

# Factors associated with depression, anxiety and stress among dentists during the COVID-19 pandemic

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**Declaration of Interests:** The authors certify that they have no commercial or associative interest that represents a conflict of interest in connection with the manuscript.

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<https://doi.org/10.1590/1807-3107bor-2021.vol35.0084>

Submitted: March 19, 2021  
Accepted for publication: June 2, 2021  
Last revision: June 24, 2021

**Abstract:** The objective of this work was to evaluate the relationship between factors associated with the COVID-19 pandemic and depression, anxiety, and stress (DAS) in dentists. Factors associated with the COVID-19 pandemic were evaluated using a questionnaire and scores of the Depression, Anxiety, and Stress Scales-21 were measured. The differences between the DAS scores based on the factors associated with the COVID-19 pandemic were tested through the successive application of multivariate analysis of variance (MANOVA,  $\alpha = 0.05$ ). After a sample size calculation, 998 participants with a mean age of 39.39 ( $\pm 11.69$ ) years were included. The effect size indicated that changes in sleep quality ( $\eta^2 = 0.161$ ), eating habits ( $\eta^2 = 0.057$ ), and physical health ( $\eta^2 = 0.051$ ) were the ones that most negatively affected DAS scores. The highest DAS scores were observed in professionals who lived with someone at high-risk for COVID-19 ( $p < 0.001$ ) and in those who did not engage in leisure activities during the pandemic ( $p < 0.001$ ). Dentists who worked on the frontline against COVID-19 had higher scores of anxiety and stress ( $p = 0.029$ ). The highest scores for anxiety, depression, and/or stress were seen in dentists living with someone at high-risk for COVID-19, who acts on the frontline, who does not practice in leisure activities during the pandemic, who completely changed eating habits, quality of sleep and physical health during the pandemic. In general, DAS levels of dentists were associated with factors related to the COVID-19 pandemic.

**Keywords:** COVID-19; Depression; Anxiety; Stress, Psychological; Dentists.

## Introduction

According to the COVID-19 panel of the Center for Systems Science and Engineering at Johns Hopkins University, in August 2020, Brazil was the second country in the world with the largest number of confirmed cases with more than 120 thousand deaths, second only to the United States.<sup>1</sup> In addition, the World Health Organization situation reports for the month of July 2020 showed that Latin America was the new epicenter of the COVID-19 pandemic in the world, with Brazil reporting the highest number of cases and deaths in the region.<sup>2</sup>



Although several studies have demonstrated the effectiveness of social distancing in controlling the spread of COVID-19,<sup>3-6</sup> Brazil is a continental country with urban characteristics—such as large low-income urban conglomerates<sup>7</sup> and a large number of informal and unemployed workers<sup>8</sup>—that hinder the effectiveness of social distancing in controlling the spread of the virus.

In addition, the COVID-19 pandemic showed an important impact on health-related quality of life in different population groups.<sup>9,10</sup> A study carried out in China showed that the risk of discomfort and anxiety/depression was significantly increased in the older population with chronic diseases and/or lower income during the pandemic.<sup>9</sup> Another study evaluated the psychological health of healthcare professionals who treated patients with COVID-19 and showed that these professionals showed worse sleep quality, higher anxiety, and severe depressive symptoms during the pandemic.<sup>10</sup> Although health professionals worldwide have received updated guidance on biosafety protocols, they are under a lot of pressure at the workplace,<sup>11</sup> as many are on the frontline of the pandemic in direct and close contact with infected patients.

Dental health professionals are in close proximity with patients during clinical care. In addition, for dental procedures that generate a large amount of droplets and aerosols, biosafety measures might be less effective in preventing the spread of COVID-19.<sup>12</sup> A previous study recommended that testing for COVID-19 in dental professionals be carried out with the same priority as testing in hospital healthcare professionals.<sup>13</sup> Possibly, the high risk of contamination in the daily lives of dental professionals can affect their psychological health. However, no study has been conducted to date to verify the relationship between factors related to the COVID-19 pandemic and the psychological health of dentists in a given country during the COVID-19 outbreak. Thus, the aim of this nationwide cross-sectional survey was to evaluate the relationship between factors associated with the COVID-19 pandemic and depression, anxiety, and stress (DAS) in Brazilian dentists during the period that the COVID-19 pandemic epicenter was Latin America. The null hypothesis was that there is

no relationship between the factors associated with the COVID-19 pandemic on dentists' DAS.

