Are dental Schools Prepared for Disease X? Dental Student's Anxiety and Concerns

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ABSTRACT

Background: This study aims to compare dental students' anxiety levels before and after the COVID-19 pandemic. In addition, it seeks to assess their concerns about potential future threats, such as a hypothetical disease with similar or more severe impacts than COVID-19, referred to as "Disease X," and identify the most effective methods to support them during such challenging times.

Materials and Methods: The present descriptive observational study was conducted from October 2019 to February 2022, with a sample size of 329 participants. One hundred dental students completed the State-Trait Anxiety Inventory for Adults, a widely used psychological instrument for measuring anxiety, before ($n = 51$) and after ($n = 49$) the COVID-19 pandemic. In addition, 229 students responded to an online questionnaire addressing their concerns about the re-emergence of pandemics or disease X after the pandemic. The anxiety scores were analyzed using a t-test and the survey using descriptive statistics and a t-test, providing a comprehensive understanding of the student's mental health and concerns.

Results: Our findings reveal a significant increase in anxiety scores after the COVID-19 pandemic ($P < 0.0001$), underscoring the profound impact of the pandemic on dental students. The majority of students (56%) took a proactive approach and suggested the development of an emergency curriculum plan, including online courses (57%) and virtual pre-clinical and clinical training (51%), as the most effective strategies to address their concerns about the re-emergence of a pandemic.

Conclusions: The pandemic increased the anxiety of dental students, and many of them are concerned about the recurrence of future pandemics or disease X.

Keywords: Anxiety, COVID-19, dental education, dental student, mental health, pandemic, stress.

Introduction

The pandemic of the coronavirus disease 2019 (COVID-19) adversely affected students' mental health and education pursuits in 2019 and 2020.[1] Fortunately, the development of large-scale vaccination and public health awareness campaigns effectively contained the pandemic. However, the COVID-19 pandemic's global repercussions persisted across various sectors, including the economy, healthcare, education, and mental health, particularly impacting vulnerable and marginalized communities.[2,3] Therefore, the World Health Organization (WHO) has emphasized the importance of preparing for any potential future pandemic, which was referred to as "Disease X."[4] Understanding the experiences of dental students

during the COVID-19 crisis is crucial in adequately equipping dental schools for the challenges posed by such emergent threats.

Stress and anxiety are the main drivers of mental health and could alter the psychological mindset according to the person's ability to cope. Upcoming uncertainty, loss of connection with faculty members and colleagues, and enforced isolation due to COVID-19 exposed the students to high stress and anxiety levels.[5,6] The COVID-19 pandemic mainly compromised dental students' academic and clinical training.[7] This impact was particularly pronounced when the dental students faced increased concern about the spread of infection while treating patients due to the heavy production of aerosols while using dental headpieces or due to

the proximity of the dental operator to the patient airway.[8] Thus, the COVID-19 pandemic has broken the sequence of obtaining practical skills in dental laboratories and clinics due to the transformation of education into distance e-learning classes instead of physical ones.[9,10]

The unique nature of dental education, which heavily emphasizes hands-on clinical training, typically exacerbates stress levels among students.[11] With the advent of COVID-19, infection control concerns have been amplified, posing a threat to the mental well-being of dental students.[1] Analyzing student anxiety before and after the COVID-19 pandemic enlightens educators on the impact of this negative experience on dental students' mental health. Proactively addressing their apprehensions and preparing dental schools for future crises can alleviate stress and better equip institutions during uncertain times.

Therefore, this case study aimed to compare anxiety levels among dental students before and after the pandemic using the State-Trait Anxiety Inventory for Adults (STAI-AD). In addition, it sought to address students' concerns about Disease X and gather their recommendations on how dental schools can foster a supportive learning environment during such crises.

Materials and Methods

The observational cross-sectional case study was conducted between October 2019 and February 2022. It was registered, and ethical approval was obtained from Minia University, Minia, Egypt (IRB: 176). The researchers obtained ethical approval from committee number 78, Decision No: 495, updated on 29/3/2021, updated on March 29, 2021, to compare stress and anxiety levels before and after the pandemic.

