

Association between dental environment stress and sense of coherence in dental students: a cross-sectional study

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Abstract: The aim of this study was to explore associated variables with sense of coherence (SOC), and dental environment stress (DES) in a sample of dental students. All undergraduate (n = 474) and graduate (n = 105) dental students enrolled in the first semester of 2020 at a public university in southern Brazil were invited to participate. Data collection was performed by an online questionnaire, which included information related to sociodemographic and educational characteristics, biopsychosocial factors, aspects related to feelings experienced in the COVID-19 pandemic, and the SOC scale. The study outcome (DES) was measured by a validated tool. Linear regression analyses were performed to identify the associations between the outcome and all independent variables. A total of 408 students were included (response rate: 70.5%). The overall mean score of the DES scale was 73.95 (SD: 24.13). Students with higher SOC scores were observed to have significantly lower DES scores (β_{GRADUATE} : -0.376; 95%: -0.482 to -0.271; $\beta_{\text{UNDERGRADUATE}}$: -0.478; 95%: -0.658 to -0.297). Female undergraduate students (β : 11.788; 95%CI: 7.161-16.415) had higher DES scores compared with undergraduate male students. In addition, the presence of anxiety symptoms when providing dental care to patients with symptoms or suspected COVID-19 infection was associated with higher DES scores (β : 10.460; 95%CI: 5.644-15.277) among undergraduate dental students. The level of stress was higher in non-white undergraduate students than white (β : 8.912; 95%CI: 3.581-14.244). Among both undergraduate and graduate dental students, higher SOC scores were associated with lower DES.

Keywords: Stress, Psychological; Sense of Coherence; Students, Dental; Epidemiology.

Introduction

Globally, it is estimated that, at any given time, 14% to 46% of university students are stressed.¹ The highest rates of stress are observed in students of health sciences programs, such as Dentistry.² Moreover, dental education, in particular, is considered a stressful learning



environment due to the occupational setting.³ Dental students are more likely to experience high levels of stress, depression symptoms, obsessive-compulsive disorders, and interpersonal sensitivity when compared with the general population.⁴ Common stressors include marital status, gender, academic period, personality type, and financial burden,⁵ but other factors related to the specificity of the profession and educational implications have also been reported.⁶

Different instruments (*e.g.*, Perceived Stress Scale) have been adopted in cross-sectional studies and found a substantial prevalence of psychological stress among dental students.⁷ Although these investigations have provided important evidence of mental health aspects of this group, none of them have used a specific approach to assess environmental stressors in these students, which could provide specific insights to support health management interventions in university settings. In this context, a Dental Environmental Stress (DES) scale was proposed by Garber *et al.*⁸ to identify and quantify these specific stressors in the dental setting. Among the labor and educational factors associated with the experience of stress in this group, the DES scale highlights the apprehension about failure, harshness in dealing with patients, clinical requirements, poor adaptation to transitions in the curriculum, and difficult relationships with academic staff (competition for grades and examinations).^{2,5} The experience of stress is associated with negative outcomes in general health,⁹ since it can influence the development and the performance of management of other mental disorders.¹⁰ Stress is responsible for triggering physiological processes that interfere in the emotional intelligence and sense of coherence (SOC) of individuals.¹¹

According to the maltogenic theory, SOC is characterized as a global life orientation that perceives the internal and external world as understandable, manageable and meaningful, and is considered one of the most critical determinants of individuals' ability to cope successfully with stress.¹² A strong SOC is associated with healthier behavioral preferences, irrespective of socioeconomic and educational

status.¹³ A person with strong SOC is more likely to cope adequately with arduous situations than a person with poor SOC in similar situations.¹⁴ A recent systematic review demonstrated that lower SOC is associated with an increased risk of all-cause mortality in the general adult population.¹⁵ Due to its relationship with health, especially mental health, investigations have found a growing body of evidence about aspects of its relationship with the occurrence of common mental disorders, such as stress. Findings from a cross-sectional study have shown evidence that individuals with lower levels of SOC usually have higher levels of perceived stress.¹⁶ However, no study has evaluated this relationship in Brazilian dental students.

