

**Mental health in college students during COVID-19 pandemic****Saúde mental em estudantes universitários durante a pandemia de COVID-19****Salud mental en estudiantes universitarios durante la pandemia de COVID-19****Received: 20/09/2020****Approved: 05/03/2021****Published: 14/04/2021****Maycoln Leôni Martins Teodoro<sup>1</sup>****Juliana Alvares-Teodoro<sup>2</sup>****Camila Batista Peixoto<sup>3</sup>****Elder Gomes Pereira<sup>4</sup>****Marina Luiza Nunes Diniz<sup>5</sup>****Sabrina Kelly Pessoa de Freitas<sup>6</sup>****Pricila Cristina Correa Ribeiro<sup>7</sup>****Cristiano Mauro Assis Gomes<sup>8</sup>****Marcela Mansur-Alves<sup>9</sup>**

This is a cross-sectional study, conducted in early 2020, which aims to investigate mental health (anxiety, depression, and stress) in college students during the initial stage of quarantine in Brazil. They answered an online survey regarding their perception of COVID-19, quarantine, personality traits, suicide ideation, and mental health (Depression, Anxiety, and Stress Scale). Data were analyzed by the CART algorithm. Participants were 1957 students (1418 women, 72.30%) with age ranging between 18 and 40 years (Mean = 26.40; SD = 5.58). Worse mental health scores were associated with worse COVID-19's impact on life, higher neuroticism, and higher suicide ideation, with 48.43% of explained variance in training sample. Our findings show that the mental health of college students may be related to the interaction of several factors that are prior to the pandemic as well as from the COVID-19.

**Descriptors:** Pandemics; Mental health; Students; Personality; Suicidal ideation.

Este é um estudo transversal, realizado no início de 2020, que teve como objetivo investigar a saúde mental (ansiedade, depressão e estresse) em estudantes universitários durante o estágio inicial da quarentena no Brasil. Os participantes responderam uma pesquisa online sobre a percepção da COVID-19, quarentena, traços de personalidade, ideação suicida e saúde mental (Escala de Depressão, Ansiedade e Estresse). Os dados foram analisados pelo algoritmo CART. Participaram 1957 estudantes (1418 mulheres, 72,30%) com idade entre 18 e 40 anos (Média = 26,40; DP = 5,58). Pontuações de saúde mental mais baixas foram associadas a um pior impacto do COVID-19 na vida do entrevistado, maior neuroticismo e maior ideação suicida, com 48,43% de variância explicada na amostra de treinamento. Esses achados mostram que a saúde mental de estudantes universitários pode estar relacionada à interação de vários fatores anteriores à pandemia, bem como da COVID-19.

**Descritor:** Pandemias; Saúde mental; Estudantes; Personalidade; Ideação suicida.

Este es un estudio transversal, realizado a principios de 2020, que tuvo como objetivo investigar la salud mental (ansiedad, depresión y estrés) en estudiantes universitarios durante la etapa inicial de la cuarentena en Brasil. Los participantes responderán a una encuesta online sobre su percepción acerca de COVID-19, la cuarentena, los rasgos de personalidad, la ideación suicida y la salud mental (Escala de Depresión, Ansiedad y Estrés). Los datos se analizaron mediante el algoritmo CART. Los participantes fueron 1957 estudiantes (1418 mujeres, 72,30%) con edades comprendidas entre los 18 y los 40 años (Promedio = 26,40; SD = 5,58). Las peores puntuaciones en salud mental se asociaron con un peor impacto de la COVID-19 en la vida del encuestado, un mayor neuroticismo y una mayor ideación suicida, con un 48,43% de varianza explicada en la muestra de entrenamiento. Estos hallazgos muestran que la salud mental de los estudiantes universitarios puede estar relacionada con la interacción de varios factores que son anteriores a la pandemia, así como de Covid-19.

