Research Square

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The impact of the SARS-CoV-2 pandemic on stress and anxiety in dentistry students

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Abstract

Objectives: To investigate the impact of the SARS-CoV-2 pandemic on stress and anxiety in preclinical and clinical dentistry students.

Materials and Methods: Dentistry students in clinical course(CC; n=64) or preclinical course(PCC; n=53) were included. The subjective perceived levels of stress and anxiety were evaluated using the Dental Environment Stress(DES) and the Depression, Anxiety and Stress Scales(DASS) questionnaire. Cortisol levels were measured in saliva samples. Knowledge of the pandemic was evaluated. All data were collected twice: during the university holidays and during term time. Descriptive and bivariate statistics were used to compare data between baseline and follow-up. Multivariate linear regression models were computed to analyze possible influencing factors.

Results: Participants showed medium levels of stress and anxiety at baseline and follow-up. The DASS score in the 'anxiety' subdomain was significantly higher in the PCC group than in the CC group at baseline($p<0.001$) and increased during term time. Mean saliva cortisol levels were higher in the CC group(9.2±5.2) than in the PCC group(4.9±2.2) at baseline($p<0.001$) but converged by follow-up. Intra-individual perception of stress at baseline was consistently the most important aspect for changes in stress and anxiety levels during term time. The SARS-CoV-2 pandemic affected stress and anxiety levels in some participants, but this was not ubiquitous.

Conclusion: Intra-individual differences in stress perception seem to be more relevant than course affiliation (preclinical or clinical) or the SARS-CoV-2 pandemic to stress and anxiety levels in dentistry students. A follow-up study when the pandemic is over would be useful to control for stress under normal circumstances.

Clinical Relevance: These results highlight the importance of individual stress management in dentistry students.

Introduction

Dentistry is a stressful profession, with 86% of dentists reporting sustained medium to high levels of stress [1]. Stress is increased physical or emotional tension and strain. It can negatively affect health [2], and lead to psychological problems, such as depressive disorders, anxiety, obsessive-compulsive disorder, and burnout [3] Studies have shown that dentistry students experience significant stress symptoms while studying [4–10]. This stress is caused by several factors, including pressure to perform, time pressure, first contact with patients, problems with teaching staff, and financial difficulties [11]. Consequently, dentistry students suffer more from anxiety, obsessive-compulsive disorders, and depression than adults of the same age do [12–15]. This problem is predominant during the clinical studies [8, 16]. In this group, 10% of students suffer from emotional exhaustion, 17% from severe lack of performance, and 28% from depersonalization [16]. These psychological problems also reduce efficiency during working and learning [17].

The severe acute respiratory syndrome-coronavirus-2 (SARS-CoV-2) pandemic may have been an additional source of stress for dentistry students during their studies. SARS-CoV-2 causes COVID-19 disease [18], and infection usually takes place via droplet transmission, putting employees in healthcare and dentistry at a higher risk of infection [19]. Various measures have been implemented to prevent the virus from spreading among healthcare professionals [19], and these measures have affected dentistry students. Safety measures included periodic testing and provision of suitable protective equipment. These changes present challenges, adjustments, and uncertainties, which may cause additional stress and anxiety among dentistry students. However, this has not been investigated thematically.

The aim of this study was to examine the impact of the SARS-CoV-2 pandemic on stress and anxiety in dentistry students at the University of Heidelberg by measuring changes in objective and subjective indicators of stress during the holidays (baseline) and during term time (follow-up). We hypothesized that stress levels at baseline would be associated with increased stress levels during term time.

Materials And Methods

Study setting

This longitudinal cohort study was approved by the local review board of the University of Heidelberg (approval number S-627/2020). The study was registered in the German Register for Clinical Studies (DRKS00023499) and was performed at the Dental School of the University of Heidelberg, Baden-Württemberg, Germany. All dentistry students in their second and fourth year of study were invited to participate in the study and give written consent. There were no other inclusion criteria. In total, 117 students agreed to participate – 64 students from the clinical course (CC group) and 53 students from the preclinical course (PCC group).

