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Review article

Mindfulness training for healthcare professionals and trainees: A meta-analysis of randomized controlled trials

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ABSTRACT

Objective: Healthcare professionals (HCPs) experience a wide range of physical and psychological symptoms that can affect quality of patient care. Previous meta-analyses exploring mindfulness-based interventions (MBIs) for HCPs have been limited by their narrow scope regarding intervention type, target population, and/or measures, and reliance on uncontrolled studies; therefore, a more comprehensive and methodologically rigorous examination is warranted. This meta-analysis quantified the effectiveness of MBIs on distress, well-being, physical health, and performance in HCPs and HCPs-in-training.

Method: RCTs examining the effect of meditation and MBIs on HCPs and HCPs-in-training were identified and reviewed. Two independent reviewers extracted data and assessed risk of bias.

Results: Thirty-eight studies were included in the analyses (n = 2505; 75.88% female). Intervention had a significant moderate effect on anxiety (Hedge's g = 0.47), depression (Hedge's g = 0.41), psychological distress (Hedge's g = 0.46), and stress (Hedge's g = 0.52). Small to moderate effects were also found for burnout (Hedge's g = 0.26) and well-being at post-intervention (Hedge's g = 0.32). Effects were not significant for physical health and performance. Larger intervention effects on overall outcomes were found with HCPs (Hedge's g = 0.52), with Mindfulness-based Stress Reduction intervention (Hedge's g = 0.47), and inactive controls (Hedge's g = 0.36).

Conclusions: Results suggest mindfulness-based interventions are effective in reducing distress and improving well-being in HCPs and HCP-ITs. Subgroup analyses suggest the importance of exploring potential participants' needs prior to selecting the type of mindfulness intervention. Future studies should assess changes in mindfulness and include active controls.

1. Introduction

Healthcare professionals (HCPs; e.g., physicians, nurses, psychotherapists) play an invaluable role in maintaining the physical and mental health of society. However, the stressful nature of their work may lead to greater susceptibility to stress, anxiety, depression, burnout, and suicide [1–6]. Not only does this have significant impact on the well-being of the HCPs, but it may also negatively impact patients and the health care system [7,8]. For example, stress and burnout have been linked to increased medical errors, longer patient recovery times, and poorer patient care/satisfaction [7,9,10]. From an organizational perspective, diminished mental health is associated with reduced work satisfaction and productivity along with increased turnover intent [11,12].

Attention has also been paid to HCPs-in training (HCPs-IT) as they face a similar susceptibility to the aforementioned concerns [13–15]. In fact, they may be especially vulnerable as they are still learning to apply their knowledge [6,8,13]. Their limited experience coupled with an evaluative component can add additional stressors. In turn, psychological distress can affect their clinical competency (e.g., higher error rates), professional qualities (e.g., lower empathy), and patient experience [13–18].

In response to the presented concerns, health and educational organizations have implemented stress management and well-being enhancement programs [6,19]. One type is based on mindfulness and meditation, where participants learn to be purposefully alert and attentive to the present moment and to self-observe in an objective and detached manner [20]. Several studies have explored the impact of mindfulness training on increasing HCPs and HCPs-IT psychosocial well-being (e.g., managing stress, decreasing anxiety and depressive symptoms, reducing burnout, increasing self-compassion) as well as patient well-being (e.g., reducing medical errors) [8,21–26]. Whereas

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some interventions focus solely on meditation (e.g., guided breathing), others use mindfulness-based interventions (MBIs) that combine meditation, discussion, teaching, and homework (e.g., Mindfulness-based Stress Reduction, MBSR) [20].

Several systematic reviews and meta-analyses have been conducted on the effectiveness of meditation and MBIs for HCPs and HCP-Its [1,6,19,22,27–33]. An effect on stress reduction was generally reported, and some studies found increases in mindfulness, mood, resilience, self-compassion, self-efficacy, and empathy [1,6,19,22,27–33]. Interestingly, MBIs' effects on anxiety, depression, and burnout were equivocal; some studies reported benefits and others reported insignificant findings [6,19,27–29,31,32]. This inconsistency may be a result of previous reviews' narrow scope in terms of intervention type, target population, and/or measures [6]. For example, while one recent meta-analysis solely examined the effect of MBIs on stress and only included HCPs [1], another only examined MBSR [30], while others limited their selection to nurses only [29,32].

Constraints on the selection criteria can reduce the number of included studies; potentially limiting the ability to explore moderating factors. Although it is assumed the teaching and practice of mindfulness is central to the intervention and thus, the effects on measured outcomes, other factors regarding the participants, the intervention, and study methodology could also impact findings. Therefore, it is common practice in meta-analytic research of mindfulness to explore the moderating effects of age, gender, intervention length, duration of homework, and study quality on effect sizes of the outcome measures [23,34–36]. Generally, age has not been observed to show moderation effects; however, equivocal findings are noted for study quality, duration of treatment and home practice [23,34–36]. A comparable meta-analysis examining a non-clinical, adult population did not find a moderation for study quality but found weak moderations for duration [23]. Previous meta-analyses of HCPs and HCPs-IT have not explored these moderating factors, likely due to the limited number of included studies.

Furthermore, many of the reviews examined both controlled and uncontrolled studies. This is problematic as studies with uncontrolled designs may inflate treatment effects compared to randomized control trials (RCTs) [23,29]. Key benefits of RCTs include greater methodological rigor, reduced bias and effect of nonspecific factors (e.g., time), and potential for evaluation using standardized criteria (e.g., Cochrane Risk of Bias Tool) [6,37]. To more precisely explore the effects of MBIs, it is of interest to focus solely on RCTs.

Currently, the literature search for previously published reviews took place before January 2017 and the meta-analyses examined a relatively small sample of studies (ranging from 8 to 28) of which even fewer are RCTs (ranging from 2 to 16) [1,19,27,29,31]. As mindfulness is a growing field of research, the large amount of newly published articles coupled with the aforementioned limitations strongly signal the need for an updated systematic analysis of the effects of meditation and MBIs on HCPs and HCPs-IT that 1) has wide inclusion criteria regarding population, intervention outcome, and intervention type, and 2) includes only RCTs.

