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In an era of uncertainty: Impact of COVID-19 on dental education

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Abstract
Purpose/Objectives: The coronavirus disease 2019 (COVID-19) pandemic arguably represents the worst public health crisis of the 21st century. However, no empirical study currently exists in the literature that examines the impact of the COVID-19 pandemic on dental education. This study evaluated the impact of COVID-19 on dental education and dental students’ experience.

Methods: An anonymous online survey was administrated to professional dental students that focused on their experiences related to COVID-19. The survey included questions about student demographics, protocols for school reopening and student perceptions of institutional responses, student concerns, and psychological impacts.

Results: Among the 145 respondents, 92.4% were pre-doctoral dental students and 7.6% were orthodontic residents; 48.2% were female and 12.6% students lived alone during the school closure due to the pandemic. Students’ age ranged from 23 to 39 years. Younger students expressed more concerns about their emotional health ($P = 0.01$). In terms of the school’s overall response to COVID-19, 73.1% students thought it was effective. The majority (83%) of students believed that social distancing in school can minimize the development of COVID-19. In general, students felt that clinical education suffered after transitioning to online but responded more positively about adjustments to other online curricular components.

Conclusions: The COVID-19 pandemic significantly impacted dental education. Our findings indicate that students are experiencing increased levels of stress and feel their clinical education has suffered. Most students appear
The novel coronavirus disease 2019 (COVID-19) pandemic arguably represents the worst public health crisis of the 21st century. Despite global efforts to mitigate disease spread, virtually no aspect of daily life remains unaffected. Students are no exception to this disruption as many institutions closed campuses or transitioned from in-person to online learning. In addition, a myriad of other activities, such as school clubs, sports, conferences, and graduations were cancelled, postponed, or moved to online venues.

The pandemic produced widespread concern among the dental community. Predominantly spread by respiratory droplet/contact,1 the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a virus that caused the COVID-19 disease, is abundantly present in nasopharyngeal and salivary secretions of affected patients.2 Since dental practice exposes practitioners to saliva, blood, and other body fluids, dentists face an increased risk for contracting the coronavirus. The unabated spread of SARS-CoV-2 highlights the need for dentists to be diligent in their efforts to avoid viral exposure and spread.

Dental educators recognize the special challenges the pandemic presents for educating dental students.3 Specifically, the pandemic disrupted the clinical experiences for students who had not yet completed clinical requirements for graduation or taken regional board exams. Early in the pandemic, the Centers for Disease Control and Prevention (CDC) asked dentists to provide only essential dental care to help preserve personal protective equipment (PPE) for frontline providers and to limit travel for non-essential services.1 Healthcare organizations urged caution about placing students in clinical settings due to the additional risks accompanying COVID-19 and aerosol generating procedures, limited supplies of PPE, and the concern that faculty navigating a new paradigm might have less time to individually supervise students. In areas where COVID-19 cases are declining, the American Dental Association (ADA) recommends that dental care be expanded to include elective procedures.4

In addition, the pandemic affected in-class education, forcing courses and testing to move to an on-line format. The CDC published guidelines for reopening institutions of higher education based on risk levels associated with an educational activity, from “lowest risk” (limited to virtual learning opportunities and events), “more risk” (classes taught in-person and other in-person events in which people have at least a 6-foot spread between them and do not share materials and supplies), and “highest risk” (individuals are not spread apart and materials and supplies are shared).1 Dental school educational activities encompass all levels of risk described by the CDC, from low risk activities, such as online case studies, to higher risk activities, such as those that might be difficult to space students and those with aerosol generating procedures that can potentially create a virus laden aerosolized environment. Providing a safe and robust learning environment in the simulation clinic is also critical to help students compensate for lost educational time.

To meet the challenges presented by the COVID-19 epidemic, the American Dental Education Association (ADEA) encouraged dental schools to work with state health departments, follow state and federal policies and recommendations, and make safe decisions for patients, students, and faculty.5 The ADEA requested that regulatory agencies be flexible about licensure examinations, curriculum, and competency assessments.5 As schools adjust to a new educational environment, little is known about dental students’ experiences, perceptions, and experiences as they navigate a new paradigm. At the same time, students also face pandemic related personal and financial stresses. Understanding the “students’ perspective” and incorporating their views is vital for administrators, faculty, and other policy makers as they re-envision dental education in a new reality.

