



## Review article

## Do workplace-based mindfulness meditation programs improve physiological indices of stress? A systematic review and meta-analysis

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## ABSTRACT

**Objective:** Mindfulness-based interventions (MBI) have been related with improved job satisfaction, wellbeing, health, and reduced workplace stress with employees. However, until now, synthesis of the evidence of the effect of MBIs on physiological indices associated with stress and ill-health has been lacking. Therefore the current systematic review aimed to synthesise the literature from employee samples to provide guidance for future investigations in terms of which physiological indicators and biological systems may be most impacted by MBIs. **Methods:** Electronic databases were searched. Studies that conducted a mindfulness-based program with an employee sample, which targeted workplace stress or work engagement, and measured a physiological outcome were selected for inclusion. Studies using either a between-group or within-group design were included. Nine papers were found to meet the inclusion criteria for our systematic review and meta-analysis of the literature. **Results:** MBIs were found to be effective in reducing cortisol production, as indicated by lowered high and low diurnal cortisol slopes. However, no changes were found for cortisol awakening response or concentrations for single a.m. and p.m. time-points. MBIs also improved autonomic balance, assessed by heart rate variability coherence measures, but not blood pressure. Sympathetic nervous system reactivity as measured by salivary alpha amylase was also reduced following MBI. While aspects of immune function were also improved following MBIs, specifically, increased antibody response to a viral vaccine and reduced C-reactive protein concentrations, each of these outcomes were only assessed in a single study. **Conclusion:** Taken together, the findings suggest that MBIs are a promising avenue for intervention for improving physiological indices of stress. Our findings suggest that changes in daytime cortisol secretion and HRV coherence may be particularly influenced by MBIs. Future studies should aim to assess multiple physiological indices to confirm the current findings and further improve current understanding of which biological systems (and indices within these systems) show responses indicative of reduced stress due to MBI.

## 1. Introduction

Workplace stress is associated with costs to individuals, organizations, and the community. It is consistently linked with poorer health outcomes, including cardiovascular disease [1,2], psychosomatic problems, musculoskeletal disorders [3] and self-reported health [4,5]. Workplace stress is also associated with mental health issues, including depression and anxiety disorders [6,7]. Finally, it is also related to a number of pre-clinical markers of ill-health, including indicators of the immune system [8], cardiovascular health [9] and the hypothalamic-pituitary-adrenal (HPA) axis [10,11]. In addition to health concerns, the cost of workplace stress extends to the employer due to higher turnover rates [12,13], increased absences [14] and decreased work engagement [15]. Given the associated costs of workplace stress to

individuals and society it is important to determine the most appropriate interventions to reduce it.

Interventions that are suitable to the workplace environment are rare [16], but a contemporary intervention with promising results across different populations and settings, including the workplace, is mindfulness meditation [17,18]. This is the act of purposefully paying attention to the present moment and being aware of mental states and processes with a sense of openheartedness, curiosity and kindness, and without judgement [19].

An increasing body of evidence demonstrates the effectiveness of mindfulness-based interventions (MBI) in improving job satisfaction, wellbeing, health, and reducing workplace stress [20–22]. However, a synthesis of the effects of MBIs on physiological indicators of workplace stress and ill-health is lacking.

