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Interventions to promote medical student well-being: an overview of systematic reviews

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ABSTRACT

Objective To conduct an overview of systematic reviews that explore the effectiveness of interventions to enhance medical student well-being.

Design Overview of systematic reviews.

Data sources The Cochrane Library of Systematic Reviews, MEDLINE, APA PsychInfo, CINAHL and Scopus were searched from database inception until 31 May 2023 to identify systematic reviews of interventions to enhance medical student well-being. Ancestry searching and citation chasing were also conducted.

Data extraction and synthesis The Assessing the Methodological Quality of Systematic Reviews V.2 tool was used to appraise the quality of the included reviews. A narrative synthesis was conducted, and the evidence of effectiveness for each intervention was rated.

Results 13 reviews (with 94 independent studies and 17 616 students) were included. The reviews covered individual-level and curriculum-level interventions. Individual interventions included mindfulness (n=12), hypnosis (n=6), mental health programmes (n=7), yoga (n=4), cognitive and behavioural interventions (n=1), mind-sound technology (n=1), music-based interventions (n=1), omega-3 supplementation (n=1), electroacupuncture (n=1) and osteopathic manipulative treatment (n=1). The curriculum-level interventions included pass/fail grading (n=4), problem-based curriculum (n=2) and multicomponent curriculum reform (n=2). Most interventions were not supported by sufficient evidence to establish effectiveness. Eleven reviews were rated as having 'critically low' quality, and two reviews were rated as having 'low' quality.

Conclusions Individual-level interventions (mindfulness and mental health programmes) and curriculum-level interventions (pass/fail grading) can improve medical student well-being. These conclusions should be tempered by the low quality of the evidence. Further high-quality research is required to explore additional effective interventions to enhance medical student well-being and the most efficient ways to implement and combine these for maximum benefit.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Two reviewers independently rated the evidence of effectiveness for each intervention and outcome to guide the selection of appropriate interventions and highlight important gaps in the evidence base.
⇒ Primary study overlaps between the included reviews precluded panoramic meta-analysis.
⇒ A comprehensive narrative synthesis summarises the effectiveness of interventions for medical student well-being from 94 independent, non-overlapping primary studies and at least 17 616 medical students.
⇒ The quality of evidence in this space is low, limiting the strength of the conclusions.

INTRODUCTION

Medical schools around the world are expected to support the well-being of their students.[1] Despite this, medical students end up experiencing more mental health problems, such as depression, anxiety and burnout, than their peers.[2 3] Although they begin medical school with better well-being than their peers, medical students' well-being declines throughout their training.[4] This has been attributed to the demanding study load, lengthy contact hours and competitive culture within undergraduate medical education.[2 5–9]

Poor well-being (including burnout and stress) is serious; it is associated with suicidal ideation, poor academic performance and low empathy in medical students.[10–12] Moreover, medical students who have low well-being are likely to have poor well-being as qualified physicians.[13 14] Physician mental ill-health has wide-ranging workforce consequences and is associated with reduced quality of care and increased medical errors.[15–17]

There is no consensus regarding the correct definition of 'well-being'. Well-being has variously been defined as 'a positive state experienced by individuals and societies',[18] as comprising 'an individual's experience of their life and a comparison of life circumstances with social norms and values'[19] and as 'the presence of positive emotions and moods (eg, contentment and happiness),

the absence of negative emotions (eg, depression and anxiety), satisfaction with life, fulfilment and positive functioning'.[20] Despite the differing definitions, there is agreement that, like health, well-being includes psychological, physical and social components.[1 18 20] Following previous research, we take medical student well-being to be any aspect of physical, social or mental and emotional health.[9]

Several reviews have explored the effectiveness of interventions to enhance medical student well-being, suggesting that mindfulness interventions and pass/fail grading may be effective.[5 21 22] However, they have focused on a single intervention,[22–25] a single facet of well-being (such as burnout),[21–28] or on evidence from a single country (often the USA).[21 26] While helpful, medical schools need to have an overview of all of the potential interventions to enhance their students' well-being. There is no up-to-date synthesis of the evidence in this field across all interventions, outcomes and countries. An overview of systematic reviews is therefore warranted to bring this vast and disparate evidence base together and help solve the problem of low medical student well-being.

Objective

To conduct an overview of systematic reviews exploring the effectiveness of interventions to enhance medical student well-being.

METHODS

We undertook an overview of systematic reviews following the Cochrane Handbook for Systematic Reviews of Interventions.[29] The reporting of this overview is guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses.[30] Where necessary, we have made adaptations for an overview of reviews following the Cochrane Handbook.[29] The overview protocol was prospectively registered (PROSPERO: CRD42023429007).

Eligibility criteria

We included systematic reviews[31–33] of interventions to enhance undergraduate medical student well-being. We only included reviews in which the participants were medical students. We included reviews that included other participant groups or outcomes, provided that the results for medical students or well-being were reported separately. As there is no core outcome set[34] for well-being, we followed previous reviews, taking well-being to be synonymous with wellness, physical well-being/health, social well-being/health, mental well-being/health, emotional well-being/health and to be closely related to depression, anxiety, quality of life, stress, burnout, resilience and suicidal ideation.[5 9 21 22] Also following the previous reviews in this area,[5 21] we distinguished between stress (an acute response caused by an external trigger) and anxiety (persistent worries that do not cease even in the absence of a stressor).[35] The eligibility criteria is summarised in table 1.