**Descriptores:** Pandemias; Salud mental; Estudiantes; Personalidad; Ideación suicida.

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## INTRODUCTION

The novel coronavirus disease (COVID-19) was declared a pandemic in March of 2020 by the World Health Organization (WHO) and quickly spread around the world. Since then, public authorities have taken several measures to contain the COVID-19 outbreak, such as an enlargement of health services and quarantine. These actions were taken in Brazil, where the first case of COVID-19 infection was diagnosed around February 29<sup>th</sup>, and quarantine began in several cities in March. Therefore, more than 5.000.000 cases have been confirmed and up to 150.000 deaths occurred up until October<sup>1</sup>.

The impact of COVID-19 goes beyond physical and economic domains, including mental health consequences, like anxiety, depression, and stress<sup>2,3</sup>. At least two-thirds of college students reported a high increase of anxiety after a lockdown in Greece<sup>4</sup>. Furthermore, females with a history of suicide have a double risk to develop depression comparing to males with no previous suicide attempt. Similar results were found in Brazil, where women presented higher scores of anxiety, depression, and stress compared to males during the COVID-19 pandemic.

Since the COVID-19 outbreak, research has identified several factors that can be associated with mental health during the pandemic. Economic effects, like family income stability, as well as living with parents, and social support were negatively associated with anxiety symptoms<sup>5</sup>. In a revision, it was shown that frustration, financial loss, inadequate information, and fear of infection play a role as stressors during the pandemic<sup>3</sup>. The feeling of fear could be associated with uncertainty about how bad the impact of COVID-19<sup>6</sup> actually is.

Prequarantine factors can also act during the pandemic producing effects on mental health. For example, having a history of psychiatric illness was associated with anxiety symptoms and anger during the quarantine<sup>7</sup>. Furthermore, personality traits, like neuroticism, extroversion, and conscientiousness were linked to an increase in levels of stress and social and behavior during the pandemic<sup>8,9</sup>. Furthermore, gender (female group), and history of suicide attempts and self-injuries were linked to mental health conditions during the pandemic<sup>4</sup>.

As reported, many variables have been identified as potential predictors of individuals' mental health during the pandemic period. This multifaceted characteristic requires multivariate statistical techniques, capable of allowing the investigation of the incremental role of each variable in predicting people's mental health. It is possible that variables considered important for the prediction of mental health in pandemics, when put together with other variables in multivariate studies, partially or completely lose their importance. Understanding the central factors that are associated with the mental health of individuals in a pandemic requires, therefore, studies that incorporate a wide set of variables.

In addition, the use of multivariate studies that are not based on statistical techniques that demand many assumptions about the characteristics of the data is relevant. It is known that general linear models, such as multiple regression, hierarchical regression, multilevel regression, require that the data have certain characteristics, such as normal outcome, homoscedasticity, temporal independence, and linearity in the relationship between variables<sup>10</sup>. These postulates are very strong and unrealistic for the characteristics of a substantial portion of the data in human sciences and health sciences<sup>10,11</sup>. In short, machine learning data analysis techniques that do not make any assumptions relevant to the characteristics of the data are more effective in meeting the challenges of investigating predictors of mental health in the pandemic period. The absence of these assumptions allows for the identification of linear relationships as well as non-linear relationships between the predictor variables and the outcome, contemplating a more complete analysis of the associations present<sup>10,11</sup>.

Due to the number of factors related to mental health during the COVID-19 pandemic, it is important to identify the existence of covariance among different constructs, selecting the main variables that are related to mental health. Thus, this study aims to investigate mental

health (anxiety, depression, and stress) in college students during the initial stage of quarantine in Brazil.

## METHODS

This was a Web-based cross-sectional survey. Participants were contacted through social media and invited to fill an online survey. The research was also publicized throughout social networks and sites from Brazilian universities. Participants filled the questionnaire in 15-20 minutes and provided their informed consent. Participants were provided contact information for mental health services upon debriefing. Approval for this study was obtained from the Institutional Review Board from the first author's university prior to data collection (07077019.3.0000.5149). For the study, the following data collection instruments were considered:

- Questionnaire about COVID-19' perception. The authors elaborated a questionnaire with sociodemographic and COVID-19' related questions including quarantine, income conditions, fear of contamination, drugs use, and medical history (presence of chronic and psychiatric diseases). Information from this questionnaire is described in Table 1 (sociodemographic questions) and Table 2 (Covid-19 questions).

