ACCEPTED MANUSCRIPT

APA JOURNAL OF OCCUPATIONAL HEALTH PSYCHOLOGY

A Systematic Review and Meta-Analysis of

Workplace Mindfulness Training Randomized Controlled Trials.

A Systematic Review and Meta-Analysis of Workplace Mindfulness Training Randomized Controlled Trials

Larissa Bartlett, Angela Martin, Amanda L. Neil, Kate Memish, Petr Otahal, Michelle Kilpatrick, Kristy Sanderson

Author note

Larissa Bartlett, Kate Memish, Petr Otahal, Amanda L Neil: Menzies Institute for Medical Research, University of Tasmania. Kristy Sanderson: School of Health Sciences, University of East Anglia and Menzies Institute for Medical Research, University of Tasmania. Angela Martin: Director of Pracademia Pty Ltd and the School of Business and Economics, University of Tasmania.

The primary author is a doctoral candidate in receipt of support through an Australian Government Research Training Program Scholarship and the TasNetworks Health and Wellbeing Top-Up Scholarship. The content of this paper formed the basis of a summary oral presentation at the 2017 APA Work, Stress and Health Conference, for which the primary author received the Student Researcher Award. The study team gratefully acknowledges

authors of studies who provided additional data for inclusion in analyses. The authors declare no conflicts of interest. Ethics approval was not required for this project.

Correspondence concerning this article should be addressed to Professor Kristy Sanderson, Chair, Applied Health Research, School of Health Sciences, Faculty of Medicine and Health Sciences, University of East Anglia, Norwich Research Park, Norwich, NR4 7TJ, UK, Tel: +44 (0) 160359 1142, Email: Kristy.Sanderson@uea.ac.uk

Acknowledgements

The study team gratefully acknowledges authors of included studies who provided additional data for inclusion in analyses. The authors declare no conflicts of interest. Ethics approval was not required for this project.

A Systematic Review and Meta-Analysis of Workplace Mindfulness Training RCTs

Abstract

This meta-analytic review responds to promises in the research literature and public domain about the benefits of workplace mindfulness training. It synthesizes randomized controlled trial evidence from workplace-delivered training for changes in mindfulness, stress, mental health, wellbeing and work performance outcomes. Going beyond extant reviews, this paper explores the influence of variability in workforce and intervention characteristics for reducing perceived stress. Meta-effect estimates (Hedge's *g*) were computed using data from 23 studies. Results indicate beneficial effects following training for mindfulness (g=0.45, p<0.001) and stress (g=0.56, p<0.001); for the mental health indicators anxiety (g=0.62, p<0.001) and psychological distress (g=0.69, p<0.001); and for wellbeing (g=0.46, p=0.002) and sleep (g=0.26, p=0.003). No conclusions could be drawn from pooled data for burnout due to ambivalence in results, for depression due to publication bias, or for work performance due to insufficient data. The potential for integrating the construct of mindfulness within demands-resources, coping and prevention theories of work stress is considered in relation to the results. Limitations to study designs and reporting are addressed, and recommendations to advance research in this field are made.

Keywords: mindfulness; stress; work; meta-analysis; mental health; wellbeing

A Systematic Review and Meta-Analysis of Workplace Mindfulness Training RCTs

Mindfulness is defined as an intentional attentiveness to present moment experience with an orientation of curiosity, openness and acceptance (Bishop et al., 2004). Over the last 30-plus years intervention research has shown mindfulness is open to development, and that established training programs result in reduced stress and improved mental health (Creswell, 2016; Gu, Strauss, Bond, & Cavanagh, 2015; Kabat-Zinn, Lipworth, & Burney, 1985; Khoury, Sharma, Rush, & Fournier, 2015; Lutz et al., 2014; Pascoe, Thompson, Jenkins, & Ski, 2017). More recent research suggests the benefits of mindfulness training may go beyond personal wellbeing to include improved work performance and relationships (Allen & Paddock, 2015; Good et al., 2016). Given the pertinence of these outcomes for working populations, interventions that develop mindfulness have gained popularity in organizations over the last decade (Lomas et al., 2017). With an estimated annual turnover of US$1.1 billion in 2017 (Scott, 2017), and regular, largely positive media coverage (Lauricella, 2016) the mindfulness training industry is booming.

However, mindfulness training programs delivered in workplaces often vary from the training protocols upon which most scientific evidence is based (Allen et al., 2015; Hyland, Lee, & Mills, 2015). These variations include reduced time commitment (or dose) of training and the use of flexible delivery methods to meet the demands of contemporary work environments (Crane et al., 2016). The result is a heterogeneous collection of mindfulness courses, ostensibly teaching the same set of skills.

A meta-analysis gathers together results from multiple scientific studies and offers a summary of the quantitative evidence. Only one meta-analysis on this topic has been published before now (Virgili, 2015). This study looked at the single outcome of psychological distress and found overall positive effects for working adults following mindfulness training. This outcome is an important indicator of benefit, as it is a key risk

factor for mental and physical health problems that are associated with chronic stress. Virgili's work was not limited to interventions delivered within the work environment. The current paper focuses only on workplace-delivered training and supports and extends the meta-analytic evidence to include a wider range of the outcomes promised in the literature. We draw on randomized controlled trial (RCT) data, as this is currently accepted as the best way to understand if effects are attributable to treatment in intervention research (Friedman, Furberg, & DeMets, 2010). Pooling data from studies using validated outcome measures and conducted in real-world settings under everyday conditions will help clarify the Stage IV[1] evidence base for the effectiveness of mindfulness training (Dimidjian & Segal, 2015; Michalak & Heidenreich, 2018).

In this meta-analysis we ask if the best available evidence from workplace-based mindfulness training supports claims of reduced stress, and of benefits for mental health, wellbeing and work performance. Further, for the first time, we explore how workforce characteristics and variations in intervention formats influence training outcomes.

Workplace stress and related problems

Employee stress is problematic for employee mental health and wellbeing and impacts human resourcing and economic outcomes for the organizations in which they work. Occupational health psychology (OHP) research commonly draws on theoretical frameworks that attribute employee stress to the perception that work demands exceed available resources (Bakker & Demerouti, 2017). Work-related stressors include a lack of perceived control or opportunity, role conflict or ambiguity, effort-reward imbalance, isolation, uncomfortable work conditions, irregular work hours, perceived injustices and difficult relationships

[1] National Institutes of Health Stage Model for clinical research (Onken, Carroll, Shoham, Cuthbert, & Riddle, 2013)

(Hargrove, Quick, Nelson, & Quick, 2011). When such situations are perceived to be beyond coping capacity (i.e. appraised as a threat) a series of automatic cognitive and neurobiological reactions occur (Ganster, Crain, & Brossoit, 2018; Garland, Hanley, Baker, & Howard, 2017; Taren et al., 2015). If the perceived threat is not resolved, a cumulative cycle of stress reactivity can occur (Garland et al., 2017). Sustained stress depletes the body's physiological, attentional and emotional coping mechanisms, and reduces capacity to cope with future challenges. This state of chronic stress is a known contributor to clinical emotional (e.g. depression), somatic (e.g. hypertension, poor immune function) and behavioral (e.g. aggression, substance use) problems (Burton, Chen, Schultz, & Li, 2017; Cuthbert & Insel, 2013; Ganster et al., 2018; Gold, 2015).

Chronic work-related stress also negatively impacts organizations through staff disengagement, attentional deficits, absenteeism and working while unwell (presenteeism), and leads to role adjustments and workers' compensation claims (Dewa, McDaid, & Ettner, 2007; Dollard & Neser, 2013). Growing awareness of these organizational impacts, coupled with a desire to nurture employee wellbeing, are driving a rise in the uptake of work-based stress-management interventions (Memish, Martin, Dawkins, Bartlett, & Sanderson, 2017).

Firm conclusions regarding best-practice programs for workplace stress management are hard to find because relevant research is conducted in variable contexts, using different programs, outcomes and methodologies (Murphy, 1996). However, approaches that aim to improve coping skills using adaptive strategies appear to be effective (Bhui, Dinos, Stansfeld, & White, 2012). Adaptive strategies target the way demand-resource imbalances are perceived and include key skills of reperceiving (appraising stressors in different ways), and decentering (creating psychological distance from the stressor so that it can be seen within its broader context) (Folkman, 2013). Interventions with this positive orientation can build

employee coping capacity, improve mental health and wellbeing, and have been shown to support work-related performance (Bono, Glomb, Shen, Kim, & Koch, 2013; Dawkins, Martin, Scott, & Sanderson, 2015; Luthans, Avolio, Avey, & Norman, 2007; Roche, Haar, & Luthans, 2014; Sin & Lyubomirsky, 2009).

The potential of mindfulness training

Mindfulness training is a multi-modal intervention informed by the principles of positive psychology, with a central focus on skills that can reduce suffering and enable more effective coping. The evidence in support of mindfulness for beneficial outcomes is largely obtained from Mindfulness-Based Stress Reduction (MBSR) intervention studies. The MBSR training protocol originates from the principles of Eastern meditative and philosophical traditions but is presented in secular format[2]. In the 1970's Kabat-Zinn et al. (1985) designed and tested MBSR to alleviate stress and suffering for people living with chronic pain. The program spans eight weeks and includes weekly 2.5-hour classes, a day-long retreat and prescribed homework of daily activities, including around 40 minutes of meditation. Evidence for the efficacy of MBSR for reducing stress in otherwise healthy populations is solid (Khoury et al., 2015). This well-articulated program has become the 'gold standard' for mindfulness training from which a range of derivations, or Mindfulness-Based Programs (MBPs), have emerged. Adaptations have been made to meet the needs of specific populations (e.g. employees, adolescents) and purposes (relationship enhancement, cognitive flexibility) (Chiesa & Malinowski, 2011). As with MBSR, MBPs include body scan, mindful movement and sitting meditations and are taught experientially in classes and then practiced as daily homework with the support of guided audio-tracks. MBPs are typically delivered by

[2] A detailed curriculum guide for MBSR is available from the University of Massachusetts Centre for Mindfulness in Medicine, Healthcare and Society at https://umassmed.edu/globalassets/center-for-mindfulness/documents/mbsr-curriculum-guide-2017.pdf

experienced mindfulness practitioners in group settings. According to guidelines for MBPs published by Crane et al. (2016), it is important to retain these elements to best facilitate the collective investigation of meditation experiences, the recognition of patterns of reactivity, and enable teacher guidance about the potential to respond differently.

Theoretical placement of mindfulness in Occupational Health Psychology (OHP)

Mindfulness training has not been extensively researched in the OHP field, and its placement within contemporary theories is emerging. Correlations with known protective resources hope, optimism and self-efficacy (Malinowski & Lim, 2015; Roche et al., 2014) indicate that being more mindful may be protective against workplace stress. This suggestion is supported by research into the mechanisms of mindfulness. For example, Garland's biobehavioral Mindfulness-to-Meaning Theory (MMT) suggests mindfulness training cultivates the adaptive coping skills of decentering and reappraisal (Garland et al., 2017). It is proposed these behavioral mechanisms interact with automatic neurobiological stress responses to intercept the cumulative cycle of reactivity associated with chronic stress. Further, the neuro-biological stress-buffering model proposed by Creswell & Lindsay (2014) suggests mindfulness meditation practice increases capacity for attentional, behavioral and emotional regulation through neuronal recruitment in brain regions responsible for these processes. In support of Creswell's model, neuro-imaging studies have shown greater mass in the pre-frontal cortex and smaller and less active amygdala in people with higher levels of mindfulness, indicating neurological evidence of improved regulatory capacity following training (Boyd, Lanius, & McKinnon, 2018; Lutz et al., 2014; Taren et al., 2015).

Aligning these mechanistic theories of mindfulness with intervention evidence and OHP theoretical models can help clarify how the training might address workplace stress. For example, a cross-sectional study of the influence of perceived autonomy and mindfulness

among nurses (Grover, Teo, Pick, & Roche, 2017) found mindfulness influenced participants' emotional regulation, which mediated improvements in perceived job control and support. The authors suggest these results show mindfulness may be a protective resource within the job demands-resources (JDR) theoretical model (Bakker & Demerouti, 2017). In addition, emerging research suggests training in mindfulness enhances the adaptive coping strategies of decentering and reappraisal (Josefsson, Lindwall, & Broberg, 2014; Keng, Choo, & Tong, 2018) indicating mindfulness training is a potentially useful stress management intervention in line with current theories of preventive stress management (Hargrove et al., 2011) and coping (Folkman, 2013). However, the extent to which mindfulness training in work settings has been tested within these three theoretical models has not previously been reported.