Search strategy

On 1 June 2023, we searched the Cochrane Library of Systematic Reviews, MEDLINE, APA PsychInfo, CINAHL and Scopus from database inception dates until 31 May 2023. A comprehensive grey literature search was conducted in OpenGrey, along with ancestry searching,[36] and citation chasing for included reviews. A comprehensive search strategy was created by an information specialist (KN). The search strategy for each database can be found in online supplemental appendix 1.

Selection process

Search results were deduplicated, exported into Endnote for manual checks and transferred to Covidence.[37] Screening by title and abstract and screening of the full texts were completed in duplicate by two reviewers (from ABW, LK, MJ, CS and CL). Disagreements were resolved

Table 1 Eligibility criteria

Criteria	Inclusion	Exclusion
Study design	Systematic reviews of randomised controlled trials and non-randomised studies of interventions, including non-randomised trials, observational studies, case-control or other controlled or uncontrolled quasi-experimental studies and cohort studies that reported quantitative outcomes.	Primary research. Non-systematic reviews, for example, non-systematic narrative reviews and literature reviews. Editorials.
Participants	Undergraduate or graduate-entry medical students enrolled on an undergraduate medical education programme.	Postgraduate medical students, non-medical students and qualified healthcare professionals.
Intervention	Any intervention aimed at enhancing medical student well-being.	Any intervention not aimed at enhancing undergraduate medical student well-being.
Comparators	No intervention (education as usual), waitlist control or no control group (pre-test/post-test).	
Outcome(s)	Medical student well-being, including physical, psychological and/or social components.	Reviews that do not include medical student well-being as an outcome.
Setting and language	Any	

in discussion and with a third reviewer (JH) where necessary.

Data collection process

A prepiloted, standardised Microsoft Excel data extraction sheet was used to extract key characteristics of reviews and their primary studies (see online supplemental appendix 2). Data extraction was performed in duplicate by two reviewers (from ABW, LK, MJ, CS and CL). Discrepancies were resolved through discussion.

Review quality appraisal

Quality assessment was performed by two independent reviewers (from ABW, LK, MJ, CS and CL) using the Assessing the Methodological Quality of Systematic Reviews V.2 (AMSTAR-2) tool.[38] Disagreements were resolved in discussion and with a third reviewer (JH) where necessary. The AMSTAR-2 has 16 items, seven of which are categorised as 'critical domains'.[38] The critical domains include whether the protocol was registered before the commencement of the review, the adequacy of the literature search, justification for excluding individual studies, the risk of bias, the appropriateness of meta-analytical methods, consideration of the risk of bias when interpreting the results of the review and an assessment of the presence and likely impact of publication bias. Each item is phrased as a question, where an answer of 'yes' indicates that the item was achieved, a 'no' indicates that the item was not present (this is considered a non-critical or critical weakness depending on the item) and a 'partial yes' indicates that the item was partially achieved.[38] Following AMSTAR-2 guidance, reviews were categorised as having high (no or one non-critical weakness), moderate (more than one non-critical weakness), low (one critical weakness with or without non-critical weaknesses) or critically low (more than one critical weakness with or without non-critical weaknesses) quality.[38] We did not reassess the quality of the individual primary studies included in each review.

Data synthesis

Pooling via panoramic meta-analysis was deemed inappropriate due to considerable primary study overlap across reviews,[29] so we conducted a narrative synthesis.[39] This was organised first by intervention and then by outcome. As we intended to describe the current body of systematic review evidence, we followed Cochrane guidance and synthesised all systematic reviews regardless of primary study overlap.[29]

In a second synthesis step, we used an established methodology to rate the evidence of effectiveness across reviews.[40] First, this involved two reviewers (ABW and MJ) independently assigning standardised 'effectiveness statements' to indicate the sufficiency of the evidence of effectiveness for each intervention and outcome (see online supplemental table 1, adapted from Ryan *et al*[40]). Effectiveness statements were 'sufficient evidence' (strong evidence to make a decision about the effect of the intervention for a specific outcome), 'some evidence' (less conclusive evidence to make a decision about the effect of an intervention), 'generally ineffective' (considerable evidence of no effect) and 'insufficient evidence' (not enough evidence to determine intervention effectiveness). Second, we used vote counting to rate the evidence of effectiveness (summing and comparing the number of primary studies showing a statistically significant benefit of an intervention, those showing no effect and those showing harm). When assigning a rating, we also considered the number of participants included in the studies for each intervention and outcome.[40] To address primary study overlap, we based ratings of the evidence of effectiveness for each intervention and outcome on independent primary studies and their participants. Discrepancies were resolved through discussion with a third reviewer (JH) where necessary.

