Stress amongst dental students: a systematic review

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Keywords
stress; dental students; undergraduates; dentistry.

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Accepted: 5 March 2010

doi:10.1111/j.1600-0579.2010.00640.x

Abstract

The present study was conducted to provide future researchers and dental educators with an overview of stress amongst undergraduate dental students reported in the literature. This overview is needed for the development of a new questionnaire measuring the level of stressors including students, staff and process of dental education. In addition, the review can be used to modify dental curricula to decrease such stress and produce better dentists. Our study consisted of a systematic review of 49 peer-reviewed articles published between 1966 till October 2008 in English, discussing different aspects of stress amongst undergraduate dental students. These aspects are demographic variables of stress, sources of stress, impact of stress, indicators of stress, instruments measuring stress level and management of stress. Major sources of reported stress were related to examinations, clinical requirements and dental supervisors. Studies suggest using signs and symptoms for early detection of stress and proper intervention.

Introduction

In recent decades, stress amongst dental students has appeared to be a major concern for dental educators. The aim of this study is to present an overview of the literature concerning stress amongst undergraduate dental students. Atkinson et al. (1) stated that the term stress describes external demands (physical or mental) on an individual's physical and psychological well-being. This stress phenomenon amongst dental students has been reported in different curricula since the 1970s. The major aspects of that stress have been illustrated in many more studies subsequently conducted in dental schools across the world. These studies have further examined sources of stress amongst undergraduate dental students (2–25). Although most of these studies were cross-sectional in design, they have shown significant increase of stress amongst dental students in relation to different variables. Moreover, stress amongst dental students occurred from different sources and affected them differently, and sometimes was shown to have significant negative effects on their performance.

Stress has been defined by Cox (1978) as 'a stimulus, a response or the result of an interaction between the two, with the interaction described in terms of some imbalance between the person and the environment' (26). However, some stress is desirable to prevent under-stimulation and even boredom, but the persistence of stress-related symptoms may result in mental and/or physical disorder, substance abuse, and diminished efficiency at work or learning.

In line with Cooper's theory of stress; stress is a continuous cycle in which stressors produce stress and stress affects positively the stressors in return (27). However, no article has been found (to the best of our knowledge) that discussed stress amongst dental students and considered stress outcomes as stressors or stressors' boosters.

The dental profession is considered to be one of the most stressful health professions (28). It was noted that stress-related illnesses, together with musculoskeletal disorders, were the main factors influencing dentists to retire early (29). In addition, intense interaction between the dentist and patient could precipitate a state of 'burnout' that consists of emotional exhaustion, depersonalisation, and reduced personal accomplishment (30).

Many studies have been conducted in different dental schools across the world (see Table 1). Most of these studies have been conducted through surveys using the Dental Environment Stress (DES) Questionnaire and have shown significant increase of stress amongst dental students (2–4, 7, 9, 12, 13, 16, 20–22, 24, 31–38). In these studies, examinations and grades appear to be the most stressful elements, along with limited time for relaxation or outside activities.

TABLE 1. Different studies in different countries

Country	Measurement tool	Year	Outcomes				
			Sources	Variables	Impact	Indicators	Management
Australia (16)	DES	1999	X	X			
Australia (38)	DES	2002		X		X	X
Canada (34)	DES	2008		X			
EU (24)	MBI, GHQ, DES	2008	X	X	X		
EU (32)	GHQ, MBI, DES	2001		X	X		X
Fiji (22)	Modified DES	2007	X	X			
Germany (33)	GHQ, MBI, DES	2002	X	X	X	X	
Greece (3)	Modified DES	2005	X	X			X
India (31)	Modified DES	2003	X	X			X
Japan (36)	PGWB, DES	2005	X	X		X	X
Jordan (20)	Modified DES	2005	X	X			X
Jordan (35)	Modified DES	2001	X	X			X
Malaysia (4)	Modified DES	2005	X	X	X	X	
Nigeria (21)	DES	2006	X	X			X
South Africa (13)	DES	1994	X	X			
Trinidad and Tobago (2)	Modified DES, BSI	2002	X	X	X		X
UK (12)	Modified DES	1999	X	X	X	X	X
USA (37)	DES	1993	X	X			
USA (7)	DES	1980	X	X			
USA (9)	DES	1989	X	X			

Pre-clinical students reported that examinations and fear of failure caused the most stress, whilst for clinical students the main stressor was the clinical training, particularly factors relating to meeting clinical requirements. Female students perceived more stress generally than male students did. However, male students were more stressed when faced with certain specific factors related to clinical training (4).

A study amongst dental students across seven European dental schools revealed that they too were deleteriously affected by stress. In particular, it was noted that these students were emotionally exhausted, experienced a high degree of psychological distress, and seemed to perform more poorly than a comparison group of medical students, whose own training is also known to be stressful (33).