## Methodology

This nationwide cross-sectional survey was evaluated and approved by the ethics committee on human research of the local University (protocol number: 4.062.728). The research database and the questionnaire in the original language, were published in an open source platform (doi: 10.17605/OSF.IO/U4KTB). The reporting guidelines for the SURvey Reporting GuidelinE (SURGE) were consulted.<sup>14</sup>

The questions were based mainly on three key domains: a) Demographic and social characteristics; b) factors associated with the COVID-19 pandemic; and c) depression, anxiety, and stress assessed by a previously validated questionnaire (DASS-21).<sup>15</sup> The questions were created by the authors and then evaluated by professionals.

### Evaluation by dentists

Five dentists evaluated the questionnaire and were asked to make observations, changes, and suggestions, in addition to pointing out possible flaws.

### Evaluation by education and linguistic specialists

Two professionals evaluated the questionnaire and were asked to make suggestions or corrections about possible difficulties in understanding the questions or response options.

### Evaluation by a psychiatrist

A psychiatrist evaluated the questionnaire and was asked to make observations, modifications, and suggestions on each question so that the research objectives were adequately achieved.

### Evaluation by a statistician specialized in psychometrics

the statistician was asked to make observations, modifications, and suggestions on each question so that the research objectives were adequately achieved.

Finally, the questionnaire was uploaded into the SurveyMonkey<sup>®</sup> Inc. platform (San Mateo, USA) to be answered by the research volunteers.

## Finalisation and application of the questionnaire

### Questionnaire description

To access the questionnaire, the participants had to read the informed consent form and agree to voluntarily participate in the research. The definitive questionnaire contained mandatory questions divided into three sections: a) demographic and social characteristics; b) factors associated with the COVID-19 pandemic, that is, being in the high-risk group for COVID-19, living with a health professional who works on the frontline against COVID-19, living with someone who is at high-risk for the disease, type of dental practice (on the frontline against COVID-19, only in private office, or not currently working), self-perception about being prepared for confronting COVID-19, opinion on social distancing measures, leisure activities, daily routine, physical health, eating habits, sleep quality, losing someone for COVID-19, financial issues, and undergoing psychotherapy; and c) depression, anxiety, and stress, evaluated by a previously-validated questionnaire (DASS - 21).<sup>15</sup> The DASS-21 is a self-reported questionnaire that contains three subscales with a four-point scoring system (0, 1, 2, and 3), varying from 0 (“totally disagree”) to 3 (“totally agree”). Each DASS subscale consists of seven items that assess DAS emotional states. The cutoff points for assessing the severity level were previously established by Lovibond and Lovibond<sup>16</sup> and the total score is calculated by adding the subscale scores. In the final calculation, the total scores for each subscale were multiplied by two.

### Sample calculation and participant recruitment

The sample size was calculated considering the following parameters: effect size  $f^2$  (Pillai's  $V$ ) = 0.017,  $\alpha$  = 0.05, power = 0.95, and number of response variables = 3 (depression, anxiety, and stress). The effect size was defined by means of a preliminary analysis using data from a pilot study carried out on 100 selected dentists, respecting the stratification by dentists' numbers in each Brazilian region. Based on these parameters, a minimum sample size of 998 individuals was estimated. The sample size calculation was performed using the G\*Power software

(Version 3.1.9.2, Germany), and the data from the pilot study did not compose the final sample.

A social media campaign targeting dentists from all over Brazil was created on Instagram® (Facebook, Menlo Park, USA).<sup>17</sup> The campaign started on July 11, 2020, and ran until July 30, 2020. Dentists were invited to participate in an online survey on their psychological health. In addition, individual invitations were sent through an online messaging application (Whatsapp®, Menlo Park, USA), by email, and disseminated by researchers on Facebook® (Menlo Park, USA). In addition, participating researchers shared the invitations on their personal Instagram profiles (feeds and stories) and asked other dentists to help publicize the campaign. The virtual questionnaire was also circulated among dentist groups on the Whatsapp® application. During the data collection period, the number of daily COVID-19 infection cases fluctuated in Brazil. The mean (M) and standard deviation (SD) of the number of cases during the collection period were M = 40.414 (SD = 16.104).<sup>1</sup>

### Data analysis

The data were tabulated and analyzed using IBM SPSS Statistics for Windows (IBM SPSS. 21.0, 2012; IBM Corp, Armonk, USA). Descriptive statistics were used to express the results as relative and absolute frequencies, means and standard deviations (SD), minimum and maximum values, and 95% confidence intervals (95% CI). The differences between the DAS scores based on factors related to the COVID-19 pandemic were tested through the successive application of multivariate analysis of variance (MANOVA). To classify the degree of DAS, a cutoff point based on the study by Lovibond and Lovibond<sup>16</sup> was used. The threshold for statistical significance adopted in all analyses was 5% ( $\alpha$  = 0.05).

