

# Psychological stress and health in undergraduate dental students: fifth year outcomes compared with first year baseline results from five European dental schools

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## Keywords

burnout; dental students; mental health; stress.

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**Accepted:** 16 July, 2007

doi:10.1111/j.1600-0579.2008.00468.x

## Abstract

Psychological stress in undergraduate dental students: fifth year outcomes compared with first year baseline results from five European dental schools.

**Objective:** To compare the levels of a series of health-related indicators from a cohort of fifth year dental students from five European schools with their first year scores, and to investigate the relationship between these follow-up measures.

**Methods:** Burnout was measured using the Maslach Burnout Inventory (MBI), consisting of three scales: Emotional Exhaustion (EE,  $\alpha = 0.90$ ), Depersonalisation ( $\alpha = 0.80$ ) and Personal Accomplishment ( $\alpha = 0.72$ ). Physical health was measured by the Physical Symptoms Questionnaire ( $\alpha = 0.82$ ), psychological distress was measured using the General Health Questionnaire (GHQ,  $\alpha = 0.89$ ) and student stress was captured using seven subscales of the Dental Environment Stress questionnaire (DES,  $\alpha = 0.92$ ). A total of 132 fifth year students responded from five dental schools (Manchester, Belfast, Cork, Helsinki and Amsterdam), a 51% response.

**Results:** Fifth year students showed relatively high mean MBI scores when compared with first year results, especially on EE; 39% could be labelled 'high scorers'; 44% of the students met the criteria for 'cases' on the GHQ. Highest mean scores on the DES were obtained on the subscales: Study Obligations, Patient-Related Aspects and Study Pressure respectively. Between schools interesting differences were detected on all variables. As hypothesised, a clear direct effect of stress on both burnout and physical symptoms was shown. An indirect effect of stress on mental health via burnout was shown.

**Conclusions:** Dental students showed a negative development through the years from first to fifth year with regard to EE and psychological distress. Both burnout constructs related to physical and mental health. It is recommended that dental faculty focus on the importance of prevention and intervention of stress amongst undergraduates.

## Introduction

Stress, as well as health and well-being, amongst dental students has been a frequent topic of research during the last decades (1–6). Although the literature on dental student stress covers different perspectives, such as general levels of stress, consequences of stress or effects of stress prevention –

most attention has been directed at perceived causes of stress. In general, three distinctive categories of stress-provoking factors can be distinguished: faculty related factors (such as a bureaucratic administration system), study-related factors (such as having to pass exams) and student-related factors (such as personality characteristics or health behaviours).

Although from a variety of countries valuable contributions have been made to our understanding of dental student stress, one major disadvantage is that the measurement instruments used vary considerably. Because of the variation in instruments applied, straightforward comparisons often are not possible. To illustrate, in a recent German/Swiss study (7), a self-constructed Psychosocial Stress Inventory was used, consisting of 24 statements about studying dentistry, to be answered on a Likert-type scale ranging from zero (not stressful) to five (highly stressful). Five subscales could be derived, representing: limited leisure time, examination anxiety, transition stress, social integration and worry. Previously, in an Israeli study published in 1997 (4), a 17-item questionnaire was used describing potential stressors in the learning environment. Using a four-point answering system varying from one (no stress) to four (severe stress), a variety of stress-provoking study aspects was categorised at item level, varying from requirements of the school system, through fear of drop out, to learning new (dental) vocabulary. Furthermore, in one of the first studies on dental student stress described in the scientific literature, Goldstein (8) adapted a stress questionnaire that was used amongst medical students to the dental school setting. This adopted a four-point Likert scale, ranging from one (not stressful) to four (very stressful), and consisted of 17 items. The items referring to time pressure – and subsequent lack of leisure time – and inconsistent feedback from the faculty staff received highest mean scores, indicating they were seen as major stressors.