Patient and public involvement

Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

RESULTS

Our searches generated 2278 records after duplicates were removed. 2181 records were excluded at the title and abstract screening stages and full texts of 91 records were sought for full-text screening. 78 records were excluded at the full-text screening stage. Articles were excluded due to ineligible participants (n=25), ineligible study design (n=21), ineligible or no reported intervention (n=18) and ineligible outcomes (n=14). A full list of excluded studies with reasons is provided in online supplemental table 2. A final sample of 13 reviews was included in this overview.[5 9 21 24 26–28 41–46] The review identification and selection processes are represented in figure 1.

Description of the included reviews

The characteristics of the included systematic reviews are described in table 2. All reviews were published between 2008 and 2023 and were from the USA,[9 21 28 43] Brazil,[24] Canada,[26 45] Australia,[5] Indonesia,[42] the UK,[27] Italy,[41] France[46] and Malaysia.[44] The reviews comprised 202 primary studies of interventions to enhance medical student well-being and included at least 37 685 medical students (three reviews included primary studies in which sample sizes were not reported). Of these studies, there were 94 non-overlapping, independent primary studies, which included at least 17 616 medical students. The descriptions of participants' demographic information were limited. Two reviews included only randomised controlled trials (RCTs)[24 45]; 11 reviews included a mix of RCTs and non-randomised studies.[5 9 21 26–28 41–44 46]

The reviews covered both individual-level and curriculum-level interventions. Individual interventions included mindfulness (n=12), hypnosis

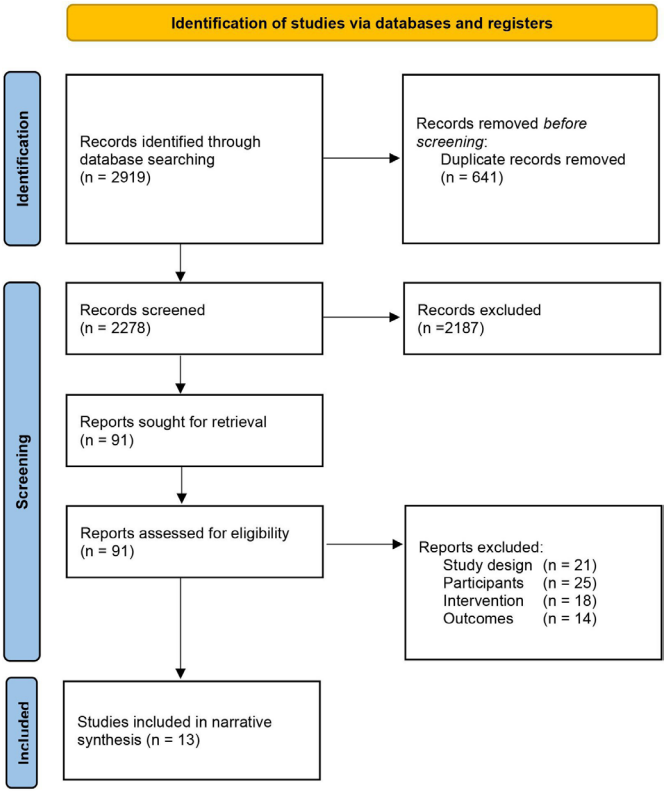

Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

(n=6), mental health programmes (education on stress management, self-care and accessing mental health services)[21] (n=7), yoga (n=4), cognitive and behavioural interventions (n=1), mind-sound technology (n=1), music-based interventions (n=1), omega-3 supplementation (n=1), electroacupuncture (n=1) and osteopathic manipulative treatment (n=1). The curriculum-level interventions included pass/fail grading (n=4), problem-based curricular structure (n=2) and multicomponent curriculum reform (reforming multiple components of the curriculum simultaneously) (n=2). A description of each intervention is provided in the narrative synthesis below.

Twelve reviews[5 9 21 24 26–28 41–45] included primary studies that measured well-being outcomes using a mix of validated and non-validated scales. For example, stress was often measured using the Perceived Stress Scale[47] (a validated scale), but it was also measured using non-validated scales developed by the authors of primary studies included in the reviews (eg, a scale to ascertain students' self-reported awareness of stress).[48] Only one review[46] included studies that exclusively used validated outcome measures.

Quality of included reviews

Eleven reviews[5 9 24 26–28 41 43–46] were rated as having 'critically low' quality according to AMSTAR-2, and two reviews[21 42] were rated as having 'low' quality. Most reviews (n=12)[5 9 21 24 26–28 41–45] did not provide a list of excluded studies with reasons for exclusion, and several (n=5)[9 28 44–46] did not report duplicate screening and/or data extraction. The quality assessments for each included review are summarised in online supplemental table 3. Reviews[5 21 24 27 28 41 43] that reported quality appraisal of their included primary studies described quality as moderate to low or risk of bias as moderate to high.

Effects of interventions

The narrative synthesis below is organised as follows: first, we present the results for individual-level interventions (mindfulness, hypnosis, mental health programmes, yoga, cognitive and behavioural interventions, mind-sound technology, omega-3 supplementation, music-based interventions, electroacupuncture and osteopathic manipulative treatment). Next, we present the results for curriculum-level interventions (pass/fail grading, problem-based curriculum and multicomponent curriculum reform). Within each intervention type, we present the results by outcome.

