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Mindfulness-based interventions for improving cognition, academic achievement, behavior, and socioemotional functioning of primary and secondary school students

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Plain language summary

Mindfulness-based interventions in schools have positive effects on cognitive and socio-emotional processes but do not improve behavior and academic achievement

MBIs have a small, positive effect on cognitive and socio-emotional outcomes, but not a significant effect on behavioral and academic outcomes.

The review in brief

The use of mindfulness-based interventions (MBIs) in schools has been on the rise. Schools are using MBI's to reduce student stress and anxiety and improve socio-emotional competencies, student behavior and academic achievement.

MBIs have small, positive effects on cognitive and socio-emotional processes but these effects were not seen for behavioral or academic outcomes. The studies are mostly of moderate to low quality. Therefore, further evidence from independent evaluators is needed to be able to evaluate the effectiveness of this type of intervention.

What did this review study?

With the diverse application and findings of positive effects of mindfulness practices with adults, as well as the growing popularity with the public, MBIs are increasingly being used with youth. Over the past several years, MBIs have received growing interest for use in schools to support socio-emotional development and improve behavior and academic achievement.

This review examines the effects of school-based MBIs on cognitive, behavioral, socio-emotional and academic achievement outcomes with youth in a primary or secondary school setting. MBIs are interventions that use a mindfulness component, broadly defined as "paying attention in a particularly way: on purpose, in the present moment, non-judgmentally", often with other components, such as yoga, cognitive-behavioral strategies, or relaxation skills training.

What studies are included?

Included studies used a randomized controlled trial, quasi-experimental, single group pre-post test or single subject design and reported at least one of these outcomes: cognition, academic performance, behavior, socio-emotional, and physiological. Study populations include preschool, primary and secondary school students.

A total of 61 studies are included in the review, but only the 35 randomized or quasi-experimental studies are used in the meta-analysis. Most of the studies were carried out in North America, and others in Asia, Europe and Canada. All interventions were conducted in a group format. Interventions ranged in duration (4-28 weeks) and number of sessions (6-125 sessions) and frequency of meetings (once every two weeks to five times a week).

What is the aim of this review?

This Campbell systematic review examines the effectiveness of school-based MBIs on cognition, behavior, socio-emotional outcomes and academic achievement. The review summarizes 61 studies and synthesizes 35 studies, with a total of 6,207 student participants.

What are the main results in this review?

MBIs have a small, statistically significant positive effect on cognitive and socio-emotional outcomes. But there is not a significant effect on behavioral and academic outcomes.

There was little heterogeneity for all outcomes, besides behavioral outcomes, suggesting that the interventions produced similar results across studies on cognitive, socio-emotional and academic outcomes despite the interventions being quite diverse.

What do the findings in this review mean?

Findings from this review indicate mixed effects of MBIs in schools. There is some indication that MBIs can improve cognitive and socio-emotional outcomes, but no support for improvement in behavior or academic achievement. Despite the growing support of MBIs for adults, youth may not benefit in the same ways or to the same extent as adults.

While not well studied, anecdotal evidence indicates costs and adverse effects of these types of interventions that should be better studied and weighed against the small to no effects on different types of outcomes when considering adoption of MBIs in schools.

These findings should be read with caution given the weakness of the evidence produced by the studies. The high risk of bias present in the studies means that further evidence is needed to evaluate the effectiveness of this type of intervention. The evidence from this review urges caution in the widespread adoption of MBIs and encourages rigorous evaluation of the practice should schools choose to implement it.

How up-to-date is this review?

The review authors searched for studies published until May 2015. This Campbell systematic review was published in March 2017.

Executive summary

BACKGROUND

Due to educational policy initiatives over the last two decades, school districts across the United States have placed more emphasis on improving academic standards and accountability. Indeed, children are spending between 20 to 25 hours per year on meeting federal, state and local school-district testing requirements (Hart et al., 2015). This increased emphasis on academic standards and high stakes testing has, at least in part, been blamed for the increasing levels of stress and anxiety children are experiencing (APA, 2009; Merkangas et al., 2010; Pope, 2010). In addition to changes in education policy requiring an increased emphasis on academic standards and accountability, schools are increasingly expected to attend to the social, emotional, and behavioral needs and problems of students. Given that as many as 13% to 20% children in the U.S. are experiencing one or more mental disorders (Center for Disease Control and Prevention, 2013), schools are increasingly challenged to respond to the growing emotional and behavioral needs of their students. Moreover, socioemotional development and competencies have been linked to learning and academic achievement, and have thus become a target for school-based interventions as a means of improving learning and academic achievement (Durlak, Weisberg, Dymnicki, Taylor, & Schhellinger, 2011; Eisenberg, Spinrade, & Eggum, 2010; Zins & Elias, 2006).

One approach to supporting improvements in socioemotional development and competencies that has received growing interest for use in schools is mindfulness-based interventions (MBIs). Mindfulness is defined as “paying attention in a particular way: on purpose, in the present moment, nonjudgementally” (Zabat-Zinn, 1994, p. 4). Research suggests positive effects of MBIs for adults with chronic conditions, mental health diagnoses, psychiatric disorders, and stress (Chiesa, Calati, & Serretti, 2011; deVibe et al., 2012; Cramer, Haller, Lauche, & Dobos, 2012; Vollestad, B. Nielsen, & H. Nielsen, 2012. Moreover, studies suggest that mindfulness based practices may improve performance on a variety of socioemotional outcomes, including self-regulation, stress, and mood disturbance (Cheisa & Serretti, 2009; Regehr, Glancy, & Pitts, 2013). There has been increasing interest in MBIs with children and adolescents, and schools are often seen as a convenient setting to implement MBIs with children and youth. Some of the more popular MBIs used in schools are Mindfulness Based Stress Reduction (MBSR; Kabat-Zinn, 1979; Bootzin & Stevens, 2005), Mindfulness Based Cognitive Therapy for Children (MBCT-C; Segal, Williams, & Teasdale, 2002; Semple, Reid, & Miller, 2005), Meditation of the Soles of the Feet (SoF; Singh et al., 2007), and Learning to Breath (LTB; Broderick & Metz, 2009). Despite the dramatic increase in the use of MBIs in schools to affect socioemotional and academic outcomes,

little effort has been invested to systematically examine the body of evidence using rigorous methods, particularly for behavioral and academic outcomes of MBIs implemented in school settings.

This review contributes to the literature by including the most recent research on MBIs in school settings, including outcomes that have not been examined in prior reviews of school-based mindfulness interventions, including behavioral and academic outcomes, and employing stringent criteria for search, selection, coding, and analysis as specified in the Campbell Collaboration policies and guidelines to inform educational policy and practice and identify gaps in the current evidence base to guide future research in this growing area of practice and research.

OBJECTIVES

The purpose of this review is to examine and synthesize evidence of mindfulness-based interventions implemented in school settings with primary and secondary school students on achievement, behavior and socioemotional outcomes to inform education practice and policy. Specifically, the primary aim of this review is designed to answer the following research question:

1. What are the effects of mindfulness-based interventions on cognition, academic achievement, behavior and socioemotional outcomes?

Moreover, within the context of this review, we aim to describe:

- The types of mindfulness-based interventions being evaluated in school settings.
- The state and quality of evidence of intervention outcomes studies of mindfulness-based interventions in school settings?

SEARCH METHODS

We attempted to identify and retrieve both published and unpublished studies through a comprehensive search that included multiple electronic databases, research registers, grey literature sources, and reference lists of reviews and relevant studies. We searched 13 electronic databases, research registers, relevant clearinghouse, government and research center websites, conference abstracts/proceedings, reference lists of prior reviews and included studies, and contact with experts and researchers in the area of school-based mindfulness interventions.

SELECTION CRITERIA

Studies were included in this review if they met the following criteria:

Types of studies: Randomized controlled trial (RCT), quasi-experimental design (QED), single-group pre-post test design (SGPP) or single subject design (SSD). We only included RCT and QED studies in the meta-analyses.

Participants: Pre-school, primary and secondary school students

Interventions: Interventions of interest include those that are a) conducted in a school setting (during the school day or in a school-based after school program) and b) use a mindfulness component/strategy. Mindfulness is broadly defined as "self-regulation of attention to the conscious awareness of one's immediate experiences while adopting an attitude of curiosity, openness, and acceptance" (Bishop et al., 2004, p. 174).

Outcomes: Studies must have reported at least one of the following outcomes:

1. Cognition (e.g., executive function, memory, cognition, attention)
2. Academic performance (e.g., standardized achievement tests, measures of content mastery, reading, grades)
3. Behavior (e.g., disciplinary referrals, aggression and other externalizing behaviors, time on task, compliance, attendance)
4. Socioemotional (e.g., anxiety, stress, engagement, social skills, self-esteem, emotion regulation, grit, internalizing behaviors)
5. Physiological (e.g., cortisol, heart rate, brain activity)

Other criteria: Studies must have reported post-test data, interventions must have been conducted in a primary or secondary school setting, and must have been conducted or published between 1990 and 2015. The search was not restricted by geography, language, publication status or other study characteristics.

DATA COLLECTION AND ANALYSIS

Titles and abstracts of the studies found through the search procedures were screened for relevance by two reviewers for most electronic databases, with the exception of the Australian Education Index, the British Education Index, and CBCA Education which were reviewed by one author. Documents that were not obviously ineligible or irrelevant based on the title and abstract review were retrieved in full text for final eligibility screening. Two reviewers independently reviewed each full text report using a screening form to determine final inclusion. Any discrepancies between the reviewers were discussed and resolved through consensus. For all studies that passed the eligibility screening process described above, two reviewers independently coded each eligible study using a structured data extraction form. Following independent coding of studies, coders then compared coding and identified and discussed discrepancies, which were resolved through consensus. If consensus could not be reached between the two coders, a third member of the review team was consulted to resolve the discrepancy.

We conducted descriptive analyses on variables of interest from all included studies to provide information regarding participant, setting, intervention characteristics for all studies that met eligibility criteria. For those that met criteria for inclusion in the meta-analysis, we estimated effect

sizes for each included RCT and QED study when enough data was reported in the study or provided by study authors. For RCT and QED studies, we calculated the magnitude of effect using the standardized mean difference effect size with Hedges' *g* correction for continuous outcomes and odds ratios for outcomes presented as dichotomous variables.

Following the estimation of individual study level effects, we conducted separate meta-analyses using Comprehensive Meta-Analysis, version 3.0 (CMA; Borenstein, Hedges, Higgins, & Rothstein, 2014) for the following outcome domains of interest: cognitive, academic, behavioral and socioemotional outcomes. To synthesize effects across studies, a weighted mean effect was calculated by weighting each study level effect size by the inverse of its variance. Random effects statistical models were used throughout. RCT and QED studies were pooled to allow for greater statistical power in all meta-analyses (heterogeneity between RCT and QED studies was not statistically significant in any of the meta-analyses). Following the estimation of summary effects, we conducted a test of homogeneity (*Q*-test) to compare the observed variance to what would be expected from sampling error. The I^2 statistic was used to describe the percentage of total variation across studies due to the heterogeneity rather than chance. We also constructed a forest plot displaying study-level mean effect sizes and 95% confidence intervals for the included studies to provide opportunity for visual analysis of the precision of the estimated effect sizes, detection of studies with extreme effects, and information regarding heterogeneity of studies. Publication bias was assessed using funnel plots. When there was significant heterogeneity across studies, we conducted moderator analyses to examine the following variables: study type (RCT, QED), provider (classroom teacher, trained instructor), researcher involvement (yes/no), homework (yes/no), manualized program (yes/no), and number of weeks (# of weeks of the intervention).

RESULTS

Of the 61 studies that met criteria for inclusion in this review, 25 were RCT studies, 19 were QED studies, 9 were SGPP studies and 8 were SSD studies. Of the 44 RCT and QED studies, 35 provided enough data to calculate an effect size and were included in one or more of the meta-analyses, depending on which outcomes of interest were reported in the studies. Of the 44 RCT and QED studies, seven were unpublished reports, with the remaining being published studies in peer-reviewed journals. The interventions represent a wide range of mindfulness intervention types, but most interventions were at least partially manualized and of shorter duration. The interventions were delivered by primarily a classroom teacher (31%) or by a mindfulness-trained interventionist (60%) external to the school system.

Meta-analytic findings indicate small, yet statistically significant effects on cognitive outcomes (k = 10; g = 0.25 (95% CI [0.06, 0.43], p = .01) and socioemotional outcomes (k = 28; g = 0.22 (95% CI [0.14, 0.30], p < .001), and small and non-significant effects on academic outcomes (k = 5; g = 0.27 (95% CI [-0.04, 0.57], p = .08.) and behavioral outcomes (k = 13; g = 0.14 (95% CI [-0.02, 0.30], p = .08). Heterogeneity was small and not statistically significant in all meta-analyses with the exception of behavioral outcomes (I^2 = 48%; T^2 = .034; Q = 22.96, p = .03). Six studies measured physiological factors, with three of those studies from the same author team. Due to the nature of these measures, the time dependency of some of these measures (cannot compare AM cortisol to

PM cortisol for example), and that so few studies measured these outcomes, quantitatively synthesizing these outcomes across these studies was not warranted.

Overall, there was a moderate to high risk of bias across the 35 studies included in the meta-analyses, with variation in high risk areas across studies. Twenty-one studies (60%) were rated low risk and 14 studies (40%) were rated high risk of bias for random sequence generation. Only one study reported that participants and study and school staff were blinded to program allocation (Sibinga et al., 2013), although they did not specify how they blinded study and school staff to condition. The remaining studies were rated as high risk (86%) or unclear risk (11%). Most of the studies in this review were rated as low risk of attrition bias (74%). For the studies included in the meta-analyses, most studies were assessed as unclear risk for reporting bias as we could not find any protocols of studies with which to compare planned to actual reported outcomes. It must be noted, however, that several studies reported to use, and then only reported data for, subscales of measures rather than reporting the full measure score or all subscale scores. Thus, it is unclear whether the a priori intentions of these authors were to only use certain subscales or if the participants did complete the full measure and the study authors only described the use of and reported data for the subscale only. We also coded for additional factors related to potential bias in this corpus of studies: researcher allegiance bias, funding source bias, and confounding factors. Of the 35 studies included in the meta-analysis, we were able to clearly identify an author role in the development and/or delivery of the intervention in 18 (51%) of the studies. The funding source was often not reported, or the studies were not funded. In four of the studies (11%), the authors identified a funding source that was also an entity involved in the development or the delivery of the intervention. We also examined whether there were confounding factors with either the treatment or comparison groups. Thirteen studies (37%) were assessed as having a confound at the level of the instructor (n = 7; only one instructor in treatment, control or both conditions) or at the school/classroom level (n = 6; one classroom or school in the treatment, control or both conditions). A larger mean effect was observed for studies in which a confound was present, thus likely upwardly biasing results; however, we conducted sensitivity analysis and found that the difference in magnitude of effect between studies with and without confounds was not statistically significant.

AUTHORS' CONCLUSIONS

Results indicate mixed results of school-based mindfulness interventions across the outcomes of interest in this review, with finding favorable impacts of mindfulness interventions on those processes that are likely more directly targeted by mindfulness interventions, namely cognitive and socioemotional outcomes. We found a lack of support at posttest to indicate that those positive effects on cognitive and socioemotional outcomes then translate into favorable outcomes for academic and behavioral outcomes as is hypothesized. The lack of heterogeneity for all outcomes with the exception of the behavioral outcomes indicate that the interventions in this review, although quite diverse in their characteristics, produced similar results across studies on cognitive, socioemotional and academic outcomes. These findings provide some support for the use of school-based mindfulness interventions for some outcomes, but do not provide overwhelming support of MBIs as being the panacea as some have advocated. The quality of the evidence varied,

with some important risks of bias present across a large proportion of studies which threatens the internal validity of the included studies and is cause for caution in interpreting the results of this review.

Overall, the evidence from this review urges caution in the enthusiasm for, and widespread adoption of, school-based mindfulness interventions for children and youth. While the evidence points to positive effects on socioemotional and cognitive outcomes, there is a lack of evidence of effects on academic and behavioral outcomes. Despite the empirical support of mindfulness-based interventions for adults, children and adolescents may not benefit from mindfulness-based interventions similarly to adults. Children and adolescents may not be developmentally ready for the complex cognitive tasks, focus and level of awareness that mindfulness-based interventions require. Moreover, we know little about the costs and adverse effects of school-based mindfulness interventions—the costs of implementing these programs may not be justified, and there are some indications that mindfulness-based interventions may have some adverse effects on children and youth; however, these have not been adequately examined. If schools do want to implement mindfulness-based interventions, we urge schools to evaluate the practice in a rigorous way and monitor outcomes and costs.

1 Background

1.1 THE PROBLEM, CONDITION OR ISSUE

Evidence suggests that students today are experiencing high levels of stress as well as other emotional and developmental challenges that may impede their ability to learn and succeed in school (APA, 2009; Merikangas et al., 2010; Pope, 2010). Approximately 13%-20% of children in the U.S. experience at least one mental disorder, and these rates have been on the rise since 2005 (Centers for Disease Control and Prevention, 2013). The increased prevalence of stress and anxiety, and at earlier ages than prior generations, has been at least partially attributed to school-related stress—particularly, high stakes testing, increased academic pressure, and the overscheduling of students in multiple extracurricular activities (APA, 2009; Gregor, 2005; Pope, 2010; Suldo et al., 2009). Indeed, students report school-related stress as being their greatest source of stress (APA, 2009) and teachers rate behaviors associated with anxiety as some of the most common problems of children and adolescence (Harrison, Vannest, Davis & Reynolds, 2012). The prevalence and levels of student stress and anxiety has become a concern for schools as emerging evidence suggests strong links between stress and anxiety with academic performance as well as with emotion regulation, behavioral functioning, and brain and cognitive development, which are also strongly linked to academic performance (Andersen, 2003; Andersen & Teicher, 2009; Sandler et al., 2000; Shonkoff et al., 2009; Suldo et al., 2009; Teicher et al., 2002; Wolchik et al., 2006).

Social-emotional development and competencies have also been linked to learning and academic achievement and increasingly viewed as a target for school-based interventions (Zins & Elias, 2006; Eisenberg, Spinrad, & Eggum, 2010; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). A growing body of evidence has found numerous social and emotional factors, including emotion regulation, effortful control, social and self-awareness, self-management, relationships skills and decision-making, to be directly and indirectly related to academic performance, school engagement, and externalizing and internalizing behaviors (Brackett & Rivers, 2014; Denham & Brown, 2010; National Center for Educational Statistics, 2002; Wang et al., 1997). Social-emotional competencies are positively related to academic success, greater impulse control, better concentration and attention in school, whereas a lack of social-emotional skills is linked to academic, social and behavioral problems (See Eisenberg et al., 2010 and Denham & Brown, 2010). For example, an inverse relationship between emotion regulation and effortful control has been found with externalizing behavior problems in pre-school age children through adolescence (Eiden et al., 2007, Eisenberg et al., 2004; Gardner et al., 2008). Conversely, students who exhibit greater ability to self-regulate are more likely to demonstrate better ability to concentrate and pay attention in school and exhibit better impulse control and fewer externalizing behaviors, leading to

improved functioning and success in school (Eigsti et al, 2006; Eisenberg et al., 2010; McClelland et al., 2007; Mischel et al., 1989).

The increased prevalence of stress, anxiety, mental health problems and other social, emotional, and behavioral risk factors, along with the increase in knowledge of the impact of these factors on learning and achievement, has prompted schools and policy-makers to begin to more explicitly attend to students' social and emotional functioning through both curricula and ancillary programs (Zins & Elias, 2006). Indeed, for students to succeed in school, it seems ever more apparent that schools need to provide strong social and emotional components and support students' well-being in addition to providing strong academic curriculum and instruction (Zins, Weissberg, Wang, & Walberg, 2004).

As schools have struggled to find ways to support students' overall well-being, one approach receiving growing interest is the use of mindfulness practices. Mindfulness, commonly defined as "paying attention in a particular way: on purpose, in the present moment, nonjudgmentally" (Kabat-Zinn, 1994, p. 4), has become mainstream and practiced by high profile stars and athletes as a means of improving health, well-being and athletic performance. Indeed, mindfulness was featured on *60 Minutes*, free lessons in mindfulness are given as perks at companies like Google (Walton, 2014), and meditation is an integral part of the Seattle Seahawks training regimen (Roenigk, 2013). Google "mindfulness" and millions of news articles, video and audio files, images, books, practice guides and links to various centers for mindfulness will be listed in the results. From a simple Google search, it appears that mindfulness is a common topic in the public sphere.

While mindfulness seems to be a popular trend being adopted by individuals, it is also beginning to be considered in various areas of public policy, including education policy. Over the past decade, interest in mindfulness has been growing and mindfulness-based approaches to improving health and well-being, particularly with adults, has spread across fields, including psychology, healthcare, neuroscience, and business. This burgeoning interest in mindfulness is due, at least in part, to a significant and growing body of evidence pointing to positive effects of mindfulness training on cognitive processes. Evidence suggests that mindfulness practice improves performance on a variety of measures of self-regulation (Lo & Allen, 2008; Heeren, Van Broek, & Philippot, 2009) and emotion regulation (e.g., Speca et al., 2000; Fincune & Mercer, 2006), as well as enhancing cognitive functions such as attention, working memory and some executive functions (Chiesa, Calati, & Serretti, 2011), all of which are important to success in school. Indeed, Mindfulness interventions have been found to alter brain structure and function, including increased blood flow to and thickening of the cerebral cortex (Davidson, 2008) and increased gray matter concentration in areas of the brain involved with emotion regulation, learning and memory (Holzel et al., 2011). A meta-analysis of 21 neuroimaging studies found consistent differences between meditators and non-meditators in eight regions of the brain key to meta-awareness, body awareness, memory and self and emotion regulation (Fox et al., 2014).