Subjects' recruitment

The study incorporated convenience dental students at Minia University. The students' age range was twenty-one to twenty-three. The undergraduate dental college program comprises 5 years. Their curriculum includes clinical courses from level three to level five. The students who participated in the study were from the fourth and fifth levels. The study included both genders, males and females. All the students provided informed consent at the beginning of the study.

The survey instruments

In this study, two self-administered surveys were utilized to evaluate dental students' anxiety and their experiences during the COVID-19 pandemic. The first survey, the STAI-AD, was administered both before and after the pandemic to measure changes in students' anxiety levels. The second was a supplementary questionnaire designed and distributed after the pandemic to capture students' stressors, coping strategies, concerns regarding future pandemics, and their suggestions for institutional support.

The STAI-AD was administered before and after the pandemic

The license for administering the STAI-AD was obtained from the publisher Mind Garden (Mind Garden Inc., Menlo Park, California, USA) to assess the dental students' anxiety for the number of participants in the study.[12] The authenticity and reliability of the STAI questionnaire have been demonstrated in previous studies.[12,13]

STAI-AD is intended to measure anxiety in adults, and this information is obtained through two divisions.[12] The first one is the State Anxiety scale (STAI-S, STAI: Form-Y1), which contains twenty statements that evaluate students' emotional state at the moment, reflecting a temporal condition.[12] The second one is the Trait Anxiety scale (STAI-T, STAI: Form-Y2), which contains twenty statements that assess the overall feelings of the students, reflecting their overall mindset and general tendencies.[12] The respondents ranked their feelings for each item in STAI-S on a Likert scale: (1) Not at all, (2) somewhat, (3) moderately, and (4) very much. Then, they ranked their feelings on a different Likert scale in STAI-T: (1) Almost never, (2) sometimes, (3) often, and (4) almost always.

Each evaluation is scored from 20 to 80 depending on the severity of anxiety; thus, the total score will reflect the participant's anxiety. Scores between 20 and 37 reflect low anxiety, while scores between 38 and 44 reflect moderate anxiety, and scores between 45 and 80 reflect high anxiety. The STAI-AD was self-administered for students who agreed to participate in the study.

The supplementary questionnaire administered after the pandemic

After the pandemic, the dental students received another self-administered online questionnaire that requested them to share their stressors and coping strategies during the COVID-19 pandemic, recall their future concerns

for disease X, and mention how dental schools can best support them during difficult times. The questionnaire was developed in English, reviewed by subject-matter experts for content validity, piloted with a group of 12 students to confirm clarity and face validity, and then distributed electronically through institutional student email accounts [Table 1]. Completing all the survey questions was mandatory for participation in the study.

Data analysis

Statistical Analysis Systems (ver8.2) was utilized for data analysis (North Carolina, USA). An unpaired t-test was used to compare the mean of S-STAI and T-STAI anxiety scores for dental students' scores before and after the pandemic. The $P < 0.05$ are considered significant. The student's responses to the supplementary questionnaire items were described using descriptive statistics.

Results

The results of this study are presented in two parts, reflecting the period before and after the COVID-19 pandemic.

STAI-AD anxiety scores before and after the pandemic

Before the Coronavirus pandemic, fifty-one students participated in the study between October 2019 and February 2020, including twenty-nine females and twenty-two males. Post-pandemic, forty-nine students participated between December 2021 and February 2022, consisting of twenty-six males and twenty-three females. The response rate is 22.17% before the pandemic and 21.3% after the pandemic.

Anxiety levels were measured using the STAI-AD, and descriptive statistics, including means and standard deviations, were calculated [Table 2]. Comparisons revealed significant increases in both state and trait anxiety scores after the pandemic ($P < 0.0001$). The mean STAI-S and STAI-T anxiety scores for students before the pandemic were 35.3 and 35.6, respectively, while the post-pandemic means were 40.7 and 41.8 [Figure 1].