Therefore, the aim of this study was to explore associated variables, mainly the sense of coherence (SOC), and dental environment stress (DES) among a sample of dental students in a Southern Brazilian University. The hypothesis was that dental students with a higher SOC presented significantly lower scores of environment stress experience.

Methodology

Study design and ethical aspects

The population of this cross-sectional study was undergraduate and graduate dental students regularly enrolled in one public University - the Federal University of Pelotas - located in the municipality of Pelotas, Brazil. This study report was prepared according to the criteria proposed in the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE). The Research Ethics Committee of the Federal University of Pelotas (3.910.723) approved the presented study under the following protocol #3910723. Students who agreed to participate had access to a digital term of free and informed consent.

Subjects

In the first semester of 2020, 579 were regularly enrolled at the School of Dentistry of Federal University of Pelotas. Of these, 474 (82%) were undergraduate dental students and 105 (18%) were

enrolled in Graduation Level Education Program in Dentistry for both MsC and Ph.D. students. All of them were initially eligible and invited to participate. Confirmations of institutional affiliation (enrolment) of all students were confirmed with the deans of both School of Dentistry and Graduate Program in Dentistry. No exclusion criterion was imposed.

Data collection

Data collection occurred between June and August 2020, and was performed by using a semi-structured questionnaire shared with students through the institutional communication platforms. The survey questionnaire containing the variables of interest was developed by two researchers with experience in epidemiology and was subsequently hosted on the *Google Forms* platform. Dental students were further contacted in personal e-mails and through class representatives. Professors, students, and employees of the university disseminated the invitation to participate in the research, containing the link to access the questionnaire on their profiles on social media (*i.e.*, Instagram and Facebook).

Due to the social implications caused by the COVID-19 pandemic, the first academic semester (2020/1) lasted up to March 2020. Afterwards, academic activities were postponed or performed remotely. Therefore, data collection was performed when only remote activities were allowed at the institution. Thus, the survey questionnaire was applied in the online version.

Variables

The dependent variable (outcome) of this study verified the level of stress in the dental environment. The DES scale was chosen because in the literature³, it is the tool most commonly used to measure the sources of stress among dental students. This tool was transculturally adapted to Portuguese using translation/back-translation approach, review by an expert bilingual committee and consensus building. The scale is a closed-ended adapted questionnaire, consisting of 36 items (potential

environmental stressors) categorized into the areas of living accommodation, interpersonal relationships, academics, clinical skills, and miscellaneous. Each item of the DES scale is scored on a 1 to 4 basis, with possible answers being (0; not applicable, 1: not stressful, 2: slightly stressful, 3: moderately stressful, 4: very stressful). Five domains are retrieved from this scale: academic performance (items 10–40); difficulties and insecurities about their professional future (items 6–24); responsibilities with patients (items 4–16); personal and institutional factors (items 8–32); interpersonal relationships (items 8–32). The sum of the stress scale score for all questions was calculated (continuous variable).¹⁷ The global score of the DES scale ranges from 0 to 144 points, with the highest score indicating an increased level of environmental stress.⁸

The independent variables included in this study identified sociodemographic and educational aspects, biopsychosocial factors, perceptions of fear and anxiety to provide dental care in the context of the COVID-19 pandemic, and SOC of the dental students. The following sociodemographic variables were included: sex (male or female); age in complete years, skin color (white or non-white); family income (in thousand Brazilian reais); sexual orientation (heterosexual or LGBTQIA+: lesbian, gay, bisexual, transgender, queer/questioning, intersex, asexual, and others). The variable skin color was collected according to the criteria of the Brazilian Institute of Geography and Statistics (In Portuguese, *Instituto Brasileiro de Geografia e Statistics*), and subsequently dichotomized (white and non-white: brown, black, yellow, or Indigenous). Family income was self-reported in Brazilian Reais and converted into thousand Brazilian Reais.

