Factors linked to changes in mental health outcomes among Brazilians in quarantine due to COVID-19

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Abstract

The 2020 COVID-19 pandemic is a crisis of global proportions with a significant impact on the country of Brazil. The aims of this investigation were to track changes and risk factors for mental health outcomes during state-mandated quarantine. Adults residing in Brazil (n = 360, 37.9 years of age, 68.9% female) were surveyed at the start of quarantine and 1 month later. Outcomes assessed included perceived stress, state anxiety and depression. Aside from demographics, behaviors and attitudes assessed included exercise, diet, use of tele-psychotherapy and number of COVID-19 related risk factors, such as perceived risk of COVID-19, information overload, and feeling imprisoned. Overall, all mental health outcomes worsened from Time 1 to time 2, although there was a significant gender x time interaction for stress. 9.7% of the sample reported stress above the clinical cut-off (2 SD above mean), while 8.0% and 9.4% were above this cutoff for depression and anxiety, respectively. In repeated measures analysis, female gender, worsening diet and excess of COVID-19 information was related to all mental health outcomes. Changes in diet for the worse were associated with increases in anxiety. Exercise frequency was clearly related to state anxiety (0 days/week > 6 days/week). Those who did aerobic exercise did not have any increase in depression. Use of tele-psychotherapy predicted lower levels of depression and anxiety. In multiple regression, anxiety was predicted by the greatest number of

COVID-19 specific factors. In conclusion, mental health outcomes worsened for Brazilians during the first month of quarantine and these changes are associated with a variety of risk factors.

Keywords: COVID-19; SARS-Cov-2; Depression; Anxiety; Stress

Introduction

Mental health comprises the set of emotions, thoughts and behaviours that enable individuals to work, cope and deal with problems in everyday tasks (*WHO, 2004*). Historically, although researchers from the biomedical sciences dedicated more time and resources in the study of physical health, findings from the last 50 years have slowly captured the interest of scientists from diverse fields to look upon mental health to explain somatic diseases, physical functioning, quality-of-life, well-being and work productivity, (*Christensen et al., 1999; Prince et al., 2007; Stults-Kolehmainen, Tuit & Sinha, 2014*). For instance, mental health is associated with disability-adjusted life years (DALYs) and premature mortality (*Vigo, Kestel, Pendakur et al., 2019*) with 17% of DALYs attributable to mental health in Brazil and 22% in the United States. Those with worse mental health, such as higher levels of chronic stress, have a greater risk for physical health problems, such as cardiovascular disease (*Stults-Kolehmainen, 2013*). Poor mental health costs society a great deal of money, in terms of lost productivity, strain on healthcare systems, loss of income and other consequences (Trautman, Rehm, Wittchen, 2016). On the other hand, recent research from the World Health Organization suggests that every one American-dollar spent in mental health care is equivalent to a return of four American-dollars in better well-being and ability to work (*WHO, 2016*).Thus, a person who has good mental health entails someone who is physically healthy, happy and productive for themselves and the greater functioning of society (*Prince et al., 2007; WHO, 2016*).

The recent outbreak of the Corona Virus Disease 2019 (COVID-19 or SARS-CoV-2) around the world at the end of 2019 and the beginning of 2020 led to a series of guidelines to avoid mass contamination and limit its lethality (*WHO, 2020*). Among these recommendations are quarantine, confinement and social distancing (*Wilder-Smith & Freeman, 2020*). These impositions mean that people cannot walk freely from their homes; they need to keep a 2-meter physical distance from one another on the streets and sick people are obliged to be confined in hospitals or their own homes without any kind of physical proximity to others. These restrictions are intended to benefit the physical health and safety of all people and must be adopted to save lives. Unfortunately, such directives come at a cost to the mental health and well-being a substantial proportion of the population (*Rubin & Wessely, 2020*). Furthermore, not all individuals in Brazil adhere to quarantine guidelines, obedience of Brazilians to social isolation during quarantine peaked at 63% on March 23rd 2020 and average 47% (*INLOCO, 2020*), perhaps explaining why Brazil has the highest contagion rate (R0 = 2.81) in the world as of April, 2020 (*Imperial College London COVID-19 Response Team, 2020*).

An updated systematic review on the effects of social distancing and quarantine on mental health revealed that anxiety, depression, stress, anger, insomnia, hopelessness, and sadness were all increased during those conditions (*Brooks et al., 2020*). A recent study (Hu, Su et al., 2020) from a cross-national sample (n = 992) in China found that levels of anxiety increased, and 9.6% of the population was anxious at clinically relevant levels. Other behavioural problems also appear during this period; participants in a nationwide survey recently published in China reported nutritional issues, lack of ability to exercise and numerous changes in daily routines and habits (*Qiu et al., 2020*). Accordingly, psychosocial and behavioural dimensions seem associated under quarantine conditions (*Filgueiras & Stults-Kolehmainen, 2020*). Similar findings were also depicted in research conducted in other quarantine situations, such as: the Severe Acute Respiratory Syndrome (SARS) epidemic in Canada (*Hawryluck et al., 2004*), Taiwan (*Bai et al., 2004*) and Hong Kong (*Lee et al., 2005*), the Middle East Respiratory Syndrome (MERS) epidemic caused by another strain of Corona Virus in Korea (*Jeong et al., 2016*) and the equine influenza epidemic in Australia (*Taylor et al., 2008*). Altogether, the evidence suggests that quarantine leads to an increase of mental health issues.

