The role of emotions in academic performance of undergraduate medical students: a narrative review

Nora Alshareef[1,2]*, Ian Fletcher[2] and Sabir Giga[2]

Abstract

Background This paper is devoted to a narrative review of the literature on emotions and academic performance in medicine. The review aims to examine the role emotions play in the academic performance of undergraduate medical students.

Methods Eight electronic databases were used to search the literature from 2013 to 2023, including Academic Search Ultimate, British Education Index, CINAHL, Education Abstract, ERIC, Medline, APA Psych Articles and APA Psych Info. Using specific keywords and terms in the databases, 3,285,208 articles were found. After applying the predefined exclusion and inclusion criteria to include only medical students and academic performance as an outcome, 45 articles remained, and two reviewers assessed the quality of the retrieved literature; 17 articles were selected for the narrative synthesis.

Result The findings indicate that depression and anxiety are the most frequently reported variables in the reviewed literature, and they have negative and positive impacts on the academic performance of medical students. The included literature also reported that a high number of medical students experienced test anxiety during their study, which affected their academic performance. Positive emotions lead to positive academic outcomes and vice versa. However, Feelings of shame did not have any effect on the academic performance of medical students.

Discussion The review suggests a significant relationship between emotions and academic performance among undergraduate medical students. While the evidence may not establish causation, it underscores the importance of considering emotional factors in understanding student performance. However, reliance on cross-sectional studies and self-reported data may introduce recall bias. Future research should concentrate on developing anxiety reduction strategies and enhancing mental well-being to improve academic performance.

Keywords Emotions, Medical students, Academic performance

*Correspondence:
Nora Alshareef
Dr.nourat@gmail.com
[1]King Abdulaziz University, Jeddah, Saudi Arabia
[2]Lancaster University, Lancaster, UK

Alshareef *et al. BMC Medical Education*   (2024) 24:907

Page 2 of 17

Introduction

Studying medicine is a multi-dimensional process involving acquiring medical knowledge, clinical skills, and professional attitudes. Previous research has found that emotions play a significant role in this process [1, 2]. Different types of emotions are important in an academic context, influencing performance on assessments and evaluations, reception of feedback, exam scores, and overall satisfaction with the learning experience [3]. In particular, medical students experience a wide range of emotions due to many emotionally challenging situations, such as experiencing a heavy academic workload, being in the highly competitive field of medicine, retaining a large amount of information, keeping track of a busy schedule, taking difficult exams, and dealing with a fear of failure [4–6].Especially during their clinical years, medical students may experience anxiety when interacting with patients who are suffering, ill, or dying, and they must work with other healthcare professionals. Therefore, it is necessary to understand the impact of emotions on medical students to improve their academic outcomes [7].

To distinguish the emotions frequently experienced by medical students, it is essential to define them. Depression is defined by enduring emotions of sadness, despair, and a diminished capacity for enjoyment or engagement in almost all activities [4]. Negative emotions encompass unpleasant feelings such as anger, fear, sadness, and anxiety, and they frequently cause distress [8]. Anxiety is a general term that refers to a state of heightened nervousness or worry, which can be triggered by various factors. Test anxiety, on the other hand, is a specific type of anxiety that arises in the context of taking exams or assessments. Test anxiety is characterised by physiological arousal, negative self-perception, and a fear of failure, which can significantly impair a student's ability to perform well academically [9, 10]. Shame is a self-conscious emotion that arises from the perception of having failed to meet personal or societal standards. It can lead to feelings of worthlessness and inadequacy, severely impacting a student's motivation and academic performance [11, 12]. In contrast, positive emotions indicate a state of enjoyable involvement with the surroundings, encompassing feelings of happiness, appreciation, satisfaction, and love [8].

Academic performance generally refers to the outcomes of a student's learning activities, often measured through grades, scores, and other formal assessments. Academic achievement encompasses a broader range of accomplishments, including mastery of skills, attainment of knowledge, and the application of learning in practical contexts. While academic performance is often quantifiable, academic achievement includes qualitative aspects of a student's educational journey [13].

According to the literature, 11–40% of medical students suffer from stress, depression, and anxiety due to the intensity of medical school, and these negative emotions impact their academic achievement [14, 15]. Severe anxiety may impair memory function, decrease concentration, lead to a state of hypervigilance, and interfere with judgment and cognitive function, further affecting academic performance [16]. However, some studies have suggested that experiencing some level of anxiety has a positive effect and serves as motivation that can improve academic performance [16, 17].

Despite the importance of medical students' emotions and their relation to academic performance, few studies have been conducted in this area. Most of these studies have focused on the prevalence of specific emotions without correlating with medical students' academic performance. Few systematic reviews have addressed the emotional challenges medical students face. However, there is a lack of comprehensive reviews that discuss the role of emotions and academic outcomes. Therefore, this review aims to fill this gap by exploring the relationship between emotions and the academic performance of medical students.

Aim of the study

This review aims to examine the role emotions play in the academic performance of undergraduate medical students.

Methods

A systematic literature search examined the role of emotions in medical students' academic performance. The search adhered to the concepts of a systematic review, following the criteria of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [18]. Then, narrative synthesise was done to analyse the retrieved literature and synthesise the results. A systematic literature search and narrative review provide complete coverage and flexibility to explore and understand findings. Systematic search assures rigour and reduces bias, while narrative synthesis allows for flexible integration and interpretation. This balance improves review quality and utility.

Eligibility criteria

Inclusion criteria

The study's scope was confined to January 2013 to December 2023, focusing exclusively on undergraduate medical students. The research encompassed articles originating within medical schools worldwide, accepting content from all countries. The criteria included only full-text articles in English published in peer-reviewed journals. Primary research was considered, embracing quantitative and mixed-method research. The selected

studies had to explicitly reference academic performance, test results, or GPA as key outcomes to address the research question.

Exclusion criteria

The study excluded individuals beyond the undergraduate medical student demographic, such as students in other health fields and junior doctors. There was no imposed age limit for the student participants. The research specifically focused on articles within medical schools, excluding those from alternative settings. It solely considered full-text articles in English-language peer-reviewed journals. Letters or commentary articles

Table 1 The reasons and numbers for excluding articles

Main reason	No. of articles
Excluding any duplicates and letters and commentary	1592
Other Factors Affecting Academic Performance	
Mentoring	3
Emotional intelligence	20
Studying habits	10
Testing scales	19
Conference papers	3
Gender discrimination	5
Environment	13
Physiological factors (menses, sleep)	22
Motivation	5
Perfectionism	3
Computer use	5
Grading system	4
Socioeconomic factors	6
Only exam anxiety	1
Math course	1
Smoking	9
Depression	7
Patient safety	1
Stress management	5
Counselling	1
Clerkship	1
Quality of life	12
Only Empathy	7
OSCE/ Assessment tools	6
Mindfulness	11
Medication	3
Mental health	7
Communication skills	3
Academic Engagement	5
Compassion	1
EEG	1
Neuroimage	2
Music	3
Nursing students	20
Junior doctors	1
Not Medical	3
Primary health care	1

were excluded, and the study did not limit itself to a particular type of research. Qualitative studies were excluded from the review because they did not have the quantitative measures required to answer the review's aim. This review excluded articles on factors impacting academic performance, those analysing nursing students, and gender differences. The reasons and numbers for excluding articles are shown in Table 1.

