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Mindfulness-Based Interventions to Reduce Burnout and Stress in Physicians: A Systematic Review and Meta-Analysis

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Abstract

Purpose

To perform a systematic review and meta-analysis of studies evaluating the effectiveness of mindfulness-based interventions (MBIs) in reducing burnout and stress among physicians.

Method

The authors searched records in MEDLINE, Embase, PsycINFO, PSYNDEX, Web of Science, CINAHL, and CENTRAL from database inception to August 8, 2019, using combinations of terms for mindfulness, interventions, and physicians. Eligible studies were randomized controlled trials (RCTs) and non-randomized trials (NRTs), including controlled and non-controlled before-after studies, all assessing burnout and stress among physicians pre- and post-intervention via validated instruments. Two reviewers independently screened records, extracted data, assessed risk of bias, and rated overall quality of evidence. The authors used random-effects modelling to calculate pooled effect sizes and conducted prespecified subgroup and sensitivity analyses to explore potential moderators.

Results

Of 6,831 identified records, 25 studies (with 925 physicians) were ultimately included. MBIs were associated with significant small reductions in burnout in the between-group (5 comparisons: standardized mean differences [SMD] = –0.26, 95% CI = –0.50; –0.03) and pre-post analyses (21 comparisons: SMD = –0.26, 95% CI = –0.37; –0.15), and with a significant medium reduction in stress in the between-group analysis (4 comparisons: SMD = –0.55, 95% CI = –0.95; –0.14) and a significant small reduction in stress in the pre-post analysis (17 comparisons: SMD = –0.41, 95% CI = –0.61; –0.20). Versions of established MBIs showed higher effectiveness in reducing stress than other forms of MBIs or a mindfulness app.

Reductions were maintained over an average follow-up of 5.3 months. The risk of bias was moderate with RCTs and high with NRTs. The overall quality of evidence was low to very low.

Conclusions

MBIs can be effective in reducing physicians' burnout and stress. Shortcomings in the quality of evidence highlight the need for high-quality controlled trials providing long-term follow-up data.

Medicine can be one of the most rewarding and at the same time demanding professions. Physicians are exposed to human suffering, need to take on tremendous responsibility, and are expected to perform faultlessly. They often need to deal with excessive workloads, long working hours, and frequent shift work and struggle to balance their professional and personal life.[1] Moreover, the modern health care system mandates that physicians keep meticulous documentation in electronic medical records, which can decrease the amount of meaningful interactions they have with patients and patients' families.[2] Finally, perfectionism, workaholism, and excessive self-sacrifice, which are widespread among physicians, undermine self-care and may lead physicians to routinely deprive themselves of basic needs like sleep and food.[3,4] Consequently, physicians suffer from higher prevalences of burnout and stress than the general population.[1,5]

Stress and burnout are widely recognized as indicators of poor physician well-being[6] and are therefore commonly used to evaluate the effectiveness of well-being interventions.[7] However, although stress and burnout are related, they are distinct constructs.[8] Stress can be defined as a subjective psychophysiological state characterized by a combination of high arousal and displeasure.[9] According to the 2 most extensively used models of work-related stress, stress occurs when job demands exceed a worker's adaptive resources and control[10] or when the worker perceives an imbalance between invested efforts and expected rewards (e.g., money, esteem, promotion prospects).[11] Burnout, by contrast, is a work-related syndrome predominantly characterized by emotional exhaustion in the wake of chronic occupational stress.[12,13] Hence, burnout is a specific type of stress that includes the development of negative attitudes toward the job, whereas stress in general is not necessarily accompanied by such attitudes.[14]

Physician burnout and stress are associated with serious negative personal consequences, such as substance abuse, relationship trouble, depression, and suicide.[4] Furthermore, burnout endangers quality of care and patient safety, as affected physicians are less likely to adhere to practice and safety standards[15] and are more likely to commit medical errors.[16,17] Not surprisingly, patients of burnt-out physicians are less satisfied with the care they receive and can take longer to recover.[18] Moreover, burnout in physicians causes substantial costs in the health care system via higher levels of absenteeism, reduced clinical hours, job turnover, and early retirement.[18] Conservative estimates attribute a cost of $4.6 billion each year to physician burnout in the United States.[19] In light of these findings, it is important to reduce physician burnout and stress, for the sake of physicians, their patients, and the health care system in general.

A promising approach to reducing physician burnout and stress is the practice of mindfulness. Mindfulness can be described as a moment-to-moment awareness, cultivated by paying attention to the present moment, as non-judgmentally and openheartedly as possible.[20] Mindfulness is usually taught via mindfulness-based interventions (MBIs). MBIs vary in length, delivery format, and the evidence they are based on, but all share a systematic and sustained training in formal and informal mindfulness meditation practices for both teachers and participants.[21] The popularity of MBIs has skyrocketed in recent years.[22] This is probably due to an increasing number of studies showing their effectiveness for a variety of mental and physical disorders, including burnout, stress, depression, anxiety, and chronic pain among a wide range of clinical and nonclinical populations.[7,23]

In the case of physicians, mindfulness and MBIs have only recently become the subject of extensive research. In their seminal study from 2009, Krasner and colleagues found that an 8-week MBI for primary care physicians reduced burnout and increased empathy.[24] Importantly,

improvements in mindfulness predicted improvements in burnout. In a randomized controlled trial (RCT) with medical interns in 2017, Ireland and colleagues found significant reductions in burnout and stress for participants in the mindfulness condition but not for those in the control condition.[25] Early reviews and meta-analyses point to the potential effectiveness of MBIs for physicians.[26–34] However, these initial reviews and meta-analyses either did not isolate MBIs (i.e., they addressed many kinds of interventions)[26–29,31] or they did not exclusively include physicians (i.e., they included different kinds of health care professionals).[30,32–34] We wanted to draw distinct conclusions regarding the effectiveness of MBIs for physicians only, as job requirements and consequences of occupational stressors differ substantially among the health professions,[35] with physicians being particularly burdened.[5] Moreover, in recent years, a number of trials of MBIs for physicians have been published, none of which were covered by the available reviews and meta-analyses.[36–44]

In sum, MBIs seem to be promising in reducing burnout and stress in physicians, but the evidence is scattered and a systematic summary of the increasing number of studies on MBIs for physicians is missing. For this reason, we conducted the first, to the best of our knowledge, systematic review and meta-analysis of studies evaluating the effectiveness of MBIs in reducing burnout and stress among physicians. Our first objective was to quantify the effect size of MBIs in reducing burnout and stress in physicians. Our second objective was to explore potential moderators (e.g., career stage, intervention type) of MBIs' effectiveness in reducing burnout and stress in physicians.

Method

Our review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (see Supplemental Digital Appendix 1 at http://links.lww.com/ACADMED/B66).[45] We prospectively registered our study protocol with PROSPERO (registration number: CRD42019133077) and published it in *BMJ Open*.[46]

Search strategy

To ensure a comprehensive and multidisciplinary literature search, we screened 7 electronic bibliographic databases—MEDLINE, Embase, PsycINFO, PSYNDEX, Web of Science, CINAHL, and the Cochrane Register of Controlled Trials (CENTRAL)—from database inception to August 8, 2019. We conducted 2 database searches, one on April 10, 2019, and one on August 8, 2019. We did not apply any language restrictions. We used combinations of 3 key blocks of search terms—for mindfulness, interventions, and physicians—using a combination of subject headings, including MeSH terms, and text words (see Supplemental Digital Appendix 2 at http://links.lww.com/ACADMED/B66). Furthermore, we carried out backward citation searches of all included studies and relevant reviews,[26–34] as well as corresponding forward citation searches in Google Scholar. To find studies in the grey literature, we contacted the authors of eligible studies, articles, and conference abstracts identified through the database searches, as well as those of significant reviews, for additional suggestions.[26–34] The grey literature search included studies up to December 2019. A science librarian at our university library advised us during the development of the search strategy.

Eligibility criteria

Eligible studies had to meet the following criteria:

Population. We included studies exclusively with physicians regardless of their career stage (practicing physicians, resident physicians, and mixed samples of practicing and resident physicians), work setting (primary, secondary, or intensive care), specialty, or country. We excluded studies with medical students and health care providers other than physicians.

Intervention. We included interventions with an explicit focus on mindfulness and excluded interventions that might have integrated mindfulness elements but that did not explicitly state a focus on mindfulness.

Design. We included studies with quantitative intervention designs, such as RCTs and non-randomized trials (NRTs), including controlled before-after studies (CBAs) and non-controlled before-after studies (NCBAs). With RCTs and CBAs, we considered any type of control condition (e.g., active intervention, non-active intervention, waitlist).