Mindfulness training at work

Based on the theoretical models discussed, it is proposed mindfulness training should increase participant mindfulness, and realize benefit for employee stress, mental health and wellbeing (Good et al., 2016; Hyland et al., 2015; Lomas et al., 2017). This proposition is supported by intervention meta-analyses for stress, mental health and wellbeing outcomes, including sleep (Khoury et al., 2015; Shallcross, Visvanathan, Sperber, & Duberstein, 2018; Virgili, 2015). It is further proposed mindfulness training is beneficial for work performance (Good et al., 2016; Hyland et al., 2015; Lomas et al., 2017). This is supported by studies of the association of mindfulness with work engagement (Shiba, Nishimoto, Sugimoto, & Ishikawa, 2015), burnout (N. Z. Taylor & Millear, 2016), leadership, productivity (King & Haar, 2017), empathy and perspective taking (Van Doesum, Van Lange, & Van Lange, 2013; Van Lange & Van Doesum, 2015) as well as attentional and cognitive functioning (Chiesa, Calati, & Serretti, 2011; Reb & Choi, 2014).

While the theoretical rationale of why mindfulness training might impact on work outcomes is logically defensible, the evidence appears to be based on few studies with small samples and quality limitations (Goyal et al., 2014; Kreplin, Farias, & Brazil, 2018; Rupprecht, Koole, Chaskalson, Tamdjidi, & West, 2018). Also, due to the time intensive nature of MBSR, an increasing number of MBPs promoted for workplace delivery are structured to maximize accessibility for and within organizations, with shortened classes and practice meditations and the use of flexible delivery modes (Chiesa & Malinowski, 2011; Crane et al., 2016; Van Gordon, Shonin, & Griffiths, 2015). These modifications are likely to impact the degree to which effects are realized (Crane et al., 2016; Jamieson & Tuckey, 2017). A better understanding of the relative importance of different training elements on efficacy will help guide future program modifications. Additionally, since MBSR was designed to be delivered in class-based format, the use of variable delivery modes is deserving of attention. In a recent review of online MBSR in non-work settings, effects were equivalent to face-to-face class-based training (Spijkerman, Pots, & Bohlmeijer, 2016), however flexible delivery has not been investigated for workplace-delivered MBPs. Further, the extent to which workplace context may influence training outcomes has not yet been systematically examined. For example, while health care and education samples are highly represented in mindfulness research (Allen et al., 2015; Hyland et al., 2015), the extent to which other populations benefit by comparison is worth exploring.

The Present Study

Limitations in the quality and quantity of studies, and the heterogeneity of intervention characteristics and study methods are reasons advanced by others for not synthesizing study data (Jamieson & Tuckey, 2017). However, we propose that the promise of mindfulness promulgated in the public domain should be supported by a synthesis of the

empirical evidence, and that sources of heterogeneity should be investigated for their influence on efficacy. A meta-analytic review of RCT evidence will highlight which outcomes are currently evidenced for workplace-delivered MBIs, and those which need further work, and thus guide future research and practice within the context of this fast-growth industry.

This paper therefore aims firstly to assess the effectiveness of mindfulness training delivered in the work context for employee mindfulness, stress, mental health, wellbeing and work performance; and secondly to explore the moderating role of workplace characteristics and of intervention dose, content and delivery mode.

Method

The Cochrane Handbook for Systematic Reviews of Interventions informed the methods used throughout this review (Higgins & Green, 2011). The review protocol was registered with PROSPERO in March 2016 (CRD42016036650).

Search strategy and study selection

Searches of publication databases (PubMed, Cochrane Library, Scopus, CINAHL and ProQuest), and of unpublished works (ProQuest Dissertations and Theses, WHO International Clinical Trials Register) were conducted in May 2016, and supplemented with hand searching of retrieved articles, press releases, conference abstracts, reviews and reports. The search strategy used controlled vocabulary (MeSH) and free text terms (Supplementary Table A). Two independent reviewers (LB, KM) assessed studies for inclusion, then for quality, before extracting characteristic and outcome data.

Studies published in English and fitting the following criteria were included. Intervention(s) were (1) explicitly described as mindfulness programs; (2) organized by employers and delivered for staff within the work context. Included studies (3) used an RCT

design with active or inactive comparators; and (4) reported data from any validated measure of mindfulness, stress, mental health, work performance or wellbeing. Studies were excluded if: (1) they were quasi-experimental, uncontrolled and non-randomized; (2) they taught primarily relaxation or yoga, and not mindfulness meditation; (3) interventions were therapeutic, such as dialectical behavior therapy, acceptance and commitment therapy and cognitive behavior therapy; and (4) used clinical or student populations.

Data extraction and synthesis

Characteristics of workplaces (sector, size, structure and industry), participants (occupation, education, marital status, age and sex), and interventions (mode, dose and content) were double coded by two independent reviewers, one with and one without prior content knowledge (LB, KM). The original inter-rater agreement was 70%; discrepancies were discussed and literature co-reviewed to attain 100% concordance. Original study outcomes were grouped into the five per-protocol review outcomes: mindfulness, stress, mental health, wellbeing and work performance (Supplementary Table B) and were included in meta-analyses if at least three studies reported sufficient data (Higgins & Green, 2011). Mental health measures and wellbeing measures were differentiated by the intent of the measure and the direction of results; wellbeing measures typically indicate an improvement when a higher score is returned.

Rating risk of bias

Bias in empirical research arises from a systematic error in study design, conduct or analysis, and may result in under- or over-estimation of intervention effects (Higgins & Green, 2011). In meta-analyses, rating bias risks provides an indicator of study quality, and differences can help explain heterogeneity in results. Bias risks were double coded (LB, KM) using the Cochrane Risk of Bias guidelines (Higgins et al., 2011). Individual studies were

scored for risk (1=low risk, 2=high risk, 3=unclear risk) for each of the bias categories listed above. Scores for each risk category were investigated as effect moderators. The potential for publication bias across our included studies was assessed by inspecting the distribution of points in the meta-analysis funnel plots (Higgins & Green, 2011; Higgins, Thompson, Deeks, & Altman, 2003; Kepes, Banks, McDaniel, & Whetzel, 2012). Duval and Tweedie's Trim and Fill method (Viechtbauer, 2010) was used to test the sensitivity of meta-analytic findings to publication bias, by adding potentially missing studies and recalculating the pooled effect size. Funnel plots were inspected and effect estimates adjusted following trim and fill analyses (Supplementary Figure A).

Estimates of effect

Standardized mean difference (SMD) effect estimates were calculated with random effects models and formulae provided by Fu et al. (2013). First, Cohen's *d* was computed for individual study outcomes using means, SDs and sample sizes at each time point. Inspection of outcome data revealed frequent imbalance at baseline, so *d* was computed using mean change scores by group, obtained by subtracting the baseline mean from the post-intervention mean for each group. If not reported, the SD for change scores (SD_{diff}) were imputed using the following formula (Fu et al., 2013; Higgins & Green, 2011).

$$SD_{diff} = \sqrt{SD_{BL}^{2} + SD_{PI}^{2} - 2r * SD_{BL} * SD_{PI}}$$

In this equation *r* is the mean correlation for within-group change from baseline to post-intervention. If not provided, *r* was imputed from other studies reporting data from the same outcome measure. Where not available, we used the conservative value of $r = 0.5$ (Fu et al., 2013). After computing SMD for individual studies, Hedge's unbiased estimate (*g*) was used for the meta-analyses. This approach accommodates bias arising from the small number of

studies and allows pooling of data from multiple measures of the same construct (Durlak, 2009; Higgins & Green, 2011).

Interpretation of SMD effect estimates is in line with guidelines (J. Cohen, 1992), where 0.2 is a weak effect, 0.5 moderate and 0.8 strong. The direction of reported effect sizes is positive if the result indicates an improvement for the intervention. Forest plots are presented for each meta-analysis. Heterogeneity for meta-analyses is indicated by the *Q* statistic (Higgins et al., 2003), and I^2 is reported for interpretation. An $I^2 = 75\%$ is considered a high degree of heterogeneity, moderate when $I^2 = 50\%$ and low when $I^2 = 25\%$. The direction and magnitude of change is reported narratively for outcomes that were not included in the meta-analyses. All analyses were conducted using R, with the *metafor* package (Viechtbauer, 2010).

Tests of moderation

The second aim of this review was to explore the influence on meta-analytic findings of bias risks, variations in the dose, content and delivery mode of MBPs, and of workforce characteristics. Moderator analyses were conducted using meta-regression when outcome data from the same measure was reported by at least 10 studies (Fu et al., 2013; Higgins et al., 2011). Hedge's *g* pooled effect estimates with 95% confidence intervals stratified by sub-groups, and the amount of heterogeneity accounted for (R^2) across sub groups are reported with tests of each moderator set at $\alpha=0.05$.

Results

Study selection

Searches yielded 473 articles after removing duplicates, and 384 were excluded after reviewing titles and abstracts. Eighty-seven full-text papers were screened for eligibility. The PRISMA diagram (Figure 1) presents the flow of articles from initial searches to the final

inclusion of 27 papers. Two (C. Taylor et al., 2016; van Dongen et al., 2016) reported different analyses from already included studies (Roeser et al., 2013; van Berkel, Boot, Proper, Bongers, & van der Beek, 2014), meaning there were 25 separate primary studies reviewed. The authors of eight of these studies were contacted and asked to supplement published results. Ultimately, 23 studies had sufficient data for meta-analysis for at least one of the review outcomes.

Insert Figure 1: PRISMA flow diagram.

Study characteristics

Table 1 presents the characteristics of 27 included studies, 21 of which were not in the last meta-analysis (Virgili, 2015). All studies collected data pre- and post-intervention and 12 reported follow up results, with intervals ranging from six to 52 weeks. Most of the reviewed studies (k=20, 80%) compared the MBP with wait-list or treatment-as-usual comparators. Samples were mostly self-selected into the study in response to invitation campaigns (k=20), while the others were directed by their employers to participate. All included studies randomized participants to group prior to training commencement.

INSERT TABLE 1: Characteristics of the included studies

As anticipated, the mindfulness interventions were widely variable, ranging in dose from 10 minute self-guided meditations five days a week with no classes (Burnett & Pettijohn, 2015), to 42 hours' class-time over eight weeks, with 25 minutes' daily practice (Kemeny et al., 2012). While some used flexible delivery methods (e.g. online, videoconferencing, audio-tracks) (Aikens et al., 2014; Burnett & Pettijohn, 2015; Grégoire & Lachance, 2015; Prasek, 2015; Wolever et al., 2012) most were taught in face-to-face group format. Two studies provided no detail about the training protocol they investigated (McConachie, McKenzie, Morris, & Walley, 2014; Wolever et al., 2012). Meditation techniques such as body scan and breath meditation were common across the rest of the

included studies, with only two not explicitly including the body scan technique. One third of MBPs studied included a mindfulness theory component, and about half of the interventions included teachings on stress physiology. Most programs prescribed between-class meditation practice, although seven did not specify the amount (Ancona & Mendelson, 2014; Crain, Schonert-Reichl, & Roeser, 2016; Jay et al., 2015; McConachie et al., 2014; Roeser et al., 2013; Shapiro, Astin, Bishop, & Cordova, 2005; C. Taylor et al., 2016); and about half included micro-practices (brief exercises lasting between one and three minutes that can be used throughout the day to embed mindfulness into daily life). A checklist of MBP characteristics is included in Table 1.

The USA had the largest number of RCTs (n=18), followed by Canada (n=4) and one study each was published from Australia, Colombia, Denmark, Italy, Netherlands, Scotland and Taiwan. The total number of participants studied was 2,290, of which 1,086 (47%) participated in mindfulness programs and 1,204 (53%) in control conditions. Study sample sizes ranged from 18 to 257. Men were consistently underrepresented (average 15%) compared with women. The populations recruited included employees in finance and insurance (2), pharmaceutical (2), high-tech manufacturing (1) and public administration and safety (1), with the remaining studies split between education and training (12) and health and community services (9).

Risks of bias in the included studies

Concealment bias was common due to difficulties in blinding participants and teachers to treatment. Non-equivalence in baseline scores for study outcomes was observed in 12 studies, indicating the presence of selection bias. In most cases data was collected through surveys completed independently by participants, so detection bias was low. Attrition bias was present for half of the studies, with only 10 reporting results of intention to treat analyses and several omitting to report drop out or sample sizes at all time points. A high risk of

reporting bias was not observed. No significant influence on effects were observed for bias risks (Supplementary Table C).

Results of the Meta-Analysis

The meta-analytic findings for mindfulness, stress, mental health and wellbeing (Aim 1) are presented in Table 2 and Figures 3, 4 and 5. Funnel plots with trim and fill adjustments are available (Supplementary Figure A). Work performance outcomes were not sufficient for meta-analysis, so summative findings are reported narratively. Results for studies using active comparators and reporting follow-up outcomes are summarized.

INSERT TABLE 2: Meta-analysis results

INSERT FIGURES 3, 4 and 5: Meta-analysis forest plots

A consistent positive effect estimate was found for mindfulness across 12 studies using four different measures (Figure 2, Table 2). A slightly higher effect was detected for unidimensional (k=5, g=0.55, p=0.012, I^2=76%) than for global scores reported from multidimensional measures (k=5, g=0.39, p<0.001, I^2=0%). Three studies reported the Five Facet Mindfulness Questionnaire (FFMQ) sub-scale means, and when pooled a strong positive effect for the observe dimension was detected, while non-react improved moderately. The other facets, describe, act-aware and non-judge, returned weak, non-significant results.

