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COVID-19 pandemic and its impact on dental students: A multi-institutional survey

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Abstract

Purpose/objectives: To investigate dental students' perceptions and concerns regarding the COVID-19 pandemic, their coping strategies and support resources, and their perceived stress levels.

Methods: A customized 19-item survey and the perceived stress scale (PSS) were applied to undergraduate dental students from the US, Spain, Ireland, Chile, India, and Brazil between April 10 and July 5, 2020. Linear modeling and mediation analysis were used to explore the relationships among demographics, stressors, coping mechanisms, social support, and stress

Results: A total of 4475 students responded to the survey. The majority (72.4%) were women, and 52.3% had no COVID-19 training at the time of the survey. The students reported that they had to accommodate to changes in patient care (96.6%) and didactic learning (95.2%) activities, while 88.5% of the respondents indicated at least one of their courses moved online. Transition to online courses went "smoothly with some troubles" for 51.8% of the respondents, and 48.3% perceived the faculty as prepared for the online transition; however, 45.9% reported feeling extremely concerned about the impact of COVID-19 on their education. The average PSS score was 21.9 of 40 (moderate stress). Multivariate models were built for participants with full data ($n = 3899$). Being male, having completed more dental coursework, and perceiving a smoother transition were associated with lower PSS scores; more concern about academic progress was associated with higher PSS. Faculty support mediated the relationship between a smoothness of transition and concern about academic progress and PSS scores

Conclusion: Stress caused by the pandemic may be alleviated by smoother transition and good faculty support.

KEYWORDS
dental education, dental school, dentistry, SARS-Cov-2

1 | INTRODUCTION

In December 2019, several cases of pneumonia of uncertain etiology were reported in Wuhan, Province of Hubei, China. After initial investigation by Chinese health authorities, the pneumonia cases were reported to be caused by a novel coronavirus, then called 2019-nCov.[1] Lately, it has also been called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[2] Initial reports described common symptoms to include the following: fever, cough,

myalgia, fatigue, and headache. Dyspnea developed in 55% of the cases, all patients had pneumonia with abnormal CT findings, and 32% needed intensive care.[3] The novel coronavirus quickly spread to other provinces in China and other countries in East Asia, and the risk for a fast global spread was predicted.[4] The first Case of 2019-nCoV in the US was reported on January 20, 2020, in Snohomish County, Washington.[5] The World Health Organization (WHO) declared the emergence of 2019-nCoV a public health emergency of international concern on January 30, 2020,[6] and on March 11, 2020, WHO declared COVID-19 outbreak a global pandemic.[7]

Although the results are uncertain, governments around the globe introduced several country-and locally-based measures in an attempt to control the spread of the disease and prevent an overwhelming impact on the health care systems.[8] These measures included social distancing requirements, lockdown/curfew, voluntary and sometimes mandatory quarantine, prohibited mass gatherings, and even mandated the isolation of households, towns, or cities; closures of places of work and educational institutions were also put in place.[8]

Dental schools were either closed or had their clinic activities postponed, impacting dental education worldwide.[9] Anxiety, stress, and other mental health issues were already prevalent among students even before the COVID-19 crisis in the US and other countries,[10,11] and have been a concerning issue in dental education for some time.[11,12]

As dental schools around the globe do the best they can, to navigate the uncharted waters of the current COVID-19 pandemic, trying to transfer instructions to online courses, the students may be under higher pressure, and suffering from even higher anxiety and stress. This was an even greater concern in countries where online classes and courses may not have existed. The pandemic created ambiguity in graduation deadlines, required clinical experiences, and how critical training and examinations would be performed.

The way students appraise situations can determine their reaction to the stressors,[13] impacting their health and well-being.[14] Previous studies have already reported that stress is prevalent among dental students,[11] and prevention strategies should include early identification of stressors by both faculty and students.[15] Common stressors include examinations, grades, workload, receiving criticism, inconsistency of feedback, dealing with difficult patients, and difficulties of learning clinical procedures.[11] Common stress reduction strategies used by dental students are practicing relaxing activities and relying on emotional support from others.[15] Mechanisms offered by dental schools to reduce stress levels have included stress management courses, relaxation techniques, and counseling.[11,12,15]

To understand how to best support dental students in such stressful situations, our study assessed dental students' appraisal of the current COVID-19 pandemics-related stressors (perceived changes in education, concerns), their coping strategies, available social support, and how they relate to their perceived stress levels.

