walcott R, Watson S, Wiyongse CS, Zigler B, Hay SI, Vos T, Murray CJ L, Whiteford HA and Ferrari AJ** (2021) Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the COVID-19 pandemic. *The Lancet* **398**(10312), 1700–1712. doi: [10.1016/S0140-6736\(21\)02143-7](https://doi.org/10.1016/S0140-6736(21)02143-7).
- Santos IS, Tavares BF, Munhoz TN, de Almeida LSP, da Silva NTB, Tams BD, Patella AM and Matijasevich A** (2013) Sensibilidade e especificidade do Patient Health Questionnaire-9 (PHQ-9) entre adultos da população geral. *Cadernos de Saúde Pública* **29**(8), 1533–1543. doi: [10.1590/0102-311X00144612](https://doi.org/10.1590/0102-311X00144612).
- Schafer KM, Lieberman A, Sever AC and Joiner T** (2022) Prevalence rates of anxiety, depressive, and eating pathology symptoms between the pre- and peri-COVID-19 eras: a meta-analysis. *Journal of Affective Disorders* **298**, 364–372. doi: [10.1016/J.JAD.2021.10.115](https://doi.org/10.1016/J.JAD.2021.10.115).
- Schimmenti A, Starcevic V, Giardina A, Khazaal Y and Billieux J** (2020) Multidimensional assessment of COVID-19-related fears (MAC-RF): a theory-based instrument for the assessment of clinically relevant fears during pandemics. *Frontiers in Psychiatry* **11**, 748. doi: [10.3389/FPSYT.2020.00748/BIBTEX](https://doi.org/10.3389/FPSYT.2020.00748/BIBTEX).
- Schuch FB, Vancampfort D, Firth J, Rosenbaum S, Ward PB, Silva ES, Hallgren M, De Leon AP, Dunn AL, Deslandes AC, Fleck MP, Carvalho AF and Stubbs B** (2018) Physical activity and incident depression: a meta-analysis of prospective cohort studies. *The American Journal of Psychiatry* **175**(7), 631–648. doi: [10.1176/APPLAJ.P.2018.17111194](https://doi.org/10.1176/APPLAJ.P.2018.17111194).
- Schuch FB, Stubbs B, Meyer J, Heissel A, Zech P, Vancampfort D, Rosenbaum S, Deenik J, Firth J, Ward PB, Carvalho AF and Hiles SA** (2019) Physical activity protects from incident anxiety: a meta-analysis of prospective cohort studies. *Depression and Anxiety* **36**(9), 846–858. doi: [10.1002/DA.22915](https://doi.org/10.1002/DA.22915).
- Seffrin A, Puccinelli PJ, Vivan L, Vancini RL, de Lira CAB, Nikolaidis PT, Rosemann T, Knechtle B and Andrade MS** (2022) Return to classes impact on mental health of university students during the COVID-19 pandemic. *Acta Neuropsychiatrica* **34**(1), 24–29. doi: [10.1017/neu.2021.31](https://doi.org/10.1017/neu.2021.31).
- Şimşir Z, Koç H, Seki T and Griffiths MD** (2022) The relationship between fear of COVID-19 and mental health problems: a meta-analysis. *Death Studies* **46**(3), 515–523. doi: [10.1080/07481187.2021.1889097](https://doi.org/10.1080/07481187.2021.1889097).
- Son C, Hegde S, Smith A, Wang X and Sasangohar F** (2020) Effects of COVID-19 on college students' mental health in the United States: interview survey study. *Journal of Medical Internet Research* **22**(9), e21279. doi: [10.2196/21279](https://doi.org/10.2196/21279).
- Spitzer RL, Kroenke K, Williams JBW and Löwe B** (2006) A brief measure for assessing generalized anxiety disorder: the GAD-7. *Archives of Internal Medicine* **166**(10), 1092–1097. doi: [10.1001/archinte.166.10.1092](https://doi.org/10.1001/archinte.166.10.1092).