A moderate reduction was found at post-intervention for perceived stress (k=13, g=0.56, p<0.001, I^2=79%). This was the outcome with greatest consistency in measurement (Figure 3, Table 2). Various measures of job stress were used by four studies, and while a weak, positive trend was observed, this did not achieve significance.

Mental health outcomes with sufficient data for meta-analysis were psychological distress, depression, anxiety and burnout (Figure 4, Table 2). Several studies reported multiple mental health outcomes (e.g. depression and anxiety), so data was pooled by construct; we do not report a global mental health score. A consistent beneficial effect was

observed for psychological distress (k=8, *g*=0.69, p<0.001, I^2=20%) and anxiety (k=4, *g*=0.62, p<0.001, I^2=0%). Change in depressive symptoms yielded an overall positive effect (k=8, *g*=0.38, p=0.002, I^2=48%). Results for burnout subscales were not significant, though a trend toward improvement was observed in pooled data.

Wellbeing measures include general wellbeing, health-related quality of life, sleep, fatigue/vitality, social functioning, work-life balance and satisfaction with life. Because studies often reported both sleep and wellbeing, data for sleep were pooled separately (Figure 4, Table 2). The overall mean effect across the eight studies reporting wellbeing was positive (k=8, *g*=0.46, p=0.002, I^2=66%), and effects for sleep showed a small but consistent improvement following training (k=5, *g*=0.26, p=0.003, I^2=0%).

Strength of Meta-Analytic Evidence

Meta-analytic results (Table 2) show heterogeneity was high for stress, depression and burnout, moderate for mindfulness and wellbeing and low for distress and anxiety. Heterogeneity can be methodological, procedural or contextual and was expected given the variability of study designs and interventions included in this review. The influence of heterogeneity on the robustness of pooled effect estimates is included in the discussion. Inspection of funnel plots revealed an uneven distribution of plot points for mindfulness, stress, depression and wellbeing, indicating the potential presence of publication bias. Trim and fill analyses (Viechtbauer, 2010) retained positive effect estimates when possibly missing studies were added to the model for all outcomes except for depression, which was reduced to non-significance (Higgins & Green, 2011) (Supplementary Figure A).

Effect Moderators

Perceived stress was assessed using the Perceived Stress Scale (PSS) by 12 studies, so was selected as the target outcome for sub-group analyses (Higgins & Green, 2011). We explored sources of heterogeneity on PSS effect estimates by examining the influence of bias

risks (Supplementary Table C) and tested the moderating effects of intervention dose, mode and content, and workforce characteristics (industry) (Table 3). Wide confidence intervals were observed for moderators that showed potential signals of influence, and none achieved significance.

INSERT TABLE 3 Moderation effects of intervention and workplace characteristics

Review of Outcomes Excluded from Meta-Analysis

The results from MBP RCTs for productivity, work engagement, attention and psychosocial job quality are reported briefly and narratively because there was insufficient data for meta-analysis.

Productivity was assessed by four studies with ambivalent results. Absenteeism and presenteeism were in the positive direction at post-intervention in three studies, but results were not significant (Bartlett, Lovell, Otahal, & Sanderson, 2016; Roeser et al., 2013; Wolever et al., 2012), and no effect was observed post training or at 12 months follow up in a fourth study (van Berkel et al., 2014; van Dongen et al., 2016). Work engagement returned null results in one study (van Berkel et al., 2014; van Dongen et al., 2016), but significant positive effects in another (Aikens et al., 2014). Aikens interpreted positive changes in engagement to reflect a 20% increase in productivity and estimated a financial benefit of 20% of salary. In contrast due to negative findings for efficacy van Berkel et al. (2014) and van Dongen et al. (2016) reported a net cost for their custom MBP.

Changes in attention were measured using different methods and constructs by three studies with inconclusive results (Baccarani, Mascherpa, & Minozzo, 2013; Flook, Goldberg, Pinger, Bonus, & Davidson, 2013; Roeser et al., 2013). Psychosocial risk factors (job demand and control) were assessed quantitatively by two studies with non-significant findings (Bartlett et al., 2016; Huang, Li, Huang, & Tang, 2015) and qualitatively by a third (C. Taylor et al., 2016). The interviews in Taylor's study suggest participants reduced negative

appraisals of work stressors and increased adaptive strategies for coping with job stress. Social support was assessed by four studies using qualitative methods (Baccarani et al., 2013; Bartlett et al., 2016; Cohen-Katz et al., 2005; Moody et al., 2013), and results indicate improved work and family relationships, and that senior leadership and manager engagement may contribute to positive outcomes for participants.

Mediation analyses

Three studies conducted mediation analyses to test whether changes in outcomes could be attributed to changes in mindfulness. A strong mediation effect was found through mindfulness for perceived stress, psychological distress, mood and sleep quality (Aikens et al., 2014; Bartlett et al., 2016; Crain et al., 2016), and changes in resilience, vigor, quality of life, social functioning and job demand and control were partially mediated by changes in mindfulness (Aikens et al., 2014; Bartlett et al., 2016).

Studies with Active Control Groups

Of the 25 included studies five used active controls but no two studies used the same intervention and control design. Four studies compared effects of MBP participation with time-matched interventions and one provided information only. Compared with yoga[3], effects for mindfulness were equivalent (d=0.04), but mindfulness training was superior for reducing stress (d=0.15) and depression (d=0.24) (Wolever et al., 2012). Depression, distress and anxiety improved more after mindfulness training than a leadership course (Pipe et al., 2009). Compared with a lifestyle intervention however, MBP participants reported changes in mindfulness were inconsistent, equivalent for depression and inferior for stress (Malarkey, Jarjoura, & Klatt, 2013). Compared with information about workplace stress, a positive effect was found for mindfulness, stress, distress and quality of life (Bartlett et al., 2016), but

[3] Wolever et al. (2012) had two control groups; treatment-as-usual and yoga. Only the results from comparing mindfulness training with the inactive group were included in the meta-analysis.

compared with equivalent amounts of free time, effects for stress were in favour of the control group (Burnett & Pettijohn, 2015).

Studies with Follow-Up

Twelve included studies reported follow-up results and effects observed at post-intervention appear to be retained at follow up. Post-intervention increases in mindfulness were retained at 11, 12 and 52 weeks (Crain et al., 2016; Grégoire & Lachance, 2015; Malarkey et al., 2013; Roeser et al., 2013) as were reductions in stress at three and 12 months (Grégoire & Lachance, 2015; Malarkey et al., 2013). Beneficial effects for psychological distress (Grégoire & Lachance, 2015; McConachie et al., 2014) depression and anxiety (Roeser et al., 2013) and wellbeing (McConachie et al., 2014) also remained stable at three months follow up. The study that reported null results for mindfulness, wellbeing, and engagement following a six-month mindfulness program saw a continuing absence of effect 12 months from baseline (van Berkel et al., 2014).

Discussion

This paper presents a systematic review and meta-analysis of data from workplace-based RCTs of mindfulness training (Aim 1). Results showed training increased mindfulness and had significant positive effects for perceived stress, psychological distress, anxiety, wellbeing and sleep, but evidence for improvements in work performance, depression and burnout was ambivalent. No significant results were observed in analyses of the influence of intervention or workplace characteristics (Aim 2).

Findings for changes in mindfulness from work-based MBPs appear weaker than obtained in studies of the gold standard MBSR program for healthy adults in non-work settings (g=0.53) (Khoury et al., 2015). This result would be weaker again if publication bias was addressed in line with trim and fill analysis, which added four studies (two positive, two

negative) into the plot, theoretically reducing the effect (g=0.29). This result indicates workplace MBP participation is effective for increasing mindfulness even with the extensive variation in training protocols.

We observed some variability in mindfulness effects by measurement instrument. The unidimensional Mindful Attention and Awareness Scale (MAAS) is recommended for use in organizational health interventions (Qu, Dasborough, & Todorova, 2015). Our pooled effect across the five studies using the MAAS was higher than the multifaceted instruments, but it also returned the largest indication of heterogeneity. The Five Facet Mindfulness Questionnaire (FFMQ) was used sufficiently frequently to look at pooled effect by dimension and these data indicate a lack of uniform improvement across mindfulness facets. This has been reported previously (Lomas et al., 2017) and has been identified for further research (Qu et al., 2015). It is feasible there is a sequential development of mindfulness qualities, but a larger sample with follow-up data is required to investigate this.

Effects for perceived stress across our included studies are in keeping with common occupational stress-management interventions such as cognitive behavioral therapy and relaxation training (Bhui et al., 2012), even when accounting for potential publication bias. Heterogeneity was high for pooled PSS results and was explored in moderation analyses (reported below). The PSS measure assesses the degree to which situations are appraised as stressful (S. Cohen, Kamarck, & Mermelstein, 1983), so these results could provide support for mindfulness training as a pathway for cultivating the adaptive strategies referred to in the theoretical biobehavioral MTM (Garland et al., 2017) and coping models (Folkman, 2013). Just three studies assessed job demand and control outcomes to examine whether mindfulness training reduces stress by improving psychosocial job quality, but these used differing approaches, reported no follow-up and results showed ambivalence. Theoretically, if mindfulness is to be considered a personal resource in the JD-R model, more evidence of a

positive relationship with other known protective characteristics such as hope, optimism and self-efficacy needs to be demonstrated, and mediation pathways tested in intervention research (Bakker & Demerouti, 2017). These outcomes were not assessed in any of the included studies, so while there is emerging theoretical and experimental support for the role of mindfulness as protective for work-related stress within the JD-R model, insufficient evidence has so far been gathered to confirm this relationship.

For mental health outcomes, our results showed the same robust post-intervention effect, with low heterogeneity and absence of publication bias for psychological distress found in the last meta-analysis on this topic (Virgili, 2015). This result is encouraging as it reinforces Virgili's findings and suggests no loss of efficacy when MBPs are conducted within the workplace context. Anxiety symptoms also responded positively to mindfulness training, with an effect estimate that is moderate to strong, significant and with low heterogeneity and publication bias. This suggests MBP participation can reduce anxiety as much as other established workplace health interventions (Martin, Sanderson, & Cocker, 2009). The collective evidence for anxiety (an automatic response to threat-perception) and psychological distress (an indicator of chronic stress) indicates mindfulness may help intercept the progressive cycle of stress and be considered a protective resource within the stress buffering, coping and biobehavioral models discussed (Creswell & Lindsay, 2014; Folkman, 2013; Garland et al., 2017). However, outcomes that can verify the mediating role of mindfulness for increasing adaptive coping strategies such as reperceiving and decentering were not assessed in any of the included RCTs.

While a reduction in depression symptoms was observed in the meta-analysis, heterogeneity was present, and once the potential influence of publication bias was accounted for, the estimate of effect reduced to non-significance. It is feasible the general level of depressive symptoms was low even if anxiety and distress were elevated, and this may

explain why the effects were weaker for depression among our sample than from studies in clinical settings, where depressive symptoms have consistently shown improvement (Flaxman & Bond, 2010). Correlational studies indicate burnout symptoms reduce when mindfulness increases (N. Z. Taylor & Millear, 2016). The burnout instrument used in all our included studies was the Maslach Burnout Inventory and the inconsistency in results we observed appears common for this measure in intervention research (Morse, Salyers, Rollins, Monroe-DeVita, & Pfahler, 2012). Burnout is increasingly recognized as a clinical condition requiring individualized treatment (Kakiashvili, Leszek, & Rutkowski, 2013) and, like depression, may respond better to clinically directed therapy than to a workplace training program.

Wellbeing indicators including life-satisfaction, work-life balance, fatigue and vitality showed promise in individual studies, as did data from quality of life measures. We pooled data for these outcomes and found a positive effect estimate in keeping with MBP studies in non-work settings (De Vibe, Bjørndal, Tipton, Hammerstrøm, & Kowalski, 2012; Gu et al., 2015), and a small likelihood of publication bias. Wellbeing is presented as a flow-on outcome in the model by Good et al. (2016) and its improvement across studies is encouraging. However, more RCT evidence is needed to defend claims of efficacy for each of these wellbeing outcomes independently. Our results for sleep showed improvement in keeping with evidence of mindfulness training in other contexts (Shallcross et al., 2018). As sleep quality is a known contributor to general wellbeing and occupational functioning (Burton et al., 2017; Knudsen, Ducharme, & Roman, 2007) these results support the potential for mindfulness for stress coping and recovery.

Despite relevance to the workplaces in which the studies were conducted, performance outcomes such as productivity, engagement and attention were inconsistently and infrequently assessed, and results were ambivalent. Productivity may have achieved

significance if we pooled results but this was not done due to construct and methodological variability. Presenteeism and absenteeism are important contributors to organizational productivity, but successful workplace preventive stress management interventions should also realize change on economic indicators of health-care utilization and direct costs to employers such as role accommodations and compensation claims (Hargrove et al., 2011). Change in these outcomes can take time to manifest and is likely to be more evident with longer term follow-up than immediately post-intervention. Surprisingly, work engagement was infrequently studied in the research reviewed despite the outcome being pertinent to staff performance and turnover, and informative for organizational perspectives of MBI efficacy.