Identifying risk factors that modify the mental health experience of quarantine and social isolation is important. Research among people in normal and healthy conditions has shown that sociodemographic variables, health behaviours and other daily routines are linked to better mental health. Among the most commonly investigated demographic variables are gender (*Almeida & Kessler, 1998; Nolen-Hoeksema, 2001*) education (*Steele et al., 2007*) and age (*Christensen et al., 1999*). For health behaviours, a large literature suggests that moderate to vigorous physical exercise from three to five times per week leads to reduced anxiety (*Wipfli, Rethorst & Landers, 2008*), depression (*Craft & Landers, 1998; de Oliveira et al., 2018*), stress (*Stults-Kolehmainen & Sinha, 2014*) and other mental health issues (*Landers & Arendt, 2007*). Similar associations are found with dietary habits; a diet low in fat, sugar or carbohydrate tends to be associated with fewer psychological issues (*Molendijk et al., 2018; O'Neil et al, 2014*). Aside from these health behaviors, finding and receiving mental health support is imperative for many individuals at risk. Psychologists and other mental health practitioners who provide online or tele-psychotherapy may also help to improve mental health conditions (*Varker et al., 2019*).

Unfortunately, resources are scarce in every field of the health system, including those for mental health (*Qiu et al., 2020*). Therefore, it is pivotal to establish *a priori* where and how to invest those scarce resources. This is a difficult task because the current stressor is highly unique. Quarantine is due to a pandemic of truly global proportions that has reached every level of society, with a long duration and remarkable social upheaval (*WHO, 2020*). There is no research on the association between psychological, demographic and behaviour variables in the general population during society-wide social isolation. Furthermore, it is a consensus that psychological phenomena, such as stress and depression, are multifactorial with a large amount of variables to consider (*WHO, 2004; 2016*). In order to help governments, service providers and scientists to

establish public policies toward resource allocation in mental health during the COVID-19 pandemic crisis, this study aimed to fill the gap in the current literature. Three psychological dimensions were queried due to their relevance in the literature: (i) perceived stress (*Hawryluck et al., 2004; Qiu et al., 2020*), (ii) depression (*Brooks et al., 2020*) and (iii) state anxiety (*Jeong et al., 2016; Rubin & Wessely, 2020*). The aims of this investigation were two-fold. First, this research was intended to track mental health changes over two time points during quarantine. The second objective was to associate mental health outcomes with pertinent demographic, behavioural and COVID-19 specific factors.

Materials & Methods

The present research is a longitudinal psychosocial study that collected data in two periods: the first week of quarantine decreed by state authorities of the last Brazilian state that adhere to quarantine (Sao Paulo, 2020) and four weeks after this decree. The Ethical Committee of the first author's institution approved the project under the process #2020.2014-0932-12. Participants were allowed to leave the online questionnaires at any time and procedures obeyed the Declaration of Helsinki.

Volunteers for this study were 360 (248 women, 68.9%) Brazilians or foreigners living in Brazil from 9 States and 23 different cities. This research was conducted in Brazilian Portuguese, so it was necessary to know how to read and write in this language. All participants digitally signed the Term of Consent and agreed to be contacted after the first round of data collection to be part of the second round. A total of 1,849 participants answered the first round, nonetheless, only 360 (19.5%) participated in the second round.

There were four instrument measures adopted: a sociodemographic and attitudinal questionnaire, the Perceived Stress Scale with 10 items (PSS-10), the Filgueiras Depression Inventory (FDI) and the State subscale of the State-Trait Anxiety Inventory (S-STAI). The sociodemographic questionnaire had 20 questions in this order: (i) age, (ii) gender, (iii) education, (iv) height, (v) weight, (vi) whether the participant had any physical risk factor for COVID-19, whether he/she used during quarantine (vii) telepsychotherapy, (viii) telemedicine, (ix) online nutritionist and (x) online fitness coach. This questionnaire also asked about exercise habits: (xi) frequency of exercise during quarantine in days, (xii) whether there were changes in the frequency of exercise comparing before and during quarantine (options were "no changes"; "increased exercise frequency" and "decreased exercise frequency") and (xiii) types of exercise (aerobic, anaerobic, both, no exercise). It also collected data regarding diet and nutritional habits: (xiv) possible changes on diet by comparing before and during quarantine; whether the person (xv) gained or (xvi) lost more than 5 kilograms since the beginning of the quarantine. Finally, attitudinal questions were also computed. One question (xvii) asked about the amount of information the participant felt he/she was receiving and the answers were provided in three possible categories to choose from: "Too much information", "Enough information" and "Little information".

Another three items were informed in a five-point Likert-type scale ranging from 1 "Totally agree" to 5 "Totally disagree"; the items were: (xviii) "Do you feel imprisoned due to this quarantine?", (xix) "Do you feel you are able to understand what is happening?", (xx) "Do you trust your own ability to differentiate good from bad sources of information?".

The PSS-10 (*Cohen & Williamson, 1988*) is a 10-item questionnaire that asks individuals about their perception regarding stress-like symptoms. It is answered in a five-point Likert-type scale ranging from 0 "Never" to 4 "Very often" (scores range from 0-40). The population mean is 17.0 (SD = 5.02) with a score over 27 indicating excessive stress (*Cacciari, Haddad, Dalmas, 2016*). The FDI (Filgueiras et al., 2014) is a 20-item scale that asks individuals to grade the level of association between the respondent's own self-perception and one-word items extracted from depression symptoms listed in the DSM-V in the last fortnight. It is rated in a six-point Likert-type scale ranging from 0 "not related to me at all" to 5 "totally related to me" (scores range from 0-100). The reference mean is 53.3 (SD = 17.3) with 88 or higher indicating a cut-off for depressive symptomology (*Filgueiras et al., 2014*). The S-STAI (Spielberg, Gorsuch & Lushene, 1970) is a subscale of a broader questionnaire that assess state (one's current mood state) and trait (dispositional and personality-related traits) anxiety. The focus of S-STAI is the mood state of the respondent who answers questions about own feelings in a four-point Likert-type scale ranging from 1 "not at all" to 4 "very much so" (scores range from 0-80). Gender-specific reference means are 36.5 (SD = 21.4) for men and 43.7 (12.6) for women, with cut-offs being 66 for men and 69 for women (*Pasquali, Pinelli Jr, Soha, 1994*).