## Results

The age of the 998 participants ranged from 22 to 72 years, with a mean age of  $39.39 \pm 11.69$  years and the average training time of  $15.83 \pm 11.96$  years. The distribution of the participants according to sociodemographic and professional characteristics is shown in Table 1. Table 2 shows the distribution

**Table 1.** Sociodemographic and professional characteristics of the sample.

Variable	n	%
Sex		
Female	726	72.7
Male	272	27.3
Age (years)		
≤ 31	342	34.3
32–44	334	33.5
> 44	322	32.3
Civil status		
Single/without partner	459	46.0
Married/with partner	539	54.0
Region of work in Brazil		
North	57	5.7
Northeast	169	16.9
Midwest	90	9.0
Southeast	519	52.0
South	163	16.3
Region of work in the State		
Capital	489	49.0
Metropolitan region	134	13.4
Interior	375	37.6
Religion		
Catholic	614	61.5
Protestant/Evangelical	107	10.7
Spiritist	169	16.9
Others*	108	10.8
Main income provider in the family		
Yes, the only one	199	19.9
Yes, together with someone else	556	55.7
No	243	24.3
Share housing		
No	89	8.9
Yes	909	91.1
Time since graduation (years)		
≤ 7	346	34.7
8–20	330	33.1
> 20	322	32.3
Have specialization		
No	181	18.1
Yes	817	81.9

\*Includes atheists and agnostics.

of the professionals according to factors related to the COVID-19 pandemic.

Table 3 shows the descriptive results of the depression, anxiety, and stress scores. The lowest

**Table 2.** Distribution of study participants according to factors related to the COVID-19 pandemic.

Variable	n	%
Are you in a high-risk group for COVID-19?		
Yes	207	20.7
No	791	79.3
Do you share residence with someone in the high-risk group for COVID-19?		
Yes	420	42.1
No	578	57.9
Do you share residence with a frontline worker against COVID-19?		
Yes	133	13.3
No	865	86.7
Work setting during the pandemic		
On the frontline against COVID-19	165	16.5
Private office	585	58.6
Not working	248	24.8
How do you feel in confronting COVID-19?		
Prepared	376	37.7
Unprepared	530	53.1
Don't know	92	9.2
Do you agree to maintain measures of social distance?		
No	38	3.8
Yes	696	69.7
Partially	264	26.5
Leisure activities during the pandemic		
Active leisure	552	55.3
Passive leisure	417	41.8
No activity	29	2.9
Change of daily routine during the pandemic		
No or little change	298	29.9
Completely changed	700	70.1
Physical health during the pandemic		
Worse/less healthy	512	51.3
No change	355	35.6
Better/healthier	131	13.1
Negative impact of the pandemic on food quality		
No	435	43.6
Yes	340	34.1
Partially	223	22.3
Negative change in sleep quality during the pandemic		
None/rarely	344	34.5
Sometimes	361	36.2
Often/always	293	29.4
Lost someone to COVID-19		
No	726	72.7
Yes, relatives/friends	187	18.7
Yes, others	85	8.5
Negative financial impact due to pandemic		
Yes	525	52.6
No	245	24.5
Partially	228	22.8
Psychotherapy		
Yes, but stopped during the pandemic	244	24.4
Yes, continued during the pandemic	106	10.6
Neither before or during the pandemic	648	64.9

**Table 3.** Descriptive statistics of depression, anxiety and stress scores in Brazilian dentists during the COVID-19 pandemic.

Subscale	Mean	Standard deviation	95%CI	Min-max
Depression	10.63	9.46	10.04–11.22	0.00–42.00
Anxiety	8.85	9.21	8.27–9.42	0.00–42.00
Stress	15.84	10.22	15.21–16.48	0.00–42.00

mean score was observed for the anxiety subscale and the highest for the stress subscale.

The results showed that 47.3% (95%CI: 44.16–50.45) of the participants reported experiencing some degree of depression, 46.3% (95%CI: 43.17–49.45) anxiety, and 47.0% (95%CI: 43.87–50.15) stress.