1.1. Study objectives

We conducted a comprehensive meta-analysis of any study utilizing a RCT design to compare a group of HCPs or HCPs-IT completing a meditation training or MBI with a control group on at least one quantitative outcome (including distress, well-being, physical health, performance, and mindfulness). The present analysis further seeks to 1) explore the impact of intervention type, control type, format of intervention delivery, and target population on outcomes, and 2) examine moderator variables (i.e., age, gender, length of intervention, duration of homework, and study quality).

2. Methods

This meta-analysis was completed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [38]. The PRISMA Checklist can be found in the online supplement.

2.1. Eligibility criteria

Studies eligible for inclusion were peer-reviewed articles and dissertations adhering to the following PICOS criteria: 1) sample consisted solely of HCPs and/or HCPs-IT, 2) intervention was based primarily on meditation or mindfulness (e.g., MBSR, mindfulness-based cognitive therapy, Vipassana meditation, movement meditation) and could be conducted in person or online and in group or individual settings, 3) intervention must be compared to a control condition (both active and inactive controls are acceptable), 4) at least one quantitative measure (e.g., mindfulness, anxiety, well-being, clinical skills) taken at baseline and post-intervention must be reported, and 5) an RCT design must be used.

Studies were excluded if: 1) quantitative measures were not used to evaluate effects on HCPs or HCPs-IT (e.g., qualitative studies), 2) mindfulness or meditation was not the primary intervention (e.g., Dialectical Behavioral Therapy) [39], 3) data were insufficient to compute standardized mean effects, 4) data were already included in other articles, and 5) publication language was not in English or French.

2.2. Search strategy and data sources

Four electronic databases (PsycINFO, PubMed, Medline, and Proquest Dissertation and Theses) were searched using the terms: *meditation or mindfulness* AND *health* professionals or psychologist or trainee or counsellor or nurse or doctor or therapist * or intern or psychiatrists or social worker or medical or student* AND *random**. The search was limited to abstract and title for PubMed and Proquest Dissertation and Theses. PsycInfo and Medline searches were limited to title, abstract, and subject heading. An example of a full electronic search strategy can be found in the online supplement. Reference lists of retrieved articles and systematic reviews were manually reviewed. Our search was conducted from the first available date to August 26, 2018.

2.3. Study selection

Duplicates were removed using Endnote X8.2 and exported to Rayyan, an online screening tool [40]. A non-blinded, standardized protocol was used to determine inclusion eligibility using the aforementioned criteria by the first (C.S.) and second (M.W.) authors. To ensure consistency in the selection process, C.S. and M.W. separately assessed the same 68 articles (10% of the articles following duplication removal) and compared reasons for inclusion or exclusion. As C.S. and M.W. agreed on all articles, they then each assessed half of the remaining articles using the same eligibility criteria. Following initial exclusion, C.S. and M.W. discussed the remaining 126 full-text articles to assess for inclusion. Any disagreements were resolved through consultation with the third author (B.K.). Authors of six eligible studies with missing data were contacted to request additional information. Two authors responded, and their studies were included. The selection process is outlined in Fig. 1.

2.4. Data items

We extracted the following information from each trial: 1) study characteristics (publication year, randomization procedure, research design, type of control and follow-up time), 2) participant characteristics (sample size for intervention and control groups, age, gender, type of HCP and attrition rate), and 3) intervention characteristics (e.g., type of intervention, length of intervention, length of homework, and instructor qualification).

Data pertaining to all available outcomes at all time points were included to reduce selection bias. We categorized our outcomes into: 1) distress outcomes (e.g., burnout), 2) well-being outcomes (e.g., self-

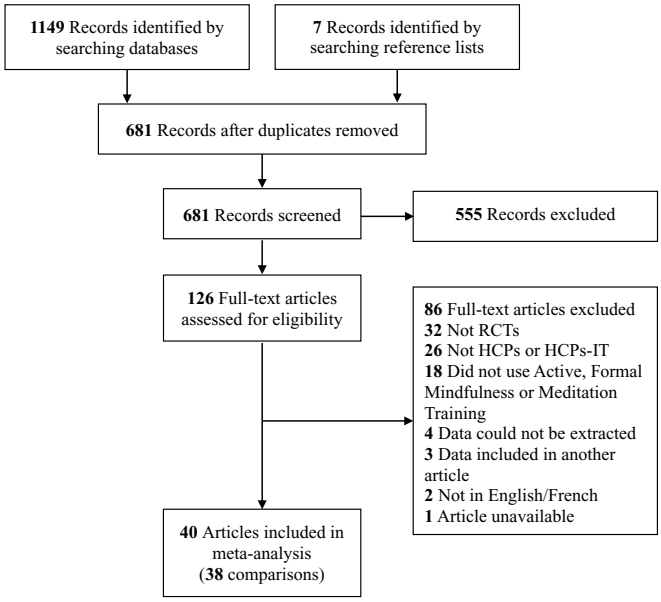

Fig. 1. PRISMA flow diagram of the study selection process.

compassion), 3) physical health outcomes (e.g., heart rate), and 4) performance outcomes (e.g., clinical skills). Mindfulness was examined separately as it is the main process component of the interventions.

2.5. Assessing risk of bias

We produced a fail-safe *N* and funnel plot to measure publication bias across studies [41]. Rules outlined in Chapter 8 of The Cochrane Handbook, Version 5.1.0 were used to examine risk of bias within studies [42]. CS and MW assessed each article independently and resolved any scoring differences through discussion. A quality score (high, low, or unclear) was assigned to seven different risk factors.

2.6. Analyses

The meta-analysis was conducted using Comprehensive Meta-Analysis, Version 3.070 [43]. Effect sizes were computed mostly using means and standard deviations. Some studies required the extraction of *F* and *p* statistics. If correlations between pre and post intervention measures were unavailable, a conservative estimate ($r = 0.7$) was used [23,34,36,41]. Mean Hedge's *g*, 95% confidence interval (95% CI), and *p* values were computed for all studies. Calculation of mean effect size was conducted by pooling individual effect sizes for each outcome measure; utilizing a random effects model as it is more conservative and resilient to heterogeneity [23]. The I^2 statistic was used to examine heterogeneity (low at 25%, moderate at 50%, and high at 75%] [44].