Volunteers of the present research answered the questionnaires in the Google Forms online platform that was configured in the same order of presentation: 1) Term of Consent, 2) demographic and attitudinal questionnaire, 3) PSS-10, 4) FDI, 5) S-STAI, 6) Thank you page. Those participants who answered "no" to the Term of Consent were addressed to the Thank you page without having any contact with the other questionnaires. First round of data collection (time 1) took place between March 20th and March 25th, 2020, whereas the second round (time 2) happened between April 15th and April 20th, 2020.

After data collection, Google Spreadsheets were utilized to consolidate the database and to export it in the format .csv. Then, researchers used SPSS (IBM, version 21.0) to run the analyses. Descriptive statistics of PSS-10, FDI and S-STAI were calculated for each categorical (demographic) variable with exception of those that were answered in Likert-type scales. Due to the large amount of variables collected in an online platform, Cronbach's alpha (α) was calculated for the three scales in time 1 and time 2; results were expected to show $\alpha > .70$. Pairwise *t*-test comparisons between groups were computed to identify significant differences between the first round (time 1) and second round (time 2) of data collection for the whole sample. A repeated-measures ANOVA was performed to compare within and between groups for each demographic independent variable. Furthermore, prevalence of stress, depression and anxiety-like symptoms were calculated in percentage of participants above the means and cut-off

points respective to the norms developed in previous studies in the Brazilian sample (*Cacciari, Haddad & Dalmas, 2016; Filgueiras et al., 2014; Pasquali, Pinelli Jr & Solha,1994*).

A correlation matrix of the PSS-10, FDI and S-STAI results at time 1 and time 2 were developed to identify possible discrepancies, associations and to ensure measure validity. The authors opted to compute three Linear Multiple Regressions (LMR) using the stepwise method to find the strength and ability of independent variables (i.e., demographic, behavioural and attitudinal) to predict PSS-10, FDI and S-STAI total scores in time 2. Total scores of mental health questionnaires in time 1 were put in the first step of the LMR, and the other variables were put in the second step. Categorical items were identified as dummy variables, whereas Likert-type answers were computed as ordinal data. The criterion for keeping a variable in the regression was the same as all other null-hypothesis tests (i.e., pairwise *t*-test and repeated-measures ANOVA); significance was deemed when $p<0.05$. The coefficient beta (β) was inspected to reveal the direction and strength of the association between independent and dependent variables; whereas the coefficient of determination (r^2) revealed the amount of variance explained by the model.

Finally, effect-sizes for the *t*-test of the LMR and the repeated-measures ANOVA (between, within and interaction) were calculated using the software G*Power 3.1 that also provided the interpretation criteria. The *t*-test effect-size was measured by the Cohen's *d*, rule of thumb for this measure is: above 0.20 and below 0.50, the effect is small, above 0.50 and below 0.80, the effect is moderate, above 0.80 the effect is large. The repeated-measure ANOVA effect-size was measured by Cohen's *f* and categorization goes as follows: above 0.10 and below 0.30, the effect is small, above 0.30 and below 0.50 the effect is moderate, and above 0.50 the effect is large.

Results

Participants reported an age average of 37.90 (SD=12.33) years and were in quarantine for 3.52 (SD=1.77) days in the first round of data collection and 19.08 (SD=3.86) days in the second round. Regarding Education, 98 volunteers reported to have either begun or finished high school (27.2%), 175 had at least began College (48.6%), 57 were attending to a Master's course (15.8%) and 30 (8.3%) had begun their PhD.

Participants reported changes in diet during the second round of data collection in reference to the first round. One hundred and sixteen participants (32.2%) reported to have worsened their diets from time 1 to time 2, 59 (16.4%) reported no significant changes in diet habits, whereas 185 (51.4%) answered that they were having a better diet than when they began quarantine.

At time 1, those reporting no exercise were 219 (60.8%), 1-to-3 days a week N=72 (20.0%) and 4 or more days a week N=69 (19.2%). At time 2, no exercise was 69 (19.2%), 1-to-3 days a week N=14 (3.9%) and 4 or more days of exercise N=277 (76.9%). No one reported exercising 7 days a week. This was in contrast to *perceptions* of change in exercise. One hundred eleven (30.8%) of respondents reported exercising less, 147 (40.8%) reported the same level of exercise and 102

(28.3%) reported more exercise. The percentage of women and men who did tele-psychotherapy was 72.8% and 27.2%, respectively.

Even though data collection used an online platform and participants had to answer a large amount of questions, Scales were reliable according to the adopted criterion ($\alpha > .70$) in both time 1 and 2. The PSS-10 had $\alpha = .855$ in the first round and $\alpha = .834$ in the second round. The FDI presented $\alpha = .911$ and $\alpha = .954$ in times 1 and 2, respectively. The SSTAI showed $\alpha = .759$ in the first time period and $\alpha = .713$ in the second time period.