From the Goldstein study onwards, more and more studies investigating dental student stress appeared in the literature. Different sets of items were used in various questionnaires, as were different types of answering scales. Garbee et al. (9) started the development of a questionnaire to monitor dental student stress, which was later refined by Grandy et al. (10) into the Dental Environment Stress (DES) questionnaire. The DES is a 38-item questionnaire aimed at identifying perceived sources of stress amongst dental students, using a four-point Likert type answering scale from one (not stressful) to four (very stressful). Nowadays, the DES has been used in several studies worldwide and has been combined with other measures, such as health behaviour questionnaires or general psychological well-being. The DES has proven to cover relevant aspects of dental students' environment.

A possible long-term consequence of (occupational) stress is professional burnout. Burnout is well-recognised to be an occupational risk factor amongst many professions, including dentists (11–13). Becoming emotionally exhausted is the key characteristic of burnout (14). Other characteristics are the development of a negative, cynical attitude towards one's patients, and the tendency to evaluate oneself and one's accomplishments negatively. A few studies have appeared describing burnout amongst dental students (7, 15), indicating that, although burnout refers to a long-term process, it is definitely apparent amongst students too. The prevalence or intensity of burnout amongst dental students, as described in literature, varies, depending on the definitions and demarcations used. On the development of burnout amongst dental students during their training, however, little is known.

In the baseline study amongst first year dental students from seven European dental schools in England, Northern Ireland,

Ireland, Finland, Germany and the Netherlands, Humphris et al. (15) examined students' perceived stress, potential for burnout and health risks. Over a third of the participants reported significant psychological distress. Furthermore, more than one-fifth of the participants reported high scores on Emotional Exhaustion (EE), the core burnout dimension. This study revisits the same cohort of dental students when they were in their fifth year of training. The aim was to compare their present perceived stress, burnout and health risk with their first year results. Furthermore, explanatory factors to account for differences in health outcomes were assessed.

## Methods

### Sample

The size of first year intake amongst the seven dental schools involved (Manchester, Liverpool, Belfast, Cork, Helsinki, Greifswald and Amsterdam) in the academic year 1997–1998 varied considerably: from 30 in Helsinki compared with 136 in Amsterdam. The overall response rate in 1997–1998 was 79.1% ( $N = 331$ ).

In 2003, the administration of the questionnaires differed somewhat per dental school. At some schools, all fifth year students present at a certain course immediately completed the questionnaire, whilst at other schools all fifth year students received a questionnaire, including a postage-free return envelope by mail. In one school, Amsterdam, only those students who had filled in the first year questionnaire were traced using code numbers and, repeatedly, were invited to participate in the fifth year by returning the questionnaire using university mail. All forms were collected by each school's organising researcher and forwarded to this paper's first author to be keyed in and statistically analysed.

### Instrument

The questionnaire used was virtually identical to the one administered in the students' first year. An exception was that all items of the Maslach questionnaire were included, whereas in the first year instrument only the EE subscale was included and the other two burnout subscales were omitted as they contained many patient focused questions which were not relevant to first year students at their stage of training. In addition, for similar reasons to those above, the full version of the DES was used in the fifth year survey. Overall, the questionnaire consisted of two sections, the first part contained questions on demographic and personal details, whilst the second part comprised standardised Likert scales on burnout, DES, psychological distress and general health.

### Burnout

The Maslach Burnout Inventory (MBI) (14) is a 22-item self-report inventory which consists of three subscales: EE (nine items, Cronbach's  $\alpha = 0.90$ ), Depersonalisation (DP: five items, Cronbach's  $\alpha = 0.80$ ) and diminished Personal Accomplishment (PA: eight items, Cronbach's  $\alpha = 0.72$ ). Items were rephrased to the students' situation where necessary. An

example of such an item is: 'I feel I'm working too hard on my studies'. Answering categories range from zero (never) to six (every day).

### Physical health

The Physical Symptoms Questionnaire (PSQ) from the Occupational Stress Indicator (16, 17) consists of 12 items on physical health, each to be answered on a six-point Likert scale with answering categories varying from one (never) to six (very often). Subjects are asked to answer how often they had complaints during the last 3 months on 12 varied aspects of physical symptoms, such as upset stomach, or sweating. The reliability of the PSQ was Cronbach's  $\alpha = 0.82$ .

