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Impact of stress on dentists' clinical performance. A systematic review

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Introduction: Dentistry is recognised as a stressful profession and dentists perceive their profession to be more stressful than other healthcare professions. While earlier studies have shown a link between stress and well-being among dentists, whether stress negatively impacts their clinical performance is an important and open question. We do know, however, that stress is associated with reduced performance in other health (and non-health) related professions. ***Objectives:*** This systematic review aimed to answer the question: how does stress impact on dentists' clinical performance? ***Methods:*** This systematic review was registered in PROSPERO (CRD42016045756). The CINHAL, Embase, Medline, PsycINFO, EThOS and OpenGrey electronic databases were searched according to PRISMA guidelines. Two reviewers independently screened the citations for relevance. The citation list of potentially eligible papers was also searched. Prospective empirical studies were considered for inclusion. The inclusion criteria were applied at the full-text stage by the two same reviewers independently. ***Results:*** The search yielded 3535 titles and abstracts. Twelve publications were considered potentially eligible, eleven of which were excluded as they did not meet the predefined inclusion criteria. ***Conclusions:*** This systematic review identified a gap in the literature as it found no empirical evidence quantifying the impact of stress on dentists' clinical performance. Prospective well-designed experimental simulation studies, comparing stress with non-stress situations on clinical performance and decision making, as well studies evaluating prospectively real-life dentists' performance under stress are warranted.

Key Words: *Stress, dentistry, work performance, clinical decision-making, systematic review*

Introduction

Dentists' stress was described in the literature as early as 1978 (Cooper *et al.*, 1978). Dentistry is recognised as a stressful profession (Blinkhorn, 1992; Myers and Myers, 2004; Wilks, 1995; Wilson *et al.*, 1998), and dentists perceive their profession to be more stressful than other healthcare professions (Gale, 1998; Moore and Brodsgaard, 2001). Nonetheless, dentists appear to experience negative emotions such as anxiety and fear related to stressful situations occurring in their daily practising lives (Chapman *et al.*, 2015). The latest British Dental Association (BDA) Survey suggested that 57.1% of community dentists and 72.9% of those working in general dental practice reported high work-related stress (Kemp and Edwards, 2015). These figures are in accord with the international literature (Ayers *et al.*, 2008; Gerschman and Burrows, 1998; Gorter *et al.*, 1999).

Dental professionals encounter numerous sources of stress, beginning in dental school (Alzahem *et al.*, 2011) and postgraduate training (Divaris *et al.*, 2012a; Divaris *et al.*, 2012b) and escalating during their practising lives. Stress affects not only general dentists but also dental hygienists (Lang *et al.*, 1990) and specialist dentists (Davidovich *et al.*, 2015; LaPorta, 2010; Marrelli *et al.*, 2014; Pirillo *et al.*, 2011).

While a plethora of studies have examined the link between stress and well-being among dentists (Bhugra *et al.*, 2008; Denton *et al.*, 2008; Myers and Myers, 2004), whether stress and negative emotions negatively affect clinical performance is an important and open question. A recent systematic review suggested that excessive intraoperative stress may compromise technical and non-technical skills and performance of novice surgeons (Arora *et al.*, 2010). Empirical studies from the broader healthcare literature have demonstrated that stress may hinder memory (Allan *et al.*, 2014; Vuori *et al.*, 2014), communication skills (Brown *et al.*, 2009), performance in simulated critical events (Hunziker *et al.*, 2011; Leblanc *et al.*, 2012), diagnostic skills (ALQahtani *et al.*, 2016; Tsiga *et al.*, 2013) and psychomotor performance (Moorthy *et al.*, 2003). Therefore, it is plausible that the intra- and perioperative stress experienced by dentists, induced by different stressors and emotions, can affect various aspects of their clinical performance with implications for patient safety (Croskerry *et al.*, 2010).

An online survey of UK general dental practitioners found that 84% of the dentists who participated felt that various occupational pressures and fears can negatively influence their decision-making (GDPUK 2008). In a subsequent research priority setting exercise, the question: ''does dentists' fear have an adverse effect on clinical decision making?'' was voted highly by members of the Primary Care Dentistry Research forum as a question that needed to be answered (Fox,

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2010). This led to an evidence summary sponsored by the Shirley Glasstone Hughes Trust published in 2010 (Fox, 2010). This rapid review failed to identify any relevant literature on the topic and suggested that this is a novel territory for primary research (Fox, 2010). Since the scope of the rapid review was limited to fear and decision making; we hypothesised that studies exploring the effect of other stressors in different aspects of clinical performance would not have been included. In addition, since the call for primary research in 2010, studies answering the above question regarding fear and decision-making may have been published.