Perceptions of stress as due to an underlying tendency towards perfectionism based on an academic history of high achievement and powerful expectations of scholastic excellence have been examined. Once in dental school, where academic excellence is the norm, an adjustment in self-concept is required, whilst a new form of clinical competitiveness also emerges. Such transitions can affect student levels of self-efficacy, which in turn can affect both achievement and psychological health (16).

Others have studied different sources that might be academic, clinic-related, social and financial, or a combination of these factors. However, these sources affected the dental students differently according to gender and year of study. (39). In addition, it has been argued that student drop-outs caused by stress may affect the profession of dentistry and future dental manpower (40).

Stress mainly arises from the need to meet clinical requirements, to pass stringent academic assessments, and to deal with clinical and supporting staff (12). It has been shown that the clinical years are more stressful than the pre-clinical years and instructors themselves often create more stress than the treatment of patients. Moreover, uncertainty about dentistry as a career and unhealthy perfectionism may be predisposing factors to stress (16, 41). It has also been found that academic pressure, working hours, as well as ongoing clinical events are usually more stressful than personal problems (42).

Although increasing stress may result in declining student performance (37), high levels of stress can result in a wide variety of physical and psychological complaints as well. Therefore, it is recommended to determine the sources of stress amongst dental students to avoid resultant detrimental effects on their physical and mental health (20). Responses to stress are also influenced by a person's system of beliefs and attitudes, another area that invites further inquiry (43).

Other studies have focused on stress amongst dentists and their coping techniques (44), questioning whether stress is more likely to occur during dental school or in practice itself (45).

In sum, the first aim of this study is to present an overview of stress amongst undergraduate dental students through a systematic review of the literature. We will discriminate between biographic variables, sources, signs and symptoms, indicators and management of stress. The second aim is to answer the question what research is further needed for the improvement of dental education. So, future researchers can start thinking of additional measures, including curriculum design and student admission policies. Moreover, an intended outcome of this overview is the construction of a new tool measuring stress amongst dental students. Such a new tool should consider new educational approaches in dentistry and new technology used

in dental education which is yet lacking in the DES questionnaire introduced by Garbee in 1980 (7) that has been frequently used in different studies.

Method

This systematic review has been conducted according to an approved protocol by two reviewers, the first author and his colleague. The aim of the evaluation of the original studies was to decide upon inclusion and to assess reliability and accuracy of the data as objectively as possible. The assessment of the quality of the studies includes the study design, sampling (size and frame), survey tool validation, response rate, survey analysis and outcome measures. The authors assessed the rigor of the studies they identified to minimise the risk of bias by their methodology (i.e. experimental studies are presented prior to quasi-experimental studies), and the rigor was considered by the availability and quality of the study design, study sampling, response rate, measurement tool, and administration of survey tool. Table 2 gives an overview of the sources from which the studies have been extracted.

Selection of studies

Different key words were used in the literature search as Stress, Dental, Students, Dentistry and Education. To narrow the search key words have been combined by using AND as follows: 'Stress amongst dental students', Stress AND Dental AND Students, Stress AND Dental AND Education, Stress AND Dental AND Undergraduates, Stress AND Dentistry.

This literature search has been executed via searching electronic databases to identify the relevant studies in Pub Med, Google Scholar, Yahoo, MeSH Database, Cochrane Library, ERIC, British Education Index, Australian Education Index, CBCA Education, Education Index, Education: A SAGE Full-text Collection, British Library, Library of Congress, Web of Science, National Library of Canada, National Library of Australia, National Taiwan Library. In addition, reference lists of retrieved articles, proceedings and abstract books of related conferences were checked. Experts, staff from collaborating centres, Non-Governmental Organizations (NGs), and other organisations have been contacted and asked about the subject. The citations identified in the electronic search have been downloaded into EndNote X2, whilst those retrieved from other sources were entered manually (e.g. hand searching, reference lists). Duplicates have been deleted and to each citation a unique identification was assigned (Primary Author Name and Year of publication). Finally, a codebook has been developed to document the findings of our search (see Table 2).

TABLE 2. Sources of studies selected initially

Source	Results
Web of Knowledge	35
Pub Med	979
Science Direct	3
SAGE	0
Yahoo	64
Scholar Google	83
British Library	12
Library of Congress	0
National Library of Australia	0
National Library of Canada	0
National Taiwan Library	0
ERIC	0
Total	1176
Duplicate	497

To decide about inclusion of any particular study, a review form has been designed (see Appendix 1A). The inclusion criteria were: studies in English concerning undergraduate dental students that investigated or discussed any aspect of stress and years of publication since 1966–October 2008. When the information provided by titles/abstracts was insufficient to decide on inclusion/exclusion, or the titles/abstracts were significantly relevant to the research question, the full-text was retrieved and evaluated. The list of excluded studies and reasons for exclusion are documented fully and are available from the authors upon request.