- Depression, Anxiety, and Stress Scale-21<sup>12</sup> (DASS-21). The DASS-21 is a four-point Likert scale measure of depression, anxiety, and stress symptoms. Despite its theoretical background as a tripartite model of psychopathology, some authors have shown that its 21 items can be analyzed as a single construct and as an indicator of negativity and distress with scores ranging from 0 to 63 points (higher scores means worse mental health)<sup>13</sup>. DASS-21 was translated, adapted, and validated for the Brazilian context with Cronbach's Alphas of 0.86 (anxiety), 0.90 (stress), and 0.92 (depression)<sup>14</sup>. In this study, we used the DASS-21 as a single factor, called mental health.

- The Big Five Inventory<sup>15</sup> (Brazilian Version, IGFP-5). IGFP-5 was adapted to Portuguese and its Brazilian version has 32 items distributed in the classic big five theory personality factors (Openness to Experience, Conscientiousness, Extraversion, Neuroticism and Agreeableness) and reliability coefficients ranged from 0.68 to 0.76 (Guttman's Lambda 2)<sup>16</sup>. Items should respond on Likert scale range from 1 to 5 (1=*Never*, and 5=*Frequently*). In this research, we use 24 items belonging to Neuroticism (8 items), Extraversion (6 items), and Conscientiousness (9 items) factors.

- Emotion Regulation Questionnaire<sup>17</sup> (ERQ). ERQ is composed of ten items, distributed in three factors (Cognitive Reassessment, Redirecting the Focus of Attention, and Emotional Suppression), that should be answered on a seven-point Likert scale, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Total scores range from 10 to 70 points and higher scores indicate a greater propensity to use that strategy of emotional regulation. Brazilian version showed satisfactory psychometric properties<sup>18</sup>.

- Satisfaction with Life Scale<sup>19</sup> (SWLS). SWLS assesses life' satisfaction through five items with a response-scale of 7-point, ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The Brazilian version has a unifactorial structure and an adequate reliability score (Alpha = 0.81)<sup>20</sup>. SWLS scores range from 5 to 35 points and higher punctuation means a better perception of life' satisfaction.

- Frequency of Suicidal Ideation Inventory<sup>21</sup> (FSII). The FSII is composed of 5 items that assess for the frequency of suicidal ideation over the past 12 months using a 5-point Likert-type scale, ranging from 1 (*never*) to 5 (*almost every day*). The Brazilian version of the FSII has good psychometric properties and Cronbach's Alpha of 0.88 for its single factor<sup>22</sup>. FSII scores vary from 5 to 25 points and higher scores mean more frequent suicidal ideation over the last 12 months.

Data were analyzed by the CART algorithm through R package, version 4.1-15<sup>23</sup>. This algorithm is vastly applied in machine learning and data mining. There are important

advantages to employ the CART algorithm. This algorithm does not require that data have a normal distribution, homoscedasticity, nor that the variables present linear relations among themselves. Because of that, CART is very feasible to analyze nominal variables with many categories, as ordinal variables and non-linear relations among the predictors and the outcome<sup>10,11,24,25</sup>.

The independent variables of the predictive model were the perception of Covid-19, compliance to quarantine, personality traits, suicide ideation, gender, and age, while the DASS-21 total raw score was the outcome, called mental health. The function of the CART R package, version 6.0-86, split randomly data into two groups: training sample (N = 75%) and test sample (N = 25%). The model was trained in the training sample and the prediction of outcome was tested in the test sample. The 10 folders cross-validation was applied to control the model training. The cost complexity information, from this analysis, was applied to prune the trained tree. This pruned tree was tested in the test model. The pruned tree was plotted through the R package, version 3.0.8.

## RESULTS

### Sociodemographic Data and Mental Health

A total of 1957 college students (of which 1418 were female, make up a percentage of 73.30%) were recruited to participate via social media. Participants were undergraduate, master, and Ph.D. students living in several Brazilian cities in social isolation for, at least, two weeks. Ages ranged from 18 to 40 years, with a mean age of 26.40 years ( $SD = 5.58$ ).