Outcomes. We included studies that measured changes in burnout and stress from pre- to post-intervention using validated self-report questionnaires. For studies measuring burnout with the Maslach Burnout Inventory, we considered only the emotional exhaustion subscale, as it is recommended that one does not aggregate the different subscales of this inventory.[13] That is, emotional exhaustion is considered the core component of burnout, and other burnout scales only include emotional exhaustion.[12]

Study selection

We exported the search results to Rayyan (Rayyan QCRI, Doha, Qatar) and Zotero 5.0.73 (Corporation for Digital Scholarship, Vienna, Virginia) and removed duplicates. Two reviewers (J.C.F. and J.J.B.) independently screened all titles and abstracts. If at least one reviewer judged an article to meet eligibility criteria, it was included in the full text review. The same 2 reviewers independently screened all full texts. Chance-corrected agreement on inclusion after full-text

screening between raters was high ($\kappa = 0.96$). We resolved discrepancies through discussion and adjudication by a third reviewer (A.S.G.).

Data extraction

Two reviewers (J.C.F. and J.J.B.) independently extracted the information from all eligible studies using a standardized Excel 2016 (Microsoft Corporation, Redmond, Washington) data extraction sheet. We pilot-tested the extraction sheet with 3 studies and made modifications afterward. We extracted data on the

- study, including authors, publication date, country, study design (RCT, CBA, or NCBA), and type of control;
- population, including sample size, age, sex, prior or current other experience with mindfulness, specialty, and career stage (resident physicians, practicing physicians, or mixed);
- intervention, including type (mindfulness-based stress reduction [MBSR], mindfulness-based cognitive therapy [MBCT], adapted MBSR or MBCT, or other forms of MBIs), format (online, offline, or mixed), hours of guided treatment (either offline or online) as defined in the intervention descriptions, and hours of individual practice; and
- outcomes, including means and standard deviations (SDs) for burnout and stress measured using validated self-report questionnaires, in order to calculate standardized mean differences (SMD).

The reviewers agreed on 97.9% of the extractions. We resolved discrepancies through discussion. If a study had missing data, we contacted the authors of that study in an effort to obtain the missing data.

Risk of bias assessment within studies

Two reviewers (J.C.F. and J.J.B.) independently performed risk of bias assessments for each individual included study. For RCTs, we used the revised Cochrane risk-of-bias tool for randomized trials (RoB 2.0).[47] RoB 2.0 is a domain-based evaluation tool that considers bias arising from 5 domains: (1) the randomization process, (2) deviations from intended interventions, (3) missing outcome data, (4) measurement of the outcome, and (5) selection of the reported results. Each study's risk of bias in any of these individual domains is rated as either "low risk of bias," "some concerns," or "high risk of bias." Furthermore, an overall risk-of-bias-judgement for each study is derived. For NRTs, we used the Effective Public Health Practice Project Quality Assessment (EPHPP).[48] It rates a study's risk of bias across 8 domains: (1) selection bias, (2) study design, (3) confounders, (4) blinding, (5) data collection methods, (6) withdrawals and dropouts, (7) intervention integrity, and (8) quantitative analyses of single studies. The quality of evidence in each of the sections is rated as "strong," "moderate," or "weak" quality (i.e., risk of bias is reversely coded). Furthermore, an additional overall rating for each study is derived. If available, we retrieved study protocols and trial registrations to identify potential bias due to selective reporting. For RCTs, the chance-corrected reliability between raters was perfect for the overall risk-of-bias judgements ($\kappa = 1.00$) and almost perfect on the individual domains ($\kappa = 0.87$). For NRTs, reliability between raters was perfect for the overall ratings ($\kappa = 1.00$) and almost perfect for ratings on individual sections ($\kappa = 0.81$).

Risk of bias assessment and quality of evidence across studies

To assess potential publication bias across the included studies, we examined the funnel plot for asymmetry using Egger's regression test[49] and computed Rosenthal's fail-safe N.[50] To assess the overall quality of evidence across the included studies, we used the Grading of

Recommendations Assessment, Development and Evaluation (GRADE) system.[51] It contains 8 dimensions: (1) risk of bias, (2) inconsistency of results, (3) indirectness of evidence, (4) imprecision of effect size, (5) publication bias, (6) large magnitude of effect, (7) dose response, and (8) effect of all plausible confounding factors. Two reviewers (J.C.F. and J.J.B.) ranked the overall quality of evidence for each outcome as "high," "moderate," "low," or "very low." The reliability between raters was fair for the overall ratings ($\kappa = 0.33$) and substantial for ratings on individual sections ($\kappa = 0.76$).

Data analysis

We analyzed the outcome data of the individual studies according to the intention-to-treat principle.[52] For effect sizes of individual studies, we calculated SMD, using the baseline (pre-intervention) value and the value from the first assessment following the intervention (post-intervention).

We calculated 2 separate meta-analyses with each of the 2 outcomes (i.e., burnout and stress). The first meta-analysis summarized between-group data of RCTs. The second meta-analysis summarized pre-post intervention data of all eligible studies. To calculate SMDs for the pre-post analysis, we standardized the post-pre intervention change with the pre-intervention SD.[53] To calculate the SMD for the between-group analysis, we standardized the difference of the post-pre intervention change between treatment and control with the pooled pre-intervention SD. Using change values in the between-group analysis instead of post values increased power and precision,[54] allowed us to control for baseline differences between groups,[55] and assured that effect sizes of pre-post and between-group analyses were comparable as all mean changes were standardized with the pre-intervention SDs.[56]

To calculate sample variance and standard errors in the pre-post analysis, we used a conservative estimate of r = .5 whenever the correlation of pre- and post-intervention measures was not available.[57] With all studies, we computed the SMD, its 95% confidence interval (CI), and associated *P* values. To calculate SMDs, we used random-effects modelling. We weighted the studies using the inverse-variance method and interpreted the magnitude of effect sizes according to Cohen as small (0.20–0.49), medium (0.50–0.79), or large (≥0.80).[58] We assessed heterogeneity among studies using I^2 statistics. Conventionally, I^2 values above 25%, 50%, and 75% are interpreted as low, moderate, and high heterogeneity, respectively.[59] We used the meta package of R version R 3.6.1 (The R Foundation, Vienna, Austria) with the formulas provided by Viechtbauer.[56]

To explore potential moderators of between-group and pre-post effects, we prespecified subgroup analyses to determine the influence of career stage, intervention type, intervention format, and study design. Furthermore, we conducted sensitivity analyses to examine whether results are maintained (1) when taking long-term follow-up instead of immediately post-intervention data and (2) when taking other values than r = .5 for pre-post intervention correlations to calculate sample variances and standard errors in the pre-post analysis (i.e., using r = .7 and r = .3 instead).

Results

Our searches yielded 6,827 records (Figure 1). We identified 2 additional records through our forward citation search,[38,60] 1 unpublished study through our grey literature search,[39] and 1 study from our own lab[37] for a total of 6,831 identified records. Once duplicates were removed, we screened the titles and abstracts of the remaining 3,759 records; 69 of these were determined to be relevant for full-text screening. A total of 25 studies were ultimately included in the

systematic review and meta-analysis (see Supplemental Digital Appendix 3 at http://links.lww.com/ACADMED/B66 for a list of excluded records); all of these studies were ultimately published in peer-reviewed journals.[24,25,36–44,60–73] One article reported results for 2 samples, each of which received a different amount of guided treatment.[62] We included the values from both samples as individual studies in the analyses (i.e., this study was considered as 2 studies in the analyses). Two articles referred to the same study and population.[60,63] We included these as a single study in the analyses.[63] Of the included studies, 21 assessed burnout (5 RCTs, 16 NRTs), and 17 assessed stress (4 RCTs, 13 NRTs).

Characteristics of the studies and participants

Six studies were RCTs,[25,36,40,61,64,65] and 19 studies were NRTs, including 3 CBAs[38,39,66] and 16 NCBAs[24,37,41–44,62,63,67–73] (see Appendixes 1 and 2 for a detailed description of the studies). Of the 6 RCTs, 4 used a waitlist[36,61,64,65] and 2 used an active control condition.[25,40]

Across all included studies, 925 physicians reported pre-intervention data; of these physicians, 714 took part in MBIs and 211 in controls. The mean age of participants was 38.0 (SD = 10.1) years, and the proportion of male to female participants was 339/567 (% female = 63%).