Individual-level interventions

Mindfulness

Twelve reviews[5 21 24 26–28 41–46] considered the effects of mindfulness interventions on well-being, stress, anxiety, depression, burnout and resilience. Mindfulness interventions were primarily based on Jon Zabat-Kinn's[49] work, seeking to bring attention to current experience through (often guided) meditation. The intervention duration varied between 4 and 22 weeks. The effects of mindfulness were mixed. None of the included reviews reported the effects of intervention duration on any of the reported outcomes.

One review[24] found no statistically significant effect of mindfulness on well-being postintervention in a meta-analysis of four studies, three of which were RCTs (standardised mean difference (SMD)=−0.27; 95% CI −0.67 to 0.13; p=0.18; I^2=76%).

Ten reviews[21 24 26–28 41 43–46] included studies of mindfulness for reducing stress. Six reviews[24 26 28 41 43 45] found a benefit of mindfulness for reducing stress. Two of these included a meta-analysis: one review[24] found a small and statistically significant effect of mindfulness on stress postintervention in their meta-analysis of five studies, four of which were RCTs (SMD=−0.29; 95% CI −0.56 to −0.02; p=0.04; I^2=57%). Another review[45] found a statistically significant reduction in stress postintervention, based on four RCTs (SMD=−0.55; 95% CI −0.74 to −0.36; p≤0.0001; I^2=0%). Four reviews that did not include a meta-analysis[26 28 41 43] concluded that mindfulness reduced stress. Three reviews[27 44 46] concluded that the effects of mindfulness on stress were mixed. One review[21] identified two studies demonstrating no statistically significant effect of mindfulness on stress.

Eight reviews[5 21 24 27 28 41 42 44] included studies of mindfulness for reducing anxiety. Four of these reviews[21 27 28 41] found a benefit of mindfulness for reducing anxiety. Two reviews[42 44] included studies with mixed findings (some showing a benefit of mindfulness for anxiety and some

Table 2 Characteristics of included studies

Author	Year	Geographical location of first author	Review aim/question	Number of included studies	Design(s) of included studies	Total number of participants	Intervention(s)	Outcome(s)
Buizza *et al*[41]	2022	Italy	To identify all studies for stress-management carried out in medical students, in order to analyse their impact on psychological distress and on academic performance, and to assess how these interventions are incorporated into the medical education curriculum.	17	RCT, non-randomised studies	1313	Mindfulness, mental health programmes, hypnosis and mind-sound technology	Stress
Da Silva *et al*[24]	2023	Brazil	To seek evidence regarding the effectiveness of mindfulness-based training programmes in reducing psychological distress and promoting the well-being of medical students.	8	RCT	694	Mindfulness	Psychological distress and well-being
Daya and Hearn[27]	2018	UK	Are mindfulness-based interventions effective for preventing and/or reducing depression, stress, burnout and fatigue in medical students?	12	RCT, non-randomised studies	1197	Mindfulness	Depression, stress, burnout and fatigue
Frajerman[46]	2020	France	To encompass all types of interventions to improve student well-being using scales already validated in the scientific literature up to 2018.	36	RCT, non-randomised studies	6979	Mindfulness, hypnosis, mental health programmes, yoga, music-based, electroacupuncture, osteopathic manipulative treatment, pass/fail grading and problem-based curriculum	Well-being and psychological distress
Kusumadewi *et al*[42]	2021	Indonesia	To identify studies for psychotherapy interventions in medical students to analyse each impact on anxiety level in medical students.	23	RCT, non-randomised studies	2539	Mindfulness, mental health programmes, cognitive and behavioural interventions and hypnosis	Anxiety
McCray *et al*[43]	2008	USA	To review studies on interventions related to burnout other than those that studies work hours limitations.	9 (3 on medical students)	RCT, non-randomised studies	349 (medical students)	Mindfulness and mental health programmes	Burnout
Regehr *et al*[45]	2014	Canada	This analysis included studies evaluating intervention programmes aimed at reducing stress in physicians and medical trainees.	12 (4 on medical students)	RCT, non-randomised studies	462 (medical students)	Mindfulness	Stress