Information sources

Eight electronic databases were used to search the literature. These were the following: Academic Search Ultimate, British Education Index, CINAHL, Education Abstract, ERIC, Medline, APA Psych Articles and APA Psych Info. The databases were chosen from several fields based on relevant topics, including education, academic evaluation and assessment, medical education, psychology, mental health, and medical research. Initially, with the help of a subject librarian, the researcher used all the above databases; the databases were searched with specific keywords and terms, and the terms were divided into the following concepts emotions, academic performance and medical students. Google Scholar, EBSCO-host, and the reference list of the retrieved articles were also used to identify other relevant articles.

Search strategy

This review started with a search of the databases. Eight electronic databases were used to search the literature from 2013 to 2023. Specific keywords and terms were used to search the databases, resulting in 3,285,208 articles. After removing duplicates, letters and commentary, this number was reduced to 1,637 articles. Exclusion and inclusion criteria were then applied, resulting in 45 articles. After two assessors assessed the literature, 17 articles were selected for the review. The search terms are as follows:

Keywords: Emotion, anxiety, stress, empathy, test anxiety, exam anxiety, test stress, exam stress, depression, emotional regulation, test scores, academic performance, grades, GPA, academic achievement, academic success, test result, assessment, undergraduate medical students and undergraduate medical education.

Emotions: TI (Emotion* OR Anxiety OR Stress OR empathy) OR emotion* OR (test anxiety or exam anxiety or test stress or exam stress) OR (depression) OR AB ((Emotion* OR Anxiety OR Stress OR empathy) OR emotion* OR (test anxiety or exam anxiety or test stress or exam stress)) (MH "Emotions") OR (MH "Emotional Regulation") DE "EMOTIONS".

Academic performance: TI (test scores or academic performance or grades or GPA) OR (academic achievement or academic performance or academic success) OR (test result* OR assessment*) OR AB (test scores or

academic performance or grades or GPA) OR (academic achievement or academic performance or academic success) OR test result* OR assessment*.

Medical Students: TI (undergraduate medical students OR undergraduate medical education) OR AB (undergraduate medical students OR undergraduate medical education), TI "medical students" OR AB "medical students" DE "Medical Students".

Selection process

This literature review attempts to gather only peer-reviewed journal articles published in English on undergraduate medical students' negative and positive emotions and academic performance from January 2013 to December 2023. Their emotions, including depression, anxiety, physiological distress, shame, happiness, joy, and all emotions related to academic performance, were examined in quantitative research and mixed methods.

Moreover, to focus the search, the author specified and defined each keyword using advanced search tools, such as subject headings in the case of the Medline database. The author used 'MeSH 2023' as the subject heading, then entered the term 'Emotion' and chose all the relevant meanings. This method was applied to most of the keywords.

Studies were included based on predefined criteria related to study design, participants, exposure, outcomes, and study types. Two independent reviewers screened each record, and the report was retrieved. In the screening process, reviewers independently assessed each article against the inclusion criteria, and discrepancies were resolved through consensus during regular team meetings. In cases of persistent disagreement, a third reviewer was consulted. Endnote library program was used for the initial screening phase. This tool was used to identify duplicates, facilitated the independent screening of titles and abstracts and helped to retrieve the full-text articles. The reasons for excluding the articles are presented in Table 1.

Data collection process

Two independent reviewers extracted data from the eligible studies, with any discrepancies resolved through discussion and consensus. If the two primary reviewers could not agree, a third reviewer served as an arbitrator. For each included study, the following information was extracted and recorded in a standardised database: first author name, publication year, study design, sample characteristics, details of the emotions exposed, outcome measures, and results.

Data items

Academic performance as an outcome for medical students was defined to include the following: Exam scores

(e.g., midterm, final exams), Clinical assessments (e.g., practical exams, clinical rotations), Overall grade point average (GPA) or any other relevant indicators of academic achievement.

Data were sought for all outcomes, including all measures, time points, and analyses within each outcome domain. In cases where studies reported multiple measures or time points, all relevant data were extracted to provide a comprehensive overview of academic performance. If a study reported outcomes beyond the predefined domains, inclusion criteria were established to determine whether these additional outcomes would be included in the review. This involved assessing relevance to the primary research question and alignment with the predefined outcome domains.

Quality assessment

The quality and risk of bias in included studies were assessed using the National Institute of Health's (NIH) critical appraisal tool. The tool evaluates studies based on the following domains: selection bias, performance bias, detection bias, attrition bias, reporting bias, and other biases. Two independent reviewers assessed the risk of bias in each included study. Reviewers worked collaboratively to reach a consensus on assessments. Discrepancies were resolved through discussion and consensus. In cases of persistent disagreement, a third reviewer was consulted.

To determine the validity of eligible articles, all the included articles were critically appraised, and all reviewers assessed bias. The validity and reliability of the results were assessed by using objective measurement. Each article was scored out of 14, with 14 indicating high-quality research and 1 indicating low-quality research. High-quality research, according to the NIH (2013), includes a clear and focused research question, defines the study population, features a high participation rate, mentions inclusion and exclusion criteria, uses clear and specific measurements, reports results in detail, lists the confounding factors and lists the implications for the local community. Therefore, an article was scored 14 if it met all criteria of the critical appraisal tool. Based on scoring, each study was classified into one of three quality categories: good, fair or poor. The poorly rated articles mean their findings were unreliable, and they will not be considered, including two articles [16, 19]. Seventeen articles were chosen after critical appraisal using the NIH appraisal tool, as shown in Table 2.

Effect measures

For each outcome examined in the included studies, various effect measures were utilised to quantify the relationship between emotions and academic performance among undergraduate medical students. The effect

Table 2 Study characteristics table

No.	Author/year	Country	Methodology	Aim	Population	Tools	Findings	Quality scoring
1	Aboalshamat (2015)	Saudi Arabia	Cross-section Study	To evaluate the psychological health of medical students and the relationship between psychological health and their academic success	(n=422) preclinical medical and dental students (2nd and 3rd year)	1. Depression Anxiety Stress Scale 2. General Self-Efficacy Scale 3-Satisfaction with Life Scale 3. Students' academic weighted grades	1. Depression is the only psychological factor linked to academic performance 2. $\eta2$ for the effect of depression on academic performance is 0.018; this value indicates that depression explains 1.8% of the variance in academic performance (Small effect size)	9/14 Good
2	Behrens (2019)	Chile/South America	Mixed-method study	1. Investigate achievement emotions and simulation-based learning 2. Relationship between achievement emotions and medical students' performance 3. The effect of emotions on learning	(n=55) 6th-year medical students	1. Achievement Emotion Questionnaire 2. Observational ward round assessment tool 3. Focus groups 4. Simulation	1. Challenging simulations increase learning, motivation and success in medical students 2. In the simulation, some students encountered shame, which appeared to be a potent external motivator for learning However, the study found non-significant correlations between achievement emotions and performance	13/14 Good
3	Ben-Loubir (2014)	Morocco	Cross-section	To investigate the association between test anxiety and academic skills.	(n=275) Medical Students	1. Socio-demographic scale 2. Test anxiety scale 3. Academic Skills Questionnaire	Test anxiety negatively correlates with academic abilities (r=-0.39) (Large effect size)	8/14 Fair
4	Burr and Dallaghan (2019)	Nebraska/USA	Cross-section study	The relationship between achievement emotions, burnout, and academic performance?	(n=264) 1st and 2nd-year medical students	1. Achievement Emotions 2. The Maslach Burnout Inventory 3. General Survey 4. Academic performance (final overall percentage for the semester)	Correlation to academic performance: Professional efficacy(r=0.57), Hope(r=0.50), pride (r=0.41), anxiety (r=0.30) and shame (r =. 40) Professional efficacy was the most significant factor in academic performance, explaining 31.3% of the variance	8/14 Fair