Moreover, mindfulness has been found to be effective in the treatment of a myriad of health, social and psychological problems. Numerous studies and meta-analyses have investigated the use of mindfulness-based interventions (MBIs) in medicine, with mindfulness training and practice being

found to help patients with chronic conditions manage pain (e.g., Cramer, Haller, Lauche, & Dobos, 2012; Veehof, Oskam, Schreurs, & Bohlmeijer, 2011), fibromyalgia symptoms (i.e., Lauche, Holger, Dobos, Langhorst, & Schmidt, 2013), and reduce stress in breast cancer patients (i.e., Zainal, Booth, & Huppert, 2013). Additionally, syntheses and meta-analyses have found positive effects of MBIs in treating individuals with mental health diagnoses, such as anxiety (deVibe et al., 2012; Vollestad, B. Nielsen, & H. Nielsen, 2012), psychiatric disorders (i.e., Chiesa, Calati, & Serretti, 2011), psychosis (Khoury, Lecomte, Gaudiano, & Paquin, 2013), personal development and quality of life (deVibe et al., 2012) as well as stress in healthy people (i.e., Cheisa & Serretti, 2009) including university students (Regehr, Glancy, & Pitts, 2013). Indeed, the use of mindfulness has greatly expanded into various fields to aid in the treatment of a vast array of conditions as well as to more generally enhance health and wellbeing.

While the vast majority of research on mindfulness has historically been focused on adults, the increase in promising research based on the diverse application of MBIs with adults and the growing popularity of mindfulness with the general public has naturally led to the extension of mindfulness to the application with children and youth (Zenner et al., 2014). It has been argued that children could benefit from mindfulness in ways similar to adults (Davis, 2012; Hooker & Fodor, 2008), and initial reviews suggest that MBIs are feasible with children and adolescents with adaptations (Burke, 2009; Zelazo & Lyons, 2012). Mindfulness-based interventions (MBIs) have been adapted from adult interventions or developed specifically for youth for a range of clinical conditions as well as more generally to enhance health and well-being, and applications for use in schools are also gaining attention.

The use of MBIs is on the rise in schools across the United States and United Kingdom as more and more schools have begun implementing various mindfulness-based programs and integrating mindfulness into the curricula (e.g., MindUP, The Inner Resilience Program, South Burlington Wellness and Resilience Program, Mindful Schools, Learning to Breathe, Mindfulness in Schools Project, Still Quiet Place, Stressed Teens, and Wellness Works in Schools). Moreover, efforts to promote mindfulness practices are being included in public policy initiatives. In the United Kingdom, for example, members of parliament have received training in mindfulness and have heard testimony of the evidence and benefits of mindfulness, including testimony from thousands of school children who have experienced mindfulness training in school. Also, an all-party parliamentary group was launched in the United Kingdom to conduct a nine-month inquiry into the potential role of mindfulness in areas of public policy, including education (Booth, 2014). The third session of the all-party parliamentary group focused on “mindfulness in health and education”, and members considered possible applications of mindfulness, with discussion of challenges for scaling up mindfulness programs to be included in teacher training as well as other potential policy actions (http://parliamentarywellbeinggroup.org.uk).

Although the use of MBIs appears to be on the rise in schools, and policy makers are calling for more mindfulness in education policy, it is unclear whether mindfulness-based approaches do indeed positively impact academic, emotional, and behavioral outcomes in students. While there is a growing body of studies of MBIs on a range of cognitive, social, and psychological outcomes including working memory, attention, academic skills, social skills, and emotional regulation

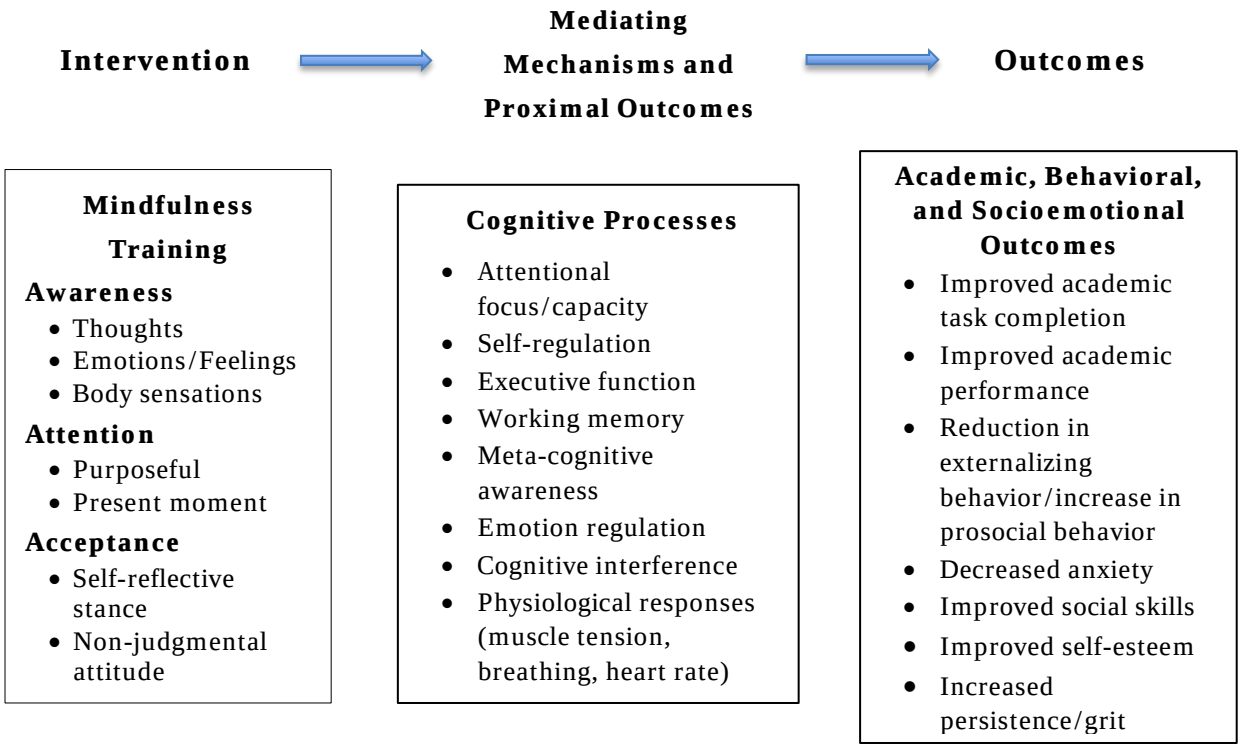
(Meiklejohn et al., 2012), few studies have synthesized this literature using systematic and quantitative methods and few have focused specifically on school-based interventions. As schools develop practices and policies to try to more effectively and efficiently improve student outcomes, it is important that researchers, practitioners, policy makers, and other key stakeholders have access to evidence of effects of MBIs to make informed decisions rather than rely on anecdotal evidence and follow current popular trends. This information is critical as schools must make important academic, curricular and budgetary decisions. If a particular psychosocial intervention has large positive effects, then the use of academic time and limited school resources may be warranted to implement such a program during the school day; however, if the effects are minimal or adverse, then the use of academic time and limited school resources may not be worth those costs.

1.2 THE INTERVENTION AND HOW IT MIGHT WORK

Mindfulness was defined by Kabat-Zinn (1994) as "paying attention in a particularly way: on purpose, in the present moment, and non-judgmentally" (p. 4). Mindfulness is a type of practice derived from the Buddhist contemplative practices and traditions of Vipassana and Zen/Chan (Chiesa, Calati, & Serretti, 2011; Eberth & Sedlmeier, 2012), which is characterized by awareness of the current state of the mind and body without judgment, elaboration, or attachment (Burke, 2010; Eberth & Sedlmeier, 2012). Many scholars have embraced a two component model of mindfulness which includes self-regulation of attention and attending to the present moment. Self-regulation of attention refers to bringing awareness to a point of full attention to one's thoughts, feelings, and sensations. This includes maintaining sustained attention, keeping attention flexible, focusing on direct/current experience and inhibiting elaborate processing. The second component, orientation to the present moment, refers to the attitude or approach one takes in attending to the present moment and is exemplified by curiosity, openness, and acceptance (Bishop et al., 2004). Shapiro and colleagues (2006) conceptualized mindfulness as being comprised of three core components: intention, attention and attitude. The second and third components are similar to the two-component model described above. It's in the first component, intention, that their model differs. Intention involves the ability to regulate attention in a conscious and purposeful way. Shapiro and colleagues assert that one's intention for undertaking mindfulness practice (e.g., self-regulation, self-exploration, self-liberation) has been largely overlooked, but is important and may evolve over time.

While several models have been put forth to describe components of mindfulness and explain processes by which MBI's may work (e.g., Grabovac et al., 2011; Howell & Buro, 2011; Jankowski & Holas, 2013; Melbourne Academic Mindfulness Interest Group, 2006; Shapiro et al., 2006; Shapiro et al., 2011; Zelazo & Lyons, 2012), the specific mechanisms of mindfulness have not been fully explicated. Most models propose on one or more possible mechanisms, including cognitive, psychological and neurobiological mechanisms. We will focus on mechanisms that are most relevant to school-related outcomes of interest to this review (see Figure 1).

Figure 1: Logic model for MBIs with school students



Evidence suggests that mindfulness invokes cognitive processes and functions that are important to academic achievement, socioemotional functioning and behavior, namely attention, self-regulation, working memory, executive function, and metacognitive awareness (Grabovec et al., 2011; Melbourne-Based Mindfulness Interest Group, 2006; Zelazo et al., 2012; Shapiro et al., 2006). Some of these constructs are fairly broad, have overlapping components or are described or classified in the literature differently, thus making discussing the mechanisms involved in mindfulness interventions somewhat challenging. For example, self-regulation is conceptualized in terms of encompassing attention in some literature, but maintained as distinct constructs in others. Despite the variation across the literature in the ways in which cognitive processes are defined and measured, it is well recognized that cognitive processes are targeted and affected by MBI's and are important to academic achievement and socioemotional and behavioral outcomes.

As noted above, "paying attention" is a key component of mindfulness practice, requiring one to focus and direct attention in specific ways. Evidence suggests that mindfulness can enhance various aspects of attention or affect brain structure in areas related to attention (Carmody, 2009; Chiesa et al., 2011; Napoli et al., 2005). Given that a student's ability to sustain attention in class and on the right things is critical, and that performance and behavior are positively associated with attention (Hart, 2004; Rudasill, Gallagher, & White, 2010), MBI's could improve school achievement and behavior by helping students focus and sustain attention in school.

Self-regulation is another mechanism by which mindfulness may positively affect school-related outcomes. Self-regulation generally refers to monitoring and controlling our thoughts, actions and emotions (Zelazo & Lyons, 2012). It is often divided into cognitive self-regulation (including executive function, attention, planning) and emotional self-regulation (behavior and mental

health; Duncan & Magnuson, 2009) and studied under the umbrella of executive function, which may also include working memory, cognitive flexibility, and inhibitory control (Zelazo & Lyons, 2012). The ability to monitor and control one's thoughts, behaviors and emotions plays an important role across all life domains, including school related outcomes. Self-regulation has been found to be related to, or a predictor for, a number of outcomes important to student success in school, such as externalizing and internalizing problems, classroom behaviors and disciplinary incidents, and math and reading (Berking & Wupperman, 2012; Ponitz et al., 2009; Quinn & Fromme, 2010; Richardson et al., 2012; Setken et al., 2010; Wyman et al., 2010). Evidence suggests that mindfulness positively effects self-regulation, as operationalized and measured in a variety of ways, and has been associated with changes in brain regions underlying self-regulation (Holzel et al., 2011). MBIs target self-regulation in that mindfulness practice requires one to attend to one's thoughts in the present moment and accept those thoughts without trying to change the thoughts or engage in action, promoting sustained attention and cognitive flexibility while also reducing emotional reactivity (Zelazo & Lyons, 2012). The emphasis on attending with acceptance and with a nonjudgmental attitude enables students to engage in more socially appropriate behavior and promote well-being by viewing situations through a different perspective and engaging in a type of detachment, which allows one to consider other potential responses and disrupt typical patterns of thinking and acting (Hart, 2004; Zelazo & Lyons, 2012). Thus, through cognitive and emotional self-regulation, MBIs may improve academic and behavioral outcomes, reduce mental health symptoms, and improve socioemotional well-being.

While mindfulness has been associated with a number of positive outcomes and may invoke a variety of potential mechanisms, mindfulness is a broad construct and interventions using mindfulness vary. This review will focus on MBIs with preschool, primary and secondary students in school settings. A number of MBI's being used in schools are being adapted from MBIs used with adults and others are being developed specifically for use with youth. For example, Mindfulness Based Stress Reduction (MBSR; Kabat-Zinn, 1979) and Mindfulness-Based Cognitive Therapy for Children (MBCT-C; Semple, Reid, & Miller, 2005), are MBIs that were originally developed for adults and have been adapted for youth. MBSR, a group intervention aimed at reducing stress, is composed of eight weekly 2.5-hour sessions with a daily 45-minute homework assignment (Grossman, Niemann, Schmidt, & Walach, 2004). Participants receive instruction in various aspects of mindfulness, including mindful awareness during meditation, yoga, and are taught to engage in continuous awareness of physical, mental, and emotional states without judgment or evaluation. Mindfulness based cognitive therapy (MBCT) was originally developed by Segal, Williams, and Teasdale (2002) as a treatment to reduce relapse of recurrent major depressive episodes in adults and was later adapted for use with children (MBCT-C; Semple, Reid & Miller, 2005; Semple, Lee, Rosa & L. Miller, 2010) to address anxiety. Researchers have adapted and implemented MBSR with children in clinical settings (Bootzin & Stevens, 2005), community settings (Saltzman & Goldin, 2008) and school settings (Bakosh, 2013; Bakosh, 2015; Sibinga, 2013; Sibinga, 2015). Both MBCT (for adults) and MBCT-C combine mindfulness-based practices such as attention on the breath and awareness of the present moment with cognitive interventions to achieve "affective self-regulation" (p. 222), but the children's version has been reduced from 12 weeks to 8 weeks in duration, there is less amount of time of each seated period and group size is smaller (Semple et al., 2010). Another distinction between the adult and child programs is that

MBCT-C encourages parental involvement in the form of information sessions, brief mindfulness training exercises, and home practice of meditation with children. Since its development, several studies of MBCT-C in school settings have been conducted (i.e., Semple et al., 2005), as well as in other settings (e.g., Lee, Semple, Rosa, & L. Miller, 2008; Bogels, Hoogstad, van Dun, DeShutter, & Restifo, 2008).

Learning to BREATHE (L2B; Broderick & Metz, 2009) is an example of an MBI that was designed specifically for the classroom setting. The curriculum "tailors mindfulness-based approaches to the developmental needs of adolescents" (p. 38) by helping students be mindful of their present situation through lessons on body, thought, and emotion awareness, reducing self-judgment, and being mindful in everyday life (Broderick & Metz, 2009). L2B is a brief, six, twelve, or sixteen week curriculum conducted in a group setting that has been integrated into school curriculum in health class (Broderick & Metz, 2009) or choir class (Metz, Frank, Reibel, Cantrell, Sanders, & Broderick, 2013). Each lesson includes a short overview of the mindfulness principle being studied, group discussion, time to practice mindfulness by applying the principle, and home meditation practice assignments with supporting materials provided (Broderick and Metz, 2009; Metz et al., 2013).

In the descriptions of these approaches, one can discern that there are more similarities between MBI approaches than differences. For example, all of the approaches incorporate a training period of guided meditation techniques focusing on mindful attention and awareness of breath, body, or mind and followed by independent practice. The interventions differ in their intended purposes, such as treatment of anxiety and stress, managing aggressive behaviors, emotional regulation, and overall health promotion and how they are implemented in school settings. MBIs have been implemented in "core" content classes (reading and Language Arts, math, science, or social studies), in "elective periods" such as physical education classes (Napoli et al., 2008), choir classes (Metz et al., 2013), enrichment or intervention periods, or in time outside the regular school day (e.g., after-school tutoring or summer school). The type of setting is often determined by the purposes or outcomes measured, as well as the practical and systemic constraints and requirements in the school. For example, Broderick & Metz (2009) examined outcomes related to mental health by conducting the intervention in students' health classes.

While many of the MBIs discussed to this point intervene directly with the youth, there are MBIs that also involve parents or teachers, either as a supplement to student training or as the primary target of the intervention. For example, Semple and colleagues (2010) conducted parent-training sessions in mindfulness, which provided an overview of the program their children would be receiving at school, as well as some opportunities for the parents to engage in mindfulness practice. Parents were also encouraged to participate in their child's home practice sessions; however, no data were collected or analyzed as a result of these parent-training sessions. It is yet unclear whether parent or teacher participation in the intervention provides any added benefit or enhances student outcomes. Other MBIs have been conducted with teachers or parents as the primary or only recipient of the intervention. In these interventions, the intent of providing teacher or parent training is to affect parent or teacher outcomes, with some hypothesizing indirect outcomes on students through changes in parent or teacher behavior from mindfulness practice. For example, Jennings and colleagues (2011) examined the effects of Cultivating Awareness and Resilience in

Education (CARE), a mindfulness-based professional development program designed for teachers to reduce stress, improve teachers' performance, and prevent "burnout." Instruction in CARE provides teachers with training in a series of mindfulness activities, with periods of silent reflection and opportunities to extend the practices into daily classroom routines. Teachers reported high satisfaction with the CARE training, but there were no measures of student performance. Because MBIs that target teachers or parents as the primary recipient of the MBI focus on different outcomes (teacher and parent outcomes versus student outcomes, with perhaps some secondary student outcomes), we believe it is most appropriate to separate interventions targeting students from studies targeting teachers or parents as the primary recipient of the intervention. Therefore, we will focus this review on interventions in which students are the primary recipients of the MBI.

1.3 PRIOR REVIEWS

While several reviews have been conducted on mindfulness-based interventions with adults for a myriad of problems and outcomes, less attention has been given to reviewing the literature on outcomes of mindfulness-based approaches for children and youth, particularly outcomes relevant to education. To date, we have located nine reviews of mindfulness-based interventions that include studies with children or youth. One of the reviews focused on health-related effects of sitting-meditative practices (Black, Milam, & Sussman, 2009) and two reviews were not specifically focused on children or education, but did include some studies of mindfulness-based approaches with children and/or youth with intellectual disabilities (Chapman, 2013) and developmental disabilities (Hwang & Kearney, 2013). The remaining five reviews examined effects of MBIs with children and youth and are more relevant to the proposed review, thus will be discussed in more depth.

Meiklejohn and colleagues (2012), Greenberg and Harris (2012), and Thompson and Gauntlett-Gilbert (2006) published traditional narrative reviews describing mindfulness interventions with children and youth. Meikeljohn and colleagues focused on literature related to integrating mindfulness training in primary and secondary education, whereas Greenberg and Harris and Thompson and Guantlett-Gilbert reviewed mindfulness practices in clinical settings or prevention or health promotion contexts. All three reviews described a variety of mindfulness-based approaches and two summarized findings of intervention studies. These reviews concluded that mindfulness-based approaches are feasible and promising, but cautioned that additional and more rigorous research was needed. While these reviews provide an overview of MBIs with children and youth, the authors did not describe their search, selection, or coding procedures and did not quantitatively synthesize effects of the interventions, thus limiting the conclusions that can be drawn regarding the effects of MBIs with children and youth.

In addition to several narrative reviews, three reviews were identified that used systematic review methods (Burke, 2010; Zenner, Hernleben-Kurz, & Walach, 2014; Zoogman, Goldberg, Hoyt, & Miller, 2014), two of which also quantitatively synthesized effects using meta-analytic methods (Zenner et al., 2014; Zoogman et al., 2014). Burke (2010) conducted a systematic review of mindfulness-based approaches with children and adolescents. Burke identified 15 studies (6 used a between-group design) that met review criteria that included articles written in English and studies that used secular contemplative mindfulness mediation techniques. The author conducted a search

for studies in 12 research databases and, although the author did not limit the review to published studies, a comprehensive search for grey literature was not conducted and dissertations or conference papers were not accessed. This review included studies of mindfulness with clinical and non-clinical samples, but not all included studies were relevant to education (e.g., outpatient gastroesophageal reflux, body weight) and only four were conducted in school settings. Eight of the studies included in the Burke review were also included in the Meiklejohn review. Burke concluded that the studies provided evidence of the feasibility and acceptability of mindfulness-based approaches for children and adolescents, but the research base is limited by a lack of rigorous efficacy studies, which was attributed, in part, to the early stage of research in this area.

Two meta-analyses of MBIs with children and youth have been published. Zoogman et al., (2014) reports the first published meta-analysis of mindfulness meditation with youth. The search was conducted in 2011 and was limited to peer-reviewed journal articles published in English. Twenty studies (13 RCTs, 1 QED, and 6 within group pre-post test studies) reporting effects of mindfulness interventions with clinical and non-clinical samples were included in the meta-analysis. The mean effect of the included interventions was 0.227 [CI 0.148, 0.305] and heterogeneity was not significant. Of the 12 moderators tested, only one moderator was significant—studies using clinical samples reported significantly larger effect sizes than studies using non-clinical samples. Additional analyses performed found significantly greater effects for psychological symptoms than measures of other outcomes. Zenner and colleagues (2014) conducted a systematic review and meta-analysis of MBis in schools with a focus on psychological outcomes (cognitive performance, emotional problems, stress and coping, and resilience). The authors conducted a comprehensive search in 2012 for published and unpublished reports yielding 24 studies (10 RCTs, 8 QEDs, 1 two-armed cohort study, and 5 non-controlled trials). The mean effect of the 19 studies using a comparison group design was g = 0.40 [0.21, 0.58]. The authors found significant effects on cognitive performance, resilience, and stress measures and non-significant effects on emotional problems. The authors found significant heterogeneity between studies. The included studies were often underpowered and small, and a wide variety of programs were evaluated, with many researchers implementing their own programs. The authors concluded that mindfulness-based approaches in schools are promising and the available evidence justifies allocating resources to mindfulness intervention implementation and evaluation. They recommended that larger studies employing more robust and well-validated measures be used in future research.

1.4 WHY IT IS IMPORTANT TO DO THE REVIEW

The aforementioned reviews contribute to our understanding of mindfulness-based approaches with children and youth; however prior reviews are limited in several ways. First, most prior reviews used non-systematic search methods and narrative synthesis methods, are not directly relevant to education settings, or were limited by including only published studies, thus limiting their applicability to informing practice and policy in education. This systematic review expands and improves upon prior work in several ways. First, this review focused on a range of outcomes relevant to educational settings and included academic performance outcomes. As academic performance outcomes have not been included in prior reviews, the present review provides timely information that can be used in school policy and practice decisions. Second, this review employed

a systematic and transparent process for searching, retrieving, and coding studies, and included searches for unpublished studies. Using a systematic method to conduct the review of outcome research limits bias and reduces chance effects, leading to more reliable results (Cooper, 1998). Further, explicitly and transparently describing the review process allows for others to replicate and expand the review to include new studies or criteria.

