REVIEW ARTICLE

The Effectiveness of Mindfulness Meditation on Burnout Among Healthcare Workers: A Systematic Review and Meta-Analysis

Kristine Jeanica D. Atienza, MD and Kimberly S. Jimenez, MD

Introduction: Burnout is becoming more common among healthcare professionals, notably during the COVID-19 pandemic. It can result in lower performance and effectiveness at work as well as employment withdrawal, all of which affects the standard of healthcare services provided.
Objective: In order to ascertain the effectiveness of mindfulness meditation-based interventions (MMBIs) in reducing burnout among healthcare workers, a systematic review and meta-analysis was done.
Methods: Two investigators searched records in CENTRAL, PubMed/MEDLINE, Google Scholar, Preprints, Grey Literature, and cross-referencing to acquire articles using search terms related to "mindfulness meditation", "healthcare workers", and "burnout". Inclusion criteria included randomized controlled trials (RCTs) and nonrandomized controlled trials (NRTs) that assessed the effectiveness of MMBIs on burnout as measured by the Maslach Burnout Inventory (MBI) among healthcare workers in the hospital setting. Study selection, data extraction, risk of bias assessment were done by the investigators independently. Analysis was done using RevMan 5 software, forest plots were generated, and subgroup analyses were done.
Results: Of 25,453 identified records, 28 studies were included. The studies were rated with low to unclear selection bias and high risk of performance bias. MMBIs were associated with significant reduction on the emotional exhaustion, depersonalization and personal accomplishment subscales with pooled mean differences of -2.60 (95% CI = -3.64, -1.55), -0.51 (95% CI = -0.77, -0.26), and 0.82 (95% CI = 0.24, 1.39), respectively. On subgroup analyses, the types of MMBI implemented had no influence in the intervention effect noted on all subscales among RCTs but had significant influence among NRTs. Reduction of burnout was noted to be higher in nurses compared with physicians and mixed healthcare workers. Overall quality of evidence for RCTs was low to moderate and very low to low for NRTs.
Conclusion: The results suggest that MMBIs can reduce the burnout symptoms of healthcare workers. To address the high risk of bias of included studies and improve quality of evidence, future research should be done with high-quality RCTs.

Key words: mindfulness, meditation, burnout, healthcare workers

Introduction

Burnout was defined by Maslach (1996) as "a syndrome of emotional exhaustion, depersonalization and reduced personal accomplishment that can occur among individuals who do 'people work' of some kind".[1] It is commonly defined for healthcare workers as an emotional and physical feeling of exhaustion, a dehumanization of their practice and feelings of incompetence.[2] It is measured in most literature using the Maslach Burnout Inventory (MBI), which is intended to assess the three domains of the burnout syndrome: emotional exhaustion (EE), depersonalization (DP), and reduced personal accomplishment (PA).[3] Nieto-Lorenzo et al (2019) found that the prevalence of burnout among the general surgery residents in the Philippines was 85%.[4] Delos Reyes (2018), on the other hand, reported that moderate levels of burnout

Department of Family and Community Medicine, Batangas Medical Center

(mean scores for EE, DP, and PA of 23.56, 6.44, and 38.18, respectively) were measured among Filipino occupational therapists.[5] Burnout is a growing concern among healthcare workers especially during the COVID-19 pandemic. Ancheta et al (2021) reported the burnout levels among nurses during the COVID-19 pandemic in the Philippines using two types of burnout: disengagement and exhaustion. The study revealed an average level for both disengagement and exhaustion indicating that the respondents were not generally disengaged from their work but were also not feeling an exceptional level of engagement and that they have an average amount of exhaustion.[7] Franco et al (2022) reported that 4% were burnout and majority had intermediate at-risk profiles for burnout among Internal Medicine trainees in Philippine General Hospital during the initial months of the pandemic.[8] Burnout leads to decreased productivity and effectiveness at work and it is associated with different kinds of job withdrawal such as absenteeism, intention to leave the job, and actual turnover.[3] These in turn affect the quality of healthcare delivery.[2]

One of the person-directed strategies for preventing burnout is mindfulness meditation, which aims to increase alertness, focus on the present, and to self-observe in an unbiased and detached manner.[9] In both clinical and nonclinical contexts, mindfulness meditation-based interventions (MMBIs) have been proven to be useful for a number of psychological issues, but are particularly good at lowering anxiety, depression, and stress.[10,11] Types of MMBIs include mindfulness-based stress reduction (MBSR), mindfulness-based cognitive therapy (MBCT), brief mindfulness training meditation, mindfulness intervention retreats, and internet and smartphone application mindfulness interventions. Perhaps the most well-known mindfulness intervention is MBSR, where much of the research on meditation has been conducted. Kabat-Zinn (1990) developed the gold standard model of MBSR consisting of weekly 2 – 2.5 hour group workshops taught by a certified teacher, daily audio-guided home practice sessions lasting approximately 45 minutes each, and an all-day mindfulness retreat that takes place in week six of the program.[12]

There are inconsistent findings on the effectiveness of MMBIs on reducing burnout as shown by different literature. A meta-analysis reported that meditative interventions demonstrated statistically significant improvement in participant's level of EE (effect size 0.37 (95%CI 0.04-0.70)), PA (effect size 1.18 (95%CI 0.10-2.25)), and life satisfaction (effect size 0.48 (95%CI 0.15-0.81)) in controlled trials among healthcare workers.[13] Mindfulness training among healthcare workers and trainees produced a small significant effect (Hedge's $g = 0.26$) on burnout, according to a meta-analysis done by Spinelli et al (2019).[9] However, Kriakous et al (2020) in a comprehensive analysis showed that, in comparison to other areas of psychological functioning, MBSR was less successful in lowering burnout and raising resilience among healthcare professionals. Further research is necessary to understand the underlying connections between burnout, resilience, and mindfulness because this contradictory finding shows that burnout is a distinct construct that is linked to mental health issues like stress, anxiety, and depression.[14]

A more comprehensive review and analysis on the effectiveness of MMBI on burnout is warranted due to the following reasons: (1) previous reviews included medical and nursing students in their analyses[9]; (2) previous reviews did not focus on mindfulness meditation[15-20]; (3) some reviews did not focus on burnout using limited articles to draw their conclusions from[9,21-23]; and (4) previous reviews used different scales to measure burnout in their analyses.[19] Lastly, there is a growing number of studies on the effectiveness of MMBI on burnout among healthcare workers in recent years that are not yet included in the previous reviews and thus were included in this systematic review and meta-analysis.

The general objective of this systematic and meta-analysis was to determine the effectiveness of MMBIs in decreasing burnout as measured by MBI among healthcare workers in the hospital setting. And the specific objectives include to determine the effects of MMBIs on the overall burnout scores and on each subscale scores, and to determine if the intervention type, profession type and study design affect the burnout scores of healthcare workers.

Methods

Protocol Review and Registration

This systematic review and meta-analysis was registered to the Research Committee of the Batangas Medical Center where the investigators are affiliated in accordance to their requirement. It was conducted following the guidelines of Cochrane Handbook for Systematic Reviews of Interventions and was reported following the Preferred Reporting for Systematic Reviews and Meta-analysis (PRISMA). Any adjustments throughout the review were fixed and updated in the details of the finished paper.

Inclusion and Exclusion Criteria of Studies

Study Population:

This systematic review and meta-analysis included studies with healthcare workers (physicians, nurses, allied health professionals) in the hospital setting with moderate to high burnout score as measured by the MBI as the study population. Studies with healthcare workers in the clinics or in the community setting and those that include students (medical, nursing, students from other health professions) were excluded.

Interventions:

Studies with interventions based primarily on mindfulness meditation (MBSR, MBCT, Brief mindfulness meditation training, retreats, Mindfulness apps) and conducted face-to-face or virtual and in individual or group settings were included. Studies where mindfulness meditation was not the main intervention were excluded.

Comparator:

The control intervention can be active intervention (e.g. psychoeducation, biofeedback, and relaxation), waitlist control or no comparator. Both the intervention and the control groups did not

receive any other interventions that might interfere with the measured outcome or should have had similar other co-interventions.

Study Design:

Randomized controlled trials and non-randomized controlled trials, such as controlled before-after and non-controlled before-after studies, were included. In order to examine the influence of the type of study design on the effectiveness of the intervention, subgroup analyses were performed.

Outcome Measure:

The primary outcome was reduction of the burnout score using the Maslach Burnout Inventory. Secondary outcomes included improvement on the levels of stress, anxiety, mindfulness, well-being, physical health or clinical performance. Studies that utilized other measurements to determine the burnout score were excluded.

Search Methods

Search terms included combination of terms related to mindfulness meditation ("mindfulness" OR "meditation" OR "mindfulness meditation" OR "mindfulness-based interventions") AND terms pertaining to healthcare workers ("healthcare workers" OR "healthcare professionals" OR "physicians" OR "doctor" OR "residents" OR "nurse" OR "nurse professionals" OR "psychologist" OR "therapists") AND "burnout". The search was limited to the following study types "randomized controlled trials" OR "clinical trials" OR "non-controlled trials". To maximize the yield of initial search, no other limits were used.

The following databases were searched for primary studies: Cochrane Central Register of Controlled Trials (CENTRAL) in the Cochrane Library, PubMed/MEDLINE, Google Scholar, and Preprints. Cross reference searches of all included studies and relevant reviews were done to find unidentified references. The following databases were also used in a grey literature search to find research that were not included in the aforementioned databases: Open Grey, Grey Literature Report of the New York Academy of Medicine, National Institute for Health and Clinical Excellence, and Preprints.