The available evidence of change in attentional capacities is insufficient to compare with positive findings from MBP participation in non-work settings (Chiesa et al., 2011). This may be because testing requires a degree of manipulation and laboratory assessments that are challenging for workplace-based research. As attentional control, stability and efficiency are considered key mechanisms of mindfulness training (Good et al., 2016; Hölzel et al., 2011), and the potential benefits of attention for work performance are evident, suitable assessment techniques for use in workplace research are needed to provide evidence in support of the promise presented in the literature.

We found no RCT evidence supporting mindfulness training for leadership or creativity, decision making, citizenship behaviors, deviance or safety despite the promising articles about mindfulness for work cited in the introduction (Good et al., 2016; Hyland et al., 2015). Our findings illustrate significant gaps recently identified in the evidence for organizational outcomes (Rupprecht et al., 2018) and support critiques of the conduct and reporting of mindfulness research more generally (Jamieson & Tuckey, 2017; Lomas et al., 2017).

Detrimental effects

We expected lower effects when active controls were used (Meinert, 2012), and this may partly explain increases in stress for mindfulness participants compared with controls in two studies (Burnett & Pettijohn, 2015; Malarkey et al., 2013). However, two other studies also found detrimental effects for emotional exhaustion (Moody et al., 2013) and wellbeing (van Berkel et al., 2014) when compared with inactive controls. Two of these four studies showing some decrement following training expressly targeted employees who were identified as 'at risk' (Burnett & Pettijohn, 2015; Malarkey et al., 2013), but so did two studies that returned positive results (Huang et al., 2015; Mackenzie, Poulin, & Seidman-Carlson, 2006). The interventions assessed by Malarkey et al. (2013) and van Berkel et al. (2014) required a commitment of more than 10 hours class-time over an eight-week period, plus 20-30 minutes' daily homework. Van Berkel's custom intervention was integrated with a broader year-long health promotion campaign, and Malarkey's assessment protocol was complex, with the collection of biomarkers and survey data at multiple time points over a six-month period. It appears work release was not provided for participants in any of the reviewed studies and it is plausible that for these more intensive interventions, the overall demands of training when added to existing workloads served to increase rather than decrease employee stress. In contrast, Burnett's (2015) intervention was comparatively low in dose, with daily 10-minute meditation practices done at the participants' computer during work time and no classes. The study authors suggest the increase in stress in Burnett's participants may be linked to pressure to improve performance. It may also be due to a perception of additional demands amongst course participants, when compared with a control group that was given free time. These exceptions highlight the potential for benefits to be offset by the demands of this type of training.

The influence of workplace and intervention characteristics

None of the tests of moderation returned significant results (Table 3). For a handful of explanatory variables, this non-significance was more likely due to inadequate power than to the absence of influence. Acknowledging the lack of significance, we present the following brief discussion for future hypothesis generation.

Intervention Characteristics

The equivalent efficacy of flexible delivery and face-to-face classes has been observed previously in studies of online MBSR in non-work settings (Spijkerman et al., 2016). The additional control over access to training offered by flexible delivery may balance out the benefits of supportive group dynamics (Crane et al., 2016). It is also possible the nonspecific effects of group membership may be more complex in workplace interventions, where learning is with co-workers, compared with community settings where pre-existing relationships between participants are less likely (Davidson & Kaszniak, 2015). Our findings for the influence of dose are similar to those observed by Carmody and Baer (2009), and it is not yet possible to derive a minimum required dose for positive effect from the current evidence base. Including micro-practices and mindfulness theory in training protocols appears to yield some influence on reductions in stress, while yoga and stress physiology elements showed no sign of moderation. The inclusion and relative importance of specific elements of training has not previously been reported for workplace MBPs.

Workforce Characteristics

Equivalent results were observed for people across industries, suggesting this approach may be suitable for workforces beyond the caring professions. However population samples were drawn from large organizations with predominantly white-collar workforces, and so it is not clear whether mindfulness training is suitable and efficacious for other settings and role types.

Practical implications

Workplace-delivered mindfulness training programs can help employees reduce stress and improve their mental health and wellbeing. The effects of training can endure for at least 12 months. Low dose interventions that use either flexible delivery or a class-based approach appear effective, and benefit does not appear to be limited to education and health care professionals. At present it is not known whether the effectiveness of training differs by role type (e.g. blue collar, administrative, professional). The promise in the public domain of mindfulness for organizational performance outcomes is not yet supported by a quality evidence base.

While the results of this meta-analysis are positive for stress and related mental health and wellbeing, the findings regarding effects beyond personal mental health provide an important counter-point to highly cited articles (e.g. Good et al., 2016) and government-endorsed recommendations such as those in the Mindful Nation UK report (Loughton & Morden, 2015) and the ensuing Building the Case for Mindfulness in the Workplace (Bristow, 2016). Given the considerable organizational expenditure and media coverage of the promise of mindfulness training for improving work performance, we feel this evidence synthesis, and its conclusion that these claims are ahead of the evidence, is both warranted and timely.

Limitations and directions for future research

Previous reviews have identified methodological limitations and multiple sources of heterogeneity in workplace stress management and mindfulness research literature. Our findings support these critiques and provide statistical evidence of their influence on results. Our tests for publication bias suggest there may be a ‘file drawer’ problem for studies that do not report significant findings, particularly for those measuring depression.

Moderation analyses could include only the 12 RCTs reporting PSS data, and so our sub-group analyses were limited. We were unable to investigate if people in certain roles

benefit more than others, due to the absence of this information in the reviewed manuscripts. Given the predominance of studies in large organizations and white collar workforces we cannot generalize to employee samples from small and medium size businesses or labor-intensive industries. The articulation of MBP format varied across studies, from little to no detail to sufficient for replication. Studies that cited external references for program format make comparing intervention characteristics less accessible for readers (McConachie et al., 2014). One study included in moderator analyses did not provide program content due to proprietary restrictions (Wolever et al., 2012).

In addition to limitations in reporting for our effect moderators, several studies did not provide detail about attrition, or report sample sizes for each time point, and while intention-to-treat analyses can account for missingness, this was not always reported either. Adherence to training protocols was also reported variously, with a small number of studies considering the influence of dose received versus dose administered, but most drew on subjective reflections and the range in measurement approaches for adherence meant these data could not be used for reporting or analysis. Follow-up data was only reported by a handful of the included studies, and frequently the time points were set for the end of a wait-list control's intervention period. This is pragmatic for conducting research in workplace settings, but better evidence would be generated by retaining control conditions through all time points and extending the follow up to one or two years from baseline. This is particularly true for organizational outcomes like productivity that may take more time to manifest than changes in personal mental health. The use of established stress management interventions as active controls in future studies would be informative for assessing the comparative benefits of mindfulness training and support organizational investment choices. Follow-up data would also generate defensible evidence of the lasting effects of training and explore the sequential development of different aspects of mindfulness. Follow-up data is also vitally important for

economic analyses, another key consideration for organizational decisions regarding training investment. The current state of evidence is insufficient for this purpose.

Process and contextual factors related to being in a workplace setting may also have influenced results (Nielsen & Miraglia, 2016), but only two studies explicitly discussed these considerations. Procedural factors such as the influence of teacher experience, self-selection versus targeted recruitment, the nature and extent of assessments and flexibility of class times and class sizes would add to the quality and depth of evidence going forward. Guidelines presented by Crane and Hecht (2018) should be followed in future to enable the thorough examination of intervention components and their relationship to results.

Despite the theoretical promise, more work is needed to explore the potential of mindfulness as a personal resource for ameliorating the demands of work (Bakker & Demerouti, 2017). Studies that examine if training in mindfulness directly influences adaptive coping strategies and/or cultivates a protective personal resource that is additional to optimism and self-efficacy will make valuable contributions to the field. Data from multiple studies using appropriately sensitive and validated measures of occupational health and performance indicators including engagement, citizenship, sociality, creativity, leadership and safety are needed to qualify claims in the public domain regarding the effects of mindfulness training for work performance.

Finally, while our results indicate that mindfulness training can be beneficial, the negative results of a small number of studies suggest potential benefits may be offset by the addition of training demands to workloads (Burnett & Pettijohn, 2015; Malarkey et al., 2013; Moody et al., 2013) and a deeper understanding of this relationship, combined with evidence about the most instrumental elements of MBPs would guide future implementation strategies.

Conclusions

Workplace-delivered mindfulness training can cultivate employee mindfulness, reduce perceived stress, anxiety and psychological distress, and be beneficial for wellbeing and sleep quality. Effect sizes are in keeping with other well recognized stress-management interventions like relaxation and CBT.

The promise for enhanced work performance following mindfulness training is not yet supported by the evidence, and claims of improvements in organizational citizenship, leadership, deviance, safety or creativity cannot be defended at the present time with RCT evidence.

We recommend future studies use validated measures of performance for organizational and individual outcomes, conduct follow-up assessments, replicate interventions in different settings, and continue to explore effects for work sectors beyond education and health. Future researchers are encouraged to account for baseline imbalance, use comparators that can inform investment decisions, include economic evaluations, conduct mediation analyses and report potential moderators such as those used in our exploratory analyses. Empirical studies that examine workplace-based mindfulness training within theoretical stress buffering, biobehavioral and JD-R frameworks are needed to place mindfulness training defensibly within the occupational health psychology literature.

While we can conclude from the current study that workplace-delivered MBPs can effectively reduce employee stress and related problems, addressing the identified limitations will help clarify the relative efficacy of differing training approaches for individuals, and ensure the promised benefits of mindfulness training for organizational outcomes are evidence based.

REFERENCES

*Denotes studies included in the review.

*Aikens, K. A., Astin, J., Pelletier, K. R., Levanovich, K., Baase, C. M., Park, Y. Y., & Bodnar, C. M. (2014). Mindfulness goes to work: impact of an online workplace intervention. *Journal of Occupupational & Environmental Medicine, 56*(7), 721-731. doi:10.1097/JOM.0000000000000209

Allen, T. D., Eby, L. T., Conley, K. M., Williamson, R. L., Mancini, V. S., & Mitchell, M. E. (2015). What Do We Really Know About the Effects of Mindfulness-Based Training in the Workplace? *Industrial and Organizational Psychology, 8*(04), 652-661. doi:10.1017/iop.2015.95

Allen, T. D., & Paddock, E. L. (2015). How being mindful impacts individuals' work-family balance, conflict, and enrichment: a review of existing evidence, mechanisms and future directions *Mindfulness in Organizations: Foundations, Research, and Applications* (pp. 213). UK: Cambridge University Press.

Ancona, M. R., & Mendelson, T. (2014). Feasibility and preliminary outcomes of a yoga and mindfulness intervention for school teachers. *Advances in School Mental Health Promotion, 7*(3), 156-170. doi:10.1080/1754730X.2014.920135

Baccarani, C., Mascherpa, V., & Minozzo, M. (2013). Zen and well-being at the workplace. *TQM Journal, 25*(6), 606-624. doi:10.1108/TQM-07-2013-0077

Bakker, A., & Demerouti, E. (2017). Job Demands-Resources Theory: Taking Stock and Looking Forward. *Journal of Occupational Health Psychology, 22*(3), 273-285. doi:10.1037/ocp0000056

Bartlett, L., Lovell, P., Otahal, P., & Sanderson, K. (2016). Acceptability, Feasibility, and Efficacy of a Workplace Mindfulness Program for Public Sector Employees: a Pilot Randomized Controlled Trial with Informant Reports. *Mindfulness, 8*(3), 639-654. doi:10.1007/s12671-016-0643-4

Bhui, K. S., Dinos, S., Stansfeld, S. A., & White, P. D. (2012). A synthesis of the evidence for managing stress at work: a review of the reviews reporting on anxiety, depression, and absenteeism. *Journal of Environmental and Public Health*, 1-22. doi:10.1155/2012/515874

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . . Velting, D. (2004). Mindfulness: A proposed operational definition. *Clinical psychology: Science and practice, 11*(3), 230-241. doi:10.1093/clipsy/bph077

Bono, J. E., Glomb, T. M., Shen, W., Kim, E., & Koch, A. J. (2013). Building Positive Resources: Effects of Positive Events and Positive Reflection on Work Stress and Health. *Academy of Management Journal, 56*(6), 1601-1627. doi:10.5465/amj.2011.0272

Boyd, J. E., Lanius, R. A., & McKinnon, M. C. (2018). Mindfulness-based treatments for posttraumatic stress disorder: a review of the treatment literature and neurobiological evidence. *Journal Of Psychiatry & Neuroscience: JPN, 43*(1), 7-25. doi:10.1503/jpn.170021

Bristow, J. (2016). *Building the Case for Mindfulness in the Workplace*. Retrieved from https://themindfulnessinitiative.org.uk/publications/building-the-case

Burnett, M., & Pettijohn, C. (2015). Investigating the efficacy of mind-body therapies and emotional intelligence on worker stress in an organizational setting: an experimental approach. *Journal of Organizational Culture, Communication and Conflict, 19*(1), 146-158.