In addition, we grouped and reported outcomes based on 1) target population (i.e., HCPs and HCPs-IT), 2) intervention type (e.g., MBSR, meditation protocol), 3) control type (i.e., active and inactive), and 4) facilitator type (e.g., electronic delivered, trained facilitator). Furthermore, we conducted meta-regression analyses to determine the effect of moderators on the pooled effect size. We examined only between-subject effects and explored five moderators: 1) mean age, 2) percentage of female participants, 3) intervention length, 4) duration of home practice (if indicated in the intervention protocol), and 5) study quality score.

3. Results

3.1. Study characteristics

The data from 40 articles were included [21,24–26,45–80]. However, two pairs of papers used the same population and methodology [52,53,66,67]. Therefore, they were combined in the analyses; leaving 38 included studies (see Table 1). Thirty studies (79%) were published as journal articles and 8 studies were doctoral dissertations. Twenty studies were conducted in North America, 8 in Asia, 3 in Australia and New Zealand, 6 in Europe, and 1 in South America. Sampling strategies included simple ($n = 20$), stratified ($n = 10$), block ($n = 4$), cluster ($n = 3$), and minimization ($n = 1$).

3.2. Participant characteristics

2505 participants were included (75.88% female). Most of the studies ($n = 26$; 68%) were conducted with HCPs-IT; specifically, 12 studies with medical students/residents, 7 with nursing, 4 with counsellors/psychologists, and 3 with mixed medical and other specialties. For HCP studies ($n = 12$), 6 were conducted with nurses, 4 with mixed HCPs, and 2 with physicians. Mean age ranged from 19.27 to 50.

3.3. Intervention characteristics

Interventions consisted of MBSR ($n = 6$), modified MBSR (MBSR-M; $n = 11$), other MBIs (MBIs-O; $n = 9$), and meditation ($n = 12$). MBSR studies used the standard protocol, whereas MBSR-M studies shortened the intervention length and/or made changes to suit a medical/hospital setting (e.g., using examples relevant to physicians). MBIs-O were any non-MBSR protocols that integrate teaching, mindfulness, and discussion (e.g., Eight-Point Program of Easwaran) [81]. Meditation interventions focused solely on teaching/practicing one meditation type (e.g., Vipassana). The duration of the interventions (intervention and homework) ranged from 2.5 to 70 h. Intervention was most commonly delivered by trained professionals ($n = 20$; e.g., MBSR instructor), followed by students ($n = 6$; e.g., peer-led interventions), and by electronics ($n = 5$). Seven studies did not specify the training of the facilitator. Thirty-four studies (89%) had one control group while 4 studies had two different control groups. Twenty-one studies were compared to waitlist, 9 to no intervention, 9 to an active intervention (e.g. relaxation task, health education course), and 3 to class or care-as-usual. Twenty-three studies did not include a follow-up component. Follow-up times ($n = 15$) ranged from 4 to 80 weeks ($M = 24.27$).

3.4. Synthesis of results

The following only reports between-group analyses as it is more conservative and generally less susceptible to bias [82]. Measures at post-intervention and follow-up were compared to baseline. Main analyses are presented in Table 2 (see the online supplement for additional analyses).

Interventions had a small to moderate significant effect on overall outcome at post-intervention (Hedge's g = 0.35; 95% CI [0.27, 0.43]) and follow-up (Hedge's g = 0.31; 95% CI [0.16, 0.46]). Heterogeneity was low at both timepoints. For distress related outcomes, significant moderate effects on anxiety (Hedge's g = 0.47; 95% CI [0.27, 0.67]), depression (Hedge's g = 0.41; 95% CI [0.26, 0.57]), psychological distress (Hedge's g = 0.46; 95% CI [0.30, 0.62]), and stress (Hedge's g = 0.52; 95% CI [0.35, 0.69]) were found at post-intervention. A small significant effect was found on burnout (Hedge's g = 0.26; 95% CI [0.11, 0.42]). At follow-up, a significant small to moderate effect was found only for stress (Hedge's g = 0.34; 95% CI [0.11, 0.57]). Heterogeneity was moderate, except for depression and burnout (low). This indicates the need for some caution when interpreting results. For well-being related outcomes, interventions had significant small to moderate effect at post-intervention (Hedge's g = 0.32; 95% CI [0.23, 0.42]) and follow-up (Hedge's g = 0.33; 95% CI [0.17, 0.49]) with low heterogeneity at both timepoints. Self-compassion (a measure included in the well-being related outcomes) had a significant small to moderate effect at post-intervention (Hedge's g = 0.35; 95% CI [0.05, 0.65]) with low heterogeneity. No significant effects on physical health and

Table 1
Description and effect size analyses of overall outcome and mindfulness for the selected studies.