Included articles were published between 2009 and 2020. Eleven studies were conducted in the United States,[24,36,40–43,63,68–70,73] 5 in the Netherlands,[39,44,61,66,71] 4 in Spain,[62,64,65] 2 in Australia,[25,38] 2 in the United Kingdom,[67,72] and 1 in Germany.[37] All studies were reported in English, except for 2 (1 in Spanish[64] and 1 in Dutch[71]).

The majority of studies had a relatively small sample size (range: 7[73] to 148,[61] median = 31). Most studies did not report on the amount of participants' prior mindfulness experiences. Five studies reported no prior experience,[36,37,61,71,73] and 6 studies reported that some of the participants had prior experience in either mindfulness, mediation, or yoga.[42,44,62,63,70] Only 2

studies reported on participants' current engagement in other mindfulness practices.[40,44] Nine studies had a sample of practicing physicians,[24,36,39,44,62,64–66] 12 had a sample of resident physicians,[25,37,38,40,42,43,61,68–71,73] and 4 had a mixed sample of practicing and resident physicians.[63,67,68,72] Studies were conducted with participants from a range of specialties, including general practice (5),[62,64,66,67] psychiatry (3),[71–73] pediatrics (2),[42,70] family or internal medicine (3),[25,36,43] surgery (1),[40] and mixed (11).[24,37–39,41,44,61,63,65,68,69]

Characteristics of the interventions

The included studies used a range of intervention types (see Appendixes 1 and 2 for a detailed description of the interventions). Ten studies used adapted versions of MBSR[25,36,37,39,40,44,62,64,73] and 4 used standard MBSR.[61,65,66,71] Furthermore, 2 studies used mind-body skills training (MBST),[41,42] 2 used the online mindfulness app Headspace,[69,70] 1 study used an adapted version of MBCT,[67] and 6 used other forms of MBIs.[24,38,43,63,68,72] The intervention formats varied slightly, with 18 studies using a face-to-face format (6 RCTs and 12 NRTs),[24,25,36–40,43,44,61,64–68,71–73] 2 using a web-based format,[69,70] and 5 using a mixed format.[41,42,62,63] The interventions varied in length, ranging from 2 days of focused face-to-face training[36,72] to 3 months of an online course and in-person training.[41] However, the majority lasted 2 or 3 months, with 8–10 weekly sessions.[24,25,37,39,40,44,61,64–67,71,73] The average amount of guided treatment was 18.8 hours for RCTs and 16.1 hours for NRTs (overall average = 16.8 hours). Only 3 studies reported actual hours of individual practice (average = 18 minutes).[37,40,71]

Meta-analyses

Burnout. MBIs were associated with a significant small reduction in the between-group analysis of RCTs (5 comparisons: SMD = –0.26, 95% CI = –0.50; –0.03, P = .03, I^2 = 0%) and in the pre-

post analysis of all included studies (21 comparisons: SMD = –0.26, 95% CI = –0.37; –0.15, P < .001, I^2 = 29%; Figure 2) for burnout.

Stress. MBIs were associated with a significant medium reduction in stress in the between-group analysis of RCTs (4 comparisons: SMD = –0.55, 95% CI = –0.95; –0.14, P < .01, I^2 = 24%) and a significant small reduction in stress in the pre-post analysis of all included studies (17 comparisons: SMD = –0.41, 95% CI = –0.61; –0.20, P < .001, I^2 = 69%; Figure 3).

Subgroup analyses

With burnout, the between-group and the pre-post effects were consistent over all prespecified categorical moderators (i.e., career stage, intervention type, intervention format, and study design; all Ps > .05; see Supplemental Digital Appendix 4 at http://links.lww.com/ACADMED/B66). With stress, the intervention type had a significant influence on the pre-post effect, with MBSR, MBST, and adapted versions of MBSR and MBCT being more effective than other forms of MBIs or a mindfulness app (P = .02; see Supplemental Digital Appendix 5 at http://links.lww.com/ACADMED/B66). There was no other significant moderator in either the between-group or pre-post analyses for stress. However, the numbers of studies in all subgroup analyses were small; hence, these results must be interpreted with caution.

Sensitivity analyses

Eleven studies provided long-term follow-up data (average = 5.3 months).[24,36,38,40,42,44,63–65,67,68] Effect-size estimates for burnout showed a significant moderate reduction in the pre-follow-up analysis (9 comparisons: SMD = –0.46, 95% CI = –0.80; –0.11, P = .01, I^2 = 71%; see Supplemental Digital Appendix 6 at http://links.lww.com/ACADMED/B66). In the between-group analysis, moderate burnout reductions were not significant, probably due to the small number of studies (2 comparisons: SMD = –0.58, 95% CI = –1.70; 0.53, P = .30, I^2 = 71%).

Effect-size estimates for stress showed significant moderate reductions in the between-group (3 comparisons: SMD = –0.78, 95% CI = –1.43; –0.12, P = .02, I^2 = 53%) and pre-follow-up analyses (9 comparisons: SMD = –0.56, 95% CI = –1.02; –0.10, P = .02, I^2 = 80%). Results for pre-post analysis did not significantly differ when using other plausible values for the pre-post intervention correlation (see Supplemental Digital Appendix 7 at http://links.lww.com/ACADMED/B66).

Risk of bias characteristics within studies

All studies used validated self-report questionnaires, as this was required for inclusion. Due to the nature of MBIs, blinding of participants and teachers to the interventions was difficult and participants often self-referred to the intervention. Missing outcome data were not an issue in the included studies, with 2 exceptions.[62,70] With RCTs, the overall risk of bias rating was moderate (i.e., some concerns) across all studies (see Supplemental Digital Appendix 8 at http://links.lww.com/ACADMED/B66). With NRTs, studies had a limited ability to control for potential confounders, with 16 studies being NCBAs and only 3 studies including a control condition. Consequently, the overall risk of bias rating across all NRTs was high (i.e., weak quality of evidence; see Supplemental Digital Appendix 9 at http://links.lww.com/ACADMED/B66).

Risk of bias characteristics and quality of evidence across studies

Egger's regression test showed no evidence of publication bias for either the between-group or the pre-post analysis (see Supplemental Digital Appendixes 10–13 at http://links.lww.com/ACADMED/B66 for funnel plots). Nevertheless, due to the relatively small number of studies, the Egger's regression tests lack sufficient power to detect bias and should not be viewed as definitive. The fail-safe N for burnout was 10 for the between-group analysis and

220 for the pre-post analysis, and the fail-safe N for stress was 11 for the between-group analysis and 278 for the pre-post analysis. The overall quality of evidence was low for RCTs due to lack of allocation concealment and blinding as well as imprecision due to small numbers of participants. The overall quality of evidence was very low for pre-post data due to lack of randomization, control, and blinding (see Supplemental Digital Appendix 14 at http://links.lww.com/ACADMED/B66 for GRADE judgements).

Discussion

MBIs for physicians have recently become the subject of extensive research. To the best of our knowledge, this is the first systematic review and meta-analysis of studies evaluating the effectiveness of MBIs to reduce burnout and stress in physicians. It examined 25 studies for a total of 925 physicians. The results showed that MBIs can be effective in reducing physicians' burnout and stress. Original and adapted versions of established MBIs, such as MBSR and MBST, showed higher effectiveness in reducing stress than other forms of MBIs or a mindfulness app. The intervention effect for burnout and stress was independent of physician career stage, study design, and the format used to deliver the intervention. The observed reductions in burnout and stress were maintained over an average follow-up of 5.3 months.

Strengths and limitations

Strengths of this systematic review and meta-analysis are that we included samples consisting solely of physicians, whereas previous reviews and meta-analyses included mixed samples;[26,27,34] this allows us to draw conclusions about this distinct population. Furthermore, we registered the study protocol, including the prespecified subgroup analyses, with PROSPERO and published it in *BMJ Open*, which ensures a high degree of transparency in the review process.[46] Two independent reviewers performed not just a subset, as is customary, but all steps of the screening

process, data extraction, risk of bias assessment, and overall quality of evidence assessment, which ensures a high degree of consistency across all steps of the review and meta-analysis. We followed a fine-meshed and yet comprehensive strategy to systematically search 7 bibliographic databases from different scientific fields, without language or date restrictions. Heterogeneity of included studies was low to moderate in the primary analyses of burnout and stress reduction (0%–69%). We examined the remaining heterogeneity through prespecified subgroup and sensitivity analyses. In addition, we searched for grey literature and did not find indications of publication bias.

