

# Learning preferences, distance education perceptions, and anxiety (STAI-S-6) among dentistry students

Luísa Schubach da Costa Barreto\*, Maria Cardoso de Castro Berry, Flavia Artese, Cátia Cardoso Abdo Quintão

Department of Social and Preventive Dentistry (PRECOM), Faculty of Dentistry, Rio de Janeiro State University, Rio de Janeiro, Brazil

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## ABSTRACT

**Aims:** To investigate undergraduate and graduate dentistry students' perceptions of distance education (DE), learning preferences, and anxiety levels during the early phase of the COVID-19 pandemic, and to compare these outcomes according to academic level.

**Methods:** A multicenter cross-sectional study was conducted between March and June 2020 using a 44-item questionnaire organized into five domains. Anxiety was assessed using the Brazilian Portuguese version of the State-Trait Anxiety Inventory Short Form (STAI-S-6). Comparisons between undergraduate and graduate students were performed using Chi-square tests, independent samples t-tests, and one-way analysis of variance, adopting a significance level of 5%.

**Results:** A total of 293 students participated (150 undergraduates and 143 graduate students). Undergraduate students were significantly younger and more frequently belonged to lower socioeconomic strata ( $p < 0.001$ ). Female students, undergraduates, and participants from intermediate-to-lower socioeconomic strata (particularly class C1 according to the Brazilian Economic Classification Criteria) exhibited higher anxiety levels ( $p < 0.05$ ). A weak negative correlation was observed between age and anxiety scores ( $r = -0.125$ ;  $p = 0.032$ ). Significant differences between groups were observed regarding perceptions of DE, learning preferences, academic performance, and the perceived relationship between DE and anxiety ( $p < 0.001$ ). Students reporting extremely negative effects of DE on academic performance and those perceiving that DE greatly increased anxiety presented the highest STAI-S-6 scores ( $p < 0.001$ ).

**Conclusion:** These findings suggest that dentistry students experienced considerable psychological burden during the early phase of the COVID-19 pandemic. Undergraduate students appeared to report greater difficulties adapting to DE and higher anxiety levels than graduate students. The results may indicate the importance of mental-health-centered educational strategies and equitable access to digital resources to support students during periods of educational disruption.

**Keywords:** Dentistry, perception, distance education, COVID-19, anxiety

## INTRODUCTION

The COVID-19 pandemic abruptly disrupted higher education worldwide, compelling institutions to adopt emergency distance education (DE) with little time for pedagogical restructuring.<sup>1</sup> This sudden transition reshaped academic routines and affected students' psychological well-being,<sup>2</sup> with meta-analytic evidence indicating a high prevalence of anxiety, depression, and stress among students receiving DE during this period.<sup>3,4</sup> Although vaccination campaigns and the return to face-to-face activities have occurred, more recent studies have described educational and psychological challenges associated with remote and hybrid learning environments. These observations are presented only to provide context for understanding the experiences reported during the early stages of the COVID-19 pandemic.<sup>1,3,5-8</sup>

In dentistry, these challenges were amplified by the central role of clinical and preclinical training.<sup>9</sup> The sudden interruption

of laboratory and clinical activities, concerns regarding infection, and uncertainty about academic progression were associated with emotional distress among dental students.<sup>3,4,7</sup> A recent meta-analysis estimated that nearly one-third of dental students experienced anxiety symptoms during the pandemic,<sup>6</sup> illustrating the magnitude of the psychological burden observed in this population.

Early studies conducted during the first waves of COVID-19 reported higher levels of anxiety, stress, and depressive symptoms, particularly among younger students, female, and those experiencing difficulties adapting to DE.<sup>10</sup> More recent investigations have described similar findings, indicating that DE, social isolation, and reduced clinical exposure were associated with less favorable emotional outcomes.<sup>11,12</sup> Although more recent studies have documented persistent academic fatigue and anxiety associated with remote and

\*Corresponding Author: Luísa Schubach da Costa Barreto, luisaschubach@gmail.com



hybrid learning environments, these observations are presented only to contextualize findings obtained during the early phase of the COVID-19 pandemic.<sup>1,13,14</sup>

Perceptions of impaired academic performance, lower content quality, and greater difficulty maintaining concentration appear to be particularly relevant, yet their relationship with validated anxiety measures remains insufficiently explored. To assess psychological impact with methodological rigor, the State-Trait Anxiety Inventory (STAI) remains one of the most frequently used instruments worldwide,<sup>15</sup> including in educational and clinical settings. The Brazilian short-form version of the state scale (STAI-S-6) demonstrates robust validity and reliability and is suitable for large online surveys requiring efficient and low-burden assessment of anxiety symptoms.<sup>16</sup>

Despite the growing body of literature examining the educational and psychological consequences of the COVID-19 pandemic, relatively few studies have directly compared undergraduate and graduate dentistry students. Because these groups differ in age, academic responsibilities, professional expectations, and levels of autonomy, they may have experienced emergency DE differently during the early phase of the pandemic. Moreover, most previous investigations have focused primarily on undergraduate students, with limited information regarding possible differences in learning preferences, perceptions of DE, and anxiety levels between academic stages. A better understanding of these differences may provide valuable insights for the development of more resilient, equitable, and student-centered educational strategies.

Therefore, the aim of this multicenter cross-sectional study was to investigate learning preferences, perceptions of DE, and state anxiety (STAI-S-6) among undergraduate and graduate dentistry students during the early phase of the COVID-19 pandemic, and to compare these outcomes according to academic level. In addition, the associations between sociodemographic characteristics, DE experiences, and anxiety scores were explored. It was hypothesized that undergraduate and graduate students would differ in their perceptions of DE and anxiety profiles.

## METHODS

### Ethics

The study protocol was approved by the This study was approved by the Universitário Pedro Ernesto Ethics Committee (Date: 17.05.2020, Decision No: 4.029.405, CAAE No: 30637420.3.0000.0008), and all participants provided electronic informed consent before enrollment. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

### Study Design

This cross-sectional observational study was designed and reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines<sup>17</sup> for cross-sectional studies and adhered to the CHERRIES (Checklist for Reporting Results of Internet E-Surveys)<sup>18</sup> criteria to ensure transparency and methodological rigor during online data collection.

This multicenter cross-sectional study was conducted between March and June 2020, during the early phase of the

COVID-19 pandemic, using a 44-item online questionnaire organized into five domains.

### Participants, Eligibility Criteria, and Recruitment

Participants included undergraduate and graduate dentistry students enrolled in multiple dental schools in Brazil during the period of emergency DE. Recruitment was conducted through institutional communication channels, including e-mail, WhatsApp Messenger, and Facebook academic groups, in order to maximize geographic and institutional representation. Eligibility criteria included current enrollment in undergraduate or graduate dental programs and voluntary agreement to participate in the study. Questionnaires with incomplete responses were excluded from the analysis.