Data have been extracted from the included studies by means of a data extraction form (see Appendix 1B). The data-extraction form includes questions distributed in three categories: (i) General Information (Primary author, Year of Publication, Country, Journal), (ii) Specific Information (Study design, Study sample, Response rate, Survey tool, Administration of survey) and (iii) Analysis of Survey Outcomes (Demographic variables of stress, Sources of stress, Signs and symptoms of stress, Indicators of stress, Instruments for measuring or discovering stress, and Management of stress).

A pilot study has been executed for both the review form and the data-extraction form on a small number of studies of different designs. This pilot study resulted in a slight revision of both forms and these were used for all included studies.

Figure 1 makes clear that the total number of studies initially selected through electronic databases was 1176. After subtraction of 497 duplicates, another 533 titles were excluded because they did not meet the criteria for inclusion. The abstracts of the remaining 146 articles were reviewed and an additional 89 articles were excluded using the review form during screening (see Appendix 1A). Thus, 57 articles remained for full-text review. These full-text reviews resulted in exclusion of a further 13 articles, for example because the title and abstract were misleading, and to an addition of five articles drawn from articles' reference lists. Ultimately, the final number of articles included for this review was 49.

Procedure

Two reviewers reviewed the articles; the primary investigator is a consultant in dental services and student in a master's programme in medical education, whilst the other is associate consultant in dental services. The reviewers used the data extraction form (Appendix 1A) and review form (Appendix 1B). In case of difference between the two reviewers, an outside expert was consulted to resolve the difference.

Data analysis

The results found from the selected studies were combined and findings reported more frequently were identified and

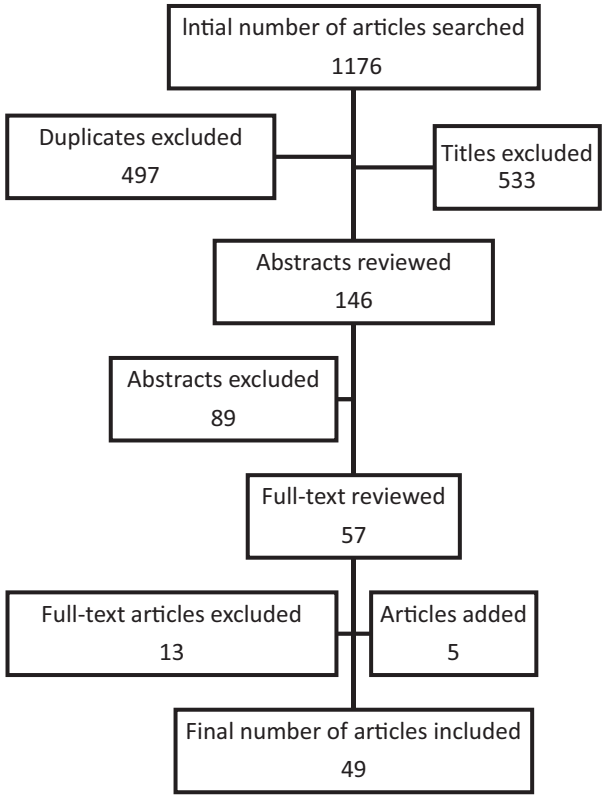

Fig. 1. Studies selection process.

summarised in Tables 3–12. Aspects of stress were categorised into a number of subclassifications: Demographic variables of stress such as gender and year of study; Sources of stress such as examinations; Impact (Symptoms and signs) of stress such as distress and fatigue; Indicators (Side Effects or Consequences) of stress such as illicit drug use and cigarettes smoking; Instruments for measuring or discovering stress such as Beck Depression Inventory; and Stress Management such as prevention and intervention. Results in all 49 articles were reviewed to identify duplicate data and contrivers, in addition to developing tables that include the different aspects of stress.

Results

Most of the previous studies about stress amongst dental students focused mainly on sources of stress and factors influencing the level of stress, such as gender and other demographic variables. Twenty-five of the previous studies mentioned the symptoms of stress and their consequences, 28 articles used instruments and tools for discovering stress or its sequences, and 18 articles discussed the management of these stressors related to stress amongst undergraduate dental students.