Limitations of this study are that there were only 6 RCTs and that a considerable proportion of the results was based on pre-post data. Nevertheless, conducting randomized trials is not always possible, and disregarding NRTs may neglect important evidence.[74] Instead of excluding NRTs, we decided to provide effect estimates separately for between-group and pre-post data. Despite their methodological differences, between-group and pre-post analyses yielded similar results (i.e., the study design had no bearing on the intervention effect). However, the number of studies in some subgroups was small. Hence, the results of the subgroup analyses must be interpreted with caution. In addition, most studies did not report whether and to what extent participants were simultaneously practicing mindfulness at home or engaging in other MBIs. Therefore, it cannot be determined to what extent effects are caused by individual home practice, single exposure to an MBI, or multiple exposures to MBIs. Furthermore, only 11 studies reported long-term follow-up data, the risk of bias was high for NRTs, and the overall quality of evidence was low to very low for all studies. Therefore, there is a need for high-quality studies with larger samples, controlled trial methodologies, and long-term follow-up data to confirm results and to determine the optimal components and length of MBIs.

Comparison with previous systematic reviews and meta-analyses

Our findings that MBIs yield improvements in burnout and stress with small to medium effect sizes mirror the findings of previous systematic reviews and meta-analyses.[7,26,29,30] We expanded on these previous systematic reviews and meta-analyses as they included only up to 3 studies on MBIs with physicians,[29] while our systematic review and meta-analysis included 25 studies. Physician career stage and study design had no bearing on the intervention effect. This is in line with a 2016 systematic review and meta-analysis involving 2,914 physicians.[29] Furthermore, in 2020, Scheepers and colleagues published a systematic narrative review of MBIs' impact on physicians' well-being and performance.[34] Similar to our work here, this review found that MBIs have a positive impact on the well-being of physicians. Nevertheless, our work expanded on this review as we quantified this impact meta-analytically and included 10 additional studies that measure burnout and stress with validated instruments.

Implications for physicians and policy makers

Many physicians suffer from burnout and stress, which can not only strongly affect them but also the quality of care they deliver. The observed standardized pre-post burnout reduction we observed among the included studies equals a 2.6-point reduction in emotional exhaustion on the Maslach Burnout Inventory. Each 1-point increase in emotional exhaustion is associated with a 5% to 7% increase in the odds of reporting a medical error,[16,17,75] a 7% higher likelihood of reporting suicidal ideation,[76] and a 43% higher likelihood of reductions in work hours.[77] Thus, even relatively small changes in burnout are associated with meaningful differences. Furthermore, MBIs are associated with increased compassion and empathy,[30] dedication to work,[66] and improved therapeutic alliance,[72] and thus, with better quality of care. Once learned, mindfulness can easily and flexibly be integrated into daily life.[78] It is not tied to places, times, or

physical objects, making it attractive to busy practitioners, such as physicians,[25] and potentially increasing its feasibility in work settings, including health care settings.[41] As burnout, once present, tends to persist,[79] we encourage health care policy makers to implement mindfulness activities in medical education. The popularity of this idea is highlighted by a recent audit showing that 80% (30/38) of U.K. medical schools have introduced mindfulness into their curriculum.[80] Nevertheless, both health care institutions and individual physicians must be equally involved to improve physicians' well-being.[3] If dealing with burnout and stress was solely seen as a personal responsibility, affected physicians may not be supported but blamed for not being resilient enough.[26] At the same time, physicians should recognize the importance of self-care and must actively engage in positive health behaviors, such as mindfulness, in the same way as they prescribe such behaviors to their patients.[3] Furthermore, MBI programs should be introduced as an opportunity to enhance well-being, professional fulfillment, and meaning, rather than just as a way to mitigate burnout and foster stress-resistance.[81–83]

Conclusions

In sum, the results of this systematic review and meta-analysis indicate that MBIs can be effective in reducing physician burnout and stress. Future studies with larger samples, controlled trial methodologies, and long-term follow-up data are needed to confirm results and to determine the optimal components and length of MBIs.

References

1. Shanafelt TD, Hasan O, Dyrbye LN, et al. Changes in burnout and satisfaction with work-life balance in physicians and the general US working population between 2011 and 2014. Mayo Clin Proc. 2015;90(12):1600-1613.
2. Patel RS, Bachu R, Adikey A, Malik M, Shah M. Factors related to physician burnout and its consequences: A review. Behav Sci (Basel). 2018;8(11):98.
3. Kuhn CM, Flanagan EM. Self-care as a professional imperative: Physician burnout, depression, and suicide. Can J Anaesth. 2017;64(2):158-168.
4. Wallace JE, Lemaire JB, Ghali WA. Physician wellness: A missing quality indicator. Lancet. 2009;374(9702):1714–1721.
5. Dyrbye LN, West CP, Satele D, et al. Burnout among U.S. medical students, residents, and early career physicians relative to the general U.S. population. Acad Med. 2014;89(3):443-451.
6. Lebares CC, Guvva EV, Desai A, et al. Key factors for implementing mindfulness-based burnout interventions in surgery. Am J Surg. 2020;219(2):328-334.
7. Khoury B, Sharma M, Rush SE, Fournier C. Mindfulness-based stress reduction for healthy individuals: A meta-analysis. J Psychosom Res. 2015;78(6):519-528.
8. Bianchi R, Schonfeld IS, Laurent E. Burnout–depression overlap: A review. Clin Psychol Rev. 2015;36:28-41.
9. Ruotsalainen J, Serra C, Marine A, Verbeek J. Systematic review of interventions for reducing occupational stress in health care workers. Scand J Work Environ Health. 2008;34(3):169-178.

10. Karasek R. Demand/Control model: A social-emotional, and psychological approach to stress risk and active behavior development. In: Stellman JM, ed. Encyclopaedia of Occupational Health and Safety. Geneva, Switzerland: International Labour Office; 1998:34.06–34.14.

11. Siegrist J. Adverse health effects of high-effort/low-reward conditions. J Occup Health Psychol. 1996;1(1):27-41.

12. Kristensen TS, Borritz M, Villadsen E, Christensen KB. The Copenhagen Burnout Inventory: A new tool for the assessment of burnout. Work Stress. 2005;19(3):192-207.

13. Maslach C, Jackson SE, Leiter MP. The Maslach Burnout Inventory. 3rd ed. Palo Alto, CA: Consulting Psychologists Press; 1996.

14. Schaufeli WB, Buunk BP. Burnout: An overview of 25 years of research and theorizing. In: Schabracq M, Winnubst J, Cooper C, eds. The Handbook of Work and Health Psychology. 2nd ed. Chichester, UK: John Wiley & Sons; 2003:383-425.

15. de Oliveira GS, Chang R, Fitzgerald PC, et al. The prevalence of burnout and depression and their association with adherence to safety and practice standards: A survey of United States anesthesiology trainees. Anesth Analg. 2013;117(1):182-193.

16. Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. Ann Surg. 2010;251(6):995-1000.

17. West CP, Huschka MM, Novotny PJ, et al. Association of perceived medical errors with resident distress and empathy: A prospective longitudinal study. JAMA. 2006;296(9):1071–1078.

18. West CP, Dyrbye LN, Shanafelt TD. Physician burnout: Contributors, consequences and solutions. J Intern Med. 2018;283(6):516-529.

19. Han S, Shanafelt TD, Sinsky CA, et al. Estimating the attributable cost of physician burnout in the United States. Ann Intern Med. 2019;170(11):784-790.

20. Kabat-Zinn J. Coming to Our Senses: Healing Ourselves and the World Through Mindfulness. London, UK: Hachette Books; 2005.

21. Crane RS, Brewer J, Feldman C, et al. What defines mindfulness-based programs? The warp and the weft. Psychol Med. 2017;47(6):990-999.

22. Van Dam NT, van Vugt MK, Vago DR, et al. Mind the hype: A critical evaluation and prescriptive agenda for research on mindfulness and meditation. Perspect Psychol Sci. 2018;13(1):36-61.

23. Khoury B, Lecomte T, Fortin G, et al. Mindfulness-based therapy: A comprehensive meta-analysis. Clin Psychol Rev. 2013;33(6):763-771.

24. Krasner MS, Epstein RM, Beckman H, et al. Association of an educational program in mindful communication with burnout, empathy, and attitudes among primary care physicians. JAMA. 2009;302(12):1284-1293.

25. Ireland MJ, Clough B, Gill K, Langan F, O'Connor A, Spencer L. A randomized controlled trial of mindfulness to reduce stress and burnout among intern medical practitioners. Med Teach. 2017;39(4):409-414.

26. Panagioti M, Panagopoulou E, Bower P, et al. Controlled interventions to reduce burnout in physicians: A systematic review and meta-analysis. JAMA Intern Med. 2017;177(2):195-205.