Three variables identified the educational aspects of the participants. An objective question with two response options (yes or no) evaluated whether Dentistry was the students' first-choice of an undergraduate course. The variable graduation stage categorized the undergraduate students into groups of participants who were in pre-clinical (only theoretical curricular activities, without practical clinical activity) or clinical (performance

of curricular clinical activities) stages. Nevertheless, graduated students were also identified according to their academic level (MSc or Ph.D. student). The history of physical activity practice and use of medication for anxiety and depression control were recalled through the following objective questions, respectively: “Do you practice any physical activity (daily or at least 150 minutes of moderate intensity activity per week)?”; “Do you take/have you ever taken anxiolytic and/or antidepressant medication?”. Two response options were available (yes or no).

Based on the approach adopted by Ahmer and collaborators (2020), a block of questions identified the perception of fear and anxiety of dental students to providing dental care in the COVID-19 pandemic.¹⁸ The interrogative sentences had three response options (yes, no, do not know) and are presented as follows: a) “Do you have fear that you could carry the infection from your dental practice back to your family?”; b) “Are you anxious when providing treatment to a patient who is coughing or suspected of being infected with COVID-19?”; c) “Do you feel nervous when talking to patients in close vicinity?”. In this study, each sentence was considered a dichotomous variable (yes or no/do not know).¹⁸ When answering this questionnaire, students were requested to answer it based on a hypothetical scenario, which would occur as soon as the pandemic state allowed clinical activities.

The SOC scale, which was translated into Portuguese and adapted for the Brazilian context, is a 29-item questionnaire with a 7-point Likert scale¹⁹ used to identify the students’ ability to cope with stressful situations. The psychometric properties of this scale have been extensively tested in a number of studies across several samples and languages with Cronbach’s alpha coefficients ranging from 0.70 to 0.95, supporting the internal consistency reliability of SOC.²⁰ Total scores on this scale range from 29 to 203 points, with higher scores indicating a stronger SOC. Thirteen of the items are worded “negatively” and have to be reversed in scoring, so that a high score always expresses a strong SOC.¹⁴ Therefore, in the present study, it was considered in a continuous variable.

Data analysis

Statistical analysis was conducted using Stata version 14.0 (Stata Corporation; College Station, USA). All data that support the findings of this study are available from the corresponding author upon reasonable request, in accordance with FAIR Data Principles (www.force11.org/group/fairgroup/fairprinciples).

Descriptive data analysis was performed using mean and standard deviation (SD) for continuous variables and relative and absolute frequency distributions for categorical variables. A parametric distribution for total DES scores (outcome) was detected to both undergraduate ($p = 0.327$; Shapiro-Wilk test) and graduate ($p = 0.839$; Shapiro-Wilk test) dental students. The T-test for independent samples was used to verify the significance of distribution of the global DES scores according to the categorical variables. Missing data were detected only in the family income variable; therefore, no attempt to input further data input was performed.

Unadjusted and adjusted linear regression analyses were performed to verify the association between the outcome and independent variables. Variables that showed a p -value < 0.25 in the unadjusted analysis were included in the initial adjusted model. The final multivariate adjusted model was built using the “forwards” strategy, observing statistical significance and effect modifications in the model. The results of linear regression analysis are described in beta coefficient (β) and 95% confidence interval (95%CI). Statistical significance was set at $p < 0.05$.

Results

Initially, a total of 579 under- and graduate dental students were eligible, and 408 answered the questionnaire (response rate: 70.5%). Of these, the majority were undergraduate students ($n = 331$; 81%); 19% ($n = 77$) of participants were enrolled in postgraduate programs. Figure presents the flowchart detailing the sample inclusion process of this study.

In general, the majority of the participants were female (68.6%), white skin color (82.0%), and self-