Study Selection

Study selection was done by the two investigators independently. The title and abstracts of the articles obtained through electronic search were downloaded; duplications and irrelevant articles were removed manually. For articles that were judged as meeting the inclusion criteria, full-text copies were acquired. Full-text screening and cross-checking were done in order to assess the eligibility of the articles. Any discrepancies were resolved through discussion among the investigators. The reasons why ineligible studies were excluded were found and noted. The 'Characteristics of excluded studies' table includes a list of studies that first seemed to fulfill the inclusion criteria but were ultimately excluded. The screening process of study inclusion and exclusion was illustrated in the PRISMA flow diagram.

Data Extraction

A standard data collection form was developed in hard copy form and in MS Excel form for data extraction. Extracted data from eligible studies included: authors, publication date, country, experimental design, type of control, sample size, mean age, sex proportion, profession type, intervention type, delivery format (online/offline/mixed), duration of an average single session, number of sessions, home practice, individual or group practice, type of facilitator, means and SD for burnout, and other reported secondary outcomes. The data were extracted independently by the two investigators. All the extracted data were cross-checked by each investigator. Any discrepancies with the data were resolved through discussion.

Dealing with Missing Data

The authors of the original study with missing data were contacted via email. The study was excluded from the review if missing data was not acquired.

Risk of Bias Assessment

The investigators independently performed risk of bias assessment using the Cochrane Collaboration Risk of Bias Assessment Tool for RCTs and the Effective public health practice project (EPHPP) quality assessment tool for quantitative studies for controlled before-after studies (CBAs) and non-controlled before-after studies (NCBAs). The Cochrane Collaboration Risk of Bias Assessment Tool[24] is a domain-based evaluation that takes into account bias brought on by random sequence generation, allocation concealment, participant and personnel blinding, outcome assessment blinding, incomplete outcome data, selective reporting, and other bias. Each domain's bias risk was categorized as either "low risk of bias," "unclear risk," or "high risk of bias," and each study's total risk of bias was judged. Using the EPHPP quality assessment tool for quantitative studies[25], the evidence was rated as 'strong', 'moderate' or 'weak' in the following sections: selection bias, study design, confounders, blinding, data collection methods, withdrawals and drop-outs, intervention integrity, and quantitative analyses of single studies, and a global rating for each study was made.

Data Analysis

RevMan 5 software was used for data analysis. For continuous data, mean difference was used. For controlled trials, this was the change in mean scores before and after the intervention among the experimental group relative to the control group (between-group comparison). For non-controlled trials, this was the change in scores post-intervention relative to pre-intervention only (within-group comparison). Forrest plots were produced for each of the outcomes for within-group and between-group effect sizes. To assess for heterogeneity, Chi-square test and I^2 test were used. There was no statistical heterogeneity between each study if $I^2 < 50\%$, $P > .1$ and a fixed effect model (FEM) was used to synthesize the data. If $I^2 \geq 50\%$, $p < .1$ there is a statistical heterogeneity, and the data were integrated by the random effect model

(REM). Comparison of the different types of profession of the healthcare workers was also done as a potential moderator of the effectiveness of MMBIs. Lastly, a subgroup analysis among the different types of MMBIs was also done. Sensitivity analysis was utilized in order to gauge the strength of the measures of primary outcome. It is comprised of restricting the analysis to published studies and restricting the analysis to studies with a low risk of bias. However, no sensitivity analysis was done since the analysis was already restricted to published studies and only one study was deemed to have a low risk of bias hence analysis was not possible.

Grading the Quality of Evidence

The "Grades of Recommendations Assessment, Development and Evaluation (GRADE)" standard was used to assess the quality of evidence. A comprehensive display of results on the relevant GRADE domains (indirectness, imprecision, risk of bias, publication bias and consistency of effect) with the level of certainty of evidence (high, moderate, low and very low) was provided. GRADE quality of evidence of high quality indicates that additional research is very unlikely to change the author's confidence in the estimate of effect; moderate quality indicates that additional research is likely to have an important impact and may change the estimate; low quality indicates that additional research is very likely to have an important impact and is very likely to change the estimate; and very low quality indicates that additional research is very likely to have an important impact and is likely to change the estimate.[26]

Results

Study Selection

The authors' searches yielded 25,439 records from various databases (Figure 1), and 14 articles found during cross-referencing for a total of 25,453 articles. They removed duplicates (n = 24,744) and screened the titles and abstracts of 337 articles. They removed the articles that did not fulfill the inclusion criteria and thus were deemed irrelevant to the review (n = 287). They also tried to access the full-text copies of 49 articles, however they were unable to retrieve the full-text copies of four articles leading to 45 articles assessed for eligibility. A total of 28 articles were included in the review (Tables 1 & 2) and 17 articles were excluded due to the following reasons: incomplete data outcome (n = 6), participants included those in the community setting (n = 2), the studies used the abbreviated version of MBI (n = 8), and the intervention of 1 article did not solely focus on mindfulness meditation.

Characteristics of the Studies and Participants

A total of 28 studies were included in this review. Of the included studies, 13 were RCTs[27-39], 13 were NCBAs40-52 and 2 were CBAs.[53-54] Of the 13 RCTs, 8 utilized wait-list as control[27,29,30,32-35,39] 4 used active controls (psychoeducation[37], theoretical/educational training[31,38], Moodzone app[36]) and 1 used life-as-usual[28] as control. Control groups utilized in the CBAs were active control (relaxation training[53]) and no active control.[54] Included articles were published between 2005 and 2022. Eleven studies were conducted in USA[27,28,33,34,43,46,47,49,51-53], 4 in Spain[29-31,44], 4 in the United Kingdom[35,36,40,45], 2 in Canada[33,50], 2 in China[38,48], 1 in Brazil[42], France[41], Iran[54], Japan[37], and Australia[39]. All were written and available in the English language.

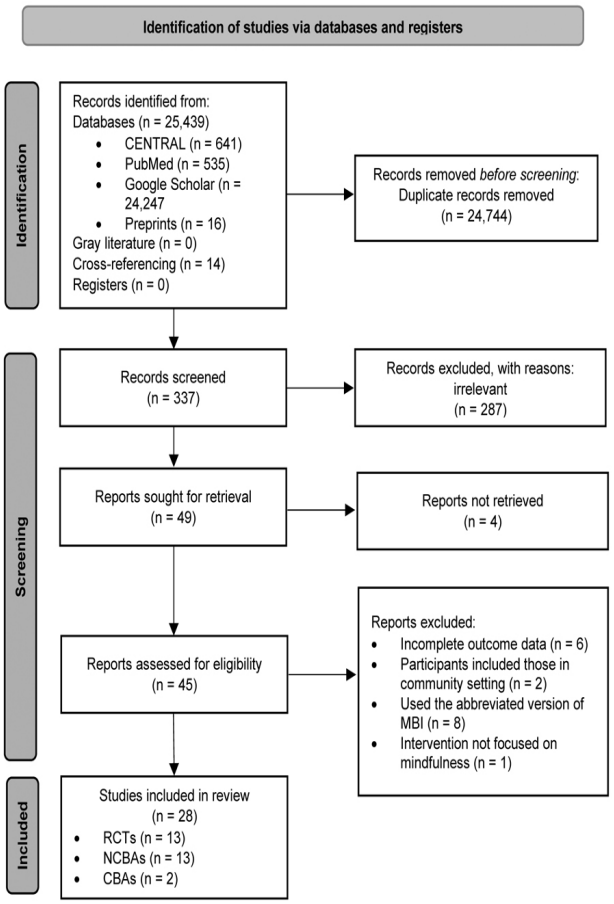

Figure 1. PRISMA flow diagram of studies reviewed, included and excluded.

The total number of participants across all studies included in this review was 3,656, and sample size ranged from a minimum of 10 and a maximum of 2,182. Three studies[30,34,54] out of the 28 articles did not provide information regarding the gender distribution of the participants. There were more female participants compared to males within all the study samples with the exception of three studies[29,46,47]. The mean age and age ranges of the sample participants were provided in all studies except for three studies[34,48,51]. The mean age ranged from 27.68 to 52.36 years. Thirteen studies[28,30,31,34-36,39-41,43-45,50] enrolled a mixture of healthcare workers (physicians, nurses, nursing aides, psychologists, dieticians, osteopath, research coordinator, mental health professionals, others) as their population; seven enrolled practicing physicians and resident trainees from various specialties[27,29,46,47,49,51,52] (family medicine, internal medicine, emergency medicine, pediatrics, psychiatry, others); and eight focused on nurses and nursing staff working in different areas[32,33,40,38,42,48,53,54] (emergency department, ICU, primary care, others).

Characteristics of the Interventions

The standard MBSR program based on Kabat-Zinn (1990)[12] was used in eight studies[30-32,34,38,41,50,54]. Adaptations and modifications by shortening the duration and length of the traditional MBSR program were done in nine studies[27,28,33,37,43,44,53]; two studies[29,46] added a maintenance phase of 10 months to the original 8 weeks; the study by Pflugeinsen et al. (2016)[49] used a brief video-module administered mindfulness program; and dos Santos et al. (2016)[42] developed a stress reduction program based on Kabat-Zinn's (1990) MBSR and Breathworks Mindfulness by Burch (2008). Modifications of MBCT was used by three studies[35,40,45]. Mindfulness-based retreats were done by two studies[47,51]. Smartphone application mindfulness intervention using the Headspace app was utilized by Taylor et al. (2022)[36] and Xu et al. (2021)[39]. Mindful Living With Stress was utilized by Pan et al. (2019)[46], and Mind-body Skills Training (MBST) was used by Romcevich et al. (2019)[52].