Univariate analysis between demographic characteristics and mental health (DASS-21) are described in Tables 1. Higher scores of worse mental health were found in groups of females ( $p < 0.001$ ), self-declared race (black > yellow,  $p < 0.01$ ), lesbian, gay, bisexual, transgender, and queer (LGBTQ) ( $p < 0.001$ ), and undergraduate participants ( $p < 0.001$ ). The presence of children and marital status presented no significance to mental health scores. Furthermore, a higher number of diseases and lower-income are related to worse mental health scores.

Table 2 presents mental health scores related to COVID-19 questions. Worse scores of mental health were mainly related to being in full quarantine, a decrease of income, an increase of alcohol use after the beginning of the pandemic, afraid of being infected, and COVID-19's impact on life.

**Table 1.** Mental health (depression, anxiety, and stress) according to participants' socio-demographic characteristics. Brazil, 2020.

Variables	Sample n (%)	DASS Mean (SD)	F, T / sig***
<b>Gender</b>			
Female	1418 (72.50)	27.68 (15.00)	5.52**
Male	539 (27.50)	22.16 (14.07)	
<b>Declared color/race</b>			3.75*
Black	197 (10.10)	28.01 (14.45)	Black > Yellow
Brown	608 (31.10)	26.66 (15.37)	
White	1123 (57.40)	25.80 (14.79)	
Yellow	25 (1.30)	18.40 (12.94)	
Indigenous	4 (0.20)	11.50 (9.04)	
<b>Marital status</b>			0.73
Married	364 (18.60)	25.35 (15.10)	
Single	1529 (78.10)	26.38 (14.90)	
Others	64 (3.30)	25.67 (15.57)	
<b>Children</b>			1.74
No	1769 (90.40)	26.00 (14.82)	
Yes	175 (8.90)	27.74 (16.07)	
<b>Sexual orientation</b>			5.70**
Heterosexual	1411 (72.10)	24.64 (14.87)	
LGBTQ	488 (24.90)	30.33 (14.36)	
<b>Formal education</b>			3.92**
Undergraduate	1042 (53.20)	27.99 (14.88)	
Graduate	915 (46.80)	24.08 (14.77)	
<b>Income</b>			13.62**
Up to 2 BMW	539 (27.50)	28.71 (15.07)	Till 02 > 2-10; 10 2-10 > 10 ND > 10
Between 2 and 10 BMW	1139 (58.20)	25.80 (14.85)	
More than 10 BMW	179 (9.10)	20.71 (13.36)	
Not declared	100 (5.10)	26.32 (14.95)	
<b>Number of diseases</b>			186.10**
None	658 (66.60)	18.83 (12.81)	2 > None, 1 1 > None
1	676 (34.50)	26.45 (13.43)	
2 or more	623 (31.80)	33.60 (18.89)	
<b>Medicine</b>			
<b>Antidepressant</b>			8.24**
No	1581 (80.80)	24.82 (14.68)	
Yes	376 (19.20)	31.81 (14.79)	
<b>Anxiolytic</b>			7.07**
No	1896 (96.90)	25.74 (14.83)	
Yes	61 (3.10)	39.33 (12.70)	
<b>Analgesic</b>			0.73
No	1793 (91.60)	26.13 (15.00)	
Yes	164 (8.40)	26.55 (14.45)	
<b>Others psychotropics</b>			7.72**
No	1765 (90.20)	25.32 (14.78)	
Yes	192 (9.80)	33.96 (14.30)	