In short, this review contributes to the literature by including the most recent research on MBIs in school settings, including outcomes that have not been included in prior reviews of school-based MBIs, and employing stringent criteria for search, selection, coding, and analysis as specified in the Campbell Collaboration policies and guidelines. Thus, this review provides the most up-to-date and rigorous review of MBIs to inform educational policy and practice and identify gaps in the current evidence base to guide future research.

2 Objectives

The purpose of this review is to examine and synthesize evidence of mindfulness-based interventions implemented in school settings with primary and secondary school students on achievement, behavior, socioemotional and physiological outcomes to inform education practice and policy. Specifically, the primary aim of this review is designed to answer the following research question:

What are the effects of mindfulness-based interventions on cognition, academic achievement, behavior, socioemotional and physiological outcomes?

Moreover, within the context of this review, we also aim to describe:

- the types of MBIs being evaluated in school settings.
- the state and quality of evidence of intervention outcomes studies of MBIs in school settings.

3 Methods

The study protocol that guided this review (Maynard et al., 2013) can be accessed at https://campbellcollaboration.org/library/mindfulness-based-interventions-primary-and-secondary-school-students.html.

3.1 CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

3.1.1 Types of studies

To be included in this review, studies must have used one of the following research designs: randomized controlled trial (RCT), quasi-experimental design (QED; studies using a comparison group design, but assigned groups to condition non-randomly), single-group pre-post test design (SGPP) or single subject design (SSD). For RCT and QED studies, wait list control, no treatment, treatment-as-usual and alternative treatment groups were considered acceptable comparison groups. The type of comparison group used in each study was coded and examined as a moderator. We did not require that studies provide pre-test data or make statistical adjustments; however, we coded such data for use in analysis. To be eligible for inclusion, SSD studies must have employed one of the following designs: alternating treatments, multiple baseline, or withdrawal. Although it is not typical for single-group or single subject designs to be included in Campbell reviews, this is a relatively nascent area of research and we believe it is important to provide a comprehensive picture of the state of evidence related to mindfulness-based interventions in school settings. These studies were included in this review to provide a description of MBIs being used in schools and the means and extent to which interventions are being assessed. We quantitatively synthesized effects separately by study design. Limitations and biases related to study designs that are inherently weaker were explicitly recognized and discussed.

3.1.2 Types of participants

Participants were children in pre-school, primary and secondary school grades in regular education, special education or alternative education settings from any country. As we anticipated, and as prior reviews have suggested, effects of MBIs may differ based on whether the sample is comprised of students that are high risk or come from a clinical population or from the general population of students. Therefore, we included MBIs that were implemented with any sample of students (e.g., general population, ADHD, special education) and coded the studies accordingly. Because we were interested in informing education policy, studies that included participants in inpatient hospital or residential settings were excluded from this review. Studies in which parents

or teachers were the primary recipients of the intervention were excluded, although studies that included a parent or teacher component of an MBI intervention with students were included.

3.1.3 Types of interventions

Interventions of interest included those that were a) conducted in a school setting (during the school day or in a school-based after school program) and b) used a mindfulness component/strategy. Mindfulness was broadly defined as "self-regulation of attention to the conscious awareness of one's immediate experiences while adopting an attitude of curiosity, openness, and acceptance" (Bishop et al., 2004, p. 174). While definitions and mindfulness practices vary across studies, "most involve focusing non-judgmental attention on moment-to-moment private experiences, such as breath, thoughts, physical sensations, or other external aspects of the environment" (Thompson & Gauntlett-Gilbert, 2008, p. 398). For the purposes of this review, mindfulness-based interventions included methods for teaching mindfulness awareness where participants are encouraged to focus their attention either on a covert activity (e.g., thoughts, feelings, urges) or overt activity (e.g., lights, sounds, smells). Mindfulness interventions could include present moment work, meditation, relaxation skills training, breathing techniques and awareness of moment techniques delivered in vivo, via formal meditation practices or informal mindfulness exercises. Some specific interventions eligible included, but were not limited to, Mindfulness Based Stress Reduction (MBSR), Mindfulness Based Cognitive Therapy (MCBT), Learning to BREATHE, Inner Kids Program, and Acceptance and Commitment Therapy (ACT).

We included studies that used multi-component interventions as long as one of the components was a mindfulness strategy. We coded for the various components used in addition to mindfulness and reported this information in the description of the interventions.

We excluded Transcendental Meditation (TM) interventions. TM is another meditation-based intervention that has been implemented in schools (e.g., Quiet Time Program by David Lynch Foundation; Barnes et al., 2013) and examined for the reduction of stress in adolescents (e.g., Barnes, Trieber, & Davis, 2001). While MBIs and TM share a component of meditation, TM based interventions were not considered for this review for several reasons. While TM is a concentrative technique in which the meditator focuses the mind using a mantra, a picture, or a physical experience (Sedlmeier et al., 2012), there is concern about the religious aspect of TM, which is not usually present in MBIs. In fact, in one area, school administrators cancelled plans to implement TM due to concerns by parents that it would be promoting a religion (The Associated Press, 2006). Further, a United States federal appeals court (1979) called TM a form of religious teaching and ruled that the practice could not be taught as an elective in public high schools in the state of New Jersey, United States (*Malnak v. Yogi*, 1979). While some MBIs may also have a religious component, MBIs are generally recognized and taught as a secular intervention, whereas religious aspects are consistently present with TM. Moreover, MBIs typically contain a practice of generalizing the skill of mindfulness into day-to-day activities such as academic tasks or the regulation of attention, whereas TM is primarily viewed a period of meditation in order to "take a break" from day-to-day activities. Due to the differences in nature and intent between MBIs and TM, interventions utilizing TM were excluded from this review.

3.1.4 Types of outcome measures

Studies must have reported at least one of the following outcomes:

1. Cognition (e.g., executive function, memory, cognition, attention)
2. Academic performance (e.g., standardized achievement tests, measures of content mastery, reading, grades)
3. Behavior (e.g., disciplinary referrals, aggression and other externalizing behaviors, time on task, compliance, attendance)
4. Socioemotional (e.g., anxiety, stress, engagement, social skills, self-esteem, emotion regulation, grit, internalizing behaviors)
5. Physiological (e.g., cortisol, heart rate, brain activity)

Measurement of above outcomes could have been conducted using standardized or unstandardized instruments and self-, parent-, or teacher reported or researcher administered measures were eligible. To be included in the meta-analysis, primary study authors must have reported enough information to calculate an effect size. If sufficient information to calculate an effect size was not provided, every effort was made to contact primary study authors to request the necessary information.

For studies in which the author reported both the total scale score and individual subscale scores for a measure, we did the following. For measures in which the total scale and all subscales were coded as the same outcome construct (as defined above), we used only the total scale score for analysis. For measures in which the subscales were measuring different outcome constructs (as defined above), we kept only the subscales scores for analysis.

3.1.5 Duration of follow-up

It was anticipated that most studies would report outcomes at post-test and thus post-test outcomes were the primary focus of this review; however, we noted studies that reported follow-up data or a subsequent report was published with outcomes examined at a follow-up time point.

3.1.6 Types of settings

The review included interventions conducted in a school setting.

3.1.7 Other criteria

Studies were included if they were conducted or published between 1990 and present. We selected 1990 as the cut off as MBIs implemented in school settings is a newer phenomenon and we wanted the literature to be relevant to current practices. No additional criteria were applied. The search was not restricted by geography, language, publication status or other study characteristics.

3.2 SEARCH METHODS FOR IDENTIFICATION OF STUDIES

3.2.1 Electronic searches

We included all studies that met the inclusion criteria outlined above. We attempted to identify and retrieve both published and unpublished studies through a comprehensive search that included multiple electronic databases, research registers, grey literature sources, and reference lists of reviews and relevant studies.

1) *Electronic Databases*

   a. Academic Search Complete
   b. Australian Education Index
   c. British Education Index
   d. CBCA Education
   e. Education Complete
   f. ERIC
   g. MEDLINE
   h. ProQuest Dissertations and Theses
   i. PsycINFO
   j. Social Science Citation Index
   k. Social Service Abstracts
   l. Sociological Abstracts
   m. SPORTDiscus

2) *Research Registers and Websites*

   a. Cochrane Collaboration Library
   b. Database of Abstracts of Reviews of Effectiveness
   c. National Technical Information Service
   d. System for Information on Grey Literature
   e. Evidence for Policy Practice Information and Coordinating Centre (EPPI-Centre)
   f. Association for Mindfulness in Education (mindfuleducation.org)
   g. Mindfulness in Schools Project (mindfulnessinschools.org)

Search terms and keywords: We used combinations of terms related to the intervention, population, study design, and setting to search the electronic databases. Database-specific strategies were explored for each database, including the use of truncation and database-specific limiters and thesauri were consulted to employ more precise search strategies within each database. Below are examples of the types of terms we used:

1) Intervention: mindful* OR meditat* OR yoga OR "breath* technique" OR "mindfulness based stress reduction" OR MBSR OR "Mindfulness-based cognitive therapy" OR MBCT OR "learning to breathe" OR MindUP OR "Meditation on the Soles of the Feet" OR "non-judgmental awareness" OR "present-moment")

   AND

2) Report type: evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR "control group" OR "controlled trial" OR "quasi-experiment*" OR random*

   AND

3) Targeted population: "elementary school" OR "primary school" OR "high school" OR "secondary school" OR "middle school" OR kindergarten OR pre-kindergarten

The full search strategy for each database is reported in Appendix 8.1.

3.2.2 Searching other resources

1) Grey literature sources

a. Social Science Research Network

b. Authors of prior studies were contacted in an attempt to obtain unpublished studies, studies in process and published studies missed in the database search.

c. Conference abstracts and proceedings were reviewed to identify potentially relevant studies. Conference searches included:

   i. The Society for Research on Educational Effectiveness (https://www.sree.org/pages/conferences/index.php), and the

   ii. American Educational Research Association Repository (http://www.aera.net/EventsMeetings/tabid/10063/Default.aspx.

   iii. Society for Research on Child Development (SCRD)

   iv. Society for Research on Adolescence (SRA)

d. Clearinghouses, research centers and government websites were reviewed to identify potential sources of relevant data:

   i. The US Department of Education's web site contains reports of funded programs and initiatives: http://www2.ed.gov/about/offices/list/opepd/ppss/reports.html

   ii. The Institution of Education Sciences, What Works Clearinghouse contains reports of intervention investigations: http://ies.ed.gov/funding/grantsearch/index.asp

iii. Mindfulness Experience: http://www.mindfulexperience.org/mrg-user-reviews.php

iv. Garrison Institute's Contemplative Education Database: www.garrisoninstitute.org

2) The reference lists from prior reviews and included studies were reviewed for potential studies. We also conducted forward citation searching using Google Scholar to search for studies citing our included studies.

3.3 DATA COLLECTION AND ANALYSIS

3.3.1 Selection of studies

Titles and abstracts of the studies found through the search procedures were screened for relevance by two reviewers for most electronic databases, with the exception of the Australian Education Index, the British Education Index, and CBCA Education. The three databases noted above were searched by a search specialist contracted to conduct searches in those databases, as the review authors did not have access. For the search results in those three databases, one reviewer screened titles and abstracts for relevance. Titles and abstracts that were obviously ineligible or irrelevant were screened out at the title/abstract stage. For example, studies that were deemed inappropriate at the title/abstract review stage were those that did not involve the target population (e.g., they involved college students or adults), did not involve an intervention, or were theoretical in nature. If there was any question as to the appropriateness of the study at this stage by either of the abstract screeners, the full text document was obtained. Documents that were not obviously ineligible or irrelevant based on the title and abstract review were retrieved in full text for final eligibility screening. Two reviewers independently reviewed each full text report using a screening form to determine final inclusion. Any discrepancies between the reviewers were discussed and resolved through consensus.

3.3.2 Data extraction and management

For all studies that passed the eligibility screening process described above, two reviewers independently coded each eligible study using a structured data extraction form (Appendix 8.2; see also Maynard et al., 2015). The data extraction form, which was pilot tested by the coders, included items related to bibliographic information and source descriptors; methods and procedures; context, nature, and implementation of the intervention; sample characteristics; and outcome data needed to calculate effect sizes. Due to the large number of studies, four trained coders on the review team contributed to coding primary studies: Brandy Maynard, Michael Solis, Veronica Miller, and Kristen Brendel. Following independent coding of studies, coders then compared coding and identified and discussed discrepancies, which were resolved through consensus. If consensus could not be reached between the two coders, a third member of the review team was consulted to resolve the discrepancy.

3.3.3 Assessment of risk of bias in included studies

Two review authors independently assessed risk of bias in RCT and QED studies using the Cochrane Collaboration's risk of bias tool (Higgins et al., 2011). We assessed risk of bias for each of the six following domains: sequence generation, allocation, blinding, complete outcome data, and selective reporting. We also coded for additional factors related to potential bias in this corpus of studies: researcher allegiance bias, funding source bias, and confounding factors. In terms of allegiance bias and funding source bias, we assessed whether the study authors were directly involved in either the development or delivery of the intervention or were funded by an entity that had some stake in the intervention. Because studies are more likely to be biased in favor of the treatment intervention when study authors have a direct role in the development or the implementation of the study (Luborsky et al., 1999; Munder et al., 2013), or when funded by a source that has a stake in the intervention (Lundh et al., 2012), we believe it was important to assess for these biases in this review. We also examined whether there were confounding factors with either the treatment or comparison groups. Specifically, we examined whether there was one unit (e.g., teacher, classroom, school) in one or both conditions. When the treatment or comparison condition is confounded in this way, it is impossible to distinguish between the effect of that unit and the effect of the intervention and thus unobserved factors may be contributing to the outcome.

Each study was coded as "low", "high", or "unclear" risk of bias on each of the domains. Following independent coding by two authors, coders met to identify any discrepancies and all discrepancies were resolved through consensus. If consensus could not be reached between the two reviewers, a third member of the review team was consulted. Risk of bias in each domain was reported within and across studies in the results section using narrative and graphs. We anticipated that most studies included in this review would be at high risk of bias, thus we did not plan to restrict analyses based on risk of bias.

3.3.4 Synthesis procedures and statistical analysis

We conducted descriptive analyses on variables of interest from all included studies to provide information regarding:

- Study participants (e.g., risk level/subgroups, gender, race, income level, grade, age),
- Settings where studies are situated (e.g., school type, classroom type, geographical location/country, community characteristics),
- Relevant intervention characteristics (e.g., mindfulness strategies used, involvement of parents/teachers, duration of intervention, modality of intervention, implementer training).
- Risk of bias across RCT and QED studies included in the meta-analyses on each domain

Following descriptive analysis, we estimated effect sizes for each included RCT and QED study when enough data was reported in the study or provided by study authors. For RCT and QED studies, we calculated the magnitude of effect using the standardized mean difference effect size

with Hedges' *g* correction for continuous outcomes and odds ratios for outcomes presented as dichotomous variables. For studies in which the unit of assignment (e.g., classroom, school) did not match the unit of analysis (e.g., student) and the primary study authors did not account for clustering in their analysis (or the data extracted from the studies used for calculating effect sizes was not adjusted), we followed recommendations in the Cochrane Handbook (cite, 2011, 16.3.4) to derive approximately correct analysis by reducing the size of each trial to its 'effective sample size' (Rao, 1992) by dividing the sample size for each group by the 'design effect' (1 + (M-1)ICC). We applied this correction only to findings that were statistically significant as nonsignificant findings will remain nonsignificant without the correction (WWC manual). With the exception of Kuyken et al. (2013) and Metz et al. (2013), ICCs were not reported by study authors. In cases where study authors reported ICCs, we used the ICCs reported by the authors. For studies in which ICCs were not reported, we used an ICC of .20 for achievement outcomes and .10 for behavioral and socioemotional outcomes (cite WWC procedures manual). The direction of effect sizes were transformed to a positive effect to indicate the treatment group performed more favorably than the control group and a negative effect to indicate the control group performed more favorably than the treatment group.

Following the estimation of individual study level effects, we conducted separate meta-analyses using Comprehensive Meta-Analysis, version 3.0 (CMA; Borenstein, Hedges, Higgins, & Rothstein, 2014) for the following outcome domains of interest: cognitive, academic, behavioral and socioemotional outcomes. Within each of these domains, several included studies used multiple measures and/or multiple reports (e.g., parent, teacher) of the same measure. These circumstances created statistical dependencies that violate assumptions of standard meta-analytic methods. In order to ensure independence of study-level effect sizes, the mean of the measures was taken to estimate a study-level average across the measures within each outcome domain so that only one effect size estimate from each independent sample on each outcome domain was used in the meta-analyses. We followed standard procedures in CMA version 3.0 to use the mean of the selected outcomes for studies with multiple measures of the same outcome construct. In cases where multiple points of follow-up were provided, we coded follow-up points to conduct a separate analysis for effect sizes comparing studies with similar points of follow-up; however, there were not a sufficient number of studies measuring points beyond post-test, thus we only post-test effects were synthesized. One study provided data on two treatment groups—one group of general population students and another group of homeless students (Viafora et al., 2015). In this case, we used the data from the general population group for analysis (there was no comparison group for the homeless student group).

To synthesize effects across studies, a weighted mean effect was calculated by weighting each study level effect size by the inverse of its variance. Random effects statistical models were used throughout. The random effects variance component was estimated using the methods of moments method. RCT and QED studies were pooled to allow for greater statistical power in all meta-analyses (heterogeneity between RCT and QED studies was not statistically significant in any of the meta-analyses).

Following the estimation of summary effects, we conducted a test of homogeneity (*Q*-test) to compare the observed variance to what would be expected from sampling error. The I^2 statistic was used to describe the percentage of total variation across studies due to the heterogeneity rather than chance. We also constructed a forest plot displaying study-level mean effect sizes and 95% confidence intervals for the included studies to provide opportunity for visual analysis of the precision of the estimated effect sizes, detection of studies with extreme effects, and information regarding heterogeneity of studies. Publication bias was assessed using funnel plots and the Egger's test, both conducted in CMA version 3.0.

When there was significant heterogeneity across studies, as determined by a statistically significant *Q*, we conducted moderator analyses using a random effects ANOVA for categorical variables. We did not assume a common among-study variance component across subgroups; tau-squared was computed within groups and not pooled across groups. The categorical variables examined per our protocol included: study type (RCT, QED), provider (classroom teacher, trained instructor), researcher involvement (yes/no), homework (yes/no), and manualized program (yes/no). For the one continuous variable we examined (number of weeks of the intervention), we used random effects meta-regression. All moderator analyses were conducted in CMA version 3.0.

3.4 DEVIATIONS FROM THE PROTOCOL

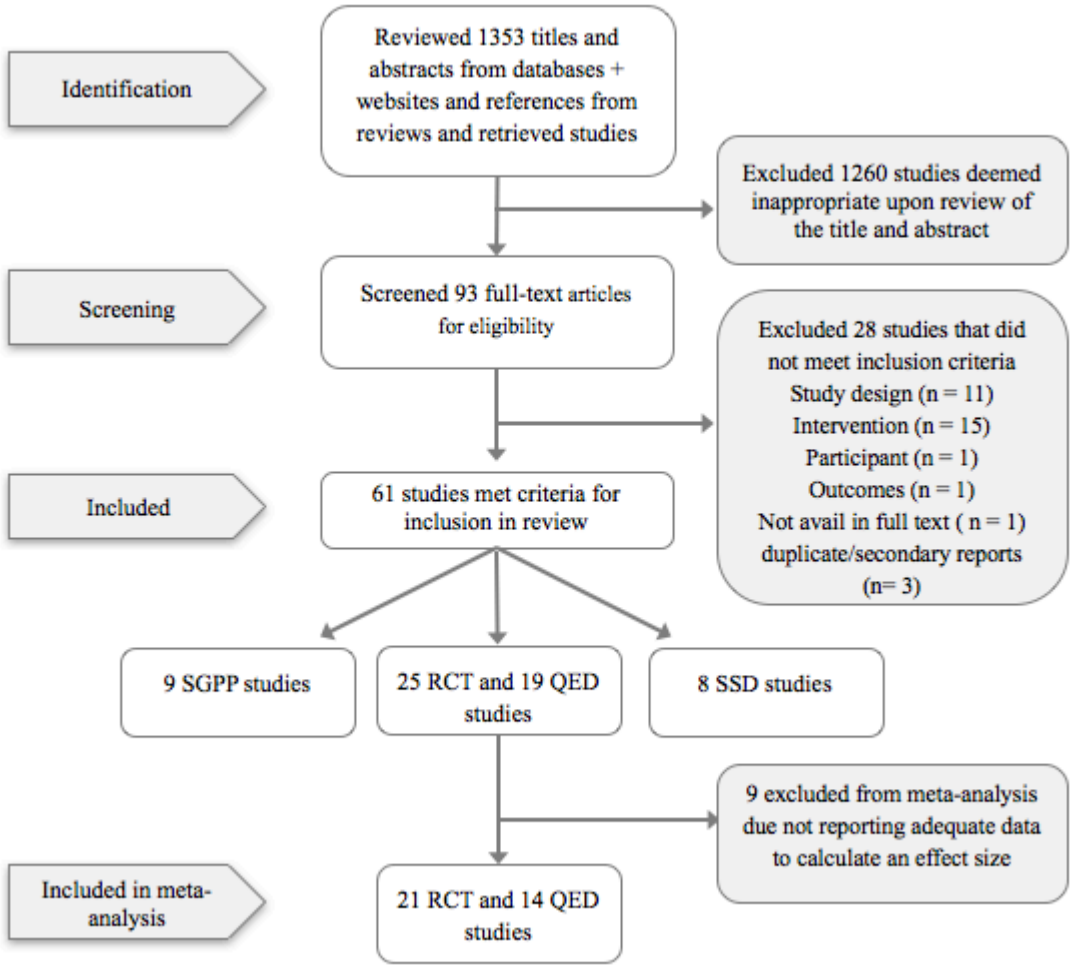
We experienced circumstances that required us to deviate from the protocol at times. During the literature search, the CINHAL and FRANCIS databases were undergoing technical difficulties and we were not able to access those databases, thus we did not search those databases as planned. We found six studies that measured physiological outcomes. While six studies measured physiological outcomes, not all studies measured the same, or enough of the same conceptually similar outcomes to warrant meta-analysis. Thus, we did not quantitatively synthesize effects of physiological outcomes, but rather provided a descriptive analysis of these studies. Also of note is that we did not originally plan to document adverse outcomes, but decided post-hoc to review studies for reporting of adverse outcomes.