Most of the studies included in the review performed the sessions offline except for the app-based[34,37] and for the four studies[43,44,48,49] that combined both offline and online delivery formats. Majority of the studies utilized small group sessions except for app-based[36,39] and in two adaptations of MBSR which are individual-focused[37,44]. Duration of each sessions ranged from 10 minutes to 2.5 hours and the length of the programs ranged from 2 days to 10 months of maintenance phase. Follow-up ranged from 3 months to 15 months. Majority also provided audio-guided home practice and homework to facilitate the training. The facilitators included certified MBSR instructors and teachers, clinical psychologist, experienced counsellor, MBCT teacher, certified professional coach, and consultant psychiatrist.

Risk of Bias Assessment

The different domains of the risk of bias assessment for the included RCTs are shown in Figure 2. There is low risk of selection bias due to random sequence generation in nine studies, whereas the studies by Cohen-Katz, et al.[32], Mackenzie, et al.[33], Shapiro, et al.[34] and Xu, et al.[39] had unclear risk of bias since they did not provide information about their randomization process. In terms of selection bias due to allocation concealment, only the studies by Ameli, et al.[28] and Taylor, et al.[36] had low risk of bias since the rest of the RCTs did not mention about allocation concealment and thus were assigned with unclear risk of bias. There was a high risk of performance bias in terms of blinding of participants and personnel in the majority of the RCTs included due to the nature of the intervention with only the study by Taylor, et al.[36] having a low risk of bias. The studies done by Strauss, et al.[35], Taylor, et al.[36], Watanabe, et al.[37], and Xu, et al.[39] had low risk of detection bias since blinding of outcome assessment was done. Two studies had high risk of detection bias since blinding of outcome assessment was not done (Ameli, et al.[28] & Cascales-Perez, et al.[31]). The rest had unclear risk of detection bias. There was a low risk of attrition bias and reporting bias in all of the RCTs included.

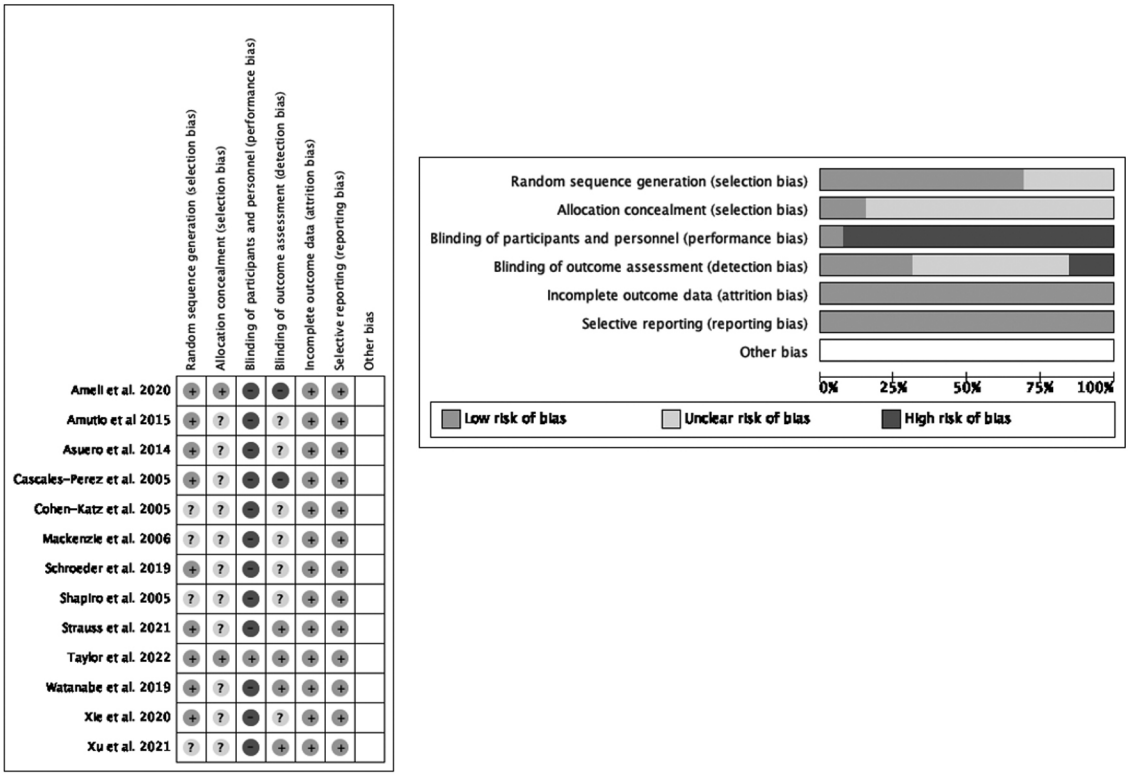

Figure 2. Risk of bias assessment for rcts on cochrane collaboration risk of bias assessment tool.

Risk of bias assessment using the EPHPP for NRTs is shown in Table 1. Having 2 or more weak ratings in the domains in the EPHPP criteria will make the global rating weak hence all NRT studies included in this review have a weak global rating. Selection bias due to the participants being volunteers or self-referred; as well as confounders not being controlled by the authors, and absence of blinding due to the nature of the intervention render these studies to have weak ratings.

Meta-analyses

Only five studies (3 RCTs[30,31,34] and 2 NRTs[42,51]) reported the overall burnout score (Figure 3), two30,31 of them also provided the scores for each subscale of MBI and thus were included in the analysis for each MBI subscale. The rest of the studies only provided the individual score for each MBI subscales and not the overall burnout score. MMBIs

Table 1. Table of included randomized controlled trials (RCTs).

Author, Year	Country	Design (Cntrl)	Participants	Sample size, total (tx/cntrl)	Sex, male/ Female	Age, mean (SD)	Intervention (length; format; individual or group; facilitator)	Outcomes	Other Outcomes
Ameli et al, 2020	USA	RCT (Life-as-usual)	Mixed healthcare workers (nurse, physicians, social worker, others)	82 (45 / 37)	17 / 65	32	Adapted MBSR (five 7.5-hour sessions + 1.5-hour in-class session; 5 weeks; weekly at-home practice; offline; group; professionally trained teacher)	MBI * subscales	MAAS-T, MAAS-S, MSCS-G, PANAS, VAS-A
Amutio et al, 2015	Spain	RCT (Waitlist)	Mixed Physicians	42 (21 / 21)	24 / 18	47.31 (9.42)	Adapted MBSR with 2 phases (phase 1: eight 2.5-hour + one 8-hour retreat, audio-guided home practice; 8 weeks; phase 2: one 2.5-hour session, audio-guided home practice, 10 months; offline; group; MBSR instructor)	MBI subscales	FFMQ, HR, BP
Asuero, et al, 2014	Spain	RCT (Waitlist)	Mixed primary healthcare workers (nurse, physicians, others)	68 (43 / 25)	n.i.	Tx: 48.8 (7.8) Cntrl: 46.9 (6.7)	MBSR (eight 2.5-hour sessions + one 8-hour intensive session, audio-guided home practice, 8 weeks; offline; group; certified MBSR teacher)	MBI total and subscales	FFMQ, Jefferson Questionnaire, POMS
Cascales-Perez et al, 2005	Spain	RCT (active control: theoretical training)	Mixed primary healthcare workers (nurse, physician, psychologist, nurse assistant, hospital porter)	58 (30 / 28)	11 / 47	Tx: 52.36 (9.44) Cntrl: 49.64 (9.70)	MBSR (eight 2.5-hour sessions + one 6-hour retreat, audio-guided home practice, 8 weeks; offline; group; Mindfulness instructor)	MBI total and subscales	FFMQ, POMS, PROQoL-vIV, SF-36
Cohen-Katz et al, 2005	USA	RCT (Waitlist)	Nurses	27 (14 / 13)	100% female	46	MBSR (eight 2.5-hour sessions + one 6-hour retreat, audio-guided home practice, 8 weeks; offline; group; Mindfulness teacher)	MBI subscales	BSI, MASS
Mackenzie et al, 2006	Canada	RCT (Waitlist)	Nurses and nurse aides	30 (16 / 14)	1 / 29	Tx: 48.62 (6.52) Cntrl: 44.78 (8.16)	Adapted MBSR (four 30-min sessions, 6 sessions, audio-guided home practice, 4 weeks; offline; group; Mindfulness teacher)	MBI subscales	JSS, OLQ, SRDI, SWLS
Schroeder et al, 2016	USA	RCT (Waitlist)	Physicians (Family or Internal medicine)	33 (17 / 16)	9 / 24	42.76 (8.43)	Adapted MBSR (13-hour weekend program + 2-hour follow-up sessions, total of 18 hours; offline; group; Mindfulness instructor)	MBI subscales	BRS, MAAS, MPQ, PSS-10, SCBCS
Shapiro et al, 2005	USA	RCT (Waitlist)	Mixed healthcare workers	38 (18 / 20)	n.i.	n.i.	MBSR (eight 2.5-hour sessions + one 8-hour retreat; 8 weeks; offline; group; clinical psychologist)	MBI total	BSI, SCS, SWLS
Strauss et al, 2021	UK	RCT (Waitlist)	Mixed healthcare workers (physician, psychologist, nurses, allied, others)	234 (115 / 119)	38 / 194	Tx: 42.95 (10.05) Cntrl: 44.92 (10.68)	MBCT for Life (eight 2-hour sessions, weekly homework, 8 weeks; offline; group; MBCT teachers)	MBI-HSS subscales	DASS-21, FFMQ-SF, iMTA PCQ, SOCS, SWEMWBS
Taylor et al, 2022	UK	RCT (active control: Moodzone app)	Mixed healthcare workers (allied, physician, manager, nurse, psychologist, others)	2182 (1095 / 1087)	356 / 1815	Tx: 40.64 (11.02) Cntrl: 40.42 (10.92)	App-based MBI: Headspace app (at least one 10-min practice daily, 4.5 months; online; individual)	MBI subscales	CEQ, CLS, DASS-21, FFMQ15, RRS, SCS-SF, SWEMWBS
Watanabe et al, 2019	Japan	RCT (active control: psycho-education)	Junior nurses	80 (40 / 40)	100% female	30.1 (8.4)	Adapted MBSR (four 30-min sessions, detailed manual, 4 weeks; offline; individual; trained senior nurses)	MBI subscales	EQ-5D; GAD-7; HADS; HPQ; ISI;
Xie et al, 2020	China	RCT (active control: educational intervention)	ICU nurses	106 (53 / 53)	100% female	27.7 (7.7)	MBSR (eight 2.5-hour sessions; weekly homework, 8 weeks; offline; group; experienced counsellor)	MBI subscales	AAQ-II, MAAS
Xu et al, 2021	Australia	RCT (Waitlist)	Mixed ED staff (nurse, physician, allied, others)	148 (74 / 74)	33 / 115	<30: 61 30 – 39: 37 ≥ 50: 20	App-based MBI: Headspace app (daily 10-min guided sessions, 4 weeks; online; individual)	MBI subscales	MASS, PSS, WEMWBS