2 | MATERIALS AND METHODS

A questionnaire was designed consisting of 19 questions: five questions regarding students' demographic information, seven questions about their perception regarding changes in dental education due to the current COVID-19 situation (appraisal of stressors: e.g., sudden changes in training experiences, availability of support resources), three questions about their concerns as they relate to the pandemics, three questions regarding their support availability, and one question asking students to select coping strategies they use out of six options (link to *supplementary material item #1*).

Multiple rounds of discussion occurred among the research team members before achieving consensus regarding the domains and questions. When a consensus was achieved, the survey was presented to a panel of five faculty members and five students that were not part of the research team. This panel analyzed the applicability of the content. The experts were asked to rate each scale item on a four-point Likert scale, ranging from 1 (not relevant) to 4 (very relevant). The content validity index (CVI) was obtained by dividing the number of panelists who choose options 3 and 4 by the total number of panelists. The accepted rate scale was 0.80. A low CVI indicated that certain items would be eliminated or revised to establish sufficient content validity. When all questions reached 0.80, the survey was finalized. The well-known perceived stress scale (PSS), commonly used to help understand how different situations affect our feelings and our perceived stress, was used to assess students' stress levels[15] (link to *supplementary material item #2*). PSS ranges from 0 to 40, with higher scores indicating higher perceived stress.[16]

The anonymous survey was applied to dental students from North American dental schools (University of Iowa, University of Missouri-Kansas City, University of Texas-Houston, University of Florida, Roseman University, Tufts University, and Indiana University) and dental schools from Spain (UIC Barcelona), Ireland (University College Cork), Chile (University of Talca), India (DY Patil, Manipal, Indira Gandhi, Oxford, Sri Venkateshwaraa,

and VSPM Nagpur), and Brazil (University of Sao Paulo, Federal University of Pelotas, Federal University of Rio Grande do Norte, Federal University of Passo Fundo, Federal University of Juiz de Fora, Federal University of Campina Grande, and others).

The survey link was distributed electronically by a formal collaborator at each dental school who was familiar to the student respondents. A unique Qualtrics link was generated for each school fielded from the University of Iowa. Some dental schools housed their Qualtrics survey, as determined by local Institutional Review Boards (IRBs), then shared the data with the data analysis center (University of Iowa). Students were informed that the completion of the questionnaire served as consent to participate. A human subjects research determination form was reviewed and approved by the Institutional Review Board and the Human Subjects Office at the University of Iowa, and this project was determined to be non-human subjects research (202003613). Each school participating has either their own IRB approval or has an agreement with Iowa that their survey and responses will be supervised by the University of Iowa IRB. All data were collected between April 10 and July 5, 2020.

Univariate summary statistics of each survey question and score were reported as counts (percentages) for categorical variables and mean (range) for continuous variables. Scores were generated for questions under the same domain. Changes in learning experiences score (questions 7, 8, and 9) ranged from 0 to 6; higher scores indicate more disruptions to learning. Smooth transition score (questions 6, 10, 11, and 12) ranged from 0 to 10, and higher scores indicate smoother transitions. Concern score, a sum across three items (questions 13, 14, and 15) with response options ranging from 0 to 4, ranged from 0 to 12 with higher scores indicating more concern. Individual social support scores ranged from 0 to 4, with higher scores indicating more support. Total social support score (the combination of each score, i.e., questions 16, 17, and 18) ranged from 0 to 12 with higher scores indicating more social support. The coping score ranged from −3 (more emotion-focused coping: e.g., by not thinking much about it or avoiding the topic, including questions 19a, 19e, and 19f) to 3 (more problem-focused coping: e.g., by reaching out to faculty and staff with questions, reaching out to peer dental students/family and friends for support, including questions 19b, 19c, and 19d).

Bivariate analyses were performed to help inform the multivariate analysis strategy. To relate PSS to demographics, perceptions, and coping mechanisms, linear mixed models were used. A mixed modeling framework was used to account for the effects of country and school and the correlations of the responses of students within each. Random intercepts for each country and school were included. All models were adjusted for demographics, including gender, percent of dental school completed, and school type (public or private). Three models were used to explore these relationships: the first only included demographics, the second model accounted for perceptions (stress appraisal) as well, and the third model included demographics, stressors, and coping mechanisms. Finally, mediation analysis was used to assess the potential mediating effect of social support – from faculty, peers, or family and friends – on the presence or appraisal of stressors and overall stress levels experienced by students, PSS. For the mediation analysis of each social support tenant and each stressor, three models that adjusted for demographics were examined. The first related PSS to social support, the second related social support to the appraisal of stressors, and the third related PSS to both social support and the appraisal of stressors. All analyses were conducted using R version 4.0.0.