### Psychological distress

The General Health Questionnaire (GHQ) 12-item version has proven its reliability and validity in numerous studies (18). In the present study, Cronbach's  $\alpha$  was 0.89. Scoring can vary, either calculating group mean scores (score range: 0–3), or determining numbers of cases (score range: 0–0–1–1). The case cut-off point is  $>3$  as a determinant for psychological ill health.

### Dental environment stress

The DES questionnaire assesses sources of stress associated with undergraduate course work and training in dental students (19). The DES can be used in two versions, the full version or the 16-item (short) version. The full version is a 38-item questionnaire based on a four-point Likert scale, with scores ranging from one (not stressful) to four (very stressful). The full scale has a reliability index of Cronbach's  $\alpha = 0.92$  (as measured amongst fifth year students). Factor analysis [principle component analysis (PCA) with varimax rotation] revealed nine factors with eigenvalue  $>1$ , explaining 69% of the variance. Two factors (representing 10 items) could not reach a minimal internal consistency of Cronbach's  $\alpha = 0.60$ , these were excluded from further analysis. The remaining seven factors could be interpreted as the following scales measuring distinctive aspects of dental study: Study Obligations (nine items,  $\alpha = 0.90$ ), Gender and/or Racial Related (six items,  $\alpha = 0.81$ ), Study Contents (three items,  $\alpha = 0.83$ ), Patient-Related Aspects (three items,  $\alpha = 0.68$ ), Rules and Regulations (two items,  $\alpha = 0.79$ ), Lack of Self-Confidence (two items,  $\alpha = 0.82$ ) and Study Pressure (two items,  $\alpha = 0.61$ ). An example of an item from the Study Obligations scale is: 'Difficulty of classwork'.

The DES short version consists of 16 items of the full DES, only referring to non-patient-related aspects of the dental environment (Cronbach's  $\alpha = 0.90$ , as measured amongst first year students) (15). For comparison reasons the short version was also included in the present analysis.

### Analyses

The response group data were analysed using descriptive statistics, frequencies, and by chi-square and univariate (one-way ANOVA) testing techniques. Scales were constructed using PCA (varimax rotation), and by selecting components with

eigenvalue ( $\lambda$ ) larger than or equal to one. Scale reliabilities were indicated by Cronbach's  $\alpha$ .

Differences in scale mean were tested in multivariate and univariate analyses, using fixed factor general linear model (GLM). The factors: gender and cities were entered into these analyses (with  $\alpha$  set at 0.05) following Tukey honestly significant difference (HSD) multiple comparison testing where necessary. Bonferroni correction principles given the number of comparisons were adopted.

A path analytical approach adopting structural equation modelling (20) was performed to investigate the influence of perceived stress from dental undergraduate training on both mental and physical health. It was hypothesised that the prolonged stress from training would exacerbate burnout and affect self-reported health.

## Results

### Sample

Data were collected from five dental schools, as Liverpool and Greifswald were unable to collaborate because of organisational problems. The response rate was 51%, giving a total sample size of 132. The details are presented in Table 1.

### Demographic profile

The gender ratio amongst the participants was 58% female: 42% male (first year: 49%:51%). The percentages of males and females were equally distributed amongst the dental schools:  $\chi^2(4) = 5.24$ ;  $P = 0.26$ . Mean age was 24 years, with students from Helsinki and Amsterdam being slightly older than the ones from the other dental schools [ $F(4,127) = 16.82$ ;  $P < 0.001$ ]. Thirteen per cent were either married or cohabitating, the remainder were single or at least not living with a partner. The lowest proportion of singles was found in Helsinki (71%), and highest in Manchester (97%); 68% lived in their own accommodation (first year: 37%), whereas 14% were family based (first year: 23%) and 17% lived in university halls (first year: 40%).

### Burnout

During the first year survey, only the EE scale of the MBI was administered, as most students were not treating patients. In the present study, all three MBI scales were administered. MBI mean scores and standard deviations were calculated for the three scales and compared with manual guidelines (MBI – Human Services Survey, overall sample,  $N = 11.067$ ) (14) (Table 2). Multivariate analysis showed differences in mean on the MBI:  $F(12,304.55) = 3.631$ ;  $P < 0.0001$ . Univariate analysis showed a main effect for dental school on EE:  $F(4,117) = 6.494$ ;  $P < 0.0001$ . Also an interaction effect for dental school and gender was found on EE:  $F(4,117) = 3.076$ ;  $P = 0.019$ : females being more emotionally exhausted than males in Belfast and Helsinki, whereas the opposite was true in Manchester and Cork. In Amsterdam no gender differences on EE were shown.