* Only included 2 subscales of MBI (Emotional Exhaustion and Depersonalization)

Abbreviations: AAQ-II, Acceptance and Action Questionnaire-II; BAI, Beck Anxiety Inventory; BDI, Neck Depression Inventory; BRS, Brief Resilience Scale; BSI, Brief Symptom Inventory; BP, Blood pressure; CEQ, Credibility and Expectancy Questionnaire; Cntrl, control group; CLS, Compassionate Love Scale; DAAS-21, Depression, Anxiety, and Stress Scale; ED, Emergency department; EQ-5D, EuroQoL, FFMQ, Five Facet Mindfulness Questionnaire; FFMQ-SF, Five Facet Mindfulness Questionnaire-Short Form; GAD-7, Generalized Anxiety Disorder Scale; HADS, Hospital Anxiety and Depression Scale; HPQ, WHO Health and Work Performance Questionnaire; HR, Heart rate; ISI, Insomnia Severity Index; iMTA PCQ, Institute for Medical Technology Assessment Productivity Cost Questionnaire; JSS, Job Satisfaction Scale; OLQ, Orientation to Life Questionnaire; MAP, Mindful Awareness Practice; MAAS, Mindfulness Attention Awareness Scale; MAAS-S/T; Mindful Attention Awareness Scale State/Trait, MBI, Maslach Burnout Inventory; MBI-HSS, Maslach Burnout Inventory-Human Services Survey; MBCT, Mindfulness-Based Cognitive Therapy; MBSR, Mindfulness-Based Stress Reduction; MSCS-G, Mindful Self-care Scale-General; MPQ, Meditation Practice Questionnaire; PANAS, Positive and Negative Affect Schedule; POMS, Profile of Mood States; PROQoL-vIV, Professional Quality of Life; PSS, Perceived Stress Scale; PSS-10, Perceived Stress Scale 10-Item version; PSWQ, Penn State Worry Questionnaire; POMS, RRR, Ruminative Response Scale; SCBS, Santa Clara Brief Compassion Scale; SCS, Self-Compassion Scale; SCS-SF, Self-Compassion Scale-Short Form; SD, standard deviation; SRDI, Smith Relaxation Dispositions Inventory; SF-36, Short Form Health Survey; SOCS, Sussex-Oxford CS; SWLS, Satisfaction With Life Scale; S/WEMWBS, Short/Warwick Edinburgh Mental Wellbeing Scale; Tx, Tre; treatment group; VAS-A, Visual Analog Scale-Anxiety.

were associated with significant reduction in the overall burnout score among healthcare workers in the between-group analysis of RCTs (3 comparisons: MD = -6.62; 95% CI = -12.25, -0.98; p = 0.02; I^2 = 0%) and pre-post analysis of NRTs (2 comparisons: MD = -11.74; 95% CI = -15.76, -7.71; p = 0.63; I^2 = 0%) with the pooled mean difference of -10 (95% CI = -13.28, -6.73; p = <0.00001; I^2 = 0%).

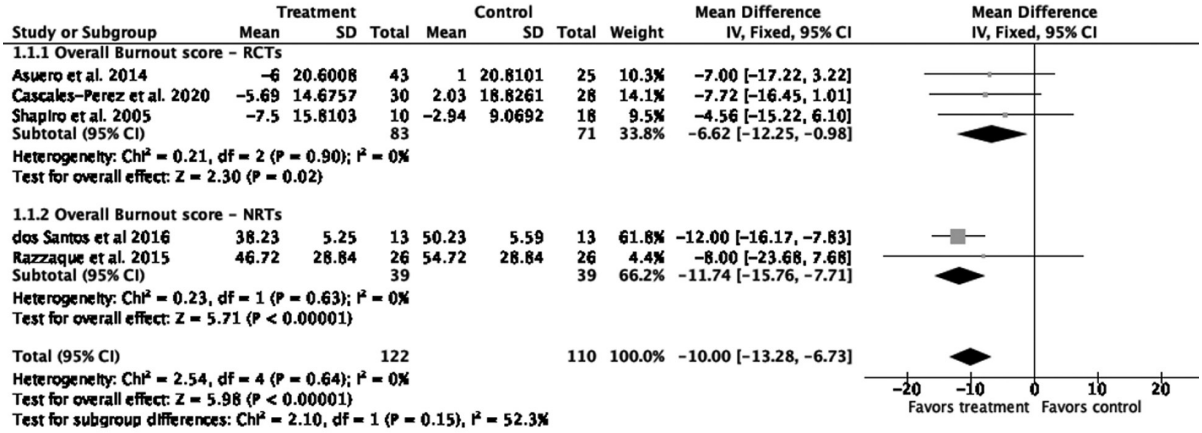

Figure 3. Forest plot of the effects of mindfulness meditation-based interventions on the overall burnout score among healthcare workers as measured by the Maslach Burnout Inventory.

Table 2. Table of Included non-randomized trials (NRTs).

Author, Year	Country	Design (Cntrl)	Participants	Sample size, total (tx/cntrl)	Sex, male/ Female	Age, mean (SD)	Intervention (length; format; individual or group; facilitator)	Outcomes	Other Outcomes
Askey-Jones, 2018	UK	NCBA	Mixed allied healthcare workers	86	21 / 65	45.7	MBCT (eight sessions, audio-guided home practice, 8 weeks; offline; group; MBCT teacher)	MBI subscales	FMI
Dobkin et al, 2016	France	NCBA	Mixed healthcare workers (physicians, psychologists, nurses, dieticians, osteopath, research coordinator)	22	6 / 16	46.7 (11.5)	MBSR (eight 2.5-hour sessions + one-day retreat, homework, 8 weeks; offline; group; MBSR instructor)	MBI subscales	BDI, FFMQ, RCRS, RIAS, PSS, SOC
dos Santos et al, 2016	Brazil	NCBA	Nursing staff (nurses, technicians, nursing assistants)	13	1 / 12	47.38 (8.25)	Adapted MBSR (SRP based on MBSR and Breathworks Mindfulness with 24 60-min sessions; 6 weeks; offline; group; mindfulness instructor)	MBI total	BDI, PSS, SCS, SRQ, STAI, SWLS, WHOQOL-BREF, WSS
Fortney et al, 2013	USA	NCBA	Mixed healthcare workers (physicians, physician assistant, nurse)	30	12 / 18	40.5 (10.1)	Adapted MBSR (13-hour weekend program + 2-hour follow-up sessions, total of 18 hours; audio-guided home practice; offline and online; group; Mindfulness instructor)	MBI subscales	DASS-21, PSS, RS-21, SCBC
Gonzalo et al, 2019	Spain	NCBA	Mixed healthcare workers (physicians, nurses, nursing assistants)	32	5 / 27	< 35: 3.1% 36 – 50: 50% > 50: 46.9%	Adapted MBSR (5-8 min practices, 8 weeks, audio-guided home practice; offline and online; individual; mindfulness instructor)	MBI-HSS subscales	FFMQ, JSE, SCS
Hamilton-West et al, 2018	UK	NCBA	NHS general practitioners	22	8 / 14	44.5 (7.4)	Modified MBCT (eight 2-hr sessions, 8 weeks; homework was less time-consuming compared to traditional MBCT; offline; group; MBCT teacher)	MBI subscales	PSS
Krasner et al, 2009	USA	NCBA	Primary care physicians (FM, IM, pedia)	70	38 / 32	n.i.	Adapted MBSR with 2 phases (phase 1: eight 2.5-hour + one 7-hour retreat, audio-guided home practice, 8 weeks; phase 2: one 2.5-hour session, 10 months; offline; group; MBSR instructor)	MBI subscales	Big 5 personality Mini-markers, FFMQ, Scale, JSE, PBS, POMS
O'Shea et al, 2022	USA	NCBA	Emergency medicine residents	50	27 / 23	29.3 (2.9)	Mindfulness-based retreat (three 2.5-hour sessions; home practice manual; group; offline; MBSR teacher)	MBI subscales	MAAS, PSS
Pan et al, 2019	China	NCBA	Nurses	22	1 / 18	27.68 (5.9)	MLWS (six 2-hour sessions, 6 weeks; group; homework; online and offline; principal investigator)	CMBI subscales	C-BDI, Ch-FFMQ, CPSS, C-STAI
Pflugeinsen et al, 2016	USA	NCBA	Physicians from various specialties	23	14 / 9	46	Adapted MBSR (three 90-min in-person training, eight online video trainings, weekly teleconference coaching calls, 8 weeks; individual and group; online	MBI subscales	KIMS, PSS