27. Regehr C, Glancy D, Pitts A, LeBlanc VR. Interventions to reduce the consequences of stress in physicians: A review and meta-analysis. J Nerv Ment Dis. 2014;202(5):353-359.

28. Clough BA, March S, Chan RJ, Casey LM, Phillips R, Ireland MJ. Psychosocial interventions for managing occupational stress and burnout among medical doctors: A systematic review. Syst Rev. 2017;6(1):144-162.

29. West CP, Dyrbye LN, Erwin PJ, Shanafelt TD. Interventions to prevent and reduce physician burnout: A systematic review and meta-analysis. Lancet. 2016;388(10057):2272-2281.

30. Lomas T, Medina JC, Ivtzan I, Rupprecht S, Eiroa-Orosa FJ. A systematic review of the impact of mindfulness on the well-being of healthcare professionals. J Clin Psychol. 2018;74(3)319-355.

31. Petrie K, Crawford J, Baker STE, et al. Interventions to reduce symptoms of common mental disorders and suicidal ideation in physicians: A systematic review and meta-analysis. Lancet Psychiatry. 2019;6(3):225-234.

32. Lamothe M, Rondeau É, Malboeuf-Hurtubise C, Duval M, Sultan S. Outcomes of MBSR or MBSR-based interventions in health care providers: A systematic review with a focus on empathy and emotional competencies. Complement Ther Med. 2016;24:19-28.

33. Boellinghaus I, Jones FW, Hutton J. The role of mindfulness and loving-kindness meditation in cultivating self-compassion and other-focused concern in health care professionals. Mindfulness. 2014;5(2):129-138.

34. Scheepers RA, Emke H, Epstein RM, Lombarts KMJMH. The impact of mindfulness-based interventions on doctors' well-being and performance: A systematic review. Med Educ. 2020;54(2):138-149.

35. Rutledge T, Stucky E, Dollarhide A, et al. A real-time assessment of work stress in physicians and nurses. Health Psychol. 2009;28(2):194-200.

36. Schroeder DA, Stephens E, Colgan D, Hunsinger M, Rubin D, Christopher MS. A brief mindfulness-based intervention for primary care physicians: A pilot randomized controlled trial. Am J Lifestyle Med. 2016;12(1):83-91.

37. Fendel JC, Aeschbach VM, Göritz AS, Schmidt S. A mindfulness program to improve resident physicians' personal and work-related well-being: A feasibility study. Mindfulness. 2020;11:1511-1519.

38. Forbes M, Byrom L, van der Steenstraten I, Markwell A, Bretherton H, Kay M. Resilience on the run: An evaluation of a well-being program for medical interns. Intern Med J. 2020;50(1):92-99.

39. Kersemaekers W, Vreeling K, Verweij H, et al. Effectiveness and feasibility of a mindful leadership course for medical specialists: A pilot study. BMC Med Educ. 2020;20(1):34.

40. Lebares CC, Guvva EV, Olaru M, et al. Efficacy of mindfulness-based cognitive training in surgery: Additional analysis of the mindful surgeon pilot randomized clinical trial. JAMA Netw Open. 2019;2(5):e194108. doi:10.1001/jamanetworkopen.2019.4108

41. Nguyen MC, Gabbe SG, Kemper KJ, Mahan JD, Cheavens JS, Moffatt-Bruce SD. Training on mind-body skills: Feasibility and effects on physician mindfulness, compassion, and associated effects on stress, burnout, and clinical outcomes. J Posit Psychol. 2020;15(2):194-207.

42. Romcevich LE, Reed S, Flowers SR, Kemper KJ, Mahan JD. Mind-body skills training for resident wellness: A pilot study of a brief mindfulness intervention. J Med Educ Curric Dev. 2018;5:2382120518773061. doi:10.1177/2382120518773061

43. Runyan C, Savageau JA, Potts S, Weinreb L. Impact of a family medicine resident wellness curriculum: A feasibility study. Med Educ Online. 2016;21(1):1-5. doi:10.3402/meo.v21.30648

44. van Wietmarschen H, Tjaden B, van Vliet M, Battjes-Fries M, Jong M. Effects of mindfulness training on perceived stress, self-compassion, and self-reflection of primary care physicians: A mixed-methods study. BJGP Open. 2018;2(4):bjgpopen18X101621. doi:10.3399/bjgpopen18X101621

45. Moher D, Liberati A, Tetzlaff J, Altman D; PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. Ann Intern Med. 2009;151(4):264-269.

46. Fendel JC, Bürkle JJ, Göritz AS. Mindfulness-based interventions to reduce burnout and stress in physicians: A study protocol for a systematic review and meta-analysis. BMJ Open. 2019;9(11):e032295. doi:10.1136/bmjopen-2019-032295

47. Higgins JP, Sterne JA, Savovic J, et al. A revised tool for assessing risk of bias in randomized trials. Cochrane Database Syst Rev. 2016;10:29-31.

48. Armijo-Olivo S, Stiles CR, Hagen NA, Biondo PD, Cummings GG. Assessment of study quality for systematic reviews: A comparison of the Cochrane Collaboration Risk of Bias Tool and the Effective Public Health Practice Project Quality Assessment Tool: Methodological research. J Eval Clin Pract. 2012;18(1):12-18.

49. Egger M, Smith GD, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ. 1997;315(7109):629-634.

50. Rosenthal R. The file drawer problem and tolerance for null results. Psychol Bull. 1979;86(3):638-641.

51. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. BMJ. 2008;336(7650):924-926.

52. Higgins JP, Green S. Cochrane Handbook for Systematic Reviews of Interventions. Chichester, UK: John Wiley & Sons; 2008.

53. Becker BJ. Synthesizing standardized mean-change measures. Br J Math Stat Psychol. 1988;41(2):257-278.

54. Schmidt FL, Hunter JE. Methods of Meta-Analysis: Correcting Error and Bias in Research Findings. 3rd ed. London, UK: SAGE Publications; 2015.

55. Morris SB. Estimating effect sizes from pretest-posttest-control group designs. Organ Res Methods. 2008;11(2):364-386.

56. Viechtbauer W. Approximate confidence intervals for standardized effect sizes in the two-independent and two-dependent samples design. J Educ Behav Stat. 2007;32(1):39-60.

57. Fu R, Vandermeer BW, Shamliyan TA, et al. Handling continuous outcomes in quantitative synthesis. In: Methods Guide for Effectiveness and Comparative Effectiveness Reviews. Rockville, MD: Agency for Healthcare Research and Quality; 2013. https://www.ncbi.nlm.nih.gov/sites/books/NBK154408. Accessed December 21, 2020.

58. Cohen J. Statistical Power Analysis for the Behavioral Sciences. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum; 1988.

59. Higgins JPT. Measuring inconsistency in meta-analyses. BMJ. 2003;327(7414):557-560.

60. Pflugeisen BM, Mundell K, Ebersole D, Drummond D, Chen D. Impact of single-breath mindfulness technique on physician burnout and stress. J Community Med Health Educ. 2016;6(3):1-4. doi:10.4172/2161-0711.1000430

61. Verweij H, van Ravesteijn H, Lagro-Janssen ALM, Speckens AEM. Mindfulness-based stress reduction for residents: A randomized controlled trial. J Gen Intern Med. 2018;33(4):429-436.

62. Montero-Marin J, Gaete J, Araya R, et al. Impact of a blended web-based mindfulness programme for general practitioners: A pilot study. Mindfulness. 2018;9(1):129-139.

63. Pflugeisen BM, Drummond D, Ebersole D, Mundell K, Chen D. Brief video-module administered mindfulness program for physicians: A pilot study. Explore (NY). 2016;12(1):50-54.

64. Franco Justo C. Reducing stress levels and anxiety in primary-care physicians through training and practice of a mindfulness meditation technique [article in Spanish]. Aten Primaria. 2010;42(11):564-570.

65. Amutio A, Martínez-Taboada C, Delgado LC, Hermosilla D, Mozaz MJ. Acceptability and effectiveness of a long-term educational intervention to reduce physicians' stress-related conditions. J Contin Educ Health Prof. 2015;35(4):255-260.

66. Verweij H, Waumans RC, Smeijers D, et al. Mindfulness-based stress reduction for GPs: Results of a controlled mixed methods pilot study in Dutch primary care. Br J Gen Pract. 2016;66(643):e99-e105.

67. Hamilton-West K, Pellatt-Higgins, T, Pillai N. Does a modified mindfulness-based cognitive therapy (MBCT) course have the potential to reduce stress and burnout in NHS GPs? Feasibility study. Prim Health Care Res Dev. 2018;19(6):591-597.