The MBI manual also offers a more detailed instruction to categorise subjects. Using this instruction, for each MBI scale

	Fifth year participation (2003)	Males (2003) (%)	Females (2003) (%)	First year participation (1998)	Percentage participating after 5 years (%)
Manchester	32	18 (56)	14 (44)	58	55
Belfast	22	7 (32)	15 (68)	39	56
Helsinki	17	5 (29)	12 (71)	29	58
Amsterdam	39	18 (46)	21 (54)	99	39
Cork	22	8 (36)	14 (64)	35	62
Liverpool	–	–	–	27	0
Greifswald	–	–	–	44	0
All	132	56 (42)	76 (58)	331	40
All (excluding Liverpool and Greifswald)	132			260	51

TABLE 1. Sample and demographic characteristics by dental school

TABLE 2. Maslach Burnout Inventory (MBI): mean (and SD's) fifth year students

	N	EE	DP	PA
Manchester	32	21.25 (10.58)	8.09 (7.12)	35.00 (5.73)
Belfast	22	28.13 (10.62)	9.13 (4.32)	31.31 (7.03)
Helsinki	17	24.88 (11.86)	7.17 (4.23)	32.47 (7.30)
Amsterdam	39	18.27 (8.29)	6.21 (4.65)	31.02 (4.53)
Cork	22	28.76 (11.51)	6.22 (6.45)	33.00 (7.44)
All	132	23.31 (11.00)	7.29 (5.61)	32.54 (6.27)
All males	56	22.80 (12.39)	8.16 (6.17)	31.92 (6.95)
All females	76	23.69 (9.89)	6.62 (5.09)	33.00 (5.74)
MBI-HSS	11067	20.99 (10.75)	8.73 (5.89)	34.58 (7.11)

HSS, Human Services Survey, North American manual norms (14) (see text for testing of differences in mean); EE, Emotional Exhaustion; DP, Depersonalisation; PA, Personal Accomplishment.

high scorers could be identified. 39% of the dental students could be labelled high scorers on EE in their fifth year, whereas in their first year this was 22%, showing a 17% increase. Most notable were students from Belfast and Cork, of whom more than half of the respondents were in this category. Furthermore, 22% of the students were high on DP, and 41% were low on PA (Table 3).

## Psychological distress

Psychological distress was measured using the GHQ-12, using scores >3 as a cut-off point for cases of psychological ill health. Of the fifth year students, 44% could be labelled cases (first year: 36%). Notably, almost half of the students from Cork, Belfast and Manchester could be labelled this way (Table 4). Multivariate analysis showed differences in mean between the dental schools:  $F(4,120) = 2.446$ ;  $P = 0.05$ , but after Bonferroni correction for number of tests these differences appeared not to be statistically significant. No main effect for gender was found.

## Physical health

Physical health was measured by the PSQ. Univariate analysis showed no differences in mean between the dental schools, but

TABLE 3. Maslach Burnout Inventory (MBI) high scores: EE &gt; 26, DP &gt; 12, PA &lt; 32

	EE (%)	EE (1st year) (%)	DP (%)	PA (%)
Manchester	10 (31)	14 (24)	12 (22)	5 (16)
Belfast	13 (59)	10 (26)	6 (27)	9 (41)
Helsinki	10 (23)	1 (3)	1 (6)	8 (47)
Amsterdam	6 (16)	13 (13)	5 (13)	22 (56)
Cork	12 (57)	9 (26)	5 (23)	10 (48)
All	51 (39)	72 (22) (including Liverpool and Greifswald)	29 (22)	54 (41)
All males	22 (40)		14 (25)	24 (44)
All females	29 (40)		15 (20)	30 (40)

EE, Emotional Exhaustion; DP, Depersonalisation; PA, Personal Accomplishment.