MANOVA indicated that the following variables were not related to DAS scores: negative financial impact due to the pandemic [F (6, 1988) = 1.181;  $p = 0.314$ ], living with a frontline health professional [F (3, 994) = 1.100;  $p = 0.348$ ], being in the high-risk group for COVID-19 [F (3, 994) = 0.603;  $p = 0.613$ ], losing someone to COVID-19 [F (6, 1988) = 0.972;  $p = 0.443$ ], and self-perceived preparedness to confront COVID-19 [F (6, 1988) = 1.871;  $p = 0.082$ ].

Table 4 shows the variables that were associated with the DAS scores. The effect size analysis indicated that a negative change in the quality of sleep during the pandemic ( $\eta^2 = 0.161$ ), a negative impact of the pandemic on eating habits ( $\eta^2 = 0.057$ ), and physical health during the pandemic ( $\eta^2 = 0.051$ ) were, in that order, most negatively associated with the psychological health of dentists.

Table 5 shows the descriptive results and comparisons between the groups. Compared to their peers, higher DAS scores were observed in professionals who during the pandemic lived with someone at high-risk of COVID-19, did not engage in leisure activities, completely changed their daily routine, had a higher frequency of negative changes in sleep quality, and was undergoing or interrupted psychotherapy. Dentists on the COVID-19 frontline had higher scores of anxiety and stress, but not depression, compared to professionals working only in a dental office. Participants who agreed to social distancing measures had higher scores of depression (compared to those who did not agree and partially agreed), anxiety (compared to those who partially agreed), and stress (compared to those who did not agree). Dentists with worse physical health during the pandemic had

higher scores of depression (compared to those who indicated health improvement), anxiety, and stress (compared to those without changes). Finally, dentists who reported worse eating habits during the pandemic had the higher scores for depression and stress.

## Discussion

In general, the results of the present study showed that dentists' DAS levels were negatively impacted by factors related to the COVID-19 pandemic. For this reason, the null hypothesis was rejected. The highest scores for anxiety, depression, and/or stress were seen in dentists living with someone at high-risk of COVID-19, who were on the frontline against COVID-19, who agreed to social distancing measures, who did not engage in leisure activities during the pandemic, who completely changed their daily routine, eating habits, and quality of sleep during the pandemic, and undergoing psychotherapy.

The need for social isolation and other preventive measures has changed the way of life of most people around the world. In addition, the high risk of contagion, especially among health professionals, has introduced new habits in the professionals' work routine.<sup>3-6</sup> This study showed that the negative effect of the COVID-19 pandemic on the quality of sleep of dentists negatively affected their DAS levels. Previous studies corroborate these findings, showing a strong relationship between sleep disorders and depression,<sup>18,19</sup> anxiety,<sup>18,19</sup> and stress.<sup>20,21</sup> In addition, a recent systematic review showed that health professionals experienced increased symptoms of depression, anxiety, psychological distress, and poor sleep quality during the COVID-19 pandemic.<sup>22</sup> Although some countries, such as Italy and Israel, have published studies related to this issue,<sup>23,24</sup> no study was yet conducted to assess the effect of the COVID-19 pandemic on the psychological health of dentists in Brazil, which is at the moment, the second most affected country.

**Table 4.** Multivariate and univariate analysis of variance for depression, anxiety, and stress of Brazilian dental surgeons during the COVID-19 pandemic