Table 2 (continued)

No.	Author/year	Country	Methodology	Aim	Population	Tools	Findings	Quality scoring
5	Del-ben (2013)	Brazil	Cross-section	1. To assess academic motivation, anxiety, depression and social adjustment among first-year medical students 2. Determine the influence on their academic performance	($n=85$) 1st-year medical students	1. Beck's Anxiety and Beck's Depression 2. Social Adjustment Scale 3. The Academic Motivation Scale 4. GPA	There was no correlation between academic motivation, anxiety and depressive and social adjustment with academic achievement	8/14 Fair
6	Dendle (2018)	Australia	one-year prospective cohort study	Examine the impacts of workplace and study-related stress factors on students' psychological distress and academic performance during their first clinical year	($n=126$) 1st year medical students	1. Kessler psychological distress scale 2. The General Health Questionnaire 3. Sources of workplace stress 4. Academic scores	There was no correlation between the anxiety and academic performance	9/14 Good
7	Green (2016)	Connecticut/USA	Cross-section & RCT	1. Determine the relationship between test anxiety and performance on the (USMLE) exam 2. Determine the impact of a test-taking strategies course on test anxiety and USMLE scores	($n=25$) 2nd-year medical students before USLME step-1	1. Westside test anxiety 2. USMLE score 3. Medical college admission test	1. Test anxiety negatively correlated with USMLE step 1 ($r=-0.24$) 2. A test-taking strategy course relatively reduced anxiety but did not increase test scores 3. Anxiety may impair performance by interfering with attention to task-relevant information, decreasing the cognitive resources available for task processing	10/14 Good
8	Hahn (2017)	Germany	Quantitative Explorative study	To investigate the relationship between anxiety, depression and academic performance among medical students	($n=200$) Second-year medical students	1. Multiple Choice Vocabulary Intelligence Test 2. State-Trait-Anxiety Inventory 3. Beck's Depression Inventory II	1. Anxiety did not correlate with depressive symptoms or past or future academic achievement 2. Depression did not correlate with academic performance	5/10 Poor

Table 2 (continued)

No.	Author/year	Country	Methodology	Aim	Population	Tools	Findings	Quality scoring
9	Hautz (2017)	Swiss	RCT (Shame)	To further enhance the understanding of state shame and its influence on learning	(n=49) 4th and 3rd medical students	Experimental shame scale. Outcome assessed: number of lumps correctly documented during final performance assessment, time on task and OSCE score	1. Students training with a standardised patient experienced more shame during training 2. Shame does not have any effect on OSCE scores	9/14 Good
10	Hayat (2018)	Iran	descriptive-correlative study	The role of medical students' emotions and motivation in their academic achievement	(n=370) medical students	1. Academic emotions Questionnaire 2. Work preference inventory 3. Academic score	1. Motivation (β=0.56) and positive emotions (β=0.11) increase medical students' academic performance, explaining 40% of the variance 2. Negative emotions: anger, anxiety, hopelessness, shame, and boredom, were found to have a negative and significant correlation with the academic achievement of learners (r=-0.15, r=0.24, r=0.23, r=-0.215, and r=-0.21) (small effect)	9/14 Good
11	Kausar (2018)	Pakistan	Cross-section	To explore the effect of pre-exam stress levels of final-year medical students on their academic performance	(n=79) Students of final medical year	Medical Student Stressors Questionnaire	Pre-exam stress enhances medical students' academic performance x^2=23.52 (p=0.00) (W=0.78 large effect)	9/14 Good
12	Kim (2016)	Korea	Cross-section	Investigate the effect of test anxiety on OSCE among Medical students	(n=101) 3rd and 4th year medical students	1. Korean Achievement Emotions Questionnaire	1. Test anxiety is moderately associated with achievement emotions in the class, which are anxiety and boredom (r=0.46 and 0.32, p<0.00) 2-Test anxiety is not significantly correlated with the OSCE scores (r=0.09, p=0.40) or GPAs (r=0.09, p=0.41)	7/14 Fair

Table 2 (continued)

No.	Author/year	Country	Methodology	Aim	Population	Tools	Findings	Quality scoring
13	Junaid (2020)	Saudi Arabia	Analytical Cross section	Prevalence of anxiety and its effect on the academic performance among medical students	($n = 247$) medical students	1. Beck Anxiety Inventory 2. GPA	Anxiety was high and negatively correlated with academic performance mean CGPA = 3.93, SD = 0.88, $p = 0.00$ Cohen's d = 1.1 (large effect size)	5/14 Poor
14	Mihailescu (2016)	Romania	Quantitative Cross-section	Association between anxiety and depression and academic performance	($n = 254$) 1st and 2nd-year medical students	1. Zung Self-rating Anxiety scale 2. Zung Self-rating Depression Scale 3. GPA	Depression and anxiety are negatively correlated with academic performance in medical students (rho=-0.14, $p < 0.05$), (rho=-0.19, $p < 0.05$)	9/14 Good
15	Moreira (2018)	Portugal	Cross-section	Prevalence of anxiety and depression in Portuguese medical students compared to non-medical students	Total ($n = 750$) students ($n = 512$) medical students and ($n = 238$) nonmedical students	1. Socio-demographic survey 2. Hospital Anxiety and Depression Scale (HADS)	Depression is associated with poor academic performance but is not statistically significant. Anxiety negatively significantly associated with the average curricular grade χ2 = 4.49; $p < 0.00$ (W = 0.76 large effect size)	7/14 Fair
16	Nazir et al. (2021)	Pakistan	Cross-section	Assess test anxiety and its influencing factors on medical students	($n = 680$) medical students	1. Test anxiety inventory	There is a significant association between test anxiety and academic performance, with excellent students exhibiting lower levels of test anxiety compared to those with lower academic grades OR = 1.47 (95% CI:1.05, 2.06), $P = 0.02$	7/14 Fai
17	Zalihic (2017)	Bosna and Hercegovina	Cross section	Examine the impact of anxiety sensitivity on the success of medical students	($n = 100$) 1st and 5th-year medical students	1. Anxiety Sensitivity Index	Anxiety has a positive statistically significant on academic performance OR = 1.28 (95% CI: 1.16–1.51), $p = 0.00$	8/14 Fair

measures commonly reported across the studies included prevalence rat, correlation coefficients, and mean differences. The reviewer calculated the effect size for the studies that did not report the effect. The choice of effect measure depended on the nature of the outcome variable and the statistical analysis conducted in each study. These measures were used to assess the strength and direction of the association between emotional factors and academic performance.

The synthesis method

The findings of individual studies were summarised to highlight crucial characteristics. Due to the predicted heterogeneity, the synthesis involved pooling effect estimates and using a narrative method. A narrative synthesis approach was employed in the synthesis of this review to assess and interpret the findings from the included studies qualitatively. The narrative synthesis involved a qualitative examination of the content of each study, focusing on identifying common themes. This synthesis was employed to categorise and interpret data, allowing for a nuanced understanding of the synthesis. Themes related to emotions were identified and extracted for synthesis. Control-value theory [20] was used as an overarching theory, providing a qualitative synthesis of the evidence and contributing to a deeper understanding of the research question. If the retrieved articles include populations other than medical, such as dental students or non-medical students, the synthesis will distinguish between them and summarise the findings of the medical students only, highlighting any differences or similarities.

