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New psychometric evidences on the Dental Environment Stress questionnaire among Romanian students

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Abstract:

BACKGROUND: The academic environment is a challenge for dental students due to the multiple sources of stress they face. For this reason, the present study analyzes the psychometric properties of the Dental Environment Stress (DES) questionnaire. The secondary objective was to identify the specific sources of stress perceived by dental students related to gender and years of study.

MATERIALS AND METHODS: A cross-sectional study was conducted among dental students (n = 340; M_{age} = 22.45) from the Romanian University of Medicine and Pharmacy in October– December 2019. The factorial structure of the questionnaire was performed by means of the confirmatory factor analysis (CFA) and the multi group-CFA. The convergent and divergent validities were measured by associating DES with scales that measure depression, anxiety, and tension/stress (Depression Anxiety Stress Scale-21-R), perceived stress (Perceived Stress Scale-14), and life satisfaction (Satisfaction with Life Scale).

RESULTS: New measure obtained supported a five-factor and thirty-item structure, which is gender invariant. All the factors within DES have a significant positive correlation with depression, anxiety, tension/stress, and perceived stress and a negative correlation with life satisfaction. The Cronbach's α coefficients are acceptable (range: 0.67–0.89). The female students perceive aspects related to performance, the relations with the faculty, clinical responsibilities, and personal life to be more stressful than males. Senior students perceive more stressed aspects related to personal life, while freshmen have higher scores on stress associated with clinical responsibilities.

CONCLUSIONS: The present results show that DES has psychometric properties which are adequate for the assessment of dental stress in the case of Romanian students; nevertheless, it is necessary to extend the use of DES to students attending other universities and to dental practitioners.

Keywords:

Dental, education, psychological, stress, undergraduate

Introduction

Over the past 35 years, research studies showed a significant amount of stress experienced by undergraduate dental students.[1-5] In order to address the educational psychological, and social needs of their students, teachers should be aware of the main sources of stress and its impact on academic performances or well-being. Thus, the evaluative feedback from dental students enables to improve the education performance.[6]

The sources of stress for dental students are diverse, from grade competition and heavy workload[4,5] to high parental expectation and living condition in home.[2] However, the most important remain those related to academic factors such as competition for grades and examinations.[7,8]

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Although there are many studies about the level of stress among undergraduate students, there is no data on Romanian dental students. As there is no validated tool for measuring stress for the dental area, we aimed to validate the Dental Environment Stress (DES) questionnaire by evaluating factorial and convergent validity, as well as measurement invariance across gender. The secondary objective is to identify the specific sources of stress perceived by dental students related to gender and years of study.

DES questionnaire developed by Garbee *et al*.[9] is the most used measure in education literature from different countries.[5,9-11] The DES questionnaire identifies and quantifies the specific stress factors for dental students.[9] The original version of this survey tool contains 38 items to determine the potential stressors for the undergraduate dental training, grouped into several categories: academic performance, clinic and patient responsibilities, faculty relations, personal life issues, professional identity, and financial obligations. There are four response categories from 1 – not stressful to 4 – very stressful.[8]

The cultural adaptation of DES led to versions with 36 items and 5 factors obtained through exploratory factor analysis in the case of Brazilian students,[5] while there are also versions of DES that includes 41 items of which 25 borrow from the original DES, divided into seven categories related to different sources of stress: assessment of own effectiveness, faculty and administration, workload, patient therapy, clinical training, pressure due to proper tasks, and social stressors.[4,5,12]

Materials and Methods

Study design and setting

This cross-sectional and quantitative study was conducted on 340 undergraduates (83 males; 257 females; M_{age} = 22.45; standard deviation (SD) = 2.45) with the dual purpose of DES validation and analysis of stress sources among dental students.

Study participants and sampling

A random sampling method was used to recruit students from the Faculty of Dental Medicine, University of Medicine and Pharmacy, Bucharest, Romania, between October and December 2019. Participants were informed about the purpose of the study and were assured of confidentiality and anonymity. All the respondents participated voluntarily in the completion of the proposed instruments, with no subsequent reward. The set of questionnaires was administered in the pencil-paper version in the classrooms with a duration of about 20–25 min. The description of the sample with regard to years of study shows that the latter was made up of 60 1st-year students (18%), 119 3rd-year students (35%), and 161 6th-year students (47%).