Socio-demographic data were recorded and participants were asked to complete validated questionnaires to determine stress and anxiety levels and knowledge of the SARS-CoV-2 pandemic. Salivary cortisol levels were also measured. The questionnaires and salivary cortisol tests were conducted once during the holidays before the course started (baseline) and again during term time (follow-up). To protect participants, suitable measures were taken, such as maintaining social distancing and wearing protective equipment during cortisol tests. SARS-CoV-2 tests were also carried out to make sure that participants were not infected.

Level of knowledge and stress triggered by the SARS-CoV-2 pandemic

To subjectively evaluate knowledge of the pandemic and stress triggered by the pandemic, we asked three questions, each of which was answered on a Likert scale of 0–100 (0 = never/low, 100 = very often, very high). The questions were: 1) How often do you inform yourself about the current status of the pandemic, 2) How would you rank your level of knowledge of SARS-CoV-2, which causes COVID-19, and 3) Do you feel more stress in your studies because of the pandemic. There was one additional question

(Do you feel stress when you think about the course), which received a yes/no answer. We also administered a questionnaire that assessed the level of knowledge of the pandemic. The questionnaire contained 11 questions and was adapted from the guidelines for medical staff published by Modi et al. and translated into German [20].

Stress and anxiety measurements

Stress was evaluated in participants using the German version of the Dental Environment Stress (DES), which has been described as a reliable and valid tool for measuring stress [21, 22]. The DES contains 25 items representing various stressors, which are divided into seven subdomains: faculty and administration (questions 9, 12, 18), academics (questions 1–4), manual skills (questions 6, 10), financial obligations (question 21), patient care (questions 5, 7, 8, 11), personal problems (questions 13–17, 22, 25), and family (questions 19, 20, 22–24). Students were asked to score each item on a 50-point Likert scale (not stressful = 10, highly stressful = 50), so the total DES score ranged from 250 to 1250 points. Sum scores were also calculated for the seven subdomains.

Anxiety was assessed in participants using the short version of the Depression, Anxiety and Stress Scales (DASS) [23]. The DASS contains 21 items related to depression (seven questions), anxiety (seven questions) and stress (seven questions). Participants scored each item on a 4-point Likert scale (0 = did not apply to me at all, 1 = applied to me to some degree or some of the time, 2 = applied to me to a considerable degree or a good part of time, 3 = applied to me very much or most of the time). The total score ranged from 0 to 21. Scores of ≥ 10 were indicative of depression and stress and scores of ≥ 6 were indicative of anxiety.

Saliva cortisol levels

To evaluate stress objectively, we measured cortisol levels in participants' saliva. Because cortisol levels fluctuate during the day, saliva samples were collected between 12:00 am and 1:00 pm. Saliva samples were collected using Cortisol Salivettes® (SARSTEDT AG & CO.; Nümbrecht; Germany). Participants were asked to rinse their mouths with water for 10 minutes before taking the saliva sample. After rinsing, participants chewed a cotton roll for 45–60 seconds and placed it in the Salivette®. The Salivettes® were then hermetically sealed and sent on the same day to the test laboratory (Daacro GmbH & Co. KG; Trier, Germany) for evaluation. Cortisol levels were measured in in nmol/liter.

Statistical evaluation

Mean values ± standard deviations (SD), counts (n), and frequencies (%) were used to present baseline and follow-up data. Results were given as means ± SD or counts (%). Pairwise comparisons were performed using t-tests and chi-squared tests. Multivariate regression analyses were performed to detect possible influences of confounders on dependent variables (DES, DASS-S, and DASS-A scores, and cortisol values). Bivariate associations were considered significant at $p < 0.05$.

All statistics were calculated using SPSS version 22.0 (IBM corporation; New York, USA). P values less than 0.05 were regarded as statistically significant.

Results

Participants characteristics

Out of the 165 dentistry students who were invited to participate in the study, 117 (n = 64 in the CC group and n = 53 in the PCC group) gave their informed consent (response rate 70.9%). The mean ± SD age was 24.7 ± 2.7 years in the CC group and 22.9 ± 3.2 years in the PCC group. Thirty participants in the CC group (46.9%) and 21 participants in the PCC group (37.7%) were male. Participants in the CC group informed themselves significantly more often about the coronavirus pandemic than participants in the PCC group did ($p = 0.001$). Furthermore, participants in the CC group felt more stress at baseline because of the coronavirus pandemic than participants in the PCC group did ($p < 0.001$). The questionnaire on knowledge of the coronavirus revealed no differences between the groups at baseline but significantly more knowledge in the PCC group than in the CC group at follow-up ($p = 0.005$).