The Control-Value Theory, formulated by Pekrun (2006), is a conceptual framework that illustrates the relationship between emotions and academic achievement through two fundamental assessments: control and value. Control pertains to the perceived ability of a learner to exert influence over their learning activities and the results they achieve. Value relates to a student's significance to these actions and results. The theory suggests that students are prone to experiencing good feelings, such as satisfaction and pride when they possess a strong sense of control and importance towards their academic assignments. On the other hand, individuals are prone to encountering adverse emotions (such as fear and embarrassment) when they perceive a lack of control or worth in these particular occupations. These emotions subsequently impact students' motivation, learning strategies, and, eventually, their academic achievement. The relevance of control-value theory in reviewing medical student emotions and their influence on academic performance is evident for various reasons. This theory offers a complete framework that facilitates comprehending the intricate connection between emotions and academic achievement. It considers positive and negative emotions, providing a comprehensive viewpoint on how emotions might influence learning and performance. The relevance of control and value notions is particularly significant for medical students due to their frequent exposure to high-stakes tests and difficult courses. Gaining insight into the students' perception of their power over academic assignments and the importance they attach to their medical education might aid in identifying emotional stimuli and devising remedies. Multiple research has confirmed the theory's assertions, showing the critical influence of control and value evaluations on students' emotional experiences and academic achievements [21, 22].

Data extraction

For this step, a data extraction sheet was developed using the data extraction template provided by the Cochrane Handbook. To ensure the review is evidence-based and bias-free, the Cochrane Handbook strongly suggests that more than one reviewer review the data. Therefore, the main researcher extracted the data from the included studies, and another reviewer checked the included, excluded and extracted data. Any disagreements were resolved via discussion by a third reviewer. The data extraction Table 2 identified all study features, including the author's name, the year of publication, the method used the aim of the study, the number and description of participants, data collection tools, and study findings.

Finalisation of references and study characteristics
PRISMA sheet and the summary of final studies that have been used for the review

When the keywords and search terms related to emotions, as mentioned above, in the eight databases listed, 3,285,208 articles were retrieved. After using advanced search and subject headings, the number of articles increased to 3,352,371. Similarly, searching for the second keyword, 'academic performance,' using all the advanced search tools yielded 8,119,908 articles. Searching for the third keyword, 'medical students,' yielded 145,757 articles. All terms were searched in article titles and abstracts. After that, the author combined all search terms by using 'AND' and applied the time limit from 2013 to 2023; the search narrowed to 2,570 articles. After duplicates, letters and commentary were excluded, the number was reduced to 1,637 articles. After reading the title and abstract to determine relevance to the topic and applying the exclusion and inclusion criteria mentioned above, 45 articles remained; after the quality of the retrieved literature was assessed by two reviewers, 17 articles were selected for the review. The PRISMA flow diagram summarising the same is presented in Fig. 1. Additionally, One article by Ansari et al. (2018) was selected for the review; it met most inclusion and exclusion criteria except that the outcome measure is cognitive function and not academic performance. Therefore, it was excluded from the review. Figure 1 shows the Prisma flow diagram (2020) of studies identified from the databases.

Study characteristics

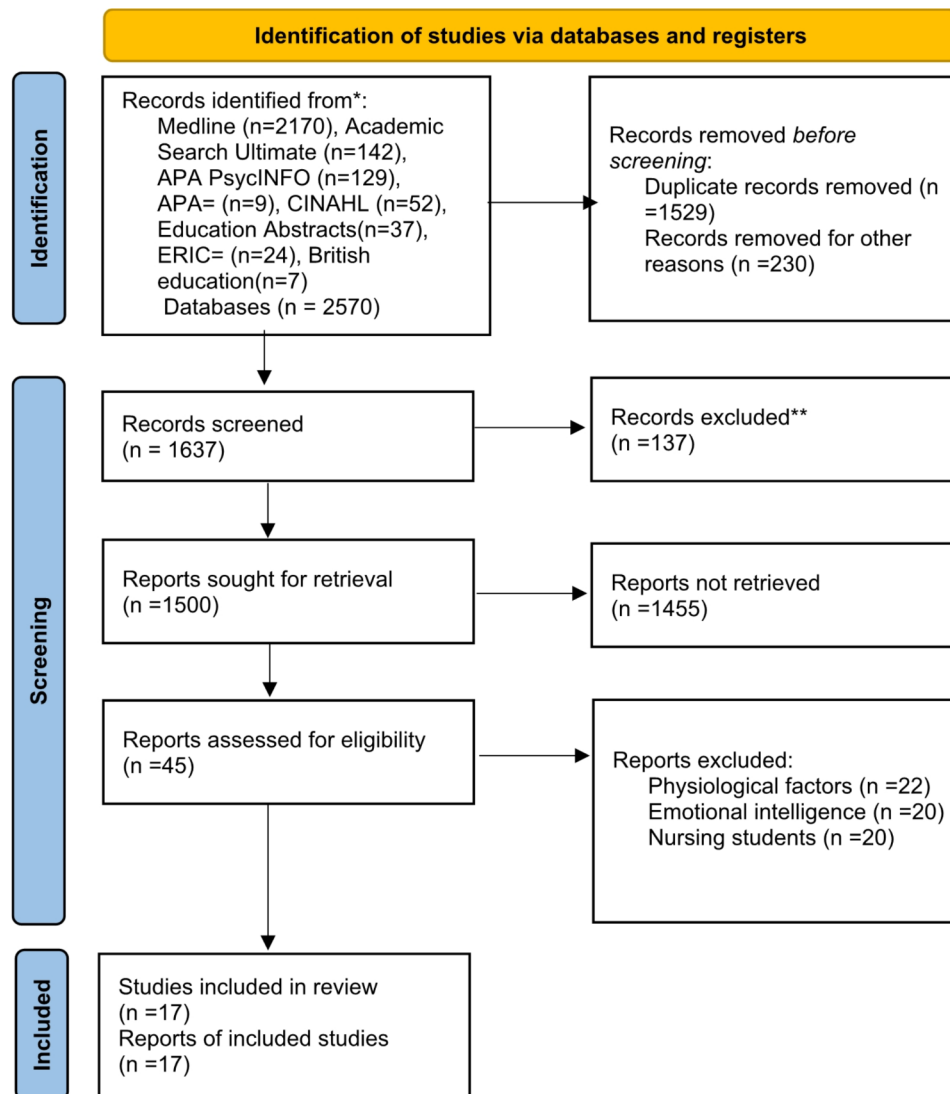Table 2, summarising the characteristics of the included studies, is presented below.

Identification of studies via databases and registers

Fig. 1 Prisma flow diagram (2020)

Findings of the study

Country of the study

Many of the studies were conducted in developing countries, with the majority being conducted in Europe ($n=4$), followed by Pakistan ($n=2$), then Saudi Arabia ($n=2$), and the United States ($n=2$). The rest of the studies were conducted in South America ($n=1$), Morocco ($n=1$), Brazil ($n=1$), Australia ($n=1$), Iran ($n=1$), South Korea ($n=1$) and Bosnia and Herzegovina ($n=1$). No included studies were conducted in the United Kingdom.

Study design

Regarding study design, most of the included articles used a quantitative methodology, including 12 cross-sectional studies. There were two randomised controlled trials, one descriptive correlation study, one cohort study, and only one mixed-method study.

Population and study setting

Regarding population and setting, most of the studies focused on all medical students studying in a medical school setting, from first-year medical students to those in their final year. One study compared medical students with non-medical students; another combined medical students with dental students.

Study aims

The study aims varied across the included studies. Seven studies examined the prevalence of depression and anxiety among medical students and their relation to academic performance. Four studies examined the relationship between test anxiety and academic performance in medical education. Four studies examined the relationship between medical students' emotions and academic

achievements. One study explored the influence of shame on medical students' learning.