TABLE 4. General Health Questionnaire (GHQ) 12: mean (and SD's), and cases in % in fifth and first year

	GHQ-12: mean (SD) <sup>1</sup> , range 0–3	Fifth year, cases (score > 3), scale 0–0–1–1 (%)	First year, cases (score > 3), scale 0–0–1–1 (%)
Manchester	1.24 (0.55)	15 (47)	18 (36)
Belfast	1.14 (0.49)	13 (49)	9 (24)
Helsinki	1.13 (0.47)	7 (41)	3 (10)
Amsterdam	0.97 (0.50)	9 (33)	31 (34)
Cork	1.38 (0.54)	14 (53)	10 (35)
All	1.15 (0.52)	58 (44)	111 (36), (including Liverpool and Greifswald)
All males	1.15 (0.54)	26 (46)	
All females	1.15 (0.51)	32 (43)	

<sup>1</sup>See text for testing of differences in mean.

a main effect for gender was found:  $F(1,116) = 5.446$ ;  $P = 0.021$ , indicating females suffer from more health complaints than males (Table 5).

TABLE 5. Mean and standard deviations Physical Symptoms Questionnaire

Physical Symptoms	Mean	Standard deviations	N
Males	31.3	10.37	54
Females	34.4	9.02	72
Total	33.1	9.71	126

### Dental environment stress

In the first year report on DES a short version of the DES was used, in which all items referring to patient contacts were left out. In the present study, for comparison reasons, both the full DES results will be presented (Table 6), and the short version of the DES (Table 7). Highest mean scores were obtained on Study Obligations, Patient-Related Aspects and Study Pressure respectively. Multivariate analysis showed statistically significant differences in mean on the DES scales:  $F(28,304.29) = 5.237$ ;  $P < 0.0001$ . Univariate analysis showed differences in mean between the dental schools on: Study Obligations [ $F(4,90) = 7.902$ ;  $P < 0.0001$ ]; Study Contents [ $F(4,90) = 3.463$ ;  $P = 0.011$ ]; Patient-Related Aspects [ $F(4,90) = 2.829$ ;  $P = 0.029$ ]; Rules and Regulations [ $F(4,90) = 10.185$ ;  $P < 0.0001$ ]; Lack of Self-Confidence [ $F(4,90) = 3.388$ ;  $P = 0.012$ ] and Study Pressure [ $F(4,90) = 3.303$ ;  $P = 0.014$ ] (Table 5). A main effect for gender was found on: Study Contents [ $F(1,90) = 5.722$ ;  $P = 0.019$ ]; Patient-Related Aspects [ $F(1,90) = 4.989$ ;  $P = 0.028$ ] and Lack of Self-Confidence [ $F(1,90) = 6.520$ ;  $P = 0.012$ ].

To compare DES between first and fifth year of the study, the short version of the DES (Table 7) was also analysed separately for high scorers (which is a score  $>38$  on the 16 items). For the full sample, the percentage remained at exactly 34%. Highest percentages of high scorers were found in Belfast, Manchester and Cork. Sharpest increase of high scorers over the 4 years was found in Cork (+23%), sharpest decrease, and also lowest percentage, was found in Helsinki (−20%). (A detailed overview of product moment correlation coefficients between the variables is available on request by the first author.)

TABLE 7. Dental Environment Stress (short version): high scorers ( $>38$ ); first and fifth year comparison

	Fifth year high scorers (%)	First year high scorers (%)
Manchester	15 (47)	27 (49)
Belfast	11 (50)	12 (32)
Helsinki	2 (12)	12 (32)
Amsterdam	8 (21)	2 (7)
Cork	9 (41)	18 (18)
All	45 (34)	110 (34) [including Liverpool (38%) and Greifswald (35%)]
All males	19 (37)	
All females	26 (36)	