### Survey Administration and Structure

Data were collected using a self-administered questionnaire created in Google Forms and organized into five domains: (1) demographic and socioeconomic characteristics; (2) social isolation and concerns related to the COVID-19 pandemic; (3) preferences regarding distance education; (4) perceptions of the impact of DE on academic performance and anxiety; and (5) psychological assessment using the Brazilian Portuguese version of the State-Trait Anxiety Inventory Short Form (STAI-S-6) (Table 1).<sup>16</sup>

To prevent duplicate submissions and ensure the integrity of the dataset, participants were required to sign in to a Google account before accessing the survey. This verification procedure was used exclusively to restrict responses to one submission per participant and did not allow investigators to identify respondents. No personally identifiable information was collected, and all responses were analyzed anonymously. Access to the database was restricted to the research team and protected by password-secured files, ensuring confidentiality and compliance with ethical standards. Socioeconomic status was classified according to the Brazilian Economic Classification Criteria (ABEP), which categorizes households into strata ranging from A (highest) to E (lowest) based on household assets and educational level.

### Anxiety Assessment

Psychological assessment was performed using the validated Brazilian Portuguese version of the STAI-S-6, which consists of six items derived from the original 20-item state anxiety scale.<sup>16</sup> Responses were recorded on a four-point Likert scale ranging from 1 ("not at all") to 4 ("very much"). Positively worded items were reverse scored, and the resulting raw scores were converted to the standardized STAI metric according to the procedure proposed by Fioravanti-Bastos et al.<sup>16</sup> Higher scores corresponded to higher levels of state anxiety.

### Sample Size Calculation

Sample size calculations were performed using G\*Power software (version 3.1; Heinrich-Heine University, Düsseldorf, Germany). Sample size estimation was based on detecting a clinically meaningful difference in STAI-S-6 anxiety scores between undergraduate and graduate students. Preliminary estimates of variability were obtained from a pilot study conducted with dentistry students, which yielded standard deviations of 11.41 and 7.97 for undergraduate and graduate students, respectively. A minimum difference of 6.67 points was derived from the distribution of pilot scores and was

**Table 1. Schematic representation of the questions included in the online questionnaire to collect information on undergraduate and graduate dentistry students****Section 1. Sociodemographic data (10 questions)****Questions about your personal life, status and academic degree**

- Q1. Gender: ☐ Male ☐ Female  
 Q2. How old are you?  
 Q3. What race do you declare yourself? ☐ White ☐ Black ☐ Brown ☐ Yellow ☐ Indigenous  
 Q4. Which religion do you stand for? ☐ Catholic ☐ Protestant ☐ Spiritism ☐ Jewish ☐ Buddhist ☐ No religion to state  
 Q5. What is your civil status? ☐ Single ☐ Married ☐ Divorced ☐ Widower  
 Q6. Mark the Brazilian region you currently live in: ☐ North ☐ Northeast ☐ Southeast ☐ Midwest ☐ South  
 Q7. How many people currently live in the household with you? ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q8. Where are you taking virtual dentistry classes? ☐ Graduation ☐ Postgraduate courses  
 Q9. Which educational institution are you attending? ☐ Public ☐ Private  
 Q10. What is your highest academic degree reached? ☐ Complete high school ☐ Graduate ☐ Specialist ☐ Masters ☐ Doctorate

**Section 2. Socioeconomic criteria (15 questions)****Questions about items in the household that you currently live for economic classification. All items of electronics that are listed below must be working, including those that are stored. If they are not working, consider only if you intend to repair or replace them within the next 6 months**

- Q11. Number of passenger cars exclusively for private use: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q12. Number of monthly employees, considering only those who work at least 5 days a week: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q13. Number of washing machines, excluding six pack: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q14. Number of bathrooms: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q15. Quantity of DVD, including any device that reads DVD and disregards car DVD: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q16. Number of refrigerators: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q17. Number of independent freezers or part of duplex refrigerator: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q18. Number of microcomputers, considering desktop computers, laptops, notebooks and netbooks, disregarding tablets, palms or smartphones  
☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q19. Quantity of dishwasher: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q20. Quantity of microwave oven: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q21. Number of motorcycles, excluding those used exclusively for professional use: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q22. Number of clothes drying machines, considering lava and drought: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q23. The water used at home comes from: ☐ General distribution network ☐ Well or spring ☐ Other source  
 Q24. Considering the street segment of your household, you would say that the street is: ☐ None ☐ 1 ☐ 2 ☐ 3 ☐ 4 or more  
 Q25. How educated is the head of the family? Consider as the head of the household the person who contributes most of the household income in question  
☐ Illiterate/elementary 1 incomplete ☐ Elementary 1 completed/elementary 2 incomplete ☐ Completed elementary/high school incomplete ☐ Completed high school/incomplete higher education ☐ Completed higher education

**Section 3. Work relationships (2 questions)****For each question, the participant can only choose one option**

- Q26. What is your main concern regarding the coronavirus pandemic?  
☐ Professional instability, the chance of unemployment ☐ Economic crisis in the country ☐ Contagion ☐ Food ☐ Education  
 Q27. How are you respecting the quarantine during social isolation?  
☐ I do not leave home for nothing ☐ I am staying home as much as possible (going out only to buy food/medicine) ☐ I am going out as usual

**Section 4. Methods of distance education (11 questions)****For each question, the participant can only choose one option**

- Q28. During COVID-19 pandemic, what is your frequency of virtual lessons? ☐ Always ☐ Many times ☐ Sometimes ☐ Rarely ☐ Never  
 Q29. Which of the following options would be your preferred distance education modality?  
☐ Video lessons recorded and available for me to watch for as long as I want, without the possibility of asking questions  
☐ Video lessons recorded and available for me to watch for as long as I want, with the possibility of taking questions by e-mail  
☐ Unrecorded video lessons, only with the teacher's virtual presence, without sharing slides on the screen, without the student's face screen and without the possibility of asking questions.  
☐ Video lessons not recorded, with virtual presence of the teacher, with slide sharing on the screen, with the screen of the student's face and with the possibility of asking questions  
☐ Unrecorded video lessons, without the teacher's virtual presence, only with his live voice, with sharing slides on the screen, without the screen of the student's face and with the possibility of answering questions.  
 Q30. Did you have difficulty attending online classes?  
☐ No difficulty ☐ Low difficulty ☐ Average difficulty ☐ A lot of difficulty ☐ Extreme difficulty  
 Q31. What was the biggest difficulty encountered when attending classes online?  
☐ Not applicable (as theoretically reported having no difficulty in the previous question) ☐ Impaired Wi-Fi connection ☐ How to make questions  
☐ Lack of interaction between student and teacher ☐ I can't focus ☐ Platform adaptation  
 Q32. What would be your suggestion for improving distance learning methods?  
☐ Standardization and organization of content with creation of schedules and goals to develop student autonomy  
☐ Improve dynamics, have a summary at the end of the class, provide complementary material such as PDF documents and exercises  
☐ Availability to answer questions with an online tutor  
☐ Video storage lessons so I can watch as many times as I want  
☐ Improving the stability of videoconferencing platforms  
 Q33. Regarding the online class hours, what time do you define as ideal for one lesson? ☐ 15 minutes ☐ 30 minutes ☐ 45 minutes ☐ 1 hour ☐ More than 1 hour  
 Q34. What is your class modality of preference? ☐ Online class ☐ Face-to-face class  
 Q35. Mark the option that justifies the chosen preference: ☐ More organized content ☐ Practicality in answering questions ☐ Greater interactivity between student and teacher ☐ I stay more concentrated ☐ I am used to it  
 Q36. Video lessons require the student to look at the computer screen for a long period of time. How do you think it affects your performance during distance education? ☐ Affects extremely negatively ☐ Affects negatively ☐ Does not affect ☐ Affects positively ☐ Affects extremely positively  
 Q37. Regarding the content of the course, how do you evaluate online classes?  
☐ Very limited ☐ Limits a little ☐ No effect ☐ Covers a little ☐ Completely covers  
 Q38. To what extent do you believe that distance learning activities affect students' anxiety levels?  
☐ Increases a lot ☐ Increases a little ☐ Does not affect ☐ Reduces a little ☐ Reduces a lot