Therefore, the aim of this review was to evaluate the impact of stress and anxiety on dentists' clinical performance.

The term stress relates to the intra and/or perioperative stress induced by different stressors and emotions that a dentist may experience. This review did not attempt to prove causality between dentists' ill mental health (such as depression, burnout, or anxiety as a clinical condition) and poor performance.

Methods

We used systematic review methods and adhered to the preferred reporting items for systematic reviews and meta-analysis statement (PRISMA). A systematic review protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42016045756. The PECO framework was used to structure the research question and search strategy.

P: (population): dentists, general dental practitioners
E: (exposure): stress, fear, anxiety, emotions
C: (comparison): no stress or fear or anxiety or emotions
O: (outcome): decision making, diagnosis, treatment planning, performance, clinical performance, clinical competence, psychomotor performance, communication skills

Studies were selected based on the inclusion and exclusion criteria stated below.

Type of studies:

Primary prospective empirical studies, either observational (in a practice or clinical setting) or experimental (in a simulated environment) were included. Both randomised and non-randomised studies were considered for inclusion. Retrospective studies, non-empirical studies and opinion pieces were excluded. We excluded retrospective studies as they have a higher risk of bias than prospective studies and measuring stress retrospectively is inaccurate. We included both experimental and observational prospective comparative studies (e.g. clinical trials, cohort studies) to explore both the impact of stress in real life and in an experimental setting. In observational studies, we expect the condition is more similar to that dentists experience, however, measuring the existence or level of stress is difficult. In experimental studies, measuring stress (and its impact) is highly likely to be more accurate, but it might not directly reflect the real-life working environment.

Type of participants:

Studies recruiting dentists were considered for inclusion. Any studies involving solely other healthcare professionals were excluded.

Type of exposure:

Studies that reported stress or anxiety using validated self-report or physical measures were considered for inclusion. Those only measuring participants' perceptions were excluded.

Type of outcome measures:

Relevant outcome measures included measurable changes in different aspects of performance (decision making, diagnosis, treatment planning, performance, clinical performance, clinical competence, psychomotor performance, communication skills). Studies reporting only participants' perceptions were excluded.

A literature search was performed using electronic bibliographic databases and manual searching of citations of relevant studies. The following electronic bibliographic databases: CINAHL, Embase (Ovid), Medline (Ovid), and PsycINFO were searched. The grey literature was searched via EThOS and OpenGrey databases. The reference lists of potentially eligible studies were searched. Both MeSH Terms and subheadings and free text search terms were used in the literature search. The search strategy for the electronic databases (CINHAL, Embase, Medline and PsycINFO is shown in Table 1. Different combinations of free text search terms were used to identify relevant studies on the EThOS and OpenGrey databases. The electronic searches were last updated on the 31st of March 2017, and supplementary searches (screening citation lists of potentially eligible studies) were completed in April 2017.

The citations retrieved from the electronic searches were inserted into the Endnote X7.4 reference management software, and duplicate removed. Two reviewers (AP and MBD) independently scanned all the titles and abstracts of the retrieved studies using the Rayyan systematic review web app (Elmagarmid A, 2014). Abstracts considered as potentially eligible, as well as those that did not supply enough information, were reserved for the assessment of the full-text article. The inclusion criteria were then applied against the full-text version of papers independently by the same two reviewers. Any differences concerning eligibility after the full text was evaluated were resolved through consensus, and when differences persisted, a third reviewer (DRM) was consulted before a final decision was reached. A record of reasons for excluding studies was made.

Two appraisal tools were utilised for the risk of bias assessment, depending on the study type included.

- For RCTs: Cochrane Collaboration's Risk of Bias (RoB) tool.
- For non-randomised studies with a separate a control group: the Effective Practice and Organisation of Care (EPOC) RoB Tool.