							and offline; certified professional coach)		
Poulin et al, 2008	USA	CBA (active control: bIPMR; nonactive control: waitlist)	Nurses and nurse aides	40 Tx: 16 bIPMR: 10 Waitlist: 14	3 / 37	Tx: 48.6 (6.5) bIPMR: 46 (11.7) Waitlist: 44.8 (8.1)	Adapted MBSR (30-min training sessions; audio-guided home practice, homework; offline; group; MBSR instructor)	MBI subscales	SRDI, SWLS
Raab et al, 2015	Canada	NCBA	Mental health professionals	22	100% female	Range: 24 - 69	MBSR (eight 2.5-hour sessions + one-day retreat, home practice, 8 weeks; offline; group; MBSR instructor)	MBI-HSS subscales	SCS, QOLI
Razzaque et al, 2015	USA	NCBA	Psychiatrists	26	9 / 17	n.i.	MBPD retreat (2-day retreat; offline; group; experienced consultant psychiatrist)	MBI total	FMI, SCBS, WAI
Romcevich et al, 2018	USA	NCBA	Pediatric residents	10	3 / 7	29.3	MBST (four 90-min sessions, 4 weeks; individual mindfulness plan; offline; group; resident with 5 years of informal meditation and mindful movement experience)	MBI subscales	BRS, CAMS-R, NSS, PSS
Sharifi et al, 2017	Iran	CBA (no active control)	Nurses	60 (30 / 30)	n.i.	Tx: <30: 20% 31-40: 60% 41-50: 20% Cntr: <30: 33.3% 31-40: 15.3% 41-50: 13.3%	MBSR including mindfulness practice and awareness of pleasant and unpleasant events and the use of mindfulness in daily routine activities	MBI subscales	Gray-Taft and Anderson standard questionnaire of job stress

Abbreviations: bIMPR; brief Imagery and Progressive Muscle Relaxation; BRS, Brief Resilience Scale; BDI, Neck Depression Inventory; C-BDI, Chinese version of Beck Depression Inventory; CAMS-R, Cognitive and Affective Mindfulness Scale-Revised; Cntrl, control group; DASS-21, Depression Anxiety Stress Scale-21; FFMQ, Five Facet Mindfulness Questionnaire; Ch-FFMQ, Chinese version of Five Facet Mindfulness Questionnaire; FM, Family Medicine; FMI, Freiberg Mindfulness Inventory; IM, Internal Medicine; JSE, Jefferson Scale of Empathy, KIMS, Kentucky Inventory of Mindfulness Skills; MAAS, Mindfulness Attention Awareness Scale; MBI, Maslach Burnout Inventory; CMBI, Chinese version of Maslach Burnout Inventory; MBCT, Mindfulness-Based Cognitive Therapy; MBSR, Mindfulness-Based Stress Reduction; MBPD, Mindfulness-Based Professional Development; MBST, Mind-Body Skills Training; MLWS, Mindful Living With Stress; NCBA, non-controlled before-after; n.i., no information provided; NHS, National Health Service; NSS, Neff's Self-Compassion Scale; PBS, Physician Belief Scale; PSS, Perceived Stress Scale; CPSS, Chinese version of Perceived Stress Scale; POMS, Profile of Mood States; QOLI, Quality of Life Inventory; RS-14, 14-item; RCRS, Rochester Communication Rating Scale; Resilience Scale; RIAS, Roter Interaction Analysis System; SCBC, Santa Clara Brief Compassion Scale; SCS, Self-Compassion Scale; SCQ, SD, standard deviation; SOC, Sense of Coherence; SRDI, Smith Relaxation Dispositions Inventory; SRP, Stress Reduction Program; SRQ, Self-Reporting Questionnaire; STAI, State-Trait Anxiety Inventory; C-STAI, Chinese version of State-Trait Anxiety Inventory; SWLS, Satisfaction with Life Scale; Tx, treatment group; WAI, Working Alliance Inventory; WHOQOL-BREF, World Health Organization Quality of Life; WSS, Workplace Stress Scale

Table 3. Within studies' risk of bias assessment for NRTs on Eight EPHPP criteria and global rating.

Study	Selection bias	Study design	Confounders	Blinding	Data collection methods	Withdrawals and drop-outs	Intervention Integrity			Analyses			
							Percentage allocation	Intervention consistency	Unintended intervention	Allocation unit	Analysis unit	Method appropriate	Intention to treat
Askey-Jones 2018	Weak	Moderate	Weak	Weak	Strong	Moderate	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Dobkin et al. 2016	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	No
dos Santos et al. 2016	Weak	Moderate	Weak	Weak	Strong	Moderate	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Fortney et al. 2013	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Gonzalo et al. 2019	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Hamilton-West et al. 2018	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	No
Krasner et al. 2009	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
O'Shea et al. 2022	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Pan et al. 2019	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	No
Pflugeinsen et al. 2016	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	No
Poulin et al. 2008	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Raab et al. 2015	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Razzaque et al. 2015	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Romcevich et al. 2018	Weak	Moderate	Weak	Weak	Strong	Moderate	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes
Sharifi et al. 2017	Weak	Moderate	Weak	Weak	Strong	Strong	80 - 100%	Yes	Can't tell	Organization/ institution	Organization/ institution	Yes	Yes

Between-group analysis using random effect model of the effectiveness of MMBIs among RCTs showed a significant reduction of the emotional exhaustion (EE) subscale score (see Figure 4), however, with significant substantial heterogeneity (MD = -1.85; 95% CI = -3.26, -0.44; p = 0.002; I^2 = 63%). Within-group analysis among NRTs, on the other hand, showed significant reduction in the EE subscale scores, with noted substantial heterogeneity (MD = -3.86; 95% CI = -5.88, -1.85; p = 0.0003; I^2 = 67%). The pooled mean difference of all included studies was -2.60 (95% CI = -3.64, -1.55; p < 0.00001; I^2 = 66%). Subgroup analysis between the two study designs showed no significant subgroup difference of p = 0.11 and I^2 = 61.1%.

Between-group and within-group analyses using fixed effect model on the effectiveness of MMBIs on the depersonalization (DP) subscale scores (Figure 5) showed significant reduction with low heterogeneity (MD = -0.57, 95%CI = -0.90, -0.24; p = 0.16; I^2 = 29%; and MD = -0.44; 95% CI = -0.83, -0.04; p = 0.57; I^2 = 0%, respectively). Pooled mean difference of -0.51 (95% CI = -0.77, -0.26; p = 0.34; I^2 = 9%) was noted. Consistent reductions on the DP subscale scores were noted between the two study designs (Subgroup difference: p = 0.62; I^2 = 0%).

A trend towards improvement in the personal accomplishment (PA) subscale scores (see Figure 6) were noted on the between-group analysis of included RCTs using the random effect model, however, the results were not statistically significant with no noted heterogeneity (MD = 0.09; 95% CI = -0.33, 0.51; p = 0.46; I^2 = 0%). Within-group analysis of the included NRTs using the random effect model showed significant improvement in the PA subscale scores, with noted significant moderate heterogeneity of the results (MD = 1.49; 95% CI = 0.40, 2.58; p = 0.03; I^2 = 48%). Pooled mean difference of all included studies showed statistically significant improvement in the PA subscale scores with noted significant heterogeneity (MD = 0.82; 95% CI = 0.24, 1.39; p = 0.05; I^2 = 35%). Test for subgroup differences between the two study designs were significant with p = 0.02 and I^2 = 81.9%.