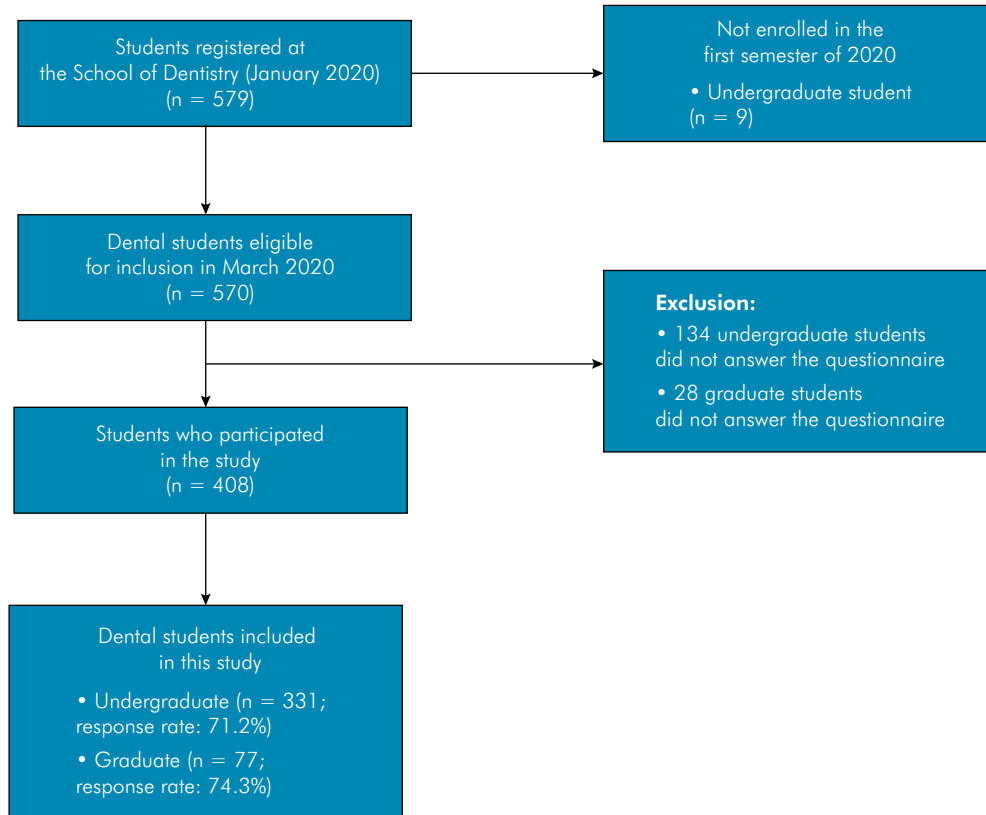


Figure. Flowchart of the participants during the study.

reported to be heterosexual (89.2%). The mean age of the sample was 22.7 (SD: 3.49) years for undergraduate and 30.38 (SD: 6.97) years for graduate students. The average family income in both groups was approximately R\$8,000 Brazilian reais (approximately USD 1,502,98 - Rate updated on September 16th 2022). Approximately half of the undergraduates did not have a practical routine of physical activities (51.9%), while 57.1% of the graduates practiced physical activities. Less than one third of the participants used medication for the management of anxiety and depression. Relative to the assessment of fear and anxiety in dental care within the context of the COVID-19 pandemic, the majority of students stated that they were afraid of becoming a vector of transmission of the virus between the clinic and the family environment (59.8% of the undergraduate and 63.6% of the graduate students). Moreover, they emphasized that they felt anxious about attending

to patients with flu-like symptoms or those who were potentially contaminated by the SARS-CoV-2 virus (36.2% of the undergraduate and 68.8% of the graduate students). Nevertheless, a low number of students felt nervous when talking to patients at a close range during pandemic (36.2% and 44.2%, respectively).

The mean total score of the DES scale was 73.95 (SD: 24.13) (minimum: 0; maximum: 134). Lastly, the mean total score of the SOC scale was 133.1 (SD: 22.55) (minimum: 73; maximum: 200). The distribution of the DES scale scores in all independent variables can be found in Table 1.

The mean scores of the domains of potential stressors assessed by the DES scale according to the student groups are demonstrated in Table 2. Undergraduate dental students had significantly higher mean scores in almost all domains, namely: 'academic performance' ($p < 0.001$), 'difficulties

Table 1. Sociodemographic and educational aspects, biopsychosocial factors, assessment of fear and anxiety in dental care in the context of the COVID-19 pandemic and mean score of SOC scale in the sample by DES total score.