The online survey post-COVID-19 pandemic

After the pandemic, the total number of respondents to the emailed online survey questionnaire was 229,

Table 1: The survey questions were collected after the pandemic

1. Please mention the factors that increased your stress during the COVID-19 pandemic.
2. Please recall your favorite coping strategies for managing stress during the COVID-19 pandemic.
3. How concerned are you about the recurrence of another pandemic? Extremely concerned, moderately concerned, slightly concerned, not concerned.
4. As a dental student, what concerns you the most about the recurrence of a pandemic? (Multiple select) Unclear curriculum plan during emergency crises, isolation from family and friends, limited clinical and laboratory training, difficulty in controlling infection in dental clinical settings, financial challenges due to enforced isolation, lack of mental health support for students, or others.
5. If you have other concerns, please mention them.
6. How can the dental school help ease your stress in the event of an emerging pandemic? (Multiple select) Provide a clear emergency curriculum plan, offer online curriculum options, develop virtual laboratory/clinical training, provide early optional temporal or permanent program exit (e.g., dental assistant diploma, dental technician), offer elective courses in cognitive therapy and emotional regulation, provide online support groups, reduce teaching costs during the pandemic, or other.
7. If you want to suggest other school plans, please mention them.

Table 2: The mean and standard deviation of participants' anxiety scores in the state-trait anxiety inventory (STAI-T and STAI-S) before and after the COVID-19 pandemic

The STAI type/Time of administration	Mean±Standard Deviation	Minimum	Maximum	*P*-value
STAI-S/Before Covid-19	35.30±4.427	30	48.00	<0.0001
STAI-S/After Covid-19	40.71±5.932	30	52.00	
STAI-T/Before Covid-19	35.60±5.135	28.00	47.00	<0.0001
STAI-T/After Covid-19	41.79±5.823	30.00	52.00	

The *P*<0.05 are considered significant, STAI-T: State-Trait Anxiety Inventory-Trait, STAI-S: State-Trait Anxiety Inventory-State
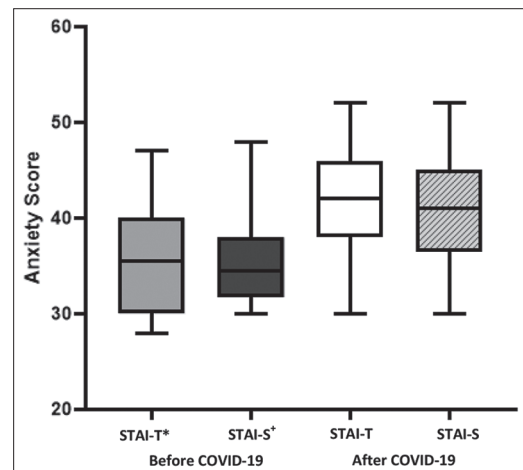

Figure 1: The average anxiety scores in STAI-T and STAI-S for dental students before and after the COVID-19 pandemic. *STAI-T: State-Trait Anxiety Inventory-Trait, +STAI-S: State-Trait Anxiety Inventory- State

and the response rate was 99%. The number of male participants is 119 (52%), and the number of female participants is 110 (48%). Table 3 summarizes the dental students' responses to the stressors they experienced during the COVID-19 pandemic and their favorite coping strategies. The students' answers to open-ended questions are also summarized in Table 3. Clinical training and exams commonly concerned students during the COVID-19 pandemic, and students used different coping strategies to manage their stress.

When students were surveyed regarding their concerns about re-emerging pandemics and their impact on dental education, the majority were moderately concerned or highly concerned about the recurrence of the pandemic (43% and 38%, respectively). Nevertheless, fewer participants reported slight or no concerns regarding the recurrence of the pandemic (13% and 6%, respectively).

Dental students also reported what concerns them the most about the recurrence of the pandemic [Table 4]. The isolation from family and friends was a primary concern, followed by limited clinical or laboratory training and difficulty controlling infection in the dental setting. Interestingly, 9% of the dental students had other concerns and indicated the following: Economic distress negatively affecting the ability to control the infection and treat infected patients; hospital capacities to treat a high number of patients at once; losing family members or close friends in the pandemic; inability to provide high-quality internet for online education; incapability to treat a dental patient during the pandemic.