Study name	Participants (N)	Mean age	% female	Int type (n)	Cx type (n)	Int length (Hr)	Attrn rate (%)	Extracted measures
Alexander et al., 2015 [45]	Nurses (40)	46.38	97.5	MoM (20)	CAU (20)	8 weeks	0	FMI; HPLP-II; MBI
Amutio et al., 2015 [46]	Physicians (42)	47.31	57.1	MBSR (21)	Waitlist (21)	70	0	FFMQ; Heart Rate; SRSI
Burger, 2015 [47]	Students (Nur; 60)	19.5 to 52	82.7	MM (32)	Waitlist (28)	4.67	13.33	ANT; FFMQ; MAT; PSS-10;
Burrows, 1984 [48]	Students (MH; 39)	29.82	56.41	CM (12)	Relaxation (13) No int (14)	5.67	17.02	POI
Chang et al., 2016 [49]	Nurses (50)	31.5	–	MoM (25)	No Int (25)	8.7 + HW	20	PKPCT V II; WHOQol-BREF;
Chen Yu et al., 2013 [50]	Students (Nur; 60)	19.5	86.7	MM (30)	No int (30)	3.5	0	SAS; SDS
Danilewitz et al., 2016 [51]	Students (Med; 30)	–	73	MBSR-M (15)	Waitlist (15)	10 + HW	26.67	AAS; DASS; FFMQ; JSPE; SCS
de Vibe et al., 2013; 2018 [52,53]	Students (Med&MH; 288)	23.8	76	MBSR-M (144)	No int (144)	39.5	63.19	FFMQ; GHQ12; MBI; PMSS; SWB; WCC
Erogul et al., 2014 [54]	Students (Med; 58)	23.5	45.6	MBSR-M (28)	No int (30)	33.67	1.69	PSS; RS; SCS
Frisvold, 2019 [55]	Nurses (40)	48.35	100	MBSR (20)	Health education (20)	69	5	BMI; CAM-SR; CES-D; DASS-21; PSQI; PSS; Weight
Greene & Hiebert, 1988 [56]	Students (Nur; 24)	–	75	MM (12)	CSO (12)	13.5	0	POI; SOSI
Ireland et al., 2017 [57]	Students (Med; 44)	26.88	64	MBIs-O (23)	Active break (21)	10 + HW	0	CBI; PSS-10
Jain et al., 2007 [58]	Students (Med&Nur; 104)	25	81.48	MBSR-M (33)	Relaxation (35) Waitlist (36)	12 + HW	22.12	BSI; DER; INSPIRIT-R; PSOM
Kang et al., 2009 [59]	Students (Nur; 41)	22.47	100	MBSR-M (21)	No int (20)	14 + HW	21.95	BDI; PWISF; STAI
Kim et al., 2013 [60]	Nurses (22)	46.3	95.45	MoM (11)	No int (11)	16	4.55	ACTH; Cortisol; DHEAS; PCL-C
Kuhlmann et al., 2016 [61]	Students (Med&Dent; 80)	23.39	84	MBIs-O (31)	Relaxation (32) Waitlist (17)	7.5 + HW	56.28	GSI; SSCS
Leggett, 2010 [62]	Students (Nur; 85)	–	87.1	MBIs-O (42)	CAU (43)	16.17	5.56	CES-D; CSE; Diastolic; Heart Rate; MAAS; SCCA; Systolic
Mackenzie et al., 2006 [63]	Nurses & Nurse aides (30)	46.83	96.67	MBSR-M (16)	Waitlist (14)	5.33	0	JSS; MBI; OLQ; SRDI; SWLS
Manotas, 2012 [64]	HCP (131)	39.07	90.24	MBSR-M (66)	Waitlist (65)	17.33	34.35	AAQ-II; BSI; ESQ; FFMQ; PSS; TMS
Martin-Asuero et al., 2014 [21]	HCP (68)	47	92	MBIs-O (43)	Waitlist (25)	28 + HW	0	FFMQ; JSPE; MBI; PMS
Moir et al., 2016 [65]	Students (Med; 275)	20.9	53	MBIs-O (133)	No int (142)	25 weeks	15.64	GAD; LASA; MSLQ; PCL; PHQ-9; RS
Oman et al., 2008; 2010 [66,67]	HCP (61)	22.3	86.21	MBIs-O (30)	Waitlist (31)	16 + HW	4.92	IRI; JS; MMRS; RCSE
Paholpak et al., 2012 [68]	Students (Med; 58)	23.29	50	MM (30)	Non-meditative activity (28)	9.33	0	APM; SCL-90; WMS-I
Park, 2014 [69]	Students (Nur; 89)	19.27	100	VM (29)	Biofeedback (29) No int (31)	4 weeks	0	PSS; STAI
Phang et al., 2015 [70]	Students (Med; 73)	21.04	76	MBIs-O (37)	Waitlist (36)	12.33	6.67	GHQ; GSE; MASS; PSS
Phang et al., 2015 [71]	Students (Med; 76)	20.93	78.95	MBIs-O (38)	Waitlist (38)	5 weeks	1.32	DASS; GSE; MAAS; PSS
Pipe et al., 2009 [72]	Nurses (34)	49.78	96.88	MBSR-M (17)	Leadership course (17)	22	2.94	CES; SCL-90
Reiman, 1984 [73]	Students (MH; 37)	–	–	VM (22)	No int (15)	23.33	0	TAIS
Schroeder et al., 2018 [74]	Physicians (33)	42.76	73	MBSR-M (16)	Waitlist (17)	13	21.21	BRS; MAAS; MBI; PSS; SCBS
Shapiro et al., 1998 [75]	Students (Med; 78)	–	56.16	MBSR-M (37)	Waitlist (41)	17.5 + HW	6.41	ECRS; INSPIRIT; SCL-90; STAI
Shapiro et al., 2005 [76]	HCP (Mix; 38)	–	–	MBSR (18)	Waitlist (20)	16 + HW	26.32	BSI; MBI; PSS; SCS; SWLS;
Song & Lindquist, 2014 [24]	Students (Nur; 50)	19.55	81.82	MBSR (25)	Waitlist (25)	16 + HW	12	DASS; MAAS
Spragg, 2011 [77]	Students (MH; 30)	25.5	93.75	MBSR (15)	Waitlist (15)	69.5	53.33	IRI; KIMS; MBI; SCS
Swift et al., 2017 [78]	Students (MH; 40)	27.5	70	MBIs-O (20)	Waitlist (20)	2.5 + HW	0	FFMQ; TPI-T
van Dijk et al., 2017 [79]	Students (Med; 167)	23.5	78.44	MBSR-M (83)	CAU (84)	23.47	25.15	BSI; IBI; FFMQ; JSPE; LiSat-9; MHC-SF
Verwij et al., 2018 [80]	Students (Med; 148)	31.2	88	MBSR (80)	Waitlist (68)	69	6.76	FFMQ; JSPE; Medical Errors; MHC-SF; PSW; SCS-SF; SWHI; UBOS-C

(*continued on next page*)

Table 1 (*continued*)

Study name	Participants (N)	Mean age	% female	Int type (n)	Cx type (n)	Int length (Hr)	Attrn rate (%)	Extracted measures
Warneck et al., 2011 [25]	Students (Med; 66)	23.92	42	MM (32)	Waitlist (34)	28	15.15	DASS; PSS
Yang et al., 2018 [26]	Students (Med; 88)	25.11	63.6	MM (45)	Waitlist (43)	7.08	6.82	FFMQ; GWBS; PSS-10