**Section 5. Psychological assessment (6 questions)****Your personal self-assessment regarding the CURRENT moment. Please select one of the numbers 1, 2, 3 or 4 to indicate how you feel NOW. There are no right or wrong answers. Do not spend too much time on any of the statements. Try to mark an answer that comes closest to how you feel IN THIS MOMENT. For each question, the participant can only choose one option**

- Q39. I feel calm: ☐ 1=not at all ☐ 2=somewhat ☐ 3=moderately ☐ 4=very much  
 Q40. I am tense: ☐ 1=not at all ☐ 2=somewhat ☐ 3=moderately ☐ 4=very much  
 Q41. I feel at ease: ☐ 1=not at all ☐ 2=somewhat ☐ 3=moderately ☐ 4=very much  
 Q42. I feel nervous: ☐ 1=not at all ☐ 2=somewhat ☐ 3=moderately ☐ 4=very much  
 Q43. I am relaxed: ☐ 1=not at all ☐ 2=somewhat ☐ 3=moderately ☐ 4=very much  
 Q44. I am worried: ☐ 1=not at all ☐ 2=somewhat ☐ 3=moderately ☐ 4=very much

Q: Question, COVID-19: Coronavirus disease 2019, Wi-Fi: Wireless fidelity, PDF: Portable document format, DVD: Digital versatile disc, AI: Artificial Intelligence, STAI: State-Trait Anxiety Inventory





considered clinically meaningful. Assuming a two-sided significance level of 5% and a statistical power of 90%, intentionally chosen to reduce the probability of type II error, a minimum sample of 92 participants (46 per group) was required. The corresponding expected standardized effect size (Cohen's *d*) was approximately 0.68, indicating a moderate-to-large effect.<sup>20</sup>

## Statistical Analysis

All data analyses were performed using SPSS software (IBM SPSS Statistics, version 21.1; IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for all variables. Data distribution was assessed using the Shapiro-Wilk test.

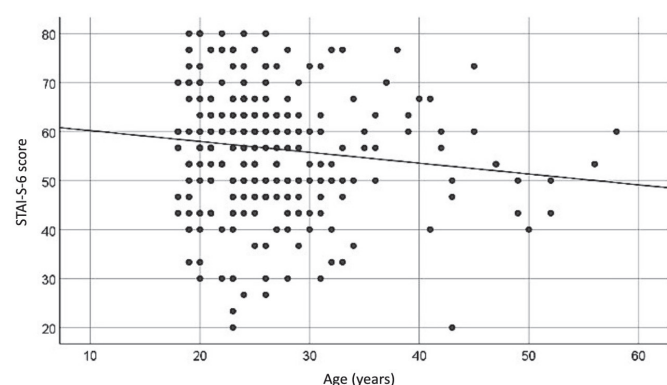
Comparisons between undergraduate and graduate students were performed using independent samples *t*-tests for continuous variables and Chi-square tests for categorical variables. One-way analysis of variance (ANOVA) was used to compare mean STAI-S-6 scores across categories containing more than two groups. When appropriate, post hoc comparisons were performed, and statistically significant differences between groups were indicated by superscript letters in the tables.

Pearson's correlation coefficient was used to evaluate the association between age and STAI-S-6 scores. Correlation coefficients were interpreted according to conventional thresholds, with values below 0.30 considered weak, between 0.30 and 0.50 moderate, and above 0.50 strong. Statistical significance was established at  $p < 0.05$ .

## RESULTS

### Sample Characterization

A total of 293 dentistry students completed the survey, including 150 undergraduate and 143 graduate students. The mean age of participants was 26.5 years, with undergraduate students being significantly younger than graduate students ( $22.0 \pm 3.4$  vs.  $31.0 \pm 7.4$  years;  $p < 0.001$ ; Cohen's  $d = 1.58$ ). Most respondents were female (82.9%), enrolled in public institutions (67.6%), and belonged to economic classes A or B (78.9%) according to ABEP criteria. The STAI-S-6 demonstrated satisfactory internal consistency in the present sample, with a Cronbach's alpha coefficient of 0.82. A weak but statistically significant negative correlation was observed between age and STAI-S-6 scores ( $r = -0.125$ ;  $p = 0.032$ ) (Figure 1). Significant differences between undergraduate and graduate students were observed across several demographic and socioeconomic variables (Table 2).



**Figure 1.** Scatter plot showing the correlation between age and STAI-S-6 anxiety scores among dentistry students. The fitted regression line illustrates the weak negative association identified ( $r = -0.125$ ;  $p = 0.032$ )

STAI-S-6: State-Trait Anxiety Inventory-State 6-item short form

**Table 2.** Profile and between-group comparison of demographic, socioeconomic, and academic variables in the study sample

