



University of Dundee

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Wadi, Majed Mohammed; Yusoff, Muhamad Saiful Bahri; Rahim, Ahmad Fuad Abdul; Lah, Nik Ahmad Zuky Nik

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Factors influencing Test Anxiety in Health Professions Education **students**: a Scoping Review

Authors:

- 1) Majed Mohammed Wadi
Medical Education Department, College of Medicine, Qassim University, Saudi Arabia
Email: m.wadi@qu.edu.sa
majedwadi@usm.student.my
- 2) Muhamad Saiful Bahri Yusoff
Medical Education Department, School of Medical Sciences, Universiti Sains Malaysia
Email: msaiful_bahri@usm.my
- 3) Ahmad Fuad Abdul Rahim
Medical Education Department, School of Medical Sciences, Universiti Sains Malaysia
Email: fuad@usm.my
- 4) Nik Ahmad Zuky Nik Lah
Obstetrics and Gynecology Department, School of Medical Sciences, Universiti Sains Malaysia
Email: nikzuky@usm.my

Corresponding author:

- 1) Majed Mohammed Wadi
Medical Education Department, College of Medicine, Qassim University, Saudi Arabia
Email: m.wadi@qu.edu.sa
majedwadi@usm.student.my

Abstract

Test anxiety (TA) affects students in health professions education (HPE) academic performance and well-being, and has long-term consequences that last beyond graduation, jeopardizing patients' access to the best possible health care. This study aimed to investigate and categorize the factors that influence TA among HPE students and provide evidence-based foundation for future action. We conducted a scoping study using the following six electronic databases. Only 74 articles out of 995 were selected. Each study's identified factors were classified as increasing or decreasing TA. Seven themes emerged from the factors. Assessment system, study and learning skills, psychology/cognition, personal characteristics, and supporting and relationship were all found to be positively and negatively associated with TA. Curriculum overload increased TA, while interventional procedures decreased TA. This scoping review identified factors that contribute to test anxiety either by increasing or decreasing it. The identified factors were further categorised into several themes. The themes that emerged could be used by different levels of curriculum management in HPE schools to minimise TA.

Key word: test anxiety, student, health professions education

Introduction:

Study-related anxiety among health professions students continues to be a concern for both students and educators. Globally, a meta-analysis reported that the prevalence of anxiety among medical students is around 34% (Quek et al., 2019). Although test anxiety (TA) is a subset of the general anxiety and stress phenomena in higher education, it is the major cause of stress in university life (Soares and Woods, 2020). While several sources of stress have been associated with academic life, studies showed that stress due to examinations is the most frequently reported (Yusoff et al., 2010; Yusoff et al., 2011; Yusoff, 2011; Aziz and Serafi, 2017; Boparai et al., 2013; Quek et al., 2019; Frajerman et al., 2019). Gerwing et al. (2015) found that the prevalence of TA among university students was 38.5%, while in health professions education (HPE), it was 50% (Macauley et al., 2018).

The concept of TA goes beyond just a simple worry about facing examinations; it includes physiological and psychological changes that occur after reaching certain thresholds (Leal et al., 2017). It may be manifested as organic symptoms (Testa et al., 2013) or impairment of psychological functions, such as concentration (Hjeltnes et al., 2015) and working memory, which affect academic performance of students (Moran, 2016). TA leads to chronic stress which in turn is associated with many adverse effects on the well-being of HPE students, including burnout, depression, poor academic performance, poor clinical performance, impaired decision-making, poor peer interaction, interpersonal conflict, academic dishonesty and sleeping problems (Ribeiro et al., 2018; Frajerman et al., 2019). Moreover, it has also been linked to substance abuse, alcohol consumption and suicide (Flaherty and Richman, 1993; Hays et al., 1996; Newbury-Birch et al., 2000; Pickard et al., 2000). Eventually, all these consequences affect the provision of optimal medical care for patients.

Previous studies have reported different predisposing factors of TA among university students, such as lack of effective study skills, test preparation, time management, fear of failure and inability to cope with university adversities. Other influencers are demographic in nature such as female sex, rural background and low socioeconomic class (Duraku, 2017; Samina Malik, 2015a).

However, the existing literature rarely sheds meaningful light on TA in HPE or on the factors that shape it.