Abbreviations: AAQ-ll, Acceptance and Action Questionnaire; AAS, Adapted Altruism Scale; ACTH, adrenocorticotropic hormone; ANT, Attention Network Test; Attrn, Attrition; BDI, Beck Depression Inventory; BMI, Body Mass Index; BRS, Brief Resilience Scale; BSI, Brief Symptom Inventory; CAM-SR, Cognitive and Affective Mindfulness-Self-Report; CBI, Copenhagen Burnout Inventory; CES-D, Centre for Epidemiologic Depression Scale; CSE, Clinical Skills Evaluation; CoM, Concentrative Meditation; Cx, Control; CSO, Cognitive Self-Observation; DASS-21, Depression, Anxiety Stress Scales-21; DASS, Depression, Anxiety, Stress Scales; Dent, Dental; DER, Daily Emotion Report; DHEAS, dehydroepiandrosterone sulfate; ECRS, Empathy Construct Rating Scale; ESQ, Emotional Style Questionnaire; FFMQ, Five Facet Mindfulness Questionnaire; FMI, Freiburg Mindfulness Inventory; GAD-7, Generalized Anxiety Disorder; GHQ, General Health Questionnaire; GHQ12, 12-item General Health Questionnaire; GSE, General Self-Efficacy; GSI, Global Severity Index; GWBS, General Well-Being Scale; HPLP-ll, HCP, Healthcare Practitioner; Health-Promoting Lifestyle Profile; HW, Homework; INSPIRIT-R, Index of Core Spiritual Experiences; Int; Intervention; IRI, Interpersonal Reactivity Index; JS, Johnson Scale; JSPE, Jefferson Scale of Physician Empathy; JSS, Job Satisfaction Survey; KIMS, Kentucky Inventory Mindfulness Skills; LASA, Linear Analog Scale Assessment; LiSat-9, Life Satisfaction Questionnaire; MAAS, Mindful Attention Awareness Scale; MAT, Medication Administration Task; MBI, Maslach Burnout Inventory; Med, Medical; MH, Mental Health; MHC-SF, Mental Health Continuum-Short Form; MHC-SF, Mental Health Continuum-Short Form; MBIs-O, Mindfulness Based Intervention Other; MBSR, Mindfulness Based Stress Reduction; MBSR-M, Mindfulness Based Stress Reduction Modified; MM, Mindfulness Meditation; MoM, Movement Meditation; MMRS, Multidimensional Measure of Religiousness/Spirituality; MSLQ, Motivated Strategies for Learning; Nur, Nursing; OLQ, Orientation to Life Questionnaire; PCL−C, Post-Traumatic Stress Disorder Checklist–Civilian Version; PCL, Perceived Competence for Learning; PHQ-9, Patient-Health Questionnaire-9; PKPCT V ll, Power as Knowing Participation in Change Test V ll; PMS, Profile of Mood States; PMSS, Perceived Medical School Stress Instrument; POI, Personal Orientation Inventory; PSOM, Positive States of Mind; PSQI, Pittsburgh Sleep Quality Index; PSS-10, Perceived Stress Scale-10; PSS, Perceived Stress Scale; PSW, Penn State Worry; PWI-SF, Psychosocial Well-Being Index Short Form; RCSE, Relationship-Contingent Self-Esteem; RS, Resilience Scale; SAS, Self-Rating Anxiety Scale; SCBS, Santa Clara Brief Compassion Scale; SCCA, Student Clinical Completion Appraisal; SCL90, Symptom Checklist-90; SCS-SF, Self-Compassion Scale-Short Form; SCS, Self-Compassion Scale; SDS, Self-Rating Depression Scale; SOSI, Symptoms of Stress Inventory; SRDI, Smith Relaxation Dispositions Inventory; SRSI, Smith Relaxation States Inventory; SSCS, Chronic Stress Screening Scale; STAI, State-Trait Anxiety Inventory; SWB, Subjective Wellbeing; SWHI, Survey Work–Home Inter-action; SWLS, Satisfaction With Life Scale; TAIS, Attentional and Interpersonal Style; TMS, Toronto Mindfulness Scale; TPI-T, Therapeutic Presence Inventory-Therapist; UBOS-C, Utrechtse Burnout Schaal (Dutch version of MBI); VM, Vipassana Meditation; WCC, Ways of Coping Checklist; WHOQol-BREF, World Health Organization Quality of Life- BREF.

performance outcomes at both timepoints were found. Finally, a small to moderate effect on mindfulness was observed at post-intervention (Hedge's g = 0.35; 95% CI [0.24, 0.45]) and follow-up (Hedge's g = 0.34; 95% CI [0.17, 0.52]) with low heterogeneity at both timepoints.

3.5. *Synthesis of grouped analyses*

Grouped analyses are summarized in the online supplement. At post-test, larger intervention effects on overall outcomes were found with HCPs (Hedge's g = 0.52; 95% CI [0.34, 0.70]), MBSR intervention (Hedge's g = 0.47; 95% CI [0.17, 0.76]), and inactive controls (Hedge's g = 0.36; 95% CI [0.28, 0.45]). Of the studies that specified the type of facilitator (e.g., electronic-delivery, trained instructor, student), electronic-delivery produced the largest effect on overall outcome (Hedge's g = 0.39; 95% CI [0.17, 0.61]). Larger intervention effects on mindfulness were also found with HCPs (Hedge's g = 0.48; 95% CI [0.25, 0.71]), MBSR intervention (Hedge's g = 0.45; 95% CI [0.22, 0.69]), and electronic-delivery (Hedge's g = 0.38; 95% CI [0.10, 0.65]).

In addition, MBSR had the largest effect on stress (Hedge's g = 0.77; 95% CI [0.02, 1.52]. MBIs-O had the largest effect on burnout (Hedge's g = 0.47; 95% CI [0.10, 0.85] and MBSR-M had largest effects on anxiety (Hedge's g = 0.70; 95% CI [0.30, 1.09]), depression (Hedge's g = 0.68; 95% CI [0.41, 0.94], and psychological distress (Hedge's g = 0.52; 95% CI [0.25, 0.80]. Well-being outcomes were most effected by meditation (Hedge's g = 0.44; 95% CI [0.14, 0.74]. Finally, the largest intervention effects for mindfulness were found with HCPs (Hedge's g = 0.48; 95% CI [0.25, 0.71) and through MBSR (Hedge's g = 0.45; 95% CI [0.22, 0.69]). Heterogeneity was moderate to high for the effect of MBSR on stress and for MBSR-M on anxiety and psychological distress (all other findings had low heterogeneity). Caution may be needed when interpreting these findings. Follow-up findings suggest MBSR-M had the largest effect on both overall outcomes (Hedge's g = 0.42; 95% CI [0.20, 0.64) and mindfulness (Hedge's g = 0.45; 95% CI [0.19, 0.71) with low heterogeneity.