|                                                                                                                                                                                                                    | Groups                 |                                |                           |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------------------------------|---------------------------|--------|
|                                                                                                                                                                                                                    | Total<br>(n=293) n (%) | Undergraduate<br>(n=150) n (%) | Graduate<br>(n=143) n (%) | p*     |
| Gender                                                                                                                                                                                                             |                        |                                |                           |        |
| Female                                                                                                                                                                                                             | 243 (82.9)             | 124 (82.7)                     | 119 (83.2)                | >0.999 |
| Male                                                                                                                                                                                                               | 50 (17.1)              | 26 (17.3)                      | 24 (16.8)                 |        |
| Race                                                                                                                                                                                                               |                        |                                |                           |        |
| White                                                                                                                                                                                                              | 193 (65.9)             | 86 (57.3)                      | 107 (74.8)                | 0.002  |
| Black                                                                                                                                                                                                              | 22 (7.5)               | 18 (12)                        | 4 (2.8)                   |        |
| Brown                                                                                                                                                                                                              | 74 (25.3)              | 43 (28.7)                      | 31 (21.7)                 |        |
| Others                                                                                                                                                                                                             | 4 (1.4)                | 3 (2)                          | 1 (0.7)                   |        |
| Religion                                                                                                                                                                                                           |                        |                                |                           |        |
| Catholic                                                                                                                                                                                                           | 129 (44.3)             | 51 (34.5)                      | 78 (54.5)                 | 0.014  |
| Protestant                                                                                                                                                                                                         | 51 (17.5)              | 31 (20.9)                      | 20 (14)                   |        |
| Spiritism                                                                                                                                                                                                          | 21 (7.2)               | 11 (7.4)                       | 10 (7)                    |        |
| Buddhist                                                                                                                                                                                                           | 3 (1)                  | 2 (1.4)                        | 1 (0.7)                   |        |
| No religion to state                                                                                                                                                                                               | 87 (29.9)              | 53 (35.8)                      | 34 (23.8)                 |        |
| Civil status                                                                                                                                                                                                       |                        |                                |                           |        |
| Single                                                                                                                                                                                                             | 231 (78.8)             | 144 (96)                       | 87 (60.8)                 | <0.001 |
| Married                                                                                                                                                                                                            | 57 (19.5)              | 6 (4)                          | 51 (35.7)                 |        |
| Divorced                                                                                                                                                                                                           | 5 (1.7)                | 0 (0)                          | 5 (3.5)                   |        |
| Brazilian region                                                                                                                                                                                                   |                        |                                |                           |        |
| North                                                                                                                                                                                                              | 18 (6.1)               | 7 (4.7)                        | 11 (7.7)                  | 0.066  |
| Northeast                                                                                                                                                                                                          | 49 (16.7)              | 33 (22)                        | 16 (11.2)                 |        |
| Southeast                                                                                                                                                                                                          | 209 (71.3)             | 103 (68.7)                     | 106 (74.1)                |        |
| South                                                                                                                                                                                                              | 17 (5.8)               | 7 (4.7)                        | 10 (7)                    |        |
| Number of people currently living in the household                                                                                                                                                                 |                        |                                |                           |        |
| None                                                                                                                                                                                                               | 18 (6.1)               | 5 (3.3)                        | 13 (9.1)                  | 0.002  |
| 1                                                                                                                                                                                                                  | 49 (16.7)              | 15 (10)                        | 34 (23.8)                 |        |
| 2                                                                                                                                                                                                                  | 71 (24.2)              | 39 (26)                        | 32 (22.4)                 |        |
| 3                                                                                                                                                                                                                  | 78 (26.6)              | 44 (29.3)                      | 34 (23.8)                 |        |
| 4 or more                                                                                                                                                                                                          | 77 (26.3)              | 47 (31.3)                      | 30 (21)                   |        |
| Institution                                                                                                                                                                                                        |                        |                                |                           |        |
| Public                                                                                                                                                                                                             | 198 (67.6)             | 93 (62)                        | 105 (73.4)                | 0.050  |
| Private                                                                                                                                                                                                            | 95 (32.4)              | 57 (38)                        | 38 (26.6)                 |        |
| Highest academic degree                                                                                                                                                                                            |                        |                                |                           |        |
| Completed high school                                                                                                                                                                                              | 148 (50.5)             | 148 (98.7)                     | 0 (0)                     | <0.001 |
| Graduated, DDS                                                                                                                                                                                                     | 47 (16)                | 2 (1.3)                        | 45 (31.5)                 |        |
| Specialist                                                                                                                                                                                                         | 39 (13.3)              | 0 (0)                          | 39 (27.3)                 |        |
| Masters, MSD                                                                                                                                                                                                       | 53 (18.1)              | 0 (0)                          | 53 (37.1)                 |        |
| Doctorate, PhD                                                                                                                                                                                                     | 6 (2)                  | 0 (0)                          | 6 (4.2)                   |        |
| Economic class rate                                                                                                                                                                                                |                        |                                |                           |        |
| A                                                                                                                                                                                                                  | 87 (29.7)              | 35 (23.3)                      | 52 (36.4)                 | <0.001 |
| B1                                                                                                                                                                                                                 | 65 (22.2)              | 23 (15.3)                      | 42 (29.4)                 |        |
| B2                                                                                                                                                                                                                 | 79 (27)                | 46 (30.7)                      | 33 (23.1)                 |        |
| C1                                                                                                                                                                                                                 | 44 (15)                | 33 (22)                        | 11 (7.7)                  |        |
| C2                                                                                                                                                                                                                 | 18 (6.1)               | 13 (8.7)                       | 5 (3.5)                   |        |
|                                                                                                                                                                                                                    | Mean (SD)              | Mean (SD)                      | Mean (SD)                 | p**    |
| Age (years)                                                                                                                                                                                                        | 26 (7.1)               | 22 (3.4)                       | 31 (7.4)                  | <0.001 |
| Legend: *Chi-square test for categorical variables and **independent samples t-test for age. DDS: Doctor of dental surgery, MSD: Master of science in dentistry, PhD: Doctor of philosophy, SD: Standard deviation |                        |                                |                           |        |

Legend: \*Chi-square test for categorical variables and \*\*independent samples *t*-test for age. DDS: Doctor of dental surgery, MSD: Master of science in dentistry, PhD: Doctor of philosophy, SD: Standard deviation

### Comparison Between Groups

Significant differences between undergraduate and graduate students were observed regarding social isolation, pandemic-related concerns, preferences related to DE, perceived difficulties, instructional modality, perceived academic performance, content quality, and the perceived relationship between DE and anxiety (Table 3;  $p < 0.05$ ).



Table 3. Comparison of perceptions, concerns, and DE-related variables between undergraduate and graduate dentistry students