Demographic variables of stress

Demographic variables that may influence stress are listed in Table 3. The most frequently mentioned variable is year of dental programme where the junior and senior dental students differ in reporting level of stress (2, 3, 9, 13, 16, 20–22, 24, 31, 34, 35, 37, 46–49). Female dental students generally reported significantly more stress than male dental students, whilst senior dental students generally have more stress than junior dental students (2–4, 8, 12, 16, 20–22, 24, 31, 33–38, 46, 49–54). Other demographic variables are country (24, 49, 52), nationality (16, 20), and race and ethnicity (22, 38). Moreover, first priority for dentistry as a choice for admission affected the stress level where students choosing dentistry as first choice for admission reported less stress (20, 21, 31, 35, 36).

Other less frequently mentioned variables discussed were tuition payer (22), marital status (34), support (34), student debt (19), predental education (19, 52), social class (55), age (46, 52) and stage of course (38).

Sources of stress

Most of the studies identifying sources of stress came up with a list of stressors affecting dental students. The major stressor was different amongst different studies or different countries, but the following major five groups of stressors appeared in most studies: (i) living accommodation factors, (ii) personal factors, (iii) educational environment factors, (iv) academic factors and (v) clinical factors. These five groups will be discussed below.

Living accommodation factors

Factors related to accommodation are presented in Table 4. Studies conducted in countries where government and family support dental students financially reported problems with accommodation as major factor resulting in stress for dental students (2, 12, 33, 53). However, the results do not point in the same direction. One study revealed that students living at home were less stressed than those living away (33), whilst another study reported that students living with their parents had higher stress scores than students living away from home (19). Lack of recreation facilities within the accommodation also appeared as a source of stress for some, especially male dental students (13, 53).

Personal factors

Personal factors that can be a source of stress for dental students are summarised in Table 5. Most frequently mentioned personal factors in countries where dental students support themselves financially (for example the USA and Canada) were financial problems (7, 9, 12, 22, 25, 53). Sometimes students just cannot afford the costs that are incurred studying dentistry. Apparently, studying dentistry is also time consuming. Students usually need to spend more than 40 h weekly in dental school to attend their lectures and training sessions. Moreover, they need ample time for self-study activities and to satisfy practical requirements. Several dental educational programmes use the student study time inefficiently which may lead to inadequate time for social activity (13, 56, 57), lack of time for relationships (19), reduced holidays (12, 53), lack of time for relaxation (16, 21, 35, 37), lack of free time to complete assignments (13, 19, 37, 49), late work-session ending time (31), other time

TABLE 3. Demographic variables

Year of study (2, 3, 9, 13, 16, 20–22, 24, 31, 34, 35, 37, 46–49)
Age (46, 52)
Gender (2–4, 8, 12, 16, 20–22, 24, 31, 33–38, 46, 49–54)
Marital status (34)
Country (24, 49, 52)
Nationality (16, 20)
Race and ethnicity (22, 38)
Tuition payer (22)
First choice for admission (20, 21, 31, 35, 36)
Support (34)
Student debt (19)
Predental education (19, 52)
Social class (55)
Stage of course (38)

TABLE 4. Living accommodation factors

Problem with accommodation (2, 12, 33, 53)
Home residence (19)
Lack of recreation facilities (13, 53)

TABLE 5. Personal factors

Financial problems (7, 9, 12, 22, 25, 53)
Limitation of leisure time (25, 56)
Reduced holidays (12, 53)
Lack of time for relaxation (16, 21, 35, 37)
Lack of free time to do assignments (13, 19, 37, 49)
Late ending time (31)
Time constraints (58)
Time management (58)
Lack of time for relationship (19)
Inadequate time for social activity (13, 56, 57)
Personal problems (2, 7)
Family problems (7)
Self efficacy beliefs (3, 16)
Lack of social recognition (57)
Worry propensity (57)
Language barrier (31)
Mental distress (53)
Personality traits (59)
Emotional intelligence (46, 52)
Satisfaction to study dentistry (52)

constraints (58) and limitation of leisure time (25, 56). Personal factors less frequently mentioned in the literature are personal problems (2, 7), family problems (7), self-efficacy beliefs (3, 16), lack of social recognition (57), worry propensity (57), time management (58), personality traits (59), emotional intelligence (46, 52), satisfaction to study dentistry (52) and mental distress (53).

Sometimes a language barrier causes stress (31), as when students come from a different country or study dentistry in a language that is different from their mother tongue.