Exploring test anxiety and its effects on medical and health professions students' success are critical first steps in understanding its full ramifications. With further insight, students and health professions educators, working collaboratively, may reduce the incidence of test anxiety, improve student retention rates, and promote feelings of empowerment and a renewed sense of self in those at risk. Early assessment, recognition, intervention, improved outcomes, and higher success rates among health professions student populations may become commonplace. We believe that high-quality studies on TA should be generalized to benefit HPE educators. The purpose of this study was to assess the factors associated with TA among HPE students and then to thematize them meaningfully, thereby providing an evidence-based foundation for future action.

Methods:

This study employed a scoping review, using the five-stage framework proposed by Arksey and O'Malley (2005). These are (1) identifying the initial research questions, (2) identifying relevant studies, (3) study selection, (4) charting the data and (5) collating, summarizing and reporting the results. An optional sixth stage involving a consultation exercise was excluded in this review as it is beyond the aim of this study.

Stage 1: Identifying the initial research questions

Our review focused on the identification of key features of assessment settings contributing to anxiety among HPE students. The review questions were:

1. What are the factors in the assessment setting that increase test anxiety?
2. What are the factors in the assessment setting that minimize test anxiety?

Stage 2: Identifying relevant studies

Key concepts and search terms were developed to capture literature related to test anxiety within HPE. The terms "student," "test anxiety," and "coping behavior" were used. Using Boolean operators, related synonyms of these terms were also used to capture as many published articles as possible. ~~The linked descriptive key search terms developed to guide the search are outlined in Table 1.~~ The following SIX electronic databases were searched to identify peer-reviewed literature: PubMed, CINAHL, PsychINFO, ERIC (through EBSCOHOST), SCOPUS and ProQuest. In addition, a manual search of the reference lists of the identified articles were undertaken, and Google Scholar was utilized to identify any other primary sources within grey literature. The review of literature was completed over a period of four months, ending in July 2020. ~~A full list of inclusion and exclusion criteria is outlined in Table 2.~~ The inclusion criteria were: 1) original research or review articles published in a peer-reviewed journal; 2) written in English; and 3) focused on students in health professions education.

Stage 3: Study selection

Articles were screened by their titles and abstracts by two reviewers (MW and MSBY) independently. Shortlisted articles were again assessed for full-text eligibility. Discrepancies between the two reviewers were resolved by consensus or by consulting the third reviewer (AFAR). The reporting of article selection followed the Preferred Reporting of Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Liberati et al., 2009). Fig. 1 illustrates the process of article selection.

All retrieved studies were appraised using the Critical Review Forms: one for quantitative studies (Law et al., 1998a; b) and the other for qualitative studies (Letts et al., 2007a; b). Both these forms contain items scored as either '1' (criterion is met) or '0' (criterion is not reported or is insufficiently addressed). First, the two reviewers independently assessed six articles. Scores were discussed until consensus was reached. The other articles were appraised by either of the two reviewers, followed by collaborative discussions when there were doubts.

Stage 4: Data charting and collation

Key items of information from the included articles were charted into a form that was developed based on the research questions. Key information extracted included first author's name, title, year of publication, country of origin, aim or research questions, study design and summary or general findings.

Stage 5: Summarizing and reporting findings

After the extraction, separation, grouping and abstraction of text findings, two reviewers independently categorized the findings into main themes and sub-themes. Upon further discussion, prominent themes constituting the frequently reported overlapping data were selected from the authors' independent analyses, renamed and included in the final analysis.

Results:

In this scoping review, out of 995 articles, 74 studies met our inclusion criteria (Figure 1). Of the reported studies that were finally included, 60 (80%) had been conducted mostly between 2011 and 2020 in over 24 countries. Almost one third of the studies, 27 (36%), were from the United States. Almost half the studies, 37 (49%), were cross-sectional in design. The major target health professions were medical and nursing students: 28 (37%) and 22 (29%), respectively (Table 1). ~~Table 4 shows the summary of all 74 studies with classification of the identified factors into two major classes: increasing or decreasing TA.~~ The main characteristics of included articles were presented as appendix (supplementary material).

~~The identified factors influencing TA were presented in Table 2; those increasing TA, and in table 3; those decreasing TA. These factors were further categorized into themes according to their relevance (Tables 5 and 6).~~

The identified factors that influence TA are presented in Tables 2 and 3: those that increase TA and those that decrease TA, respectively. According to their significance, these factors were subsequently classified into themes. Five themes that emerged were found to be related to both the classes, either increasing or decreasing TA: assessment system, study and learning skills, psychology/cognition, personal characteristics and supporting and relationship, while two themes were found to be related to either increasing or decreasing TA separately, namely curriculum for factors increasing TA, and interventional procedures for factors decreasing TA.