|                                                                                                                                                                                                                         | Groups         |                                |                           |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|--------------------------------|---------------------------|--------|
|                                                                                                                                                                                                                         | Total<br>n (%) | Undergraduate<br>(n=150) n (%) | Graduate<br>(n=143) n (%) | p*     |
| <b>Social isolation</b>                                                                                                                                                                                                 |                |                                |                           |        |
| I am going out as usual                                                                                                                                                                                                 | 36 (12.3)      | 5 (3.3)                        | 31 (21.7)                 | <0.001 |
| I am staying home as much as possible (going out only to buy food/medicine)                                                                                                                                             | 195 (66.6)     | 95 (63.3)                      | 100 (69.9)                |        |
| I do not leave home for nothing                                                                                                                                                                                         | 62 (21.2)      | 50 (33.3)                      | 12 (8.4)                  |        |
| <b>Concern</b>                                                                                                                                                                                                          |                |                                |                           |        |
| Professional instability, the chance of unemployment                                                                                                                                                                    | 28 (9.6)       | 9 (6)                          | 19 (13.3)                 | 0.001  |
| Economic crisis in the country                                                                                                                                                                                          | 70 (23.9)      | 27 (18)                        | 43 (30.1)                 |        |
| Contagion                                                                                                                                                                                                               | 181 (61.8)     | 102 (68)                       | 79 (55.2)                 |        |
| Food                                                                                                                                                                                                                    | 4 (1.4)        | 4 (2.7)                        | 0 (0)                     |        |
| Education                                                                                                                                                                                                               | 10 (3.4)       | 8 (5.3)                        | 2 (1.4)                   |        |
| <b>Frequency of virtual lessons</b>                                                                                                                                                                                     |                |                                |                           |        |
| Many times                                                                                                                                                                                                              | 37 (12.6)      | 14 (9.3)                       | 23 (16.1)                 | 0.083  |
| Sometimes                                                                                                                                                                                                               | 62 (21.2)      | 30 (20)                        | 32 (22.4)                 |        |
| Rarely                                                                                                                                                                                                                  | 115 (39.2)     | 57 (38)                        | 58 (40.6)                 |        |
| Never                                                                                                                                                                                                                   | 79 (27)        | 49 (32.7)                      | 30 (21)                   |        |
| <b>Distance education preferences</b>                                                                                                                                                                                   |                |                                |                           |        |
| Video lessons recorded and available for me to watch for as long as I want, without the possibility of asking questions                                                                                                 | 5 (1.7)        | 5 (3.3)                        | 0 (0)                     | 0.002  |
| Video lessons recorded and available for me to watch for as long as I want, with the possibility of taking questions by email                                                                                           | 172 (58.7)     | 95 (63.3)                      | 77 (53.8)                 |        |
| Unrecorded video lessons, only with the teacher's virtual presence, without sharing slides on the screen, without the student's face screen and without the possibility of asking questions                             | 3 (1)          | 0 (0)                          | 3 (2.1)                   |        |
| Video lessons not recorded, with virtual presence of the teacher, with slide sharing on the screen, with the screen of the student's face and with the possibility of asking questions                                  | 85 (29)        | 33 (22)                        | 52 (36.4)                 |        |
| Unrecorded video lessons, without the teacher's virtual presence, only with his live voice, with sharing slides on the screen, without the screen of the student's face and with the possibility of answering questions | 28 (9.6)       | 17 (11.3)                      | 11 (7.7)                  |        |
| <b>Difficulty</b>                                                                                                                                                                                                       |                |                                |                           |        |
| No difficulty                                                                                                                                                                                                           | 59 (20.1)      | 17 (11.3)                      | 42 (29.4)                 | <0.001 |
| Low difficulty                                                                                                                                                                                                          | 79 (27)        | 41 (27.3)                      | 38 (26.6)                 |        |
| Average difficulty                                                                                                                                                                                                      | 97 (33.1)      | 51 (34)                        | 46 (32.2)                 |        |
| A lot of difficulty                                                                                                                                                                                                     | 38 (13)        | 25 (16.7)                      | 13 (9.1)                  |        |
| Extreme difficulty                                                                                                                                                                                                      | 20 (6.8)       | 16 (10.7)                      | 4 (2.8)                   |        |
| <b>Difficulty justification</b>                                                                                                                                                                                         |                |                                |                           |        |
| Not applicable (as theoretically reported having no difficulty in the previous question)                                                                                                                                | 47 (16)        | 18 (12)                        | 29 (20.3)                 | 0.348  |
| Impaired Wi-Fi connection                                                                                                                                                                                               | 72 (24.6)      | 41 (27.3)                      | 31 (21.7)                 |        |
| How to make questions                                                                                                                                                                                                   | 7 (2.4)        | 5 (3.3)                        | 2 (1.4)                   |        |
| Lack of interaction between student and teacher                                                                                                                                                                         | 19 (6.5)       | 11 (7.3)                       | 8 (5.6)                   |        |
| I can't focus                                                                                                                                                                                                           | 126 (43)       | 64 (42.7)                      | 62 (43.4)                 |        |
| Platform adaptation                                                                                                                                                                                                     | 22 (7.5)       | 11 (7.3)                       | 11 (7.7)                  |        |
| <b>Improvement suggestion</b>                                                                                                                                                                                           |                |                                |                           |        |
| Standardization and organization of content with creation of schedules and goals to develop student autonomy                                                                                                            | 56 (19.1)      | 23 (15.3)                      | 33 (23.1)                 | 0.142  |
| Improve dynamics, have a summary at the end of the class, provide complementary material such as PDF documents and exercise                                                                                             | 124 (42.3)     | 74 (49.3)                      | 50 (35)                   |        |
| Availability to answer questions with an online tutor                                                                                                                                                                   | 10 (3.4)       | 5 (3.3)                        | 5 (3.5)                   |        |
| Video storage lessons so I can watch as many times as I want                                                                                                                                                            | 82 (28)        | 39 (26)                        | 43 (30.1)                 |        |
| Improving the stability of videoconferencing platforms                                                                                                                                                                  | 21 (7.2)       | 9 (6)                          | 12 (8.4)                  |        |
| <b>Ideal time of lesson</b>                                                                                                                                                                                             |                |                                |                           |        |
| <30 minutes                                                                                                                                                                                                             | 41 (14)        | 20 (13.4)                      | 21 (14.7)                 | 0.709  |
| 45 minutes                                                                                                                                                                                                              | 92 (31.5)      | 45 (30.2)                      | 47 (32.9)                 |        |
| 1 hour                                                                                                                                                                                                                  | 118 (40.4)     | 65 (43.6)                      | 53 (37.1)                 |        |
| More than 1 hour                                                                                                                                                                                                        | 41 (14)        | 19 (12.8)                      | 22 (15.4)                 |        |
| <b>Class modality</b>                                                                                                                                                                                                   |                |                                |                           |        |
| Online class                                                                                                                                                                                                            | 22 (7.5)       | 3 (2)                          | 19 (13.3)                 | <0.001 |
| Face-to-face class                                                                                                                                                                                                      | 271 (92.5)     | 147 (98)                       | 124 (86.7)                |        |
| <b>Class modality justification</b>                                                                                                                                                                                     |                |                                |                           |        |
| More organized content                                                                                                                                                                                                  | 12 (4.1)       | 4 (2.7)                        | 8 (5.6)                   | 0.451  |
| Practicality in answering questions                                                                                                                                                                                     | 11 (3.8)       | 6 (4)                          | 5 (3.5)                   |        |
| Greater interactivity between student and teacher                                                                                                                                                                       | 78 (26.6)      | 38 (25.3)                      | 40 (28)                   |        |
| I stay more concentrated                                                                                                                                                                                                | 157 (53.6)     | 80 (53.3)                      | 77 (53.8)                 |        |
| I am used to it                                                                                                                                                                                                         | 35 (11.9)      | 22 (14.7)                      | 13 (9.1)                  |        |
| <b>Performance</b>                                                                                                                                                                                                      |                |                                |                           |        |
| Affects extremely negatively                                                                                                                                                                                            | 44 (15)        | 31 (20.7)                      | 13 (9.1)                  | <0.001 |
| Affects negatively                                                                                                                                                                                                      | 141 (48.1)     | 80 (53.3)                      | 61 (42.7)                 |        |
| Does not affect                                                                                                                                                                                                         | 108 (36.9)     | 39 (26)                        | 69 (48.3)                 |        |
| <b>Content</b>                                                                                                                                                                                                          |                |                                |                           |        |
| Very limited                                                                                                                                                                                                            | 71 (24.2)      | 55 (36.7)                      | 16 (11.2)                 | <0.001 |
| Limits a little                                                                                                                                                                                                         | 116 (39.6)     | 61 (40.7)                      | 55 (38.5)                 |        |
| No effect                                                                                                                                                                                                               | 43 (14.7)      | 14 (9.3)                       | 29 (20.3)                 |        |
| Covers a little                                                                                                                                                                                                         | 37 (12.6)      | 14 (9.3)                       | 23 (16.1)                 |        |
| Completely covers                                                                                                                                                                                                       | 26 (8.9)       | 6 (4)                          | 20 (14)                   |        |
| <b>Relationship DE/anxiety</b>                                                                                                                                                                                          |                |                                |                           |        |
| Increases a lot                                                                                                                                                                                                         | 90 (30.7)      | 65 (43.3)                      | 25 (17.5)                 | <0.001 |
| Increases a little                                                                                                                                                                                                      | 125 (42.7)     | 58 (38.7)                      | 67 (46.9)                 |        |
| Does not affect                                                                                                                                                                                                         | 39 (13.3)      | 16 (10.7)                      | 23 (16.1)                 |        |
| Reduces a little                                                                                                                                                                                                        | 39 (13.3)      | 11 (7.3)                       | 28 (19.6)                 |        |
| <b>Anxiety (categorized)</b>                                                                                                                                                                                            |                |                                |                           |        |
| Has no anxiety                                                                                                                                                                                                          | 16 (5.5)       | 9 (6)                          | 7 (4.9)                   | 0.874  |
| Higher anxiety                                                                                                                                                                                                          | 277 (94.5)     | 141 (94)                       | 136 (95.1)                |        |