Study quality

The studies were assessed for quality using tools created by the NIH (2013) and then divided into good, fair, and poor based on these results. Nine studies had a high-quality methodology, seven achieved fair ratings, and only three achieved poor ratings. The studies that were assigned the poor rating were mainly cross-sectional studies, and the areas of weakness were due to the study design, low response rate, inadequate reporting of the methodology and statistics, invalid tools, and unclear research goals.

Outcome measures

Most of the outcome measures were heterogenous and self-administered questionnaires; one study used focus groups and observation ward assessment [23]. All the studies used the medical students' academic grades.

Results of the study

The prevalence rate of psychological distress in the retrieved articles

Depression and anxiety are the most common forms of psychological distress examined concerning academic outcomes among medical students. Studies consistently show concerningly high rates, with prevalence estimates ranging from 7.3 to 66.4% for anxiety and 3.7–69% for depression. These findings indicate psychological distress levels characterised as moderate to high based on common cut-off thresholds have a clear detrimental impact on academic achievement [16, 24–26].

The studies collectively examine the impact of psychological factors on academic performance in medical education contexts, using a range of effect sizes to quantify their findings. Aboalshamat et al. (2015) identified a small effect size ($\eta2=0.018$) for depression's impact on academic performance, suggesting a modest influence. Mihailescu (2016) found a significant negative correlation between levels of depression/anxiety (rho=-0.14, rho=-0.19), academic performance and GPA among medical students. Burr and Beck Dallaghan (2019) reported professional efficacy explaining 31.3% of the variance in academic performance, indicating a significant effect size. However, Del-Ben (2013) et al. did not provide the significant impact of affective changes on academic achievement, suggesting trivial effect sizes for these factors.

In conclusion, anxiety and depression, both indicators of psychological discomfort, are common among medical students. There is a link between distress and poor academic performance results, implying that this relationship merits consideration. Table 3 below shows the specific value of depression and anxiety in retrieved articles.

Test anxiety

In this review, four studies examined the relationship between test anxiety and academic performance in medical education [27–30]. The studies found high rates of test anxiety among medical students, ranging from 52% [27] to as high as 81.1% [29]. Final-year students tend to experience the highest test anxiety [29].

Test anxiety has a significant negative correlation with academic performance measures and grade point average (GPA) [27–29]. Green et al. (2016) found that test anxiety was moderately negatively correlated with USMLE score ($r=-0.24$, $p=0.00$); high test anxiety was associated with low USMLE scores in the control group, further suggesting that anxiety can adversely affect performance. The findings that a test-taking strategy course reduced anxiety without improving test scores highlight the complex nature of anxiety's impact on performance.

Nazir et al. (2021) found that excellent female medical students reported significantly lower test anxiety than those with low academic grades, with an odds ratio of 1.47, indicating that students with higher test anxiety are more likely to have lower academic grades. Kim's (2016) research shows moderate correlations between test anxiety and negative achievement emotions such as anxiety and boredom, but interestingly, this anxiety does not significantly affect practical exam scores (OSCE) or GPAs. However, one study found that examination stress enhanced academic performance with a large effect size (W=0.78), with stress levels at 47.4% among their sample, suggesting that a certain stress level before exams may be beneficial [30].

Table 3 The score of depression and anxiety in the retrieved articles

Author	Scale used	Depression	Anxiety
Abolashamat et al. (2015)	Depression Anxiety Stress	69% (high)	66.4% (high)
Burr and Dallaghan (2019)	Beck anxiety	-	30%
Del-ben et al. (2013)	Beck's anxiety & depression	6.8 (low)	7.3 (mild)
Junaid et al., (2020)	Beck anxiety	-	49.4% (high)
Moreira et al. (2018)	Hospital Anxiety & depression Scale	3.7% (low)	21.5% (high)
Mihailescu et al. (2016)	Zung anxiety & depression	29% (low)	41% (low)
Zalihić et al. (2017)	Anxiety sensitivity index	-	30% (moderate)

Shame

Three papers explored shame's effect on medical students' academic achievement [24, 31, 32]. Hayat et al. (2018) reported that academic feelings, like shame, significantly depend on the academic year. shame was found to have a slight negative and significant correlation with the academic achievement of learners (r=-0.15). One study found that some medical students felt shame during simulations-based education examinations because they had made incorrect decisions, which decreased their self-esteem and motivation to learn. However, others who felt shame were motivated to study harder to avoid repeating the same mistakes [23].

Hautz (2017) study examined how shame affects medical students' learning using a randomised controlled trial where researchers divided the students into two groups: one group performed a breast examination on mannequins and the other group on actual patients. The results showed that students who performed the clinical examination on actual patients experienced significantly higher levels of shame but performed better in examinations than in the mannequin group. In the final assessments on standardised patients, both groups performed equally well. Therefore, shame decreased with more clinical practice, but shame did not have significant statistics related to learning or performance. Similarly, Burr and Dallaghan (2019) reported that the shame level of medical students was (40%) but had no association with academic performance.

Academic performance, emotions and medical students

Three articles discussed medical students' emotions and academic performance [23, 24, 32]. Burr and Dallaghan (2019) examine the relationship between academic success and emotions in medical students, such as pride, hope, worry, and shame. It emphasises the links between academic accomplishment and professional efficacy, as well as hope, pride, worry, and shame. Professional efficacy was the most significant factor linked to academic performance, explaining 31.3% of the variance. The importance of emotions on understanding, processing of data, recall of memories, and cognitive burden is emphasised throughout the research. To improve academic achievement, efforts should be made to increase student self-efficacy.

Hayat et al. (2018) found that positive emotions and intrinsic motivation are highly connected with academic achievement, although emotions fluctuate between educational levels but not between genders. The correlations between negative emotions and academic achievement, ranging from −0.15 to -0.24 for different emotions, suggest small but statistically significant adverse effects.

Behren et al.'s (2019) mixed-method study found that students felt various emotions during the simulation,

focusing on positive emotions and moderate anxiety. However, no significant relationships were found between positive emotions and the student's performance during the simulation [23].

Discussion

This review aims to investigate the role of emotions in the academic performance of undergraduate medical students. Meta-analysis cannot be used because of the heterogeneity of the data collection tools and different research designs [33]. Therefore, narrative synthesis was adopted in this paper. The studies are grouped into four categories as follows: (1) The effect of depression and anxiety on academic performance, (2) Test anxiety and academic achievement, (3) Shame and academic performance, and (4) Academic performance, emotions and medical students. The control-value theory [20], will be used to interpret the findings.

The effect of depression and anxiety on academic performance

According to the retrieved research, depression and anxiety can have both a negative and a positive impact on the academic performance of medical students. Severe anxiety may impair memory function, decrease concentration, lead to a state of hypervigilance, interfere with judgment and cognitive function, and further affect academic performance [4]. Most of the good-quality retrieved articles found that anxiety and depression were associated with low academic performance [16, 24–26]. Moreira (2018) and Mihailescu (2016) found that higher depression levels were associated with more failed courses and a lower GPA. However, they did not find any association between anxiety level and academic performance.

By contrast, some studies have suggested that experiencing some level of anxiety reinforces students' motivation to improve their academic performance [16, 34]. Zalihic et al. (2017) conducted a study to investigate anxiety sensitivity about academic success and noticed a positive relationship between anxiety level and high academic scores; they justified this because when medical students feel anxious, they tend to prepare and study more, and they desire to achieve better scores and fulfil social expectations. Similarly, another study found anxiety has a negative impact on academic performance when excessive and a positive effect when manageable, in which case it encourages medical students and motivates them to achieve higher scores [35].