Scores for the anxiety subdomain in the DASS questionnaire were significantly higher in the PCC group than in the CC group at baseline (CC: 2.6 ± 2.8, PCC: 4.9 ± 4.2; $p < 0.001$) and increased at follow-up (CC: 4.0 ± 3.3, PCC: 6.00 ± 4.4), but slightly missed the cut-off value for a psychological disorder. Similarly, scores for the stress subdomain were also higher in the PCC group than in the CC group at baseline (CC: 5.2 ± 4.0, PCC: 7.4 ± 4.3) and also increased at follow-up (CC: 8.5 ± 4.2, PCC: 8.4 ± 4.8), but also missed the cut-off value for a psychological disorder.

Several subdomains of the DES questionnaire differed significantly between the study groups, but there was no difference in the mean total DES score between the CC group (615.9 ± 97.7) and the PCC group (580.40 ± 98.9), which indicated medium stress levels in both groups ($p > 0.05$). In addition, the total score did not change remarkably during study period (Tables 1 and 2).

Table 1
Descriptive statistics for participant characteristics at baseline. Data are presented as means (SD) or counts (frequency) (clinical course n = 64; preclinical course n = 53)

	Clinical course	**Preclinical course**	
	Mean (SD) or frequency (%)	Mean (SD) or frequency (%)	p value
Age	24.7 (2.7)	22.9 (3.2)	**< 0.001**
Gender (male)	30 (46.9%)	21 (37.7%)	0.431
Information about COVID-19	71.3 (21.5)	61.9 (23.1)	**0.001**
Stress due to COVID-19	62.7 (21.8)	41.9 (28.3)	**< 0.001**
Stress when thinking about the course	50 (78.1%)	43 (81.1%)	0.947
Cortisol level, nmol/L	9.2 (5.2)	4.9 (2.2)	**< 0.001**
DASS-A	2.6 (2.8)	4.9 (4.2)	**< 0.001**
DASS-S	5.2 (4.0)	7.4 (4.3)	0.067
Questionnaire about COVID-19	77.6 (11.2)	77.3 (11.0)	0.083
Total score DES	615.9 (97.7)	580.4 (98.9)	0.055
DES subdomains			
Faculty and administration	106.6 (20.3)	92.5 (20.5)	**0.001**
Academics	122.3 (25.3)	131.9 (22.3)	**0.027**
Manual skills	56.1 (14.4)	62.5 (18.2)	**0.002**
Financial obligations	23.9 (11.2)	23.4 (11.9)	0.064
Patient care	115.5 (27.0)	81.9 (36.5)	**< 0.001**
Personal problems	123.4 (34.7)	128.3 (43.7)	0.095
Family	93.9 (33.6)	86.8 (26.7)	0.268

Table 2
Descriptive statistics for participant characteristics at follow-up. Data are presented as means (SD) or counts (frequency) (clinical course n = 64; preclinical course n = 53)

	Clinical course	**Preclinical course**	
	Mean (SD) or frequency (%)	Mean (SD) or frequency (%)	p value
Age	24. 9 (2.7)	22.91 (3.24)	**< 0.001**
Gender (male)	30 (46.9%)	21 (37.7%)	0.431
Information about COVID-19	62.1 (21.0)	50.4 (24.2)	**0.006**
Stress due to COVID-19	1.3 (0.5)	1.3 (0.4)	0.698
Stress when thinking about the course	45 (70.3%)	39 (73.6%)	0.695
Cortisol level, nmol/L	8.1 (5.1)	7.2 (4.6)	0.327
DASS-A	4.0 (3.3)	6.0 (4.4)	**0.008**
DASS-S	8.5 (4.2)	8.4 (4.8)	0.982
Questionnaire about COVID-19	73.6 (7.9)	78.6 (10.2)	**0.003**
Total score DES	594.2 (141.6)	571.1 (117.5)	0.345
DES subdomains			
Faculty and administration	108.9 (58.3)	92.0 (23.2)	**0.048**
Academics	125.5 (25.8)	130.2 (24.1)	0.313
Manual skills	51.1 (15.4)	58.7 (19.0)	**0.019**
Financial obligations	19.5 (11.1)	25.9 (13.2)	**0.006**
Patient care	101.7 (33.8)	67.9 (35.2)	**< 0.001**
Personal problems	121.4 (39.8)	134.7 (48.1)	0.104
Family	90.5 (32.0)	88.5 (31.4)	0.738