Legend: \*Chi-square test. Underlined categories indicate proportions with standardized adjusted residuals  $\geq 1.96$ . Wi-Fi: Wireless fidelity, PDF: Portable document format, DE: Distance education



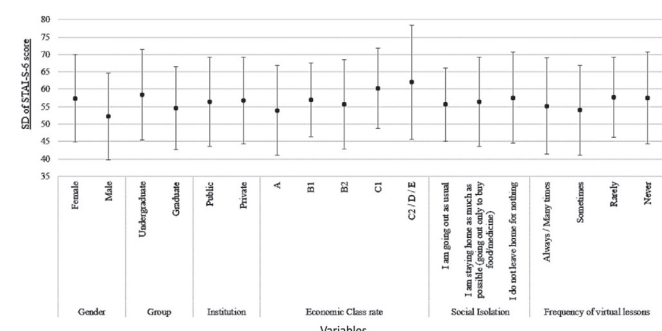
## Anxiety State Scale Impact

STAI-S-6 scores differed significantly according to gender, academic level, socioeconomic status, perceived academic performance, and the perceived relationship between DE and anxiety (Table 4; Figures 2 and 3).

**Table 4. Between-group comparisons of mean STAI-S-6 scores across demographic, educational, and behavioral variables**

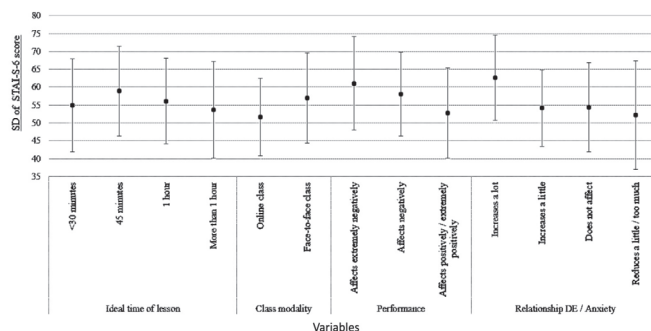
|                                                                             | STAI-S-6 score (SD)       | p      |
|-----------------------------------------------------------------------------|---------------------------|--------|
| Gender <sup>1</sup>                                                         |                           |        |
| Female                                                                      | 57.4 (12.5)               | 0.008  |
| Male                                                                        | 52.3 (12.4)               |        |
| Group <sup>1</sup>                                                          |                           |        |
| Undergraduate                                                               | 58.4 (13.0)               | 0.009  |
| Graduate                                                                    | 54.6 (11.9)               |        |
| Institution <sup>1</sup>                                                    |                           |        |
| Public                                                                      | 56.4 (12.8)               | 0.803  |
| Private                                                                     | 56.8 (12.4)               |        |
| Economic class rate <sup>2</sup>                                            |                           |        |
| A                                                                           | 53.9 <sup>a</sup> (12.9)  | 0.022  |
| B1                                                                          | 56.9 <sup>ab</sup> (10.7) |        |
| B2                                                                          | 55.7 <sup>ab</sup> (12.8) |        |
| C1                                                                          | 60.3 <sup>b</sup> (11.6)  |        |
| C2/D/E                                                                      | 62.0 <sup>ab</sup> (16.4) |        |
| Social isolation <sup>2</sup>                                               |                           |        |
| I am going out as usual                                                     | 55.6 (10.5)               | 0.730  |
| I am staying home as much as possible (going out only to buy food/medicine) | 56.4 (12.8)               |        |
| I do not leave home for nothing                                             | 57.6 (13.1)               |        |
| Frequency of virtual lessons <sup>2</sup>                                   |                           |        |
| Always/many times                                                           | 55.2 (13.8)               | 0.226  |
| Sometimes                                                                   | 54.0 (12.9)               |        |
| Rarely                                                                      | 57.7 (11.5)               |        |
| Never                                                                       | 57.6 (13.2)               |        |
| Ideal time of lesson <sup>2</sup>                                           |                           |        |
| <30 minutes                                                                 | 55.0 (13.0)               | 0.104  |
| 45 minutes                                                                  | 58.9 (12.5)               |        |
| 1 hour                                                                      | 56.1 (12.0)               |        |
| More than 1 hour                                                            | 53.7 (13.6)               |        |
| Class modality <sup>1</sup>                                                 |                           |        |
| Online class                                                                | 51.7 (10.9)               | 0.059  |
| Face-to-face class                                                          | 56.9 (12.7)               |        |
| Performance <sup>2</sup>                                                    |                           |        |
| Affects extremely negatively                                                | 61.1 <sup>a</sup> (13.1)  | <0.001 |
| Affects negatively                                                          | 58.1 <sup>ab</sup> (11.7) |        |
| Does not affect/affects positively or extremely positively                  | 52.7 <sup>b</sup> (12.6)  |        |
| Self-perception-relationship DE/anxiety <sup>2</sup>                        |                           |        |
| Increases a lot                                                             | 62.7 <sup>a</sup> (11.9)  | <0.001 |
| Increases a little                                                          | 54.2 <sup>b</sup> (10.7)  |        |
| Does not affect                                                             | 54.4 <sup>b</sup> (12.4)  |        |
| Reduces a little/too much                                                   | 52.1 <sup>b</sup> (15.2)  |        |

Legend: 1-Independent samples t-test; 2-One-way ANOVA. Means with different superscript letters indicate statistically significant differences between groups ( $p < 0.05$ ). Means sharing at least one letter are not significantly different. STAI-S-6: State-Trait Anxiety Inventory-State 6-item short form, SD: Standard deviation, DE: Distance education, ANOVA: Analysis of variance



**Figure 2.** Mean STAI-S-6 scores according to demographic and socioeconomic characteristics. Black dots represent mean values and vertical bars indicate  $\pm$  standard deviation

STAI-S-6: State-Trait Anxiety Inventory-State 6-item short form



**Figure 3.** Mean STAI-S-6 anxiety scores and standard deviations according to DE-related variables. Black dots represent the mean STAI-S-6 scores for each DE category, and vertical bars indicate  $\pm$  standard deviation

STAI-S-6: State-Trait Anxiety Inventory-State 6-item short form, DE: Distance education

Students reporting extremely negative effects of DE on academic performance presented the highest STAI-S-6 scores ( $61.1 \pm 13.1$ ), whereas those reporting no negative effects exhibited lower scores ( $52.7 \pm 12.6$ ;  $p < 0.001$ ;  $\eta^2 = 0.11$ ).

Similarly, students who perceived that DE greatly increased anxiety exhibited the highest STAI-S-6 scores ( $62.7 \pm 12.4$ ), significantly higher than those observed in the remaining categories ( $p < 0.001$ ;  $\eta^2 = 0.18$ ). No significant differences in STAI-S-6 scores were observed according to social isolation status, frequency of virtual classes, or preferred class duration ( $p > 0.05$ ).