Burton, W. N., Chen, C.-Y., Schultz, A. B., & Li, X. (2017). Association Between Employee Sleep With Workplace Health and Economic Outcomes. *Journal of Occupational and Environmental Medicine, 59*(2), 177-183. doi:10.1097/jom.0000000000000934

Carmody, J., & Baer, R. A. (2009). How long does a mindfulness-based stress reduction program need to be? A review of class contact hours and effect sizes for psychological distress. *Journal of Clinical Psychology, 65*(6), 627. doi:10.1002/jclp.20555

Chiesa, A., Calati, R., & Serretti, A. (2011). Does mindfulness training improve cognitive abilities? A systematic review of neuropsychological findings. *Clinical Psychology Review, 31*(3), 449-464. doi:10.1016/j.cpr.2010.11.003

Chiesa, A., & Malinowski, P. (2011). Mindfulness-based approaches: are they all the same? *Journal of Clinical Psychology, 67*(4), 404-424. doi:10.1002/jclp.20776

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159. doi:10.1037/0033-2909.112.1.155

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A Global Measure of Perceived Stress. *Journal of Health and Social Behavior, 24*(4), 385-396.

Cohen-Katz, J., Wiley, S., Capuano, T., Baker, D. M., Deitrick, L., & Shapiro, S. (2005). The effects of mindfulness-based stress reduction on nurse stress and burnout: a qualitative and quantitative study, part III. *Holistic nursing practice, 19*(2), 78-86 79p.

Crain, T. L., Schonert-Reichl, K. A., & Roeser, R. W. (2016). Cultivating Teacher Mindfulness: Effects of a Randomized Controlled Trial on Work, Home, and Sleep Outcomes. *Journal of Occupational Health Psychology*. doi:10.1037/ocp0000043

Crane, R. S., Brewer, J., Feldman, C., Kabat-Zinn, J., Santorelli, S., Williams, J. M. G., & Kuyken, W. (2016). What defines mindfulness-based programs? The warp and the weft. *Psychological Medicine, 47*(6), 1-10. doi:10.1017/S0033291716003317

Crane, R. S., & Hecht, F. M. (2018). Intervention Integrity in Mindfulness-Based Research. *Mindfulness*. doi:10.1007/s12671-018-0886-3

Creswell, J. D. (2016). Mindfulness Interventions. *Annual Review of Psychology, 68*, 491-516. doi:10.1146/annurev-psych-042716-051139

Creswell, J. D., & Lindsay, E. K. (2014). How Does Mindfulness Training Affect Health? A Mindfulness Stress Buffering Account. *Current Directions in Psychological Science, 23*(6), 401-407. doi:10.1177/0963721414547415

Cuthbert, B. N., & Insel, T. R. (2013). Toward the future of psychiatric diagnosis: the seven pillars of RDoC. *BMC Medicine, 11*(1), 1-8. doi:10.1186/1741-7015-11-126

Davidson, R. J., & Kaszniak, A. W. (2015). Conceptual and methodological issues in research on mindfulness and meditation. *American Psychologist, 70*(7), 581-592. doi:10.1037/a0039512

Dawkins, S., Martin, A., Scott, J., & Sanderson, K. (2015). Advancing conceptualization and measurement of psychological capital as a collective construct. *Human Relations, 68*(6), 925-949. doi:10.1177/0018726714549645

De Vibe, M., Bjørndal, A., Tipton, E., Hammerstrøm, K. T., & Kowalski, K. (2012). Mindfulness Based Stress Reduction (MBSR) for Improving Health, Quality of Life, and Social Functioning in Adults. *Campbell Systematic Reviews, 2012*(3), 127. doi:10.4073/csr.2012.3

Dewa, C. S., McDaid, D., & Ettner, S. L. (2007). An international perspective on worker mental health problems: who bears the burden and how are costs addressed? *Canadian Journal of Psychiatry, 52*(6), 346. doi:10.1177/070674370705200603

Dimidjian, S., & Segal, Z. V. (2015). Prospects for a clinical science of mindfulness-based intervention. *American Psychologist, 70*(7), 593-620. doi:10.1037/a0039589

Dollard, M. F., & Neser, D. Y. (2013). Worker health is good for the economy: Union density and psychosocial safety climate as determinants of country differences in worker health and productivity in 31 European countries. *Social Science and Medicine, 92*, 114-123. doi:10.1016/j.socscimed.2013.04.028

Duchemin, A. M., Steinberg, B. A., Marks, D. R., Vanover, K., & Klatt, M. (2015). A small randomized pilot study of a workplace mindfulness-based intervention for surgical intensive care unit personnel: Effects on salivary α-amylase levels. *Journal of Occupational and Environmental Medicine, 57*(4), 393-399. doi:10.1097/JOM.0000000000000371

Durlak, J. A. (2009). How to Select, Calculate, and Interpret Effect Sizes. *Journal of Pediatric Psychology, 34*(9), 917-928. doi:10.1093/jpepsy/jsp004

Flaxman, P. E., & Bond, F. W. (2010). Worksite stress management training: moderated effects and clinical significance. *Journal of Occupational Health Psychology, 15*(4), 347-358. doi:10.1037/a0020522

Flook, L., Goldberg, S. B., Pinger, L., Bonus, K., & Davidson, R. J. (2013). Mindfulness for Teachers: A Pilot Study to Assess Effects on Stress, Burnout, and Teaching Efficacy. *Mind, Brain, and Education, 7*(3), 182-195. doi:10.1111/mbe.12026

Folkman, S. (2013). Stress: Appraisal and Coping. In M. D. Gellman & J. R. Turner (Eds.), *Encyclopedia of Behavioral Medicine* (pp. 1913-1915). New York: Springer

Friedman, L. M., Furberg, C., & DeMets, D. L. (2010). *Fundamentals of Clinical Trials* (4th ed.). New York: Springer.

Fu, R., Vandermeer, B. W., Shamliyan, T. A., O'Neil, M. E., Yazdi, R., Fox, S. H., & Morton, S. C. (2013). Handling Continuous Outcomes in Quantitative Synthesis. . In Agency for Healthcare Research and Quality (Ed.), Methods Guide for Effectiveness and Comparative Effectiveness Reviews [Internet]. Rockville, MD. Retrieved from www.ncbi.nlm.nih.gov/books/NBK154408/.

Ganster, D. C., Crain, T. L., & Brossoit, R. M. (2018). Physiological Measurement in I/O and OB: A Review and Recommendations for Future Use. *The Annual Review of Organizational Psychology and Organizational Behavior, 5*(12), 1-12. doi:10.1146/annurev-orgpsych-032117-104613

Garland, E. L., Hanley, A. W., Baker, A. K., & Howard, M. O. (2017). Biobehavioral Mechanisms of Mindfulness as a Treatment for Chronic Stress: An RDoC Perspective. *Chronic Stress (Thousand Oaks), 1*. doi:10.1177/2470547017711912

Gold, P. W. (2015). The organization of the stress system and its dysregulation in depressive illness. *Molecular Psychiatry, 20*(1), 32. doi:10.1038/mp.2014.163

Good, D. J., Lyddy, C. J., Glomb, T. M., Bono, J. E., Brown, K. W., Duffy, M. K., . . . Lazar, S. W. (2016). Contemplating Mindfulness at Work. *Journal of Management, 42*(1), 114. doi:10.1177/0149206315617003

Goyal, M., Singh, S., Sibinga, E. M., Gould, N. F., Rowland-Seymour, A., Sharma, R., . . . Haythornthwaite, J. A. (2014). Meditation programs for psychological stress and well-being: A systematic review and meta-analysis. *JAMA Internal Medicine, 174*(3), 357-368. doi:10.1001/jamainternmed.2013.13018

Grégoire, S., & Lachance, L. (2015). Evaluation of a brief mindfulness-based intervention to reduce psychological distress in the workplace. *Mindfulness, 6*(4), 836-847. doi:10.1007/s12671-014-0328-9

Grover, S. L., Teo, S. T. T., Pick, D., & Roche, M. (2017). Mindfulness as a personal resource to reduce work stress in the job demands-resources model. *Stress and Health, 33*(4), 426-436. doi:10.1002/smi.2726

Gu, J., Strauss, C., Bond, R., & Cavanagh, K. (2015). How do mindfulness-based cognitive therapy and mindfulness-based stress reduction improve mental health and wellbeing? A systematic review and meta-analysis of mediation studies. *Clinical Psychology Review, 37*, 1-12. doi:10.1016/j.cpr.2015.01.006

Hargrove, M. B., Quick, J. C., Nelson, D. L., & Quick, J. D. (2011). The theory of preventive stress management: a 33-year review and evaluation. *Stress and Health, 27*(3), 182-193. doi:10.1002/smi.1417

Higgins, J. P. T., Altman, D. G., Gotzsche, P. C., Juni, P., Moher, D., Oxman, A. D., . . . Sterne, J. A. C. (2011). The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ, 343*(d5928). doi:dx.doi.org/10.1136/bmj.d5928

Higgins, J. P. T., & Green, S. (Eds.). (2011). *Cochrane Handbook for Systematic Reviews of Interventions* (5.1.0 ed.). www.handbook.cochrane.org: The Cochrane Collaboration.

Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *BMJ, 327*(7414), 557-560. doi:10.1136/bmj.327.7414.557

Hölzel, B. K., Lazar, S. W., Gard, T., Schuman-Olivier, Z., Vago, D. R., & Ott, U. (2011). How Does Mindfulness Meditation Work? Proposing Mechanisms of Action From a Conceptual and Neural Perspective. *Perspectives on Psychological Science, 6*(6), 537-559. doi:10.1177/1745691611419671

Huang, S. L., Li, R. H., Huang, F. Y., & Tang, F. C. (2015). The Potential for Mindfulness-Based Intervention in Workplace Mental Health Promotion: Results of a Randomized Controlled Trial. *PLoS One, 10*(9), 15. doi:10.1371/journal.pone.0138089

Hülsheger, U. R., Feinholdt, A., & Nübold, A. (2015). A low-dose mindfulness intervention and recovery from work: Effects on psychological detachment, sleep quality, and sleep duration. *Journal of Occupational and Organizational Psychology, 88*(3), 464-489. doi:10.1111/joop.12115

Hyland, P. K., Lee, R. A., & Mills, M. J. (2015). Mindfulness at Work: A New Approach to Improving Individual and Organizational Performance. *Industrial and Organizational Psychology, 8*(04), 576-602. doi:doi:10.1017/iop.2015.41

Jamieson, S. D., & Tuckey, M. R. (2017). Mindfulness Interventions in the Workplace: A Critique of the Current State of the Literature. *Journal of Occupational Health Psychology, 22*(2), 180-193. doi:10.1037/ocp0000048

Jay, K., Brandt, M., Hansen, K., Sundstrup, E., Due Jakobsen, M., schraefel, M. C., . . . Andersen, L. L. (2015). Effect of Individually Tailored Biopsychosocial Workplace Interventions on Chronic Musculoskeletal Pain and Stress Among Laboratory Technicians: Randomized Controlled Trial. *Pain Physician, 18*(5), 459-471 413p.