3.6. *Risk of bias within studies*

Results are displayed in Fig. 2. Most studies were rated at low (63%) or unclear (34%) risk for random sequence generation. For allocation concealment, almost all studies (97%) had unclear risk, with the remaining 3% at high risk. All studies had high risk of performance bias, as it is not feasible to blind participants. Almost all studies (97%) had unclear risk for detection bias, with the remaining 3% identified as high risk. Attrition bias was generally low (42%) or unclear (26%) risk, although 32% were at high risk. For reporting bias, risk was either low (11%) or unclear (89%). In terms of other biases, most studies were identified as low (61%) or unclear (13%) risk, although 26% were deemed high risk. To assess the effect of study quality, values of 0 to high risk, 1 to unclear, and 2 to low risk were assigned and scores were added together for each article. Out of a possible 14 points, quality scores ranged from 6 to 11 with an average of 8.10 (SD = 1.23).

3.7. *Risk of bias across studies*

The effect size for all controlled analyses corresponded to a z-value of 8.82 ($p < .001$); signifying at least 732 studies with null effect would be needed to invalidate our findings. Using the Trim and Fill method, 9 studies would need to fall on the left of the mean effect size for a symmetrical funnel plot (Fig. 3). The new imputed effect size was Hedge's g = 0.28 (95% CI [0.20, 0.35]). Although the imputed effect size is smaller than the original effect sizes, these analyses still suggest our effect sizes are valid and robust.

Table 2
Effect sizes and other between-group statistics for controlled studies at post-intervention and follow-up.

Time point	Outcomes	Ns	Hedge's g	95% CI	*p*	I^2 (%)	Q
Post intervention	Overall outcome	38	0.35	0.27, 0.43	$p < .001$	0.00	32.72
	Anxiety	14	0.47	0.27, 0.67	$p < .001$	53.93	28.22
	Burnout	9	0.26	0.11, 0.42	0.001	0.00	3.71
	Depression	14	0.41	0.26, 0.57	$p < .001$	21.46	16.55
	Psychological distress	14	0.46	0.30, 0.62	$p < .001$	40.51	21.85
	Stress	18	0.52	0.35, 0.69	$p < .001$	43.40	30.04
	Well-being outcomes	24	0.32	0.23, 0.42	$p < .001$	0.00	15.68
	Physical health outcomes	3	−0.13	−0.46, 0.19	0.41	0.00	1.79
	Performance outcomes	8	0.21	−0.01, 0.43	0.06	37.86	11.26
	Cognitive Performance	5	0.11	−0.11, 0.33	0.34	0.00	1.81
	Clinical skills	4	0.27	−0.15, 0.68	0.21	68.46	9.51
	Mindfulness	18	0.35	0.24, 0.45	$p < .001$	0.00	9.59
Follow-up	Overall outcome	10	0.31	0.16, 0.46	$p < .001$	0.00	4.72
	Burnout	2	0.60	−0.28, 1.48	0.18	51.39	2.06
	Depression	1	0.40	−0.02, 0.83	0.06	–	–
	Psychological distress	3	0.20	−0.08, 0.47	0.17	17.21	2.42
	Stress	5	0.34	0.11, 0.57	0.004	0.00	3.10
	Well-being outcomes	9	0.33	0.17, 0.49	$p < .001$	0.00	5.52
	Physical health outcomes	1	0.13	−0.29, 0.56	0.54	–	–
	Performance outcomes	1	0.21	−0.14, 0.56	0.24	–	–
	Mindfulness	7	0.34	0.17, 0.52	$p < .001$	0.00	3.62

Abbreviations: 95% CI, 95% Confidence Interval; Ns, Number of studies; Post, Post Intervention.

3.8. Additional analyses

Following intervention, the effect size of overall outcomes was positively moderated by age ($n = 31$; $\beta = 0.01$, SE = 0.001, $p < .001$), percentage of female participants ($n = 35$; $\beta = 0.004$, SE = 0.001, $p < .001$), intervention length ($n = 32$; $\beta = 0.02$, SE = 0.003, $p < .001$), duration of home practice ($n = 19$; $\beta = 0.01$, SE = 0.003, $p < .001$), and study quality score ($n = 38$; $\beta = 0.04$, SE = 0.01, $p < .001$). Although these moderations were positive and significant, they were very weak in predicting changes in intervention effect sizes.

4. Discussion

4.1. Summary of main analyses

This meta-analysis examined 40 articles (38 studies) using a RCT design to explore the effects of meditation/mindfulness training on psychological, physical, and performance outcomes in HCPs and HCPs-ITs. Consistent with previous reviews, our results suggest these interventions have small to moderate effectiveness at post-intervention and follow-up, specifically for distress and well-being related outcomes. [1,6,23,31].

HCPs and HCPs-IT may experience negative psychological outcomes due to the stressful nature of their work, and mindfulness-based interventions were generally found to reduce symptoms. Significant moderate effects on anxiety, depression, psychological distress, and stress were found, along with a small effect on burnout. Only stress showed a small to moderate effect at follow-up. Whereas moderate effects on stress have been generally consistent in other meta-analyses, other symptoms, such as depression and anxiety have been more equivocal; especially burnout [6,29,31]. One meta-analysis found no significant effects [19], two had too few studies to compute effects [1,31], and one found small to moderate effects on emotional exhaustion and large effects on the personal accomplishment facets of burnout [27]. However, the meta-analyses with significant effects had more studies, suggesting more robust findings. Our findings were more conservative than previous meta-analyses, but we included more studies. These conservative findings are also reflective of the general physician burnout research [7].