### Explanatory factors for student burnout, stress and health

To investigate the influence of perceived stress from dental undergraduate training on both mental and physical health, a path analytical approach was performed, adopting structural equation modelling (20). It was hypothesised that the prolonged stress from training would exacerbate burnout and affect self-reported health. Hence, stress may affect health directly or indirectly through burnout. This model may be represented by Fig. 1 with paths drawn between the psychological constructs to indicate significant relationships. The data entered into the model was the final fifth year sample. These students will have experienced an extensive period of training and therefore give a credible test of the effects of chronic perceived stress on health. Each of the latent variables constructed in the model (denoted by the ellipses in Fig. 1) were defined by multiple indicators defined as follows. The dental stress construct consisted of six of the seven subscales of the DES. One subscale (scale 2) was omitted as it suffered a relatively high level of missing information ( $n = 30$ ). The burnout measure was described by the subscales of EE and depersonalisation. The PA scale was not included as there is some evidence that this subscale can be considered theoretically independent to the other two scales. Both the mental and physical health aggregate scales were transformed into two subscales each by virtue of their

TABLE 6. Study stress as measured by the DES (full version): mean (and SD's)

	Study obligations	Gender and/or racial related	Study contents	Patient-related aspects	Rules and regulations	Lack of self-confidence	Study pressure
Manchester	2.77 (0.69)	1.43 (0.56)	1.87 (0.66)	2.34 (0.76)	1.89 (0.84)	2.04 (0.72)	2.09 (0.63)
Belfast	2.55 (0.60)	1.11 (0.19)	2.28 (0.75)	1.96 (0.59)	1.25 (0.48)	2.40 (0.86)	2.54 (0.81)
Helsinki	1.95 (0.63)	1.15 (0.25)	1.64 (0.60)	2.00 (0.66)	1.71 (0.89)	1.67 (0.46)	2.02 (0.78)
Amsterdam	2.15 (0.68)	1.19 (0.39)	1.82 (0.63)	2.47 (0.68)	2.69 (0.89)	1.67 (0.78)	2.03 (0.58)
Cork	2.73 (0.83)	1.33 (0.71)	1.95 (0.84)	2.31 (0.78)	1.81 (0.80)	2.00 (0.97)	2.27 (0.73)
All	2.43 (0.75)	1.24 (0.44)	1.91 (0.71)	2.27 (0.72)	1.98 (0.94)	1.94 (0.81)	2.17 (0.70)
All males	2.37 (0.85)	1.18 (0.30)	1.76 (0.74)	2.21 (0.78)	1.99 (0.96)	1.67 (0.74)	2.12 (0.78)
All females	2.48 (0.66)	1.28 (0.52)	2.02 (0.67)	2.31 (0.67)	1.98 (0.93)	2.14 (0.82)	2.21 (0.64)

See text for testing of differences in mean. DES, Dental Environment Stress.

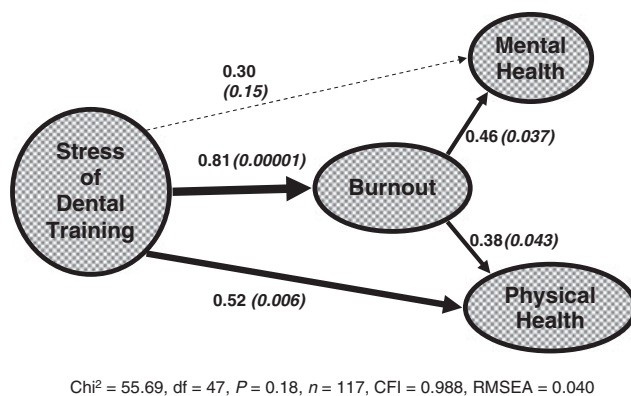


Fig. 1. Path model fifth year students with standardised regression parameters and significance values in italicised brackets. (Individual items and error variances have been omitted for clarity, with width of arrows indicating strength of effect for ease of interpretation.)

items being odd and even numbered. The purpose of constructing these subscales was to enable all four major psychological constructs (i.e. stress, burnout, physical and mental health) to be introduced as latent variables. Latent variables require at least two raw data indices. Chi-square and its significance, and two goodness of fit indexes, namely: comparative fit index (CFI, criterion 0.95 or higher) and the root mean square error approximation (RMSEA, criterion 0.06 or less) were inspected to assess the adequacy of the model reflecting the sample of raw data (21).