Mean salivary cortisol levels were significantly higher ($p < 0.001$) in the CC group at baseline (9.2 ± 5.2) than in the PCC group (4.9 ± 2.2), indicating medium stress levels in the CC group. This difference between the groups was no longer significant at follow-up ($p > 0.05$) (Tables 1 and 2).

Multivariate analysis

Multivariate analysis with cortisol levels as the dependent variable confirmed the bivariate analysis. The baseline cortisol level was the most important determinant for changes in cortisol levels between baseline and follow-up ($p < 0.001$). Participants with higher cortisol levels at baseline had a higher increase in cortisol levels at follow-up, whereas clinical or preclinical studies had no effect on cortisol levels ($p = 0.777$) (Table 3).

Table 3
Multivariate regression analysis with changes of cortisol level as the dependent variable and target variables at baseline

Variable	C	95% CI LB	95% CI UB	p value
Change in cortisol level				
Course (clinical course)	0.288	-1.727	2.304	0.777
Cortisol level	-0.859	-1.075	-0.642	**< 0.001**
Significant p values are marked in bold. C = regression coefficient; LB = lower boundary; UB = upper boundary				

Multivariate analysis with DES scores as the dependent variable showed that knowledge of COVID-19 ($p = 0.009$) and the baseline DES score ($p = 0.000$) significantly affected changes in the DES score at follow-up, confirming the bivariate analysis (Table 4). Higher stress levels at baseline further increased the DES score at follow-up and vice versa. Knowledge of the pandemic had the opposite association with DES scores at follow-up.

Table 4
Multivariate regression analysis with changes in DES score as the dependent variable and target variables at baseline

Variable	C	95% CI LB	95% CI UB	p value
Change in DES score				
Information about COVID-19	-0.895	-1.561	-0.229	**0.009**
DES score	0.575	0.460	0.690	**< 0.001**
Significant p values are marked in bold. C = regression coefficient; LB = lower boundary; UB = upper boundary				

Table 5
Multivariate regression analysis with changes of DASS stress score as the dependent variable and target variables at baseline

Variable	C	95% CI LB	95% CI UB	p value
Change in DASS-S				
Gender (male)	-0.941	-2.297	0.415	0.172
Stress when thinking about the course (yes)	2.555	0.888	4.223	**0.003**
Stress due to COVID-19	0.036	0.012	0.060	**0.004**
DASS-S	0.CC515	0.357	0.673	**< 0.001**
Significant p values are marked in bold. C = regression coefficient; DASS-S = DASS stress score; LB = lower boundary; UB = upper boundary				

Factors that increased the DASS stress score at follow-up were stress when thinking during the course ($p = 0.003$), stress due to COVID-19 ($p = 0.004$), and the baseline DASS stress score ($p < 0.001$). According to the multivariate regression model, stress when thinking during the course ($p = 0.006$) and the baseline DASS anxiety score ($p < 0.001$) were the most important factors affecting changes in DASS anxiety scores at follow-up (Table 6). Increasing stress was associated with older age and stress when thinking about the course at baseline. Higher DASS anxiety scores at baseline reduced the increase in stress levels at follow-up and vice versa.