Subgroup Analyses

Emotional Exhaustion

Subgroup analyses to identify the effects of the different types of MMBI on the EE subscale scores among RCTs and NRTs were undertaken and the results are shown in Table 4. Subgroup difference using random effect model was not significant among the RCTs (p = 0.17; I^2 = 43%) meaning that the effects of MMBIs on the EE subscale were consistent among RCTs. The traditional MBSR program produced the highest reductions in the EE subscale among RCTs (MD = -3.94; 95% CI = -7.09, -0.79) however, substantial heterogeneity was noted (p = 0.006; I^2 = 72%). The adapted MBSR and app-based program did not produce significant effects with the trends toward reduction of EE and negligible heterogeneity (MD = -0.62; 95% CI = -2.98, 1.73; p = 0.25; I^2 = 26%, and MD = -0.15; 95% CI = -3.31, 3.00; p = 0.93; I^2 = 0%, respectively). Substantial heterogeneity was noted on the subgroup analyses using random effect model based on the type of MMBI utilized among NRTs (p = 0.01; I^2 = 76.2%). Modified MBCT produced the highest reductions

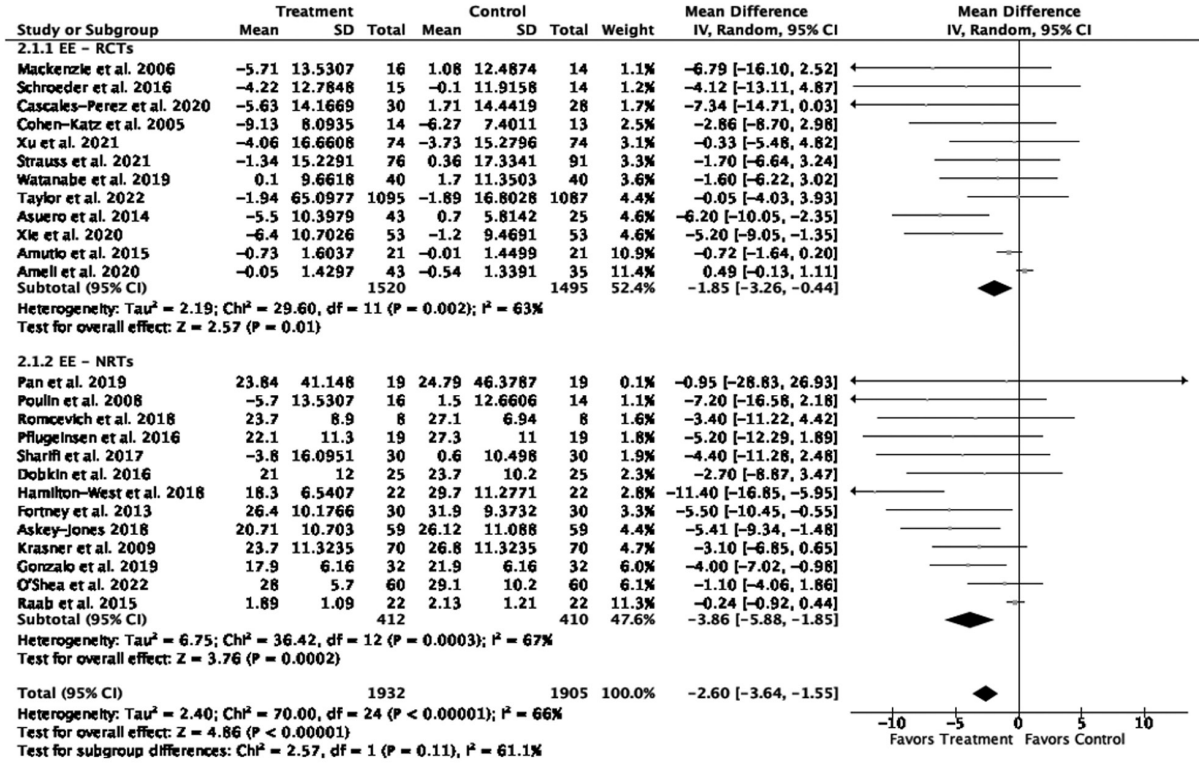

Figure 4. Forest plot of the effects of mindfulness meditation-based interventions on the emotional exhaustion subscale of the Maslach Burnout Inventory.

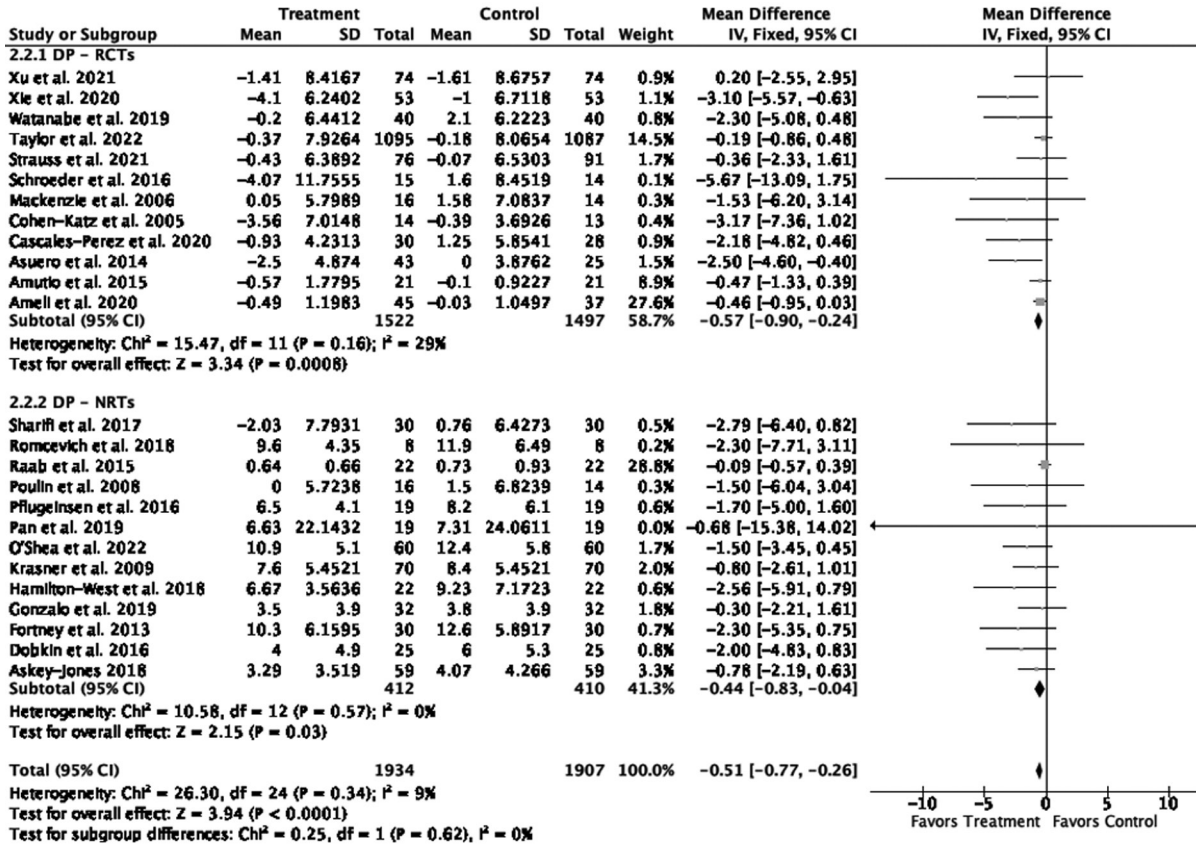

Figure 5. Forest plot of the effects of mindfulness meditation-based interventions on the depersonalization subscale of the Maslach Burnout Inventory

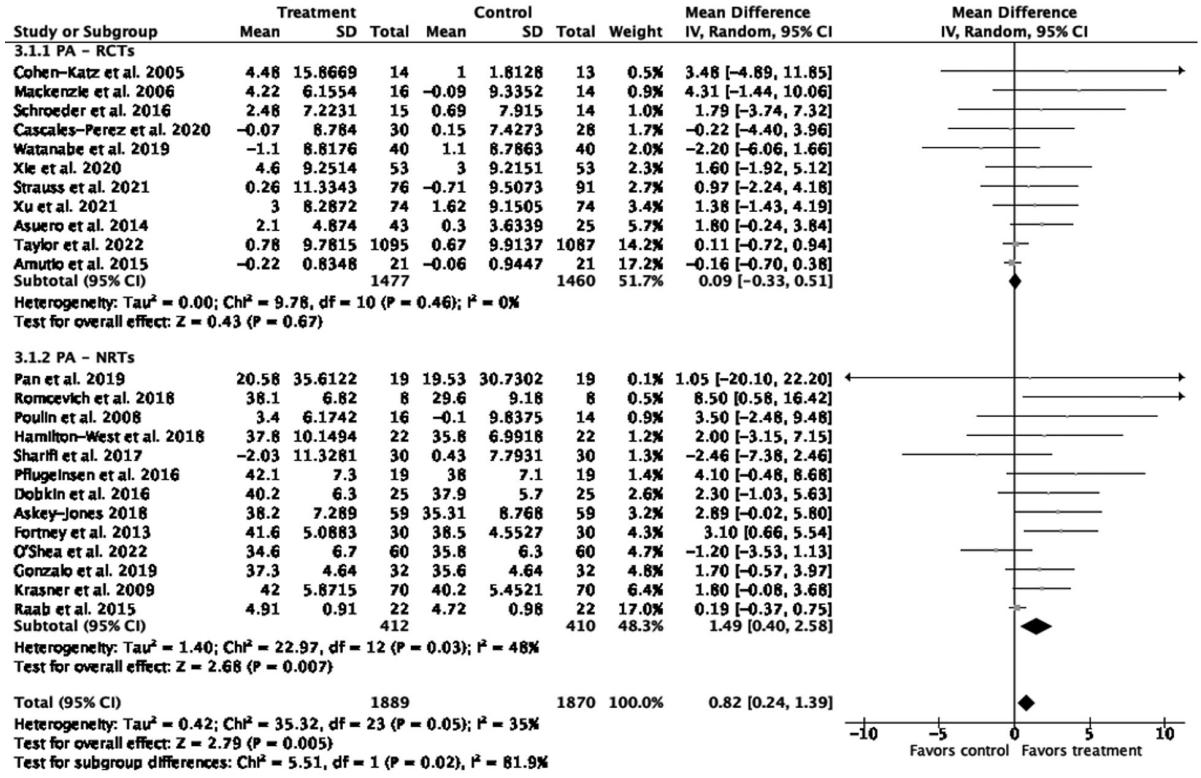

Figure 6. Forest plot of the effects of mindfulness meditation-based interventions on the personal accomplishment subscale of the Maslach Burnout Inventory

in the EE subscale scores, however, substantial heterogeneity between the two studies included in the analysis was noted (MD = -8.10; 95% CI = -13.93, -2.26; p = 0.08; I^2 = 67%). Four studies that utilized the adapted MBSR showed consistency in the EE subscale scores with significant results (MD = -4.67; 95%CI = -7.01, -2.32; p = 0.90; I^2 = 0%). The traditional MBSR program produced no significant reductions in the EE subscale scores with low heterogeneity among the studies included (MD = -1.22, 95% CI = -3.06; 0.61; p = 0.26; I^2 = 26%).