Josefsson, T., Lindwall, M., & Broberg, A. (2014). The Effects of a Short-term Mindfulness Based Intervention on Self-reported Mindfulness, Decentering, Executive Attention, Psychological Health, and Coping Style: Examining Unique Mindfulness Effects and Mediators. *Mindfulness, 5*(1), 18-35. doi:10.1007/s12671-012-0142-1

Kabat-Zinn, J., Lipworth, L., & Burney, R. (1985). The clinical use of mindfulness meditation for the self-regulation of chronic pain. *Journal of Behavioral Medicine, 8*(2), 163-190. doi:10.1007/BF00845519

Kakiashvili, T., Leszek, J., & Rutkowski, K. (2013). The medical perspective on burnout. *International Journal of Occupational Medicine and Environmental Health, 26*(3), 401-412. doi:10.2478/s13382-013-0093-3

Kemeny, M. E., Foltz, C., Cavanagh, J. F., Cullen, M., Giese-Davis, J., Jennings, P., . . . Ekman, P. (2012). Contemplative/emotion training reduces negative emotional behavior and promotes prosocial responses. *Emotion, 12*(2), 338-350. doi:10.1037/a0026118

Keng, S.-L., Choo, X., & Tong, E. M. W. (2018). Association between Trait Mindfulness and Variability of Coping Strategies: a Diary Study. *Mindfulness*. doi:10.1007/s12671-018-0885-4

Kepes, S., Banks, G. C., McDaniel, M., & Whetzel, D. L. (2012). Publication Bias in the Organizational Sciences. *Organizational Research Methods, 15*(4), 624-662. doi:10.1177/1094428112452760

Khoury, B., Sharma, M., Rush, S. E., & Fournier, C. (2015). Mindfulness-based stress reduction for healthy individuals: A meta-analysis. *Journal of Psychosomatic Research, 78*(6), 519-528. doi:10.1016/j.jpsychores.2015.03.009

King, E., & Haar, J. M. (2017). Mindfulness and job performance: a study of Australian leaders. *Asia Pacific Journal of Human Resources, 55*(3), 298-319. doi:10.1111/1744-7941.12143

Klatt, M. D., Buckworth, J., & Malarkey, W. B. (2009). Effects of low-dose mindfulness-based stress reduction (MBSR-ld) on working adults. *Health Education & Behavior, 36*(3), 601-614. doi:10.1177/1090198108317627

Knudsen, H. K., Ducharme, L. J., & Roman, P. M. (2007). Job stress and poor sleep quality: Data from an American sample of full-time workers. *Social Science and Medicine, 64*, 1997-2007. doi:10.1016/j.socscimed.2007.02.020

Kreplin, U., Farias, M., & Brazil, I. A. (2018). The limited prosocial effects of meditation: A systematic review and meta-analysis. *Scientific Reports, 8*(1), 2403. doi:10.1038/s41598-018-20299-z

Lauricella, S. (2016). The Ancient-Turned-New Concept of "Spiritual Hygiene": An Investigation of Media Coverage of Meditation from 1979 to 2014. *Journal of Religion and Health, 55*(5), 1748-1762. doi:10.1007/s10943-016-0262-3

Lomas, T., Medina, J. C., Ivtzan, I., Rupprecht, S., Hart, R., & Eiroa-Orosa, F. J. (2017). The impact of mindfulness on well-being and performance in the workplace: an inclusive systematic review of the empirical literature. *European Journal of Work and Organizational Psychology*, 1-22. doi:10.1080/1359432X.2017.1308924

Loughton, T., & Morden, J. (2015). *Mindful Nation UK*. Retrieved from London: http://themindfulnessinitiative.org.uk/images/reports/Mindfulness-APPG-Report_Mindful-Nation-UK_Oct2015.pdf

Luthans, F., Avolio, B. J., Avey, J. B., & Norman, S. M. (2007). Positive Psychological Capital: Measurement and Relationship with Performance and Satisfaction. *Personnel Psychology, 60*(3), 541-572. doi:10.1111/j.1744-6570.2007.00083.x

Lutz, J., Herwig, U., Opialla, S., Hittmeyer, A., Jäncke, L., Rufer, M., . . . Brühl, A. B. (2014). Mindfulness and emotion regulation—an fMRI study. *Social Cognitive and Affective Neuroscience, 9*(6), 776. doi:10.1093/scan/nst043

Mackenzie, C. S., Poulin, P. A., & Seidman-Carlson, R. (2006). A brief mindfulness-based stress reduction intervention for nurses and nurse aides. *Applied Nursing Research, 19*(2), 105-109. doi:10.1016/j.apnr.2005.08.002

Malarkey, W. B., Jarjoura, D., & Klatt, M. (2013). Workplace based mindfulness practice and inflammation: a randomized trial. *Brain Behavior and Immunity, 27*(1), 145-154. doi:10.1016/j.bbi.2012.10.009

Malinowski, P., & Lim, H. J. (2015). Mindfulness at Work: Positive Affect, Hope, and Optimism Mediate the Relationship Between Dispositional Mindfulness, Work Engagement, and Well-Being. *Mindfulness*, 1-13. doi:10.1007/s12671-015-0388-5

Manotas, M., Segura, C., Eraso, M., Oggins, J., & McGovern, K. (2014). Association of brief mindfulness training with reductions in perceived stress and distress in Colombian health care professionals. *International Journal of Stress Management, 21*(2), 207-225. doi:10.1037/a0035150

Martin, A., Sanderson, K., & Cocker, F. (2009). Meta-analysis of the effects of health promotion intervention in the workplace on depression and anxiety symptoms. *Scandinavian Journal of Work, Environment and Health, 35*(1), 7-18.

McConachie, D. A. J., McKenzie, K., Morris, P. G., & Walley, R. M. (2014). Acceptance and mindfulness-based stress management for support staff caring for individuals with intellectual disabilities. *Research in Developmental Disabilities, 35*(6), 1216-1227. doi:10.1016/j.ridd.2008.07.011

Meinert, C. L. (2012). *ClinicalTrials: Design, Conduct and Analysis* (2nd ed.). New York: Oxford University Press.

Memish, K., Martin, A., Dawkins, S., Bartlett, L., & Sanderson, K. (2017). Workplace Mental Health: A Review of Guidelines. *Preventive Medicine, 101*, 213-222. doi:10.1016/j.ypmed.2017.03.017

Michalak, J., & Heidenreich, T. (2018). Dissemination before evidence? What are the driving forces behind the dissemination of mindfulness-based interventions? *Clinical psychology: Science and practice, 0*(0), e12254. doi:10.1111/cpsp.12254

Moody, K., Kramer, D., Santizo, R. O., Magro, L., Wyshogrod, D., Ambrosio, J., . . . Stein, J. (2013). Helping the helpers: mindfulness training for burnout in pediatric oncology--a pilot program. *Journal of Pediatric Oncololgy Nursing, 30*(5), 275-284. doi:10.1177/1043454213504497

Morse, G., Salyers, M. P., Rollins, A. L., Monroe-DeVita, M., & Pfahler, C. (2012). Burnout in Mental Health Services: A Review of the Problem and Its Remediation. *Administration and Policy in Mental Health and Mental Health Services Research, 39*(5), 341-352. doi:10.1007/s10488-011-0352-1

Murphy, L. R. (1996). Stress Management in Work Settings: A Critical Review of the Health Effects. *American Journal of Health Promotion, 11*(2), 112-135. doi:10.4278/0890-1171-11.2.112

Nielsen, K., & Miraglia, M. (2016). What works for whom in which circumstances? On the need to move beyond the 'what works?' question in organizational intervention research. *Human Relations, 70*(1), 40-62. doi:10.1177/0018726716670226

Onken, L. S., Carroll, K. M., Shoham, V., Cuthbert, B. N., & Riddle, M. (2013). Reenvisioning Clinical Science: Unifying the Discipline to Improve the Public Health. *Clinical Psychological Science, 2*(1), 22-34. doi:10.1177/2167702613497932

Pascoe, M. C., Thompson, D. R., Jenkins, Z. M., & Ski, C. F. (2017). Mindfulness mediates the physiological markers of stress: Systematic review and meta-analysis. *Journal of Psychiatric Research*. doi:10.1016/j.jpsychires.2017.08.004

Pipe, T. B., Bortz, J. J., Dueck, A., Pendergast, D., Buchda, V., & Summers, J. (2009). Nurse leader mindfulness meditation program for stress management: a randomized controlled trial. *J Nurs Adm, 39*(3), 130-137. doi:10.1097/NNA.0b013e31819894a0

Prasek, A. (2015). *Randomized Controlled Trial to Evaluate a Self-Guided, Web-Based Mindfulness Program for Stress Reduction and Wellbeing Promotion.* (3728249 Ph.D.), University of Minnesota, Ann Arbor. ProQuest Dissertations & Theses A&I database.

Qu, Y., Dasborough, M. T., & Todorova, G. (2015). Which Mindfulness Measures To Choose To Use? *Industrial and Organizational Psychology, 8*(04), 710-723. doi:10.1017/iop.2015.105

Reb, J., & Choi, E. (2014). Mindfulness in organizations *Psychology of Meditation.* (pp. 279-309): Nova Science Publishers, Hauppauge, NY.

Roche, M., Haar, J. M., & Luthans, F. (2014). The role of mindfulness and psychological capital on the well-being of leaders. *Journal of Occupational Health Psychology, 19*(4), 476. doi:10.1037/a0037183

Roeser, R. W., Schonert-Reichl, K. A., Jha, A., Cullen, M., Wallace, L., Wilensky, R., . . . Harrison, J. (2013). Mindfulness training and reductions in teacher stress and burnout: Results from two randomized, waitlist-control field trials. *Journal of Educational Psychology, 105*(3), 787-804. doi:10.1037/a0032093

Rupprecht, S., Koole, W., Chaskalson, M., Tamdjidi, C., & West, M. (2018). Running too far ahead? Towards a broader understanding of mindfulness in organisations. *Current Opinion in Psychology*. doi:10.1016/j.copsyc.2018.10.007

Scott, B. (2017, March 1). Why Meditation and Mindfulness Training Is One of the Best Industries for Starting A Business in 2017. *Inc.* Retrieved from https://www.inc.com/bartie-scott/best-industries-2017-meditation-and-mindfulness-training.html

Shallcross, A. J., Visvanathan, P. D., Sperber, S. H., & Duberstein, Z. T. (2018). Waking Up to the Problem of Sleep: Can Mindfulness Help? A Review of Theory and Evidence for the Effects of Mindfulness for Sleep. *Current Opinion in Psychology*. doi:10.1016/j.copsyc.2018.10.005

Shapiro, S. L., Astin, J. A., Bishop, S. R., & Cordova, M. (2005). Mindfulness-Based Stress Reduction for Health Care Professionals: Results From a Randomized Trial. *International Journal of Stress Management, 12*(2), 164-176. doi:10.1037/1072-5245.12.2.164

Shiba, K., Nishimoto, M., Sugimoto, M., & Ishikawa, Y. (2015). The Association between Meditation Practice and Job Performance: A Cross-Sectional Study. *PloS One, 10*(5), e0128287. doi:10.1371/journal.pone.0128287

Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: a practice-friendly meta-analysis. *Journal of Clinical Psychology, 65*(5), 467-487. doi:10.1002/jclp.20593

Spijkerman, M. P. J., Pots, W. T. M., & Bohlmeijer, E. T. (2016). Effectiveness of online mindfulness-based interventions in improving mental health: A review and meta-analysis of randomised controlled trials. *Clinical Psychology Review, 45*, 102-114. doi:10.1016/j.cpr.2016.03.009

Taren, A. A., Gianaros, P. J., Greco, C. M., Lindsay, E. K., Fairgrieve, A., Brown, K. W., . . . Creswell, J. D. (2015). Mindfulness meditation training alters stress-related amygdala resting state functional connectivity: a randomized controlled trial. *Social Cognitive and Affective Neuroscience, 10*(12), 1758-1768. doi:10.1093/scan/nsv066

Taylor, C., Harrison, J., Haimovitz, K., Oberle, E., Thomson, K., Schonert-Reichl, K., & Roeser, R. W. (2016). Examining ways that a mindfulness-based intervention reduces stress in public school teachers: A mixed-methods study. *Mindfulness, 7*(1), 115-129. doi:10.1007/s12671-015-0425-4

Taylor, N. Z., & Millear, P. M. R. (2016). The contribution of mindfulness to predicting burnout in the workplace. *Personality and Individual Differences, 89*, 123-128. doi:10.1016/j.paid.2015.10.005

van Berkel, J., Boot, C. R., Proper, K. I., Bongers, P. M., & van der Beek, A. J. (2014). Effectiveness of a worksite mindfulness-related multi-component health promotion intervention on work engagement and mental health: results of a randomized controlled trial. *PLoS One, 9*(1), e84118. doi:10.1371/journal.pone.0084118

Van Doesum, N. J., Van Lange, D. A. W., & Van Lange, P. A. M. (2013). Social mindfulness: Skill and will to navigate the social world. *Journal of Personality and Social Psychology, 105*(1), 86-103. doi:10.1037/a0032540

van Dongen, J. M., van Berkel, J., Boot, C. R. L., Bosmans, J. E., Proper, K. I., Bongers, P. M., . . . van Wier, M. F. (2016). Long-Term Cost-Effectiveness and Return-on-Investment of a Mindfulness-Based Worksite Intervention: Results of a Randomized Controlled Trial. *Journal of Occupational & Environmental Medicine, 58*(6), 550-560. doi:10.1097/JOM.0000000000000736

Van Gordon, W., Shonin, E., & Griffiths, M. D. (2015). Towards a second generation of mindfulness-based interventions. *Australian and New Zealand Journal of Psychiatry, 49*(7), 591-592. doi:10.1177/0004867415577437

Van Lange, P. A., & Van Doesum, N. J. (2015). Social mindfulness and social hostility. *Current Opinion in Behavioral Sciences, 3*, 18-24. doi:10.1016/j.cobeha.2014.12.009

Viechtbauer, W. (2010). Conducting Meta-Analyses in R with the metafor Package. *Journal of Statistical Software, 36*(3).

Virgili, M. (2015). Mindfulness-Based Interventions Reduce Psychological Distress in Working Adults: a Meta-Analysis of Intervention Studies. *Mindfulness, 6*(2), 326-337. doi:10.1007/s12671-013-0264-0

Wolever, R. Q., Bobinet, K. J., McCabe, K., Mackenzie, E. R., Fekete, E., Kusnick, C. A., & Baime, M. (2012). Effective and viable mind-body stress reduction in the workplace: a randomized controlled trial. *J Occup Health Psychol, 17*(2), 246-258. doi:10.1037/a0027278

Tables and Figures for inclusion in the published paper.