Note: \* p<0,01; \*\* p<0,001 \*\*\* Test t / Variance /Significance

**Table 2.** Mental health (depression, anxiety, and stress) according to COVID-19' related questions. Brazil, 2020.

Variables	Sample n (%)	DASS Mean (SD)	F, T / sig***
<b>Quarantine</b>			25.97**
No	167 (8.50)	25.16 (15.42)	Full > No; Partial
Partial	1340 (68.50)	24.81 (14.59)	
Full	450 (23.00)	30.56 (15.04)	
<b>Quarantine weeks</b>			1.09
Up to 3 weeks	211 (10.80)	26.82 (15.50)	
More than 3 weeks	1769 (88.70)	26.12 (14.86)	
<b>Income drop after quarantine</b>			21.40**
Yes	1047 (53.50)	28.09 (15.07)	
No	858 (43.80)	23.69 (14.58)	
Not declared	52 (2.70)	28.21 (14.95)	
<b>Relationship quality at home in quarantine</b>			7.76**
Bad relationship	354 (18.20)	32.54 (13.91)	
Good relationship	1593 (81.80)	24.78 (14.79)	
<b>Covid' impact in life</b>			13.14**
Not or almost nothing affected	1330 (68.00)	21.95 (13.44)	
Strongly affected	627 (32.00)	35.10 (14.06)	
<b>Alcohol consumption after quarantine</b>			12.36**
No alcohol use	611 (31.20)	25.20 (15.55)	Inc > No, Dec., Same
Decrease	554 (28.30)	26.32 (14.62)	
Same	497 (25.40)	24.46 (14.70)	
Increase	295 (15.10)	30.73 (13.84)	
<b>Have you moved away because of quarantine?</b>			1.46
No	1556 (79.50)	25.87 (15.21)	
Yes	401 (20.50)	27.32 (13.85)	
<b>Covid-19' information</b>			2.99*
No	153 (7.80)	28.93 (14.51)	
Yes	1804 (92.20)	25.93 (14.97)	
<b>Infection afraid</b>			59.98**
Not afraid	226 (11.50)	22.28 (15.68)	
A bit	1083 (55.40)	23.95 (14.05)	
A lot	646 (33.00)	31.23 (14.90)	

Note: \* p<0,05 \*\* p<0,001 \*\*\* Test t / Variance /Significance

Mental health score was correlated with all psychological measures. Related to personality traits (IGFP-5), higher scores of DASS-21 (Mean = 26.10, SD = 14.95) presented positive association with Neuroticism (Mean = 24.79, SD = 4.81) (0.40,  $p < 0.001$ ) and negative with Extroversion (Mean=24.48, SD = 8.01) (-0.14,  $p < 0.001$ ), and Conscientiousness (Mean = 24.56, SD = 5.20) (-0.19,  $p < 0.001$ ). Furthermore, we found significant and positive correlations between worse mental health and suicidal ideation (FSII, Mean = 7.57, SD = 4.12) (0.55,  $p < 0.001$ ) and negative with satisfaction in life (SWLS, Mean = 21.41, SD = 6.76) (-0.44,  $p < 0.001$ ) and emotional regulation (ERQ, Mean = 42.16, SD = 9.90) (-0.13,  $p < 0.001$ ).

The CART algorithm made a tree with 101 leaves, which produced 31.79% of prediction error and explained 68.21% of DASS-21 total raw score variance in the training sample. However, its fit was not verified in the 10 folders cross-validation. In this context, the tree produced 68.15% of prediction error and explained 31.85% of outcome variance in the training sample. This evidence indicated strong overfitting.

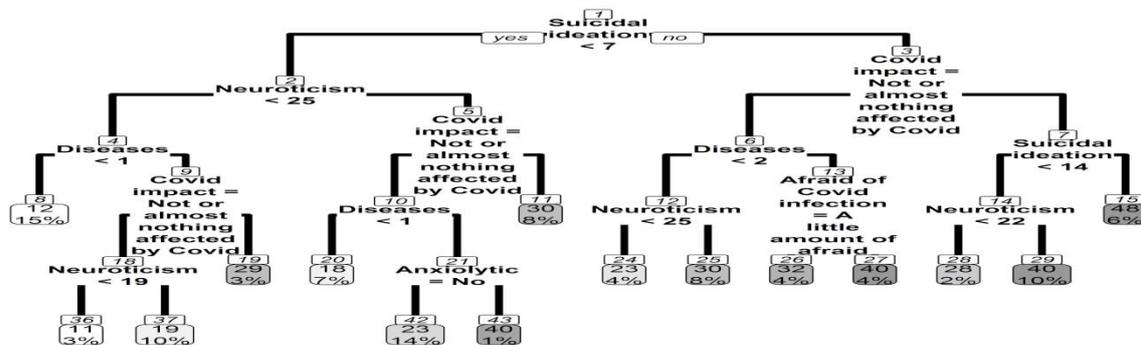
The pruned tree generated 15 leaves and produced a prediction error of 49.66% and explained 50.34% of the outcome. The fit of this tree was similar in the 10 folders cross-validation. In this context, the pruned tree produced a prediction error of 54.83% and explained 45.17% of the outcome. There is a small difference between these fits, indicating that the pruned tree comes from a predictive model with a reasonable degree of generality. The pruned