The results of the analysis showed a clear role of burnout to act as a mediator of stress on both health indices. Of interest was a clear direct effect of DES on physical health but little direct association between stress and mental health. The indirect effect of stress on mental health via burnout was 0.37. A bootstrap calculation (drawing 2000 samples) showed that this was significant ( $P = 0.043$ ) (22). However, the indirect effect of stress on physical health via burnout was limited (parameter estimate was 0.31 which showed a non-significant  $P$  level of 0.076). The fit of the model appears good as shown by the CFI (0.988) and RMSEA (0.04, 95% CI: 0.00–0.76) indices and a non-significant chi-square statistic: 55.68 d.f. = 47,  $P = 0.18$ .

## Conclusions and discussion

In their fifth year, more than one-third of the students reported EE scores that can be labelled high or very high, according to manual guidelines. This is an increase when compared with the same cohort's first year scores, when about one-fifth reported these levels. Most notable were fifth year students from Belfast and Cork, of whom more than half of the respondents were in this category. About 20% of the fifth year students reported high or very high levels of DP. Mean levels of EE as found amongst the students are relatively unfavourable when compared with manual guidelines. As EE and DP are both indicative of professional burnout, these findings should be regarded as a serious risk indicator for future professional health. In this study (diminished) PA was not a convincing indicator of burnout, which is in line with previous studies amongst graduated dentists (12).

A comparison can be made with Manchester medical students, amongst whom the MBI was also administered in their first ( $N = 172$ ) and fifth year ( $N = 155$ ) in an identical study (23). Using the same criteria, 13% of the Manchester medical students were high on EE (first year: 5%), 7% were high on DP (first year: no score) and 16% were low on PA (first year: no score). Dental students reported unfavourable MBI scores at a much higher level than their fellow medical students. As was the case with medical students, it can be concluded that a small percentage of dental students suffered from a demanding study environment throughout the years and accounts for a serious burnout risk, and potential mental and physical health problems.

When measuring psychological distress, an increase from the first to the fifth year was reported amongst this cohort of dental students. Parallel with the results on the burnout measure, the UK and Ireland located students reported most distress. Once again, a comparison with the Manchester medical students was possible. The medical students, contrary to the dental students, reported a decrease in cases: from 37% in their first year to 22% in their fifth year, which is almost half the percentage of the fifth year dental students. These results show that not only on an occupation related measure for well-being, as the burnout instrument is, but also on a more general distress indicator, dental students give reason for concern.

Study Obligations, Patient-Related Aspects and Study Pressure, respectively, showed highest mean scores in the dental school environment. Apparently, these aspects of dental training required most from the students, regardless of city or school. Each school involved will have to deduce which specific factors could be held accountable for the levels reported. For instance, in Amsterdam, Rules and Regulations were felt to be demanding, and it is tempting to speculate that the large size of that particular dental school caused this particular problem.

Somewhat surprisingly, no difference appeared in the mean percentage between the first and fifth year high scorers on the DES. In both the first and the final year, 34% of the participants had a score  $>38$ , which was considered the criterium in previous studies. When schools were inspected separately however, Belfast, Amsterdam and Cork showed an increase. Amongst these students the dental environment was felt to be more stressful in their final year. The factors that caused this increase are likely to be different for each school.

The path analysis showed the mediating effect of burnout on the relationship between stress and mental health. Whereas the direct effect of stressors on mental health was insignificant, the role that stress played on burnout which in turn influenced mental health is important. Burnout levels may translate stress into mental health problems. For many individuals, being under psychological stress can be difficult to identify, and even harder to acknowledge. A common response from dedicated professionals is the social psychological phenomenon of the so-called fundamental attribution error (24). This implies that an individual is likely to hold external circumstances accountable for negatively evaluated changes in performance or condition, whereas others strongly believe that these changes are the result of internal aspects of the individual. When under psychological stress, people often make this attribution error, thereby ignoring the seriousness of the situation. For many, it

is easier to become aware of one's physical complaints than it is to acknowledge being under psychological pressure. Therefore, one good lesson for the students could be to pay attention to negative physical changes, as these may very well be a reflection of psychological stress.