This study examined the impact of the COVID-19 pandemic on dental education and explored students’ views related to school closure and educational experiences as well as the impact of the COVID-19 pandemic on their physical, mental, social, and financial health. The results should be helpful to other schools as they try to protect students, faculty, staff, and patients and still ensure continuity of dental education. In addition, the findings should help inform future disaster planning and improve public health.
2 | METHODS

2.1 | Setting and participants

The project was conducted at Roseman University of Health Sciences (RUHS) College of Dental Medicine (CODM) as part of an internal study. RUHS is a private, nonprofit health sciences university. It offers a dental medicine doctoral (DMD) degree and residency training in orthodontics. The DMD program, located in Utah, is a 4-year program with an enrollment of 366 students. The orthodontic program, based in Nevada, is a 3-year training program with 30 residents. The CODM operates dental clinics at both the Utah and Nevada campuses. Each campus maintained clinical operations for urgent care services during the pandemic. Both dental programs are accredited by the Commission on Dental Accreditation in the United States.

The CODM Dean’s Office posted the survey online and sent an email to students and residents asking them to complete the survey. The email also included a description of the survey and an assurance that participation was voluntary and that responses would be kept anonymous. No incentives were offered for completing the survey. The window for survey completion ran 2 weeks (from April 23, 2020, to May 7, 2020) with a reminder email sent at the end of the first week. Institutional Review Board exemption was obtained for this study.

2.2 | Survey instrument

This is a cross-sectional survey study aimed at assessing the impact of COVID-19 on students. Since no validated survey could be found in the literature, the CODM leadership developed a survey as part of the CODM quality improvement program to evaluate the pandemic’s effect on students and to assess the CODM’s pandemic-related educational strategies and responses. Survey items focused on 6 general domains: (1) protocol considerations after reopening the school, (2) institutional responses, (3) student academic concerns, (4) student physical health concerns, (5) student mental health concerns, and (6) student financial health concerns. Survey items were then independently reviewed by a 5-member interdisciplinary team consisting of public administration professional, health psychologist, assessment professional, nursing faculty, and doctoral student. Suggestions and comments by the team to improve clarity, content, and validity were incorporated into a revised survey. The interdisciplinary team reviewed the revised survey to reconfirm face validity and to make sure questions aligned with survey aims. To ensure that student answers focused on the pandemic but not pre-pandemic events, survey items related to concerns and psychological impacts all had an item stem starting with “In light of COVID-19.” The final survey consisted of demographic questions and 38 items related to school closure; educational experience; and physical, mental, and financial health.

2.3 | Data analyses

The study used descriptive statistics to explore the distribution of the item responses. Continuous variables were reported in range, mean, and standard deviation (SD). Ordinal and categorical variables were reported in frequency and proportion. Independent samples t-test was used to compare group difference in continuous variables, and z-test and $\chi^2$ test used to compare group difference between proportions as appropriate. Spearman correlations examined the relationship between age, impact of school closure, and concerns related to COVID-19. All analyses were conducted using R version 4.0.0. Statistical significance level was set at $P < 0.10$, 2-sided.

3 | RESULTS

3.1 | Demographics

A total of 145 dental students answered the survey, a response rate of 36.6%. Among the 145 respondents, 92.4% were DMD students and 7.6% were orthodontic residents. Further demographic details can be found in Table 1. During school closure, 86.9% of students resided in the state where their program was located, 12.6% lived alone, and 55.3% lived with their spouse. Students exercised on an average of 8.5 hours per week. There were 16.8% of students reporting some level of immunocompromise, and 14.0% reported that an individual close to them tested positive for COVID-19.