Variable	F	DF <sub>h</sub>	DF <sub>e</sub>	p-value	η <sup>2</sup>
Live with someone in the high-risk group for COVID-19	7.055	3	994	< 0.001	0.021
Depression	13.549	1	996	< 0.001	0.013
Anxiety	14.261	1	996	< 0.001	0.014
Stress	21.151	1	996	< 0.001	0.021
Work setting during the pandemic	2.353	6	1988	0.029	0.007
Depression	2.709	2	995	0.067	0.005
Anxiety	4.541	2	995	0.011	0.009
Stress	3.679	2	995	0.026	0.007
Agrees to measures of social distance	6.187	6	1988	< 0.001	0.018
Depression	11.300	2	995	< 0.001	0.022
Anxiety	16.410	2	995	< 0.001	0.032
Stress	17.101	2	995	< 0.001	0.033
Leisure activities during the pandemic	10.314	6	1988	< 0.001	0.030
Depression	25.546	2	995	< 0.001	0.049
Anxiety	22.026	2	995	< 0.001	0.042
Stress	20.592	2	995	< 0.001	0.040
Change of daily routine during the pandemic	9.662	3	994	< 0.001	0.028
Depression	14.625	1	996	< 0.001	0.014
Anxiety	16.711	1	996	< 0.001	0.017
Stress	28.757	1	996	< 0.001	0.028
Physical health during the pandemic	17.669	6	1988	< 0.001	0.051
Depression	38.921	2	995	< 0.001	0.073
Anxiety	41.016	2	995	< 0.001	0.076
Stress	51.335	2	995	< 0.001	0.094
Negative impact of the pandemic on eating habits	20.204	6	1988	< 0.001	0.057
Depression	45.487	2	995	< 0.001	0.084
Anxiety	32.045	2	995	< 0.001	0.061
Stress	51.542	2	995	< 0.001	0.094
Negative change in sleep quality during the pandemic	63.610	6	1988	< 0.001	0.161
Depression	126.860	2	995	< 0.001	0.203
Anxiety	141.638	2	995	< 0.001	0.222
Stress	213.124	2	995	< 0.001	0.300
Psychotherapy	7.906	6	1988	< 0.001	0.023
Depression	17.645	2	995	< 0.001	0.034
Anxiety	15.686	2	995	< 0.001	0.031
Stress	23.586	2	995	< 0.001	0.045

DF<sub>h</sub>: hypothesis degree of freedom; DF<sub>e</sub>: degree of freedom of error.

The use of validated questionnaires is important to obtain accurate results. Although the present study used a validated questionnaire to assess depression, anxiety and stress (DAS), the main study outcomes, it is important to highlight that changes on sleep quality were self-reported. Previously validated scales of sleep quality<sup>25</sup> were not used since we

evaluated sleep quality changes and thus it would be necessary to apply the scale before and after the pandemic. Our results corroborate with a previous longitudinal study performed with a validated questionnaire that indicated that a lockdown period due to COVID-19 had a negative impact on adults' sleep quality.<sup>26</sup> However, the development of longitudinal

**Table 5.** Means and standard deviations of the scores for depression, anxiety, and stress in Brazilian dental surgeons due to factors related to the COVID-19 pandemic.

Variable	Depression		Anxiety		Stress	
	M	SD	M	SD	M	SD
Live with someone in the high-risk group for COVID-19						
Yes	11.91 <sup>a</sup>	10.24	10.13 <sup>a</sup>	9.84	17.57 <sup>a</sup>	10.70
No	9.70 <sup>b</sup>	8.74	7.91 <sup>b</sup>	8.61	14.59 <sup>b</sup>	9.67
Work setting during the pandemic						
On the frontlines against COVID-19	11.25	9.77	10.58 <sup>a</sup>	9.95	17.21 <sup>a</sup>	10.98
Private office	10.05	9.16	8.21 <sup>b</sup>	8.87	15.12 <sup>b</sup>	9.67
Not working	11.58	9.87	9.19 <sup>ab</sup>	9.37	16.63 <sup>ab</sup>	10.82
Agrees to measures of social distance						
No	8.47 <sup>a</sup>	9.33	6.68 <sup>ab</sup>	9.33	12.63 <sup>a</sup>	9.13
Yes	11.56 <sup>b</sup>	9.75	9.93 <sup>a</sup>	9.66	17.07 <sup>b</sup>	10.49
Partially	8.49 <sup>a</sup>	8.27	6.30 <sup>b</sup>	7.25	13.08 <sup>ab</sup>	8.94
Leisure activities during the pandemic						
Active leisure	8.97 <sup>a</sup>	8.75	7.47 <sup>a</sup>	8.42	14.52 <sup>a</sup>	9.72
Passive leisure	12.30 <sup>a</sup>	9.66	10.11 <sup>a</sup>	9.49	16.93 <sup>a</sup>	10.32
No activity	18.21 <sup>b</sup>	11.81	16.90 <sup>b</sup>	12.52	25.45 <sup>b</sup>	11.34
Change of daily routine during the pandemic						
No or little change	8.89 <sup>a</sup>	9.10	7.03 <sup>a</sup>	8.08	13.22 <sup>a</sup>	9.37
Yes, completely changed	11.37 <sup>b</sup>	9.52	9.62 <sup>b</sup>	9.55	16.96 <sup>b</sup>	10.37
Physical health during the pandemic						
Worse/less healthy	13.11 <sup>a</sup>	9.88	11.31 <sup>a</sup>	10.08	18.87 <sup>a</sup>	10.27
No change	8.09 <sup>ab</sup>	7.93	6.03 <sup>b</sup>	6.77	12.35 <sup>b</sup>	8.99
Better/healthier	7.82 <sup>b</sup>	9.05	6.84 <sup>ab</sup>	8.77	13.50 <sup>ab</sup>	9.57
Negative impact of the pandemic on eating habits						
No	7.95 <sup>a</sup>	8.48	6.77 <sup>a</sup>	8.19	12.53 <sup>a</sup>	9.44
Yes	14.21 <sup>b</sup>	10.14	11.89 <sup>b</sup>	10.27	19.64 <sup>b</sup>	10.45
Partially	10.39 <sup>c</sup>	8.39	8.25 <sup>ab</sup>	8.11	16.53 <sup>c</sup>	9.18
Negative change in sleep quality during the pandemic						
None/rarely	6.20 <sup>a</sup>	7.57	4.15 <sup>a</sup>	6.05	9.24 <sup>a</sup>	7.84
Sometimes	9.84 <sup>b</sup>	7.49	8.33 <sup>b</sup>	7.65	16.09 <sup>b</sup>	8.08
Often/always	16.80 <sup>c</sup>	10.35	14.99 <sup>c</sup>	10.50	23.28 <sup>c</sup>	9.85
Psychotherapy						
Yes, but stopped during the pandemic	12.59 <sup>a</sup>	9.86	10.79 <sup>a</sup>	9.71	18.43 <sup>a</sup>	10.05
Yes, continued during the pandemic	13.83 <sup>a</sup>	10.56	11.55 <sup>a</sup>	10.62	19.55 <sup>a</sup>	10.52
Neither before or during the pandemic	9.37 <sup>b</sup>	8.86	7.67 <sup>b</sup>	8.54	14.26 <sup>b</sup>	9.89