In the broader literature, the impact of anxiety on academic performance has contradictory research findings. While some studies suggest that having some level of anxiety can boost students' motivation to improve their academic performance, other research has shown that

anxiety has a negative impact on their academic success [36, 37]. In the cultural context, education and anxiety attitudes differ widely across cultures. High academic pressure and societal expectations might worsen anxiety in many East Asian societies. Education is highly valued in these societies, frequently leading to significant academic stress. This pressure encompasses attaining high academic marks and outperformance in competitive examinations. The academic demands exerted on students can result in heightened levels of anxiety. The apprehension of not meeting expectations can lead to considerable psychological distress and anxiety, which can appear in their physical and mental health and academic achievement [38, 39].

Test anxiety and academic achievement

The majority of the studies reviewed confirm that test anxiety negatively affects academic performance [27–29]. Several studies have found a significant correlation between test anxiety and academic achievement, indicating that higher levels of test anxiety are associated with lower exam scores and lower academic performance [40, 41]. For example, Green et al. (2016) RCT study found that test anxiety has a moderately significant negative correlation with the USMLE score. They found that medical students who took the test-taking strategy course had lower levels of test anxiety than the control group, and their test anxiety scores after the exam had improved from the baseline. Although their test anxiety improved after taking the course, there was no significant difference in the exam scores between students who had and had not taken the course. Therefore, the intervention they used was not effective. According to the control-value theory, this intervention can be improved if they design an emotionally effective learning environment, have a straightforward instructional design, foster self-regulation of negative emotions, and teach students emotion-oriented regulation [22].

Additionally, according to this theory, students who perceive exams as difficult are more likely to experience test anxiety because test anxiety results from a student's negative appraisal of the task and outcome values, leading to a reduction in their performance. This aligns with Kim's (2016) study, which found that students who believed that the OSCE was a problematic exam experienced test anxiety more than other students [9, 22, 42].

In the wider literature, a meta-analysis review by von der Embse (2018) found a medium significant negative correlation (r=-0.24) between test anxiety and test performance in undergraduate educational settings [43] . Also, they found a small significant negative correlation (r=-0.17) between test anxiety and GPA. This indicates that higher levels of test anxiety are associated with lower test performance. Moreover, Song et al. (2021) experimental

study examined the effects of test anxiety on working memory capacity and found that test anxiety negatively correlated with academic performance [44]. Therefore, the evidence from Song's study suggests a small but significant effect of anxiety on working memory capacity. However, another cross-sectional study revealed that test anxiety in medical students had no significant effect on exam performance [45]. The complexities of this relationship necessitate additional investigation. Since the retrieved articles are from different countries, it is critical to recognise the possible impact of cultural differences on the impact of test anxiety. Cultural factors such as different educational systems, assessment tools and societal expectations may lead to variances in test anxiety experience and expression across diverse communities [46, 47]. Culture has a substantial impact on how test anxiety is expressed and evaluated. Research suggests that the degree and manifestations of test anxiety differ among different cultural settings, emphasising the importance of using culturally validated methods to evaluate test anxiety accurately. A study conducted by Lowe (2019) with Canadian and U.S. college students demonstrated cultural variations in the factors contributing to test anxiety. Canadian students exhibited elevated levels of physiological hyperarousal, but U.S. students had more pronounced cognitive interference. These variations indicate that the cultural environment has an influence on how students perceive and respond to test anxiety, resulting in differing effects on their academic performance in different cultures. Furthermore, scholars highlight the significance of carrying out meticulous instruments to assess test anxiety, which are comparable among diverse cultural cohorts. This technique guarantees that the explanations of test scores are reliable and can be compared across different populations. Hence, it is imperative to comprehend and tackle cultural disparities in order to create efficient interventions and assistance for students who encounter test anxiety in diverse cultural environments. Therefore, there is a need for further studies to examine the level of test anxiety and cultural context.

Shame and academic performance

The review examined three studies that discuss the impact of feelings of shame on academic performance [23, 24, 48]. Generally, shame is considered a negative emotion which involves self-reflection and self-evaluation, and it leads to rumination and self-condemnation [49]. Intimate examinations conducted by medical students can induce feelings of shame, affecting their ability to communicate with patients and their clinical decisions. Shame can increase the avoidance of intimate physical examinations and also encourage clinical practice [23, 24, 48].

Alshareef *et al. BMC Medical Education*   (2024) 24:907

Page 14 of 17

One study found that some medical students felt shame during simulations-based education examinations because they had made incorrect decisions, which decreased their self-esteem and motivation to learn. However, others who felt shame were motivated to study harder to avoid repeating the same mistakes [23]. Shame decreased with more clinical practice, but shame did not affect their learning or performance [48]. The literature on how shame affects medical students' learning is inconclusive [31].

In the broader literature, shame is considered maladaptive, leading to dysfunctional behaviour, encouraging withdrawal and avoidance of events and inhibiting social interaction. However, few studies have been conducted on shame in the medical field. Therefore, more research is needed to investigate the role of shame in medical students' academic performance [49]. In the literature, there are several solutions that can be used to tackle the problem of shame in medical education; it is necessary to establish nurturing learning settings that encourage students to openly discuss their problems and mistakes without the worry of facing severe criticism. This can be accomplished by encouraging medical students to participate in reflective practice, facilitating the processing of their emotions, and enabling them to derive valuable insights from their experiences, all while avoiding excessive self-blame [50]. Offering robust mentorship and support mechanisms can assist students in effectively managing the difficulties associated with intimate examinations. Teaching staff have the ability to demonstrate proper behaviours and provide valuable feedback and effective mentoring [51]. Training and workshops that specifically target communication skills and the handling of sensitive situations can effectively equip students to handle intimate tests, hence decreasing the chances of them avoiding such examinations due to feelings of shame [52].

Academic performance, emotions and medical students

The literature review focused on three studies that examined the relationship between emotions and the academic achievements of medical students [23, 24, 32].

Behren et al. (2019) mixed-method study on the achievement emotions of medical students during simulations found that placing students in challenging clinical cases that they can handle raises positive emotions. Students perceived these challenges as a positive drive for learning and mild anxiety was considered beneficial. However, the study also found non-significant correlations between emotions and performance during the simulation, indicating a complex relationship between emotions and academic performance. The results revealed that feelings of frustration were perceived to reduce students' interest and motivation for studying,

hampered their decision-making process, and negatively affected their self-esteem, which is consistent with the academic achievement emotions literature where negative emotions are associated with poor intrinsic motivation and reduced the ability to learn [3].

The study also emphasises that mild anxiety can have positive effects, corroborated by Gregor (2005), which posits that moderate degrees of anxiety can improve performance. The author suggests that an ideal state of arousal (which may be experienced as anxiety) enhances performance. Mild anxiety is commonly seen as a type of psychological stimulation that readies the body for upcoming challenges, frequently referred to as a "fight or flight" response. Within the realm of academic performance, this state of heightened arousal can enhance concentration and optimise cognitive functions such as memory, problem-solving skills, and overall performance. However, once the ideal point is surpassed, any additional increase in arousal can result in a decline in performance [53]. This is additionally supported by Cassady and Johnson (2002), who discovered that a specific level of anxiety can motivate students to engage in more comprehensive preparation, hence enhancing their performance.