- Su Z, McDonnell D, Wen J, Kozak M, Abbas J, Šegalo S, Li X, Ahmad J, Cheshmehzangi A, Cai Y, Yang L, Xiang Y-T** (2021) Mental health consequences of COVID-19 media coverage: the need for effective

- crisis communication practices. *Globalization and Health* 17(1), 1–8. doi: [10.1186/S12992-020-00654-4](https://doi.org/10.1186/S12992-020-00654-4).
- Szylovec A, Umbelino-Walker I, Cain BN, Ng HT, Flahault A and Rozanova L** (2021) Brazil's actions and reactions in the fight against COVID-19 from January to March 2020. *International Journal of Environmental Research and Public Health* 18(2), 555. doi: [10.3390/ijerph18020555](https://doi.org/10.3390/ijerph18020555).
- Togni G, Puccinelli PJ, Costa T, Seffrin A, de Lira CAB, Vancini RL, Santos DDAT, Nikolaidis PT, Knechtle B, Andrade MS** (2021) Factors associated with reduction in physical activity during the COVID-19 pandemic in São Paulo, Brazil: an internet-based survey conducted in June 2020. *International Journal of Environmental Research and Public Health* 18(21), 11397. doi: [10.3390/IJERPH182111397](https://doi.org/10.3390/IJERPH182111397).
- Varma P, Junge M, Meaklim H and Jackson M** (2021) Younger people are more vulnerable to stress, anxiety and depression during COVID-19 pandemic: a global cross-sectional survey. *Progress in Neuro-Psychopharmacology & Biological Psychiatry* 109, 110236. doi: [10.1016/j.pnpbp.2020.110236](https://doi.org/10.1016/j.pnpbp.2020.110236).
- Wang F, Zhang L, Ding L, Wang L and Deng Y** (2022) Fear of COVID-19 among college students: a systematic review and meta-analysis. *Frontiers in Public Health* 10, 846894. doi: [10.3389/fpubh.2022.846894/FULL](https://doi.org/10.3389/fpubh.2022.846894/FULL).
- Wathelet M, Duhem S, Vaiva G, Baubet T, Habran E, Veerapa E, Debien C, Molenda S, Horn M, Grandgenèvre P, Notredame C-E and D'Hondt F** (2020) Factors associated with mental health disorders among university students in France confined during the COVID-19 pandemic. *JAMA Network Open* 3(10), e2025591. doi: [10.1001/jamanetworkopen.2020.25591](https://doi.org/10.1001/jamanetworkopen.2020.25591).
- White RL, Babic MJ, Parker PD, Lubans DR, Astell-Burt T and Lonsdale C** (2017) Domain-specific physical activity and mental health: a meta-analysis. *American Journal of Preventive Medicine* 52(5), 653–666. doi: [10.1016/j.amepre.2016.12.008](https://doi.org/10.1016/j.amepre.2016.12.008).
- World Health Organization** (2022) Coronavirus (COVID-19) Dashboard with Vaccination Data. Available at <https://covid19.who.int/> 22 April 2022.
- Xiong J, Lipsitz O, Nasri F, Lui LMW, Gill H, Phan L, Chen-Li D, Iacobucci M, Ho R, Majeed A and McIntyre RS** (2020) Impact of COVID-19 pandemic on mental health in the general population: a systematic review. *Journal of Affective Disorders* 277, 55–64. doi: [10.1016/j.jad.2020.08.001](https://doi.org/10.1016/j.jad.2020.08.001).
- Yehudai M, Bender S, Gritsenko V, Konstantinov V, Reznik A and Isralowitz R** (2022) COVID-19 fear, mental health, and substance misuse conditions among university social work students in Israel and Russia. *International Journal of Mental Health and Addiction* 20(1), 316–323. doi: [10.1007/S11469-020-00360-7](https://doi.org/10.1007/S11469-020-00360-7).
- Zhu H, Wei L and Niu P** (2020) The novel coronavirus outbreak in Wuhan, China. *Global Health Research and Policy* 5(1), 1–3. doi: [10.1186/S41256-020-00135-6/METRICS](https://doi.org/10.1186/S41256-020-00135-6/METRICS).