Variables	Undergraduate (n = 331)		Graduate (n = 77)	
	n	%	n	%
Sex				
Male	107	32.3	21	27.3
Female	224	67.7	56	72.7
Age (complete years) – Mean/SD	22.7	3.49	30.38	6.97
Skin color				
White	266	80.4	68	88.3
Non-white	65	19.6	9	11.7
Family income (Thousand reais)* – Mean/SD	8,370.83	30,793.31	8,498.68	6,140.78
Sexual orientation				
Heterosexual	291	87.1	73	94.8
LGBTQIA+	40	12.1	4	5.2
Dentistry as a first-choice course				
Yes	106	32.0	20	26.0
No	225	68.0	57	74.0
Graduation stage				
Pre-clinical	127	38.4	-	-
Clinic	204	61.6	-	-
Graduation period				
Master's program	-	-	32	41.6
Doctoral program	-	-	45	58.4
Practice of physical activities				
No	172	51.9	33	42.9
Yes	159	48.1	44	57.1
Medication (anxiolytic/antidepressant)				
No	239	72.2	59	76.6
Yes	92	27.8	18	23.4
Are you afraid that you could carry the infection from your dental practice back to your family?				
No	133	40.2	28	36.4
Yes	198	59.8	49	63.6
Are you anxious when providing treatment to a patient who is coughing or suspected of being infected with COVID-19?				
No	168	63.8	24	31.2
Yes	163	36.2	53	68.8
Do you feel nervous when talking to patients in close vicinity?				
No	211	63.8	43	55.8
Yes	120	36.2	34	44.2
Sense of coherence scale – Mean/SD	130.52	21.34	144.18	24.35

* Variable with missing data; SD: Standard deviation; LGBTQIA+: lesbian, gay, bisexual, transgender, intersex, queer/questioning, asexual and many other terms (such as non-binary and pansexual); COVID-19: Coronavirus disease.

Table 2. Distribution of scores obtained in the domains/components of the dental environmental stress (DES) scale between students' groups.

DES - c ⁻ (SD)	Whole sample		Undergraduate		Graduate		p-value*
	n	%	n	%	n	%	
Academic performance	23.13	7.38	24.00	7.24	19.38	6.80	< 0.001
Difficulties and insecurities about their professional future	14.43	5.84	15.25	5.63	10.94	5.44	< 0.001
Responsibilities with patients	7.03	3.91	6.95	4.01	14.12	5.86	0.326
Personal and institutional factors	15.67	6.03	16.03	6.02	10.61	5.66	0.012
Interpersonal relationships	13.70	6.65	14.42	6.66	10.61	5.66	< 0.001
Total score	73.95	24.13	76.63	23.92	62.43	21.64	<0.001

*T-test for independent samples; c⁻: mean; SD: standard deviation.

and insecurities about their professional future' ($p < 0.001$), 'personal and institutional factors' ($p = 0.012$), 'interpersonal relationships' ($p < 0.001$) and 'total score' ($p < 0.001$). However, no statistically significant differences were identified in the mean score obtained between the groups in the domain 'responsibilities in relation to patients' ($p = 0.326$).

The unadjusted and adjusted linear regression models by students' groups are showed in Tables 3 (undergraduate students) and 4 (graduate students). After adjustments, a better SOC was demonstrated to be significantly associated with lower levels of stress in the dental environment in both student groups (β : -0.376; 95%CI:-0.482 to -0.271 (undergraduate students); β : -0.478; 95%CI:-0.658 to -0.297 (graduate students). For the graduate dental students, no other independent variables were significantly associated with DES.

Undergraduate students of non-white skin color (*i.e.*, black, brown, yellow, and Indigenous students) showed a higher level of stress in the dental environment than those of white skin color (β :8.912; 95%CI: 3.581-14.244). Moreover, it was observed that on an average, DES was 11.7 higher in female (95%CI:7.161-16.415), when compared with male undergraduate dental students, and tended to increase as the age of this group advanced (β :0.972; 95%CI:0.355-1.589). Undergraduate dental students who felt anxious about providing dental care in patients with flu-like symptoms or who were

potentially contaminated by the COVID-19 were also more predisposed to experiencing stress (*vs.* no; β : 10.460; 95%CI:5.644-15.277).