The reviewed research reveals a positive correlation between positive emotions and academic performance and a negative correlation between negative emotions and academic performance. These findings align with the control–value theory [8, 22], which suggests that positive emotions facilitate learning through mediating factors, including cognitive learning strategies such as strategic thinking, critical thinking and problem-solving and metacognitive learning strategies such as monitoring, regulating, and planning students' intrinsic and extrinsic motivation. Additionally, several studies found that extrinsic motivation from the educational environment and the application of cognitive and emotional strategies improve students' ability to learn and, consequently, their academic performance [23, 24, 32]. By contrast, negative emotions negatively affect academic performance. This is because negative emotions reduce students' motivation, concentration, and ability to process information [23, 24, 32].

Limitations of the study

This review aims to thoroughly investigate the relationship between emotions and academic performance in undergraduate medical students, but it has inherent limitations. Overall, the methodological quality of the retrieved studies is primarily good and fair. Poor-quality research was excluded from the synthesis. The good-quality papers demonstrated strengths in sampling techniques, data analysis, collection and reporting. However, most of the retrieved articles used cross-section studies,

and the drawback of this is a need for a more causal relationship, which is a limitation in the design of cross-sectional studies. Furthermore, given the reliance on self-reported data, there were concerns about potential recall bias. These methodological difficulties were noted in most of the examined research. When contemplating the implications for practice and future study, the impact of these limitations on the validity of the data should be acknowledged.

The limitation of the review process and the inclusion criteria restricted the study to articles published from January 2013 to December 2023, potentially overlooking relevant research conducted beyond this timeframe. Additionally, the exclusive focus on undergraduate medical students may constrain the applicability of findings to other health fields or educational levels.

Moreover, excluding articles in non-English language and those not published in peer-reviewed journals introduces potential language and publication biases. Reliance on electronic databases and specific keywords may inadvertently omit studies using different terms or indexing. While the search strategy is meticulous, it might not cover every relevant study due to indexing and database coverage variations. However, the two assessors' involvement in study screening, selection, data extraction, and quality assessment improved the robustness of the review and ensured that it included all the relevant research.

In conclusion, these limitations highlight the need for careful interpretation of the study's findings and stress the importance of future research addressing these constraints to offer a more comprehensive understanding of the nuanced relationship between emotions and academic performance in undergraduate medical education.

Conclusion and future research

The review exposes the widespread prevalence of depression, anxiety and test anxiety within the medical student population. The impact on academic performance is intricate, showcasing evidence of adverse and favourable relationships. Addressing the mental health challenges of medical students necessitates tailored interventions for enhancing mental well-being in medical education. Furthermore, it is crucial to create practical strategies considering the complex elements of overcoming test anxiety. Future research should prioritise the advancement of anxiety reduction strategies to enhance academic performance, focusing on the control-value theory's emphasis on creating an emotionally supportive learning environment. Additionally, Test anxiety is very common among medical students, but the literature has not conclusively determined its actual effect on academic performance. Therefore, there is a clear need for a study that examines the relationship between test anxiety and academic performance. Moreover, the retrieved literature did not

provide effective solutions for managing test anxiety. This gap highlights the need for practical solutions informed by Pekrun's Control-Value Theory. Ideally, a longitudinal study measuring test anxiety and exam scores over time would be the most appropriate approach. it is also necessary to explore cultural differences to develop more effective solutions and support systems tailored to specific cultural contexts.

The impact of shame on academic performance in medical students was inconclusive. Shame is a negative emotion that has an intricate influence on learning outcomes. The inadequacy of current literature emphasises the imperative for additional research to unravel the nuanced role of shame in the academic journeys of medical students.

Overall, emotions play a crucial role in shaping students' academic performance, and research has attempted to find solutions to improve medical students' learning experiences; thus, it is recommended that medical schools revise their curricula and consider using simulation-based learning in their instructional designs to enhance learning and improve students' emotions. Also, studies have suggested using academic coaching to help students achieve their goals, change their learning styles, and apply self-testing and simple rehearsal of the material. Moreover, the study recommended to improve medical students' critical thinking and autonomy and changing teaching styles to support students better.

Author contributions

NA made substantial contributions throughout the systematic review process and was actively involved in writing and revising the manuscript. NA's responsible for the design of the study, through the acquisition, analysis, and interpretation of data, to the drafting and substantive revision of the manuscript. NA has approved the submitted version and is personally accountable for her contributions, ensuring the accuracy and integrity of the work. IF was instrumental in screening the literature, extracting data, and conducting the quality assessment of the included studies. Additionally, IF played a crucial role in revising the results and discussion sections of the manuscript, ensuring that the interpretation of data was both accurate and insightful. IF has approved the submitted version and has agreed to be personally accountable for his contributions, particularly in terms of the accuracy and integrity of the parts of the work he was directly involved in. SG contributed significantly to the selection of papers and data extraction, demonstrating critical expertise in resolving disagreements among authors. SG's involvement was crucial in revising the entire content of the manuscript, enhancing its coherence and alignment with the study's objectives. SG has also approved the submitted version and is personally accountable for his contributions, committed to upholding the integrity of the entire work.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Consent of publication was obtained from the other authors.

Competing interests
The authors declare no competing interests.