Supplementary materials

Table 1: Review of Workplace Mindfulness RCTs: Characteristics of Included Studies

Study	Sample size	Intervention	Comparison	Delivery mode	Weeks	Each class#	Daily homework#	Mindful theory	Stress physiology	Body scan	Breath	Open monitoring	Walking	Yoga	Journaling	Micro-practice	Compassion	Eating	Population
Aikens, 2014	89	Custom online mindfulness	WL	Online supported	7	60	30			x	x	x	x	x		x			Pharmaceutical manufacturing
Ancona, 2014	43	HLF Yoga & Mindfulness	TAU	F2F class	3	45	ns	x	x		x			x					School teachers
Baccarani, 2013	20	Zen meditation	TAU	F2F class	4	90	45				x	x		x		x			University staff
Bartlett, 2015	120	MBSR-ld	Information	F2F class	5	90	20	x	x	x	x					x			Public servants
Burnett, 2015	55	MBST	Free-time	Self-guided audio	5	10	10			x	x								Health service employees
**Cohen-Katz, 2015	27	MBSR	WL	F2F class	8	150	45	x	x	x	x	x	x	x	x	x			Nurses
Crain, 2016	113	Workplace Mindfulness Training	WL	F2F class	8	v	ns	x	x	x	x	x				x	x		School teachers
**Duchemin, 2015	32	MBSR-ld	WL	F2F class	8	60	20			x	x			x				x	Hospital-based intensive care
Flook, 2013	18	MBSR	WL	F2F class	8	150	30	x	x	x	x	x	x	x		x	x	x	School teachers
Gregoire, 2015	49	Custom MBP	WL	Seminar + self-guided	5	60	15			x	x	x					x		Call center staff
Huang, 2015	144	MBSR-ld	TAU	F2F class	8	120	45	x	x	x	x	x	x	x		x	x		Manufacturing admin & production staff
Jay, 2015	112	Custom MBCT-ld	TAU	F2F class	10	50	ns			x	x			x					Pharmaceutical lab technicians

Kemeny, 2012	82	Custom Contemplative Training	WL	F2F class	8	480	25		x	x	x	x	x	x			x		School teachers
Klatt, 2009	48	MBSR-ld	WL	F2F class	8	60	20	x	x	x	x	x	x	x	x				University staff
Mackenzie, 2006	30	MBSR-ld	WL	F2F class	4	30	10	x		x	x	x		x		x		x	Nurses
Malarkey, 2013	186	MBP-ld	Lifestyle education	F2F class	8	60	20		x	x	x		x	x	x	x			University staff
Manotas, 2014	83	MBSR-ld	TAU	F2F class	4	120	25	x	x	x	x	x		x				x	Hospital-based health care staff
McConachie, 2014	120	ACT plus Mindfulness	WL	F2F class	6	480	ns								x				Intellectual disability carers
Moody, 2013	48	MBSR-custom	TAU	F2F class	8	60	20	x	x	x	x	x		x	x	x	x	x	Oncology staff
Pipe, 2009	33	MBSR-ld	Leadership course	F2F class	4	120	30		x	x	x			x		x			Nurse leaders
Prasek, 2015	192	Sherman Project	WL	Online self-guided	7	15	10		x	x	x			x	x	x		x	University staff
Roeser, 2013	113	SMART-in-Education	WL	F2F class	8	150	ns		x	x	x	x	x	x	x	x	x	x	School teachers
Shapiro, 2005	38	MBSR	WL	F2F class	8	120	ns			x	x	x		x		x	x		Hospital-based health carers
*Taylor, 2016		SMART-in-Education	WL	F2F class	9	150	ns												School teachers
van Berkel, 2014	257	Mindful VIP (custom)	TAU	F2F class	8	90	30			x	x		x	x	x	x		x	Research institute
*van Dongen, 2016		Mindful VIP (custom)	TAU	F2F class	8	90	30												Research institute
Wolever, 2012	239	Mindfulness at Work	Yoga & TAU	Online supported	12	60	10												Insurance

* Reports additional findings from primary study; ** Not included in meta-analysis; # Units reported in hours; ns = not specified; x = included in description of program
WL = wait-list control group; TAU = treatment as usual control group; F2F = face to face
MBSR (ld)= Mindfulness-Based Stress Reduction (low-dose); MBST = Mindfulness-Based Stress Training; ACT = Acceptance and Commitment Training

Table 2. Review of Workplace Mindfulness RCTs: Meta-Analytic Effect Estimates

		SMD	95% CI		Significance	Heterogeneity	
	k	Hedge's g	Lower	Upper	p	Q	I^2
MINDFULNESS							
All data	10	0.45	0.26	0.64	<0.001	19.52	54%
MAAS	5	0.55	0.12	0.98	0.012	16.54	76%
Multi-facet measures	5	0.39	0.23	0.55	<0.001	2.92	0%
FFMQ Observe	3	0.82	0.37	1.26	<0.001	3.96	49%
FFMQ Describe	3	0.23	-0.19	0.64	0.280	3.45	42%
FFMQ Act Aware	3	0.07	-0.23	0.36	0.646	0.78	0%
FFMQ Non-react	3	0.52	0.23	0.82	0.001	1.85	0%
FFMA Non-judge	3	0.28	-0.01	0.58	0.059	0.71	0%
STRESS							
All data	13	0.56	0.29	0.83	<0.001	56.15	79%
PSS	12	0.54	0.26	0.83	0.00	54.77	80%
Job-stress	4	0.10	-0.11	0.32	0.339	3.88	23%
MENTAL HEALTH							
Psychological distress	8	0.69	0.49	0.90	<0.001	8.73	20%
Depression	8	0.38	0.14	0.62	0.002	13.53	48%
Anxiety	4	0.62	0.32	0.92	<0.001	0.77	0%
Burnout - EE	4	0.52	0.19	1.22	0.149	11.41	74%
Burnout - PA	3	0.46	-0.03	0.96	0.066	2.69	26%
Burnout - DP	3	0.16	0.25	0.58	0.439	0.25	0%
WELLBEING							
All data	8	0.46	0.17	0.72	0.002	20.39	66%
General wellbeing	3	0.32	0.01	0.63	0.046	3.04	34%
Sleep Problems	5	0.26	0.09	0.43	0.003	0.96	0%

SMD: Standardized Mean Difference effect estimates computed using a random effects model with α=0.05; MAAS: Mindful Attention and Awareness Scale; FFMQ: Five Facet Mindfulness Questionnaire; PSS: Perceived Stress Scale (10 or 14-item versions); Burnout - EE: Emotional Exhaustion; Burnout - PA: Personal Accomplishment; Burnout - DP: Depersonalization.

Table 3. Review of Workplace Mindfulness RCTs: Moderation Effects of Intervention and Workplace Characteristics on Perceived Stress

	No. studies	Test of moderators		Sub-group Hedges	95%CI		
	k	p	R^2	g	Lower	Upper	z
Perceived Stress	**12**			**0.54**	**0.26**	**0.83**	
Influence of Intervention Characteristics							
Delivery mode		0.557	0%				
F2F weekly classes	8			0.54	0.18	0.91	2.91
Other format	4			0.56	0.01	1.01	2.40
Dose (contact time)							
Class hours		0.520	0%				
Up to 7	4			0.58	0.08	1.08	2.26
8 and over	8			0.53	0.17	0.89	2.86
Weeks		0.489	0%				
Up to 7	5			0.66	0.24	1.08	3.09
8 and over	7			0.46	0.08	0.84	2.38
Dose (homework)							
Daily home practice		0.806	0%				
Up to 10 minutes	5			0.47	0.07	0.88	2.28
More than 10 minutes	7			0.60	0.19	1.02	2.84
Content*							
Stress physiology		0.783	0%				
Included	7			0.53	0.15	0.90	2.73
Not included	4			0.44	0.01	0.89	1.90
Mindfulness theory		0.079	27%				
Included	5			0.73	0.40	1.07	4.37
Not included	6			0.29	0.07	0.65	1.56
Movement/yoga		0.806	0%				
Included	9			0.47	0.19	0.75	3.28
Not included	2			0.53	-0.82	1.89	0.77
Micro-practice		0.142	19%				
Included	6			0.65	0.37	0.92	4.64
Not included	5			0.28	-0.18	0.75	1.19
Influence of Work Characteristics							
Industry		0.296	30%				
Human services	8			0.50	0.10	0.90	2.47
Other	4			0.62	0.26	0.99	3.34

Hedge's g: standardized mean difference by group for perceived stress stratified by moderator sub group;
F2F: face-to-face; R^2: amount of heterogeneity accounted for; p: test of moderators (α=0.05)
* K=11 for sub-group analyses by content, as one of the studies did not report this information.