In the following paragraphs, we elaborate first on the five themes that contain both increasing and decreasing factors for TA. These are followed by a discussion on the two unidirectional themes: one with factors which increase TA and the other with those that decrease it.

Theme 1: Assessment system

Three categories related to the assessment system were found to be associated with each increasing and decreasing factors of TA. Factors related to increasing TA were examination

formats, logistic matters and policy/regulation of assessment, factors responsible for decreasing TA were assessment approaches, logistics matters and grading methods.

Referring to [Table 2](#), under examination formats, we found the OSCE to be the most frequently cited examination format associated with test anxiety (Furlong et al., 2005; Brand and Schoonheim-Klein, 2009; Muldoon et al., 2014; Kalantari et al., 2017; Nancy Zhang and Walton, 2018; Guraya et al., 2018; Kim, 2016; Macauley et al., 2018), followed by oral examination (Tsegay et al., 2019; Patil and Aithala, 2017) and other test formats ([Table 2](#)). Regarding the logistics of assessment, the most frequently cited were problems of test construction (Patil and Aithala, 2017; Khoshhal et al., 2017; Tagher and Robinson, 2016) followed by clarity of the tasks being assessed (Nancy Zhang and Walton, 2018; Kim, 2016) and long duration of the examination (Khoshhal et al., 2017; Hashmat et al., 2008). Concerning the policy of assessment, frequent tests with short gaps in between and also fixed dates of tests were the most reported as provoking test anxiety (Patil and Aithala, 2017; Preoteasa et al., 2015; Schwartz et al., 2015)

In contrast, regarding factors decreasing TA ([table 3](#)), open-book tests (Broyles et al., 2005; Durning et al., 2016; Michael et al., 2019; Lyndon et al., 2014) and collaborative testing (Bovee, 2016; Brodersen, 2017; Fournier et al., 2017) were the most widely-cited factors in the assessment approach category. Using crib sheets (Rice et al., 2017; Brodersen, 2017) and modifying the test time to suit the students (Preoteasa et al., 2015; Schwartz et al., 2015) were found to be the most-reported factors under the category of logistics matters. In the grading system, a pass/fail grading system rather than numerical/letter grades was associated with decreased test anxiety (Rohe et al., 2006; Spring et al., 2011; Bloodgood et al., 2009; Ali et al., 2015; Lyndon et al., 2014).

Theme 2: Study and learning skills

Learning skills, study skills and time management were the three categories that emerged under this theme. A frequently reported factor that increased TA under the learning skills category was inability to recall (Khoshhal et al., 2017; Patil and Aithala, 2017; Alammari and Bukhary, 2019).

With regard to improper time management, procrastination was repeatedly identified as a factor aggravating TA (Alammari and Bukhary, 2019; Patil and Aithala, 2017; Guraya et al., 2018; Custer, 2018; Tagher and Robinson, 2016) ([Table 2](#)).

Comparatively, the most-reported learning skills which reduced TA was acquiring and using effective learning skills (Green et al., 2016; Cipra and Müller-Hilke, 2019; Niu Zhang and Henderson, 2019; S. Sansgiry et al., 2005; Brodersen, 2017). Test-taking strategies and practicing answering questions (formative assessment) were also proven to be effective in decreasing TA under the category of study skills. Moreover, improving time management skill was reported as a crucial skill for reducing TA (Sansgiry and Sail, 2006; S. Sansgiry et al., 2005; Niu Zhang and Henderson, 2019; Edelman and Ficarelli, 2005) ([Table 3](#)).

Theme 3: Psychology/cognition

In this theme, we identified five categories affecting TA. Three of them were associated with factors increasing TA: irrational thoughts and beliefs, previous psychological illness and irrational self-expectation. Irritating thoughts and beliefs were found to be the most frequently reported factor that increased TA (Crego et al., 2016; Guraya et al., 2018; Khoshhal et al., 2017; Patil and Aithala, 2017; Encandela et al., 2014; REHMAN et al., 2020; Nancy Zhang and Walton, 2018; Alammari and Bukhary, 2019; Al-Sahman et al., 2019; Tagher and Robinson, 2016; Liu and Xu, 2017) ([Table 2](#)).