Participants also recommended several strategies dental schools could implement to adequately manage dental education during the pandemic [Table 4]. Most students recommended that dental schools provide an emergency curriculum plan, an online-supported curriculum, and virtual laboratory or clinical training. Among the dental students, 9% suggested the following: Developing an emergency curriculum that focuses on providing valuable clinical training, providing a clear and strict infection control plan, offering cognitive therapy channels for students in need, and providing students with access to the internet for online education.

Discussion

The primary objective of this study was to assess anxiety levels among dental students from both pre- and post-COVID-19 periods, underlying causes, and the coping

Table 3: The dental student's response to open-ended questions was distributed after the COVID-19 pandemic

Stressors	1. Training in the clinic 2. Exams 3. Health problems 4. Social or family problems and listening to bad news
Favorite coping strategies	1. Sports and walking 2. Listening to music 3. Talking with family and friends 4. Other (reading, watching TV, drowning)
Concerns	1. Education halt 2. Economic distress negatively affects the ability to control the infection and treat infected patients 3. Hospital capacity to treat a high number of patients 4. Losing family members or close friends in the pandemic 5. Inability to provide high-quality internet for online education 6. Incapability to treat a dental patient during the pandemic.
Recommendation to dental schools	1. Developing an emergency curriculum that focuses on providing effective clinical training 2. Providing a clear and strict infection control plan 3. Offering cognitive therapy channels for students in need 4. Providing students with access to the Internet for online education

Table 4: The dental student's response to major concerns regarding the recurrence of the pandemic and how dental schools can better support them in this difficult time

No.	Concerns regarding a recurrence of the pandemic.	% (n)
1	Isolation from family and friends	51% (116)
2	Limited clinical and laboratory training	49% (113)
3	Difficulty in controlling infection in dental clinical settings	47% (107)
4	Unclear curriculum plan during emergency crises	39% (89)
5	lack of mental health support for students	31% (71)
6	Financial challenges due to pandemic-related issues	29% (67)
7	Other	9% (20)
No.	Strategies for dental schools to ease the stress in the event of emerging pandemic	% (n)
1	Provide a clear emergency curriculum plan	56% (127)
2	Offer online curriculum options	57% (131)
3	Develop virtual laboratory/clinical training	51% (116)
4	Provide early optional temporal or permanent exit (e.g., dental assistant diploma, dental technician)	30% (69)
5	Offer elective courses in cognitive therapy and emotional regulation	28% (64)
6	Provide online support groups	38% (87)
7	Reduce teaching costs during the pandemic	35% (79)
8	Other	9% (21)

strategies the students employed during the pandemic. The results indicated a significant increase in students' psychological distress after the pandemic. This aligns with a previous study among dental students in Jeddah,

which reported moderate anxiety for 41% and severe anxiety for 7% of respondents, using the Generalized Anxiety Disorder 7-item Scale. Many students expressed concerns about their future profession and hygiene/social habit changes.[14] A systematic review of 23 studies (2020–2023) further corroborates this and identifies key risk factors for poor mental health among dental students during the pandemic, including female gender, year of study, and living circumstances.[15]

In the present study, the STAI psychological assessment is known for reliability and validity in examining anxiety in adults.[12,13] It showed that even before COVID-19, students faced considerable mental pressure due to the demanding nature of dental education, which affected their ongoing mental health. Previous studies observed that 3rd- and 4th-year dental students experienced higher levels of stress and anxiety compared to 1st- and 2nd-year students. This is mainly due to prolonged exposure to rigorous training, which affects their psychological stability. As a result, they suffered from limited social interactions, reduced family time, and strained relationships, all of which contributed to increased anxiety levels.[16,17]