Table 4. Subgroup analyses: Effect sizes and other statistics for different subgroups of studies on burnout.

Comparison	Moderator	Subgroup	k	MD	95% CI	Chi^2 p	I^2
EE	Study design	RCTs	12	-1.85	-3.26, -0.44	0.002	63%
		NRTs	13	-3.86	-5.88, -1.85	0.0003	67%
		Subgroup difference				0.11	61.1%
DP		RCTs	12	-0.57	-0.90, -0.24	0.16	29%
		NRTs	13	-0.44	-0.83, -0.04	0.57	0%
		Subgroup difference				0.62	0%
PA		RCTs	11	0.09	-0.33, 0.51	0.46	0%
		NRTs	13	1.49	0.40, 2.58	0.03	48%
		Subgroup difference				0.02	81.9%
EE - RCTs	MMBI type	Traditional MBSR	5	-3.94	-7.09, -0.79	0.006	72%
		Adapted MBSR	4	-0.62	-2.98, 1.73	0.25	26%
		App-based	2	-0.15	-3.31, 3.00	0.93	0%
		Subgroup differences				0.17	43%
	Profession type	Mixed	6	-1.93	-4.61, 0.76	0.007	69%
		Physicians	2	-0.76	-1.68, 0.16	0.46	0%
		Nurses	4	-3.79	-6.33, -1.25	0.60	0%
		Subgroup differences				0.08	61.4%
EE - NRTs	MMBI type	Traditional MBSR	4	-1.22	-3.06, 0.61	0.26	26%
		Adapted MBSR	4	-4.67	-7.01, -2.32	0.90	0%
		Modified MBCT	2	-8.10	-13.93, -2.26	0.08	67%
		Subgroup differences				0.01	76.2%
	Profession type	Mixed	5	-3.32	-6.05, -0.39	0.003	75%
		Physicians	5	-4.49	-8.13, -0.86	0.03	63%
		Nurses	3	-5.21	-10.65, 0.23	0.85	0%
		Subgroup differences				0.76	0%
DP - RCTs	MMBI type	Traditional MBSR	5	-1.13	-1.85, -0.41	0.10	49%
		Adapted MBSR	4	-0.55	-1.02, -0.07	0.30	18%
		App-based	2	-0.17	-0.82, 0.48	0.79	0%
		Subgroup differences				0.15	47.7%
	Profession type	Mixed	6	-0.46	-0.83, -0.09	0.30	18%
		Physicians	2	-0.54	-1.39, 0.31	0.17	46%
		Nurses	4	-2.67	-4.25, -1.08	0.93	0%
		Subgroup differences				0.03	71.6%

DP – NRTs	MMBI type	Traditional MBSR	4	-0.22	-0.68, 0.23	0.25	28%
		Adapted MBSR	4	-1.07	-2.45, 0.32	0.70	0%
		Modified MBCT	2	-1.05	-2.35, 0.32	0.34	0%
		Subgroup differences				0.30	17.4%
	Profession type	Mixed	5	-0.25	-0.68, 0.18	0.38	4%
		Physicians	5	-1.41	-2.54, -0.28	0.90	0%
		Nurses	3	-2.23	-5.01, 0.55	0.89	0%
		Subgroup differences				0.08	61.0%
PA - RCTs	MMBI type	Traditional MBSR	5	0.01	-0.50, 0.52	0.31	17%
		Adapted MBSR	3	0.32	-2.45, 3.09	0.15	47%
		App-based	2	0.21	-0.58, 1.00	0.40	0%
		Subgroup differences				0.91	0%
	Profession type	Mixed	5	0.43	-0.28, 1.14	0.57	0%
		Physicians	2	-0.14	-0.68, 0.40	0.49	0%
		Nurses	4	0.84	-1.44, 3.12	0.23	31%
		Subgroup differences				0.37	0.3%
PA - NRTs	MMBI type	Traditional MBSR	4	0.34	-0.19, 0.86	0.16	42%
		Adapted MBSR	4	2.61	1.10, 4.13	0.74	0%
		Modified MBCT	2	2.67	0.14, 5.21	0.77	0%
		Subgroup differences				0.006	80.5%
	Profession type	Mixed	5	1.69	0.21, 3.18	0.04	61%
		Physicians	5	1.84	-0.59, 4.28	0.05	57%
		Nurses	3	0.11	-4.11, 4.32	0.32	13%
		Subgroup differences				0.76	0%

Abbreviation: k = number of studies

The included studies also differed in the types of healthcare workers that participated in their research. Subgroup analyses using random effect model based on the type of profession (mixed healthcare workers, physicians only and nurses only) were done. There was noted significant subgroup differences based on the types of profession ($p = 0.08$; $I^2 = 61.4\%$) among the RCTs included in the analysis. MMBIs showed highest reduction in the EE subscale scores among the studies that focused on nurses with no noted heterogeneity on the results of the four studies included (MD. = -3.79; 95% CI = -6.33, -1.25; $p = 0.60$; $I^2 = 0\%$). The interventions did not produce significant results with the trend towards reduction of the EE subscale scores and no noted heterogeneity between the two RCTs that focused on the physicians (MD = -0.76; 95% CI = -1.68, 0.16; $p = 0.46$; $I^2 = 0\%$). Six RCTs that used mixed healthcare workers in their sample population also showed no significant reduction in the EE subscale scores after the intervention with noted significant substantial heterogeneity (MD = -1.93; 95% CI = -4.61, 0.76; $p = 0.007$; $I^2 = 69\%$). No significant subgroup differences among the NRTs based on the profession type were noted ($p = 0.76$; $I^2 = 0\%$). The interventions produced significant reduction in the EE subscale scores among physicians and mixed healthcare workers, however, the analyses showed substantial heterogeneity among study results (Physicians only: MD = -4.49; 95% CI = -8.13, -0.86; $p = 0.03$; $I^2 = 63\%$; Mixed healthcare workers: MD = -3.32; 95% CI = -6.05, -0.39; $p = 0.003$; $I^2 = 75\%$). No significant reduction in the EE subscale scores among nurses in three NRTs with no noted heterogeneity among study results (MD = -5.21, 95% CI = -10.65, 0.23; $p = 0.85$; $I^2 = 0\%$).

Depersonalization

Consistent effects on the DP subscale scores were noted on the subgroup analyses using fixed effect model based on the type of the interventions utilized by the included RCTs (Subgroup difference: $p = 0.15$; $I^2 = 47.7\%$). The five RCTs that used the traditional MBSR program produced the highest significant reduction in the DP subscale

scores with no significant heterogeneity (MD = -1.13; 95% CI = -1.85, -0.41, p = 0.10; I^2 = 49%); this was followed by the adapted MBSR (MD = -0.55; 95% CI = -1.02, -0.07; p = 0.30; I^2 = 18%). Reductions in the DP subscale scores across the two app-based studies were not significant with no noted heterogeneity on their results (MD = -0.17, -0.82, 0.48; p = 0.79; I^2 = 0%). Among the NRTs, consistent results based on the MMBI used were noted (Subgroup difference: p = 0.30; I^2 = 17.4%). All types of MMBI produced no statistical reduction in the DP subscale scores, with the trend toward reduction, and with no noted significant heterogeneity among the study results.

The types of profession also had significant effects on the reduction of DP subscale scores among RCTs (p = 0.08; I^2 = 71.6%) and NRTs (p = 0.08; I^2 = 61%) using the fixed effect model. Among the RCTs, four studies that focused on nurses as their sample population had the highest reduction of DP subscale scores after the interventions with no noted significant heterogeneity on the study results (MD = -2.67; 95% CI = -4.25, -1.08; p = 0.93; I^2 = 0%), followed by the results of six studies that utilized mixed healthcare worker (MD = -0.46; 95% CI = -0.83, -0.09; p = 0.30; I^2 = 18%). Subgroup analysis of the two RCTs that focused solely on physicians produced no significant reduction in the DP subscale scores, with trends toward benefit, with no noted heterogeneity on their results (MD = -0.54; 95% CI = -1.39, 0.31; p = 0.17; I^2 = 46%). Among the NRTs included in the analysis, the three studies that focused on nurses produced that highest reduction in the DP subscale score with no noted heterogeneity however that result was not statistically significant (MD = -2.23; 95% CI = -5.01, 0.55; p = 0.89; I^2 = 0%). Analysis of the five NRTs that focused on physicians showed significant reduction in the DP subscale scores with no noted heterogeneity (MD = -1.41; 95% CI = -2.54, -0.28; p = 0.90; I^2 = 0%). Lastly, the five NRTs that utilized mixed healthcare workers produced reduction in the DP subscale scores with no noted heterogeneity, however the results were not statistically significant (MD = -0.25; 95% CI = -0.68, 0.18; p = 0.38; I^2 = 4%).