In comparison, behavioral and cognitive modifications were found to be associated with factors decreasing TA. Of them, behavioral modifications was the most-reported factor (Quinn and Peters, 2017; Rajiah and Saravanan, 2014; Rukholm and Viverais, 1993; Cai et al., 2018; Crego et al., 2016; O'Carroll and Fisher, 2013) followed by cognitive restructuring (Warshawski et al., 2019; Poorman et al., 2019; Encandela et al., 2014; March and Robinson, 2015; Brodersen, 2017) ([Table 3](#)).

Theme 4: Personal characteristics

In this theme, categories that increase TA include gender, previous academic performance, age, addiction and personality type. One category was found to reduce TA: self-care.

The female gender was found to be more vulnerable to TA (Hashmat et al., 2008; Pahwa et al., 2008; Fournier et al., 2017; Khoshhal et al., 2017; Guraya et al., 2018; Tsegay et al., 2019; Gilavand et al., 2019; REHMAN et al., 2020; Macauley et al., 2018; Lyndon et al., 2014) followed by past history of poor academic performance (Tsegay et al., 2019; Fournier et al., 2017; Rukholm and Viverais, 1993; Macauley et al., 2018). Other factors such as age, self-care, addiction and personality type were also found to influence TA (Table 2).

In comparison, one category was identified that reduced TA; self-care. Practicing sport (Brodersen, 2017; Encandela et al., 2014) and care of nutrition (Brodersen, 2017) were also found to improve students' well-being and alleviate test anxiety (Table 3).

Theme 5: Support and relationship

In this theme, we gathered factors related to support and relationships (Table 2). Lacking financial support (REHMAN et al., 2020; Niu Zhang and Henderson, 2019; Macauley et al., 2018) and loss of social support (Tsegay et al., 2019; REHMAN et al., 2020; Turner et al., 2015) were most frequently reported to be associated with increasing TA followed by the lack of parental support (Patil and Aithala, 2017; REHMAN et al., 2020).

As opposed to this, support of family and friends, in terms of emotion and advising, was frequently reported as factors that decreased TA (Loya and Jiwane, 2019; Warshawski et al., 2019; Rukholm and Viverais, 1993). Furthermore, providing short review courses by institutions was regularly reported as a means of decreasing TA (Stewart et al., 2007; Niu Zhang and Henderson, 2019; Yusefzadeh et al., 2019) (Table 3).

Theme 6: Curriculum implementation

All categories under this theme increased TA: excessive course load, frequent assignments and learning environment. Excessive course load was the most frequently reported factor (Al-Sahman

et al., 2019; Tsegay et al., 2019; Patil and Aithala, 2017; Hashmat et al., 2008; Sansgiry and Sail, 2006; Niu Zhang and Henderson, 2019) followed by frequent assignments (Patil and Aithala, 2017) and learning environment, such as a school's general atmosphere and the difficulties related to accommodation (Liu and Xu, 2017) ([Table 2](#))

Theme 7: Interventional procedures

This theme deals with interventional procedures to alleviate TA. Three categories were found under this theme: meditation, sensory intervention and other interventions. These categories are associated only with factors decreasing TA. The most frequent interventions reported was meditation that included relaxation techniques, deep breathing and yoga (Shapiro, 2014; Brodersen, 2017; Manansingh et al., 2019; Poorman et al., 2019; Edelman and Ficarelli, 2005; Malathi and Damodaran, 1999) followed by sensory interventions such as music (Loya and Jiwane, 2019; Son et al., 2019; Brodersen, 2017; Shapiro, 2014) and aromatherapy (Johnson, 2014; Son et al., 2019; Shapiro, 2014; Brodersen, 2017). Other interventions included hypnotherapy (Shapiro, 2014; Brodersen, 2017) ([Table 3](#)).

Discussion:

Although considerable research about TA has been done among medical, nursing, dental and other HPE students, they seem to have just focused on one group of students. This scoping review aimed to explore researches identifying factors influencing TA in all HPE students all over the world. The identified factors were divided into two classes: increasing and decreasing TA. These factors were then categorized and thematized. The thematic analysis revealed five themes that included factors for both classes and two exclusive themes: one contained only factors that increased TA and the other only factors that decreased it.

Theme 1: Assessment system

The formats of the examinations have a positive association with TA. Among these formats, the OSCE was the most often-reported format increasing TA. This was most probably due to the direct interaction between examiners and examinees (McDonald, 2010). This is supported by another study, in a non-HPE scenario, which revealed that direct interaction with examiners increased TA (Fernholz et al., 2019). Additionally, this study also found that flawed and unclear test items raised TA. This finding is also in alignment with other studies which found that flawed test items contributed to TA (Trifoni and Shahini, 2011; Sadker and Zittleman, 2004; Wadi et al., 2014). Numan and Hasan (2017) found that consecutive examinations with short gaps in between contributed to TA. This was also found in this review.