References

1. Weurlander M, Lonn A, Seeberger A, Hult H, Thornberg R, Wernerson A. Emotional challenges of medical students generate feelings of uncertainty. Med Educ. 2019;53(10):1037–48.
2. Boekaerts M, Pekrun R. Emotions and emotion regulation in academic settings. Handbook of educational psychology: Routledge; 2015. pp. 90–104.
3. Camacho-Morles J, Slemp GR, Pekrun R, Loderer K, Hou H, Oades LG. Activity achievement emotions and academic performance: a meta-analysis. Educational Psychol Rev. 2021;33(3):1051–95.
4. Aboalshamat K, Hou X-Y, Strodl E. Psychological well-being status among medical and dental students in Makkah, Saudi Arabia: a cross-sectional study. Med Teach. 2015;37(Suppl 1):S75–81.
5. Mirghni HO, Ahmed Elnour MA. The perceived stress and approach to learning effects on academic performance among Sudanese medical students. Electron Physician. 2017;9(4):4072–6.
6. Baessler F, Zafar A, Schweizer S, Ciprianidis A, Sander A, Preussler S, et al. Are we preparing future doctors to deal with emotionally challenging situations? Analysis of a medical curriculum. Patient Educ Couns. 2019;102(7):1304–12.
7. Rowe AD, Fitness J. Understanding the role of negative emotions in Adult Learning and Achievement: a Social Functional Perspective. Behav Sci (Basel). 2018;8(2).
8. Pekrun R, Frenzel AC, Goetz T, Perry RP. The control-value theory of achievement emotions: An integrative approach to emotions in education. Emotion in education: Elsevier; 2007. pp. 13–36.
9. Zeidner M. Test anxiety: The state of the art. 1998.
10. Cassady JC, Johnson RE. Cognitive test anxiety and academic performance. Contemp Educ Psychol. 2002;27(2):270–95.
11. Tangney JP, Dearing RL. Shame and guilt: Guilford Press; 2003.
12. Fang J, Brown GT, Hamilton R. Changes in Chinese students' academic emotions after examinations: pride in success, shame in failure, and self-loathing in comparison. Br J Educ Psychol. 2023;93(1):245–61.
13. York TT, Gibson C, Rankin S. Defining and measuring academic success. Practical Assess Res Evaluation. 2019;20(1):5.
14. Abdulghani HM, Irshad M, Al Zunitan MA, Al Sulihem AA, Al Dehaim MA, Al Esefir WA, et al. Prevalence of stress in junior doctors during their internship training: a cross-sectional study of three Saudi medical colleges' hospitals. Neuropsychiatr Dis Treat. 2014;10:1879–86.
15. Moreira de Sousa J, Moreira CA, Telles-Correia D, Anxiety. Depression and academic performance: a Study Amongst Portuguese Medical Students Versus non-medical students. Acta Med Port. 2018;31(9):454–62.
16. Junaid MA, Auf AI, Shaikh K, Khan N, Abdelrahim SA. Correlation between academic performance and anxiety in Medical students of Majmaah University - KSA. JPMA J Pakistan Med Association. 2020;70(5):865–8.
17. MihĂllescu AI, Diaconescu LV, Donisan T, Ciobanu AM, THE INFLUENCE OF EMOTIONAL, DISTRESS ON THE ACADEMIC PERFORMANCE IN UNDERGRADUATE MEDICAL STUDENTS. Romanian J Child Adolesc Psychiatry. 2016;4(1/2):27–40.
18. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372.
19. Hahn H, Kropp P, Kirschstein T, Rücker G, Müller-Hilke B. Test anxiety in medical school is unrelated to academic performance but correlates with an effort/reward imbalance. PLoS ONE. 2017;12(2):1–13.
20. Pekrun R. The control-value theory of achievement emotions: assumptions, corollaries, and Implications for Educational Research and Practice. Educational Psychol Rev. 2006;18(4):315–41.
21. Graesser AC. Emotions are the experiential glue of learning environments in the 21st century. Learn Instruction. 2019.
22. Pekrun R, Perry RP. Control-value theory of achievement emotions. International handbook of emotions in education: Routledge; 2014. pp. 120–41.
23. Behrens CC, Dolmans DH, Gormley GJ, Driessen EW. Exploring undergraduate students achievement emotions during ward round simulation: a mixed-method study. BMC Med Educ. 2019;19(1):316.
24. Burr J, Beck-Dallaghan GL. The relationship of emotions and Burnout to Medical Students' academic performance. Teach Learn Med. 2019;31(5):479–86.
25. Zalihić A, Mešukić S, Sušac B, Knezović K, Martinac M. Anxiety sensitivity as a predictor of academic success of medical students at the University of Mostar. Psychiatria Danubina. 2017;29(Suppl 4):851–4.
26. Del-Ben CM, Machado VF, Madisson MM, Resende TL, Valério FP, Troncon LEDA. Relationship between academic performance and affective changes during the first year at medical school. Med Teach. 2013;35(5):404–10.
27. Nazir MA, Izhar F, Talal A, Sohail ZB, Majeed A, Almas K. A quantitative study of test anxiety and its influencing factors among medical and dental students. J Taibah Univ Med Sci. 2021;16(2):253–9.
28. Green M, Angoff N, Encandela J. Test anxiety and United States Medical Licensing Examination scores. Clin Teacher. 2016;13(2):142–6.
29. Ben Loubir D, Serhier Z, Diouny S, Battas O, Agoub M, Bennani Othmani M. Prevalence of stress in Casablanca medical students: a cross-sectional study. Pan Afr Med J. 2014;19:149.
30. Kausar U, Haider SI, Mughal IA, Noor MSA, Stress levels; stress levels of final year mbbs students and its effect on their academic performance. Prof Med J. 2018;25(6):932–6.
31. Hautz WE, Schröder T, Dannenberg KA, März M, Hölzer H, Ahlers O, et al. Shame in Medical Education: a randomized study of the Acquisition of intimate Examination skills and its effect on subsequent performance. Teach Learn Med. 2017;29(2):196–206.
32. Hayat AA, Salehi A, Kojuri J. Medical student's academic performance: the role of academic emotions and motivation. J Adv Med Educ Professionalism. 2018;6(4):168–75.
33. Deeks JJ, Riley RD, Higgins JP. Combining Results Using Meta-Analysis. Systematic Reviews in Health Research: Meta-Analysis in Context. 2022:159–84.
34. Aboalshamat K, Hou X-Y, Strodl E. The impact of a self-development coaching programme on medical and dental students' psychological health and academic performance: a randomised controlled trial. BMC Med Educ. 2015;15:134.
35. Jamil H, Alakkari M, Al-Mahini MS, Alsayid M, Al Jandali O. The impact of anxiety and depression on academic performance: a cross-sectional study among medical students in Syria. Avicenna J Med. 2022;12(03):111–9.
36. Mirawdali S, Morrissey H, Ball P. Academic anxiety and its effects on academic performance. 2018.
37. Al-Qaisy LM. The relation of depression and anxiety in academic achievement among group of university students. Int J Psychol Couns. 2011;3(5):96–100.
38. Cheng DR, Poon F, Nguyen TT, Woodman RJ, Parker JD. Stigma and perception of psychological distress and depression in Australian-trained medical students: results from an inter-state medical school survey. Psychiatry Res. 2013;209(3):684–90.
39. Lee M, Larson R. The Korean 'examination hell': long hours of studying, distress, and depression. J Youth Adolesc. 2000;29(2):249–71.
40. Ali SK. 861 – Social phobia among medical students. Eur Psychiatry. 2013;28:1.
41. Bonna AS, Sarwar M, Md Nasrullah A, Bin Razzak S, Chowdhury KS, Rahman SR. Exam anxiety among medical students in Dhaka City and its Associated Factors-A cross-sectional study. Asian J Med Health. 2022;20(11):20–30.
42. Kim K-J. Factors associated with medical student test anxiety in objective structured clinical examinations: a preliminary study. Int J Med Educ. 2016;7:424–7.
43. Von der Embse N, Jester D, Roy D, Post J. Test anxiety effects, predictors, and correlates: a 30-year meta-analytic review. J Affect Disord. 2018;227:483–93.

44. Song J, Chang L, Zhou R. Test anxiety impairs filtering ability in visual working memory: evidence from event-related potentials. J Affect Disord. 2021;292:700–7.

45. Theobald M, Breitwieser J, Brod G. Test anxiety does not predict exam performance when knowledge is controlled for: strong evidence against the interference hypothesis of test anxiety. Psychol Sci. 2022;33(12):2073–83.

46. Lowe PA. Examination of test anxiety in samples of Australian and US Higher Education Students. High Educ Stud. 2019;9(4):33–43.

47. Kavanagh BE, Ziino SA, Mesagno C. A comparative investigation of test anxiety, coping strategies and perfectionism between Australian and United States students. North Am J Psychol. 2016;18(3).

48. Mihăilescu AI, Diaconescu LV, Ciobanu AM, Donisan T, Mihailescu C. The impact of anxiety and depression on academic performance in undergraduate medical students. Eur Psychiatry. 2016;33:S341–2.

49. Terrizzi JA Jr, Shook NJ. On the origin of shame: does shame emerge from an evolved disease-avoidance architecture? Front Behav Neurosci. 2020;14:19.

50. Epstein RM. Mindful practice. JAMA. 1999;282(9):833–9.

51. Hauer KE, Teherani A, Dechet A, Aagaard EM. Medical students' perceptions of mentoring: a focus-group analysis. Med Teach. 2005;27(8):732–4.

52. Kalet A, Pugnaire MP, Cole-Kelly K, Janicik R, Ferrara E, Schwartz MD, et al. Teaching communication in clinical clerkships: models from the macy initiative in health communications. Acad Med. 2004;79(6):511–20.

53. Gregor A. Examination anxiety: live with it, control it or make it work for you? School Psychol Int. 2005;26(5):617–35.

Publisher's Note