To complement the statistical significance tests, effect size estimates were calculated for all significant comparisons involving STAI-S-6 scores (Table 5). A large effect size was observed for age differences between undergraduate and graduate students (Cohen's  $d = 1.58$ ). Small-to-moderate effects were identified for gender (Cohen's  $d = 0.41$ ) and academic level (Cohen's  $d = 0.31$ ). For variables analyzed using one-way ANOVA, the largest effect size was found for the perceived relationship between DE and anxiety ( $\eta^2 = 0.18$ ), followed by the perceived impact of DE on academic performance ( $\eta^2 = 0.11$ ), whereas socioeconomic status showed a smaller effect ( $\eta^2 = 0.05$ ).

**Table 5. Effect sizes for significant comparisons involving STAI-S-6 scores**

| Variable                                       | Statistical test           | Effect size        | Magnitude         |
|------------------------------------------------|----------------------------|--------------------|-------------------|
| Age (undergraduate vs. graduate students)      | Independent samples t-test | Cohen's $d = 1.58$ | Large             |
| Gender                                         | Independent samples t-test | Cohen's $d = 0.41$ | Small-to-moderate |
| Academic level                                 | Independent samples t-test | Cohen's $d = 0.31$ | Small             |
| Socioeconomic status                           | One-way ANOVA              | $\eta^2 = 0.05$    | Small             |
| Perceived impact of DE on academic performance | One-way ANOVA              | $\eta^2 = 0.11$    | Moderate          |
| Perceived relationship between DE and anxiety  | One-way ANOVA              | $\eta^2 = 0.18$    | Large             |

Legend: Interpretation of effect sizes followed conventional criteria. For Cohen's  $d$ , values of approximately 0.20, 0.50, and 0.80 were considered small, moderate, and large, respectively. For eta squared ( $\eta^2$ ), values of approximately 0.01, 0.06, and 0.14 were interpreted as small, moderate, and large effects, respectively. STAI-S-6: State-Trait Anxiety Inventory-State 6-item short form, DE: Distance education, ANOVA: Analysis of variance

## DISCUSSION

This study provides insight into dentistry students' psychological and academic experiences during the early phase of the COVID-19 pandemic, when emergency DE was abruptly implemented. Relatively few studies have directly compared undergraduate and graduate students, and the present findings suggest that academic level may influence how students perceive DE and its relationship with anxiety.



More recent studies have reported similar educational and psychological challenges in hybrid and DE settings, although caution is warranted when comparing these findings with data obtained during the early phase of the pandemic.<sup>11,12,14,21</sup>

An important finding of the present study was that subjective perceptions related to DE, particularly perceived academic performance decline and the belief that DE was associated with increased anxiety, were accompanied by higher STAI-S-6 scores. These findings suggest that students' appraisal of DE may have been more strongly related to psychological distress than structural characteristics of DE itself.<sup>22-24</sup>

Differences in social isolation patterns and pandemic-related concerns were observed between undergraduate and graduate students. Graduate students appeared to be more concerned about professional instability and the economic consequences of the pandemic, whereas undergraduate students more frequently reported concerns related to contagion and educational issues. These differences may reflect distinct academic responsibilities and career stages, findings that are consistent with previous reports describing heterogeneous psychological responses among health professions students.<sup>24,25</sup>

The interruption of clinical and preclinical activities was associated with emotional distress among dental students, consistent with previous studies showing that reduced opportunities for practical training, uncertainty regarding academic progression, and concerns about professional preparedness are associated with anxiety and perceived academic impairment.<sup>3,4,9,26</sup> Limited teacher-student interaction and reduced opportunities for hands-on learning have also been identified as stressors that may negatively affect student engagement and perceived quality of education.<sup>7,10,13</sup>

Undergraduate students exhibited higher anxiety levels than graduate students. This finding may reflect differences in academic maturity, self-regulation skills, familiarity with independent learning, and expectations regarding professional training. Similar patterns have been reported in studies evaluating emotional responses across different educational stages.<sup>10,11,27</sup> Socioeconomic disparities also emerged as an important factor, with students from lower economic strata presenting higher anxiety scores, which is consistent with evidence suggesting greater academic and digital burdens among socially vulnerable students.<sup>28</sup> Although the correlation between age and STAI-S-6 scores reached statistical significance, its magnitude was weak ( $r=-0.125$ ), indicating limited practical relevance. Therefore, age alone should not be considered a major determinant of anxiety levels among dentistry students.

A noteworthy contribution of this study was the association between subjective DE experiences, including perceived academic performance decline and self-perceived anxiety related to DE, and objective anxiety scores measured by the STAI-S-6. Similar relationships have been described in studies reporting that cognitive overload, prolonged screen exposure, and perceived reductions in learning quality are associated with less favorable psychological outcomes.<sup>10-12,21,27</sup> Recent investigations have also suggested that DE fatigue may be accompanied by reduced concentration and increased frustration.<sup>10,14,28</sup>

The findings of the present study underscore the importance of pedagogical approaches that combine flexibility with structured and interactive educational activities.

Strategies such as shorter synchronous sessions, active learning opportunities, and improved instructional design may help reduce cognitive burden and enhance student engagement.<sup>10-12,22</sup> In dental education, combining digital resources with supervised practical activities and hybrid learning models may contribute to improving academic continuity and student well-being.

Although Artificial Intelligence (AI)-based educational tools were not investigated in the present study, recent technological advances may provide opportunities to address some of the educational challenges identified during emergency DE. Future studies are warranted to evaluate the potential role of AI-assisted educational approaches in dental education.

## Limitations

Several limitations should be considered when interpreting the present findings. First, the cross-sectional design precludes causal inference. Second, the use of self-reported measures may have introduced reporting bias. Third, because the survey was administered online, selection bias cannot be excluded. Furthermore, data collection was conducted between March and June 2020, and therefore the findings reflect the specific circumstances of the early phase of the COVID-19 pandemic. Consequently, caution is warranted when extrapolating these results to later phases of the pandemic or contemporary educational settings.

Potentially relevant confounding variables, including previous psychiatric disorders, psychotropic medication use, social support, and academic performance before the pandemic, were not assessed and may have influenced anxiety scores. Although multivariable regression models may be useful for identifying independent predictors of anxiety, such analyses were beyond the exploratory objectives of the present study. Future longitudinal investigations are warranted to better elucidate the relative contribution of these factors to psychological outcomes among dentistry students.

## CONCLUSION

These findings suggest that dentistry students experienced considerable psychological burden during emergency DE implemented in the early phase of the COVID-19 pandemic, with higher anxiety levels observed among females, undergraduate students, and individuals from lower socioeconomic backgrounds. The results may indicate that difficulties adapting to DE and the perception that DE increased anxiety were associated with higher STAI-S-6 scores. Overall, these findings underscore the potential importance of mental-health-oriented educational strategies and equitable access to digital resources during periods of major educational disruption. Lessons learned from the early pandemic period may help inform the development of more resilient and student-centered educational models in the future.

## ETHICAL DECLARATIONS

### Ethics Committee Approval

This study was approved by the Universitário Pedro Ernesto Ethics Committee (Date: 17.05.2020, Decision No: 4.029.405).

### Informed Consent

Electronic informed consent was obtained from all individual participants prior to their inclusion in the study. Participants





were fully informed about the study's aims, procedures, potential risks and benefits, and their rights, including the right to withdraw at any time without consequence. All participants voluntarily provided electronic informed consent.

## Peer Review Process

This manuscript was subject to external peer review.