Data collection tool and technique

The instruments used were as follows:

DES questionnaire – DES[9]-38 items rated on a scale of 1 – not stressful to 4 – very stressful. The first translation from English was done independently by two bilingual dentists fluent in the English language and a professional translator. In order to assess the semantic equivalence, a back-translated English version was done by an English native speaker fluent in the Romanian language. Then, the first Romanian version was developed considering cultural and linguistic issues, and it was tested on a sample of thirty dental students. In this pilot study, students were asked also about the difficulties in understanding the items. No dental student had doubts or suggestions relating to rephrasing the items, thus the final Romanian version of the DES questionnaire was established.

Perceived Stress Scale-14 (PSS-14)[13] is a self-administered instrument which examines the subjective feeling of stress felt over the last month; it was originally conceived by its authors[13] as a unidimensional scale (14 items, out of which 7 are reversed, assessed on a scale from 0 – never to 4 – very often; sample item: *In the last month, how often have you been upset because of something that happened unexpectedly?*). Cronbach's α coefficients are 0.78 for the general population, 0.85 for the student population,[14] and >0.80 for a population of medical residents.[13] The Romanian version of PSS-14 applied to a general population from three large regions of the country shows an acceptable internal consistency coefficient, α = 0.74.[15] Studies have shown good methodological sensitivities of the test in the case of medical staff.[2,16] In this study, we used the single-factor scale form that measures perceived stress, and the Cronbach's α coefficient obtained is 0.82.

Depression Anxiety Stress Scale (DASS)-21-R questionnaire[17] is a three-scale set built to assess the negative emotional states of depression, anxiety, and tension/stress, each with seven items assessed on a continuum from 0 – did not apply to me at all to 3 – applied to me very much or most of the time. DASS-21-R was built to assess the aforementioned clinically significant emotional states rather than anxiety and depression. Studies show that the Cronbach's α coefficients vary between 0.86 (anxiety), 0.90 (stress), and 0.92 (depression) in the case of a population of patients and caregivers.[18] In the present study, the obtained Cronbach's α coefficients are high: 0.84 for depression, 0.87 for anxiety, and 0.86 for tension/stress.

Satisfaction with Life Scale (SWLS) is a short five-item instrument designed to measure the global cognitive judgments of life satisfaction.[19] Here is a typical item: *The conditions of my life are excellent*. The SWLS is a seven-point Likert style response scale with good internal consistency of $\alpha = 0.84$, obtained on samples of students.[20] Scores on the SWLS have been shown to correlate with measures of mental health and to be predictive of future behaviors such as suicide attempts. The scale has been validated in many cultural contexts.[21] In the present research, we obtained an acceptable consistency, $\alpha = 0.78$.

The data were analyzed with the SPSS 22.00 and Amos 20.00 software (IBM, New York, NY, USA). Cronbach's α coefficient was calculated to assess the internal consistency of all the instruments used. The values over 0.70 are considered acceptable and ≥ 0.80 adequate.[22] The confirmatory factor analysis (CFA) was used in order to test the factor validity of DES. For this purpose, we used the following indexes: Chi-square test (χ^2), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative-fit-index (CFI), parsimony normal fit index (PNFI), parsimony comparative fit index (PCFI), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR) and Akaike's information criterion (AIC). Given the reference points suggested by specialized literature, the value of χ^2/df is considered acceptable if it is <3, and good if it is <2. It is considered that RMSEA and SRMR with values under 0.05 show a good fit, while values that are higher than 0.08 are considered acceptable. For GFI and CFI indexes, it is considered that 0.90 is an acceptable fit and over 0.95 is a good fit.[23] For the gender factor invariance, we tested the configural, metric, scalar, and residual invariance by means of multi group-CFA. We used two criteria: $\Delta\chi^2$ should not be statistically significant, and ΔCFI should be <0.01. Finally, in order to establish the convergent validity, we made correlations between the DES scores and the scores of the instruments for depression, anxiety, perceived stress, and life satisfaction.

Ethical consideration

The study was approved by the Ethical Commission of the University of Medicine and Pharmacy, Bucharest, as part of the 94/2016 Protocol.