Personal Accomplishment

The types of MMBI used produced consistent effects on the PA subscale scores among RCTs (p = 0.91, I^2 = 0%) using the fixed effect method. There were noted improvements in the PA subscale scores on each type of MMBI analyzed with no noted heterogeneity across the study results, however the results were not statistically significant. On the other hand, subgroup analyses using fixed effect model based on the type of MMBI used showed heterogenous results among NRTs (p = 0.006; I^2 = 80.5%). The two studies that utilized modified MBCT showed highest improvements in the PA subscale scores with statistically significant results and no noted heterogeneity (MD = 2.67; 95%CI = 0.14; 5.21; p = 0.77; I^2 = 0%); this was followed by the aggregate results of the four studies that utilized adapted versions of the MBSR (MD = 2.61; 95%CI = 1.10, 4.13; p = 0.74; I^2 = 0%). The four NRTs that utilized the traditional MBSR program showed improvements in the PA subscale scores with no significant heterogeneity, however, the results were not statistically significant (MD = 0.34; 95% CI = -0.19, 0.86; p = 0.16; I^2 = 42%).

The types of profession had consistent effects on the PA subscale scores among RCTs using the fixed effect model (p = 0.37; I^2 = 0.3%) and NRTs using random effect model (p = 0.76; I^2 = 0%). Improvements on the PA subscale scores were all not statistically significant (see Table 2) except for the result on the subgroup analysis among NRTs that used mixed healthcare workers (MD = 1.69; 95% CI = 0.21, 3.18; p = 0.04; I^2 = 61%), but of note was the significant heterogeneity among study results.

Publication Bias and Grading of Quality of Evidence

Funnel plots for each subscale were generated to assess for publication bias. Comparing the symmetry on the two sides of the overall effect, it was noted that there is asymmetry on the funnel plots generated for all subscales with the point estimates aggregating to the left side of the overall effect for EE and DP; and right side of the overall effect for PA. Egger's regression test showed evidence of publication bias on the analysis of the EE subscales for both RCTs and NRTs, analysis of RCTs for DP and analysis of NRTs for PA (Sig 0.008, Sig 0.001, Sig 0.009 and Sig 0.042, respectively). No evidence of publication bias based on the Egger's regression test were noted for the analysis of NRTs for DP and RCTs of PA. The overall quality of evidence for the EE subscale of both the RCTs and NRTs was very low due to lack of allocation concealment, lack of blinding, heterogeneity, and plausible residual confounders. For the DP subscale, quality of evidence was moderate for between-group comparison and low for within-group comparison due to lack of randomization, blinding and control. The analyses for PA subscale yielded low overall quality of evidence for RCTs and NRTs due to lack of randomization, control, and blinding.

Discussion

Analysis of five studies showed that MMBIs produced significant reduction in the overall burnout scores among healthcare workers. However, it is recommended that we do not combine the MBI sores into a single, total score[1] since the same total score can be achieved by different combinations of the three subscales. Hence analysis of the three subscales were undertaken. The emotional exhaustion subscale is the most widely used and the most thoroughly analyzed component of burnout.[3] Analysis using random effects model of 12 RCTs and 13 NRTs revealed that MMBIs produced significant reduction in the EE subscale scores among health care workers with pooled mean difference of -2.60 (95% CI = -3.64, -1.55). The result of this meta-analysis is comparable with previous meta-analyses that also reported significant reduction on the EE subscale scores among primary healthcare professionals[55] (SMD = -0.54; 95% CI, -0.72 to -0.36; p-value < 0.001), and among training and practicing physicians[19] (MD = -2.65; 95% CI, -3.64 to -1.67; p-value < 0.0001). According to earlier research, a 1-point rise in the EE subscale score was associated with 6.9% increase in the risk of reporting suicidal thoughts[56], a 5% to 7% increase in the likelihood of reporting medical errors[57-59], and a 43% greater likelihood of work hour reductions.[60] Hence, a reduction of 2.60 points in the EE subscale score could be associated with meaningful difference in the burnout severity

of healthcare workers and ultimately in reduced medical errors and improved well-being.

MMBIs produced significant reduction in the DP subscale scores among healthcare workers after fixed effect model analysis of 12 RCTs and 13 NRTs, with no noted significant heterogeneity (pooled MD = -0.51; 95% CI = -0.77, -0.26). Similar results on DP subscale scores were also noted in previous meta-analyses among primary healthcare professionals[55] (SMD = -0.34; 95% CI, -0.52 to -0.17; p-value < 0.001) and among training and practicing physicians[19] (MD = -0.64; 95% CI, -1.14 to -0.15; p-value = 0.01). Previous studies reported that a 1-point increase in DP subscale score is associated with 10.9% rise in the odds of reporting suicidal ideation[56], and reporting medical errors increased by 11%[57], thus a decrease of 0.51 points could still be considered a clinically meaningful difference.

Analysis of the effectiveness of MMBIs on the PA subscale scores among healthcare workers showed that MMBIs produce significant improvement with pooled MD of 0.82 (95%CI = 0.24, 1.39). A previous meta-analysis also reported small and significant improvement in the PA subscale scores among primary healthcare professionals[55] (SMD = 0.34; 95% CI, 0.17 to 0.52; p-value < 0.001) after MMBIs. The previous meta-analysis focused solely on the effects of MMBIs on primary healthcare professionals thus included smaller number of studies as compared to this meta-analysis. In terms of PA, a 1-point decrease is associated with 5.7% rise in the odds of reporting suicidal ideation[56] and an increase in reporting medical errors by 6%[57] hence a 0.82 change in score may be considered a meaningful difference clinically.

The types of MMBI implemented in the included studies had no influence in the intervention effect noted on all three subscales among RCTs but had significant influence among NRTs. This may be attributable to the low methodological quality of NRTs included that can yield to heterogenous results. In terms of the type of profession of the healthcare workers included in the various studies, among RCTs, the profession type had significant influence in the intervention effect for EE and DP and no influence in PA. Among NRTs, the type of profession had no influence in the EE and PA scores and had significant influence in the DP scores. Reduction of burnout was noted to be highest on nurses after the intervention. However, due to the small number of studies included in all subgroup analyses, these results should be regarded with caution.

This is the first meta-analysis, to the best of our knowledge, that evaluated the effectiveness of MMBIs among various healthcare workers using changes in the overall MBI scores, and changes in the EE, DP and PA subscale scores. This allowed analysis of continuous outcomes using the same measure. The modifying effects of the study design, type of MMBI used and profession type were also analyzed via subgroup analyses. Another strength of this review is that the methods of search strategy, study selection, risk of bias assessment, and data extraction were done by two independent reviewers, thus minimizing bias and improving the validity and reliability of this review. However, there are some limitations of the evidence included in this review. For the included RCTs, selection bias in terms of randomization was low for some studies but unclear for other studies since there was no data regarding random sequence generation and allocation concealment from these studies. There is also a high risk of performance bias due to absence of blinding but of note is that blinding is not possible due to the nature of the intervention. For the NRTs, the global rating for risk of bias was weak due selection bias, possible confounders and lack of blinding. These limitations can introduce heterogeneity across the included studies and consequently the pooled results may become unreliable and the conclusions drawn from the analysis may lack robustness. The overall quality of evidence for the RCTs in this review was low to moderate and was very low to low for the NRTs. Improvement in the quality of evidence by future research with high-quality RCTs is recommended in order to confirm the results.

In terms of limitations of the review process used, some of the studies were excluded due to missing outcome data and four articles were not retrieved due to unavailability of full-text copies. Excluding these studies from this meta-analysis due to missing data may introduce bias. The inclusion or deletion of these studies may have an impact on this review's overall conclusions if studies with missing data consistently differ from those without missing data. Also, potentially, missing data can make publication bias worse. If studies with missing data have a higher likelihood of producing null or nonsignificant results and a lower likelihood of being published, including solely published studies in the meta-analysis may create bias toward favorable or significant outcomes.[61]

Conclusion and Recommendations

This systematic review and meta-analysis showed that mindfulness meditation-based interventions lead to improved burnout symptoms of healthcare workers in the hospital setting across all domains. The traditional mindfulness-based stress reduction program produced the highest changes in the emotional exhaustion and depersonalization subscale scores among RCTs and reduction of burnout was noted to be higher in nurses compared with physicians and mixed healthcare workers. Pooled mean differences of the different subscales of MBI showed that MMBIs produced statistically similar results despite methodological differences between RCTs and NRTs; however, future study utilizing high-quality RCTs is advised in order to increase the quality of evidence and confirm the results.

Burnout among healthcare workers is a growing concern in the Philippines especially in the setting of the COVID-19 pandemic. Even small changes in the burnout score can lead to clinically significant improvement for healthcare workers. Hence, the results of this review may be used by healthcare policy makers in making strategies that prioritize the mental health and well-being of healthcare workers, leading to improved job satisfaction and ultimately improving the quality of healthcare delivery. The authors encourage healthcare policy makers to implement mindfulness meditation in healthcare settings by developing guidelines and collaborating with professional organizers and mindfulness experts to develop standardized training curricula as well as developing codes of conduct to ensure mindfulness programs are delivered in an ethical and culturally sensitive manner. In addition, mindfulness meditation-based interventions could be implemented and included in the traditional and complementary medicine services of the Department of Family and Community Medicine that can be offered to the Batangas Medical Center employees and patients who are healthcare workers.

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