The pandemic further escalated anxiety levels, primarily due to the lack of clinical training, fear of examinations, online and distance learning, and reduced social interaction. A major stressor during the COVID-19 pandemic was the suspension of clinical training for senior dental students. In a study conducted among dental students in Australia, more than 75% of the participants were disappointed at the decline in the quality of their education following the curricular changes imposed by COVID-19, as the lockdowns and strict safety measures substantially reduced opportunities for clinical and pre-clinical training.[18] E-learning could not adequately replace practical training, which is crucial for becoming a competent dental surgeon. The lack of hands-on experience led to increased anxiety, particularly among 4th- and final-year students.[19]

Only dental students from both junior and senior years participated in this study. Previous research has reported mixed findings regarding the relationship between year of study and anxiety levels. For instance, Yildirim and Atas found that senior (clinical) students experienced higher levels of anxiety and stress compared to pre-clinical students.[8] Conversely, another study has shown that students in the pre-clinical years reported significantly higher anxiety levels.[8]

According to Agius *et al*., students preferred face-to-face interactions with tutors and peers over distance learning.[20] They were particularly concerned about changes in examination procedures, which did not align with their academic schedule. The most affected students included those with family responsibilities and international students who struggled to adapt to a new lifestyle in a foreign country while managing a demanding curriculum.[20] Other studies found that many students considered quitting clinical practice and training until the pandemic subsided or a cure was developed to ensure their safety.[21,22]

Dentists were among the professionals most susceptible to COVID-19, as multiple studies confirmed virus transmission through water droplets and aerosols generated during dental procedures. This heightened their risk of infection and significantly impacted their mental health, leading to chronic anxiety and depression.[23] The virus's ability to survive in harsh environments made it highly transmissible, increasing concerns among dental professionals about spreading the infection to their families and communities. A study reported that approximately 92% of dentists across 30 countries feared virus transmission.[24]

Despite the challenges, online teaching served as an effective alternative for continuing academic education and learning new concepts during lockdowns and the absence of physical training.[25,26] In addition, universities implemented safety measures, including six-foot social distancing, mandatory face masks, frequent use of hand sanitizers, and restrictions on large gatherings. Training sessions were resumed in many institutions under strict health protocols.[19,27]

According to participants, activities, such as listening to music and engaging with family and friends helped alleviate their anxiety. A survey of 402 Australian university students found that music listening was among the most effective stress management strategies, and using music to cope was also associated with better overall well-being, even under COVID-19 stressors.[28] While another study on dental students during the COVID-19 pandemic revealed that greater social support (e.g., from family, friends) predicted lower levels of depression and stress.[29]

The WHO introduced the term disease X to highlight the importance of preventing and preparing for potential pandemics that could cause global threats. Digital transformation of dental education and the development

of an emergency curriculum plan, combined with a compact infection control policy, can aid in reducing the adverse impact of such an event. Dental students emphasized channels for behavioral and cognitive therapy and student support during difficult times. This study has several limitations. The absence of a calculated sample size restricts the generalizability of the findings to dental students at other institutions or internationally. Furthermore, the cross-sectional design captures students' concerns at a single point in time, limiting insight into how anxiety levels may evolve over different stages of the pandemic or in response to changing educational strategies. Despite these limitations, this study has notable strengths. The supplementary online questionnaire achieved a very high response rate (99%), which enhances the representativeness of the findings and reduces the likelihood of non-response bias. In addition, the use of a validated instrument (STAI-AD) and a carefully developed supplementary questionnaire reviewed by subject-matter experts further strengthens the reliability and validity of the results.

Conclusions

Within the limitations of this study, it is evident that the COVID-19 pandemic has negatively impacted the mental health of dental students, leading to increased anxiety levels. Concerns about potential future threats, such as Disease X, have prompted students to recommend proactive measures by dental schools. Digitalizing dental education is a valuable strategy that can be utilized during emergencies. In addition, implementing a robust infection control plan tailored for dental schools is crucial to ensure the continuity of clinical training. Comprehensive academic and mental health support is essential for effective emergency curriculum planning. To address inevitable economic distress, offering early exit career programs, such as dental assistance or dental technology, can support students during challenging times.

Funding

Data Availability Statement

The data are available upon reasonable request.

Conflicts of Interest

The authors declare no conflict of interest.

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