Discussion

The aim of the present study was to assess the factors associated with stress in the dental environment, especially their association with SOC. Overall, it was demonstrated that a better SOC was associated with lower levels of stress. However, female dental students, higher age, non-white, those with a sexual orientation other than heterosexual, and those undergoing clinical training in the undergraduate program presented significantly higher DES scores.

Stress is defined as the body's reactions to a real or perceived mental change that implies a physical, or emotional response. In addition, environmental stress refers to a spontaneous subjective psychological response to an environmental stimulus. This response can be positive, which stimulates and motivates, or negative, which is depressing and reduces the performance of an individual.²¹ The physiological responses producing adaptation to stressful life events involve the hypothalamic-pituitary-adrenal axis and the autonomic nervous system, and their interactions with the metabolic and immune systems. Hyperstimulation of these regulatory systems may lead to alterations in health status.²² Moreover,

stress is associated with physical disturbance such as an increased risk of cardiovascular diseases⁹ and mortality.²³

Overall, for almost all domains of DES, significantly higher levels of stress were observed in undergraduate in comparison with graduate

Table 3. Un- and adjusted linear regression analysis between independent variables and the global score of the dental environmental stress scale for undergraduate students.

Variables	Dental environmental stress – Undergraduate					
	Unadjusted			Adjusted		
	$\beta_{UNADJUSTED}$	95%CI	p-value	$\beta_{ADJUSTED}$	95%CI	p-value
Sex			< 0.001			< 0.001
Male	1			1		
Female	16.446	11.203–21.688		11.788	7.161–16.415	
Age (complete years)	1.011	0.274–1.740	0.007	0.972	0.355–1.589	0.002
Skin color			0.002			0.001
White	1			1		
Non-white	10.352	3.930–16.774		8.912	3.581–14.244	
Family income (Thousand reais)	-4.910	-0.000–0.000	0.914	-	-	-
Sexual orientation			0.046			0.051
Heterosexual	1			1		
LGBTQIA+	8.036	0.138–15.934		6.414	-0.031–12.867	
Practice of physical activities			0.751			-
No	1			1		
Yes	0.836	-4.346–6.019		-	-	
Medication (anxiolytic/ antidepressant)			< 0.001			0.276
No	1			1		
Yes	13.587	7.997–19.178		2.792	-2.238–7.823	
Do you have fear that you could carry the infection from your dental practice back to your family?			< 0.001			0.537
No	1			1		
Yes	9.431	4.248–14.614		1.520	-3.325–6.367	
Are you anxious when providing treatment to a patient who is coughing or suspected of being infected with COVID-19?			< 0.001			< 0.001
No	1			1		
Yes	15.805	10.916–20.693		10.460	5.644–15.277	
Do you feel nervous when talking to patients in close vicinity?			0.002			0.907
No	1			1		
Yes	8.273	2.961–13.585		0.293	-4.618–5.205	
Sense of Coherence Scale	-0.501	-0.609–-0.382	< 0.001	-0.376	-0.482–-0.271	< 0.001

β : Beta coefficient; 95%CI: 95% confidence interval; -: Variable not included in the final adjusted analysis; LGBTQIA+: lesbian, gay, bisexual, transgender, intersex, queer/questioning, asexual and many other terms (such as non-binary and pansexual); COVID-19: Coronavirus disease.

students. The Undergraduate phase in Dentistry is highly demanding and the acquisition of technical and practical skills may be considered a burden

during this phase of academic life.²⁴ Moreover, there probably is a higher level uncertainty about the professional future among these students.

Table 4. Un- and adjusted linear regression analysis between independent variables and the global score of the dental environmental stress scale for graduate students.