Results

The construct validity of the instrument was established by means of CFA. Before performing the CFA, we examined the multivariate normality distribution of observed variables using Mardia's multivariate normality test. Given that the latter was 16.34 and significantly different from zero ($P < 0.001$), we applied the bootstrapping method (2000 samples) in order to obtain a robust statistic.[23] CFA revealed five factors, having between 5 and 12 items each. The analysis of factor loading for every item showed that in the case of eight items (items 6, 10, 15, 16, 23, 24, 26, and 27), the factor loading is under 0.40. Therefore, the respective items were removed, which resulted in an improved model. Finally, we retained thirty items with factor loading between 0.41 (item 29) and 0.92 (item 14).

Table 1 shows two models: the first, with five factors without the correlation of errors, the second model, with five factors and the correlation of errors for six items (Factor 1), two items (Factor 2), eight items (Factor 3) and two items (Factor 4).

The coefficients obtained for the first model were as follows: $\chi^2 = 2395.224$; df = 790; χ^2/df = 3.05; GFI = 0.82; AGFI = 0.77; PNFI = 0.63; PCFI = 0.69; CFI = 0.77; RMSEA = 0.055 (90% confidence interval [$CI_{90\%}$] – 0.052–0.057); SRMR = 0.0781; AIC = 2679.224; $P < 0.001$.

In the case of the second model, with correlated errors, the values of the coefficients obtained were as follows: $\chi^2 = 1777.436$; df = 772; χ^2/df = 2.30; GFI = 0.87; AGFI = 0.83; PNFI = 0.68; PCFI = 0.75; CFI = 0.89; RMSEA = 0.044 (90% $CI_{90\%}$ – 0.041–0.047); SRMR = 0.0698; AIC = 2093.436; $P < 0.001$ [Table 1]. Although the values of the indicators are good, including χ^2/df and RMSEA, the CFI is slightly below the accepted value of 0.90. However, if in a model, the GFI is > than 0.85 and AGFI is >0.80, and RMSEA is <10, the values obtained are acceptable.[24] Consequently, we retained Model 2 whose coefficients suggest that this is an acceptable model fit.

Depending on the items contained within every factor, they were named: Factor 1 – academic performance (eight items), Factor 2 – relations with the faculty (five items), Factor 3 has items related to clinical responsibilities and related to patients (five items), Factor 4 – personal life (nine items), and Factor 5 – professional identity (three items). The correlations between factors were 0.30 between F4 and F5 (the weakest) and 0.84 between F1 and F2 (the strongest).

For the factorial analysis across gender, we used both the criteria of comparison mentioned above (statistics data) based on the differences for χ^2 coefficients and CFI. As Table 2 shows, ΔCFI varies between 0.000 and 0.005, therefore it is <0.01, while the value of $\Delta\chi^2$ is not statistically significant. We also mention that RMSEA was between 0.000 and 0.001 (<0.015).

As for the internal consistency for the obtained factors, Cronbach's α coefficients show acceptable reliability of the instrument: $\alpha = 0.75$ (academic performance), $\alpha = 0.72$ (relations with the faculty), $\alpha = 0.67$ (clinical responsibilities), $\alpha = 0.83$ (personal life),

Table 1: Confirmatory factor models

Models Five factors	χ^2	df	χ^2/df	GFI	AGFI	CFI	RMSEA	SRMR	AIC
Uncorrelated errors	2395.224	790	3.05	0.82	0.77	0.77	0.055 (0.052-0.057)	0.0781	2679.224
Correlated errors	1777.436	772	2.30	0.87	0.83	0.89	0.044 (0.041-0.047)	0.0735	2093.436

df=Degree of freedom, χ^2/df=Ratio of Chi-square to degree of freedom, GFI=Goodness-of-fit index, AGFI=Adjusted GFI, CFI=Comparative of fit index, RMSEA=Root mean square error of approximation, SRMR=Standardized root mean square residual, AIC=Akaike's information criterion

Table 2: Factorial invariance of Dental Environment Stress questionnaire across gender

Models	Comparative fit indices								
	χ^2	df	CFI	RMSEA	$\Delta\chi^2$	Δdf	*P*	ΔCFI	ΔRMSEA
Configural	1310.721	772	0.846	0.045	-	-	-	-	-
Metric	1335.113	797	0.846	0.045	24.39	25	0.497	0.000	0.000
Scalar	1347.792	812	0.847	0.044	37.07	40	0.603	0.001	0.000
Residual	1370.369	851	0.850	0.042	59.64	79	0.949	0.005	0.001

df=Degree of freedom, χ^2/df=Ratio of Chi-square to degree of freedom, CFI=Comparative of fit index, RMSEA=Root mean square error of approximation

and α = 0.76 (professional identity). For the total DES scale, α = 0.89.