3.2 | Assessment of protocol consideration after school reopens

When asked what protocols should be considered after reopening, 62.3% felt that everyone should wear masks either always or often while at school, while 12.6% felt masks should never be required. Opinions about wearing gloves showed an almost even distribution, with 20.3% indicating that everyone should always wear gloves in school and 23.8% believing that gloves should never be required. Opinions about testing also lacked consensus, with 23.1% opting for daily COVID-19 testing and 38.5%
TABLE 1  Demographic characteristics of students (N = 145)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years – mean (SD) [range]</td>
<td>28 (3.4) [23–39]</td>
</tr>
<tr>
<td>Year in school – n (%)</td>
<td></td>
</tr>
<tr>
<td>1st year dental student</td>
<td>46 (31.9)</td>
</tr>
<tr>
<td>2nd year dental student</td>
<td>40 (27.8)</td>
</tr>
<tr>
<td>3rd year dental student</td>
<td>32 (22.2)</td>
</tr>
<tr>
<td>4th year dental student</td>
<td>15 (10.4)</td>
</tr>
<tr>
<td>1st year orthodontic resident</td>
<td>6 (4.2)</td>
</tr>
<tr>
<td>2nd year orthodontic resident</td>
<td>3 (2.1)</td>
</tr>
<tr>
<td>3rd year orthodontic resident</td>
<td>2 (1.4)</td>
</tr>
<tr>
<td>Race – n (%)</td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>94 (66.2)</td>
</tr>
<tr>
<td>Asian</td>
<td>30 (21.1)</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>1 (0.7)</td>
</tr>
<tr>
<td>Other</td>
<td>17 (12.0)</td>
</tr>
<tr>
<td>Ethnicity – n (%)</td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>9 (6.5)</td>
</tr>
<tr>
<td>Non-Hispanic or Non-Latino</td>
<td>130 (93.5)</td>
</tr>
<tr>
<td>Gender – n (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>73 (51.8)</td>
</tr>
<tr>
<td>Female</td>
<td>68 (48.2)</td>
</tr>
</tbody>
</table>

favoring weekly COVID-19 testing. Almost 83% of students believed that social distance practices minimize the development of COVID-19 (Supporting Information Appendix 1, which is available online).

3.3 | Assessment of institutional responses

In terms of CODM’s overall response to COVID-19, 73.1% students rated it as somewhat or extremely effective. For transitioning to remote online courses, 70.4% of students felt positively and 71.0% of students reported that their professors were effective in teaching online courses. In contrast, students were far less positive about their clinical training, with only 27.1% of students reporting their professors as being effective in providing clinical experience during school closure (Supporting Information Appendix 2).

3.4 | Assessment of academic concerns

Most students (72.0%) completed at least 1 online course prior to dental school, and 34.8% reported completing at least 4 online classes prior to school closure. Virtually all students (87.6%) reported a high degree of comfort adapting to technology with only 12.4% feeling neutral. No student reported being uncomfortable with technology. Over one-third (38.0%) were concerned about the quality of their online course(s). Regarding academic learning, 43.1% of the students often or always found it difficult to focus on school work, and 44.5% often or always experienced difficulty finding motivation to study. Almost half (42.8%) of students expressed concern about the likelihood that they would be able to complete their degree program on time; 46.2% of students were concerned about passing their dental board exams in a timely manner. Yet despite this concern, most students expressed reluctance about making up lost educational time and experience, with only 11.0% definitely willing to take a shorter winter break, 10.3% definitely willing to cancel all travel plans for the year, 6.6% definitely willing to extend the school day to 12 hours, and 5.9% definitely willing to attend school 6 days per week (Supporting Information Appendix 2).

3.5 | Assessment of physical health concerns

Supporting Information Appendix 1 displays students’ concerns about their physical health from the COVID-19 crisis. There were 40.2% of students concerned about their physical health, with 18.1% often or always experiencing restless sleep. Over one-fifth of students (20.8%) often or always felt anxious that they might be infected with the COVID-19 virus, with 69.5% of the students expressing concern about contracting COVID-19 from providing patient care in the clinics, 64.9% about contracting it from attending classes in school, and 66.9% concerned about contracting it from interacting with people in the school buildings.

3.6 | Assessment of mental health concerns

Supporting Information Appendix 1 summarizes students’ self-report of mental health concerns arising from COVID-19. Many students (32.0%) had concerns about their emotional health. Twenty-nine percent of students felt they were often or always unable to control important things in their life, and 18.8% often or always could not cope with all of the things that they had to do. Nearly one-quarter of students (24.3%) often or always felt angry because things were outside of their control, with 37.9% often or always stressed. Nearly half (49.3%) often or always expressed anxiety regarding the uncertainty of the current crisis, and 8.3% of students often or always felt depressed. There were 21.4% of students expressing concern about not being able to secure housing after
they returned to school from the pandemic shutdown. There were 80.0% of the students concerned about the well-being of their family members, and 40.7% concerned about being able to keep up with their social connections. Almost 1 in 10 (9.7%) often or always felt lonely.

### 3.7 Assessment of financial health concerns

Nearly half of students (49.0%) expressed concern about their financial stability, and 22.2% often or always reported anxiety that they will have difficulty finding a job after graduation. Over one-quarter of the students (27.8%) were often or always anxious that they will be unable to make ends meet in the next few months (Supporting Information Appendix 1).