Continued

Table 2 Continued

Author	Year	Geographical location of first author	Review aim/question	Number of included studies	Design(s) of included studies	Total number of participants	Intervention(s)	Outcome(s)
Shiralkar *et al*[28]	2013	USA	To describe how stress-management programmes were incorporated into the medical education curriculum for medical students and their impact on psychological distress.	13	RCT, non-randomised studies	3011	Hypnosis, mindfulness and pass/fail grading	Stress, depression, anxiety and burnout
Spring *et al*[9]	2011	USA	To review all available literature with regard to pass/fail grading in medical education.	13 (4 on well-being)	Non-randomised studies	3958	Pass/fail grading	Well-being
Wasson *et al*[21]	2016	USA	What undergraduate medical education learning environment interventions are associated with improved emotional well-being among medical students?	28	RCT, non-randomised studies	8224	Mindfulness, mental health programmes, hypnosis and multicomponent curriculum reform	Emotional well-being
Witt *et al*[5]	2019	Australia	To conduct a systematic review and meta-analysis of universal interventions aimed at addressing mental ill health, suicidal ideation and behaviour in medical students.	39	RCT, non-randomised studies	7387	Mindfulness, mental health programmes, yoga, omega-3 supplementation and problem-based curricular structure	Suicidal ideation, depression, anxiety, stress and burnout
Yogeswaran and El Morr[26]	2021	Canada	To investigate whether online mindfulness interventions can be used to promote mental health for medical students.	2	Non-randomised studies	99	Mindfulness (online)	Mental health
Yusoff[44]	2014	Malaysia	To what extent are stress management interventions for training medical students associated with improved psychological outcomes in comparison to no intervention?	13	RCT, non-randomised studies	1428	Mindfulness, self-hypnosis and mental health programmes	General psychological distress, stress, anxiety and depression

RCT, randomised controlled trial.

showing no statistically significant effect). Moreover, two reviews[5 24] concluded that there is no effect of mindfulness on anxiety. One of these reviews[5] included a meta-analysis of five RCTs, which demonstrated no significant effect of mindfulness on postintervention anxiety scores (SMD=−0.62, 95% CI −1.63 to 0.38; p=0.22; I^2: 97%).

Of the six reviews[5 24 27 28 44 46] that explored the effects of mindfulness on depression, two identified studies demonstrating a benefit.[28 46] On the other hand, two reviews[27 44] included studies with ambiguous results (some showing a benefit and some showing no effect). Finally, two reviews[5 24] concluded that mindfulness has no effect on depression. One of these reviews[5] included a meta-analysis of six RCTs, which found no statistically significant effect of mindfulness on depression (SMD=−0.52, 95% CI −1.18 to 0.13; p=0.12; I^2: 93%).

Limited evidence has documented the effects of mindfulness on burnout. Three reviews considered mindfulness and burnout.[26 27 46] One review[26] included studies with mixed findings on the effects of mindfulness on burnout (one demonstrating a benefit and two showing no effect). Two others concluded that there was no significant effect of mindfulness on burnout.

One review identified one study showing no effect of mindfulness on resilience.[24]

Hypnosis

Six reviews[21 28 41 42 44 46] reported on the effects of hypnosis on anxiety. Hypnosis interventions typically included clinical hypnosis delivered by an accredited hypnotherapist and self-hypnosis following training by a psychiatrist. Intervention duration varied between a single 1-hour session and 8–10 weeks of once-a-week hourly sessions. All six reviews[21 28 41 42 44] explored the effects of hypnosis on anxiety, identifying studies with equivocal results (some showing a benefit and some showing no effect). None of the included reviews reported the effects of intervention duration on anxiety.

Mental health programmes

Seven reviews[5 21 41–44 46] considered the effectiveness of mental health programmes for stress, anxiety, depression and suicidal ideation. Mental health programmes involve education around stress management, self-care and accessing mental health services.[21] The intervention duration ranged from 2 days to 8 weeks. None of the included reviews reported the effects of intervention duration on any of the reported outcomes.

Four reviews[5 43 44 46] included studies of mental health programmes for reducing stress. One review[44] reported mixed findings on the effect of mental health programmes on stress (some showing a benefit and some showing no effect). The remaining three reviews[5 43 46] concluded that there was no effect of mental health programmes on stress.

Of the four reviews[5 41 42 44] that explored the effects of mental health programmes on anxiety, two[41 42] concluded that there was a benefit. Conversely, another[44] included studies with ambiguous results (some primary studies showing a benefit, some showing no effect and one showing a harmful effect). Yet another review[5] conducted a meta-analysis of three non-randomised studies, finding no statistically significant reduction in anxiety following mental health programmes (SMD=−0.17, 95% CI −0.37 to 0.04; p=0.11; I^2: 0%).

Four reviews included studies of mental health programmes for depression.[5 21 43 46] Two of these found the benefit of mental health programmes for reducing depression.[5 21] Another[46] found studies with mixed findings (some showing a benefit and some showing no effect). The fourth review[43] identified two studies in which there was no statistically significant effect of mental health programmes on depression.

Limited evidence has reported the effects of mental health programmes on suicidal ideation. Three reviews[5 21 46] included the same primary study demonstrating a significant reduction in suicidal ideation following a mental health programme aimed at reducing mental health stigma and providing education about mental health services.[50]

Yoga

Four reviews[5 41 42 46] explored the effects of yoga on well-being, stress, anxiety and depression. Interventions were based on Hatha yoga,[51] consisting of *asanas* (postures and stretches), *pranayama* (breathing exercises) and meditation. Interventions lasted between 6 and 16 weeks. One review found a benefit of yoga for medical students' mental well-being and for reducing their anxiety.[42] Two reviews[41 46] identified studies in which there was no statistically significant effect on stress. Finally, two reviews[5 46] included the same primary study in which there was no statistically significant effect of yoga on depression.[52]

Cognitive and behavioural interventions

One review[42] included studies of the effects of cognitive and behavioural interventions. These interventions included elements of positive psychology (interventions that seek to cultivate positive feelings, thoughts and behaviours)[53] and cognitive behavioural therapy (a talking therapy in which negative patterns of thought and behaviour are identified and challenged).[54] The intervention duration varied from a single session to a series of sessions lasting between 10 and 16 weeks. One review[42] identified studies with mixed findings regarding the effect of cognitive and behavioural interventions on both anxiety and depression.