For the subsamples of men and women, the obtained coefficients are acceptable as well: academic performance (α = 0.75 – females; α = 0.77 – males); relations with the faculty (α = 0.73 – females; α = 0.69 – males); clinical responsibilities (α = 0.66 – females; α = 0.63 – males), personal life (α = 0.84 – females; α = 0.80 – males), and professional identity (α = 0.78 – females; α = 0.72 – males).

The items which the students in the group perceived to be the most stressful: examinations and grades (M = 3.31; SD = 0.80), fear of failing course or year (M = 2.83; SD = 1.13), and competition for grades (M = 2.82; SD = 1.10). Although gender disparity is great among the respondents (83 males and 257 females), we carried out the analysis of the gender effect. We did not discover significant gender differences with regard to stress sources. Therefore, we analyzed the gender differences in the case of the items within the DES questionnaire. In the case of the following four items, female students have higher scores in comparison with the male students: lack of cooperation by patients in their home care (t = −1.75; P = 0.080), conflict with the partner over career decision (t = −1.76; P = 0.079), inconsistency of feedback on your work between different instructors (t = −2.24; P = 0.027), and fear of being unable to catch up if behind (t = −1.69; P = 0.091).

In addition, we calculated the difference with regard to the years of study. With respect to this, the dimension "personal life" reveals the differences between the 1st-year students and the 6th-year students. Stress caused by the "responsibilities for personal life" is higher in the case of 6th-year students ($M_{1\text{ st -year students}}$ = 18.48; SD = 5.60; $M_{6\text{ th -year students}}$ = 20.19; SD = 7.08; t = −1.69; P = 0.091). The items that contribute to this difference between the first and the sixth academic years are the necessity to postpone having children, lack of home atmosphere in living quarters, and conflict with partner over career decision. In exchange, the 1st-year students registered a higher score for the dimension "clinical responsibilities and responsibilities related to patients," in comparison with the 6th-year students ($M_{1\text{ st -year students}}$ = 2.52 ± 0.60; $M_{6\text{ th -year students}}$ = 2.33 ± 0.58; t = 2.11; P = 0.036). The items involved in this differentiation are responsibilities for comprehensive patient care and difficulty in learning precision manual skills required in preclinical and laboratory work.

Considering the prior literature,[25] we established the following hypothesis: the identified dental sources of stress, namely stress generated by academic performance, relations with the faculty, clinical responsibilities, personal life, and professional identity, will correlate positively with depression, anxiety, general and perceived stress, and negatively with life satisfaction. The obtained results confirmed the hypothesis. Thus, as expected, we obtained significant correlations between all the five factors of DES questionnaire and the other validated measures [Table 3].

Discussion

DES questionnaire is an instrument used to assess the sources of stress in the case of dental students. Given that there were no instruments meant to assess stress in the dental domain in Romania, we aimed at establishing the usefulness of the instrument by validating DES. The study found robust evidence of the construct validity of the instrument for a five-factor structure (academic performance, relations with the faculty, clinical responsibilities, personal life, and professional identity) and thirty items selected in the instrument after we carried out the CFA. The rest of the items have a factor loading between 0.41 (item 29) and 0.92 (item 14).

In other cultures, the adaptation and the validation of the DES questionnaire resulted in a four-factor

Table 3: Intercorrelations between Dental Environment Stress questionnaire and other validated measures

Variables	F1	F2	F3	F4	F5
DASS-21-R					
Depression	0.40**	0.32**	0.28**	0.31**	0.48**
Anxiety	0.71**	0.62**	0.78**	0.53**	0.65**
Tension/stress	0.68**	0.73**	0.56**	0.46**	0.40**
SWLS					
Life satisfaction	−0.21**	−0.15*	−0.16*	−0.04	−0.41**
PSS-14					
Perceived stress	0.41**	0.24**	0.28**	0.16*	0.51**