4 Results

4.1 RESULTS OF SEARCH

Electronic searches of bibliographic databases and searches of other sources identified a total of 1353 citations. Titles and abstracts were screened for relevance and 1260 were excluded as duplicates or deemed inappropriate. The full text of the remaining 93 potential studies was reviewed and screened for eligibility by two independent coders. Sixty-one studies passed full-text screening and were included in the review. See Figure 4.1 for the flow chart of the study selection process.

Figure 4.1: Flow chart of study selection process



4.1.1 Included studies

Of the 61 studies that met criteria for inclusion in this review, 25 were RCT studies, 19 were QED studies, 9 were SGPP studies and 8 were SSD studies. Of the 44 RCT and QED studies, 35 provided enough data to calculate an effect size and were included in one or more of the meta-analyses, depending on which outcomes of interest were reported in the studies. Characteristics of included RCT and QED studies is reported in Appendix 8.3, SGPP studies are reported in Appendix 8.4 and SSD studies are reported in Appendix 8.5.

4.1.2 Excluded studies

Twenty–eight reports were excluded and three others were identified as secondary reports of included studies during the full-text screening stage. The majority of studies were excluded due to not meeting criteria for study design (e.g., the article did not report results of an intervention, used a mindfulness comparison group; n = 11). The remaining studies were excluded due to not meeting criteria related to intervention characteristics (i.e., not a school-based intervention; n = 15), participant characteristics (e.g., teachers; n=1), outcomes (n = 1) or were not available in full text (n=1). A list of excluded studies and reasons for exclusion is presented in Appendix 8.6.

4.2 DESCRIPTION OF INCLUDED RCT & QED STUDIES

Of the 44 RCT and QED studies, seven were unpublished reports, with the remaining being published studies in peer-reviewed journals. Most of the studies were conducted in North America (74%), with others conducted in Asia (5%), Europe (16%) and Canada (5%). All studies were written in English, with the exception of Justo et al. (2011) written in Spanish. Sample sizes ranged from 23 to 557, with a mean sample size of 141. The studies measured one or more of the outcomes of interest: 10 studies measured cognitive outcomes, 5 measured academic outcomes, 13 measured behavioral outcomes, 28 measured socioemotional outcomes and 6 measured physiological outcomes. No studies reported adverse outcomes. See Table 4.1 for a summary of characteristics across the included 44 studies as well as the subgroup of the 35 studies included in at least one meta-analysis.

Table 4.1: Characteristics of included RCT and QED studies

Characteristic	All studies N (%)	Studies in MA N (%)	Characteristic	All studies N (%)	Studies in MA N (%)
Publication Year			Geographic Region		
1990-2004	1 (2)	0 (0)	Asia	2 (5)	2 (5)
2005-2008	3 (7)	1 (2)	Australia	0 (0)	0 (0)
2009-2012	16 (36)	13 (37)	Europe	7 (16)	5 (14)
2013-2016	24 (55)	21 (60)	Canada	2 (5)	2 (5)
			United States	33 (75)	26 (74)
Study Design			Manualized Program		
RCT	25 (59)	21 (60)	Fully manualized	18 (41)	17 (49)
QED	19 (43)	14 (40)	Partially manualized	20 (45)	16 (46)
Publication Type			Unable to determine	6 (14)	2 (5)
Journal	36 (82)	27 (77)	Grade levels		
Dissertation	7 (16)	7 (20)	Preschool	2 (5)	2 (5)
Other report	1 (2)	1 (2)	Elementary	13 (30)	10 (29)
Sample Size			Middle School	7 (16)	6 (17)
1-50	10 (23)	9 (26)	High school	16 (36)	12 (34)
51-100	13 (30)	10 (29)	Mixed grades	6 (14)	5 (14)
101-200	12 (27)	7 (20)	Intervention Components		
201-300	4 (9)	4 (11)	Present moment work	38 (86)	30 (86)
>300	5 (11)	5 (14)	Meditation	37 (84)	30 (86)
Primary Provider			Relaxation skills training	27 (61)	21 (60)
Classroom teacher	18 (41)	11 (31)	Breathing techniques/ breath awareness	41 (93)	33 (73)
Trained Instructor	23 (52)	21 (60)	Mindfulness in daily activities	18 (41)	15 (43)
Other	3 (7)	3 (9)	Body scan	20 (45)	16 (46)
			Yoga	21 (48)	18 (51)

4.2.1 Participant characteristics

A total of 6,207 students were participants in the studies included in the meta-analyses. The mean age of participants across studies that reported age (n = 32) was 12.64 years. Approximately one third of the studies were conducted with elementary students and one third with high school students. Two studies were conducted with pre-school students, seven with middle school students, and six with students across grade levels. Most studies that reported the gender of the sample (n = 41) included a balanced mix of male and female students, although two studies included only male students and three included only female students. The majority of studies (84%) included students from the general population of regular education schools. The seven studies that included a special population included students who were at risk of dropout, African American students at risk of cardiovascular disease, urban boys with financial need and academic potential, at-risk high school girls, students with autism spectrum disorders, Special education needs (including emotional, behavioral, and learning difficulties) and at risk for being excluded from school, and students at risk students attending a disciplinary alternative education program.

4.2.2 Intervention characteristics

The included studies examined a range of MBIs. Of the 44 RCT and QED studies included in this review, almost half of the interventions were based on MBCT or MSBR (n = 20) and/or incorporated yoga (n = 21). Most of the interventions were either fully manualized or partially manualized interventions (n = 38). All of the interventions were delivered in a group format, with most programs delivered during the school day (n = 40) and the remaining programs delivered after school (n = 4). Interventions ranged in duration and frequency. For studies reporting adequate information, interventions ranged from 4 to 28 weeks (N = 42, M= 10.5, SD = 5.5) and were provided in 6 to 125 sessions (N = 42, M = 26, SD = 25). Interventions also varied in terms of how frequently students met to receive the intervention from one time every other week to 5 times a week, for an average of 13 hours of mindfulness instruction (SD = 11). Most interventions incorporated breathing techniques/breath awareness, present moment work (86%), and meditation (84%). Relaxation skills training was reported in 61% of the interventions and body scan in 45% of the interventions. At home practice was assigned or encouraged in about half (45%) of the studies. Some interventions included other components in addition to mindfulness, such as cognitive and/or behavioral strategies (n = 8), yoga (n = 11) or other strategies, such as talk/discussion, touch therapy, psychoeducation, aromatherapy, and/or literature (n = 11). Most studies (77%) did not measure fidelity of the intervention.

4.3 RISK OF BIAS IN INCLUDED RCT & QED STUDIES

Overall, there was a moderate to high risk of bias across the 35 studies included in the meta-analyses, with variation in high risk areas across studies. (See Figure 4.3 for a summary of risk across studies, Appendix 8.7 for a Table reporting each domain of risk for each study and Appendix 8.xx for a for Risk of bias within studies.

4.3.1 Selection bias

Selection bias is composed of random sequence generation and allocation concealment. We rated a study as being low risk on random sequence generation if they reported that they used randomization to assign participants to treatment and control groups. Twenty-one studies (60%) were rated low risk and 14 studies (40%) were rated high risk of bias for random sequence generation. In education and social science research, very rarely do studies report enough information to rate the level of risk on allocation concealment; therefore, we rated studies as unclear risk if they were randomized trials and high risk if they were non-randomized trials, unless study authors provided information about concealment procedures. Only four studies (11%) provided sufficient information to rate studies as low risk of bias on allocation concealment (Bluth et al., 2015; Flook et al., 2015; Haden et al., 2014; Noggle et al., 2012).

4.3.2 Performance and detection bias

For the types of interventions in this study, it is not typical, nor often practical, to blind study participants or personnel. Therefore, as we expected, most of the studies in this review were rated high risk for performance bias. Only one study reported that participants and study and school staff were blinded to program allocation (Sibinga et al., 2013), the remaining studies were rated as high risk (86%) or unclear risk (11%). For detection bias, expecting assessors to be blinded to condition is possible and a reasonable expectation for these study designs. We rated studies as low risk of bias if they reported blinding of outcome assessors or used only self-report measures. Overall, 60% of the included studies were rated as low risk of detection bias either because outcome assessors were blinded (n = 2) or studies used solely self-report questionnaires (n = 19).

4.3.3 Attrition bias

Most of the studies in this review were rated as low risk of attrition bias (74%). Four were rates as unclear risk, primarily because it was unclear what the analytic sample size was for the analyses or they were not clear on the initial sample size and thus we could not adequately calculate attrition. Five studies were rated at high risk of bias because their overall attrition rate was greater than 20% or there was high differential attrition between groups and the authors did not use any analytic approaches to impute missing data.

4.3.4 Reporting bias

We were not able to locate a study protocol for any of the included studies; therefore, we judged most of the included studies to be at unclear risk of selective reporting bias. Because we don't have study protocols for the studies included in this review to compare what they had planned to measure to what they actually reported, it is uncertain whether these studies reported results for all outcomes they actually measured. One study mentioned the use of a study protocol (Schonert-Reichl et al., 2015), but no other information regarding the publishing of the protocol was provided and it could not be located. It must also be noted that several studies reported data for subscales of measures rather than reporting data for the full measure or all of the other subscale scores. Thus, it is unclear whether the a priori intentions of these authors were to only use certain subscales or if the participants did complete the full measure and the study authors only reported data for the subscale only.

Because some studies were not included in the meta-analysis due to not reporting sufficient data to calculate an effect size, several studies that would have been rated as high risk due to not providing sufficient data to calculate an effect size were not included in the meta-analysis.

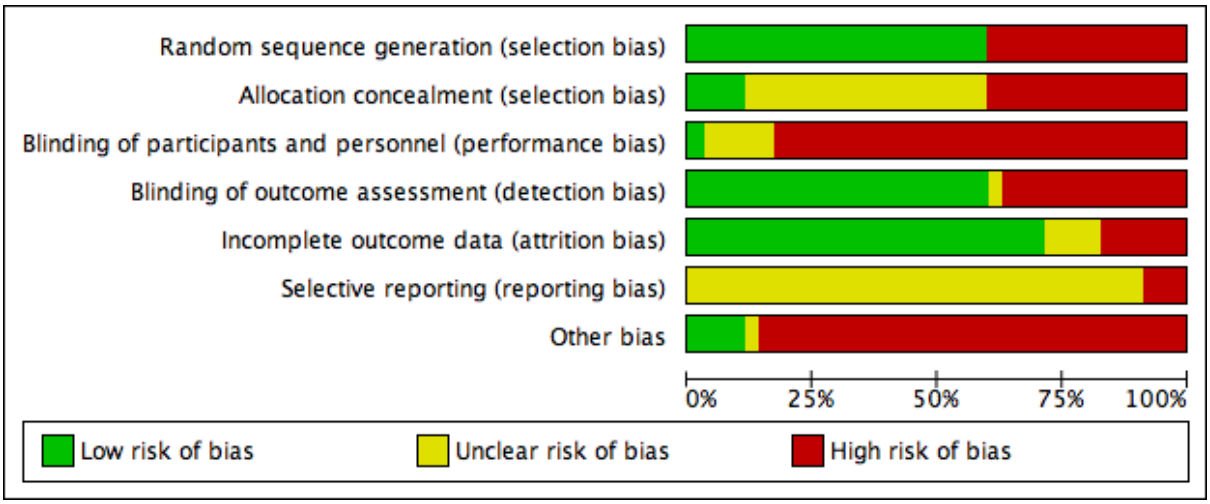
4.3.5 Other biases

We coded for additional factors related to potential bias in this corpus of studies: researcher allegiance bias, funding source bias, and confounding factors. Coding for allegiance bias and funding source bias was challenging, as study authors were often not explicit about their role or relationship in the study development or implementation and rarely acknowledged conflicts of interest. Of the 35 studies included in the meta-analysis, we were able to clearly identify an author role in the development, adaptation, and/or delivery of the intervention in 19 (54%) of the studies, one study in which an author had some affiliation with the organization delivering the intervention and another study in which one author was employed at the school where the intervention was delivered. In all other studies, it was unclear whether the author was independent or just did not report their involvement. We conducted sensitivity analyses to examine researcher involvement on magnitude of effect size. Larger effects were found in studies with researcher involvement compared to those with no researcher involvement on behavioral outcomes but smaller effects were found in studies with researcher involvement on socioemotional, academic, and cognitive outcomes, although the differences between groups were not statistically significant for any outcome.

In terms of the funding source, most authors either did not report the funding source or the studies were not funded. In four of the studies (11%), the authors identified a funding source that was also an entity involved in the development or the delivery of the intervention.

We also examined whether there were confounding factors with either the treatment or comparison groups. Specifically, we examined whether there was one unit (e.g., teacher, classroom, school) in one or both conditions. When the treatment or comparison condition is confounded in this way, it is impossible to distinguish between the effect of that unit and the effect of the intervention and thus unobserved factors may be contributing to the outcome. Fourteen studies (40%) were assessed as having a confound at the level of the instructor (n = 7; only one instructor in treatment, control or both conditions) or at the school/classroom level (n = 7; one classroom or school at the treatment, control or both conditions). A larger mean effect was observed on all outcomes for studies in which a confound was present compared to those without confounds, thus likely upwardly biasing results; however, the differences in magnitude of effect between studies with and without confounds was not statistically significant.

Figure 4.3: Risk of bias across studies



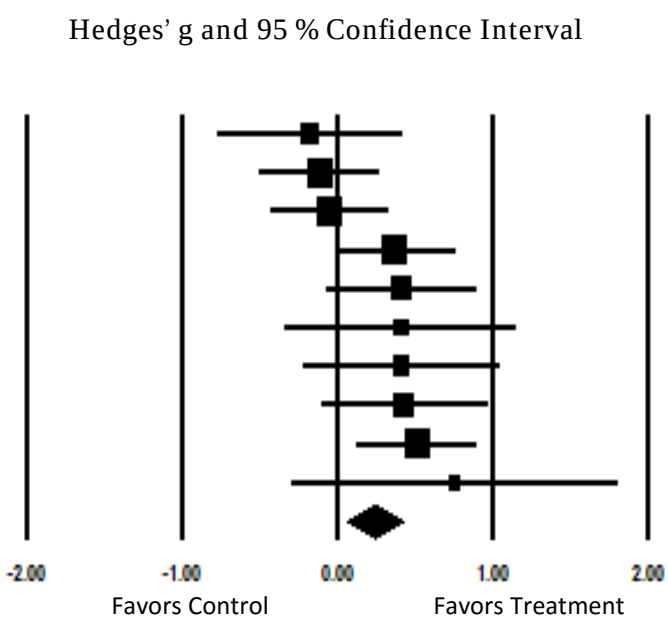
4.4 SYNTHESIS OF RESULTS

4.4.1 Mean effects on cognitive outcomes

Twenty effect sizes from 10 studies were synthesized to examine effects on cognitive outcomes. Results indicate that the overall mean effect (Hedges' *g*) at post-test on cognitive measures was 0.25 (95% CI [0.06, 0.43], p = .01). Heterogeneity analysis indicated a low amount of heterogeneity (I^2 = 25%) that was not statistically significant (Q = 12.10, p = .21). The mean effect size and confidence intervals for each study are shown in the forest plot in Figure 4.4 below. See Appendix 8.8 for a full list of all measures of cognitive outcomes included in this meta-analysis by study.

Figure 4.4: Forest plot of mean effects on cognitive outcomes

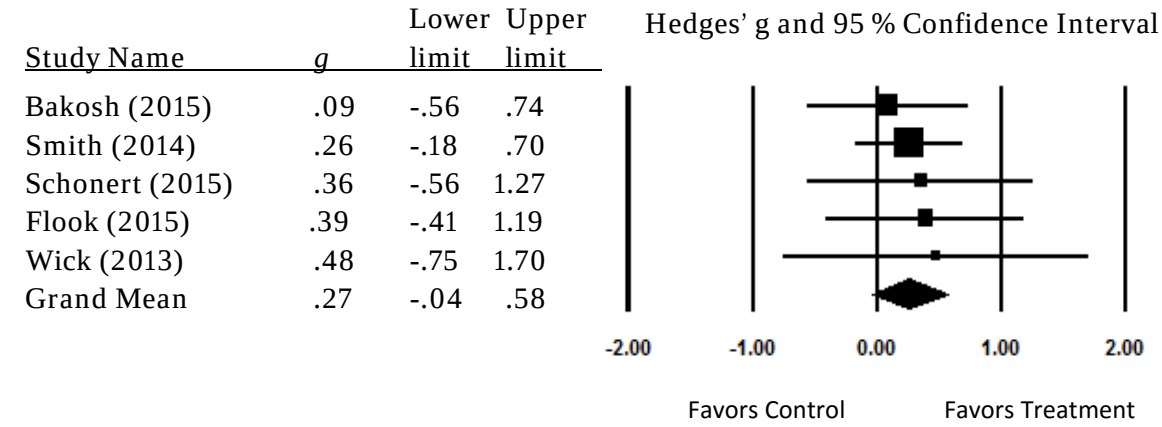
Study Name	*g*	Lower limit	Upper limit
Flook (2015)	-.17	-.78	.43
Britton (2014)	-.11	-.50	.23
Powell (2008)	-.05	-.42	.33
Quach (2014)	.38	-.01	.76
Flook (2010)	.41	-.08	.90
Schonert (2015)	.41	-.33	1.15
Chukwu (2015)	.42	-.22	1.05
Bergen-Cico (2015)	.43	-.10	.97
Parker (2014)	.52	.12	.91
Razza (2015)	.76	-.30	1.82
Grand Mean	.25	.06	.43



4.4.2 Mean effects on academic outcomes

Fifteen effect sizes from five studies were synthesized to examine effects on academic outcomes. Results indicate that the overall mean effect (Hedges' *g*) at post-test on academic outcomes was 0.27 (95% CI [-0.04, 0.57], $p = .08$.). Heterogeneity was not significant ($I^2 = 0\%$; $Tau^2 = .00$ $Q = 0.52$, $p = .97$). The mean effect size and confidence intervals for each study are shown in the forest plot in Figure 4.5 below. See Appendix 8.9 for a full list of all measures included in this meta-analysis by study.

Figure 4.5: Forest plot of mean effects on adademic outcomes



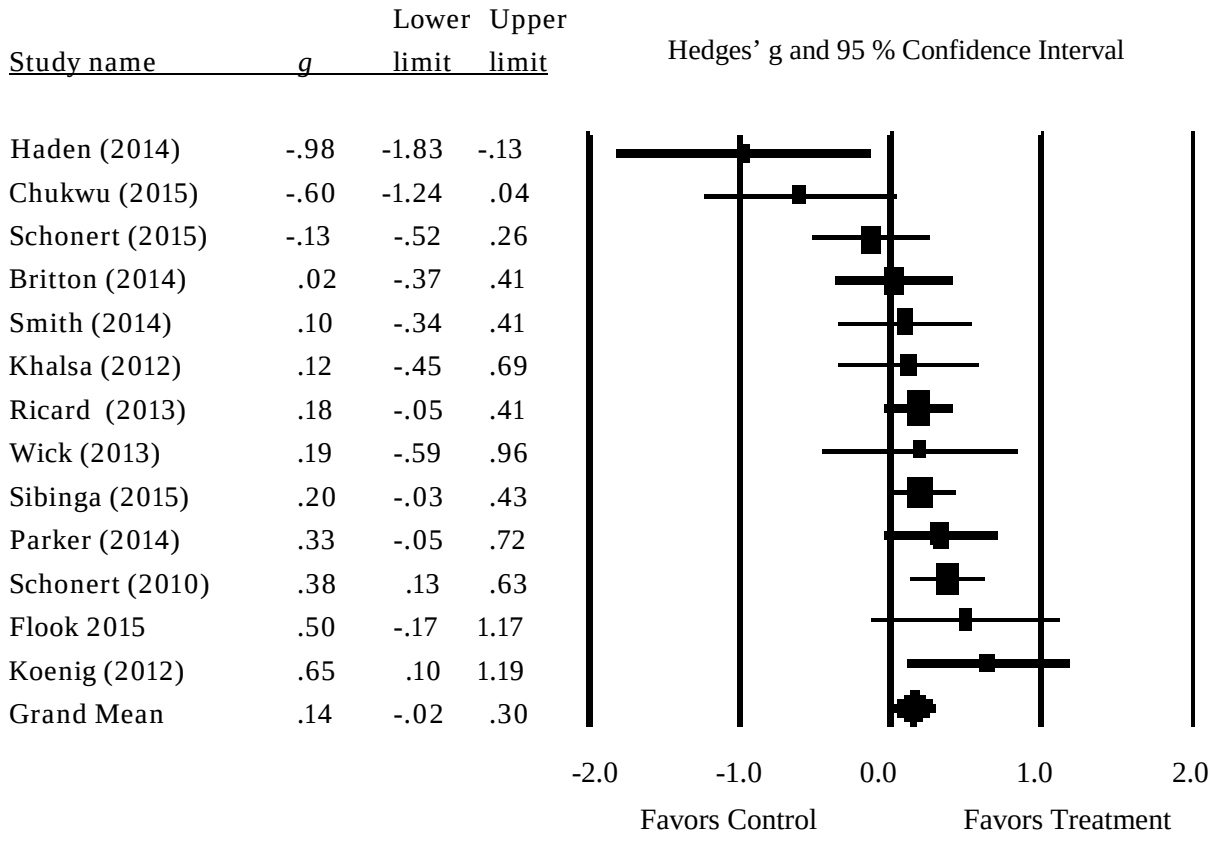
4.4.3 Mean effects on behavioral outcomes

Twenty-eight effect sizes from 13 studies were synthesized to examine effects on behavioral outcomes. Results indicate that the overall mean effect (Hedges' *g*) at post-test on behavioral outcomes was 0.14 (95% CI [-0.02, 0.30], $p = .08$). It is important to note that there was a moderate amount of heterogeneity ($I^2 = 48\%$; $T^2 = .034$; $Q = 22.96$, $p = .03$). The mean effect size and confidence intervals for each study are shown in the forest plot in Figure 4.6 below. See Appendix 8.10 for a full list of all measures included in this meta-analysis by study.