tree explained 41.58% of the outcome in the test sample, which is a similar fit found in the training sample and corroborates that this tree has a reasonable degree of generality.

The predictors selected by the CART algorithm to predict the DASS-21 total raw score were (1) suicidal ideation, (2) neuroticism, (3) COVID impact, (4) diseases, (5) anxiety, (6) fear of COVID infection. The DASS-21 total raw score in the training sample showed a minimum score of zero and a maximum score of 63 points, the maximum value possible of the scale. The mean was 26.11 points (SD = 14.97), and the skew of 0.31 and the kurtosis of -0.81 indicated that the DASS-21 total raw score seems to show a normal distribution in the training sample.

The 15 leaves of the pruned tree are shown in Figure 1. These leaves inform that there are 15 different groups or profiles of individuals, regarding DASS-21 total raw score as the outcome. Each rectangle with two numbers in Figure 1 represents one leaf. The top number indicates the mean of DASS-21 for that group, while the bottom number shows the size of the group in the training sample, in terms of relative percentage. For example, the leaf at the extreme left of Figure 1 has two numbers (12 and 15%). The top number, that is, 12 shows that this group of participants have a mean of 12 points in the DASS-21 total raw score. The bottom number, which is 15%, shows that this group is 15% of the training sample.

We can interpret all of the leaves by reading the tree in a top-down screening. For example, we can observe that the extreme left leaf in Figure 1 is participants that have suicidal ideation below 7 points (node 1 of the tree), as well as neuroticism below 25 points (node 2) and do not show any diseases (node 4). Those participants showed the second-lowest mean in the DASS-21 total raw score (12 points, 1 SD below average), indicating that scores below of average in suicidal ideation, neuroticism, and a number of diseases are a protective factor against what represents the DASS-21 total raw score, that is, mental suffering. On the other side, the leaf on the extreme right side of Figure 1 represents the participants who present the most mental suffering. They have a mean of 48 points in the DASS-21 total raw score (more than 1 SD above mean) and they are 6% of the training sample. They are individuals who showed suicidal ideation equal or above 14 points (more than 1 SD above mean), and also perceived that COVID had a high impact on their lives.



**Figure 1.** Pruned tree with data from the *Mental Health Survey in University Students* by the CART Algorithm, Brazil, 2020.

Some variables acted as predictors only when conditioned by other variables. This happened with the anxiety variable and the fear of COVID infection variable. The use of anxiety is associated with increasing a lot the mental suffering in people who answered suicidal ideation below 7 points, as well as answered values equal or above in neuroticism, have not perceived that COVID had a high impact in their lives and presented at least one disease. Only in this case, the use of anxiety increases the mean from 23 to 40 points in the DASS-21 total raw score, which means more than one standard deviation above the mean.

## DISCUSSION

Studies have suggested that the mental health of college students worsened during the pandemic of COVID-19<sup>4,5</sup>. However, most studies are limited to univariate statistics, which restrict the conclusion of the association of variables in the intensity of worsening mental health. The main goal of this study was to evaluate mental health (anxiety, depression, and stress) in college students during the initial stage of quarantine in Brazil. We found that worse mental health at the beginning of the pandemic was associated with suicidal ideation in the past 12 months, high levels of neuroticism, number of diseases, use of anxiolytic, and COVID-19 related variables such as life impact of disease and fear of infection.

Like other studies, our results showed that some sociodemographic characteristics like being a woman<sup>26</sup>, and having some financial drop after the beginning of the pandemic<sup>3</sup> can be associated with worse mental health in univariate analysis. However, these variables were not retained in the final regression model, indicating the necessity to use multivariate analysis in transversal studies.