3 | RESULTS

A total of 4475 students responded to the survey, and 72.4% were women. Brazil contributed with 1514 students, India with 1499, the US with 796, Chile with 398, Spain with 176, and Ireland with 95. The mean PSS score was 21.9, which falls within the moderate (14–26) range of the scale. Variation among countries ranged from the lowest mean of 18.0 in the US to the highest mean of 24.9 in Brazil. *Supplementary material item #3* (add a link) presents a table with the bivariate analysis between country and each question in the survey. *Supplementary material item #4* (add a link) presents a table with contextual information related to COVID-19 pandemic development in each of the most contributory institutions, including general information about the dental school and local and institutional COVID-19 experiences and responses.

The analytic process was approached via three sequential mixed models and was guided by the Stress Process model.[13] We first entered the demographic variables to control their effects on the PSS outcome. Next, we entered the variables representing the appraisal of various stressors related to the COVID-19 pandemic, then added the coping variable to assess the role of coping over and above the impact of stressors appraised. For the models, only those participants with full data on all variables to be examined are included ($n = 3,899$). To account for the effects of country and dental school, mixed models with random effects for the country and dental school were used. Results from the first model showed that across all countries and schools, males had lower PSS scores. Those in public schools had marginally higher PSS than those in private schools. Percent of dental school completed was not associated with PSS (Table 1).

TABLE 1 Mixed model results

Term	Model 1 demographic characteristics		Model 2 appraisal of stressors added		Model 3 coping style added	
	Estimate (SE)[a]	p-value[a]	Estimate (SE)[b]	p-value[b]	Estimate (SE)[c]	p-value[c]
Gender (male)	−2.20 (0.23)	<0.001	−1.90 (0.20)	<0.001	−1.90 (0.21)	<0.001
Percent of dental school completed	0.52 (0.38)	0.173	−0.69 (0.34)	0.042	−0.69 (0.34)	0.042
School type (public)	1.08 (0.56)	0.061	−0.04 (0.54)	0.948	−0.03 (0.54)	0.952
Changes in learning	–	–	−0.09 (0.10)	0.385	−0.09 (0.10)	0.381
Smooth transition	–	–	−0.89 (0.05)	<0.001	−0.89 (0.05)	<0.001
Concern	–	–	1.02 (0.04)	<0.001	1.02 (0.05)	<0.001
Coping	–	–	–	–	0.01 (0.07)	0.842

[a]Model including only demographics.
[b]Model including demographics and appraisal of stressors.
[c]Model including demographics, appraisal of stressors, and coping style.

The second model includes stress appraisal variables: changes in learning, smooth transition, and concern for education. A less smooth transition and more concern were associated with increased PSS. Once these factors were added, the negative effect of being in public school compared to private was made insignificant, while the percent of dental school completed became significant – more dental school was associated with lower PSS (Table 1). Then, we added in coping strategies. Coping style was not significant (Table 1).

Finally, we investigated if social support mediates the relationship between each stressor and PSS. Increased changes in learning, after accounting for demographics, were not associated with decreased PSS ($\beta = -0.13$, SE = 0.1, $p = 0.2$). No mediation analysis was performed because changes in learning were not significantly associated with PSS.

A smoother transition, after accounting for demographics, was associated with decreased PSS ($\beta = -1.0$, SE = 0.06, $p < 0.001$). It was also associated with increased social support ($\beta = 0.52$, SE = 0.02, $p < 0.001$). Once social support was added to the model, the coefficient for smooth transition became smaller ($\beta = -0.69$, SE = 0.05, $p < 0.001$). The results of this mediation analysis show that the ratio of the indirect effect to the direct effect was 0.35, which indicates that about 35% of the association between the appraised stressor, whether the transition to online education was smooth, and PSS was explained by the presence of social support. Looking at each aspect of social support individually, we noticed that support from faculty explained 28%, support from family and friends 18%, and support from peers 8% of the association between smooth transition and PSS.

More concern about academic progress, after accounting for demographics, was associated with increased PSS ($\beta = 1.1$, SE = 0.04, $p < 0.001$). It was also associated with decreased social support ($\beta = -0.04$, SE = 0.01, $p = 0.003$).