Nevertheless, in this review several factors were found to decrease TA. Regarding using open-book tests as an approach to decrease TA, Parsons (2008) and Block (2012) found that open-book tests improve test anxiety among university students. The notion of using a pass-fail grading system rather than numerical or letter grade to decrease TA was also discussed in another study (Roberts and Dorstyn, 2017). This change shifted students' mindsets from a grade orientation to achievement behavior (Slavin et al., 2014). The implications of these findings provide insights to adopt various amendments to the assessment system in HPE to reduce TA.

Theme 2: Study and learning skills

The included studies in this scoping review explain the importance of study skills, learning skills and time management as important factors that influence TA. This is supported by studies in non-HPE in which researchers found that lack of study skills and improper time management aggravated TA (Misbah Malik et al., 2016; Numan and Hasan, 2017; S. Malik, 2015b). In contrast, students who had good study skills and time management skills were stronger and able to overcome test anxiety. In this context, Motevalli et al. (2013) introduced a comprehensive training model that enhanced study skills and was able to reduce TA. A similar initiative was taken by Siddiqui et al. (2015) in which they introduced a learning course to prepare medical students for academic life. They found that the course improved academic performance. For this reason, it is highly recommended for HPE schools to have developmental programmes dealing with these skills. Adoption of such programmes has been shown to significantly reduce TA (Soares and Woods, 2020; Huntley et al., 2019)

Theme 3: Psychology/cognition

Psychology and cognition play an integral role in TA as these have substantial influence in aggravating or alleviating it (Zeidner, 1998). A test or any other evaluation setting is perceived as a self-threat and consequently evokes anxiety. Within this process, several intrusions also contribute. These include irrational thoughts and beliefs and high self-expectations (Zeidner, 2007). This is consistent with other studies involving non-HPE students where researchers found that psychological interpretation of the evaluation situation substantially induces TA (Wong, 2008; Nathaniel von der Embse et al., 2018).

Nevertheless, this review showed that several psychological modifications such as behavioral and cognitive modifications were effective in reducing TA. This is also supported by meta-analyses and systematic review studies conducted by (N. Von der Embse et al., 2013; Ergene, 2003) where they found that the most effective interventions focused on manipulation of behavioral and cognitive aspects. This theme elucidates the importance of providing psychological interventions for HPE students to alleviate their TA level.

Theme 4: Personal characteristics

Concerning personal characteristics in this review, female and first year students were more vulnerable to TA. This is in line with findings of the metanalysis by Nathaniel von der Embse et al. (2018). For this reason, educational institutions should enhance the capabilities of these groups to overcome TA. Other factors within this theme, in this scoping review, are related to lifestyle; sport and nutrition. Maintaining regular physical activities and a balanced diet help to beat TA (Uysal et al., 2018; Long and Stavel, 1995). HPE schools can adopt regular awareness sessions to promote these aspects of lifestyle.

Theme 5: Support and relationship

Support and relationship play an important role in the management of TA. It was found that social support predicted TA (I. Yildirim, 2008; İbrahim Yildirim, 2007; Kurt et al., 2014); good social support by family members or friends decrease TA while its absence increase it. Several studies emphasized the significance of academic counselling as a measure to enhance students' general wellbeing and subsequently decrease TA (Hyseni Duraku and Hoxha, 2018; Rankin et al., 2018). Counselling support is another form that can be adopted in HPE schools to detect and prevent TA.

Theme 6: Curriculum implementation

The current review identified that the high content load HPE curricula is positively correlated with TA. This overload is attributed to the concern of curriculum designers that HPE graduates will take care of people's lives and therefore they require extensive scientific foundations (Ganguly et al., 2019; Olopade et al., 2016). This finding is also reported in other disciplines; Education and Psychology, where their graduates are responsible of peoples' lives (Misbah Malik et al., 2016; Numan and Hasan, 2017; Nathaniel von der Embse et al., 2018). Using contextual national competency frameworks, ensuring the integration of the different disciplines within the curriculum, adopting interprofessional education had been used many schools to ameliorate curricular overload (Nathaniel von der Embse et al., 2018; N. Von der Embse et al., 2013; Soares and Woods, 2020).