TABLE 6. Educational environment factors

Patient tardiness or no show for appointments (4, 9, 16, 35, 37)
Approachability of staff (12, 21)
Work environment (12, 48)
Home and family environment (48)
Prolonged frequent strikes by faculty (53)

TABLE 7. Academic factors

Examination and grades (4, 9, 12, 13, 16, 20–22, 25, 35, 37, 49, 56)
Fear of failing (4, 8, 12, 16, 20–22, 49)
Fear of being unable to catch up if getting behind (4, 16, 49)
Fear of parents after failure (22, 31)
Fear of employment after graduation or unemployment (20, 22, 31)
Fear of postgraduate study (31)
Amount of assigned class work (3, 19, 22, 31, 37, 57)
Full loaded day (4, 22, 35)
Overextended work (57)
Peer competition (4, 8, 37)
Lack of confidence (12, 31)
New curriculum (12, 21)
Academic overload (25, 33)
Workload (57, 58)
Curriculum design (33)
Study pressure (24)
Expectation versus reality of school (12)
Study obligation (24)
Difficulty of class work (37)
Worry about competence (56)
Getting study materials (21)
Faculty–student relationships (25)
Faculty and administration (7)
Rules and regulations (37)
Manual skills (7)
Ensuring getting good marks (19)
Attitude of staff (31)
Lack of positive feedback (8)
Lack of input (37)
Inconsistency of professor's feedback (9)
High demand of the course (20)
Amount of cheating in dental school (37)

Educational environment factors

Educational environment factors related to stress are presented in Table 6. Dental students consider patient tardiness or no-show as a major source of stress (4, 9, 16, 35, 37). In addition, some educational environment factors are related to student support such as approachability of staff (12, 21), work environment including rules and regulations (12, 48), and home and family environment (48). Prolonged frequent strikes by faculty which resulted in cessation of education could be a source of stress because students were delayed in their graduation (53).

Academic factors

Academic factors, listed in Table 7, are mostly related to performance results, workload and fear. The most frequently

TABLE 8. Clinical factors

Completing clinical requirements (4, 9, 19, 35, 37, 49, 56)
Criticism by supervisor (4, 21, 22, 31)
Patient contact (32, 33)
Responsibility for comprehensive patient care (7, 16, 25)
Atmosphere created by clinical faculty (9, 37, 49)
Patient-related aspects (24)
Difference in opinion between staff (20)
Excessive work (53)
Performance pressure (3, 57)
Shortage of allocated clinical time (4)

TABLE 9. Signs and symptoms of stress

Anxiety (11, 12, 39)
Depression (11, 12, 39, 56)
Upset stomach (24)
Sweating (24)
Psychological distress (32, 33, 53)
Burnout (33, 58)
Environmental stress (33)
Emotional exhaustion (32, 56)
Low academic achievement (4, 60)
Worry, tension, being upset, nervousness, discomfort, regret, lack of confidence, fatigue, crying, indecision, unhappiness, avoidance, turmoil, insecurity, sadness, guilt, blame, irritability, apathy, weight loss, physical complaints (10, 61)
Exam low performance (51)
Hostility (39)
Social life effects (53)
Physical ill-health (48)
Mental ill-health (48)
Denial (54)
Substance use (54)
Gastrointestinal symptoms (61)
Sleeplessness (61)
Psychosocial disturbance (4)

TABLE 10. Indicators of stress

Low grades and marks (38, 51)
Low Academic achievement (55)
Unprofessional attitudes (55)
Illicit drug use (47)
Cigarettes smoking (36, 47, 48)
Lack of social integration and depersonalisation (56)
Depressed mood (58)
Memory problems (58)
High General Health Questionnaire (GHQ) score (53)
High salivary cortisol, *Immunoglobulin A* and *Chromogranin A* level (51)
Alcohol consumption (48)

TABLE 11. Instruments for the measurement of stress

State-Trait Anxiety Inventory (10, 11)
Beck Depression Inventory (10, 11)
Visual Analog Scale (51)
General Well-Being Inventory (64)
Dental Environment Stress Questionnaire (DES) (2–4, 7, 9, 12, 13, 16, 20–22, 24, 31–38) General Health Questionnaire (GHQ) (29, 50)
Perceived Stress Scale (65)
Maslach Burnout Inventory (28, 29)
Symptoms Questionnaire (30)
Brief Symptoms Inventory (BSI) (2)

TABLE 12. Management of stress

1. Effective support (12, 25, 39, 48, 53)
2. Counselling services (12, 25, 36, 53, 66)
3. Student-friendly approach, address students concerns, eliminate unit requirements (3, 12, 38, 66)
4. Instructors promote physical exercise and provide orientations, study guides, syllabuses, formative assessments, ample time, and elimination of quotas, team assignment, and periodic interaction of the dental faculty with psychologists. Students advised to select carefully which instructor should be asked for comments (31, 36)
5. Stress reduction and assertiveness training workshops that include aspects of academic problem solving, synchro-energiser and progressive relationship training, deep breathing and progressive muscular relaxation, relaxed teaching method, early patient contact and residing at home (2, 32, 50, 53, 54, 61, 67)
6. Student selection should be based on emotional intelligence score, personality traits (52, 59)

reported source of stress for dental students is examination and grades which relate to students performance (4, 9, 12, 13, 16, 20–22, 25, 35, 37, 49, 56). Other factors in this category relate to workload and pressure and include amount of assigned class work (3, 19, 22, 31, 37, 57), heavy work days (4, 22, 35), academic overload (25, 33), workload (57, 58), overextended work (57), study pressure (24), study obligation (24), difficulty of class work (37) and peer competition (4, 8, 37). Female dental students suffer more than male students from lack of confidence (12, 31), or worry about competence (56).