4.4.3.1 Moderator analysis for behavioral outcomes

We conducted moderator analyses to examine whether study or intervention characteristics could explain the variation observed across studies. None of the moderators examined were statistically significant: study type ($Q_b = 3.51$; $p = .06$), provider ($Q_b = 0.71$; $p = .40$), homework ($Q_b = 0.28$; $p = .60$), manualized program ($Q_b = 7.27$; $p = .06$), number of weeks ($Q = .003$; $p = .97$).

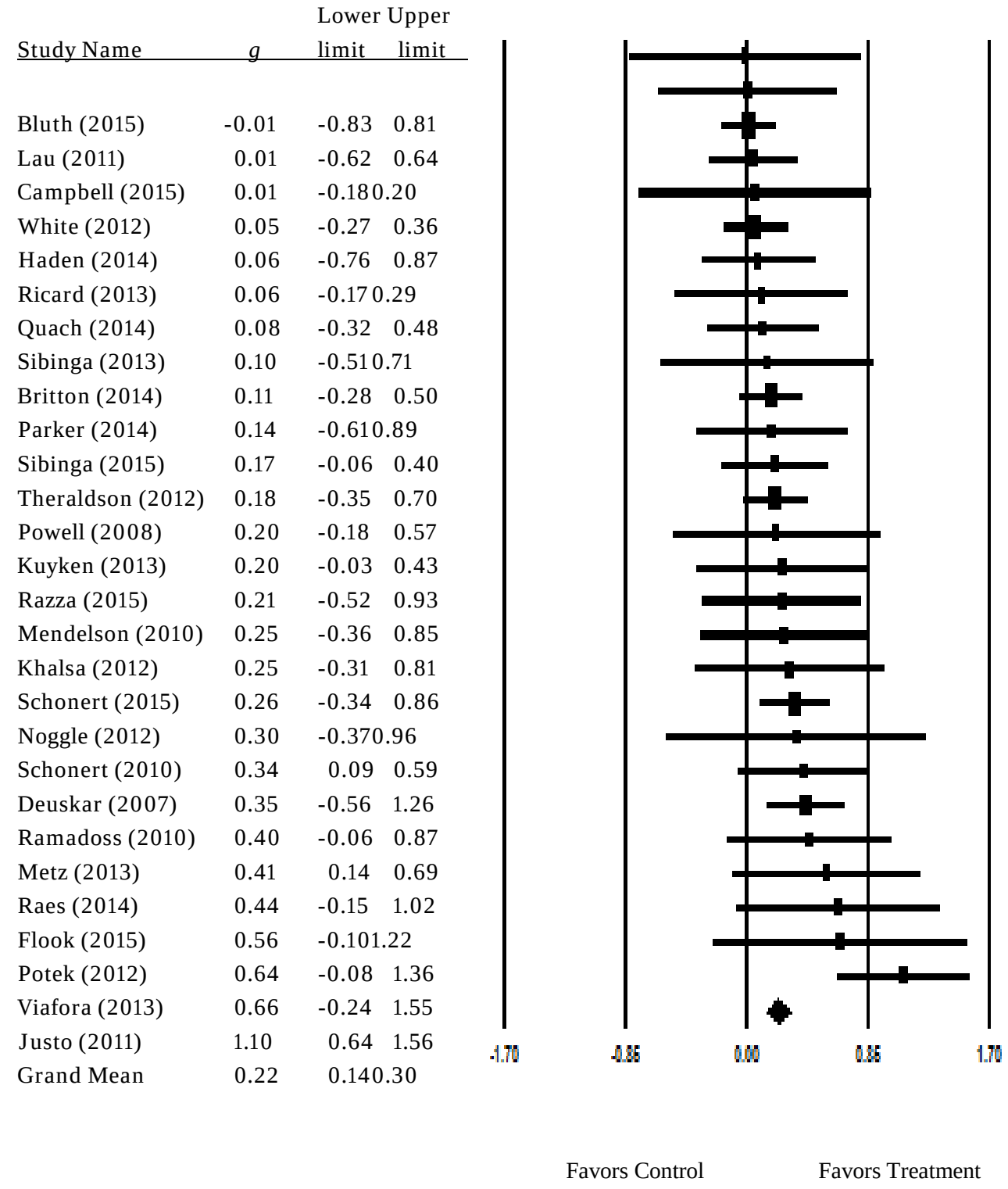
Figure 4.6: Forest plot of mean effects on behavioral outcomes



4.4.4 Mean effects on socioemotional outcomes

One hundred sixty-eight effect sizes from 28 studies were synthesized to examine effects on socioemotional outcomes. Results indicate that the overall mean effect (Hedges' *g*) at post-test on socioemotional outcomes was 0.22 (95% CI [0.14, 0.30], $p < .001$). There was a small amount of heterogeneity ($I^2 = 14\%$; $Q = 31.20$, $p = .263$; $Tau^2 = .01$). The mean effect size and confidence intervals for each study are shown in the forest plot in Figure 4.7 below. See Appendix 8.11 for a full list of all measures included in this meta-analysis by study.

Figure 4.7: Forest plot of mean effects on socioemotional outcomes



4.4.5 Physiological outcomes

Six studies measured physiological factor in their study; three of those studies were conducted by the same author team (Barnes et al., 2004; Barnes et al., 2008; Gregoski et al., 2011). Two studies measured cortisol; one study measured cortisol at three time points during the day (AM, pre-lunch, and afternoon; Shonert-Reichl, 2015) while the other study measured total cortisol output (Sibinga et al., 2013). One study measured sleep (Sibinga et al., 2013), two studies measured sodium excretion rates (Barnes et al., 2008; Gregoski et al., 2011) and three studies measured systolic and diastolic blood pressure and heart rate (Barnes et al., 2004; Barnes et al., 2008; Gregoski et al., 2011). Due to the nature of these measures, the time dependency of some of these measures (cannot compare AM cortisol to PM cortisol for example), and that so few studies measured these outcomes, quantitatively synthesizing these outcomes across these studies was not warranted.

4.5 PUBLICATION BIAS

There was a sufficient number of studies to examine publication bias for cognitive, behavioral and socioemotional outcomes using funnel plots (see Figure 8.12 in Appendix) and for socioemotional outcomes using Egger's linear regression approach (a minimum of 17 studies is recommended; Card, 2012). In examining the funnel plot for behavioral outcomes, the funnel plot appears relatively symmetrical, but the funnel plot for cognitive and socioemotional outcomes appears to be somewhat asymmeterical, with a larger number of studies clustering on the right side of the funnel. Results of Egger's regression for socioemotional outcomes was not significant (t = 1.76, p = .09), indicating an absence of publication bias in the studies contributing effect sizes for socioemotional outcomes. The funnel plot for cognitive outcomes, however, is less symmetrical, and few small sample studies with small effects were observed, indicating the possibility of publication bias.

5 Discussion

5.1 SUMMARY OF MAIN RESULTS

The present review identified a total of 61 studies that met review criteria, including 44 randomized or quasi-experimental studies and an additional 17 studies that used a single-group pre-posttest design or single subject study design to examine effects of a school-based mindfulness intervention on a cognitive, academic, behavioral, socioemotional or physiological outcome. It is interesting to note that we observed an increase in the number of MBI studies over time, as a higher proportion of the included studies were published more recently. Of the included studies, 35 provided adequate effect size data to be included in a meta-analysis for at least one of the outcomes of interest for this review. Results indicate mixed results of school-based mindfulness interventions across the outcomes of interest in this review, with small positive effects observed on cognitive and socioemotional outcomes and positive, yet non-significant effects on academic and behavioral outcomes. The lack of heterogeneity for all outcomes with the exception of the behavioral outcomes indicate that the interventions in this review, although quite diverse in their characteristics, produced similar results across studies on cognitive, socioemotional and academic outcomes. These findings provide some support for the use of school-based mindfulness interventions for some outcomes, but do not provide overwhelming support of mindfulness interventions as being the panacea as some have advocated. Given the quality and high risk of bias across studies in several areas, caution must be used in the interpretation of the study results.

First, the results of this review largely correspond to what we would expect given the mechanisms by which mindfulness interventions are hypothesized to work. The proximal processes targeted by mindfulness interventions are cognitive processes, which are then hypothesized to impact more distal outcomes—academic, behavioral, and socioemotional outcomes. Our results provide support for favorable impacts of mindfulness interventions on those processes that are likely more directly targeted by mindfulness interventions, namely cognitive outcomes. Socioemotional outcomes may be a more proximal target as well as many of the measures were linked to emotional regulation processes that are invoked in mindfulness training. There is no direct support, at least not at posttest, to indicate that more distal outcomes, such as behavior and academic achievement, which are hypothesized to be impacted through improved cognitive and socioemotional outcomes, are affected by MBIs. It could also be that the effects found for cognitive and socioemotional outcomes may be due to the type of self-report measures typically used to measure these types of outcomes versus the administrative measures used to measure academic outcomes and observational measures to measure behavioral outcomes.

The mixed effects found in this review could be due to several possible explanations. First, as alluded to above, mindfulness interventions are most directly targeting cognitive and psychological/socioemotional processes. Thus, we expected that we would be more likely to find positive effects on those outcomes than behavioral or academic outcomes, which are arguably more distal outcomes. Mindfulness interventions may not be powerful enough to affect cognitive and socioemotional process sufficiently to mediate academic or behavioral outcomes as hypothesized by proponents of MBIs. Alternatively, since the vast majority of participants were not clinical or special needs populations, and were likely functioning within normal ranges across these measures (and thus have less opportunity to improve greatly), there may have been less opportunity for substantial improvement in the populations being studied, and thus small effects observed. Using mindfulness based interventions as a universal intervention with those already in normal ranges on cognitive, socioemotional and behavioral measures may be unnecessary, or perhaps measures need to be more sensitive to smaller changes to find effects when testing MBIs as a universal prevention strategy. It could also be that MBIs may have greater impact with students who are experiencing clinical, or high levels of, distress, anxiety or stress and could then have a greater impact on behavioral and academic outcomes. These issues require further exploration- examining differential impacts of MBIs with clinical versus non-clinical populations could provide some needed nuance to the MBI effectiveness literature.

The MBIs in this review were also shorter-term interventions. It is possible that MBIs may have a greater impact with greater dosage over longer durations. A number of authors and proponents of MBIs often cite the short duration as a limitation in observing effects of mindfulness on various outcomes (Carmody, & Baer, 2008; Carson, Carson, Gil, & Baucom, 2004; Chiesa, Calati, & Serretti, 2011; Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010), and some studies indicate that a longer duration would have greater effects (Mathew, Whitford, Kenny, & Denson, 2010; Miller, Fletcher, & Kabat-Zinn, 1995). Also, we examined effects of interventions at posttest, thus we are unsure what the longer-term effects of MBIs on proximal and distal outcomes. Academic outcomes are often more difficult to change immediately, and given that the studies in this review measured grades, it may take a longer measurement period to see meaningful change in grades, as well as the other outcomes of interest.

5.2 QUALITY OF THE EVIDENCE

The quality of the evidence varied, with some important risks of bias present across a large proportion of studies which threatens the internal validity of the included studies and is cause for caution in interpreting the results of this review. Overall, a large proportion of included studies presented with a high risk of bias related to allocation concealment and performance bias. In most studies, reporting bias was rated as unclear risk of bias, which is problematic as reporting bias is a potential threat and we could not adequately assess it in this body of literature. Publication bias may also be present in this literature, as some funnel plots were asymmetrical, thus indicating potential for publication bias on at least some of the outcomes. A large proportion of the studies included in this review were conducted by researchers who were likely invested in the programs (involved in development or implementation) and had tacit knowledge of the interventions, and participants and personnel were not blinded in the majority of the studies- thus we are concerned

that this body of evidence is biased in favor of the MBIs due to allegiance and experimenter expectancy effects. In examining the results of the meta-analyses, the confidence intervals were fairly wide, with the exception of socioemotional outcomes, which were much narrower. This is reasonable in that we had a much larger number of studies and low heterogeneity across studies included in the meta-analysis for socioemotional outcomes. Thus, we can be more confident in the estimate of the average effect for socioemotional outcomes and less so in the average effect observed for cognitive, academic and behavioral outcomes. Also, a number of studies were confounded and, while the differences in mean effects were not significantly different for those studies that had a confound and those that did not, the magnitude of effects were larger in those that had a confound, and thus could be upwardly biasing the mean effect. Overall, there is room for improvement in the current evidence of effects of school-based mindfulness interventions.

5.3 LIMITATIONS AND POTENTIAL BIASES IN THE REVIEW PROCESS

We made every attempt to search for published studies; however, the majority of the studies included in this review were published journal articles, with approximately 20% being unpublished dissertations. Three of the databases were reviewed by only one of the authors, thus there may be a greater chance of errors in identifying potential studies from these three databases. The review authors did not use a formal method to assess the quality of the body of evidence; the authors did however assess risk of bias and reported on study characteristics that are indicators of study quality. There is some indication of publication bias present, which could be upwardly biasing the mean effect for all or some outcomes examined in this review.

5.4 AGREEMENTS AND DISAGREEMENTS WITH OTHER STUDIES OR REVIEWS

The findings of the present review largely correspond with other systematic reviews and meta-analyses of MBIs with children and youth. Narrative reviews, including those by Meiklejohn and colleagues (2012), Greenberg and Harris (2012), and Thompson and Gauntlett-Gilbert (2006) concluded that mindfulness-based approaches were feasible and promising, but cautioned that additional and more rigorous research was needed. Findings from a systematic review of 15 studies (6 between-group designs) of mindfulness-based approaches with children and adolescents (Burke, 2010) concluded that the studies provided evidence of the feasibility and acceptability of mindfulness-based approaches for children and adolescents, but the research base was limited by a lack of rigorous efficacy studies. Finally, two meta-analyses of MBIs with children and youth found positive and significant effects of MBIs on primarily psychological outcomes. Zoogman et al., (2014) reported a synthesis of studies examining mindfulness meditation with youth across outcomes, including psychological and non-psychological symptoms (specific outcomes are not reported). The search was conducted in 2011 and was limited to peer-reviewed journal articles published in English. Twenty studies (13 RCTs, 1 QED, and 6 within group pre-post test studies) were included in the review, yielding an overall mean effect of 0.227 [CI 0.148, 0.305], with lager mean effects found across studies using clinical samples compared to studies using non-clinical samples. Zenner and colleagues (2014) conducted a systematic review and meta-analysis of

mindfulness-based interventions in schools with a focus on psychological outcomes. The authors conducted a search in 2012 for published and unpublished reports yielding 24 studies (10 RCTs, 8 QEDs, 1 two-armed cohort study, and 5 non-controlled trials). The mean effect across all outcomes of the 16 studies using a comparison group design was g = 0.40 [0.21, 0.58], with significant heterogeneity between studies. In the current meta-analysis of socioemotional outcomes (the outcome category that most closely aligns with the Zoogman et al. and Zenner et al. reviews), the mean effect of 0.21 is similar to the mean effect of 0.227 estimated by Zoogman et al. and smaller than the mean effect estimated by Zenner et al. The differences in mean effects between the present review and Zoogman et al. could be due to the inclusion of different outcomes, studies and effect size estimation procedures. The present review provides the first synthesis of effects specifically on cognitive, academic and behavioral outcomes in addition to the socioemotional outcomes reported in prior reviews.

6 Authors' conclusions

6.1 IMPLICATIONS FOR PRACTICE AND POLICY

The number and types of MBIs being implemented in schools is expanding significantly, and intervention research is beginning to shed more light onto the effects and mechanisms of mindfulness interventions on a range of outcomes. Up to this point, much of the arguments and enthusiasm for the broad implementation of mindfulness-based approaches with children, as well as those in schools, have been predicated on generalizing the positive evidence from mindfulness research with adults and from expert opinion, or the use of cherry-picking studies in favor of MBIs to promote mindfulness interventions with children. This review adds to the body of evidence examining MBIs for children, and for the use of MBIs in school settings specifically. While the results of this review found positive effects favoring mindfulness interventions on cognitive and socioemotional outcomes, we urge caution in the use of these findings to support further implementation of MBIs in schools.

Schools often justify the implementation of socioemotional programs, including mindfulness-based training, on the premise that those programs will, in turn, promote positive behavior and improve academic achievement. The evidence to support MBIs to improve behavioral and academic outcomes, at least in the short-term, is not yet supported by the evidence. There is also seemingly widespread belief that MBIs, given the positive effects with adults, have great potential for direct and indirect benefits for students. Moreover, those who argue for an expansion of MBIs with children do not adequately, if at all, consider the costs or potential negative effects. Although rarely discussed and more rarely studied, adverse effects of mindfulness and meditation are gaining more attention, as Willoughby Britton, a mindfulness researcher at Brown, has begun to map and analyze accounts of harmful effects of contemplative practices, which include mindfulness and meditation (Rocha, 2014; Britton & Lindahl, 2015), through interviews with meditation teachers and practitioners from across a range of contemplative practice traditions. Some of her preliminary findings indicate that meditation can result in difficult or challenging experiences and cause or worsen symptoms. None of the studies included in this review measured potentially adverse outcomes, and if they didn't find positive effects, authors were more likely to provide justifications for why their intervention did not work rather than to consider that their intervention was not effective. There were exceptions to this, however. For example, Tharaldsen (2002) found that participants in their study experienced deterioration in life satisfaction and no improvement in psychological symptoms. They considered the possibility that their results "may be a result of an increased focus on troublesome emotions due to awareness training and a maladaptive use of distraction skills that lead to avoidance" and that "certain aspects of mindfulness can be more

confusing than beneficial to adolescents" (Tharaldsen, 2012, p. 120). Indeed, children and adolescents may not benefit from mindfulness-based interventions similarly to adults, and there may be some adverse effects, because children and adolescents may not be developmentally ready for the complex cognitive tasks, focus and level of awareness that mindfulness-based interventions require (Melbourne Academic Mindfulness Interest Group, 2006; Shapiro, 1992).

There are also direct and indirect costs in implementing these interventions, and the cost-benefit of mindfulness-based intervention is largely ignored. The direct costs of implementing mindfulness-based interventions are those that are obvious to the implementation of any intervention in schools, namely the cost of materials and personnel needed to implement the intervention. The included studies did not provide sufficient information to calculate the total cost of the interventions that schools would be responsible for if they were to adopt these interventions. Indirect costs, but nonetheless important, are opportunity costs, specifically the cost of lost instructional time or not implementing something else that could be more effective (Melbourne Academic Mindfulness Interest Group, 2006). Some of these interventions were very short in duration, in that they only took up a few minutes of the school day on a daily basis and thus resulted in little lost instructional time. However, other interventions used more class time, or even an entire class period. It is unclear if the small effects gained from these interventions on cognitive and socioemotional outcomes are worth the lost instructional time. If the primary focus of schools is to enhance academic outcomes, then using instructional time to provide a universal MBI may not be a good use of time, considering that we found a lack of evidence for significant effects on academic outcomes. However, there remains yet much we do not know about the effects of MBIs, specifically whether students near or in the clinical range of anxiety or other emotional disorders may benefit more than students in the general population of the school. Prior reviews found some evidence for greater effects with children and adolescents from clinical populations (Zoogman et al., 2014), and thus there may be some students for which MBIs may be worth the cost and time.

Overall, the evidence from this review urges caution in the enthusiasm for, and widespread adoption of, MBIs for children and youth—specifically for use in schools. While the evidence points to positive effects on socioemotional and cognitive outcomes, there is a lack of evidence of effects on academic and behavioral outcomes. Moreover, we know little about the costs and adverse effects of school-based mindfulness interventions. The costs of implementing these programs may not be justified, and there are some indications that MBIs may have some adverse effects on children and youth that have not received adequate attention. If schools do want to implement MBIs, we urge schools to evaluate the practice in a rigorous way and monitor outcomes and costs.

6.2 IMPLICATIONS FOR RESEARCH

The number of studies examining effects of MBIs have expanded considerably, particularly over just the past few years. Clearly, there is much interest in examining the effects of school-based mindfulness interventions. However, a large proportion of studies in this review were conducted by authors who clearly had some involvement in the development, adaptation, or delivery of the intervention and thus were not independent evaluators. Moreover, several of the studies were funded by bodies that had an interest in the success of the MBIs being evaluated. Overall, authors engaged in the evaluation of school-based mindfulness interventions appear to be largely biased in

favor of mindfulness interventions. This is problematic in that studies in which authors have some allegiance to the intervention or are otherwise involved in the development or implementation of the intervention are more likely to find positive effects than studies that are not conducted by authors with a vested interest in the outcomes of the interventions. The large proportion of studies in which authors had some role in the development and delivery of the interventions under investigation in this review may have biased the mean effect in favor of mindfulness interventions and overestimated the effects of these interventions. Moreover, the tacit knowledge that researchers who develop or implement the interventions they are testing may positively skew the outcomes in such a way that would not be replicable if someone with less knowledge or investment were implementing the intervention. It is recommended that future evaluations of MBIs be conducted by an independent third party investigator, and when possible, that personnel and assessors be blinded to group assignment.

Also, a significant number of studies in this review had major and troublesome confounds that clearly limits the extent to which we can draw causal inferences from this body of research. For each outcome examined in this review, all studies with confounds were biased in favor of the treatment group, thus resulting in an upward bias of the mean effect across studies. Future studies should avoid confounds in their study designs.

Other important areas in which to further develop school-based mindfulness intervention research is to move beyond mean effects of interventions and begin to explicitly examine the mechanisms of change (e.g., what are the pathways and mediators), which components of mindfulness interventions are effective and/or necessary (e.g., is home practice necessary and how much? Does yoga/movement enhance mindfulness practice), what works for whom and under what circumstances, and examine adverse effects of these interventions.

6.3 REFERENCES TO INCLUDED STUDIES

References to studies that have supplemental reports are identified by coordinating superscript numbers. Primary articles are indicated by an A; secondary with a B.