Theme 7: Interventional procedures

Several interventional procedures were identified in this scoping review as being able to alleviate TA. These interventions almost similar to what had been done in non-HPE. For example, practicing pranayama, a sort of yoga (Nemati, 2013), performing religious rituals (Campbell, 2018) and listening to the Holy Qur'an (Ghiasi and Keramat, 2018). These interventions focus on the meditation role, in which participants can practice some activities to regulate attention and re-organise individual values and self-related assumptions. In a recent meta-analysis study, meditation was found to be superior over relaxation techniques (Montero-Marin et al., 2019).

This review has identified several themes either aggravating or reducing TA among HPE students. Although this review explored different themes influencing TA among HPE students which in fact are not exclusive to HPE, the theme of assessment system seems to be very distinct to HPE. This is because the inherited nature of designing and implementing assessment in HPE where the designers try to keep high standards of assessment system to graduate safe health care providers. They also adopted many assessment modalities to assess different levels of competency. Balancing acts between the two notions; alleviating test anxiety while maintaining standards of assessment system is highly required.

This paper does not only shed light on areas of assessment practice that can be manipulated to reduce TA, but also provides a data-driven exploration of other areas which forms the basis of different interventions at the whole system in HPE.

One of the limitations of this scoping review is the inclusion of only articles published in the English Language. This leads to omitting some relevant studies that excluded after the board searching. Moreover, the review reported only factors that are associated with the increase or decrease of TA. Further studies including systematic review and meta-analysis are recommended to do in-depth analysis of the interventions that targeting HPE as efforts to decrease TA.

Conclusions

This scoping review identified factors that increase or decrease test anxiety. The factors were thematized into seven themes. Five of them were found to be associated positively and negatively with TA. These five themes were: psychological factors, assessment system, study skills, personal and supporting factors. The other two themes were unidirectional: curriculum overload which was associated with increasing TA and interventional procedures which was associated with decreasing TA. This scoping review contributed in thematizing and categorizing the factors associated with TA. The emerging themes could be used to manage TA at various levels of curriculum management in HPE schools. According to the findings of this review, TA could be modified by improving the learning environment, reforming HPE curricula to address TA, promoting institutional student support services such as academic advising and counseling, promoting healthy lifestyles among students, and faculty development in providing constructive feedback, all of which are necessary to manage TA and its associated effects.

List of abbreviations:

TA: Test anxiety

HPE: Health Professions Education

PRISMA: Preferred Reporting of Items for Systematic Reviews and Meta-Analyses

Declarations:

- **Ethics approval and consent to participate**
The study was approved by the Institutional Human Research Ethics Committee at USM with reference number (JEPeM USM Code: USM/JEPeM/18060286).
- **Consent for publication**
All authors have read and agreed on publishing this article
- **Availability of data and material**
Upon request
- **Conflict of interests**
In this study, the authors declare that there is no competing of interest between them.
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- **Authors' contributions**
MW and MSBY were involved in the conception, design, review, and analysis of the data, as well as writing the initial draft manuscript and incorporating all co-authors'

revisions. AFAR was involved in the conception and design of the manuscript, as well as in its revision. By reviewing, analyzing, and revising the protocol, NAZNL contributed to its improvement. All authors read and approved the final version of the manuscript.