Table 1. Search Strategy

Database	*Search Terms*		
	P	*E*	*O*
CINHAL	1. Dentists 2. dentist 3. (MH "Dentists") 4. (MH "Dentistry, Operative") 5. dentistry 6. (MH "Dentistry") 7. "dental"	8. (MH "Stress") 9. (MH "Stress, Occupational") 10. (MH "Stress, Psychological") 11. "stress" 12. (MH "Fear") 13. "fear" 14. (MH "Anxiety") 15. "anxiety" 16. (MH "Emotions") 17. emotion*	18. decisions 19. decision 20. ''decision making'' 22. (MH "Decision Making, Clinical") 23. (MH "Decision Making") 24. (MH "Judgment") 25. judgement 26. (MH "Clinical Competence") 27. (MH "Motor Skills") 28. ''clinical performance'' 29. performance 30. (MH "Psychomotor Performance") 31. (MH "Job Performance") 32. "psychomotor" 33. ''treatment planning'' 34. ''treatment plan'' 35. "diagnostic error" 36. (MH "Diagnostic Reasoning") 37. (MH "Diagnostic Errors") 38. (MH "Treatment Errors") 39. (MH "Communication") 40. (MH "Communication Skills")
Embase (Ovid)	1.dental.mp. 2. dentistry/ 3. dentistry.mp. 4. dentist/ 5. dentist*.mp.	7. stress/ 8. acute stress/ 9. emotional stress/ 10. job stress/ 11. stress.mp. 12. fear/ 13. fear.mp. 14. anxiety/ 15. anxiety.mp. 16. emotion/ 17. emotion*.mp.	19. decision making/ 20. ''decision making''.mp. 21. clinical decision making/ 24. decision*.mp 25. treatment planning/ 26. ''treatment plan''.mp. 27. ''treatment planning.mp. 28. performance/ 29. job performance/ 30. mental performance/ 31. motor performance/ 32. psychomotor performance/ 33. clinical competence/ 34. clinical practice/ 35. ''clinical performance''.mp. 36. interpersonal communication/ 37. psychomotor.mp. 38. communication skill/ 39. ''communication skills''.mp. 40. diagnostic error/
Medline (Ovid)	1. Dental Staff/ 2. dental.mp. 3. Dentistry/ 4. dentistry.mp. 5. Dentists/ 6. dentist*.mp.	7. stress.mp. 8. Fear/ 9. fear.mp. 10. Anxiety/ 11. anxiety.mp. 12. Emotions/ 13. emotion*.mp.	14. Decision Making/ 15. ''decision making''.mp. 16. ''decision making model''.mp. 17. Clinical Decision-Making/ 20. decision*.mp. 21. treatment plan.mp. 22. treatment planning.mp. 23. Work Performance/ 24. Psychomotor Performance/ 25. Clinical Competence/ 26. Motor Skills/ 27. performance.mp. 28. '' clinical performance''.mp. 29. psychomotor.mp. 30. Diagnostic Errors/ 31. Communication/ 32. ''communication skills''.mp.

table 1 continued overleaf...

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PsychInfo	1. SU.EXACT("Dental Surgery") 2. SU.EXACT("Dentists") 3. SU.EXACT("Dentistry") 4. (dentist*)	5. SU.EXACT("Stress") 6. SU.EXACT("Occupational Stress") 7. SU.EXACT("Psychological Stress") 8. stress* 9. SU.EXACT("Fear") 10. fear OR 11. SU.EXACT("Anxiety") 12. anxiety 13. SU.EXACT("Emotions") 14. emotion*	15. SU.EXACT("Decision Making") 16. ''decision making'' 17. decision* 18. SU.EXACT("Clinical Judgment (Not Diagnosis)") 19. SU.EXACT("Diagnosis") 20. SU.EXACT("Treatment Planning") 21. ''treatment plan'' 22. ''treatment planning'' 23. SU.EXACT("Performance") 24. SU.EXACT("Job Performance") 25. SU.EXACT("Motor Performance") 26. SU.EXACT("Motor Skills") psychomotor 27. SU.EXACT("Competence") 28. SU.EXACT("Professional Competence") 29. ''clinical performance'' 30.SU.EXACT("Communication Skills") 31. communication

Results

The search of electronic databases yielded 3535 references. After removing duplicates and assessing titles and abstracts, twelve publications were considered potentially eligible. Full texts were retrieved and analysed for eligibility. No further studies were identified after screening the citation lists of these papers. Figure 1 (PRISMA flowchart) summarises the process of literature identification and selection. Of those twelve papers, eleven were rejected for the reasons listed in Table 2.

The remaining citation was a thesis abstract in French (Caron, 2004). The abstract did not provide sufficient information to make a judgment regarding its eligibility. One section of the thesis apparently considered the impact of stress on the practice of dentists but there was no information regarding how stress or its impact, were assessed. The contact details of the authors were not available, and further attempts to retrieve them from other sources failed. The institutional library of the University to which the Thesis was submitted to and the French National Library were contacted via e-mail by AP and a University Library information administrator, but the full document could not be retrieved.

Therefore, our systematic search of the literature retrieved no relevant publications for analysis, indicating a gap in the dental literature on this topic.