Mind-sound technology

One review[41] included a single study[55] demonstrating the benefit of mind-sound technology for reducing anxiety and depression. In this 6-week intervention, participants introduce sounds into various parts of the body with their own voice, stimulating different parts of the brain.

Table 3 Evidence of effectiveness for interventions by outcome

Intervention	Outcome	Review(s)	No. of studies across review(s)*	No. of studies showing benefit*	No. of studies showing no effect*	No. of studies showing harm*	No. of students	Evidence of effectiveness
Individual-level interventions								
Mindfulness	Well-being	1	4	1	3	0	453	Insufficient evidence
	Stress	10	18	13	4	1	1789	Some evidence of benefit
	Anxiety	8	8	5	3	0	1294	Some evidence of benefit
	Depression	6	12	8	4	0	1625	Some evidence of benefit
	Burnout	3	4	1	3	0	404	Insufficient evidence
	Resilience	1	1	0	1	0	57	Insufficient evidence
Hypnosis	Anxiety	6	2	1	1	0	71	Insufficient evidence
Mental health programmes	Stress	4	6	2	4	0	849	Generally ineffective
	Anxiety	4	11	7	3	1	1947	Some evidence of benefit
	Depression	4	6	4	2	0	2687	Some evidence of benefit
	Suicidal ideation	3	1	1	0	0	188	Insufficient evidence
Yoga	Well-being	1	1	1	0	0	90	Insufficient evidence
	Stress	2	2	2	0	0	50	Insufficient evidence
	Anxiety	1	2	2	0	0	82	Insufficient evidence
	Depression	2	1	0	1	0	16	Insufficient evidence
Cognitive and behavioural	Anxiety	1	2	1	1	0	101	Insufficient evidence
	Depression	1	3	2	1	0	163	Insufficient evidence
Mind-sound technology	Anxiety	1	1	1	0	0	42	Insufficient evidence
	Depression	1	1	1	0	0	42	Insufficient evidence
Omega-3 supplementation	Anxiety	1	1	1	0	0	68	Insufficient evidence
	Depression	1	1	0	1	0	68	Insufficient evidence
Music-based interventions	Stress	1	1	1	0	0	90	Insufficient evidence
	Anxiety	1	1	1	0	0	90	Insufficient evidence
	Burnout	1	1	0	1	0	90	Insufficient evidence
Electroacupuncture	Anxiety	1	1	1	0	0	25	Insufficient evidence
	Depression	1	1	1	0	0	25	Insufficient evidence
	Burnout	1	1	1	0	0	25	Insufficient evidence
Osteopathic manipulative treatment	Stress	1	1	0	1	0	30	Insufficient evidence

Continued

Table 3 Continued

Intervention	Outcome	Review(s)	No. of studies across review(s)*	No. of studies showing benefit*	No. of studies showing no effect*	No. of studies showing harm*	No. of students	Evidence of effectiveness
Curriculum-level interventions								
Pass/fail grading	Stress	4	3	3	0	0	1554	Some evidence of benefit
	Anxiety	4	2	2	0	0	362	Insufficient evidence
	Depression	4	2	2	0	0	362	Insufficient evidence
	Burnout	2	1	1	0	0	1192	Insufficient evidence
Problem-based curriculum	Anxiety	2	1	0	1	0	637	Insufficient evidence
	Depression	2	2	0	2	0	982	Insufficient evidence
Multicomponent curriculum reform	Well-being	1	1	1	0	0	478	Insufficient evidence
	Stress	2	1	1	0	0	875	Insufficient evidence
	Anxiety	2	1	1	0	0	875	Insufficient evidence
	Depression	2	1	1	0	0	875	Insufficient evidence

*Figures reflect independent, non-overlapping primary studies and their participants.

Music-based interventions

One review[46] identified one study[56] that showed a statistically significant reduction in stress and anxiety following a music-based intervention. There was no statistically significant effect of the intervention on burnout. The intervention comprised a single session lasting 20 min in which participants listened to light instrumental music.[56]

Omega-3 supplementation

One review[5] included a single study[57] in which omega-3 fatty acid supplementation had a modest treatment effect on anxiety, but not depression. The frequency and duration of supplementation were not reported.

Electroacupuncture

One review[46] included one study showing the benefit of electroacupuncture (needles are placed in the body and a small amount of electricity is passed through them via an electrode) for reducing medical student stress.[58] The intervention consisted of a 20-min session, once a week, for 6–8 weeks.