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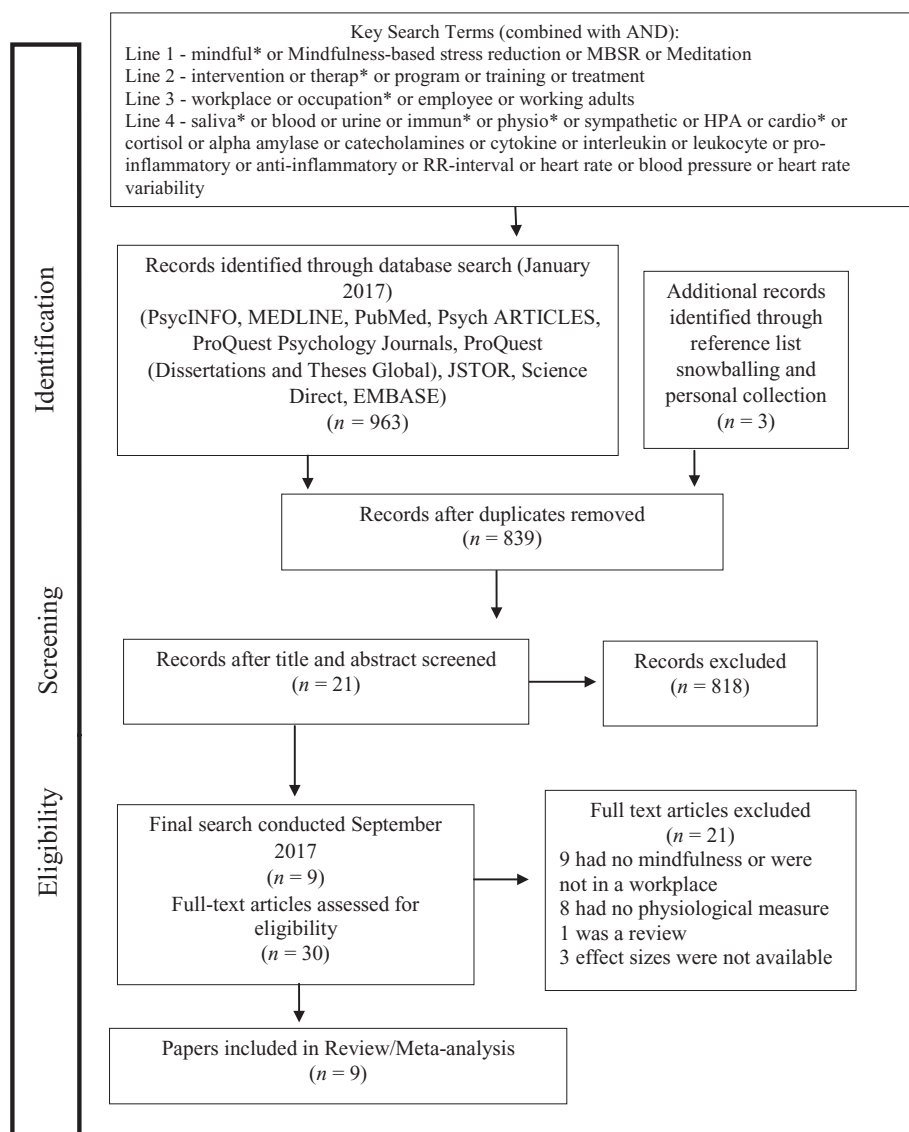


Fig. 1. Flow chart of study selection process.

Recent reviews conclude that MBIs improve dysregulated cortisol responses and immune functioning [23–25]; however, these reviews investigated patient populations and healthy adults, rather than MBIs in workplace settings. Previous research has shown different forms of chronic stress (e.g. work stress, caregiving, death/loss) have disparate effects on physiological outcomes [26,27]. Moreover, the few reviews that have considered employees and include physiological indicators, consider indices of multiple biological systems (e.g., the immune system, hypothalamic–pituitary–adrenal axis) together [20,28]. This coarse, unidimensional approach may contribute to the mixed findings of the effects of MBIs on physiological outcomes [20]. In the present review, we will synthesise the effects of MBI on discrete biological systems.

Inclusion of physiological indices are important to consider as they may act as pre-clinical markers of the development of ill-health [29]. When a stressor is experienced biological systems are activated to prepare the body to overcome the stressor. For example, the hormone cortisol, a primary product of the HPA axis, is associated with cardiovascular mortality and depression [30–32]. Likewise, C-reactive protein (CRP) and interleukin 6 (IL-6), two biomarkers of systemic inflammation are predictors of depression [33]. Increased CRP levels are also associated with increased risk of myocardial infarction [34]. Lower

heart-rate variability (HRV), an indicator of cardiovascular function, is linked to all-cause mortality and cardiovascular disease [35]. By considering physiological indicators of stress we can gain a greater understanding of the potential mechanisms of action of MBI on these biological systems.

A relevant model that can explain how MBIs modify dysregulated physiological responding is the integrated specificity model. The central tenant of the model is that the cognitive appraisal of a stressor is associated with distinct emotions, which in turn results in a specific, integrated pattern of physiological responses [36]. For example, threat emotions have been found to explain 56% of the variance in cardiovascular reactivity to an acute stressor [37], while social evaluative threat has also been associated with increased cortisol and pro-inflammatory responses [38]. Mindfulness may be a particularly effective resource as it increases an individual's ability to experience stressors without automatically perceiving them as a threat [39]. Indeed, higher levels of dispositional mindfulness have been found to moderate the effects of a social evaluative stressor on negative affect and cortisol responses [40]. The positive relationships observed between dispositional mindfulness and health [20–22] may be due to the MBIs reducing the experience of threat or harm emotions and the subsequent adverse physiological reactions these emotions provoke. However, as

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