Quite a number of studies mentioned fear as a source of stress. First, students often had a fear of failing (4, 8, 12, 16, 20–22, 49), and second, a fear of being unable to catch up once they got behind (4, 16, 49). Third, students are anxious about employment after graduation in their future career (20, 22, 31), especially in places that featured high competition in dental practice. Fourth, some students (in India and Fiji) had fear of parents after failure (22, 31). Finally, students had fear of postgraduate study (31), doubting whether they had the capacities to be admitted in their desired postgraduate programme.

Other academic factors less frequently mentioned in the literature included implementation of a new curriculum (12, 21), the curriculum design or system of study (33), expectation versus reality of the school (12), securing proper study materials (21), faculty–student relationships (25), faculty and administration (7), rules and regulations (37), manual skills (7), concern about good marks (19), attitude of staff (31), lack of positive feedback (8), lack of tutor input (37), inconsistency of professors' feedback (9), high demand of the course (20) and amount of cheating in dental school (37).

Clinical factors

Clinical factors of stress mostly related to requirements, patients and staff. These factors are listed in Table 8. The major factor in this category causing stress was fear of failure to complete clinical requirements (4, 9, 19, 35, 37, 49, 56). Other factors related to criticism by supervisors (4, 21, 22, 31), patient contact (32, 33), responsibility for comprehensive patient care (7, 16, 25), the atmosphere created by clinical faculty (9, 37, 49), patient-related aspects (24) and difference in opinion amongst staff (20). Other clinical factors resulting in stress were shortage of allocated clinical time (4), performance pressure (3, 57) and excessive work (53).

Signs and symptoms of stress

Students affected by stress show various signs and symptoms, as shown in Table 9. Stressed dental students may show anxiety (11, 12, 39), depression (11, 12, 39, 56), upset stomach (24), sweating (24), psychological distress (32, 33, 53), burnout (33, 58), environmental stress (33), emotional exhaustion (32, 56) and low academic achievement (4, 60). Grandy et al. reported in detail various signs and symptoms of stress of students such as worry, tension, being upset, nervousness, discomfort, regret, lack of confidence, crying, indecision, unhappiness, avoidance, turmoil, insecurity, sadness, guilt, blame, irritability, apathy, weight loss, physical complaints and fatigue (10, 61).

Other signs and symptoms reported less frequently in the literature were low exam performance, where stressed dental students showed lower performances in exams than non-stressed students (51). Other signs included hostility (39), social life effects (53), physical ill-health (48), mental ill-health (48), denial (54), substance use (54), gastrointestinal symptoms (61), sleeplessness (61) and psychosocial disturbance (4).

Indicators (effects) of stress

One can use the indicators or effects of stress, listed in Table 10, for early intervention. Stress of students can be predicted by noticing their behaviours and habits such as illicit drug use (47), cigarette smoking (36, 47, 48), alcohol consumption (48) and low-standard professional attitudes (55).

Grades and marks (38, 51), in addition to academic achievement (55) can also be used as indicators of stress, where stressed students may have low grades and low achievement.

Stressed students who had relationship problems indicated lack of social integration and depersonalisation (56), and this affected students' relationship to patients and staff in a negative manner.

The literature reported the use of some indicators to examine stress amongst students such as mood (whether depressed or not) (58), and memory, the latter being affected negatively by stress (51, 58).

Instruments for the measurement of stress

Only a few articles discussed instruments to discover stress amongst dental students. These are listed in Table 11. Most frequently used instruments in detecting stress amongst dental students were the DES questionnaire and modified versions of it (2–4, 7, 9, 12, 13, 16, 19–22, 24, 31–38, 42, 49, 52, 62), the General Health Questionnaire (33, 53), the State-Trait Anxiety Inventory (10, 11), the Maslach Burnout Inventory (33, 63) and the Beck Depression Inventory (10, 11).

Less used instruments for detecting psychological stress amongst dental students in the literature are the Visual Analog Scale (54), the General Well-Being Inventory (64), the Perceived Stress Scale (PSS) (65), the Brief Symptoms Inventory (BSI) (2) and the Symptoms Questionnaire (SQ) (39).