The majority of participants are female (58%), which adequately reflects trends at the dental schools over the last decade. With regard to the outcomes, it is understood that gender differences do not, or hardly, play a role. Although gender differences in perceived dental student environment stress have been described in previous studies (6), the present findings are in line with other recent findings. In the Humphris *et al.* (15) first year study of the same cohort gender differences were not reported, nor were they described in the comparable Manchester study amongst medical students that preceded the first year study (23). It has been stated that gender differences amongst the dental profession would diminish as more females would assume an assertive role in society (25). Furthermore, Wilson *et al.* (26), made an interesting distinction between recently graduated dentists and the ones in practice for a longer time, and described gender differences only to be prominent amongst the latter group. The present findings underline this observation.

Several limitations of the present study must be acknowledged and, subsequently, some caution in the interpretation of the outcomes is warranted. In the first place, although the overall response percentage was satisfactory (51%), amongst the dental schools large differences occurred. Apart from that, the method of questionnaire collection differed between schools, from supervised classroom administration to return envelope posting methods. It is possible that selection of participants is accountable for variations in outcome although we do not know in which way. For instance, those under stress may not have been willing to participate as it would require extra energy. But, on the other hand, those under stress may have been willing to participate even more strongly, as an investigation such as this would reflect their worries. From previous research on burnout, it is known that both ways of reasoning do occur. In addition, the path analytical presentation does not infer causality but a logical ordering of the constructs under investigation. We accept that other models exist. Furthermore, although the method of self-report is common when investigating phenomena as described in groups, and the instruments used are known for their reliability and validity, the interpretation of the findings should be made with care. One never knows if denial of emotional difficulties influenced the actual report. And finally, although the participating dental schools were spread over five countries and differed in size, certain restrictions to the generalisability of the study results must be acknowledged. The countries involved were all Western European, so cross-cultural implications should be made with care.

In research on occupational stress, the so-called interactional approach is usually used as a theoretical starting point (27). Briefly, the essence of this approach is that an individual perceives certain aspects of the environment to be either threatening or as a resource, which, in combination with the physical, psychological and social qualities of the person, lead to physiological, behavioural, emotional and cognitive reactions. The fact that study-related factors, such as study obligations and study

pressure, could be held accountable for differences in burnout scores underlines the interactive process amongst these students. In other words, the coping mechanisms amongst a substantial amount of dental students fail when they are dealing with the demands of the curriculum. Whether the curriculum is too demanding or whether the students' coping skills are insufficient is debatable. The review section of this paper demonstrated that, generally speaking, dental students, regardless of location, have always perceived their school environment to be demanding. Therefore, most attention should be focused on teaching students how to cope with the tasks they are confronted with. It is very unrealistic to assume that they will not meet with a highly demanding professional environment after graduation. Apart from the direct benefit during the undergraduate years for the student, improving coping skills will give benefits later in life.

In future, research on dental student's well-being calls for two main approaches. We have a body of literature describing aspects that may be held accountable for student well-being, of which only a few have been described in the present paper. Also, we have an insight into various health effects amongst students at risk. The first approach would be to start longitudinal monitoring of dental students in their study environment and to continue this in their professional career. Whilst focusing on perceived stress, personality characteristics, life events, health and other aspects, much could be learned about possible early warning signs and risk factors for future health problems. A recent small-scale study showed that this approach offers valuable information (28). The second sensible step in research would be to initiate and investigate possibilities for stress prevention and intervention. In line with Dyrbye *et al.* (29), who recently performed a highly interesting review on well-being amongst US and Canadian medical students, we can conclude that we have chronicled the backgrounds of dental student stress to a satisfying degree. What is needed now is to determine how the structure of our curricula, or how our dental school teachers and mentors, or how systematic evaluation systems, may help identify those students struggling and suffering along the way. Possibilities for implementation of training in time management, student self-reflection and effective stress coping strategies, have not yet been described. There is certainly a need for well-designed evaluation studies of potential preventive interventions. Given the fact that ineffective stress management is likely to influence future professional functioning, any funding of such initiatives, either by dental school, universities, governmental departments or professional associations, should be considered a good investment for the benefit of both undergraduates, dental professionals and their patients.

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