M: mean; SD: standard deviation. <sup>a,b,c</sup> Different letters in a column indicate statistical difference between groups (Tukey test).

studies to assess changes in dentists' sleep quality and their relationship to depression, anxiety, and stress during COVID-19 pandemic are recommended.

The deterioration of eating habits and physical health reported by dentists during the pandemic also showed a negative impact on DAS levels. It is possible that social isolation measures in quarantine influence people to adopt a more sedentary lifestyle

and eat less healthy and out-of-hours food.<sup>27</sup> Recently, 35 research organizations from Europe, North Africa, West Asia, and the Americas carried out research that investigated the effects of home confinement on individuals' eating behavior and physical activity during the COVID-19 pandemic.<sup>28</sup> The authors showed that although social isolation is a necessary public health measure, it alters physical activity and

eating habits in a way that can negatively affect the health of individuals.

Surprisingly, some important factors assessed in this study were not associated with anxiety, depression, and/or stress in dentists. Among them was the financial impact of the pandemic, being at risk of COVID-19, or losing someone to COVID-19. Although 52.6% of dentists experienced a negative financial impact during the pandemic, this factor was not associated with their psychological health. This could be related to the short duration and lack of the most restrictive measures of social isolation (such as lockdown) in Brazil.<sup>8</sup> Dental services are essential activities and continued to be offered throughout Brazil,<sup>29</sup> but with reduced patient flow. In addition, being at high-risk for COVID-19 or losing someone to the disease did not affect the DAS scores. A part of the Brazilian population does not believe in the severity of the disease, relaxing social isolation measures even though they are at risk. Although the dentists' political beliefs were not evaluated, it is possible that this behavior is related to the denial speeches of some Brazilian political authorities who, at various times, have downplayed the severity of the SARS-CoV-2 virus infection.<sup>8,30,31</sup> On the other hand, the present study did not investigate the closeness of dentists to COVID-19 victims, regardless of whether they were related, which might have affected the results. The lack of knowledge of this variable could be a limitation of this study.

Although "being in the high-risk group" did not affect the psychological health of dentists, living with someone from the high-risk group was associated with negative changes in the DAS scores. This suggests a greater concern of the dentists for the health of their relatives and friends compared to their own health. In addition, dentists with no leisure activity during the pandemic also had higher DAS scores than those who did have them. Previous studies have shown that leisure activities are directly associated with psychological health, as they provide a sense of well-being and are low-cost strategies that improve individuals' health.<sup>32,33</sup> However, leisure activities at home, during the sanitary demands of social distancing, are more limited and require creativity to develop constant dynamic activities without leaving home.