Once social support was added to the model, the coefficient for concern became smaller ($\beta = 1.0$, SE = 0.04, $p < 0.001$). The ratio of the indirect effect to the direct effect was 0.03, indicating that social support explained about 3% of the association between concern and PSS. Similarly to smooth transition, faculty support (3%) and family and friends (4%) contributed the most, while peer support did not (0%).

4 | DISCUSSION

This study aimed to investigate dental students' perceptions and concerns regarding the COVID-19 pandemic, and their coping strategies and support resources in relation to their perceived stress levels. Overall, being female, perceiving a less smooth transition to online learning and having more concern about academic progress and dental education were associated with higher PSS scores.

Gender is a predictor of stress and anxiety, as female students universally report higher levels of stress.[14,15,17,18] The present study is consistent with this trend, with females reporting higher PSS scores. This may be a result of females being more likely to articulate their worries and emotions in questionnaires.[14,17]

In addition to gender, those who felt that the transition to online learning went smoothly reported lower PSS scores. A perceived smooth transition was associated with the faculty members being prepared for the transition to online learning and the belief that the school was doing the best possible to address the challenges associated with the COVID-19 pandemic.

Dental students reporting more pandemic-related concerns had higher PSS scores. Higher concern includes concern about the pandemics' effect on their dental education and concern about graduating on time. Higher concern was associated with a lower perceived smooth

transition, less support (from faculty, peers, family, and friends), and less belief that the school was doing the best possible job on addressing these challenges. It has been shown in the literature that seeking social support results in less perceived stress.[18] Having access to a sufficient amount of support is critical especially in unprecedented situations like COVID-19 that creates a lot of ambiguity in life.[17,18] Our results highlight the important roles of faculty and staff to ensure a smooth transition to online learning with sufficient support to minimize student distress.

The COVID-19 pandemic has altered the environment and made it more difficult for dental students to have close professional relationships with faculty. Social distancing, as well as moving to an online learning format limited dental students' contact with their faculty and peers. Dental students who felt that they had support from their faculty during the transitions were shown to have a lower PSS score. Support from faculty was also the major factor mediating the association between less smooth transitions and higher stress scores, suggesting that the negative impacts of the structural stressors could be mitigated by strong support from the faculty and staff. Literature has shown that one of the most significant and strongest predictors of stress/anxiety is the students' satisfaction with their faculty relationships[11,17]; faculty support has also been shown to be associated with lower stress levels in dental students.[17]

Our data suggest that having faculty support was also associated with a perceived smoother transition to online learning, which was then associated with less concern about the effect of the pandemic on students' education. This highlights that faculty support may be a key component in how dental students appraise stressors related to the COVID-19 pandemic, cope with such stressors, and experience overall stress levels.

Although this study has several strengths, such as a large sample size from multiple countries, it also has some limitations. The schools sampled in this study were chosen based on contacts the primary investigator had both in and outside the United States. Thus, the data collected in this study are large, but convenient sample. Several schools declined to participate due to limited activities and resources in their schools during the height of the pandemic. Also, in some places, the lack of an online mode of obtaining ethical clearances and other permissions hindered the participation of few institutes. Students at these institutions may have had differing experiences related to the pandemic than those from schools that participated. In addition, the cross-sectional design of the study precludes investigating causality and only allows for examining possible associations.

Looking towards the future to life after the COVID-19 pandemic, it will be beneficial to investigate the changes in prominent stressors of dental students. It is evident that the faculty-student relationship is a critical mediator of stress and anxiety in dental school pre-COVID-19 and amidst the pandemic, and will be a possible prominent mediator post-COVID-19. The faculty-student relationship plays a large role in the psychological health of dental students, affecting their academic success and performance.[17] The COVID-19 pandemic posed a tremendous challenge to both faculty and students, leaving no time to prepare for the changes that had to occur to prevent the spread of the illness. This highlights the importance of strengthening baseline supportive relationships between the faculty and students and developing support provision mechanisms that can be activated in such unanticipated situations, for example, when ordinary forms of social interactions are disrupted. With this in mind, as dental schools move forward through the COVID-19 pandemic, an emphasis should be made to foster the faculty-student relationship.

5 | CONCLUSION

In this large sample of dental students in different countries, being a woman, having a less smooth transition, and demonstrating more concern were associated with increased perceived stress levels; support from faculty was the major factor in mediating the relationship between transition in learning and stress levels.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.