68. Goldhagen B, Kingsolver K, Stinnett S, Rosdahl J. Stress and burnout in residents: Impact of mindfulness-based resilience training. Adv Med Educ Pract. 2015;6:525-532. doi:10.2147/AMEP.S88580

69. Wen L, Sweeney TE, Welton L, Trockel M, Katznelson L. Encouraging mindfulness in medical house staff via smartphone app: A pilot study. Acad Psychiatry. 2017;41(5):646-650.

70. Taylor M, Hageman JR, Brown M. A mindfulness intervention for residents: Relevance for pediatricians. Pediatr Ann. 2016;45(10):373-376.

71. Hoenders HJR, Booij SH, Knegtering H, van den Brink H. Mindfulness training for psychiatrists in residency: A pilot study [article in Dutch]. Tijdschr Psychiatr. 2016;58(11):809-813.

72. Razzaque R, Wood L. Exploration of the effectiveness and acceptability of a professional mindfulness retreat for psychiatrists. Mindfulness. 2016;7(2):340-348.

73. Bentley PG, Kaplan SG, Mokonogho J. Relational mindfulness for psychiatry residents: A pilot course in empathy development and burnout prevention. Acad Psychiatry. 2018;42(5):668-673.

74. Sharma M, Nazareth I, Petersen I. Observational studies of treatment effectiveness: Worthwhile or worthless? Clin Epidemiol. 2019;11:35-42.

75. West C, Tan AD, Habermann TM, Sloan JA, Shanafelt TD. Association of resident fatigue and distress with perceived medical errors. JAMA. 2009;302(12):1294-1300.

76. Shanafelt TD, Balch CM, Dyrbye L, et al. Special report: Suicidal ideation among American surgeons. Arch Surg. 2011;146(1):54-62.

77. Shanafelt TD, Mungo M, Schmitgen J, et al. Longitudinal study evaluating the association between physician burnout and changes in professional work effort. Mayo Clin Proc. 2016;91(4):422-431.

78. Gilmartin H, Saint S, Rogers M, et al. Pilot randomised controlled trial to improve hand hygiene through mindful moments. BMJ Qual Saf. 2018;27(10):799-806.

79. Campbell J, Prochazka AV, Yamashita T, Gopal R. Predictors of persistent burnout in internal medicine residents: A prospective cohort study. Acad Med. 2010;85(10):1630-1634.

80. Harrison L. Is there a movement towards the acceptance of mindfulness in medical education? An audit of mindfulness activity in UK medical schools. MedEdPublish. 2019;8(2):14. doi:10.15694/mep.2019.000084.1

81. Shanafelt T, Trockel M, Ripp J, Murphy ML, Sandborg C, Bohman B. Building a program on well-being: Key design considerations to meet the unique needs of each organization. Acad Med. 2019;94(2):156-161.

82. Berg DD, Divakaran S, Stern RM, Warner LN. Fostering meaning in residency to curb the epidemic of resident burnout: Recommendations from four chief medical residents. Acad Med. 2019;94(11):1675-1678.

83. Shanafelt TD. Enhancing meaning in work: A prescription for preventing physician burnout and promoting patient-centered care. JAMA. 2009;302(12):1338-1340.

Figure Legends

Figure 1

Flowchart showing the inclusion and exclusion of records in a 2019 systematic review and meta-analysis of studies evaluating mindfulness-based interventions to reduce burnout and stress in physicians. Abbreviations: RCTs, randomized controlled trials; NRTs, non-randomized trials.

Figure 2

Forest plot of the effects of mindfulness-based interventions to reduce burnout in physicians: (Panel A) between-group analysis of randomized controlled trials (RCTs) and (Panel B) pre-post analysis of both RCTs and non-randomized trials. Results stem from a 2019 systematic review and meta-analysis of studies evaluating mindfulness-based interventions to reduce burnout and stress in physicians. Each solid line represents a single study, plotted according to the standardized mean difference (SMD) based on post-pre intervention changes. Abbreviation: CI, confidence interval.

Figure 3

Forest plot of the effects of mindfulness-based interventions to reduce stress in physicians: (Panel A) between-group analysis of randomized-controlled trials (RCTs) and (Panel B) pre-post analysis of both RCTs and non-randomized trials. Results stem from a 2019 systematic review and meta-analysis of studies evaluating mindfulness-based interventions to reduce burnout and stress in physicians. Each solid line represents a single study, plotted according to the standardized mean difference (SMD) based on post-pre intervention changes. Abbreviation: CI, confidence interval.