Beyond distress, measures of well-being, physical health, and performance also contribute to overall health and can be protective factors [6]. Furthermore, changes in clinical skills will naturally affect patient outcome. A small to moderate significant effect was found on well-being, which is consistent with previous reviews and meta-analyses [23,27,31]. However, physical health, cognitive performance, and clinical skills were not significantly affected by mindfulness training. Other related meta-analyses have not quantified these effects, though qualitative analyses suggest potential benefits [27,29]. The scope of our

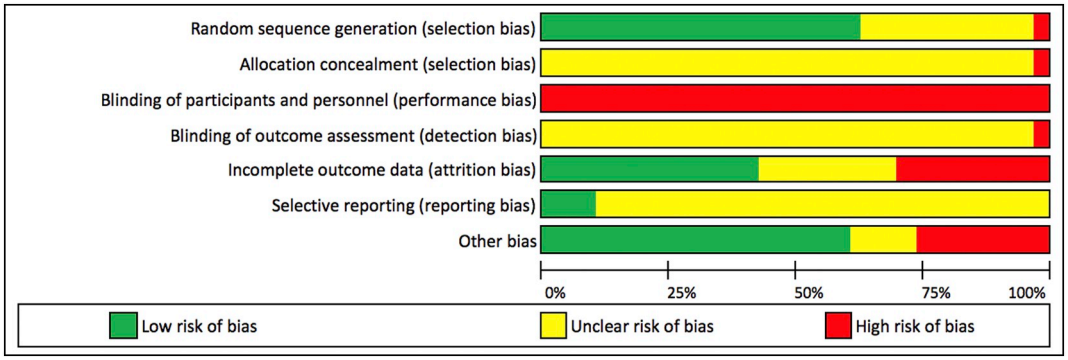

Fig. 2. Cochrane risk of bias ratings for individual studies. The average number of included studies falling under low risk (green), unclear risk (yellow), and high risk (red) are shown for each of the seven types of bias. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

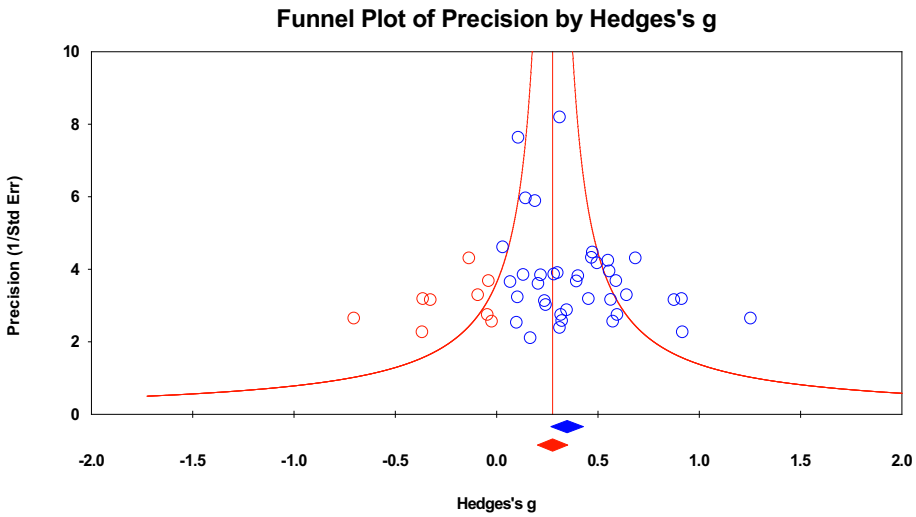

Fig. 3. Funnel plot of precision by Hedge's *g* for controlled data. In the absence of publication bias, the studies are distributed symmetrically. Larger studies appear towards the top of the graph and cluster around the mean effect size while smaller studies appear towards the bottom.

interpretation is reduced due to the limited number and high heterogeneity of studies including clinical skills outcomes. Furthermore, combining psychosocial with physical and cognitive measures may underestimate the observed effects.

Finally, when exploring the effects of MBIs, it is important to examine whether a change in mindfulness occurs, as the primary goal of MBIs is to increase mindfulness. However, less than half the studies (47%) included a validated measure. The results suggested a small to moderate increase in mindfulness that persisted to follow-up, which is aligned with previous reviews and meta-analyses [23,31].

4.2. Summary of grouped analyses

When reporting differences between HCPs and HCPs-IT, we found larger effects of mindfulness training on overall outcomes (including mindfulness) at both timepoints for HCPs. A similar difference was found in a previous meta-analysis, where interventions targeting younger physicians had smaller benefits on burnout than those with more experience [7]. Although these findings do not discount the benefit of mindfulness with HCPs-IT, they reflect the potential for HCPs and HCPs-IT to require differing forms of support [7].

There were a wide range of included interventions, and all appeared to significantly affect overall outcomes. However, specific interventions appeared to affect individual outcomes differently. For example, MBSR had the largest reported effect on stress, but no significant effects on burnout or well-being. This finding may help clarify why previous meta-analyses have reported equivocal results; differing effects will likely be found depending on intervention type. In addition, previous research found MBSR had larger reported effects than meditation training alone; particularly for stress reduction [31]. While our results echo this finding on distress-related outcomes, meditation appeared to be most effective in increasing well-being. This highlights the possibility that the multi-faceted methods of MBIs are more important in reducing distress, but simpler methods of meditation practice are sufficient when focusing on well-being. Further research is needed to explore this potential difference.

It may be of value for future studies to continuing exploring other characteristics of HCPs and HCPs-IT to develop a more holistic and broad understanding of the impacts of mindfulness. Knowledge can be drawn from the included studies; while measures of anger, altruism, compassion to others, coping, empathy, life satisfaction, quality of life, self-efficacy, self-esteem, and spirituality were extracted, there were too few studies to warrant separate analysis. We may also recommend exploring measures related to qualities and skills often considered desirable in professionals (e.g., ambiguity tolerance, emotional intelligence, empathy, humility, leadership, resilience) [83–87] as well as utilizing behavioral measures to assess impact on important clinical skills (e.g., diagnostic accuracy). Furthermore, exploration of the interpersonal impacts of mindfulness training may be of value. A qualitative review of MBIs on nurses suggested improved communication with both patients and colleagues [29]. Considering HCPs and HCPs-IT work in a social field, it may be relevant to explore the impacts of mindfulness on work relationships (e.g., satisfaction) and perceived comfort with patients.