*P<0.05, **P<0.01. F1=Academic performance, F2=Relations with the faculty, F3=Clinical responsibilities and related to patients, F4=Personal life, F5=Professional identity, DASS=Depression Anxiety and Stress Scale, SWLS=Satisfaction with Life Scale, PSS=Perceived Stress Scale

solution. For example, in the case of Chilean and Argentine dental students, the extracted factors were "academic workload," "clinical training," "time constraints," and "self-efficacy beliefs."[10] In the case of a sample of Brazilian dental students (n = 225), seven factors were identified, by means of EFA: "academic performance," "difficulties and insecurities regarding the individual's professional future," "responsibilities with patients," "individual and institutional factors," and "interpersonal relationships."[5] Similarly, other studies identified seven factors but, in the case of the 41-item version, these were self-efficacy beliefs, faculty and administration, workload, patient treatment, clinical training, performance pressure, and social stressors.[10]

Categorically, the factor structure and reliability may differ if we apply the obtained version to other groups of dental students in other regions of Romania and/or other groups of population.

For the sample of dental students on which DES was tested from a psychometric point of view, the five-factor measuring model was gender invariant, as the fit coefficients of multi group-CFA show. In addition, DES shows a satisfying internal consistency and criteria validity since the total score of stress and the scores for the sources of dental stress correlate with measures of depression, anxiety, and stress, and it is negatively associated with the scale of life satisfaction. In other words, students with high levels of dental stress factors tend to evince high levels of anxiety, depression, perceived stress, and low levels of life satisfaction. The negative associations between the sources of dental stress and well-being are acknowledged in literature. For example, a study of a sample of Romanian dental students has shown that stress related to academic life has a negative influence on well-being.[7] However, life satisfaction is the cognitive component of well-being. Simultaneously, the literature also shows the relationship between dental stress and the dental students' mild and moderate depression.[26] Under physical and psychological stress, students can also evince the symptoms of anxiety and depression.[9,25] These prior studies confirm the relationship obtained between the sources of stress of DES and depression and anxiety (DASS-21-R). The internal consistency for the thirty-item scale is high, namely 0.89. In the case of subscales, Cronbach's α varies from 0.67 – the scale of "clinical responsibilities" – to 0.83 – the scale of "personal life." The scale of "clinical responsibilities" may be less precise than other scales. At the same time, the coefficient is not surprising, given the limited number of items.[27]

The results show that the fear of failure, examinations, and competitions for grades are the highest stressors for the analyzed dental students. The data are consistent with other studies carried out on students from various cultures which demonstrate that fear of failure and examinations are the two stressors that are common to all dental students, irrespective of their year of study.[28]

The female students obtained higher scores in comparison with the male students concerning some items related to clinical responsibilities and relations with the faculty and to the stress generated by obtaining the performance. The results are similar to those of other studies that show that female students evince greater fear of failure and examinations.[28] Unlike other studies, the present study highlights the stress of female students with regard to conflict with a partner over a career decision. As some studies show, women's health is affected by several factors, including discrimination and domestic violence.[29] As for years of study, 6th-year students evince greater stress related to their "personal life," while 1st-year students evince greater stress related to "learning manual precision abilities required in preclinical and laboratory activities." This is explained by Garbee *et al*.[9] by the fact that there is a discrepancy between the students' expectations and the reality of medical school, and the emotional stress caused by this discrepancy has intensified the psychological stress of students.

To sum up, the study provides evidence for the use of DES in investigating sources of stress in the dental environment and for comparing gender differences and years of study. The new DES version displayed good factorial validity, invariance across gender, and good reliability.

Limitations and recommendation

In addition to the number of students in the sample which needs to be larger in future studies, another limitation consists of the fact that the students attend the same university. Therefore, caution is required when it comes to generalizing the obtained results. It would be interesting to compare the respective students with dental students from other regions of the country. Another limitation is

the absence of the students' marital status. Despite these limitations, the contribution of this study consists of the fact that it provides evidence for the construct validity, the measurement of invariance across gender, reliability, and convergent/divergent validity and it provides support for the use of DES as an instrument of sources of stress perceived by dental medicine students.

Conclusions

This is the first study to focus on the validation of the DES by using a sample of Romanian dental students. The model resulted from the CFA showed a reliable instrument with five factors with thirty items and correlated errors. The fact that we obtained a model with good or acceptable fit does not mean that we obtained the real model. Therefore, there may be alternative models that fit the data in addition to the model found within the present data, and our model may be only one of those that fit the data. Regarding the sources of stress identified for the whole group (examinations and grades, fear of failing course, or year and competition for grades), they are consistent with previous studies that analyzed stress in the case of undergraduate dental students.

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Conflicts of interest

There are no conflicts of interest.

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