Figure 1

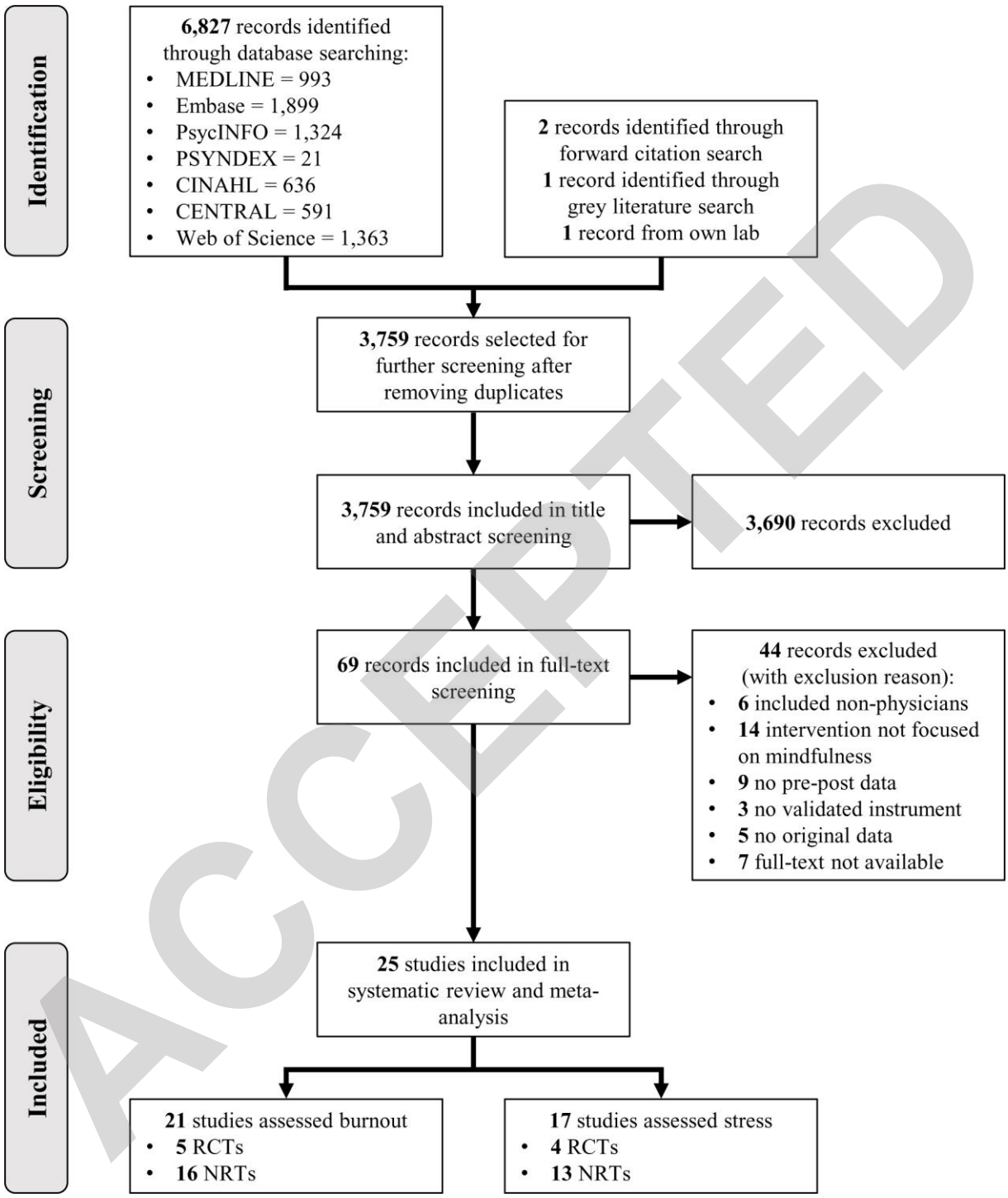


Figure 2a

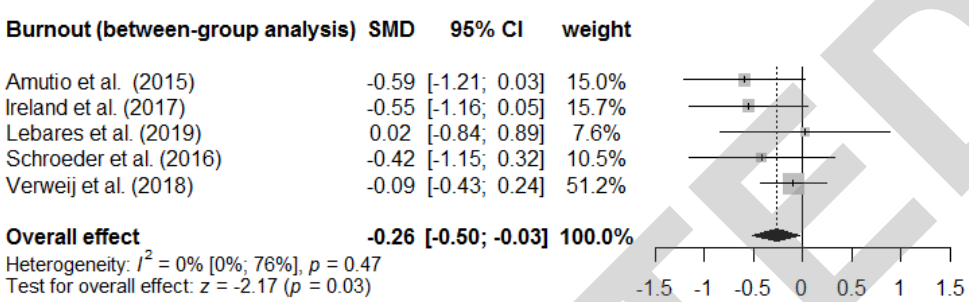


Figure 2b

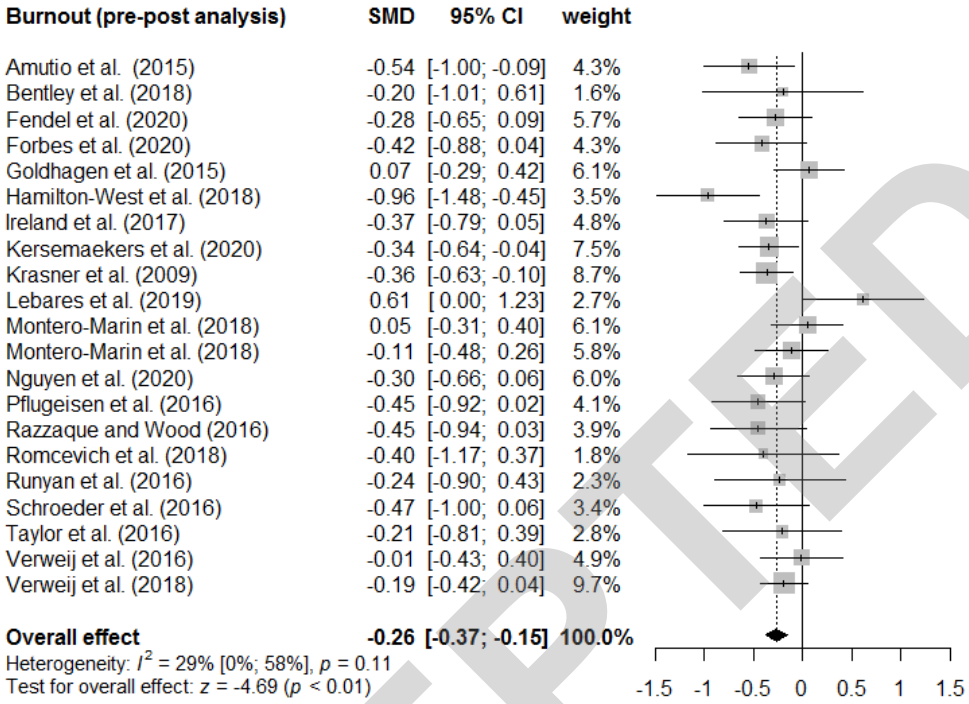


Figure 3a

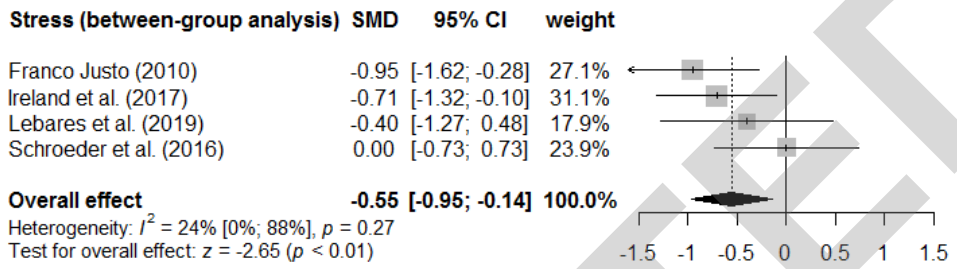
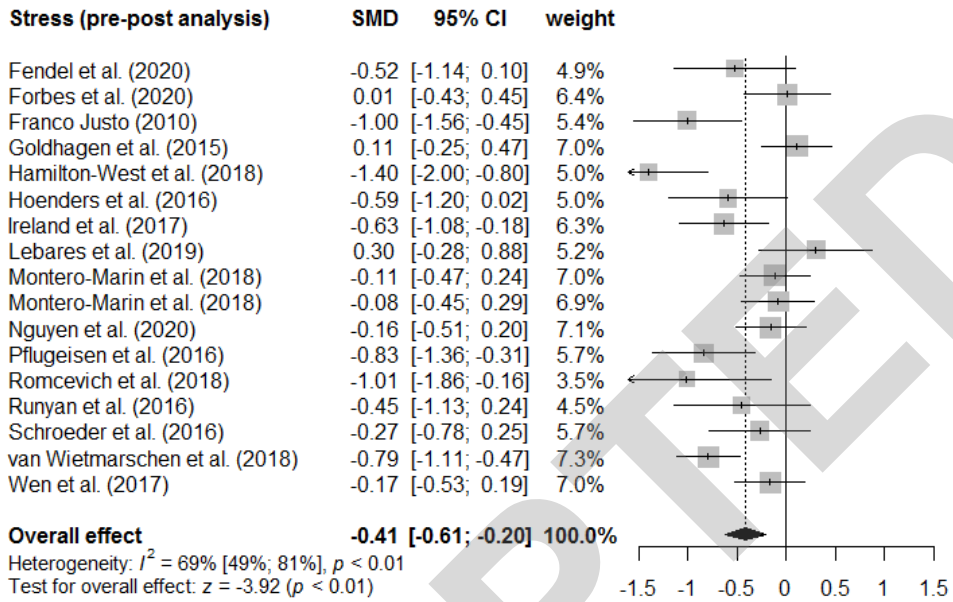


Figure 3b



Appendix 1

Characteristics of Studies, Participants, and Interventions of Randomized-Controlled Trials (RCTs), Included in a 2019 Systematic Review and Meta-Analysis of Studies Evaluating Mindfulness-Based Interventions to Reduce Burnout and Stress in Physicians

Authors, year[ref]	Country	Design (control)	Participants	Specialty	Participants,[a] total (interv/ cntrl)	Sex, male/ female[b] (% female)	Age, mean (SD)	Intervention (length; format[c])	Hours of guided treatment[d]	Measure of burnout / stress
Amutio et al, 2015[65]	Spain	RCT (waitlist)	Practicing physicians	Mixed	42 (21/21)	18/24 (57)	47.3 (9.4)	MBSR (eight 2.5-hour sessions + one 8-hour retreat, 8 weeks; offline)	28	Maslach Burnout Inventory - Human Services Survey / –
Franco Justo, 2010[64]	Spain	RCT (waitlist)	Practicing physicians	General practice	38 (19/19)	27/11 (29)	49.8 (11.7)	Adapted MBSR (ten 1.5-hour sessions, 10 weeks; offline)	15	– / Perceived Stress Scale
Ireland et al, 2017[25]	Australia	RCT (active control: 1-hour extra break per week)	Resident physicians	Family or internal medicine	44 (23/21)	16/28 (64)	26.9 (4.8)	Adapted MBSR (ten 1-hour sessions, 10 weeks; offline)	10	Copenhagen Burnout Inventory / Perceived Stress Scale
Lebares et al, 2019[40]	United States (California)	RCT (active control: psychoeducation)	Resident physicians	Surgery	21 (12/9)	13/8 (36)	28.3 (2.3)	Adapted MBSR (eight 2-hour sessions + two 2.5-hour retreats, 8 weeks; offline)	21	Abbreviated Maslach Burnout Inventory / Perceived Stress Scale
Schroeder et al, 2016[36]	United States (Oregon)	RCT (waitlist)	Practicing physicians	Family or internal medicine	33 (16/17)	9/24 (73)	42.8 (8.4)	Adapted MBSR (two 6.5-hour sessions, 2 days; offline)	13	Maslach Burnout Inventory / Perceived Stress Scale
Verweij et al, 2018[61]	The Netherlands	RCT (waitlist)	Resident physicians	Mixed	148 (80/68)	18/130 (88)	31.2 (4.6)	MBSR (eight 2.5-hour sessions + 1 6-hour retreat, 8 weeks; offline)	26	Maslach Burnout Inventory - Human Services Survey / –

Abbreviations: interv, intervention group; cntrl, control group; SD, standard deviation; MBSR, mindfulness-based stress reduction.