Discussion

This review aimed to identify prospective empirical studies quantifying the impact of stress (or different stressors) on different aspects of dentists' performance. These type of experimental studies are common in psychology and have recently started appearing in healthcare research, in areas such as medicine and surgery (Arora *et al.*, 2010; Hunziker *et al.*, 2011; Leblanc *et al.*, 2012; Piquette *et al.*, 2014; Tsiga *et al.*, 2013). According to the present systematic review, there are no prospective experimental studies published as yet, on the impact of intra- or perioperative stress on dentists' clinical performance.

However, the results of one of the excluded studies are noteworthy (Chipchase *et al.*, 2017). This study was excluded based on its design (cross-sectional- survey) and the fact that the outcome of interest was the perceptions of dentists' response to stressful clinical situations rather than an objective measure of change in performance. Participants felt that highly stressful situations affected their work. Areas affected included modifications in treatment planning, referral decisions, changes in the delivery of treatment (quality, quantity, and timing), avoiding specific treatments, and modifications in the way they communicated with patients (Chipchase *et al.*, 2017).

Therefore, given the paucity of empirical evidence, future studies are necessary to shed light on this important topic, which on the basis of the wider health literature, may be linked to patient safety and quality of care. Mirroring the approaches adopted in that literature, future dental studies could take place either in a clinical setting (observational studies) where the dentists are observed in real-life clinical situations, or in a simulated environment (experimental studies) where the dentists are asked to perform simulated tasks. Stress may be provoked by different stressors such as time pressure or simulated risk of litigation and assessed by validated self-report measures (psychological questionnaires) or physical measures such as heart rate, skin conductance or cortisol levels. Areas of performance to be evaluated may include decision making (treatment planning and diagnostics including the incidence of errors), psychomotor skills (e.g. quality of cavity preparations, iatrogenic damage to adjacent teeth) and clinical performance, cognitive ability (e.g. memory), interaction with patients (e.g. communication skills) or adherence to guidelines and best practice recommendations. The EPICOT framework was adapted to provide systematic and structured implications for future research (Brown *et al.*, 2006). It is well-recognised and is being used by established systematic review organisations such as the Cochrane Collaboration (Schünemann HJ, 2011). Our recommendations for future research are summarised in Table 3.

Table 2. Excluded studies and reasons for exclusion

	Citation	*Reason*
1.	Abdelkarim, A., and Jerrold, L. (2015): Litigation and legislation. Risk management strategies in orthodontics. Part 1: Clinical considerations. American Journal of Orthodontics & Dentofacial Orthopedics 148,345-349.	Opinion Piece How to avoid litigation
2.	Anonymous. (1986): Emphasis. Controlling anxiety in the dental office. Journal of the American Dental Association (1939) 113,728-733, 735.	Opinion piece on patient's anxiety
3.	Azodo, C.C., Ezeja, E.B., and Ehikhamenor, E.E. (2011): Occupational violence against dental professionals in southern Nigeria. *African Health Sciences* **11**,486-492.	Survey Influence of violence towards dental professionals.
4.	Chapman, H.R., Chipchase, S.Y., and Bretherton, R. (2015a): Understanding emotionally relevant situations in primary dental practice. 2. Reported effects of emotionally charged situations. *British Dental Journal* 219,E8-E8.	Not experimental. Perceived impact of stress. Not actual measurement of stress.
5.	Chapman, H.R., Chipchase, S.Y., and Bretherton, R. (2015b): Understanding emotionally relevant situations in primary dental practice. 3. Emerging narratives. *British Dental Journal* 219,491-496.	Not experimental. Focusing on role of CBT (cognitive behavioural therapy) on stress.
6.	Fox, C. (2010): Evidence summary: Does dentists' fear have an adverse effect on clinical decision-making? *British Dental Journal* 209,181-182.	Review
7.	Chipchase, S.Y., Chapman, H.R., and Bretherton, R. (2017): A study to explore if dentists' anxiety affects their clinical decision-making. *British Dental Journal* 222,277-290.	Questionnaire. Self-perceived stress and self-perceived impact in decision making
8.	Johnson, I., Chestnutt, I., and Smith, A. (2010): Dental decisions--an emotional experience? *Dental Update* 37,700-705.	Opinion Piece.
9.	Mellor, A.C., and Milgrom, P. (1995): Dentists' attitudes toward frustrating patient visits: Relationship to satisfaction and malpractice complaints. *Community Dentistry and Oral Epidemiology* **23**,15-19.	Survey, does not assess stress. Stress is not a variable.
10.	Moore, R., and Brødsgaard, I. (2001): Dentists' perceived stress and its relation to perceptions about anxious patients. *Community Dentistry & Oral Epidemiology* **29**,73-80.	Not experimental. Not reporting impact of stress on performance.
11.	Ronneberg, A., Strom, K., Skaare, A.B., Willumsen, T., and Espelid, I. (2015): Dentists' self-perceived stress and difficulties when performing restorative treatment in children. *European Archives of Paediatric Dentistry: Official Journal of the European Academy of Paediatric Dentistry* **16**,341-347.	Survey Looking at stressors rather than impact.
12.	Caron, A. 2004. Stress factors of dentist (general and specific concepts), Université Paul Sabatier.	Not available online or via ILL Request. Unable to assess