Table 1 depicts average and standard deviation (SD) of PSS-10, FDI and S-STAI stratified by the independent variables at time 1 and time 2. Mental health variables worsened significantly from the first round of data collection to the second, *i.e.*, stress ($p = .007$), depression ($p = .00003$) and anxiety ($p = .004$). Repeated-measures ANOVA revealed that within-group effects were significant for all outcomes (criterion $p < .05$) demonstrating that from time 1 to time 2 there was an increase in stress, depression and anxiety. Across all mental health outcome variables, significant between-group effects were observed for the following 3 predictors: 1. gender (women had significantly higher scores than men), 2. changes in diet (participants who felt that their diet worsened reported increased levels of psychological issues), and 3. amount of information (those who reported to receive too much information about COVID-19/quarantine also showed greater mental health dysfunction). Effect sizes ranged from .01 to .51. A gender *x* time interaction was observed ($p = .0000008$) for perceived stress. Men did not change in stress level but women had a significant increase (effect size = .28).

Beyond those three variables, between groups significant differences regarding perceived stress occurred for four other variables: number of days of exercise per week, type of exercise, use of online fitness coaching and risk for COVID-19. Regarding depression, statistical differences appeared in four other variables: education, type of exercise, use of online nutritionists and use of tele-psychotherapy. Finally, regarding anxiety, between groups significant differences were shown in two other variables: risk for COVID-19 and use of tele-psychotherapy. Results for the repeated-measures ANOVA are depicted in the supplemental material.

PLEASE, INSERT TABLE 1 ABOUT HERE

For perceived stress, 237 (65.8%) and 269 (74.7%) of participants scored above the population mean at time 1 and 2, respectively. Prevalence of excessive stress ($\geq$2 SD above reference mean) was 6.9% (IC 95 5.2%-8.6%) in the first round and 9.7% (IC 95 8.2%-11.2%) in the second round. Of the 34 individuals in this category, 94% of these individuals were women. 82% did no exercise at all, but the remaining 18% complete 6 days a week of exercise. Also, 0% utilized tele-psychotherapy. Regarding depression, 224 (62.2%) and 260 (72.2%) of participants were above the reference mean at Time 1 and 2, respectively. High depression ($\geq$2 SD above reference mean) had a prevalence of 4.2% (IC 95 3.6%-4.8%) at time 1 and 8.0% (IC 95 7.1%-8.9%) at

time 2. Participants > 2 SD (n = 24) were mostly women (88%) and did not utilized tele psychotherapy (88%). The number of male participants above the reference mean for state anxiety was 54 (48.2%) and 72 (64.3%) at time 1 and 2, respectively. For women it was 132 (53.2%) and 163 (65.7%). Prevalence of excessive state anxiety ($\geq$2 SD above reference mean) was 8.7% (IC 95 7.4%-10.0%) in the first round against 14.9% (IC 95 12.3%-17.5%) in the second round. Those > 2 SD had worsening diet (45 of 53 participants) and reported no tele-psychotherapy (81%).

Correlations between mental health variables were all statistically significant, but varied between small and moderate at time (r=.33 - .50) at time 1 and small (r = .20 - .27) at time 2. The intertemporal correlations from time 1 to time 2 for stress, depression and anxiety were .61, .69 and .79, respectively. Small correlations were found between different predictor variables, such as exercise frequency and perceived stress (r = -.28); whereas, moderate correlations were found between the same variable between time 1 and time 2 (intertemporal correlations). Tables 3 and Supplemental 2 provide the correlation matrix of the psychological variables.

PLEASE, INSERT TABLE 2 ABOUT HERE

The linear multiple regression (LMR) model for perceived stress revealed that the dependent variable (PSS-10, time 2) was predicted by the score of the PSS-10 at time 1, number of days of exercise, risk for COVID-19, types of exercise, changes in the frequency of exercise, feeling imprisoned, days in quarantine and gender in order of strength of the coefficient β. Altogether, those variables explained 56% of the variance. The depression LMR showed that the dependent variable (FDI time 2) was predicted by the score of the FDI time 1, types of exercise, own ability to understand what is happening, level of education and gender respectively. Independent variables explained 33% of the variance of depression in the second round of data collection. Finally, the state anxiety LMR depicted that the dependent variable (S-STAI time 2) was predicted, in order of association, risk for COVID-19, feeling safe, the score of S-STAI time 1, weight loss, changes on diet, amount of information, feeling imprisoned and age. Independent variables of this LMR explained cumulatively 42% of the variance. Table 3 presents the coefficient β, the t-test statistics, effect-size and coefficient of determination for the three LMR.

PLEASE, INSERT TABLE 3 ABOUT HERE

Discussion

The current investigation provides a unique glimpse into the mental health of Brazilians in the midst of quarantine from the COVID-19 pandemic, a novel, disruptive and society-wide stressor. Findings indicate that a substantial portion of respondents were distressed at both time points,

with worsening mental health from the initiation of quarantine to a point one month later. More specifically, increases in perceived stress, depression and state anxiety were observed, with a gender x time interaction recorded for stress. Men experienced increases in depression and anxiety over time, but not for perceived stress. Across genders, the number of days in quarantine was linearly related to worse perceptions of perceived stress. Repeated measures ANOVA revealed that 3 factors were all related to worse levels of stress, depression and anxiety: female gender, worsening diet and excess of COVID-19 information. In regression analyses, however, mental health outcomes were influenced by a variety of other demographic, COVID-19 specific, and behavioural factors, such as use of tele-psychotherapy. Exercise-related factors, such as exercise frequency, were the predominate predictors of perceived stress.