[a]Number of participants taking part in the pre-intervention measurement.

[b]Number of participants reported in the study with data on sex available; total is not necessarily equal to the total number of participants taking part in the pre-intervention measurement.

[c]Intervention format was either offline (i.e., in-person), online (i.e., web-based), or offline & online (i.e., a mixture of offline and online elements).
[d]Hours in which participants had guided treatment (either offline or online); hours of individual practice excluded.

Appendix 2

Characteristics of Studies, Participants, and Interventions of Non-Randomized Trials, Included in a 2019 Systematic Review and Meta-Analysis of Studies Evaluating Mindfulness-Based Interventions to Reduce Burnout and Stress in Physicians[a]

Authors, year[ref]	Country	Design (control)	Participants	Specialty	Participants,[b] total (interv/ cntrl)	Sex, male/ female[c] (% female)	Age, mean (SD)	Intervention (length; format[d])	Hours of guided treatment[e]	Measure of burnout / stress
Bentley et al, 2018[73]	United States (North Carolina)	NCBA	Resident physicians	Psychiatry	6	5/2 (29)	n.i.	Adapted MBSR (eight 1.5-hour sessions, 8 weeks; offline)	12	Maslach Burnout Inventory - Human Services Survey / –
Fendel et al, 2020[37]	Germany	NCBA	Resident physicians	Mixed	9	4/5 (56)	33.3 (4.1)	Adapted MBSR (eight 2.25-hour sessions + one 6-hour retreat, 8 weeks; offline)	24	Copenhagen Burnout Scale (work-related burnout) / Perceived Stress Scale
Forbes et al, 2020[38]	Australia	CBA (active control: teaching program)	Resident physicians	Mixed	62 (23/29)	11/13 (54)	29.0 (5.1)	Other form of MBI: Resilience training (four 1.5-hour sessions, unknown weeks; offline)	6	Professional Quality of Life scale version 5 / Kessler Psychological Distress Scale
Goldhagen et al, 2015[68]	United States (North Carolina)	NCBA	Resident physicians	Mixed (family medicine, psychiatry, anesthesiology)	47	22/25 (52)	n.i.	Other form of MBI: Resilience training (two to three 1-hour sessions, 2–8 weeks; offline)	3	Oldenburg Burnout Inventory / Depression Anxiety Stress Scale
Hamilton-West et al, 2018[67]	United Kingdom	NCBA	Practicing & resident physicians	General practice	22	8/14 (64)	44.5 (7.4)	Adapted MBCT (eight 2-hour sessions, 8 weeks; offline)	16	Maslach Burnout Inventory - Human Services Survey / Perceived Stress Scale

Hoenders et al, 2016[71]	The Netherlands	NCBA	Resident physicians	Psychiatry	11	4/7 (64)	n.i.	MBSR (eight 2-hour sessions, 8 weeks; offline)	16	– / Perceived Stress Scale
Kersemaekers et al, 2020[39]	The Netherlands	CBA (non-active control)	Practicing physicians	Mixed (internal medicine, surgery, supportive)	59 (52/7)	39/20 (66)	47.9 (8.0)	Adapted MBSR (ten 5-hour sessions, 10 weeks; offline)	50	Maslach Burnout Inventory - Human Services Survey / –
Krasner et al, 2009[24]	United States (New York)	NCBA	Practicing physicians	Mixed (family medicine, internal medicine, pediatrics, combined internal medicine and pediatrics)	68	38/32 (46)	n.i.	Other form of MBI: Continuing medical education course (eight 2.5-hour sessions + one 7-hour retreat, 8 weeks; offline)	27	Maslach Burnout Inventory / –
Montero-Marin et al, 2018[62f]	Spain	NCBA	Practicing physicians	General practice	30	7/23 (77)	52.7 (6.3)	Adapted MBSR (one 4-hour offline session + eight 0.75-hour online modules, 4 weeks & 1 day; offline & online)	10	Burnout Clinical Subtype Questionnaire / Negative Affect Schedule
Montero-Marin et al, 2018[62f]	Spain	NCBA	Practicing physicians	General practice	28	7/21 (75)	47.4 (8.2)	Adapted MBSR (one 4-hour offline session + eight 0.75-hour online modules, 4 weeks & 1 day; offline & online)	7	Burnout Clinical Subtype Questionnaire / Negative Affect Schedule
Nguyen et al, 2020[41]	United States (Ohio)	NCBA	Practicing & resident physicians	Mixed (emergency medicine, internal	50	24/26 (52)	35.7 (9.8)	MBST & online modules (three 1-hour offline sessions + four 1-hour online	7	Abbreviated Maslach Burnout Inventory / Perceived Stress Scale

				medicine, surgery)				modules, 12 weeks; offline & online)		
Pflugeisen et al, 2016[63g]	United States (Washington)	NCBA	Practicing & resident physicians	Mixed (family medicine, internal medicine, surgery, sleep medicine, obstetrics/gynecology, anesthesia)	19	12/9 (43)	48.3 (10.0)	Other form of MBI: Video-modules (three 1.5-hour offline sessions + eight 5–7-min online video trainings + eight 1-hour weekly teleconference coaching calls, 8 weeks; offline & online)	12	Maslach Burnout Inventory / Perceived Stress Scale
Razzaque and Wood, 2016[72]	United Kingdom	NCBA	Practicing & resident physicians	Psychiatry	26	9/17 (65)	n.i.	Other form of MBI: Mindfulness-Based Professional Development retreat (two 12-hour sessions, 2 days; offline)	24	Maslach Burnout Inventory / –
Romcevich et al, 2018[42]	United States (Ohio)	NCBA	Resident physicians	Pediatrics	10	3/7 (70)	29.3 (n.i.)	MBST & online modules (four 1.5-hour offline sessions + eight 1-hour online modules, 4 weeks; offline & online)	14	Maslach Burnout Inventory / Perceived Stress Scale
Runyan et al, 2016[43]	United States (Massachusetts)	NCBA	Resident physicians	Family or internal medicine	9	3/9 (75)	n.i.	Other form of MBI: Wellness curriculum (four 2-hour sessions, 4 weeks; offline)	8	Maslach Burnout Inventory / Perceived Stress Scale
Taylor et al, 2016[70]	United States (Illinois)	NCBA	Resident physicians	Pediatrics	31	n.i.	n.i.	Headspace/app-based mindfulness intervention (ten 10-min group	2	Abbreviated Maslach Burnout Inventory / –

								sessions, 10 days; online)		
van Wietmarschen et al, 2018[44]	The Netherlands	NCBA	Practicing physicians	Mixed (87% primary care)	49	12/42 (78)	40.9 (9.0)	Adapted MBSR (eight 3.25-hour sessions, 8 weeks; offline)	26	– / Perceived Stress Scale
Verweij et al, 2016[66]	The Netherlands	CBA (waitlist)	Practicing physicians	General practice	43 (23/20)	33/17 (34)	54.9 (5.7)	MBSR (eight 2.5-hour sessions + one 6-hour retreat, 8 weeks; offline)	26	Maslach Burnout Inventory - Human Services Survey / –
Wen et al, 2017[69]	United States (California)	NCBA	Resident physicians	Mixed (surgery, anesthesia, obstetrics/gynecology)	30	3/27 (90)	n.i.	Headspace/app-based mindfulness intervention (free usage of 10-min guided sessions and additional longer and focused sessions, 4 weeks; online)	n.i.	– / Negative Affect Schedule

Abbreviations: interv, intervention group; cntrl, control group; SD, standard deviation; NCBA, non-controlled before-after study; n.i., no information provided; MBSR, mindfulness-based stress reduction; CBA, controlled before-after study; MBI, mindfulness-based intervention; MBCT, mindfulness-based cognitive therapy; MBST, mind-body skills training; min, minutes.

[a]A few of the included studies were originally identified in the searches as published online ahead of print articles or via the forward citation or grey literature search. These were all later published in peer-reviewed journals and thus have years listed that are after the date of the search.

[b]Number of participants taking part in the pre-intervention measurement.

[c]Number of participants reported in the study with data on sex available; total is not necessarily equal to the total number of participants taking part in the pre-intervention measurement.

[d]Intervention format was either offline (i.e., in-person), online (i.e., web-based), or offline & online (i.e., a mixture of offline and online elements).

[e]Hours in which participants had guided treatment (either offline or online); hours of individual practice excluded.

[f]This article reported results for 2 samples, each of which received a different amount of guided treatment.[62] The authors included both samples as individual studies in the analyses.

[g]Two articles reported on the same study and population.[60,63] The authors included these as a single study in the analyses.[63]