### 3.8 Relationship between age, school impact, and student concerns

Spearman correlations\(^6\) between age, impact of school closure, and student concerns related to COVID-19 found that younger students had significantly more emotional health concerns than older students \((r = -0.215; P = 0.01)\). Students reporting a greater negative impact of school closure were more likely to report emotional health concerns \((r = -0.330; P < 0.01)\), conveyed more social connection concerns \((r = -0.252; P < 0.01)\), and expressed greater concern about contracting COVID-19 while attending classes \((r = 0.166; P = 0.05)\) and moving around in the school buildings \((r = 0.176; P = 0.04)\). In addition, students most affected by the closure found more difficulty in finding the motivation to study \((r = -0.206; P = 0.01)\). Table 2 shows all of these correlations.

### 3.9 Assessment of differences between DMD students and residents

DMD students and residents differed in several demographic aspects (Figure 1). DMD students were younger \((27.7 \text{ years}; \text{SD} = 3.3)\) compared to residents \((31.4 \text{ years}; \text{SD} = 4.1)\) \((P < 0.01)\). Approximately 95.3% of the DMD students were non-Hispanic/non-Latino, but only 70.0% of residents were non-Hispanic/non-Latino \((P < 0.01)\). The majority of DMD students (70.0%) identified as Caucasian, but only 27.3% of the residents identified themselves as Caucasian \((P = 0.02)\). In terms of residence during school closure, 85.7% of DMD students lived in the state where their DMD program was located, while 100% of the residents lived in the state where their residency program was located \((P < 0.01)\). Regardless of marital status, living arrangements of DMD students and residents also differed significantly \((P < 0.01)\). Approximately 55.6% of DMD students lived with their spouse and 9.8% lived alone; 36.4% of residents lived with their spouse and 45.5% lived alone.
FIGURE 1  Demographic differences between DMD students and residents
In general, DMD students and residents voiced similar views regarding protocol consideration after school reopens, institutional responses, concerns, and psychological impacts. There were only 4 areas that DMD students and residents demonstrated statistically significant differences (Supporting Information Appendix 3). First, residents were more concerned about contracting COVID-19 from interacting with people in the school building than DMD students (81.9% vs. 65.4% respectively; \( P = 0.07 \)). Second, residents were more often experiencing anxiety regarding difficulty finding a job after graduation than DMD students (54.6% vs. 19.7% respectively; \( P = 0.08 \)). Third, in order to make up for the lost educational experience so that they can graduate on time, 7.1% of DMD students were definitely willing to attend school for 12 hours per day; however, none of the residents were definitely willing to do so (\( P = 0.09 \)). Fourth, in evaluating CODM’s overall response to COVID-19, 75.1% of DMD students thought it was effective, but only 62.5% of residents thought so (\( P = 0.01 \)).

4 | DISCUSSION

Dentistry can be a stressful profession, and dental students face similar stressors, combined with academic pressures that tend to increase over time. Commonly identified dental school stressors include extensive coursework, pressure to do well, learning clinical procedures, and dealing with difficult patients. In addition to the usual stressors, dental students now face a global health crisis, school closures, and challenges practicing and honing their clinical skills. We found that students have been affected by this global pandemic in various ways, including increased worry regarding dental protocols after the reopening of school, institutional responses to the pandemic, academic concerns, both physical and mental health concerns, and financial concerns.

Although dentistry is clearly associated with respiratory droplets and aerosol generating procedures that can spread COVID-19, the CDC noted that, unlike medical care facilities and personnel, no cluster related to dental care facilities or personnel have been identified. However, in order to conserve PPE for those on the frontlines combating the coronavirus and to keep patients home, the ADA recommended on March 16, 2020, that dental offices restrict patient care to emergency cases.

The ADA recommendation for limiting dental care to emergencies expired on April 30, 2020, and dental offices began offering more in-person services. In a May 21, 2020, press release, the ADA outlined measures for dental offices to provide full dental services. These included that personnel use masks, goggles, and face shields while in the office. Similarly, the CDC provided guidance for dentistry, stating that dental personnel should wear a face mask at all times in the dental office and a surgical mask or respirator when working directly with patients. In addition, the CDC recommended that patients be notified in advance that anyone entering the office will be screened for COVID-19 symptoms and required to wear a face mask, removing it only for dental care. Additional guidelines outlined sanitizing and creating social distancing protocols. Our findings indicate that students favored employing these measures and guidelines to reduce spread when engaged in campus activities.