A substantial portion of the participants reported levels of stress, depression and anxiety above established means for the population. At time 2, greater than 70% of the sample was above the normative mean for both stress and depression. For anxiety, >60% of both men and women were above the normative mean. More importantly, some participants scored very high for mental health disturbances, especially at time 2. For stress, 9.7% of the sample was above 2 SD at time 2, whereas the prevalence according to the Brazilian norms is 6.8% (*Cacciari, Haddad & Dalmas, 2016*). This was an increase from 6.9% at time 1. Similar trends were seen for depression (4.2% at time 1, 8.0% at time 2; versus a norm of 4.1%) (*Filgueiras et al., 2014*) and state anxiety (8.7% increasing to 14.9%; versus a norm of 9.4%) (*Pasquali, Pinelli Jr & Solha,1994*). This is similar to anxiety levels observed in a large sample during quarantine in China (*Hu, Su et al., 2020*). While the percentage of individuals scoring at these extremes is still relatively low, it potentially represents a huge increase in burden to society when multiplied across the entire population. Mental health initiatives on the national level would have to be scaled up to meet new demand (*WHO, 2008*). Key to this endeavour would be a) identifying those most at risk and b) properly assessing their condition.

In the effort to identify those most at risk, pertinent predictors of mental health outcomes were analysed. Interestingly, each mental health indicator was predicted by a varying set of factors. Anxiety was predicted by the greatest number of COVID-19 related factors: feelings of safety, feelings of being imprisoned, risk for COVID-19 and amount of information. In other words, those who felt unsafe, cooped up, at risk for infection and being inundated with information demonstrated higher levels of anxiety. This falls in line with an expansive literature reporting that feelings of anxiety burgeon when people feel under threat, unsafe, and have too many options and an uncertain future (Carreta et al., 2014; Gilbert et al., 2008). Depression, a typically condition of regrets about the past (Buechler, 2015), was understandably not predicted by COVID-19 related factors. Only “understanding what is happening” was a significant inverse predictor. Stress was predicted by feelings of being imprisoned, days in quarantine and risk for COVID-19 and also by a number of exercise factors.

In general, exercise was associated with mental health outcomes in the expected manner – more frequent exercise and aerobic exercise being related to the lowest levels of distress. For all 3

mental health outcomes, those with no exercise (0 days per week) had the highest average levels of stress (22.9 at time 1 to 26.4 at time 2), depression (69.0 to 74.6) and anxiety (48.2 to 54.7). These seems to support the previous findings that "something is better than nothing" (Ekkekakis, 2000; Werneck, Oyeyemi, Silva, 2018). In linear regression, perceived stress was related to the greatest number of exercise-related factors: exercise frequency per week, type of exercise and perceived changes in exercise behaviour. Higher frequency of exercise (days/week) were associated with *less* stress. However, the linear relationship between perceived stress and exercise frequency was small (r = -.28), which is line with previous investigations (Stults-Kolehmainen & Sinha, 2014). It should be noted that 58.2% of the sample reported that they perceived that their exercise behaviour changed with a month of quarantine (30.8% doing less and 28.3% doing more), which follows the known phenomenon that stressful events can either inhibit or activate changes in exercise behaviors (Stults-Kolehmainen & Sinha, 2014). Furthermore, those who *perceived* that they exercised more frequently from Time 1 to Time 2 had less stress. Interestingly, of those very high for stress (< 2SD), 82% do no exercise at all, but the remaining 18% complete 6 days a week of exercise. In LMR analysis, exercise factors explained 13.1% of the adjusted variance in stress. For repeated measures, the results were slightly different, with changes in exercise not being significant, but use of online fitness coaching reaching significance. An interaction was observed in that those who performed aerobic exercise had the lowest levels of depression at both time points. In fact, those who did aerobic exercise did not have any increase in depression. However, the clearest association of exercise frequency and mental health was for anxiety. Those at the highest levels of exercise had the lowest anxiety and each day less was associated with more anxiety.

Aside from exercise, there were notable findings for dietary habits and use of tele-psychotherapy. Those who rated their dietary habits as becoming worse also had the highest levels of stress, depression and anxiety. Those with the highest levels of anxiety were those with worsening diet at the second time point (effect size for interaction was .37). Those who used online nutrition services had lower levels of depression, but there was no difference for stress or anxiety. Those who utilized online psychotherapy reported lower levels of depression and anxiety. While there is no income data to explain use of online resources, those using online resources were more educated. Thus one might surmise that those from better off demographic groups are less affected partly because of greater access to resources. Given the limited quantity of resources to mitigate mental health impairments during crises, such as pandemic and quarantine, it is crucial to identify the risk factors that may predispose individuals for worsening outcomes.

Despite the progress this study makes in tracking changes in mental health and identifying risk factors, the current research does demonstrate some limitations. First of all, there was no pre-quarantine baseline and assessments spanned just a single month. Furthermore, this was a relatively well-off population with higher-educated individuals being over-represented in the sample. There was no measure of adherence to quarantine guidelines. It is possible that those with higher compliance to regulations could be of either higher or lower distress. To lessen

survey fatigue for participants, validated measures of exercise and dietary habits, which can be very lengthy, were not utilized. More importantly, the current data needs interpreted with some caution because factors other than quarantine could contribute to changes in the mental health outcomes observed, such as growing political and economic unrest in Brazil (*THE LANCET, 2020*). Also, it should be noted that effect sizes for changes over 1 month were small (Cohen's d were .25 – stress, .30 – depression, and .38 – anxiety), possibly because in some cases individuals had improved mental health (n = 31; 8.6%) due to quarantine conditions, such as being closer to loved ones throughout the day or being removed from dangerous work environments. Lastly, correlations between instruments at time 1 or time 2 were small – possibly indicating the uniqueness of the quarantine as a stressor, particularly given the rapidly changing circumstances during this time period (Main, Zhou et al., 2011).