Variables	Dental environmental stress – Graduate					
	Unadjusted			Adjusted		
	$\beta_{UNADJUSTED}$	95%CI	p-value	$\beta_{ADJUSTED}$	95%CI	p-value
Sex			0.833			
Male	1			-		
Female	1.178	-9.923–12.281		-	-	-
Age (complete years)	-0.419	-1.127–0.028	0.241	0.211	-0.437–0.859	0.518
Skin color			0.105			0.266
White	1			1		
Non-white	12.473	-2.651–27.599		7.707	-5.995–21.410	
Family income (Thousand reais)	-0.001	-0.002–0.000	0.012	-0.001	-0.001–0.000	0.123
Sexual orientation			0.245			0.820
Heterosexual	1			1		
LGBTQIA+	12.996	-9.089–35.082		-2.283	-22.251–17.685	
Practice of physical activities			0.393			-
No	1			-		
Yes	-4.287	-14.233–5.658		-	-	
Medication (anxiolytic/ antidepressant)			0.406			-
No	1			-		
Yes	4.878	-6.754–16.511		-	-	
Are you afraid that you could carry the infection from your dental practice back to your family?			0.138			-
No	1			-		
Yes	7.632	2.498–17.763		-	-	
Are you anxious when providing treatment to a patient who is coughing or suspected of being infected with COVID-19?			0.828			-
No	1			-		
Yes	1.167	-9.507–11.842		-	-	
Do you feel nervous when talking to patients in close vicinity?			0.095			0.200
No	1			1		
Yes	8.291	-1.484–18.067		5.541	-0.658–0.297	
Sense of Coherence Scale	-0.494	-0.664–0.324	< 0.001	-0.478	-0.658–0.297	< 0.001

β : Beta coefficient; 95%CI: 95% confidence interval; -: Variable not included in the final adjusted analysis; LGBTQIA+: lesbian, gay, bisexual, transgender, intersex, queer/questioning, asexual and many other terms (such as non-binary and pansexual); COVID-19: Coronavirus disease.

These characteristics may decrease during the graduation period.

Higher level of stress in the dental school environment was associated with a weaker SOC in this sample. This finding corroborated the results of a previous study showing that Korean dental hygienists with stronger SOC had lower level of stress in the work environment.¹⁶ Strong SOC allows better management of emotional intelligence, which may positively influence the way individuals deal with stress. Emotional intelligence is defined as an individual's ability to contain negative emotions, such as those experienced in the dental environment, and replace them with positive emotions, allowing a person to understand their feelings and emotions and direct their actions, accordingly.²⁵ Individuals with low emotional intelligence face several difficulties in managing stress-related issues. Interestingly, one study observed that individuals with low emotional intelligence had weak SOC, which made it difficult to manage stress-related issues.¹¹ From this perspective, it is understood that the SOC can act as a potential moderator of stress, which justified the results found in this study.

The literature suggests that female dental students tend to perceive themselves as more stressed than men.³ This difference can be explained not only by the fact that women experience more stressful life events than their counterparts, but also because they have different stress coping strategies.²⁶ This relationship may justify the results of the present study, which indicated the higher perception of stress among female dental students. In addition, this finding may be also related to the association between academic performance and sex and its interaction with stress.²⁷ Academic performance is an important indicator because of its association with economic success, physical, and mental health.²⁸ Student academic performance is related to psychological well-being, feeling of satisfaction with achievements, and coping with stressful situations.²⁹

Racial differences have been established as predicting success in the academic performance of dental students, which may explain the results of this study, in which a higher level of perceived

environmental stress was identified among non-white individuals.³⁰ This relationship can be attributed to factors that predispose the experience of stress in this group of students, such as the stereotype threat, limitations in relation to feelings of belonging, sleep disturbances, socioeconomic conditions, and lack of motivation to carry out curricular activities.³¹ Furthermore, experience of episodes of racial discrimination (racism) in the university environment is a reality and can also increase the perceived stress level.³⁰

Research on LGBTQIA+ issues in dental education is scarce worldwide. It is known that the LGBTQIA+ population, particularly the group of university students,³² are more exposed to stressful events and have a higher chance of developing mental health problems, including substance use disorders, affective disorders and suicide risk when compared to heterosexual individuals.³³ Although no statistically significant difference was found in this relationship, a trend towards LGBTQIA+ undergraduate students showing higher mean values of the DES scale was observed, when compared with students with heterosexual sexual orientation. This may be linked to the experiences related to stigma, prejudice and discrimination experienced by these individuals, which create a stressful social environment. Discrimination against sexual minorities is a reality in the university environment, reports have pointed out that only few dental schools adopted approaches to promote a visible, comprehensive, and culturally competent university setting for this group. It is recommended that educational institutions create inclusive strategies for this group in order to provide a better university environment for their students.