Management of stress (prevention and intervention)

Few studies discussed the prevention or intervention of stress as compared to studies that reported sources of stress. These prevention and intervention procedures are illustrated in Table 12 and have been classified into six categories.

The first category relates to supporting students effectively and academically by explaining the expected outcomes and motivation to access available students' services. Female dental students especially need more effective support than male students to ensure that they have realistic expectations about the curriculum. Also, students needed to be encouraged to access student services in a proactive manner and to use social support as a coping strategy. Moreover, providing a conducive learning environment and added support during periods of transition has been recommended (12, 25, 39, 48, 53).

The second category is providing counselling services for dental students (12, 25, 36, 53, 66). Dental schools should hire a full-time psychologist to provide counselling and help students to overcome any stress source or effect.

The third category consists of stress management procedures through providing a student-friendly approach and student-centred learning or curricula (3, 12, 38, 66). This should address student concerns to decrease stress level (20). One article advised eliminating unit requirements to remove the fear of failure to complete the requirements (3).

The fourth category is related to instructors. The recommendations are that instructors should promote physical exercise and interactions with psychologists (31, 36), whilst students should carefully select the instructor to be approached for comments (8). Moreover, the provision of orientations, study guides, syllabi, formative assessments, ample time, elimination of quotas and team assignment were suggested (25).

The fifth category of procedures for stress reduction includes relaxation via synchro-energiser and progressive relationship training (67), training workshops that include aspects of academic problem solving (50), relaxed teaching method (2), early patient contact and residing at home (32), small group meetings which provides stress relief (53), deep breathing and progressive muscular relaxation (54), and introducing stress-management training over time which is proven to be effective in stress reduction and coping (61).

The final stress management category related to stress prevention refers to student selection and the development of relevant admission criteria. Student selection can be based on different tests, like an emotional intelligence test (52), and personality inventories (59).

Finally, one interesting study conducted in India recommended that parents should be advised not to force their children to study something against their will (31), since they found fear of parents after failure is a major source of stress, particularly in that part of the world. However, when such circumstances exist, promoting interactions with other students and associated peer support may serve as a stress buffer (39).

Discussion

This study to the best of our knowledge is the first systematic review of the literature about stress amongst undergraduate dental students. In this review, we made a distinction between different aspects of stress, namely demographic variables, stressors, signs and symptoms, indicators, measuring instruments, and finally the management of stress.

Previous studies about stress amongst dental students showed significant stressors mostly related to examinations, clinical requirements, patients, financial problems, lack of time for relaxation, and faculty feedback or criticism. Moreover, fear of parents after failure (31), getting material for study, clinical requirements (21) and overcrowded accommodation (53) were a major sources of stress for dental students in a few countries. Many studies reported that female dental students showed more stress than male, and sometimes the literature shows that there is a difference between preclinical and clinical years. Preclinical years stress affect female more than male, but clinical years affect male more than female students (4). Some sources of stress were found more often in female than male, such as lack of confidence in clinical decision making, and doubt to be a successful dentist (12).

First choice for admission has been reported as an important demographic variable and it has been shown that there is more stress amongst those students who were admitted in dentistry against their first choice (21, 31, 35, 36). In addition, stress differs according to the year of study, where it was reported that more stress exists in senior years generally (2–4, 8–10, 15, 17, 20–22, 24, 31, 33–37, 46, 47, 49, 51–53, 56). Dominant stressors of junior students in preclinical years differ from those of senior dental students in the clinical years, and the stress level is increasing over time (2).

According to Cooper's theory (27), stress may cause symptoms of mental illness such as anxiety, depression and somatic complaints which may act as stressors. However, all previous studies did not study (to our knowledge) the level of stress amongst dental students without mental illness. We recommend future researchers to screen dental students for mental illness before inclusion in their study to record perceived stress and stressors.

When we oversee the results and put them into perspective the following conclusions may be extracted. First, stress amongst dental students and stressors seem in general not to be dependent on the period of study. For example, we found comparable results of studies in the 1990s of the last century and first decade of the present century. Second, specific stressors seem to differ in different parts of the world. Stressors related to fear of parents were found more significant in India, stressors related to the financial situation of the students were more significant in western countries than in eastern countries, and stressors related to resources and dental material supply were more significant in poor countries in Africa (9, 19, 21, 31).

Stress amongst dental students can be discovered early by looking closely at signs and symptoms of stress including student performance. Instruments of stress are useful for early detection so that stress issues can be immediately addressed (24, 50, 68).

Prevention and intervention of stress has been reported in three articles (24, 54, 69), including ways of supporting students, counselling services, stress reduction methods and revising criteria for admission. For future studies, it is recommended to investigate the influence of new educational approaches such as two-way learning and a student-centred curriculum on the level of stress, as compared to more traditional lecture-based educational programmes.