Dentists who were on psychological treatment before the pandemic had a more negative effect on psychological health during the pandemic when compared to those who never received psychotherapy, which could be related to the greater emotional fragility of the latter professionals. However, this study did not quantify the duration of prior or current psychological treatment. In addition, the COVID-19 pandemic sparked immediate psychological responses,<sup>34</sup> which makes it difficult to draw a definitive conclusion about the negative effects on anxiety, depression, and/or stress in dentists who were already undergoing psychological treatment before the pandemic.

COVID-19 frontline dentists had the highest scores of anxiety and stress, but not of depression, when compared to private dentists. The diagnosis of depression or anxiety is associated with several symptoms that often overlap,<sup>35</sup> while stress has been shown to be a risk factor for the development of anxiety and depression.<sup>36</sup> Depression has characteristics such as hopelessness, low positive affect, low self-esteem, and low motivation. Anxiety, on the other hand, is associated with physiological hyperstimulation, while stress is caused by persistent tension, irritability, and low threshold for frustration.<sup>37,38</sup> Stress is defined as an emotional experience associated with physiological, biochemical, cognitive, and behavioral events.<sup>15</sup> Our findings are probably directly linked to emotional experiences of dentists during the pandemic. Although anxiety and stress can be causal factors for depression,<sup>18</sup> in the present study, depression showed the lowest scores in frontline dentists, which is probably related to the greater complexity in the etiology of depression, involving environmental, genetic, and biological forces.<sup>39</sup> These results should be reassessed at the end of the pandemic to verify the evolution of the psychological health of dentists. In addition, follow-up studies are encouraged to see whether professionals who have anxiety and stress will develop depression after some time.

Dentists who agreed with the social distancing measures demonstrated higher scores of depression when compared to those who disagreed or only partially agreed. It is possible that the participants who agreed with the social distancing

measures are more concerned with the impacts of COVID-19 infection than those who did not agree. This might be associated with a higher level of depression, which is a more serious impact on individuals' mental health than anxiety and stress.<sup>18</sup> In addition, those with worse physical health during the pandemic had higher scores of depression than those who reported improvement; this group also showed higher scores of anxiety and stress when compared to dentists who reported no change in physical health before and after the start of the pandemic. The worsening of physical health is possibly related to inactivity and decreased self-care during the pandemic. A meta-analysis conducted by Kvam et al.<sup>40</sup> showed that physical exercise is an effective intervention against depression and can be a feasible supplementary treatment in combination with antidepressants. However, as a limitation, the present study did not ask volunteers for specific signs or symptoms that indicated worsening or improvement of physical health.

Brazil is a heterogeneous country, and measures to combat the COVID-19 pandemic are divergent among federal, state, and municipal governments. Thus, the incidence of cases and mortality rates for COVID-19 have a high variability among states<sup>41</sup> and can have different effects on individuals' DAS. In this sense, having a national representative sample guaranteed a high accuracy of our findings. It is also important to consider the effects of the variability of epidemiological indicators throughout the pandemic and the uncertainty of when it will end. The current scenario indicates that the pandemic will continue to have a major impact on human life in the medium-term in Brazil<sup>42</sup>, and its cumulative effect

on the psychological health of individuals should be further investigated in the country and worldwide. Public policies to minimize the psychological trauma in dentists during the pandemic are encouraged, ideally planned and carried out by public bodies and regional boards (Regional Councils of Dentistry) and possibly around the world.

## Conclusion

In general, higher DAS levels of dentists in Brazil are associated with factors related to the COVID-19 pandemic. The highest scores for anxiety, depression, and/or stress were seen in dentists living with someone in the high-risk group for COVID-19, working on the pandemic frontline, who agree with social distancing measures, with no leisure activities during the pandemic, who completely changed their daily routine, eating habits, and quality of sleep during the pandemic, and were undergoing psychotherapy before the pandemic. However, as the COVID-19 pandemic is ongoing, our results need to be confirmed in future population-based studies around the world.

## Acknowledgments

We appreciate the valuable contribution of Lucas Campos and Luiz Guilherme in the design of our study. This study was financed in part by the Coordination for the Improvement of Higher Education Personnel - Government of Brazil (Capes) - Finance Code 001. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. All authors declare no conflicts of interest in this study.

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