In our results, worse mental health scores were associated with three groups of variables. The first was called pre-quarantine events, composed of those factors that certainly do exist before the pandemic. They are neuroticism and two medical conditions that are related either with the risk group to COVID-19 (number of diseases) or with worse mental health (use of anxiolytic). Personality traits have been previously studied as associated with worse indicators of mental health during the COVID-19 pandemic. Authors found that neuroticism and extraversion, but not conscientiousness were linked with higher stress scores in adults<sup>8</sup>. Considering personality traits, we found that only high levels of neuroticism were associated with worse mental health.

Neuroticism is a personality trait that refers to relatively stable tendencies to respond with negative emotions to threat, frustration, or loss. Individuals with high levels of this trait have frequent and intense emotional reactions to minor life challenges and had worse emotional regulation strategies. Neuroticism is a robust correlate and predictor of many different mental and physical disorders and, also, a strong predictor of quality and life satisfaction<sup>27</sup>. Some authors also point to the importance of considering neuroticism in mental health studies due to its economic costs and public health significance<sup>28</sup>. We expected, however, that extroversion would also be part of the final model. Maybe due to the early stage of the pandemic (3-5 weeks), those participants had not suffered the effects of social isolation yet. Together with neuroticism, having one or more diseases and the use of anxiolytic worked as associated factors to worse scores of mental health. We suppose that those participants can feel more vulnerable to the effects of COVID-19 or already had higher scores of anxiety before the pandemic.

The second group of variables associated with worse mental health contained suicidal ideation in the past 12 months. Due to the methodological design of the study, we cannot affirm that this death thoughts were present before the pandemic. However, because of the period of data gathering, and according to several suicidal ideation models<sup>29</sup>, which presuppose its appearance as a result of other factors such as hopelessness, failure, and thwarted belonging, it is likely that they started before the pandemic. Research has shown that a history of suicide attempts is associated with worse mental health conditions during the pandemic<sup>4</sup> and associated with anxiety and depression<sup>30</sup>, which supports our hypothesis.

The last group was formed by variables related to the COVID-19 outbreak itself, namely the life impact of the disease and fear of infection. In both cases, we have stressors that can produce negative psychological effects on mental health. In particular, infection fear has been identified as an important factor linked to stress during the pandemic<sup>3,7</sup>.

The results showed that, although a large number of variables are associated with worse mental health through univariate analysis, there is a considerable reduction in this number in

multivariate analysis. The retained factors associated with worse mental health are pre and post pandemic and can be combined in different ways (eg. higher suicidal ideation, and COVID-19 impact; or lower suicidal ideation, higher neuroticism, lower impact, diseases' number higher than one, and anxiolytic use) to result on the highest scores of mental distress. These results indicate that we should consider both the vulnerabilities as well as the individual perception of the pandemic to avoid partial understanding of the situation.

## CONCLUSION

The results show that the mental health of college students may be related to the interaction of several factors that are prior to the pandemic (such as personality, chronic diseases, and suicidal ideation) as well as subsequent, such as fear and being affected by Covid-19.

It is necessary to consider that the present study was restricted to the initial weeks of social isolation during the COVID-19 pandemic. Thus, some factors that may impact mental health in the medium and long term, such as socioeconomic factors, may have been underestimated. Thus, it is strategic to monitor the population and identify risk factors for mental health during the pandemic to support intervention strategies.

It is necessary to consider some limitations to interpret these results. First, the present study was cross-sectional in design, which does not allow inferring causality. Additionally, the present study investigates only college students, which restrain the generalization of their results. We suggest longitudinal studies to determine which factors can be acting as risk or protective determinants do mental health after months in quarantine.

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### CONTRIBUTIONS

**Maycoln Teodoro, Marcela Mansur-Alves, Pricila Cristina Correa Ribeiro and Juliana Alvares-Teodoro** contributed to the conception, writing and review. **Cristiano Mauro Assis Gomes** participated in data analysis and writing. **Camila Batista Peixoto, Elder Gomes Pereira, Marina Luiza Nunes Diniz and Sabrina Kelly Pessoa de Freitas** worked on data collection and data analysis.

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