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Not applicable

Table 2: Themes of factors that increase test anxiety

Themes	Category	Sub-categories (if there)	References (cited studies)
Assessment system	Format	OSCE	(Furlong et al., 2005; Brand and Schoonheim-Klein, 2009; Muldoon et al., 2014; Kalantari et al., 2017; Nancy Zhang and Walton, 2018; Guraya et al., 2018; Kim, 2016; Macauley et al., 2018)
		Oral	(Tsegay et al., 2019; Patil and Aithala, 2017)
		Computer-based	(Kolagari et al., 2018)
		Long case	(Guraya et al., 2018)
		Virtual simulation	(Cobbett and Snelgrove-Clarke, 2016)
	Logistics	Problems in test construction	(Patil and Aithala, 2017; Khoshhal et al., 2017; Tagher and Robinson, 2016)
		Clarity of task being assessed	(Nancy Zhang and Walton, 2018; Kim, 2016)
		Long duration of test	(Khoshhal et al., 2017; Hashmat et al., 2008)
	Policy/regulations of assessment	Frequent test with short gaps	(Patil and Aithala, 2017; Preoteasa et al., 2015; Schwartz et al., 2015)
		Fixed dates of tests	(Patil and Aithala, 2017; Preoteasa et al., 2015; Schwartz et al., 2015)
High stakes		(Røykenes et al., 2014; Turan and Üner, 2015)	
Study and learning skills	Lack of learning skills	Inability to recall	(Khoshhal et al., 2017; Patil and Aithala, 2017; Alammari and Bukhary, 2019)
		Surface learner	(Cipra and Müller-Hilke, 2019)
	Lack of study skills	Inefficient studying	(Patil and Aithala, 2017)
		Lack of exam taking tips	(Hashmat et al., 2008)
		Lack of study plan	(Tsegay et al., 2019)
		Memorize textbooks	(Khoshhal et al., 2017)
	Improper time management	Procrastination	(Alammari and Bukhary, 2019; Patil and Aithala, 2017; Guraya et al., 2018; Custer, 2018; Tagher and Robinson, 2016)
Study all night before exam		(Khoshhal et al., 2017; Patil and Aithala, 2017; Al-Sahman et al., 2019)	
Psychology/cognition	Irrational thoughts and believes	Negative thoughts	(Crego et al., 2016; Guraya et al., 2018; Khoshhal et al., 2017; Patil and Aithala, 2017; Encandela et al., 2014; REHMAN et al., 2020; Nancy Zhang and Walton, 2018; Alammari and Bukhary, 2019; Al-Sahman et al., 2019; Tagher and Robinson, 2016; Liu and Xu, 2017)

	Previous illness	Existing psychological distress	(Liu and Xu, 2017; Tagher and Robinson, 2016; Macauley et al., 2018)
	Self-expectation	High expectation	(Kim, 2016; Niu Zhang and Henderson, 2019)
Personal characteristics	Gender	Female	(Hashmat et al., 2008; Pahwa et al., 2008; Fournier et al., 2017; Khoshhal et al., 2017; Guraya et al., 2018; Tsegay et al., 2019; Gilavand et al., 2019; REHMAN et al., 2020; Macauley et al., 2018; Lyndon et al., 2014)
		Male	(Patil and Aithala, 2017)
	Past academic performance	History of poor academic performance	(Tsegay et al., 2019; Fournier et al., 2017; Rukholm and Viverais, 1993; Macauley et al., 2018)
	Age	Young age	(Gilavand et al., 2019; Rukholm and Viverais, 1993; Tsegay et al., 2019)
	Self-care	Neglecting breakfast/nutrition	(Khoshhal et al., 2017; REHMAN et al., 2020; Akbari et al., 2020)
		Lack of physical activity	(Khoshhal et al., 2017; Guraya et al., 2018)
	Addiction	Social media and internet addiction	(Alammari and Bukhary, 2019; Naeim et al., 2020)
		Drug addiction	(REHMAN et al., 2020)
Personality type	Extraversion and neuroticism	(Pahwa et al., 2008)	
Support and relationship	Loss of social support	Strained relationship and social distraction	(Tsegay et al., 2019; REHMAN et al., 2020; Turner et al., 2015)
	Lacking financial support	-	(REHMAN et al., 2020; Niu Zhang and Henderson, 2019; Macauley et al., 2018)
	Lacking parental support	Away from home	(Patil and Aithala, 2017; REHMAN et al., 2020)
		Parent high expectation	(Patil and Aithala, 2017)
Curriculum	Course load	Excessive course load	(Al-Sahman et al., 2019; Tsegay et al., 2019; Patil and Aithala, 2017; Hashmat et al., 2008; Sansgiry and Sail, 2006; Niu Zhang and Henderson, 2019)
	Assignment	More number of classes and home assignment	(Patil and Aithala, 2017)
	School environment	Accommodation issues	(Liu and Xu, 2017)