Dental students in pre-clinical stage usually perform activities to develop psychomotor skills with the use of manikins in technical laboratories and do not provide direct patient care. As dental students' progress through the course and begin to provide clinical care, their perceived stress increases substantially.⁵ Some aspects related to the clinical routine in university, such as assigning clinical requirements, dealing with patients, and acquiring special skills are some factors that expose

dental students to further stress in clinical stage of their education.³⁴ These findings justified the results shown in this study, *i.e.*, that students who perform clinical activities perceived more stress than those who were in the pre-clinical stage. Moreover, the overload of theoretical and practical activities increases as students advance in the course, which directly influences the higher level of perceived stress.³⁵ These reasons also justify the perceived stress of older dental students, since this occurs as students advance in the course. It is important to highlight that no collinearity was observed among these variables. At this stage of the course and during adulthood, especially among graduate students, difficulties and insecurities about the professional future also arise, which may indirectly contribute to perceived stress.³⁶ In periods of pandemic crisis, these future uncertainties may generate exacerbated worries/concerns and increased stress and mental disturbances.³⁷

The pandemic of COVID-19 had a high negative impact on the mental health and behaviors of dental students.³⁸ During the first wave of the pandemic (March to November 2020), critical measures of social isolation were imposed by governments to curb the high transmission and mortality rate of the COVID-19 disease. During this period, dental schools suspended their in-person curricular activities, while biosafety protocols and vaccine development were being planned to ensure the safe return of clinical care and safeguard the lives of the population.³⁹ As observed in this study, environmental concerns related to clinical care during the pandemic crisis period were associated with negative mental outcomes in dental students. This could be related to students' concern to provide treatment to patients with symptoms/suspects of COVID-19 infection. Moreover, the lack of adequate knowledge and training in biosafety may also justify this finding. In applied terms, it is empirically understood that the feelings that emerge when faced with the possibility of the individual becoming infected with a new and potentially lethal disease during dental care, due to inadequate execution of biosafety protocols may influence the experience of stressful events.

This study had limitations that should be considered. The cross-sectional design does not allow establishing causal inference between DES and the exploratory variables, mainly SOC. Non-response bias can also be listed as a limitation, since not all dental students who were eligible for inclusion answered the questionnaire. However, comparisons were made between participants and non-participants, and showed no significant difference for sex ($p = 0.550$ for undergraduate and $p = 0.273$ graduate dental students). Other variables were not available in the institutional data setting. Thus, these characteristics may differ between participants and non-participants.

In addition, a sample of dental students from a single educational institution were included, which does not allow the generalization of findings. The use of self-reported questionnaires may predispose to the occurrence of memory bias. In this context, data collection of this study occurred during the first wave of COVID-19 pandemic, when Brazil was the pandemic global epicenter, educational institutions had fully suspended face-to-face activities, and students were in social isolation. Thus, it is suggested that the general context could be considered an external stressor, which could influence the results described in this study. Therefore, this study may present a lower external validity, which the readers should consider.⁴⁰

This study also had strengths. The use of online questionnaires shared through institutional channels are the most practical way to collect self-reported and screening, providing valuable information to direct approaches in periods of public health crisis. This approach enabled the questionnaire to be accessed by more than two-thirds of the target audience. In fact, due to the high response rate, it was possible to infer representativeness of the sample. Based on a review conducted by the authors, this would appear to be the first study to examine the association between environmental stress and SOC in dental students in Brazil. The findings of this study add to an area that has hardly been explored in field of dental science and thus future investigations should be conducted. The authors recommend that efforts be directed

toward multicenter studies that adopt the use of recognized and valid methods to assess the occurrence of environmental stress and SOC, such as those used in this investigation. In addition, further researches should include the assessment of social support, resilience, personality type, and perceptions of academic life.

Conclusion

In conclusion, a significant association between DES and SOC was demonstrated since those with stronger SOC showed lower levels of environmental

stress in both undergraduate and graduate dental students. Moreover, female undergraduate students, those that self-reported being non-white, with higher age, and undergraduate dental students who felt anxious about providing dental care during the COVID-19 pandemic also showed higher perception of environmental stress.

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