Osteopathic manipulative treatment

One review[46] included a study exploring the effectiveness of osteopathic manipulative treatment, whereby light pressure is applied to muscles and soft tissues in which stress is known to manifest.[59] The intervention comprised one 20-min session per week, for 4 weeks. The result showed no statistically significant effect on stress.

Curriculum-level interventions

Pass/fail grading system

Four reviews[9 21 28 46] explored the effects of changing traditional medical school tiered grading systems to pass/fail grading systems on stress, anxiety, depression and burnout. Pass/fail grading was implemented in the first year of medical school, or both the first and second years. All four reviews[9 21 28 46] found the benefit of implementing a pass/fail grading system for reducing stress, anxiety and depression. Two reviews[21 28] identified the same primary study which showed a statistically significant effect of pass/fail grading systems for reducing medical student burnout.

Problem-based curriculum

Two reviews[5 46] included studies exploring the effects of changing the curriculum from a didactic, lecture-based structure to a problem-based structure on anxiety and depression. A problem-based learning curriculum emphasises self-directed learning within small-group, problem-solving sessions.[60] Both reviews[5 46] concluded that there was no statistically significant effect of implementing a problem-based curriculum on anxiety or depression.

Multicomponent curriculum reform

Two reviews[21 46] included studies of the effects of reforming multiple components of the curriculum simultaneously. This involved concurrently implementing a number of interventions, including pass/fail grading,

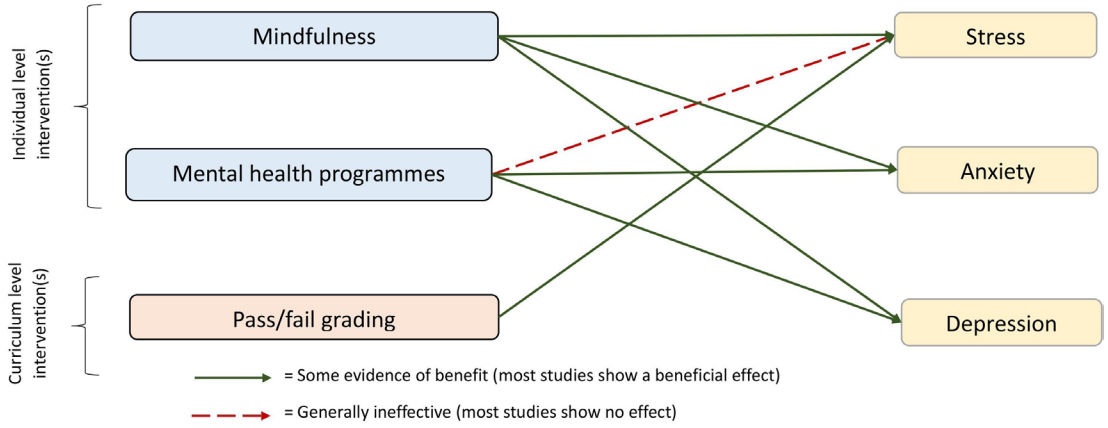

Figure 2 Interventions showing some evidence of benefit and general ineffectiveness.

reduced preclinical contact hours and mindfulness.[21] One review[21] found that multicomponent curriculum reform improved mental and social well-being. Both reviews included studies showing benefits for reducing stress, anxiety and depression.

Evidence of effectiveness

Following narrative synthesis, we rated the evidence of the effectiveness of each intervention by the outcome, adopting established methodologies from previous Cochrane overviews[40] (see online supplemental file 1). The rating of evidence of effectiveness for each intervention and outcome is summarised in table 3.

There was 'some evidence' of the benefit of mindfulness for reducing stress, anxiety and depression, of pass/fail grading for reducing stress and of mental health programmes for reducing anxiety and depression. However, mental health programmes appeared to be 'generally ineffective' for reducing stress. For most interventions, there was 'insufficient evidence' to determine effectiveness. In particular, there were a number of novel interventions for which there was evidence from only one primary study: mind-sound technology, omega-3 supplementation, electroacupuncture and osteopathic manipulative treatment. The interventions that show some evidence of a benefit and those that are generally ineffective for medical student well-being are summarised in figure 2.

DISCUSSION

Summary of findings

This overview of 13 systematic reviews found that mindfulness, mental health programmes and pass/fail grading systems can improve medical student well-being. Evidence was inconclusive for the effectiveness of hypnosis, yoga, cognitive and behavioural interventions, omega-3 supplementation, mind-sound technology, music-based interventions, electroacupuncture, osteopathic manipulative treatment, implementing a problem-based curriculum and multicomponent curriculum reform.