Conclusion

This study provides crucial data needed to understand how pandemic, state-mandated quarantine is related to changes in mental health outcomes. From the time point when quarantine was decreed until 1 month later, worsening perceived stress, depression and anxiety was observed in this sample of the Brazilian population. Moreover, many individuals in the sample reported very high levels of distress (> 2 SD). At the time of writing of this study, the quarantine is still being enforced and cases of COVID-19 and associated deaths on rising rapidly (*THE LANCET, 2020; Imperial College COVID-19 Response Team, 2020*). Future research should continue to track these trends as the crisis unfolds. Analyses from this study identified several risk factors for mental health, including gender (being female), lower education, less exercise, worsening diet and a lack of resources, such as access to tele-psychotherapy. COVID-19 related factors predicted anxiety and stress more so than depression. The implications of these data is clear; mental health worsens with great change, requiring more resources to improve the experience of life in quarantine. The extent to which these can be diligently developed and allocated will depend on a data-driven process such as described here.

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Conflict of interest

Authors report no conflict of interest.

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Table 1.

Psychosocial variables: Perceive Stress, Depression and Anxiety symptoms by demographic and behavioural independent variables.

Independent Variables	Psychosocial Variable					
	Perceived Stress (PSS-10)		Depression (FDI)		State Anxiety (S-STAI)	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Whole Sample (*N*=360)	20.54 (6.99)	22.03 (6.45)**	65.32 (24.96)	70.31 (25.44)***	43.61 (21.51)	49.88 (20.13)**
Gender						
Men (*N*=112)	17.87 (7.59)	17.28 (5.85) †	54.98 (23.75)	59.79 (25.42)**	36.53 (21.52)	45.87 (22.01)***
Women (*N*=248)	21.75 (6.35)	24.18 (5.50)***	69.98 (24.12)	75.06 (24.03)**	46.81 (20.77)	51.69 (18.98)**
Education						
High School (*N*=98)	20.94 (7.04)	22.73 (6.19) *	74.46 (23.67)	80.91 (21.38)**	46.40 (22.32)	53.36 (20.56)***
Bachelor Degree (*N*=175)	22.33 (6.91)	21.30 (6.38) *	61.51 (24.67)	67.27 (24.78)**	41.55 (20.69)	48.21 (19.46)***
Master's Degree (*N*=57)	21.39 (7.05)	23.14 (6.39) †	64.16 (24.22)	65.05 (27.52) †	45.82 (21.74)	49.32 (20.24) †
Doctorate (*N*=30)	19.74 (6.91)	21.87 (7.49) †	59.83 (25.53)	63.43 (28.24) †	42.30 (22.77)	49.30 (21.83) *
Changes in Diet						
For worse (*N*=116)	21.23 (7.26)	23.26 (6.61)***	72.78 (26.04)	76.40 (23.52)**	54.41 (22.24)	67.47 (13.73)***
No changes (*N*=59)	21.05 (6.45)	22.95 (5.53) *	67.39 (24.15)	71.12 (25.97) †	46.76 (21.15)	47.49 (17.15) †
For better (*N*=185)	19.95 (6.96)	20.97 (6.47) *	59.98 (23.31)	66.24 (25.77)***	35.83 (17.76)	39.60 (16.63)**
Changes in Exercise Frequency						
Fewer days (*N*=111)	20.69 (7.79)	21.29 (7.35) †	63.19 (25.05)	69.33 (25.65)**	43.27 (22.96)	51.41 (22.13)**
Same frequency (*N*=147)	20.47 (6.60)	21.97 (6.31)*	65.71 (25.29)	70.88 (25.32) *	42.97 (21.00)	48.67 (19.13) *
More days (*N*=102)	20.48 (6.67)	22.78 (5.52)**	67.06 (24.96)	70.55 (25.61) *	44.90 (20.76)	49.95 (19.31) *
Days of Exercise						
0 days (N=69)	22.91 (7.70)	26.41 (7.57)***	69.03 (25.24)	74.58 (24.82)**	48.23 (21.90)	54.67 (20.52)**
3 days (N=34)	16.86 (7.47)	17.40 (7.18) †	62.71 (26.21)	69.79 (26.08) *	46.93 (25.72)	55.43 (21.02) †
4 days (N=135)	21.38 (7.47)	21.73 (5.75) †	64.54 (25.07)	69.25 (25.35) *	43.26 (21.60)	50.85 (19.58)***
5 days (N=80)	19.88 (6.62)	21.44 (4.83) *	66.70 (23.18)	70.60 (24.91) *	41.92 (19.64)	46.24 (18.48) *
6 days (N=42)	20.29 (5.34)	22.21 (4.35) †	59.29 (27.59)	66.19 (25.44) *	40.05 (23.06)	45.67 (23.02)**
Type of Exercise						
Aerobic (N=107)	20.51 (7.01)	20.74 (6.04) †	59.36 (23.56)	60.23 (26.28) †	42.08 (21.07)	47.21 (20.39) *
Anaerobic (N=122)	20.00 (6.36)	21.11 (5.46) *	67.17 (24.85)	75.21 (23.30)***	43.21 (21.25)	50.04 (18.82)***
Both (N=62)	19.02 (6.80)	21.21 (6.80) *	67.81 (25.82)	74.58 (24.82) *	41.87 (22.14)	48.81 (21.21) *
None (N=69)	22.91 (7.70)	26.41 (7.57)***	69.03 (25.24)	74.58 (24.82)**	48.23 (21.90)	54.67 (20.52)**
Amount of information						
Few information (*N*=18)	20.78 (7.89)	21.39 (6.56) †	60.78 (28.74)	66.17 (28.86) †	34.11 (18.05)	37.67 (19.05)**
Enough information (*N*=153)	19.50 (6.76)	20.75 (6.30) *	61.52 (23.62)	66.22 (26.54) *	33.68 (17.63)	37.26 (16.16)**
Too much information (*N*=189)	21.36 (7.01)	23.13 (6.39)**	68.83 (25.26)	74.02 (23.71)**	52.55 (20.83)	61.25 (16.10)***
Use of telemedicine						
Yes (*N*=40)	22.05 (6.73)	22.43 (5.16) †	63.58 (24.82)	66.88 (24.72) †	41.05 (17.36)	47.65 (17.89) *
No (*N*=320)	20.35 (7.01)	21.98 (6.60)**	65.53 (25.01)	70.74 (25.53)**	43.93 (21.98)	50.15 (20.40)***
Use of online nutrition						
Yes (*N*=86)	20.89 (6.78)	22.09 (6.42)**	67.56 (24.83)	72.11 (25.63)**	44.89 (21.79)	48.16 (19.77)**
No (*N*=274)	19.43 (7.54)	21.83 (6.58)**	58.17 (24.15)	64.59 (24.10)**	39.52 (20.20)	55.35 (20.39)***
Use of online fitness coaching						
Yes (*N*=142)	20.97 (6.86)	22.74 (6.59)**	65.82 (24.85)	70.82 (25.78)**	43.17 (21.46)	49.99 (20.27)**
No (*N*=218)	19.89 (7.15)	20.94 (6.09)**	64.55 (25.20)	69.53 (24.99)**	44.28 (21.66)	49.70 (19.97) *
Use of telepsychotherapy						
Yes (*N*=136)	20.57 (6.52)	21.94 (6.24)**	61.88 (23.12)	64.72 (24.04) *	42.54 (21.12)	47.46 (19.67)**
No (*N*=224)	20.52 (7.27)	22.08 (6.59)**	70.97 (26.87)	79.51 (25.09)**	45.38 (22.11)	53.85 (20.30)**
Risk for COVID-19						
Yes (*N*=98)	23.59 (6.79)	27.14 (6.14)**	66.49 (25.21)	72.32 (25.58)**	48.96 (21.10)	58.74 (18.36)**
No (*N*=262)	19.40 (6.73)	20.12 (5.45) *	64.88 (24.90)	69.56 (25.40)**	41.61 (21.36)	46.56 (19.78)**