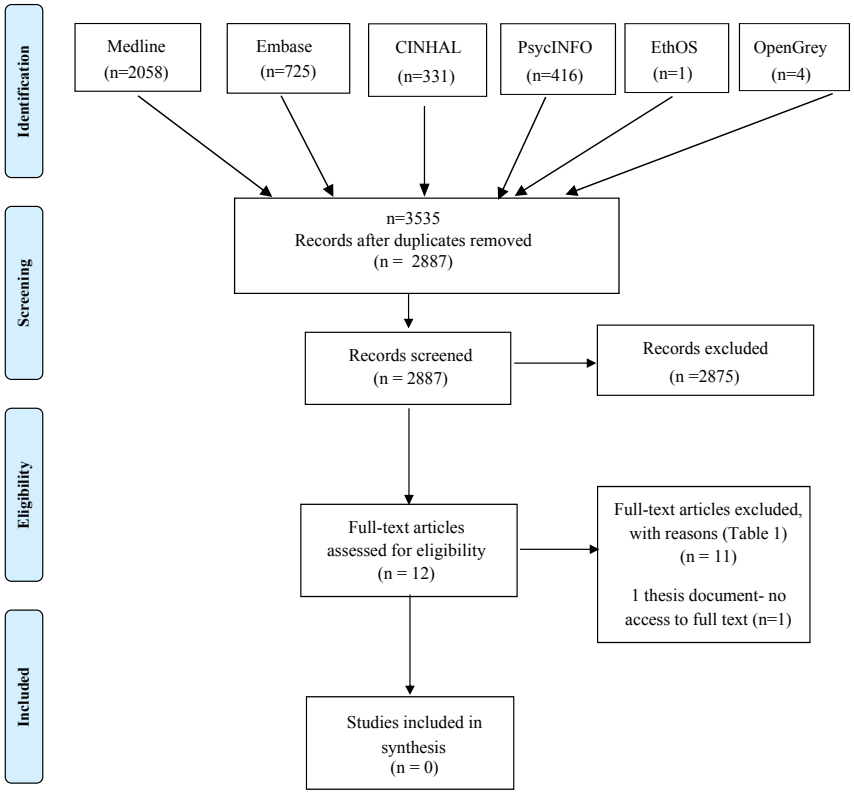

Figure 1. Prisma Flowchart: Identification and selection process of studies

Table 3. Recommendations for future research

	Core Elements	*Status of research for this systematic review*
E	Evidence	This systematic review identified **no eligible studies**.
P	Population	Dental practitioners.
E	Exposure	Stress induced by different stressors (e.g. time pressure, risk of litigation etc.)
		Stress to be evaluated by: Self-reported measures (e.g. psychological validated questionnaires)
		Physical measures (e.g. heart rate, skin conductance, cortisol levels etc.)
C	Comparison	No stress
		Different levels of stress
O	Outcome	Impact of stress on: Decision making (treatment planning and diagnostics including the incidence of errors) Psychomotor skills and clinical performance (quality of cavity or crown preparations, damage to adjacent teeth) Cognitive ability e.g. memory Interaction with patients e.g. communication skills Adherence to guidelines and best practice recommendations.
		The measures should be able to quantify the impact (e.g. percentage of errors or Likert scale to rate performance).
T	Time Stamp	April 2017
s	Study Type	Exposure to stress in daily clinical environment (observational studies)
		Exposure to stress (induced) in a simulated environment (experimental studies)

Contrary to an earlier rapid review (Fox, 2010), the present review adopted a robust and transparent systematic review method according to the PRISMA guidelines. A more sensitive and broad search was employed, including searching the psychological and grey literature. Two reviewers independently screened the retrieved articles and applied the predefined inclusion criteria. A third reviewer was available to solve any disagreements. We accept as a limitation the fact that access to one of the possibly eligible studies could not be gained (Caron, 2004).

Conclusions

This systematic review did not identify any prospective empirical studies on the impact of stress on dentists' clinical performance. Future primary research on this topic is deemed worthwhile. Prospective well-designed experimental simulation studies, comparing stress with non-stress situations on clinical performance and decision making, as well studies evaluating prospectively real-life dentist's performance under stress are warranted.

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