Relationship to other evidence

There is overwhelming evidence for mindfulness for medical student well-being.[5 21 24 26–28 41–46] By taking a broad approach, this overview of reviews has identified a vaster range of interventions than previous reviews.[5 21] These include hypnosis, yoga and cognitive and behavioural interventions, for which limited evidence is beginning to show promising effects on medical student well-being.[5 21 28 41 42 44 46]

In line with previous research, this overview indicates that the evidence for the effects of interventions to enhance medical student well-being is inconsistent.[5 24 27 41 61] Previous reviews have found that mindfulness is effective for reducing medical student stress[5 21 24] but not anxiety or depression.[5 24 27] Our findings confirm that mindfulness is beneficial for reducing stress and add that there is some evidence of the benefit of mindfulness for reducing anxiety and depression. The mixed findings regarding mindfulness may be attributable to the great variation in the way mindfulness is taught and the context in which it is delivered (and consequently received).[62]

Mental health programmes have previously been recommended to improve medical student well-being.[21] Our findings indicate that while mental health programmes can reduce medical student anxiety and depression, they are generally ineffective for reducing stress. This finding is surprising given that many of the programmes focused on educating students about stress-management techniques.[44] It could be explained by the focus of mental health programmes on the individual experience of stress, which precludes consideration of the environmental factors that contribute to medical student stress in the first place.[2 5–9]

Previous research on curriculum-level interventions found that pass/fail grading is effective for improving medical student well-being.[9 21] We confirmed that pass/fail grading can reduce stress but found that there was insufficient evidence of the benefits of pass/fail grading for reducing anxiety. However, the limited evidence that does exist for the effects of pass/fail grading on anxiety is tentatively positive.[63 64] These promising findings may

be explained by the decrease in within-cohort competition and increase in cohort cohesion that accompany the implementation of a pass/fail grading system.[65] Our research also broadly corroborates previous findings that physician well-being is best enhanced by combining individual-level and organisational-level interventions.[66 67] One review[21] included limited yet promising evidence regarding the effects of multicomponent curricular reform on medical student well-being.

Strengths and limitations

This is the first overview of reviews of interventions to enhance medical student well-being. The findings synthesise a vast amount of evidence from 13 systematic reviews, 94 independent primary studies and at least 17 616 medical students. In contrast, the largest included review[5] included only 39 primary studies and 7387 medical students. By rating the evidence of effectiveness for each intervention and outcome, our findings provide a map to guide the selection of appropriate interventions and highlight important gaps in the evidence base.

This overview also has a number of limitations. There was considerable primary study overlap, which precluded a panoramic meta-analysis. We addressed the potential bias introduced by such overlap[29] by basing our rating of the evidence of effectiveness only on non-overlapping, independent primary studies. Furthermore, the quality of the primary studies within our included reviews was described as low,[5 21 24 27 28 41 43] and all reviews were rated as 'low' or 'critically low' using the AMSTAR-2 tool.[38] Our analysis is also limited by the details of the reporting of interventions and their contexts. The heterogeneity of effects of mindfulness, for example, could be explained with additional data about the qualifications of the mindfulness teachers, the length of sessions, students' baseline well-being scores, etc. An intervention would appear less effective overall if delivered to students with moderate well-being as well as to those with poor well-being.

Finally, all reviews focused almost exclusively on psychological well-being. We know, however, that well-being has psychological, physical and social components.[1 18 20 68] In addition, all reviews focused heavily on the absence of well-being (measuring outcomes like stress, anxiety and depression). Yet, definitions of well-being emphasise both the absence of negative emotions and the presence of positive ones.[18 20] Linked to this, as there is no core outcome set[34] for well-being, it is possible that we might have missed additional relevant reviews exploring different outcomes that could be classed as well-being.

Implications for further research

This overview of reviews has highlighted a number of avenues for further research:

- Determining a core outcome set[34] for medical student well-being.
- Conducting a large-scale review and meta-analysis of primary studies using the interventions and outcomes identified in this overview. This meta-analysis should include an analysis of the effective components and contexts for maximising the benefits of interventions (eg, using component network meta-analysis).[29]
- Conducting a review of qualitative research on interventions to enhance medical student well-being to further clarify the effective components and contexts of successful interventions.
- Designing and delivering high-quality studies, such as randomised trials, to test the benefits of all interventions.
- Exploring additional interventions that are more effective at enhancing psychological well-being, along with interventions that enhance other facets of well-being (physical and social).
- This should include an exploration of the effects of interventions on both positive (such as resilience, quality of life and fulfilment) and negative (such as anxiety, depression and stress) markers of well-being.
- Exploring the longer-term consequences of some of the interventions. While it is unlikely that mental health or mindfulness programmes will have unanticipated negative consequences,[5] the repercussions of pass/fail grading systems on academic performance, preparedness for practice and well-being could either be unwanted[63] or beneficial.[9 21]

CONCLUSIONS

Mindfulness, mental health programmes and pass/fail grading may improve medical student well-being. The quality of evidence in this space is, overall, low. Given its importance for medical students, future doctors and patients, further rigorous research is needed to identify additional interventions to enhance medical student well-being, the most effective ways to implement interventions, and how to combine the interventions for maximum benefit.

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Contributors JH and ABW were involved in the conceptualisation of this research. KN developed the search strategy. ABW, LK, CS, MJ and CL screened titles and abstracts and full texts and completed data extraction and quality assessment. JH acted as a third senior reviewer to resolve discrepancies. ABW drafted the manuscript and JH and JS further developed it. All authors made substantial contributions to revisions of the manuscript. All authors read and approved the final manuscript. ABW is the guarantor.

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