Students generally rated their online curriculum positively, suggesting the crisis might offer dental schools opportunities to leverage technology in new ways that enhance dental education. In mid-March 2020, regional authorities recommended discontinuing in-person large gatherings of more than 100 people. To minimize large gatherings in school and to minimize gaps in training, the CODM leadership transitioned educational activities to remote online learning. While most students had experience with online education, many faculty members lacked both the experience and expertise using technology and online educational platforms. To facilitate the transitions, course directors worked with CODM Deans to develop new instructional methods that met course objectives and matched online courses to in-person course credit hours. The challenge of arranging online lectures led to more “classroom flipping” with PowerPoints and instructional materials posted prior to class, allowing more time for higher level educational activities during live online lectures. Some instructors used the breakout room feature in the online learning platform so student groups could work collaboratively on problems followed by group interaction with their instructors or discussion with the entire class.

In contrast, clinical care education seemed to cause the greatest concern among students. This highlights the need to consider other strategies, such as simulation, demonstration, tele-dentistry, and videotaping cases with faculty review. One interesting and concerning finding was that, despite a majority of students expressing concern about their clinical training, only a small minority favored adding an extra day, extending clinic work hours, or shortening vacation to make up lost clinical time.

Many students reported loneliness and worried about their social connections and their physical and emotional health. This is concerning since both low social connection and high stress are associated with worse health behaviors, including problems with drinking, smoking, drug use, and risky behavior. The literature suggests that, pre-pandemic, a high proportion of dental students drink excessively and experiment with illicit drugs. The loss of a supportive network through social distancing, stay-at-home orders, and school closures layered onto already
highly stressed students, may push those at risk for poor health behaviors into even riskier behaviors. This suggests the need to augment existing counseling and behavioral support for students. Communication and involvement are key elements for reducing anxiety and our findings suggest schools should proactively communicate plans with students and involve them in the decision-making process.

Although much has been written on the stress experienced by dental school students, little is known about stress related to the pandemic, and whether its effects on DMD students and residents differ. This study provides empirical evidence and insight into the stresses experienced by dental students during the COVID-19 crisis. Stress results in poorer performance and lower levels of physical and emotional health, and higher levels of emotional exhaustion and depersonalization, all of which can adversely affect dental students and professionals. Henzi and colleagues studied dental students’ perceptions of their learning environment, climate, and teacher-student relationships, and found that students reported high levels of stress and low levels of faculty supportiveness. Their study was conducted under “normal” conditions in dental schools. Our results indicate that the current pandemic exacerbates these problems and presents an opportunity for dental school administrators and faculty to consider measures to create a safe and effective learning environment for their students under all circumstances.

Of interest, over half of dental students worried about contracting COVID-19 from providing patient care or interacting with others at school, and most (80%) respondents were concerned about family members’ well-being during the COVID-19 outbreak. Most dental students believed that social distancing is effective in minimizing the spread of COVID-19 and felt that everyone should wear masks often or always at school when it reopens.

Our findings also indicated students worried about their financial situation, with over 50% of dental students expressing doubt about meeting their financial obligations, slightly more than the 48% of college students reported by Active Minds as being troubled about financial setbacks. Students were anxious about finding a job after graduation, not surprising since unemployment is at its highest level since the depression era, and a potential fall resurgence of COVID-19 could even worsen the job market. It is also not surprising that those closest to seeking jobs, senior dental students and residents, expressed the most concern. Dental students invest many years into their education, and have one of the highest debt-to-income ratios among health professions. They may now face the very real situation of looming debt and unemployment. In fact, many conveyed apprehensions about simply being able to complete their degree or pass the dental board exams.

4.1 Limitations

This study is limited to 1 dental school and is cross-sectional in nature. Students in schools and in states more adversely affected by COVID-19 might respond differently. Since the pandemic continues to evolve, it appears likely that recommendation and guidelines will change. The findings reported here only represent a snapshot in time. Nonetheless, the results can be a good representation of the experience of dental and health professional education programs and provide insight into helping student adapt as new guidelines evolve. Future longitudinal studies can be performed to compare different dental schools, or compare dental schools with other health professional schools to track outcomes and share strategic initiatives.

5 CONCLUSIONS

The COVID-19 pandemic significantly impacted dental education. Our findings indicate that students are experiencing increased levels of stress and feel their clinical education has suffered. Most students appear comfortable with technology adaptations for didactic curriculum and favor masks, social distancing, and liberal use of sanitizers. This study provides meaningful insights to inform decisions not only for dental schools but also for all health professional schools and the public.

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REFERENCES


SUPPORTING INFORMATION

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