Table 3: Themes of factors that decrease test anxiety

Themes	Categories	Sub-categories (if there)	References
Assessment system	Assessment approach	Open book test	(Broyles et al., 2005; Durning et al., 2016; Michael et al., 2019; Lyndon et al., 2014)
		Collaborative testing	(Bovee, 2016; Brodersen, 2017; Fournier et al., 2017)
		Face to face simulation	(Cobbett and Snelgrove-Clarke, 2016)
		Peer-assisted mock OSCE	(Young et al., 2014)
		Progress testing	(Chen et al., 2015)
		Rationales of Q&A	(Edelman and Ficarelli, 2005)
		Test-enhanced learning	(Messineo et al., 2015)
		Video exemplar OSCE	(Massey et al., 2017)
		Video-based learning activity	(Weeks and Horan, 2013)
	Participating in writing questions	(Poorman et al., 2019)	
	Logistics	Crib sheet	(Rice et al., 2017; Brodersen, 2017)
		Suitable test time for students	(Preoteasa et al., 2015; Schwartz et al., 2015)
		Injecting humor items	(Brodersen, 2017)
Scoring and grading methods	Pass-fail grading	(Rohe et al., 2006; Spring et al., 2011; Bloodgood et al., 2009; Ali et al., 2015; Lyndon et al., 2014)	
	Elimination testing with adopted scoring (no negative marks)	(Vanderost et al., 2018)	
	Exam analysis (discussion on test items after exam)	(Brodersen, 2017)	
Study and learning skills	Improving learning skills	Effective leaning strategies	(Green et al., 2016; Cipra and Müller-Hilke, 2019; Niu Zhang and Henderson, 2019; S. Sangsiry et al., 2005; Brodersen, 2017)
		Content mastery	(Niu Zhang and Henderson, 2019)
		Active learning	(Niu Zhang and Henderson, 2019)
	Improving study skills	Test taking strategies	(Shapiro, 2014; Brodersen, 2017)
		Practicing questions	(Poorman et al., 2019; Yusefzadeh et al., 2019)
		Comprehensive reading	(Edelman and Ficarelli, 2005)
		Note taking	(Edelman and Ficarelli, 2005)
		Class presentation	(Yusefzadeh et al., 2019)
	Group study	(Edelman and Ficarelli, 2005)	
	Time management	Improving time management skills	(Sangsiry and Sail, 2006; S. Sangsiry et al., 2005; Niu Zhang and Henderson, 2019; Edelman and Ficarelli, 2005)
Psychology/cognition	Behavioral modifications	Behavior modification	(Quinn and Peters, 2017; Rajiah and Saravanan, 2014; Rukholm and Viverais, 1993; Cai et al., 2018;

			Crego et al., 2016; O'Carroll and Fisher, 2013)
		Desensitization	(Rajiah and Saravanan, 2014; Brodersen, 2017) (Shapiro, 2014)
	Cognitive modifications	Cognitive re-structuring	(Warshawski et al., 2019; Poorman et al., 2019; Encandela et al., 2014; March and Robinson, 2015; Brodersen, 2017)
		Guided imagery	(Edelman and Ficorelli, 2005; Brodersen, 2017)
Personal characteristics	Self-care	Sport	(Brodersen, 2017; Encandela et al., 2014)
		Nutrition	(Brodersen, 2017)
Support and relationship	Institutional	Providing a short review course	(Stewart et al., 2007; Niu Zhang and Henderson, 2019; Yusefzadeh et al., 2019)
		Academic counselling	(Rajiah and Saravanan, 2014)
		Financial support	(Niu Zhang and Henderson, 2019)
	Family/friends	Emotional/advising support	(Loya and Jiwane, 2019; Warshawski et al., 2019; Rukholm and Viverais, 1993)
Interventional procedures	Meditation intervention	Relaxation techniques including deep breathing and yoga	(Shapiro, 2014; Brodersen, 2017; Manansingh et al., 2019; Poorman et al., 2019; Edelman and Ficorelli, 2005; Malathi and Damodaran, 1999)
	Sensory interventions (smelling, hearing and visual)	Music	(Loya and Jiwane, 2019; Son et al., 2019; Brodersen, 2017; Shapiro, 2014)
		Aromatherapy (lemon oil)	(Johnson, 2014; Son et al., 2019; Shapiro, 2014; Brodersen, 2017)
		Earplug	(Poorman et al., 2019)
		Coloring leisure activity	(Burton and Baxter, 2019)
	Other interventions	Hypnotherapy	(Shapiro, 2014; Brodersen, 2017)
		Mind sound technology	(Dayalan et al., 2010)
		Pet	(Brodersen, 2017)
		Auricular acupuncture	(Klausenitz et al., 2016)

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Figure and Table Legends

~~Table 1: searching terms~~

~~Table 2 Inclusion and exclusion criteria.~~

Table 1: Descriptive variables of the included studies (n = 74)

Table 2: Themes of factors that increase test anxiety

Table 3: Themes of factors that decrease test anxiety

Figure 1: PRISMA chart

Supplementary materials: Overview of the 74 included studies