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7 Information about this review

7.1 REVIEW AUTHORS

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7.2 ROLES AND RESPONSIBILITIES

Roles	Name(s)	Background, Skills, Areas of Expertise
Content	Maynard Miller Solis	Brandy Maynard and Veronica Miller will be responsible for the substantive content related to mindfulness. Maynard has been trained in and implemented Dialectical Behavior Therapy and Miller also has been trained in and regularly practices mindfulness techniques. Solis will provide content area expertise related to educational research and outcomes.

Systematic Review Methods	Maynard Solis	Brandy Maynard and Michael Solis have significant experience and expertise in systematic review methods. Both Maynard and Solis have completed and published multiple systematic reviews/research syntheses. In addition, Maynard has been trained in Campbell methods and is actively involved in Campbell – she has produced two Campbell reviews and is co-author on two additional reviews, is an editorial board member of the ECG, is a Campbell methods trainer, and has been elected as co-chair of the social welfare group. Solis also participated in two days of Campbell methods training at the 2013 C2 Colloquium.
Statistical Analysis	Maynard Solis	Brandy Maynard will be responsible for statistical analysis. Maynard has been trained in meta-analytic techniques, and Maynard, Solis, and Miller have conducted several meta-analyses.
Information Retrieval	Maynard Solis Miller	Maynard, Solis, and Miller are experienced in information retrieval. Maynard and Miller will also consult with information retrieval specialists within their institutions in the planning and execution of the search strategy. Dollars have also been budgeted to consult and procure services from an information retrieval specialist to search specialized, foreign databases to which the review team does not have experience or access.

7.3 SOURCES OF SUPPORT

We would like to thank the Campbell Collaboration Education Coordinating Group for providing financial support for this review. We would like to thank Jane Dennis for assisting with conducting database searches and Anne Farina for translating Spanish articles.

7.4 DECLARATIONS OF INTEREST

The authors declare no conflicts of interest.

7.5 PLANS FOR UPDATING THE REVIEW

This review will be updated in approximately three to five years by Brandy R. Maynard.

7.6 AUTHOR DECLARATION

Authors' responsibilities

By completing this form, you accept responsibility for maintaining the review in light of new evidence, comments and criticisms, and other developments, and updating the review at least once every five years, or, if requested, transferring responsibility for maintaining the review to others as agreed with the Coordinating Group. If an update is not submitted according to agreed plans, or if we are unable to contact you for an extended period, the relevant Coordinating Group has the right to propose the update to alternative authors.

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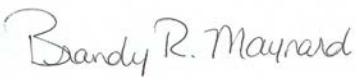
Form completed by:  **Date: 3/4/16**

8 Appendix

8.1 DOCUMENTATION OF SEARCH STRATEGIES IN ELECTRONIC DATABASES

Database (host)	Date Searched	Country	Strategy
Academic search Complete (EBSCO)	May 2015	US	(1) Intervention: mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR “Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”) AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR “control group” OR “controlled trial” OR “quasi-experiment*” OR random*) AND (“elementary school” OR “primary school” OR “high school” OR “secondary school” OR “middle school” OR kindergarten OR pre-kindergarten)
Australian Education Index (EBSCO)	May 2015	Australia	(mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR “Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”) AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR “control group” OR “controlled trial” OR “quasi-experiment*” OR random*) AND (“elementary school” OR “primary school” OR “high school” OR “secondary school” OR “middle school” OR kindergarten OR pre-kindergarten)
British Education Index (EBSCO)	May 2015	UK	(mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR

			“Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”) AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR “control group” OR “controlled trial” OR “quasi-experiment*” OR random*)
CBCA Education (ProQuest)	June 2013	Canada	(mindful* OR meditat* OR yoga OR "breath* technique" OR "mindfulness based stress reduction" OR MBSR OR "Mindfulness-based cognitive therapy" OR MBCT OR "learning to breathe" OR MindUP OR "Meditation on the Soles of the Feet" OR "non-judgmental awareness" OR "present-moment") AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR "control group" OR "controlled trial" OR "quasi-experiment*" OR random*) AND ("elementary school" OR "primary school" OR "high school" OR "secondary school" OR "middle school" OR kindergarten OR pre-kindergarten)
ERIC (EBSCO)	May 2015	US	(mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR “Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”) AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR “control group” OR “controlled trial” OR “quasi-experiment*” OR random*) AND (“elementary school” OR “primary school” OR “high school” OR “secondary school” OR “middle school” OR kindergarten OR pre-kindergarten)
MEDLINE (EBSCO)	May 2015	US	(mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR “Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”) AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR “control group” OR “controlled trial” OR “quasi-experiment*” OR random*) AND (“elementary school” OR “primary school” OR “high school” OR “secondary school” OR “middle school” OR kindergarten OR pre-kindergarten)
ProQuest Dissertation and Theses (ProQuest	May 2015	US	ab(mindful* OR meditat* OR yoga OR "breath* technique" OR "mindfulness based stress reduction" OR MBSR OR "Mindfulness-based cognitive therapy" OR MBCT OR "learning to breathe" OR

			MindUP OR "Meditation on the Soles of the Feet" OR "non-judgmental awareness" OR "present-moment") AND ab(evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR "control group" OR "controlled trial" OR "quasi-experiment*" OR random*) AND ab(: "elementary school" OR "primary school" OR "high school" OR "secondary school" OR "middle school" OR kindergarten OR pre-kindergarten) AND pd(>19901231)
PsychINFO (EBSCO)	May 2015	US	(mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR “Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”) AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR “control group” OR “controlled trial” OR “quasi-experiment*” OR random*) AND (“elementary school” OR “primary school” OR “high school” OR “secondary school” OR “middle school” OR kindergarten OR pre-kindergarten)
Social Science Citation Index (Web of Science)	May 2015	US	(mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR “Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”)
Social Services Abstracts (ProQuest)	May 2015	US	(mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR “Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”) *AND* TOPIC**:** (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR “control group” OR “controlled trial” OR “quasi-experiment*” OR random*) *AND* TOPIC**:** (“elementary school” OR “primary school” OR “high school” OR “secondary school” OR “middle school” OR kindergarten OR pre-kindergarten)
Sociological Abstracts (EBSCO)	May 2015	US	(mindful* OR meditat* OR yoga OR "breath* technique" OR "mindfulness based stress reduction" OR MBSR OR "Mindfulness-based cognitive therapy" OR MBCT OR "learning to breathe" OR MindUP OR "Meditation on the Soles of the Feet" OR "non-judgmental awareness" OR "present-moment") AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR

			"control group" OR "controlled trial" OR "quasi-experiment*" OR random*) AND ("elementary school" OR "primary school" OR "high school" OR "secondary school" OR "middle school" OR kindergarten OR pre-kindergarten)
SPORTDiscus	May 2015	US	(mindful* OR meditat* OR yoga OR “breath* technique” OR “mindfulness based stress reduction” OR MBSR OR “Mindfulness-based cognitive therapy” OR MBCT OR “learning to breathe” OR MindUP OR “Meditation on the Soles of the Feet” OR “non-judgmental awareness” OR “present-moment”) AND (evaluation OR intervention OR treatment OR outcome OR program OR trial OR experiment OR “control group” OR “controlled trial” OR “quasi-experiment*” OR random*) AND (“elementary school” OR “primary school” OR “high school” OR “secondary school” OR “middle school” OR kindergarten OR pre-kindergarten)

Note: search dates for all searches were limited from 1990 to present unless otherwise noted

8.2 DATA EXTRACTION FORM

Mindfulness-Based Interventions for Improving Academic Achievement, Behavior, and Socio-Emotional Functioning of Primary and Secondary Students
Screening Form

1. Study ID#: __ __ __ [STID]

2. Date of Screening: __ __- __ __- __ __ __ __ [SCDATE]

3. Primary Author: _____ [AUTH]

4. Bibliographic info (APA format): [BIB]

5. Is this study a: [STYPE]
   - ❑ 1. RCT
   - ❑ 2. QED
   - ❑ 3. Single subject design
   - ❑ 4. Single group pre-post design
   - ❑ 5. None of the above- IF CHECKED THEN STOP

6. Is this a study of a school-based intervention for children/youth (PK-12)? [PART]
   - ❑ 0. No- STOP
   - ❑ 1. Yes
   - ❑ 2. Unsure

7. Is this study examining effects of a mindfulness-based intervention as defined in the protocol? [INT2]
   - ❑ 0. No- STOP
   - ❑ 1. Yes
   - ❑ 2. Unsure

8. Does this study report at least one of the following outcomes: cognition, academic performance, behavior, socio-emotional functioning? [OUTCOME]
   - ❑ 0. No- STOP
   - ❑ 1. Yes

9. Is this study eligible for the review? [ELIG]
   - ❑ 0. No: Reason _____
   - ❑ 1. Yes
   - ❑ 2. Need more information to make decision

10. Notes/Comments [SNOTE]

Mindfulness-Based Interventions Review

Data Coding Form

Study ID#: _____ Coder: _____ Date of coding: _____

Section A – Source Descriptors

A1. Report Type [rtype]

- ❑ 1. Journal Article
- ❑ 2. Book/book chapter
- ❑ 3. Gov't report (local, state, federal)
- ❑ 4. Conference proceedings
- ❑ 5. Thesis or Dissertation
- ❑ 6. Unpub report (non-gov't, tech report)
- ❑ 7. Other (specify): _____
- ❑ 5. Expert Referral

A2. Country [country]

- ❑ 1. USA
- ❑ 2. Canada
- ❑ 3. Australia
- ❑ 4. Europe
- ❑ 5. Asia
- ❑ 6. Other (specify): _____

A3. Language if other than English _____ [lang]

Section B1—Group Design (RCT, QED, SGPP)
Study Methods, Quality and Risk of Bias

B1.1. Method of assignment to condition(s) [grp_assign]

- ❑ 1. Random, simple
- ❑ 2. Random, after matching, stratification, blocking, etc.
- ❑ 3. Quasi-random-assigned by some naturally occurring process
- ❑ 4. Matched or statistically SGPP study
- ❑ 5. N/A- SGPP study
- ❑ 99. Not specified / not enough information to determine

B1.2. Unit of assignment to conditions [txassign]

- ❑ 1. Individual participant
- ❑ 2. Group/Cluster: specify _____
- ❑ 3. Other: _____
- ❑ 4. N/A- SGPP study
- ❑ 99. Not enough information to determine

B1.3. How was random assignment performed: [random]

- ❑ 1. Computer generated
- ❑ 2. Random numbers table
- ❑ 3. Coin toss/dice/shuffling
- ❑ 4. Not reported
- ❑ 5. Unclear description
- ❑ 6. N/A-No random assignment

B1.4. What method was used to conceal allocation sequence? [alloc]

- ❑ 1. Sealed number/coded envelope
- ❑ 2. Other
- ❑ 3. No concealment
- ❑ 4. Not reported
- ❑ 5. Unclear description
- ❑ 6. N/A- No random assignment

B1.5. Were the outcome assessors blinded? [blind]

- ❑ 0. No
- ❑ 1. Yes

B1.6. Were participants blinded to condition? [blindpart]

- ❑ 0. No
- ❑ 1. Yes

B1.7. Did the study have high attrition (for RCT/QED, exceeds WWC attrition criteria; for SGPP, > 20%)? [grp_attrit]

- ❑ 1. Yes
- ❑ 2. No
- ❑ 99. Not enough information to calculate

B1.8. If matching was used, how were groups matched? [grp_match]

- ❑ 1. Matched on pretest measure
- ❑ 2. Matched on demographics
- ❑ 3. Matched on both of the above
- ❑ 4. Propensity Score Matching
- ❑ 5. Other matching technique: _____
- ❑ 6. N/A- SGPP study
- ❑ 7. Not enough information to determine

B1.9. Results of statistical comparisons of pretest differences [grp_pre]

- ❑ 1. No comparisons made
- ❑ 2. No statistically significant differences
- ❑ 3. Significant differences judged unimportant by coder
- ❑ 4. Significant differences judged of uncertain importance by coder
- ❑ 5. Significant differences judged important by coder
- ❑ 6. N/A- SGPP study

B1.10. If groups were non-equivalent at baseline, were statistical controls used? [grp_ctrl]

- ❑ 1. Yes
- ❑ 2. No
- ❑ 3. N/A- SGPP study

Section B2—Multiple Group (RCT, QED)
Dependent Variables and Effect Size Information

Continuous outcomes

Construct ID	*Outcome*	*Measure*	*Valid ?*	*Source (participant, clinician, parent)*	*Timing (end of treatment, 3 month, etc.)*	*Tx analytic sample size*	*Control group analytic sample size*	Intervention group Baseline Mean (SD)	Intervention group Post Mean (SD)	Control group Baseline Mean (SD)	Control group Post Mean (SD)	Values for t, F, other

Note: Construct ID- 1= Cognitive; 2= Academic performance; 3= Behavior; 4= Socio-emotional

Dichotomous outcomes

Construct ID	*Outcome*	*Measure*	*Valid ?*	*Source (participant, clinician, parent)*	*Timing of measurement (end of treatment, 3 month, etc.)*	*Tx analytic sample size*	*Control group analytic sample size*	Intervention group % successful	Intervention group % not successful	Control group % successful	Control group % not successful	Values for statistical tests (i.e. chi-square)

Note: Construct ID- 1= Cognitive; 2= Academic performance; 3= Behavior; 4= Socio-emotional

Section C—Single Subject (SSD)
Study Methods and Quality Determination

C1. SSD study design [ssd_design]

- ❑ 1. Alternating treatments
- ❑ 2. Multiple baseline
- ❑ 3. Withdrawal design
- ❑ 4. Other: _____

C2. The outcomes were measured by more than one assessor [ssd_assess]

- ❑ 1. Yes, number of assessors_____
- ❑ 2. No
- ❑ 99. Not specified

C3. The assessors collected interrater agreement in each phase for 20% of observations (Kappa). [ssd_20p]

- ❑ 1. Yes
- ❑ 2. No
- ❑ 99. Not specified

C4. Interrater reliability was =/> .80 for each phase. [ssd_rel]

- ❑ 1. Yes
- ❑ 2. No
- ❑ 99. Not specified

C5. The study included more than one phase. [ssd_phase]

- ❑ 1. Yes
- ❑ 2. No
- ❑ 99. Not specified

C6. Each phase included at least three observations [ssd_phobs]

- ❑ 1. Yes
- ❑ 2. No
- ❑ 99. Not specified

C7. The IV was systematically manipulated by the researcher(s) [ssd_ivman]

- ❑ 1. Yes
- ❑ 2. No
- ❑ 99. Not specified

Section D

Participants, Intervention Agents, and Setting Descriptors

D1. Mean Age of participants _____. [age]

D2. Grade level of participants [grd]

- ❑ 1. Elementary School (K-5)
- ❑ 2. Middle school (6-8)
- ❑ 3. High school (9-12)
- ❑ 4. Mixture of grade levels
- ❑ 99. Not enough information to determine

D3. Race/Ethnicity [raceth]

- ❑ 1. African American ___%
- ❑ 2. Asian American___%
- ❑ 3. European American ___%
- ❑ 4. Hispanic American___%
- ❑ 5. Other ___%
- ❑ 99. Not specified

D4. Sex [sex]

- ❑ Male___%

D5. Free or Reduced Lunch [frl]

- ❑ 1. Receiving ___%
- ❑ 2. Not Specified

D6. Type of students in sample [stype1]

- ❑ 1. Regular / non-clinical/ non- special ed
- ❑ 2. Clinical or Special Ed Population: Specify _____
- ❑ 99. Not specified

D7. If clinical/special ed sample, please specify: [stype2]

_____

D8. Type of School [schtyp]

- ❑ 1. Public
- ❑ 2. Private
- ❑ 3. Alternative
- ❑ 4. Charter
- ❑ 5. Other (specify): _____
- ❑ 99. Not specified

D9. Who provided the services? [intagt]

- ❑ 1. Non-School Master's or PhD clinician
- ❑ 2. School Clinician (Social Worker, Psychologist, Counselor)
- ❑ 3. Teacher
- ❑ 4. Other school personnel
- ❑ 5. Researchers
- ❑ 6. Multiple providers _____(list)
- ❑ 7. Other: _____(list)
- ❑ 99. Not specified

D10. Did the provider receive special training on the intervention? [tr_intagt]

- ❑ 1. Yes
- ❑ 2. No
- ❑ 99. Not Specified

Section E

Intervention Descriptors and Fidelity

E1. Name of intervention: _____ [name]

E2. Stated goal/purpose of the intervention: (check all that apply) [goal]

- ❑ 1. Cognitive performance
- ❑ 2. Academic Performance
- ❑ 3. Behavior
- ❑ 4. Socio-emotional functioning
- ❑ 5. Other _____
- ❑ 6. Not specified

E3. What mindfulness strategies characterize the intervention? [strategy]
(SELECT ALL THAT APPLY)

- ❑ 1. Present moment work
- ❑ 2. Meditation
- ❑ 3. Relaxation skills training
- ❑ 4. Breathing techniques/breath awareness
- ❑ 5. Awareness of moment
- ❑ 6. Mindfulness exercises
- ❑ 7. Body scan
- ❑ 8. Yoga
- ❑ 12. Other- specify: _____

E4. Was mindfulness the primary mechanism of interest in this study? [prim]

- ❑ 0. No
- ❑ 1. Yes
- ❑ 2. Unsure

E5. What non-mindfulness strategies were part of the intervention? [nonmind]
(SELECT ALL THAT APPLY)

- ❑ 0. None
- ❑ 1. Behavioral Strategies *(Interventions involve the use of various behavioral techniques, such as rewards, token economies, contingency contracts, and the like to replace or modify behavior)*
- ❑ 2. Cognitively-Oriented Programs (*Interventions focus on changing thinking processes or cognitive skill)*
- ❑ 3. Counseling, Talk Therapy (*These programs utilize traditional talk/psychotherapy techniques)*
- ❑ 4. Other (specify)_____

E6. Is this a manualized program (did researchers or implementers use a written manual, protocol or guide to implement the program/intervention)? [manual]

- ❑ 0. No
- ❑ 1. Yes
- ❑ 2. Unsure

E7. Role of the evaluator/author/research team or staff in the program. [arole]

- ❑ 1. Researcher delivered the treatment
- ❑ 2. Researcher involved in planning, designing, supervising, or managing the treatment
- ❑ 3. Researcher independent of treatment- research role only
- ❑ 4. Cannot tell

E8. Treatment Format: (SELECT ALL THAT APPLY) [format]

- ❑ 1. Individual (one-on-one)
- ❑ 2. Group
- ❑ 3. Individual & Group
- ❑ 4. Other: _____
- ❑ 5. Not enough information to determine

E9. Were parents involved in the intervention? [parent]

- ❑ 0. No
- ❑ 1. Yes: Describe parent involvement: _____
- ❑ 2. Unsure

E10. Were teachers involved in the intervention? [teacher]

- ❑ 0. No
- ❑ 1. Yes, as interventionist: Describe _____
- ❑ 2. Yes, as recipients: Describe _____
- ❑ 2. Unsure

E11. Length of treatment (# of weeks): _____ [length]

E12. Frequency of sessions (#per week) [freq]

E13. Total # of sessions: _____ [sessions]

E14. Total minutes of tx sessions_____ [hours]

E15. Minutes of mindfulness practice in sessions _____ [m-dose]

E16. How much at-home practice was expected? [hmwork]

Specify # of minutes _____

E17. Did the study measure fidelity? [fidel]

- ❑ 1. Yes
- ❑ 2. No

E18. How was fidelity assessed? [fidel_asses]

- ❑ 1. Researcher observations
- ❑ 2. Interviews of participants
- ❑ 3. Surveys of participants
- ❑ 4. Participant logs
- ❑ 5. Administrative records
- ❑ 6. Checklists
- ❑ 7. Other _____
- ❑ 99. Not specified

E19. Level of adherence to the tx: [fidel_ad]

- ❑ 1. Percent or Level _____
- ❑ 99. Not specified

Section F—Comparison Condition

F1. What did the control/comparison group receive? [compcond]

- ❑ 0. No comparison group
- ❑ 1. Nothing or wait list
- ❑ 2. "Treatment as usual": Specify _____
- ❑ 3. Specified treatment: Specify _____
- ❑ 4. Other: _____

8.3 CHARACTERISTICS OF INCLUDED STUDIES: RCT AND QED STUDIES

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Bakosh (2013-1)	NP	Inner Explorer	• Audio-guided mindfulness program based on MBSR developed by researcher • 10 minutes per day • Delivered via MP3 player and facilitated by the teacher.	US	RCT	177	2 (NR)	General population	Audio tape (recorded by MBSR trained instructors) played by Teachers	Regular education program
Bakosh (2013-2)	NP	Inner Explorer	• Audio-guided mindfulness program based on MBSR developed by researcher • 10 minutes per day • Delivered via MP3 player and facilitated by the teacher..	US	RCT	206	2 (NR)	General population	Audio tape (recorded by MBSR trained instructors) played by Teachers	Regular education program
Bakosh (2015)[1]	P	Mindfulness-based Socioemotional learning program	• Audio-guided mindfulness program based on MBSR developed by researcher • 10 minutes per day • Delivered via MP3 player and facilitated by the teacher.	US	QED	191	2 (NR)	General population	Audio tape (recorded by MBSR trained instructors) played by Teachers	Regular education program
Barnes (2004)	P	Meditation group	• A simple concentrative-type meditation technique that uses the breath as an object of focus and does not require changes in personal or spiritual beliefs. This is a beginner technique taught as Exercise 1 of the MBSR program. • 10-minute sessions at school and at home each day for 3 months and 20 minutes/week (average of 4 minutes/day) of direct	US	RCT	73	3 (12.3)	General population	Teacher	Health Education class

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			contact time with the instructor spent discussing issues related to meditation sessions (e.g., feelings and physical changes during meditation, how to improve meditation experiences, benefits, etc.).							
Barnes (2008)	P	Breathing Awareness Meditation (BAM)	• BAM involves focusing upon the moment, sustaining one's attention to the breathing process, and passively observing thoughts. This technique is taught as Exercise 1 of Mindfulness-based Stress Reduction Program. • 10-minute BAM sessions at school and at home each day for three months.	US	RCT	56	4 (15.2)	African American adolescents with high-normal systolic blood pressure levels	Teachers	Weekly 20 minute session on preventing high blood pressure using guidelines for adolescents
Bergen-Cico (2015)[1]	P	Mindful yoga	• Inspired by YogaKids, the mindful yoga intervention was designed to incorporate mindful yoga into the classroom. • Integrated into class routine three times per week for 4 minutes at the beginning of class.	US	RCT	142	3 (11.4)	General population	Teachers	Regular education program and didactic elements/discussion about mindfulness
Bluth (2015)[1]	P	Learning to BREATHE	• A mindfulness curriculum that has been created for an adolescent population. Based on themes and practices used in mindfulness based stress reduction, it uses developmentally appropriate hands-on	US	RCT	23	4 (17)	High risk students in an alternative high school	1st author who was a trained mindfulness instructor/practitioner	Evidence-based substance abuse class