Note: * $p<0.05$; ** $p<0.01$; ***$p<0.001$; † non-significant difference

Table 2.

Correlation matrix of psychosocial variables: Perceive Stress, Depression and Anxiety symptoms by time of data collection. Time 1 comprises data collection between March 20th and 25th, while Time 2 entails data collection between April 15th and 20th

Variables	Data Collection	Correlation Matrix					
		PSS-10		FDI		S-STAI	
		Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
Perceived Stress (PSS-10)	Time 1	1.00	0.61**	0.33**	0.26**	0.35**	0.13*
	Time 2		1.00	0.24**	0.20**	0.31**	0.22**
Depression (FDI)	Time 1			1.00	0.79**	0.50**	0.29**
	Time 2				1.00	0.46**	0.27**
State Anxiety (S-STAI)	Time 1					1.00	0.69**
	Time 2						1.00

Note: * $p < 0.05$; ** $p < 0.01$

548 **Table 3.**

549 Separate stepwise LMR using demographic and behavioural variables to predict Perceived
550 Stress, Depression and Anxiety symptoms. The table provides the coefficient of regression (β),
551 the t-test and effect-size. Additionally, results present the coefficient of determination (r^2) to
552 assess the amount of variance explained by models.

Variable	Multiple Linear Regression Statistics			
	β	t-test	effect-size	r^2
Perceived Stress (PSS-10) time 2				0.56
(Intercept)	1.13	0.67	0.20	
PSS-10 time 1**	3.78	4.98	0.62	
Gender*	0.35	2.03	0.25	
Feeling Imprisoned*	1.28	1.97	0.16	
Days in quarantine*	0.75	2.02	0.20	
Days of exercise**	3.46	3.38	0.53	
Types of exercise**	2.41	3.95	0.56	
Risk for COVID-19**	2.87	4.77	0.59	
Changes in freq. Exercise*	-1.54	2.01	0.13	
Depression (FDI) time 2				0.33
(Intercept)**	-9.02	4.97	0.60	
FDI time 1**	3.75	5.76	0.42	
Gender*	0.48	1.98	0.18	
Types of exercise**	2.54	3.41	0.34	
Understanding*	-1.87	1.99	0.19	
Education*	-0.96	2.08	0.33	
State Anxiety (S-STAI) time 2				0.42
(Intercept)	-9.41	1.14	0.40	
S-STAI time 1**	3.41	4.71	0.37	
Change on diet**	-2.65	3.62	0.14	
Weight Loss**	2.90	2.01	0.10	
Age*	0.20	3.59	0.50	
Feeling Safe**	-3.90	3.89	0.44	
Feeling Imprisoned*	1.05	2.59	0.70	
Risk for COVID-19**	4.75	3.65	0.34	
Amount of information*	2.18	1.98	0.11	

553 *Note:* * p <0.05; ** p <0.01

554

555 **Supplemental Material 1.**

556 Results of repeated-measures ANOVA with F-statistics, degree of freedom (df), p-value and
557 effect size for each psychosocial factor (stress, depression and anxiety) by demographic and
558 behavioural variables separately.