Modifying established interventions (like MBSR) to suit the needs of participants and setting may also be worthwhile as MBSR-M tended to have better individual outcome and long-term effects than traditional MBSR. Beyond adjusting duration of intervention, further integration of self-compassion may be important. Like mindfulness, self-compassion derives from Buddhism and is most simply described as compassion towards oneself; particularly in moments of failure or suffering [88]. Self-compassion has been suggested to have a complementary role to the effects of mindfulness on clinical outcomes (e.g., anxiety, burnout, depression, stress, quality of life) as well as a mediating effect on the relationship between mindfulness and well-being following a MBSR program [23,34,89]. Furthermore, self-compassion has been found to positively correlate with well-being and negatively correlate with psychopathology (i.e., anxiety, depression, and stress) [90]. Similar benefits have also been suggested for HCPs, along with reported improvement HCP-patient relations [33]. In the present meta-analysis, self-compassion also showed a significant, but small to moderate, impact on overall outcome. Taken together, integrating self-compassion with mindfulness training may be a valuable avenue of research for HCPs and HCPs-IT. Future studies could 1) explore the effects of developed trainings like the Mindful Self-Compassion Program [91], 2) understand the impact of adding self-compassion by comparing a MBI with enhanced self-compassion focused discussion and practice to the standard protocol, and 3) compare self-compassion-based meditation (e.g., Love and Kindness meditation) practice to other meditations.

Although intervention delivery differed between studies, significant effects were consistently found. It appears that whether the intervention is delivered electronically, by a student, or by a trained facilitator, there are significant increases in overall outcomes and mindfulness. Interestingly, electronic-delivery produced the highest effects. This finding suggests online mindfulness training may be an important avenue for HCPs and HCPs-IT. It has been noted that time constraints in the lives of HCPs and HCPs-IT likely contribute to the high attrition in mindfulness studies and the difficulty of integrating mindfulness into

the workplace [1,71,76]. For example, there is a practical issue of finding a time in which a group of HCPs and HCPs-IT may be available to attend a person-led intervention. Furthermore, the costs of hiring trained facilitators with significant mindfulness experience may also be a barrier for implementation of trainings. Electronically delivered MBIs may be more economical and practical ways for HCPs and HCPs-IT to develop mindfulness skills and warrant further study.

Examining the type of control yielded a caveat to our presented results. There were far fewer active (24%; e.g., somatic relaxation) compared to inactive controls (e.g., waitlist), and active control studies showed lower effects. Active controls have more stringent designs and are better able to account for the placebo effect. Furthermore, most interventions reviewed do not include mindfulness practice in isolation from other components. Therefore, it is possible the effects of intervention may be due to other factors (e.g., group discussion) [6].

Finally, all moderators showed significant but weak effects on outcome. These findings are similar to a previous meta-analysis examining healthy populations [23]; although the authors did not find a moderation effect of quality score and mean age. Interestingly, study quality score appears to positively moderate the efficacy of intervention such that higher quality studies suggest higher effect sizes. This contrasts a larger meta-analysis which found a significant weak, but negative moderation effects of study quality and age [34]. The reason for this discrepancy is unclear; however, we suspect there may have been an effect of study size, as studies of higher quality also had greater sample sizes. Measuring these effects was limited as some studies did not provide enough detail to extract accurate information on moderators. It is especially important authors report accurate information on intervention and home practice type and duration as the potential impact of these moderators can guide the development of future interventions and are also more equivocal in the field.

4.3. Limitations

This meta-analysis had moderate to high heterogeneity on some study outcomes; particularly when exploring the effects of MBSR and MBSR-M. This may be due to inconsistency in study measures and variations of intervention design. While this is consistent with previous analyses, caution is needed in result interpretation [23]. As previously noted, the included studies often do not measure mindfulness or use an active control. These are problematic practices as they invite potential bias and make findings harder to interpret [6,23]. For example, it would be expected mindfulness would be significantly affected by meditation and MBIs and would also account for a significant portion of outcome changes. Without measuring mindfulness, it is difficult to interpret whether the intervention was successful in its intent or if other factors are driving the observed changes. In addition, it would be important for studies to quantify and qualify mindfulness practice [30]. MBIs generally include a substantial homework component, and higher intervention attendance and home practice has been associated with greater reduction of mental distress and anxiety [52,75]. Studies reporting practice found participants generally did less than the prescribed amount and reduced practice over time [52,54,57,79]. To accurately assess the effect of intervention, obtaining and reporting this information is essential. Finally, most studies did not include follow-ups, making it difficult to interpret the long-term effects of intervention.

Based on the aforementioned findings and limitations, we recommend future researchers to 1) explore other facets of health including physical and well-being (e.g., empathy, blood pressure), 2) utilize active controls, 3) include mindfulness measures and meditation logs that note duration, style, and quality of practice, 4) include measures of clinical performance and patient outcomes as mental distress profoundly affect patients, and 5) include long-term follow-ups (e.g., 0.5 to 1-year post-intervention). While both meditation and MBIs have been shown to be beneficial, studies comparing them may help elucidate their effects outcome. For employers and educators, we recommend exploring the needs of their employees/students before selecting an intervention. As previously noted, there is also potential to enhance participant experience by focusing on their common challenges and adapting interventions to meet specific needs.

5. Conclusion

Despite its limitations, this meta-analysis extends research on mindfulness and HCPs and HCPs-IT by using wide inclusion criteria regarding population and intervention outcomes. This reduced bias in our article selection increased the number of included studies and allowed us to conduct robust additional analyses to quantify nuances in our findings. Furthermore, we solely examined RCTs to increase the methodological rigor of included studies and reduce risk of bias.

Given the important and difficult nature of their work, HCPs and HCPs-IT are encouraged to seek such interventions to help maintain their psychological well-being. The type of intervention employers offer should be reflective of their employees' specific challenges and stage of career. Increased collaboration between providers, researchers, and organizations is also highly warranted to generate access to improved and targeted interventions.

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Competing interest statement

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Appendix A. Supplementary data

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