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			activities and guided discussions to teach standard mindfulness skills, including the body scan, sitting meditation, lovingkindness practice, walking meditation, and mindful movement. • Implemented in 11 class sessions (approx. 360 minutes total).							
Britton (2014)[1]	P	Mindfulness Meditation	• Formulated according to Roth's Integrative Contemplative Pedagogy. The teacher led students in a short period of silent meditation at the beginning of the class period. Initial meditation periods lasted only 3 min, whereas the final meditation periods lasted as long as 12 min. Breath awareness and breath counting were taught for the first 2 weeks, followed by 1 week each devoted to labeling of body sensations; labeling of thoughts, and emotions; and body sweeps. During the final 2 weeks,	US	RCT	100	3 (11.8)	General population	Teachers	6 week curriculum on ancient African history

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			students were free to select from among the various techniques. • The intervention was implemented over 6 weeks. No home practice was reported.							
Broderick (2009)	P	Learning to BREATHE	• A mindfulness curriculum that has been created for an adolescent population. Based on themes and practices used in mindfulness based stress reduction, it uses developmentally appropriate hands-on activities and guided discussions to teach standard mindfulness skills, including the body scan, sitting meditation, lovingkindness practice, walking meditation, and mindful movement. Workbooks and CDs for home meditation were provided to students. • Sessions (ranging from 32 to 43 minutes in length) were delivered twice weekly during health class over five weeks for a total of 42 class sessions.	US	QED	121	4 (17.4- tx; 16.4- control)	Private catholic high school for girls	Primary researcher trained in mindfulness	Regular school curriculum
Campbell (2015)[1]	NP	.b	• Includes a range of mindfulness excercises. Includes an introduction to sitting mindful meditation practice, mindful body scans, mindful body activities relate to Tai Chi	US	QED	438[2]	4 (16)	General population	Trainers trained in the curriculum	Regular English class curriculum

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			and youga, mindfulness in the context of feelings, and mindfulness training exercises for specific situations. • Six-week mindfulness curriculum (traditionally an 8 week program with nine lessons)							
Chukwu (2015)/Desmond (2010)[1]	NP	Mindful Awareness Practices	• Included: 1) a preliminary group discussion of selected emotional, physical and social behavioral topics, 2) the practice of skills on MAP, including self-attention, concentration, planning and organization, and emotional control where the student focus shifts from external stimuli to internal awareness to sort out thoughts, emotions and physical behaviors in a non-reactive way; healthy breathing to promote slowing down and reflection; and physical movements with cognitive connection to release tension and stress; and 3) closing group reflections to allow students the opportunity for inquiry and comment. • Each lesson (24-45 minutes once weekly sessions for 10 weeks)	US	RCT	40	3 (11.5)	General population	Teachers	Homeroom period
Deuskar (2007)[1]	P	Yoga Nidra	• A combination of guided, aware relaxation, breathing	India	RCT	101	4 (NR)	General population	Audio-tape, unclear who facilitated	Unspecified (“no treatment

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			exercises and imagery via audio-tape. The tape began with an induction consisting of instructions for slow, deep breathing, and a shift to an internal focus of attention. Subjects were instructed to make their resolve, at the beginning of the practice. This was followed by deep muscle relaxation, attention on the breath and imagery. Imagery focused on desired reduction in examination anxiety, and subsequent good performance. • 30-minute audio-tape delivered in a female voice, in vernacular language, and used by the students twice a week (total of 30 sessions).							control group")
Flook (2015)[1]	P	Kindness Curriculum	• Mindfulness-based • prosocial skills training designed for preschool-age children. The foundation of the KC is mindfulness practice, aimed at cultivating attention and emotion regulation, with a shared emphasis on kindness practices (e.g., empathy, gratitude, sharing). • Two 20–30 min lessons each week over a 12-week period, totaling approximately 10 hrs of training.	US	RCT	66	1 (4.7)	General population	Experienced mindfulness instructors	Standard school curriculum

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Flook (2010)[1]	P	InnerKids/Mindful Awareness Practices	• Mindful awareness practices (MAPs) are exercises that promote a state of heightened and receptive attention to moment-by-moment experience. The program is modeled after classical mindfulness training for adults and uses secular and age appropriate exercises and games to promote (a) awareness of self through sensory awareness, attentional regulation, and awareness of thoughts and feelings; (b) awareness of others (e.g., awareness of one's own body placement in relation to other people and awareness of other people's thoughts and feelings); and (c) awareness of the environment (e.g., awareness of relationships and connections between people, places, and things). • Twice a week over 8 weeks, for a total of 16 sessions.	US	RCT	64	2 (8.2)	General population	"instructor"- not clearly described	Silent reading period
Gregoski (2011)	P	Breathing Awareness Meditation (BAM)	• The BAM exercise is one of the Mindfulness-Based Stress Reduction Program. Practice involves focusing upon the moment, sustaining attention on the breathing process, and passively observing • thoughts. • Sessions of 10-minute	US	QED	97	4 (15)	African American youth at increased risk for development of cardiovascular disease	Teachers	Health Education lessons

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			duration were conducted during health education class and at home each week day. On weekends, subjects practiced 10-minute sessions twice daily.							
Haden (2014)/ Hagins (2013)[1]	P	Yoga Practice	• Yoga practice consisted of physical postures, breathing practices and relaxation techniques in addition to short meditation practices and class rules that reflected the moral and ethical components of yoga. Specifically, each of the classes consisted of: (1) an opening ritual (centering, conscious breathing) for 3–7 min; (2) 30-min asana practice (standing, seated, backbends/ inversions); (3) brief seated meditation; and (4) closing ritual of guided relaxation in savasana (body scan). Homework on a specific aspect of the practice was encouraged each week. • Sessions were three times per week for 12 weeks.	US	RCT	30	3 (10.5)	General population	Instructors trained/ certified in yoga and with experience (unclear if classroom teacher)	Physical education class
Huppert (2010)	P	Mindfulness training	• The mindfulness training was based on the programme developed by Kabat-Zinn, presenting the principles and practice of mindfulness meditation. The mindfulness classes covered the concepts of awareness and acceptance, and the	UK	QED	134	6 (14-15)	General population from all-boys private school	Religious Teacher	Religious education classes

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			mindfulness practices included bodily awareness of contact points, mindfulness of breathing and finding an anchor point, awareness of sounds, understanding the transient nature of thoughts and walking meditation. Students received CD containing three 8-minute audio files of mindfulness exercises to be used at home (encouraged daily practice at home). • Four 40 min classes, one per week for 4 weeks,							
Justo (2011)[1]	P	Mindfulness training program	• The after-school program included guidelines, elements, and exercises of Kabat-Zinn's stress reduction program; mindfulness strategies utilized in "Acceptance and Commitment" therapy; metaphor discussion and exercises utilized in this therapy, with stories related to zen philosophy; vipassana meditation. • Ten weekly sessions, 90 minutes in length with the following structure: 10 minutes--comments from participants about the use of the mindfulness exercises between sessions, 10 minutes--doing physical exercises, 10 minutes	Spain	RCT	84	4 (17)	General population	Mindfulness instructor	Not specified

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			presentation related to sessions about metaphors to explore, 30 minutes practicing mindfulness attention to breathing. Home practice encouraged.							
Khalsa (2012)[1]	P	Yoga Ed	• Modified version of Yoga Ed. A secular program that includes yoga postures, breathing exercises, visualization, and games with emphasis on fun and relaxation. • 30-40 minute sessions 2-3 times per week for 11 weeks.	US	RCT	100	4 (16.8)	General population	Certified yoga instructor	Regular P.E. class
Koenig (2012)[1]	P	Get Ready to Learn yoga program	• The GRTL program was implemented every school day • for a period of 16 weeks. All teachers, assistants, and paraprofessionals participated either on a yoga mat or seated in a chair. The DVD was placed in a player and projected onto a screen or television monitor in view of all students. The occupational therapist modeled the program on the DVD, providing visual and verbal cues. The same DVD was used daily. The program itself began with breathing exercises (pranayamas), physical postures and exercises (asanas), deep relaxation (yoga nidra), and chanting	US	QED	46	2 (9.6 – tx (8.6-control)	Students with autism spectrum disorders	DVD instruction facilitated by teachers	Standard classroom routine

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			(kirtan).							
Kuyken (2013)[1]	P	Mindfulness in School Project (MiSP)	• The MiSP curriculum is a set of nine scripted lessons tailored to secondary schools, supported by tailored teacher training. It was designed in line with principles identified as important for effectiveness in several reviews of schools-based programs that promote mental health and well-being and teach social and emotional competence. These principles include: explicitly teaching skills and attitudes; shortening and adapting components to suit young people; using a range of age-appropriate, interactive, experiential and lively teaching methods; providing age appropriate resources to bring mindfulness to life (including a course booklet and a set of mindfulness exercises on CD or MP3 audio files); intensive, focused teacher education to build teachers' self-efficacy and well-being; and program implementation that pays close attention to clarity and fidelity, in this case supported by a manual and indicative script.	4	QED	463	5 (14.8)	General population	Teachers (either MiSP developers or trained by developers)	Standard school curriculum

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Lau (2011)[1]	P	Mindfulness programme	• The programme was modified and adapted from MBSR. The program included four major activities: (1) gentle stretching exercise, which enhances the cultivation of mindfulness through awareness of body movement and sensation; (2) practice with daily activities, including sitting, standing, walking , lying down and eating which involves the awareness of body sensations, thoughts and emotions; (3) body scan, which consists of a guided movement of attention throughout the body from the head to the toes whilst sitting or lying down; (4) loving-kindness practice, which involves sending well wishes and blessings to oneself and all other people in the world. Students were encouraged to do 15 minutes of daily home practice. Offered after school. • Two hour session per week for six weeks and one day retreat.	Hong Kong	QED	40	4 (15.8)	General population from public schools in Hong Kong	Instructor- an experienced teacher with MBSR training	Not specified
Mendelson (2010)/Gould (2012)[1]	P	Mindfulness Intervention for urban youth	• Key intervention components included yoga-based physical activity, breathing techniques, and guided mindfulness	US	RCT	82	2 (10)	General Population/urban youth	Instructors from local non-profit organization	Regular school curriculum

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			practices. Each session also included a brief period of discussion prior to the guided mindfulness practice. • Sessions were 45 minutes in length 4 days per week for 12 weeks. Home practice was encouraged.							
Metz (2013)[1]	P	Learning to BREATHE	• A mindfulness curriculum that has been created for an adolescent population. Based on themes and practices used in mindfulness based stress reduction, it uses developmentally appropriate hands-on activities and guided discussions to teach standard mindfulness skills. Lesson content focuses on six core themes: (1) body awareness; (2) understanding and working with thoughts; (3) understanding and working with feelings; (4) integrating awareness of thoughts, feelings, and bodily sensations; (5) reducing harmful self-judgments; and (6) integrating mindful awareness into daily life. Workbooks and CDs for home meditation were provided to students. • 18 sessions over 16 weeks, typically once per week for 15-25 minutes.	US	QED	216	4 (16.5)	General population	Teachers	Concert choir elective class

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Napoli (2005)	P	Attention Academy Program (AAP)	• Exercises such as paying attention to the breath, movement activities and sensory stimulating activities were used to facilitate "being in the moment". The sequential structure of the classes was: breathing exercises, a body-scan visualization application, a body movement-based task, and a post-session de-briefing or sharing of instructor feedback with the class. • 12 each bi-monthly 45-minute held over a period of 24 weeks.	US	RCT	194	2 (NR)	General population	Professionally trained mindfulness training instructors	Reading or other quiet activities in class
Noggle (2012)[1]	P	Kripalu-based Yoga	• The yoga program used in this study was completely secular and included 4 key elements of classical yoga: physical exercises and postures, breathing exercises, deep relaxation, and meditation techniques. In keeping with principles of Kripalu yoga, the overall emphasis was on self inquiry and not purely didactic teaching. Furthermore, it incorporated a distinct approach to emotion regulation in Kripalu yoga represented in the instruction to breathe, relax, feel, watch, and allow. Postures were taught as breath-coordinated	US	RCT	51	4 (NR)	General population	Certified Yoga instructors	P.E. class

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			movements, and breathing is considered the central tool for cultivating nonjudgmental, compassionate self-awareness. • Two to three 30-minute sessions a week (alternating weekly due to the school schedule) over 10 weeks (28 yoga sessions total).							
Parker (2014)[1]	P	Master Mind	• The Master Mind program is divided into four sections and each section represents one of the four foundations of mindfulness. Embedded within the four sections are the five key features of the Master Mind program: (1) mindful breathing, (2) mindful journeys, (3) mindful movements (e.g., developmentally appropriate yoga poses), (4) real-world applications, and (5) daily practice. • Once a day for approximately 15 minutes over a four week period for a total of 20 lessons.	US	RCT	111	2 (10)	General population	Teachers	Regular education curriculum

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Potek (2012)[1]	NP	Learning to BREATHE	• Specific, experiential guided lessons (adapted from the MBSR to meet the developmental needs of adolescents). Each session focused on a particular mindfulness skill. (see page 52 for a detailed outline of the overview and activities for each session). Sessions included discussion of homework and collection of homework logs, introduction of a specific skill and a brief practice of that skill, formal guided meditation, followed by group discussion and questions. • Six weekly, 40 to 45 minute periods.	US	RCT	30	4 (15)	General population	Researcher/trained instructor	Regular education curriculum
Powell (2008)[1]	P	Self Discovery Programme	• The SDP consisted of sessions designed to facilitate children's self-discovery (i.e., senses, feelings, psychological and physical well-being). The primary themes of the SDP included sensory awareness, touch therapy (e.g., peer massage), yoga, breath work, communication and relaxation. • 12 sessions delivered weekly and lasting approximately 45 minutes.	UK	QED	107	2 (9)	Special education needs, emotional, behavioral, and learning difficulties, and at risk for being excluded from school	Holistic therapists	Regular school programming and additional support as needed

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Quach (2014)[1]	NP	Seated meditation	• The sitting meditation condition consisted of three parts: (a) breathing techniques, (b) meditation, and (c) discussion. The curriculum was based on the MBSR program and was modified to suit the interests and developmental level of the adolescent population. • Met 45 minutes twice weekly for 4 weeks. Home practice: Encouraged to practice 15-30 minutes per day.	US	RCT	103	5 (13.2)	General population	Trained Instructors (researcher was non-participating observer/assistant)	Physical Education Class
Raes (2014)[1]	P	Mindfulness Group Program	• A mindfulness group training developed specifically for adolescents integrating elements of MBCT and MBSR. • Eight weekly 100 minute sessions. Home practice: 15 minutes of mindfulness practice each day	Belgium	RCT	357	4 (15.4)	General population	Trained Mindfulness instructors(Psychologists and MD)	Regular school program
Ramadoss (2010)[1]	P	Yoga-Based Transformative Life Skills	• TLS is a multimodality intervention consisting of Yoga poses, breathing techniques, and meditation. Sessions involved the following components: an initial moment of silence (centering), a “check-in”, a sequence of yoga poses and breathing exercises, and a final “check-out”. • Sessions were provided for 15 minutes per day for 18 weeks.	US	QED	557	4 (NR)	General population (urban school)	Certified yoga teachers (non-profit org.)	Regular school program

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Razza (2015)[1]	P	Modified version of Yoga Kids	• The mindful yoga program was a modified version of the standardized YogaKids. The daily practice included breathing and sun salutations during morning circle, yoga postures linked to literacy activities in the afternoon, and breathing exercises during transition periods. Thus, the practice was incorporated into the curriculum and used across the school day in the intervention classroom. • The average length of time increased gradually across the school year, from 10 min per day in the fall to 30 min per day in the spring. In total, the children received approximately 40 h of mindful yoga across 25 weeks.	US	QED	29	1 (4.3)	General population	Teacher	Regular classroom program
Ricard (2013)[1]	P	Teen Talk	• This program was a Dialectical Behavioral Therapy (DBT) Infused skills group- authors adapted activities from the standard DBT skills curriculum. The adaptation of DBT modules was aimed at teaching emotional and behavioral self-preservation skills, while facilitating an awareness of the impact of behavior on others. • Eight to ten 45–50 minute group counseling sessions	US	QED	303	5 (NR)	At-risk students attending a Disciplinary Alternative Education Program	Counselling student interns (including first author)	Treatment as usual at the alternative education program

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			two times each week for 4 weeks.							
Schonert-Reichl (2010)[1]	P	Mindfulness Education	• The ME program is a classroom-based universal preventive intervention designed to foster children's positive emotions, self regulation, and goal setting. Key components include (1) universal involvement of all children in the classroom, (2) a 10-lesson manualized curriculum with clear lessons that are grounded in theory and research, and (3) an emphasis on taking lesson content and extending the key components (e.g., positive thinking) to other aspects of the curriculum and to other dimensions of children's lives outside of school. • Approximately once a week, with each lesson lasting approximately 40–50 min. The daily core mindfulness attention exercises were done three times a day for up to at least 3 min each session.	US	QED	246	5 (11.4)	General population	Teachers	Standard educational programming
Schonert-Reichl (2015)[1]	P	Mind UP	• MindUP is a simple-to-administer mindfulness-based education SEL program. The core mindfulness practices in the program (done every day for 3 min three times a day) consist of focusing on one's	US	RCT	99	2 (10.2)	General population	Teachers	Business as usual social responsibility program

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			breathing and attentive listening to a single resonant sound. The curriculum includes lessons that promote EFs and self-regulation (e.g., mindful smelling, mindful tasting), social– emotional understanding (e.g., using literature to promote perspective-taking skills and empathy), and positive mood (e.g., learning optimism, practicing gratitude). • 12 lessons taught approximately once a week, with each lesson lasting approximately 40–50 min.							
Sibinga (2013)[1]	P	Mindfulness-Based Stress Reduction (MBSR)	• MBSR is a structured program of instruction in mindfulness, a practice of purposeful, non judgmental attention to the happenings of the present moment. • 12 weekly 50-minute sessions.	US	RCT	41	3 (12)	Urban boys with financial need and academic potential	Mindfulness trained instructor	Health education program
Sibinga (2016)[1]	NP	Adaptation of Mindfulness-Based Stress Reduction (MBSR)	• Adapted from MBSR, the intervention consisted of a structured program of instruction in the cultivation of mindfulness, a practice of purposeful non-judgmental attention to the happenings of the present moment. MBSR programs consist of three components: (1) didactic material related to mindfulness, meditation,	US	RCT	300	5 (NR)	General population	MBSR trained instructor	Healthy Topics

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			yoga, and the mind-body connection; (2) experiential practice of various mindfulness meditations, mindful yoga, and body awareness during group meetings and encouragement of home practice; and (3) group discussion focused on the application of mindfulness to everyday situations and problem-solving related to barriers to effective practice. The MBSR program includes a number of formal and informal techniques, all of which share the goal of enhancing non-judgmental present-focused awareness, aimed to reduce dysregulated focus on the past, i.e., rumination and worries about the future, i.e., anxiety. • 12-week program							
Smith (2014)[1]	P	YogaKidz	• After school yoga group. Lessons were organized into six lesson sets that concentrated on a particular theme, for example respect, hope, and gratitude. Each session consisted of class discussion of a theme (5 minutes), physical poses (20–30 minutes), breathing techniques (5–10 minutes), and relaxation practices (5–	US	RCT	77	2 (9.4)	Students from schools with high poverty and low test scores	Certified Yoga Instructors	Health Eats program

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
			10 minutes). • Twice weekly for about 40 minutes per class for up to 28 weeks.							
Tharaldsen (2012)[1]	P	Concious Coping "*Bevisst mestring"*	• CC (inNorwegian, 'Bevisstmestring') is an MBC skill training program aimed at teaching high school students mindfulness practices and cognitive coping skills to prevent mental health problems in four modules: awareness of the present, coping with distress, our emotional life and interpersonal interaction. The programme is heavily inspired by other interventions that combine mindfulness practices and coping strategies to varying degrees. • 14, 90-minute meetings	Norway	QED	72	4 (17.3)	General population	Interventionists	Regular school program
Van de Weijer (2014)	P	MindfulKids	• Children participate in secular and age appropriate meditation practices focusing on non-judging awareness of sounds, bodily sensations, the breath, thoughts, and emotion. The program is modeled after the MBSR and MBCT training for adults and inspired by the Mindful Schools program. • Trainer visits each class for 12 sessions of 30 min during 6 weeks (two sessions per week).	The Netherlands	QED	199	2 (9.3)	General population	Mindfulness Trainer (teachers present)	Regular school program

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Viafora (2015)[1]	P	Planting Seeds & Still Quiet Place	• Every class followed the same general format of mindfulness exercises, typically beginning with a mindful listening exercise, followed by mindful eating, and then a short class discussion of the previous week's home practice exercises. Each week the instructor led the class in a guided breathing exercise lasting several minutes. • The mindfulness course was delivered in 8 weeks, with 45 min weekly sessions.	US	QED	48	3 (11-13)	General population	Mindfulness instructor (teachers present)	Regular education program
White (2012)[1]	P	Mindful Awareness for Girls through Yoga	• The MBSR program developed by Kabat-Zinn (1990/ 2005) is an 8-week intervention including (a) 2.5-hour weekly classes, (b) sitting meditation, (c) body scanning (that is, awareness of different parts of the body), (d) yoga, (e) mindful eating and walking, (f) approximately 45 minutes of daily homework guided by a compact disk and a workbook and (g) one full-day retreat. • Met approximately 60 minutes immediately after school 1 day per week for 8 weeks and completed 10 minutes of yoga homework 6 days a week.	US	RCT	155	2 (9.9)	General population	Interventionist and research assistants	No treatment

First Author (year)[1]	Pub Status	Program Name	Intervention Description	Country	Design	N	Grade(Mean age or range)	Sample Characteristics	Provider	Control Condition
Wick (2013)[1]	NP	Mindfulness and Lovingkindness Meditation	• Students did Loving Kindness meditation and journaling on 1 day and participated in short mindfulness meditation focusing on breathing on the 2nd day each week. • Two days per week for 30 minutes for 10 weeks.	US	QED	38	4 (16)	At-risk high school girls	Researcher (who was school counsellor)	Regular education programming

Notes: [1] Included in at least one meta-analysis; [2]Propensity score matched sample; NR = Not Reported; **Publication Status**: P = published, NP = not published; **Grade level**: 1= Preschool, 2=Elementary School (k-5 or equivalent); 3= Middle school (6-8 or equivalent); 4 = High school (9-12 or equivalent); 5 = Mixture of grade levels; 6 = unable to determine; Teachers refer to regular classroom teachers (who may or may not have received training), Instructors refer to providers who are trained instructors in the intervention who are not the classroom teachers.