## Conflict of Interest

The authors declare no conflicts of interest related to this study.

## Financial Disclosure

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## Author Contributions

Concept: LSCB, FRGA, CCAQ; Design: LSCB, FRGA, CCAQ; Control: LSCB, FRGA, CCAQ; Resources: LSCB, FRGA, CCAQ; Materials: LSCB; Data Collection and/or Processing: LSCB; Analysis and/or Interpretation: LSCB, MCCB; Literature Review: LSCB, MCCB, FRGA, CCAQ; Writing the Article: LSCB, MCCB, FRGA, CCAQ; Critical Review: LSCB, MCCB, FRGA, CCAQ.

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## REFERENCES

- Jehi T, Khan R, Dos Santos H, Majzoub N. Effect of COVID-19 outbreak on anxiety among students of higher education: a review of literature. *Curr Psychol*. 2022;42(20):17475-17489. doi:10.1007/s12144-021-02587-6
- Xu T, Wang H. High prevalence of anxiety, depression, and stress among remote learning students during the COVID-19 pandemic: evidence from a meta-analysis. *Front Psychol*. 2023;13:1103925. doi:10.3389/fpsyg.2022.1103925
- Limeira FIR, Cruz PF, Andrade ARC, Guiomarino Neto AB, Arantes DC. Depression, anxiety and stress among dental students during COVID-19 pandemic and distance learning. *Rev ABENO*. 2022;22(2):1-12. doi:10.30979/revabeno.v22i2.1563
- Silva PGB, Oliveira CAL, Borges MMF, et al. Distance learning during social seclusion by COVID-19: improving the quality of life of undergraduate dentistry students. *Eur J Dent Educ*. 2021;25(1):124-134. doi:10.1111/eje.12583
- Kim HR, Kim EJ. Factors associated with mental health among international students during the COVID-19 pandemic in South Korea. *Int J Environ Res Public Health*. 2021;18(21):11381. doi:10.3390/ijerph182111381
- Xie H, Wang J, Chen Y. Prevalence of anxiety and depression symptoms among international students during the COVID-19 pandemic: a meta-analysis. *INPLASY*. 2022. doi:10.37766/inplasy2022.10.0012
- Keskin G. Self-report measurement of depression, anxiety, and stress caused by COVID-19 pandemic in senior undergraduate dental students. *Pesqui Bras Odontopediatria Clín Integr*. 2021;21:102. doi:10.1590/pboci.2021.102
- Andersson MA, Hitlin S. Subjective dignity and self-reported health: results from the United States before and during the COVID-19 pandemic. *SSM Ment Health*. 2022;2:100113. doi:10.1016/j.ssmmh.2022.100113
- Demirekin ZB, Buyukcavus MH. Effect of distance learning on quality of life, anxiety and stress levels of dental students during the COVID-19 pandemic. *BMC Med Educ*. 2022;22(1):3382. doi:10.1186/s12909-022-03382-y
- Amboy MKQ, Habaña MP, Ramirez LM, Sotelo MG, Penuela AC, Oducado RMF. Zoom fatigue and satisfaction with online learning among Filipino nursing students. *Innoeduca Int J Technol Educ Innov*. 2023;9(1):53-66. doi:10.24310/innoeduca.2023.v9i1.15402
- Zanini GS, Campanhã LMF, Biazus EL, Cardoso HF, Verardi CEL. Mood and anxiety in university students during COVID-19 isolation: a comparative study. *COVID*. 2025;5(8):127. doi:10.3390/covid5080127
- Voss C, Shorter P, Weatrowski G, Mueller-Coyne J, Turner K. A comparison of anxiety levels before and during the COVID-19 pandemic. *Psychol Rep*. 2022;126(6):2669-2689. doi:10.1177/00332941221093250
- Fouda SM, Madi M, Ellakany P, et al. Perception of dental students and educators about e-learning during COVID-19 pandemic. *BMC Oral Health*. 2025;25(1):829. doi:10.1186/s12903-025-06152-6
- Csorba LM, Dabija DC. Impact of the COVID-19 pandemic on students' future online education behaviour. *Heliyon*. 2024;10(20):e39560. doi:10.1016/j.heliyon.2024.e39560
- Özgüç S, Kaplan Serin E, Tanriverdi D. Death anxiety associated with COVID-19: a systematic review and meta-analysis. *Omega*. 2021;88(3):823-856. doi:10.1177/00302228211050503
- Fioravanti-Bastos ACM, Cheniaux E, Landeira-Fernandez J. Development and validation of a short-form version of the Brazilian State-Trait Anxiety Inventory. *Psicol Reflex Crit*. 2011;24(3):485-494. doi:10.1590/s0102-79722011000300009
- von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. *Lancet*. 2007;370(9596):1453-1457. doi:10.1016/S0140-6736(07)61602-X
- Eysenbach G. Improving the quality of Web surveys: the Checklist for Reporting Results of Internet E-Surveys (CHERRIES). *J Med Internet Res*. 2004;6(3):e34. doi:10.2196/jmir.6.3.e34
- Associação Brasileira de Empresas de Pesquisa (ABEP). Critério de Classificação Econômica Brasil 2019. São Paulo: ABEP; 2019. Available from: <https://www.abep.org/criterio-brasil>
- Biau DJ, Kernéis S, Porcher R. Statistics in brief: the importance of sample size in the planning and interpretation of medical research. *Clin Orthop Relat Res*. 2008;466(9):2282-2288. doi:10.1007/s11999-008-0346-9
- Pucinelli CM, Oliveira AA, Nelson Filho P, et al. Online teaching, quality of life and anxiety of Brazilian dental professors during the COVID-19 outbreak. *Braz Oral Res*. 2022;36:0036. doi:10.1590/1807-3107bor-2022.vol36.0036
- Hu C, Li F, Wang S, Gao Z, Pan S, Qing M. Role of Artificial Intelligence in personalized learning and clinical training in dental education. *Cogent Educ*. 2025;12:1. doi:10.1080/2331186x.2025.2490425
- Junqueira E. Literacies and generative AI in education: a systematic review. *Ubiquity Proc*. 2025;6(1):15. doi:10.5334/uproc.183
- Agius A, Gatt G, Zahra EV, et al. Self-reported dental student stressors and experiences during the COVID-19 pandemic. *J Dent Educ*. 2021;85(2):208-215. doi:10.1002/jdd.12409
- Rodríguez-Molinero J, Corral-Liria I, Jiménez-Fernández R, et al. Resilience and psychological factors among dentistry students receiving face-to-face lectures during the COVID-19 pandemic. *BMC Med Educ*. 2024;24(1):446. doi:10.1186/s12909-024-05445-8
- Asmoro PS. Psychosocial learning environment, learning anxiety, and learning satisfaction among distance learners during COVID-19. *Cogent Educ*. 2024;11(1):2359870. doi:10.1080/2331186x.2024.2359870
- Moradi S, Fateh MS, Movahed E, et al. Prevalence of depression, anxiety, and sleep disorder among dental students: a systematic review and meta-analysis. *J Dent Educ*. 2024;88(7):900-909. doi:10.1002/jdd.13506
- Sahin S, Tuna R. Effect of anxiety on thriving levels of university students during the COVID-19 pandemic. *Collegian*. 2022;29(3):263-270. doi:10.1016/j.colegn.2021.10.004