This overview of the literature was concentrated on dental students. To investigate the specificity of the results a comparison was made with comparable studies amongst medical students (70–79). Interestingly, Tyssen showed in his study concerning relationship between personality and stress amongst medical students that a specific combination of personality traits can predicts medical school stress. For example, he found that the combination of high neuroticism and high conscientiousness were predisposing for the development of psychological complaints (80). This has not been found in the present overview for dental students. Moreover, medical students experience the highest degree of pressure during first year when studying theoretical information and during the transition to clinical care rotations. Comparable to our findings amongst dental students, a gender difference regarding stress levels was found, where female medical students report higher levels of stress than male medical students. Medical students had higher depression rates than the general population, and female students had higher depression rates than male students (81, 82).

Management of stress has been studied more amongst medical than dental students. Studies amongst medical students recommended prevention of stress, and intervention via different modalities. These include counselling (83), student-led stress management programme (84), introducing mind-body elective (85), using pass-fail grading instead of traditional grading (71), encouraging students' socialisation (86), peer counselling at the campus (87), increasing student feedback and teaching effective coping strategies (88).

The outcome of this literature review will be used for the development of a new questionnaire that is directed to the measurement of aspects in the educational system influencing the level of stress amongst dental students. In addition to the above, these aspects include new dental technology and the students' mental health. More focus will be needed on the process of dental education, the learner and the environment (43).

Measuring stress level before admission and personality identification will help in knowing the actual increase of stress subsequent to undertaking dental education. Also, more studies are needed for programmes or courses for prevention and intervention of stress. New innovative dental curricula or modification of traditional curricula should be encouraged when attending stress in dental education. Successful reduction or intervention of stress before graduation will be considered as

preventive measure for stress after graduation and may decrease early retirement or drop-out of work in dentistry.

Limitations of this review and recommendations for future research

There are several limitations of this systematic review. First, whilst it covered studies that met the inclusion criteria, some of these studies were old or were only published in local journals (6, 89, 90). The generalisability of these findings from the latter can be questioned, because they may reflect only local problems. Second, in general, there is a lack of information concerning the stress level of students before they enter the dental education programme. No study was found that did measure the level of stress before admission to dental school. Longitudinal research could be helpful to investigate the amount of stress (increase or decrease) amongst students during their academic career. Such information will be relevant to the people who are responsible for dental education programmes. Third, most of the reported studies only used subjective measures of stress level, whereas more objective data were generally lacking. So, for future research and for educational practice, it is recommended to monitor more objectively the stress level of students, whether at the beginning of their study or at various intervals during the curriculum as a longitudinal survey. A meta-analysis of the studies might be encouraged to quantify the stressors level in studies used DES questionnaire as measuring tool. The information coming from this monitoring system may be used for prevention or intervention. Finally, it might be useful to try to gather more objective information about the stress levels of students to complement the subjective information, for example by measuring their cortisol levels in different phases of the curriculum.

Of course, we do not want to suggest that stress during the dental study should be reduced to zero. The study of dentistry and the profession of the dentist are exciting and some 'normal' stress remains necessary to optimal performance when both studying dentistry and treating patients. However, too high stress levels may have detrimental effects, first on study achievements and ultimately for the dental outcomes of real patients.

Acknowledgements

This systematic review could not have been executed without the support by Dr Abdulaziz Alrshaaid and Dr Fahd Alsaleeh. Second, the support of Dr Mohammed Alshalaan, medical library director in National Guard Health Affairs in Riyadh has been very useful for this study. Third, the help of Dr Michael Seefeldt has been valuable and appreciated. This study did not receive any fund and approval of study proposal has been obtained by International King Abdullah Medical Research Center.

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Appendix 1

Study ID: .....

(a) Review form

Screening questions:		
1. Does the study include data on stress amongst dental students?	Yes	No
2. Has the study been done on undergraduate dental students?	Yes	No
3. Is the study has been written in English?	Yes	No
Note: If any answer with No, that study will be excluded.		
Assessment:		
4. Exclude following initial screening (Title/Abstract).	Yes	No
5. Exclude following full text screening.	Yes	No

If excluded why .....
.....

(b) Data extraction form

I. General information
a. Primary author.....
b. Year of publication.....
c. Journal
d. Country.....
II. Specific information
a. Study design .....
b. Study sample .....
c. Response rate .....
d. Survey tool.....
e. Administration of survey .....
III. Outcomes
Demographic variables of stress.....
Sources of stress.....
Impacts of stress (Symptoms & Signs) .....
Indicators of stress .....
Instruments of measuring or discovering stress .....
Management of stress (Prevention & Intervention) .....

Reviewer Signature: ..... Date: .....