Figure 1. Workplace Mindfulness RCTs: PRISMA Flow Diagram

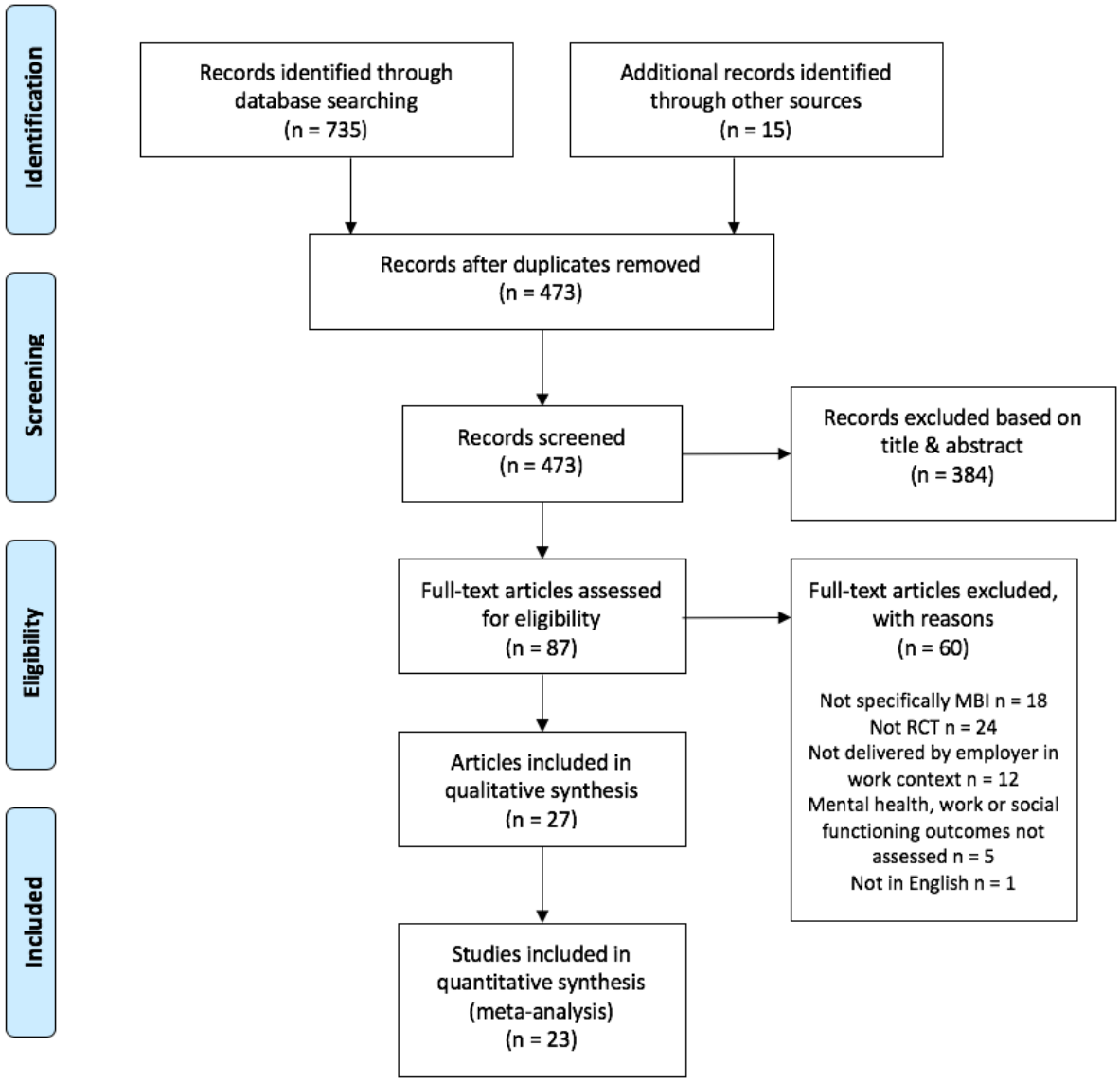

Figure 2. Workplace Mindfulness RCTs: meta-analysis results for mindfulness

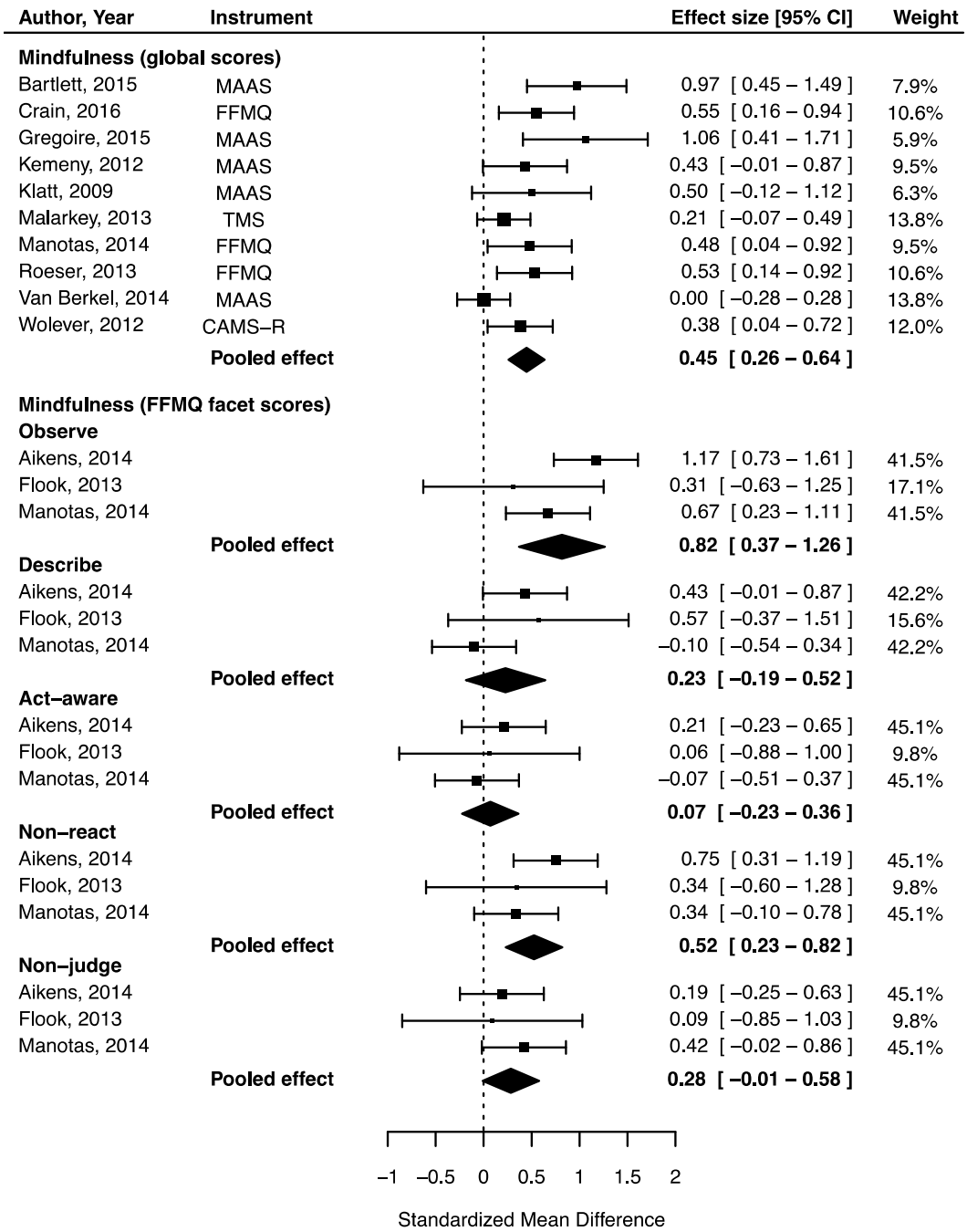

Fig 2 Legend: MAAS: Mindful Attention and Awareness Scale; FFMQ: Five Facet Mindfulness Questionnaire; TMS: Toronto Mindfulness Scale; CAMS-R: cognitive and Affective Mindfulness Scale Revised

Figure 3. Workplace Mindfulness RCTs: meta-analysis results for perceived stress and job stress

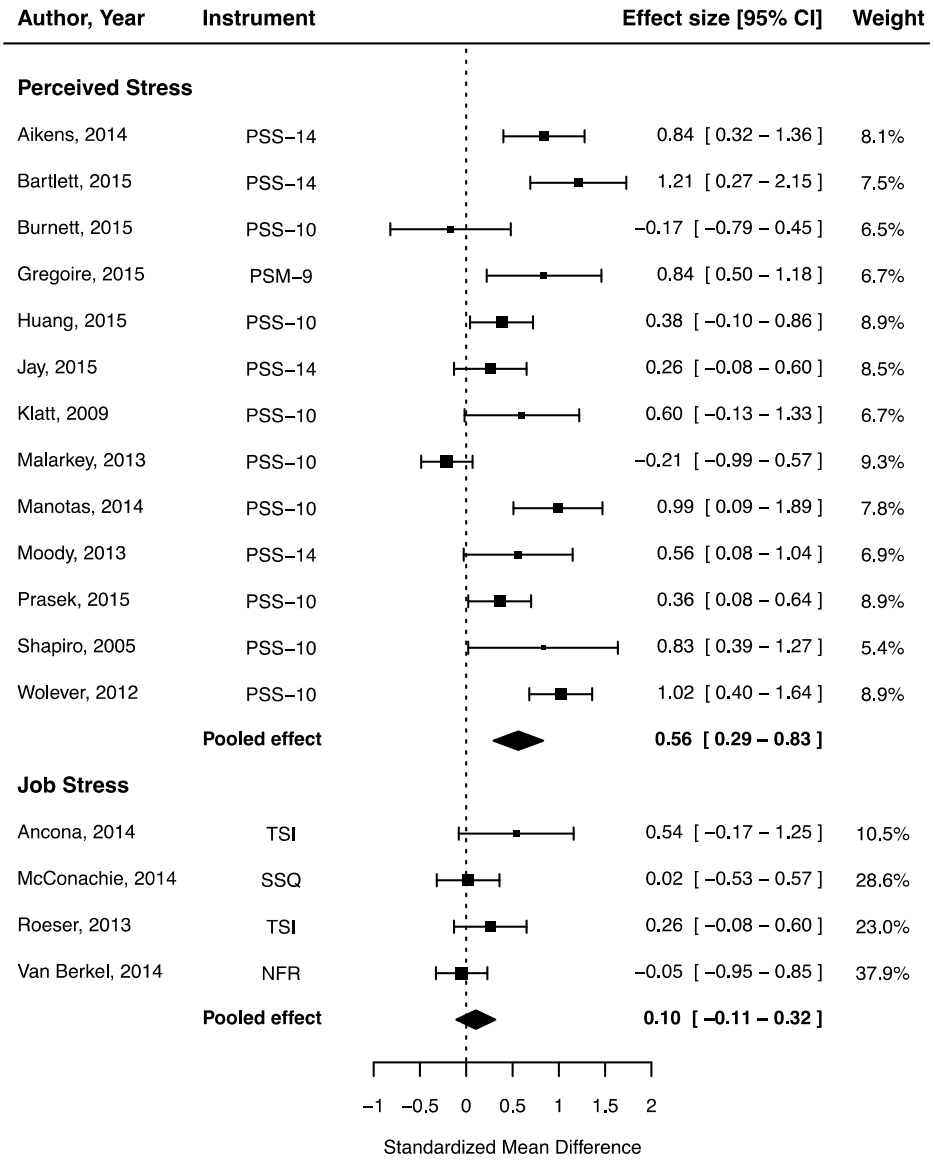

Fig 3 Legend: PSS: Perceived Stress Scale (14 or 10-item); PSM-9: Psychological Stress Measure (9 item); TSI: Teacher Stress Inventory; SSQ: Staff Stressor Questionnaire; NFR: Need for Recovery subscale from Questionnaire on the Experience and Evaluation of Work

Figure 4. Workplace Mindfulness RCTs: meta-analysis results for mental health and wellbeing

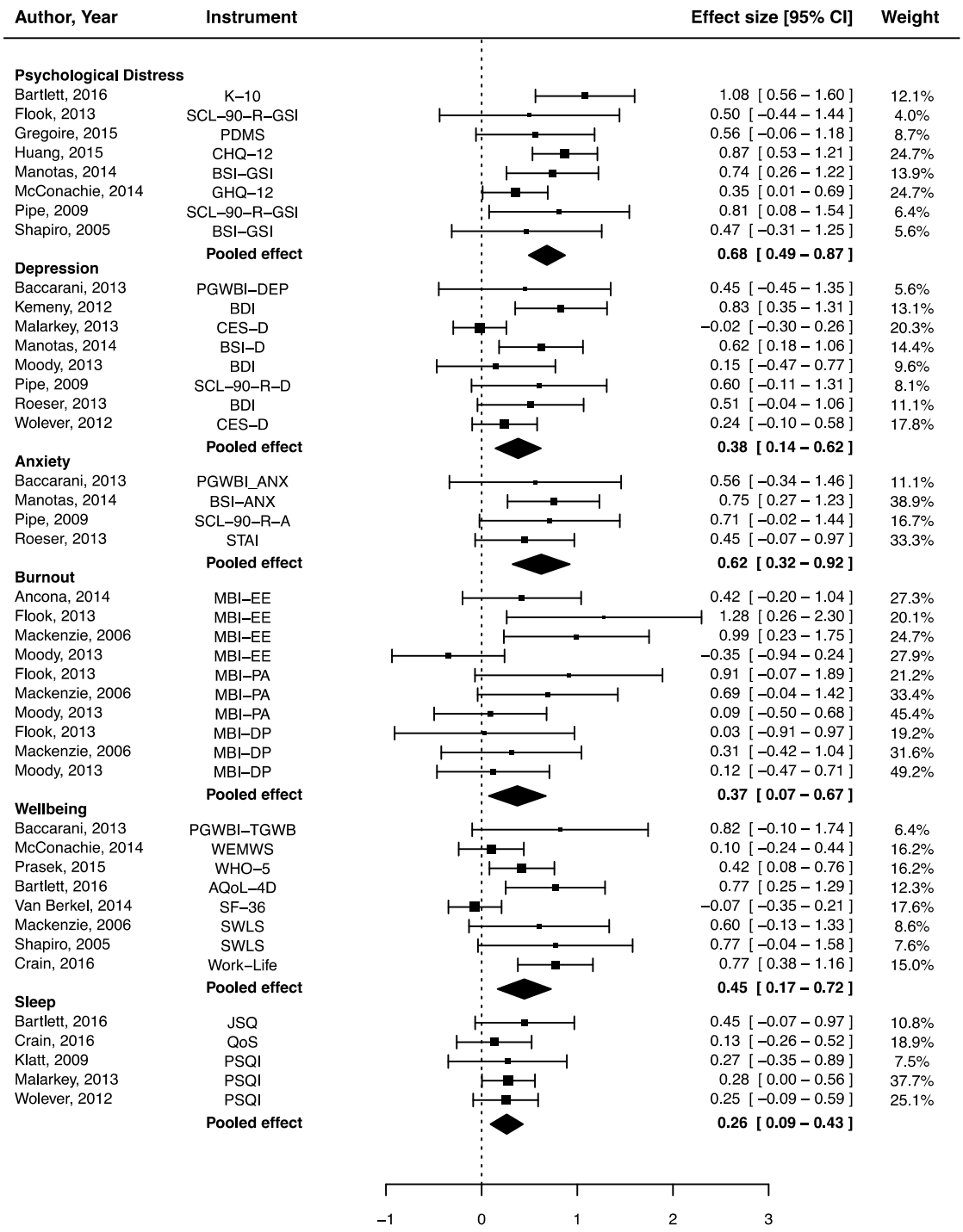

Figure 4 Legend: K-10: Kessler 10-item Measure of Psychological Distress; SCL-90-R: Symptom Checklist-90-Revised (GSI = Global Severity Index, D = Depression, A = Anxiety); PDMS: Psychological Distress Manifestation Scale; GHQ-12: General Health Questionnaire (CHQ-12 = Chinese version); BSI-GSI: Brief Symptom Inventory: Global Severity Index; PGWBI: Psychological General Wellbeing Index (TGWB = Total General Wellbeing, DEP = Depression, ANX = Anxiety); STAI: State Trait Anxiety Index; MBE: Maslach Burnout Inventory (EE = Emotional Exhaustion, PA = Personal Accomplishment; DP = Depersonalisation); WEMWS: Wawrick-Edinburgh Mental Well-being Scale; WHO-5: World Health Organisation Wellbeing Index; AQoL-4D: Assessment of Health Related Quality of Life – 4 Dimensions; SF-36: Short Form Health Survey; SWLS: Satisfaction with Life Scale; JSQ: Jenkins Sleep Questionnaire; QoS: Quality of Sleep Questionnaire; PSQI: Pittsburgh Sleep Quality Index