Table 6
Multivariate regression analysis with changes of DASS anxiety score as the dependent variable and target variables at baseline

Variable	C	95% CI LB	95% CI UB	p value
Change in DASS-A				
Age	-0.064	-0.259	0.132	0.520
Stress when thinking about the course (yes)	2.034	0.609	3.468	**0.006**
Course (clinical course)	-0.342	-1.544	0.859	0.573
DASS-A	0.629	0.471	0.788	**< 0.001**
Significant p values are marked in bold. C = regression coefficient; DASS-A = DASS anxiety score; LB = lower boundary; UB = upper boundary				

Discussion

The results of this study indicate that intra-individual differences in stress perception are more relevant to changes in stress and anxiety than course affiliation or the SARS-CoV-2 pandemic are in dentistry

students. Thus, the study hypothesis was only partially confirmed.

In agreement with other studies that used different questionnaires, many participants showed medium stress levels during their holidays and during their course [4–10]. The mean DES scores did not change much during the study period and were comparable to those reported by Garbee et al. [21]. Changes in DES scores between baseline and follow-up were affected by certain factors. For example, information about COVID-19 and DES scores at baseline affected the DES scores measured at follow-up. For the DASS questionnaire, stress when thinking during the course, stress due to COVID-19, and baseline stress scores were the most relevant factors for higher levels of general stress. These findings indicate that both individual stress perceptions and the SARS-CoV-2 pandemic might affect stress levels in dentistry students. This is in agreement with the results of Saraswathi et al. and Hakami et al. who also showed that the SARS-CoV-2 pandemic affected stress and anxiety levels in medicine and dentistry students [24, 25]. However, the DASS questionnaire evaluates stress and anxiety in general whereas the DES questionnaire evaluates stress specifically in dentistry students. It is therefore possible that the SARS-CoV-2 pandemic triggered general stress and not study-specific stress in our participants.

The salivary cortisol levels we observed in preclinical students were similar to those observed by Pani et al. in final-year dentistry students in Saudi Arabia [26]. This increase in salivary cortisol observed in both studies can be explained by the pronounced work-load of dentistry studies [12–14, 26]. The SARS-CoV-2 pandemic may have increased stress levels in dentistry students during their clinical studies. Students have additional challenges during their clinical studies, such as dealing with patients. This exposure to patients increases their risk of being infected by droplet transmission [19] and being sent into quarantine because they are infected. This loss of study time could increase stress levels. However, cortisol levels did not increase during term time in students doing the clinical part of their course, and the mean levels even decreased slightly. This is surprising because cortisol levels were measured during winter in clinical students, when the spread of SARS-CoV-2 was higher, and during summer in preclinical students, when SARS-CoV-2 transmission was lower. Our finding that cortisol levels did not differ significantly between clinical and preclinical students during their course is in contrast to the findings of other studies that stress levels increased in clinical students [8, 16]. In our study population, the individual perception of stress was more relevant to stress than course affiliation was.

Strength and weaknesses

Measuring salivary cortisol levels is a non-invasive and valid method for estimating stress levels [28–31]. However, cortisol levels vary during the day (high in the morning, low at night) [31]. In this study, salivary cortisol was measured between 12:00 am and 1:00 pm in all participants to get a reliable and constant view of the stress level. However, our results cannot be directly compared with those of all other studies because cortisol levels were measured at different times of day in different studies.

Another limitation of the study is the lack of data on stress levels in the participants before the SARS-CoV-2 pandemic. However, our results comparable to those of other studies that reported stress levels in

dentistry students before the SARS-CoV-2 pandemic. Therefore, it may be possible to generalize our findings to the non-pandemic situation.

Conclusion

Intra-individual differences in stress perception seem to be more relevant than course affiliation (preclinical or clinical) or the SARS-CoV-2 pandemic to changes in stress and anxiety levels among dentistry students. A follow-up study once the pandemic is over would be useful to determine stress levels in normal circumstances.

Declarations

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Author Contribution

A. Zenthöfer conceived the idea, performed statistical analysis and was involved in writing the manuscript. P. Rammelsberg conceived the idea and reviewed the manuscript. A. Graf assessed data and reviewed the manuscript. A-L. Klotz conceived the idea, supervised data assessment and was involved in writing the manuscript.

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Ethics and consent to participate

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent was obtained from all participants included in the study.

Conflicts of interest

The authors declare that they have no conflict of interest.

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