Variable	Repeated-measures statistics											
	Perceived Stress (PSS-10)				Depression (FDI)				State Anxiety (S-STAI)			
	F-statistics	df	*p*-value	effect-size	*F*-statistics	df	*p*-value	effect-size	*F*-statistics	df	*p*-value	effect-size
Gender												
Between	74.50		<0.001	0.28	33.97		<0.001	0.09	14.19		<0.001	0.11
Within	7.70	1.358	<0.010	0.23	28.17	1.358	<0.001	0.29	57.61	1.358	<0.001	0.35
Interaction	20.74		<0.001	0.53	0.02		=0.882	0.01	5.67		<0.050	0.03
Educatiom												
Between	1.91		=0.127	0.02	8.29		<0.001	0.06	1.50		=0.214	0.03
Within	9.08	1.356	<0.005	0.17	15.73	1.356	<0.001	0.13	31.63	1.356	<0.001	0.20
Interaction	1.21		=0.307	0.01	1.66		=0.175	0.02	0.64		=0.589	0.01
Changes on Diet												
Between	3.70		<0.050	0.13	8.75		<0.001	0.18	74.06		<0.001	0.37
Within	22.13	1.357	<0.001	0.29	22.42	1.357	<0.001	0.12	39.45	1.357	<0.001	0.51
Interaction	1.17		=0.311	0.04	1.14		=0.320	0.04	16.50		<0.001	0.25
Changes on Frequency of Exercise												
Between	0.54		=0.581	0.02	0.35		=0.703	0.01	0.29		=0.748	0.01
Within	21.66	1.357	<0.001	0.13	32.01	1.357	<0.001	0.11	50.78	1.357	<0.001	0.17
Interaction	1.21		=0.298	0.04	0.72		=0.490	0.03	1.07		=0.345	0.03
Number of days of exercise per week												
Between	12.17		<0.001	0.32	1.06		=0.378	0.04	2.19		=0.070	0.08
Within	13.99	1.355	<0.001	0.37	23.16	1.355	<0.001	0.16	30.11	1.355	<0.001	0.23
Interaction	3.21		<0.050	0.09	0.34		=0.851	0.01	0.64		=0.634	0.02
Type of exercixe												
Between	9.68		<0.001	0.21	6.01		<0.001	0.22	1.95		=0.121	0.08
Within	29.53	1.356	<0.001	0.18	31.73	1.356	<0.001	0.11	48.16	1.356	<0.001	0.19
Interaction	4.78		<0.005	0.11	3.82		<0.050	0.08	0.25		=0.862	0.01
Amount of information												
Between	81.34		<0.001	0.11	5.39		<0.050	0.09	4.65		<0.050	0.09
Within	13.82	1.357	<0.001	0.13	5.45	1.357	<0.050	0.10	12.92	1.357	<0.001	0.48
Interaction	4.37		<0.050	0.12	0.54		=0.585	0.06	0.042		=0.958	0.01
Use of telemedicine												
Between	1.12		=0.290	0.04	0.53		=0.467	0.03	0.70		=0.402	0.03
Within	4.00	1.358	<0.050	0.09	9.63	1.358	<0.001	0.11	21.26	1.358	<0.001	0.19
Interaction	1.56		=0.212	0.03	0.48		=0.487	0.03	0.02		=0.893	0.01
Use of online nutrition												
Between	1.35		=0.246	0.06	8.39		<0.050	0.09	0.15		=0.700	0.08
Within	23.86	1.358	<0.001	0.18	29.48	1.358	<0.001	0.25	96.91	1.358	<0.001	0.28
Interaction	2.61		=0.107	0.06	0.86		=0.355	0.03	41.93		<0.001	0.35
Use of online fitness coaching												
Between	4.95		<0.050	0.08	0.25		=0.619	0.03	0.04		=0.841	0.02
Within	19.25	1.358	<0.001	0.14	32.02	1.358	<0.001	0.21	46.91	1.358	<0.001	0.32
Interaction	1.23		=0.268	0.04	0.01		=0.988	0.01	0.61		=0.436	0.03
Use of telepsychotherapy												
Between	0.01		=0.944	0.01	22.49		<0.001	0.22	4.99		<0.050	0.07
Within	20.29	1.358	<0.001	0.26	42.18	1.358	<0.001	0.31	55.87	1.358	<0.001	0.40
Interaction	0.09		=0.765	0.06	10.59		<0.001	0.33	3.93		<0.050	0.07
Risk for COVID-19												
Between	74.48		<0.001	0.37	0.60		=0.440	0.02	19.60		<0.001	0.10
Within	37.98	1.358	<0.001	0.18	29.46	1.358	<0.001	0.13	57.28	1.358	<0.001	0.47
Interaction	16.74		<0.001	0.19	0.35		=0.555	0.03	6.17		<0.050	0.09

559 Note: Cohen's f interpretation is as follows above 0.10 and below 0.25, small effect-size, above 0.25 and below 0.40, moderate effect size, and above 0.40, large effect-size.

560

561 **Supplemental Material 2.**

562 Spearman-rho correlation matrix between psychosocial variables: Perceived Stress, Depression
563 and Anxiety symptoms, demographic and behavioural variables.

Variables	Correlation Matrix (Spearman-rho)									
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
1. Perceived Stress (PSS-10) time 2	1.00	0.19**	0.22**	-0.16**	-0.03	-0.02	-0.07	0.22**	-0.28**	0.48**
2. Depression (FDI) time 2		1.00	0.25**	-0.17**	0.02	-0.13*	0.02	0.20**	-0.06	0.05
3. State Anxiety (S-STAI) time 2			1.00	-0.61**	-0.10	-0.44**	-0.03	0.11*	-0.17**	0.27**
4. Changes in Diet				1.00	0.28**	-0.30**	0.07	-0.14*	0.18**	-0.18**
5. Weight Gain					1.00	-0.10	0.02	-0.02	-0.04	-0.10
6. Weight Loss						1.00	-0.12*	-0.05	0.01	-0.08
7. Changes in Exercise Frequency							1.00	-0.30**	0.31	-0.19**
8. Type of Exercise								1.00	-0.56**	0.22**
9. Number of Days of Exercise per week									1.00	-0.27**
10. Risk for COVID										1.00

Note: Psychological variables comprise only data from the second round of data collection. For the correlation between time 1 and time 2, please see table 3. * p <0.05; ** p <0.01

564