8.4 CHARACTERISTICS OF SINGLE GROUP PRE-POST TEST STUDIES

1st Author (year)	Intervention	Intervention Description	N	Grade Level	Outcomes	Author Reported Results
Beauchemin (2008)	Mindfulness meditation	45-minute initial training session, followed by 5-10 minute meditation sessions daily for 5 consecutive weeks.	34	High school	**Cognition:** cognitive interference **Socioemotional:** social skills, anxiety	Results present only a relationship between mindful meditation and outcome measures.
Bei (2013)	Cognitive-behavioral mindfulness training	Six 90 minute sessions weekly over 7 weeks. Additional at-home tasks were assigned weekly.	62	9th grade	**Behavior**: objective sleep, subjective sleep **Socioemotional:** anxiety	Results suggest training may improve sleep, but impacts on anxiety are inconclusive.
Carmona (2014)	Mindfulness Training	Initial training, followed by daily practice during one class (Physical Education class) for 12 weeks.	84	7th grade	**Academic Performance:** academic competence **Socioemotional:** stress, social skills, quality of life	Found that mindfulness practices were not impactful on stress or mindfulness.
Edwards (2014)	*Mindfulness-Based Stress Reduction for Teens*	Eight weekly 50-minute group sessions. Used Biegel's *Mindfulness-Based Stress Reduction for Teens* manual. Participants were also encouraged to develop at-home daily mindfulness practices.	20	Middle and High school	**Cognition:** attention **Behavior**: **Socioemotional:** self-compassion, perceived stress,	No significant changes in student's hostility, anxiety, or mindfulness (p >. 05). Significant change was found in students' perceived stress, depression, and self-compassion.

1st Author (year)	Intervention	Intervention Description	N	Grade Level	Outcomes	Author Reported Results
					depression, anxiety	
Mehta (2011, 2012)	Climb-Up	One-year, peer-mediated interventional program consisting of yoga, meditation, and behavioral play therapy. Twice weekly 60-minute sessions, initially for six weeks by unspecified adults. High school student volunteers were then trained to conduct the program beginning at week 5 and continue for one year.	76 (2011) 69 (2012)	2nd to 5th grade students with ADHD	**Cognition:** attentiveness **Academic Performance:** performance impairment	Results show "that the majority of children reported improved performance in school, which was sustained for the year."
Joyce (2011)	Mindful meditation	Programmed as ten 45-minute sessions, but implemented as classroom teachers saw fit. Classroom teachers also encouraged to implement additional practice throughout the school day.	120	5th to 6th grade	**Cognition:** inattention **Behavior**: conduct problems **Socioemotional:** emotional symptoms, peer relationship problems, pro-socialiality	Results "indicate improvements in emotional health, especially for students scoring in the 'borderline' and 'abnormal' categories before the program."
Wisner (2008)	Mindfulness meditation	90 minute sessions, twice weekly for 8 weeks. Additionally, 10 minute meditation periods were held during weeks 3-8 twice weekly.	35	10th to 12th grade	**Cognition:** attention **Academic Performance:** thinking skills **Socioemotional:** coping, stress	Findings "provide support for psychosocial, cognitive, and behavioral benefits to students"

1st Author (year)	Intervention	Intervention Description	N	Grade Level	Outcomes	Author Reported Results
Worth (2013)	MAPs for ADHD	Half-hour daily sessions for eight weeks.	17	Middle school	**Cognition:** executive functioning, attention, psychomotor speed	Findings indicated that "five of seven indices of ADHD found to have statistically significant improvements" after mindfulness training.
Zahn (2008)	Tai Chi Chuan	90 minute sessions of Tai Chi, once weekly for 9 weeks. An additional 20 minutes of practice was assigned three times weekly.	12	High school	**Cognition:** mindfulness **Academic Performance:** participation **Behavior**: behavioral regulation **Socioemotional:** psychological distress, self-perception, mood	"Students reported decreased tension and anxiety...and increased relaxation and calmness..." Additionally results suggest improvement in mood and quality of life.

8.5 CHARACTERISTICS OF SINGLE SUBJECT DESIGN STUDIES

1st Author (year)	Name of Intervention	Intervention Description	Study Design	Grade level or age	Outcomes	Author Reported Results
Carboni (2014)	Mindfulness training	30-45 minute, one-on-one sessions twice weekly for a minimum of ten sessions. Utilized mindfulness-based stress reduction course materials and	A-B-A	Age: 8 years	**Academic Performance:** academic engagement	Results indicated "mindfulness training was effective in increasing

1st Author (year)	Name of Intervention	Intervention Description	Study Design	Grade level or age	Outcomes	Author Reported Results
		mindfulness practices to build emotional intelligence.			**Behavior**: On-task behavior, hyperactive behaviors	the percentage of intervals of on-task behavior for participants."
Felver (2014)	*Soles of Feet*	20-30 minute one-on-one sessions with trained interventionist over five consecutive days. Used *Meditation on the Soles of the Feet* by Singh as treatment manual. Follow-up then tracked behaviors until the end of the school year.	A-B-A	Grade: 3	**Academic Performance:** task engagement **Behavior**: disruptive and off-task behavior	Results suggest "that elementary school students with high rates of disruptive behavior who complete the SOF intervention spend more time being academically engaged in the classroom and less time displaying off-task behavior."
Klatt (2013)	Move-Into-Learning (Mindfulness with yoga and arts)	45 minute sessions, once weekly for eight consecutive weeks. Based on an adult model previously studied by Klatt.	A-B-A	Grade: 3	**Cognition:** cognitive problems/ inattention **Behavior**: oppositional behavior hyperactivity **Socioemotional:**	"Preliminary observational data of the teachers assessing student behavior, on both an ADHD index and in cognitive/inattentive behavior, showed decreases in these disruptive behaviors"
Peck (2005)	Yoga programming	30 minute, twice weekly yoga sessions for 3 weeks. Utilized "Yoga Fitness for Kids" video tapes, published by Gaiam.	A-B-A	Grade: 1 to 3	**Cognition:** attention (time on task)	Researchers reported large effect sizes for all groups, with a decrease in effect size at follow-up; however all effect sizes remained medium-to-large.

1st Author (year)	Name of Intervention	Intervention Description	Study Design	Grade level or age	Outcomes	Author Reported Results
Salustri (2012)	Mindfulness-based stress reduction (MBSR)	16 in-school sessions, conducted over 8 weeks for 45 minutes per session. Utilized Kabat-Zinn's Stress Reduction and Relaxation Program manual.	A-B-A	Grade: high school	**Cognition:** Mindfulness **Academic Performance:** absences, number of assignments completed **Behavior**: late class arrivals **Socioemotional:** total life satisfaction, positive & negative affect	"Results lend support to the conclusion that the current mindfulness program was effective in teaching the participants how to increase their awareness of and attention to the present moment."
Semple (2005)	Cognitively oriented mindfulness	6 sessions, conducted over 6 weeks for 45 minutes weekly. Program materials adapted from Kabat-Zimm's mindfulness-Based Stress Reduction and Segal et al.'s Mindfullness-Based Cognitive Therapy	A-B-A	Age: 7-8 Grade: 2-3	**Cognition:** attention problems **Academic Performance:** academic functioning **Behavior**: internalizing and externalizing behaviors **Socioemotional:** anxiety, depression	"some improvements were reported for all of the children in at least one area—academic functioning, internalizing problems, or externalizing problems."
Singh (2007)	*Soles of Feet*	15 minute one-on-one sessions with trained therapist, three times a week for 4 weeks. Used *Meditation of the Soles of the Feet* as treatment	A-B-C-A	Grade: 7	**Behavior**: aggression, bullying, fire setting, cruelty to	Results suggest "when adolescents

1st Author (year)	Name of Intervention	Intervention Description	Study Design	Grade level or age	Outcomes	Author Reported Results
		manual. Following initial training, met for 15 minutes once a month with therapist over 25 weeks.			animals, noncompliance	choose to change their behavior, whether reluctantly or otherwise, they can indeed self-regulate specific behaviors in settings of their choice, and for as long as they wish."
Steiner (2013)	Yoga programming (Yoga Ed)	Twice weekly yoga sessions conducted for 3.5 months. Utilized the Yoga Ed Protocol, a national yoga protocol for children.	A-B-A	Grade: 4 to 5	**Cognition:** adaptive skills, attention **Academic Performance:** school problems **Behavior**: internalizing behaviors, externalizing behaviors, behavioral symptoms **Socioemotional:** deportment, anxiety, well-being, parent relations, social support, peers, social competence	"...reported improved attention in class and adaptive skills and reduced depressive symptoms, behavioral symptoms, and internalizing symptoms." Students and parents reported no significant changes.

8.6 EXCLUDED STUDIES

Study	Reason for exclusion
Barnes et al. (2003)	Intervention- Study examined effects of Transcendental Meditation
Beaumont (2005)	Intervention- Study examined effects of Transcendental Meditation
Bluth (2010)	Study design- Not an intervention study
Black (2014)	Study design- Study examined the effects of mindfulness meditation of varying duration across two groups.
Bogels et al. (2011)	Intervention- Not school-based
Campion & Rocco (2011)	Study design- Qualitative Design
Ernould (n.d.)	Study design- Not an intervention study (treatment manual)
Gordon et al. (2008)	Intervention- Not mindfulness-based
Groom (2014)	Intervention- Included a mantra and aspects of Transcendental Meditation
Holstine (2015)	Intervention- - Study examined effects of Transcendental Meditation
Keefe-Forbotnick (2014)	Study not available; author did not respond to request
Kim (2001)	Intervention- Not mindfulness-based (Taekwondo)
Kim et al. (2014)	Intervention- Not mindfulness-based; study examined effects of a multicomponent intervention that was primarily group art therapy with some breath meditation
Mendelson & Greenberg (2010)	Study Design- Not an intervention study
Miller (1999)	Study design- Not an intervention study
Miller (2014)	Study design- Not an intervention study; formative study using qualitative methods to design an intervention for a future study
Oberle et al. (2012)	Study design- Not an intervention study
Ramadoss (2010) (Pilot study #1)	Intervention- Not a school-based intervention
Rommel (1012)	Intervention- Not mindfulness-based (yoga movement only with no mindfulness component)
Salustri (2012)	Study design- Did not establish experimental control for withdrawal design

Study	Reason for exclusion
Semple (2005)	Intervention- not school-based (University-based clinic reading tutoring program)
Semple (2010)	Intervention- not school-based (University-based clinic reading tutoring program)
Semwal et al. (2014)	Outcomes- Study examined introversion and extroversion, which are personality traits and not social-emotional outcomes
Smith (2014) 1st study reported	Participants- not students (teachers were included)
Stewart & Alrutz (2012)	Intervention- not a mindfulness-based intervention (service learning and contemplation)
Van de Weijer-Bergsma et al. (2012)	Intervention- not school-based
van der Oord et al. (2012)	Intervention- not school-based
Wall (2005)	Study design- Not an intervention study
West (2008)	Study design- Not an intervention study

8.7 RISK OF BIAS TABLE

School-based mindfulness interventions

Study name: Bakosh (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to group
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of outcome assessors
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Authors designed the treatment intervention

Study name: Bergen-Cico (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Students randomly assigned by classroom
Allocation concealment (selection bias)	Unclear risk	Allocation concealment procedures not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or some personnel (Yoga teacher); blinding of participants to researchers
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	One teacher provided the intervention; one teacher in the control condition

Study name: Bluth (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Students randomly assigned by computer program
Allocation concealment (selection bias)	Low risk	Allocation concealment procedures not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires
Incomplete outcome data (attrition bias)	High risk	Differential attrition- high attrition in control group, no attrition in treatment group
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	One of the authors created the intervention curriculum and another of the authors was the instructor of the mindfulness classes

Study name: Britton (2014)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization of classrooms by simple coin flip
Allocation concealment (selection bias)	Unclear risk	Allocation concealment was not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	Unclear risk	Authors' role in the intervention is unclear - appears to be independent

Study name: Campbell (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires used
Incomplete outcome data (attrition bias)	Unclear risk	High attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	Low risk	No confounds. Author appears independent from intervention

Study name: Chukwu (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Assignment to group by principal alternating through the list of students whose parents had given consent
Allocation concealment (selection bias)	Unclear risk	Concealment procedures not reported
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of outcome assessors
Incomplete outcome data (attrition bias)	High risk	High attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	Low risk	No evidence of researcher involvement in the intervention

Study name: Deuskar (2007)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Clusters randomly assigned
Allocation concealment (selection bias)	Unclear risk	Allocation concealment procedures not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self-report measure used
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Confounded (each class in the school consisted of two divisions- one of the two divisions was randomly selected to the treatment and the other to the control group). Unclear whether the author was involved in intervention development.

Study name: Flook (2010)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Participants were assigned to groups using block randomization; randomization procedures not described.
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of assessors
Incomplete outcome data (attrition bias)	Low risk	No attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Intervention curriculum developed by one of the authors

Study name: Flook (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Classrooms randomly assigned to condition
Allocation concealment (selection bias)	Low risk	Allocation concealment not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of outcomes assessors (teachers); also used self-report
Incomplete outcome data (attrition bias)	High risk	High attrition for some measures
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Author developed the intervention curriculum

Study name: Haden (2014)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random assignment- research assistant not involved in the evaluations pulled names out of a hat.
Allocation concealment (selection bias)	Low risk	Research assistant who drew names and was not involved in the evaluations, conveyed group assignment to the teachers
Blinding of participants and Personnel (performance bias)	High risk	Participants and personnel were not blinded to condition
Blinding of outcome assessment (detection bias)	Low risk	Assessors were blinded to group assignment
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	Low risk	Authors appear independent of the intervention

Study name: Justo (2011)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Random assignment- procedures unclear
Allocation concealment (selection bias)	Unclear risk	Allocation concealment unclear
Blinding of participants and Personnel (performance bias)	Unclear risk	No blinding of participants or personnel
Blinding of outcome assessment(detection bias)	High risk	No blinding of outcome assessors
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Confound- one mindfulness instructor. Authors' role in intervention unclear.

Study name: Khalsa (2012)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Authors report that participants were randomly assigned by class
Allocation concealment (selection bias)	Unclear risk	Authors did not report any information about allocation concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	All outcomes were assessed using self-report questionnaires
Incomplete outcome data (attrition bias)	Low risk	Reported outcome data for 100/121 participants (17% attrition across groups)
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Funded by Kripalu Center for Yoga and Health; 3 study authors affiliated with Kripalu Center for Yoga and Health (consultants or paid staff). Unclear what role the authors had in the development of the program.

Study name: Koenig (2012)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment used- “classes were chosen by school administrators so that the intervention and control group classes were comparable on the basis of similar levels of Adaptive functioning.”
Allocation concealment (selection bias)	High risk	Allocation not concealed- classes were allocated by school administrator.
Blinding of participants and Personnel (performance bias)	High risk	Participants and personnel were not blinded.
Blinding of outcome assessment (detection bias)	High risk	Assessors (research assistants and classroom teachers involved in delivery of intervention) were not blinded to condition.
Incomplete outcome data (attrition bias)	Low risk	Low attrition rate (4%)
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	The intervention was developed by one of the authors.

Study name: Kuyken (2013)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition. Intervention schools were selected on basis of whether there was an intervention (MISP) developer or had been trained by an MISP developer.
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	All outcomes assessed using self-report questionnaires
Incomplete outcome data (attrition bias)	Low risk	Attrition for unadjusted analyses reported was low (<20%).
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Authors are co-founders of the intervention

Study name: Lau (2011)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	Allocation not concealed
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	All outcome measures were self-report questionnaires
Incomplete outcome data (attrition bias)	High risk	Authors reported to include only those participants who attended at least 80% of the programme classes, which was 61.5% of the sample.
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Experimental condition confounded- one instructor taught all mindfulness classes, thus there is no way to distinguish between the effect of the intervention from that of the instructor.

Study name: Mendelson (2010)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly assigned schools to condition
Allocation concealment (selection bias)	Unclear risk	Concealment not reported
Blinding of participants and Personnel (performance bias)	High risk	Participants and personnel were not blinded to condition
Blinding of outcome assessment (detection bias)	Low risk	All outcome measures were self-report
Incomplete outcome data (attrition bias)	Low risk	Low attrition balanced across groups
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Two researchers were involved in the development of the intervention in collaboration with the Holistic Life Foundation who implemented the intervention.

Study name: Metz (2013)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	Unclear risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	All outcome measures were self-report
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	One of the authors developed the intervention. Intervention confounded at the school level (one school per condition).

Study name: Noggle (2012)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Group allocation was conducted by blindly and randomly drawing paper slips.
Allocation concealment (selection bias)	Low risk	Group allocation was conducted by blindly and randomly drawing paper slips.
Blinding of participants and Personnel (performance bias)	Unclear risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	All outcome measures were self-report
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	The two lead yoga instructors created and implemented the intervention and were teaching faculty at the Kripalu Center for Yoga and Health. Study was funded (in part) by the Kripalu Center for Yoga and Health and 2 study authors were affiliated with Kripalu Center for Yoga and Health (consultants). The control condition was confounded at the classroom level (one class in the control condition).

Study name: Parker (2014)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Authors reported that schools were randomly assigned to condition.
Allocation concealment (selection bias)	Unclear risk	Concealment procedures were not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	Teachers completed some assessments and were not blinded to condition. Other assessments were self report.
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Authors involved in the development of the program. Confounded by school- one school assigned to treatment and one assignment to control.

Study name: Potek (2012)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Students were randomly assigned by drawing names from a hat.
Allocation concealment (selection bias)	Unclear risk	There was not enough information reported.
Blinding of participants and Personnel (performance bias)	High risk	Participants and personnel were not blinded to condition.
Blinding of outcome assessment (detection bias)	Unclear risk	A research assistant not otherwise involved in the intervention or study collected data from both groups, although it is not clear whether the assistant was blinded to condition.
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	The researcher led the mindfulness classes.

Study name: Powell (2008)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non random assignment
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of assessors
Incomplete outcome data (attrition bias)	Unclear risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Intervention developed by the author

Study name: Quach (2014)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Author reported that participants were randomly assigned to condition
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	All outcome measures were self-report
Incomplete outcome data (attrition bias)	Unclear risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Researcher attended some of the intervention groups to be “available to assist instructors as a non-participating observer” and to monitor fidelity, but researcher did not report doing the same for the control group.

Study name: Raes (2014)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization sequence generated by online random number generator
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not described
Blinding of participants and Personnel (performance bias)	Unclear risk	Participants and personnel were not blinded to condition.
Blinding of outcome assessment (detection bias)	Low risk	Self report questionnaire was used
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	High risk	Study protocol was not found. Authors reported one outcome in the paper, but stated that they had included several measures that were not reported in the manuscript- the Five-Factor Mindfulness Questionnaire (internal consistency was too low to be trusted) and the Mood Disorders Questionnaire (authors reported the sensitivity and specificity were not well know at this time in English or Dutch so did not use it as an endpoint).
Other biases (research allegiance, funding, confounds)	Low risk	Researcher appeared independent of the development or implementation of the intervention. No confounds noted.

Study name: Ramadoss (2010)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self report measures used
Incomplete outcome data (attrition bias)	Low risk	Low attrition balanced across both groups
Selective outcome reporting (reporting bias)	High risk	Protocol not found. Authors did not report adequate data at posttest on one measure.
Other biases (research allegiance, funding, confounds)	High risk	Authors were affiliated with the organization that provides the intervention.

Study name: Razza (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	Outcome assessors were not blinded
Incomplete outcome data (attrition bias)	Low risk	Low attrition balanced across both groups
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Treatment confounded at the classroom level (one classroom/teacher per each condition).

Study name: Ricard (2013)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of outcome assessors
Incomplete outcome data (attrition bias)	Unclear risk	Authors provide sample size for those that participated in the groups; it is unclear whether all of those students are included in the analysis
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Authors involved in development of intervention

Study name: Schonert-Reichl (2010)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of assessors
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Study funded by the Hawn Foundation, developer of the intervention; unclear whether authors played a role in program development

Study name: Schonert-Reichl (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomization by coin flip
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of outcome assessors
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Study funded by the Hawn Foundation, developer of the intervention

Study name: Sibinga (2013)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Randomly assigned by "computer generated scheme"
Allocation concealment (selection bias)	Unclear risk	Concealment not described
Blinding of participants and Personnel (performance bias)	Low risk	"Prior to program assignment, all participants, and the study and school staff were blinded to program Allocation." There was an active control group, so it is reasonable that the participants and personnel could be blinded to which intervention was the treatment in this study.
Blinding of outcome assessment (detection bias)	Low risk	"Prior to program assignment, all participants, and the study and school staff were blinded to program allocation."
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	High risk	Study protocol was not found. Authors reported data for all outcomes measured at posttest, although not sufficiently for including in meta-analysis; 3 month follow-up not reported.
Other biases (research allegiance, funding, confounds)	High risk	Study had confound- one instructor provided intervention; author involved in the adaptation/development of the intervention

Study name: Sibinga (2016)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Students were randomly assigned by school and grade
Allocation concealment (selection bias)	Unclear risk	Allocation concealment not described
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants; personnel were blinded to group assignment at the data management, analysis and interpretation levels
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires
Incomplete outcome data (attrition bias)	High risk	High attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Authors involved in the adaptation/development of the treatment intervention

Study name: Smith (2014)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Students were randomly assigned to condition
Allocation concealment (selection bias)	Unclear risk	Concealment procedures not reported
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	High risk	No blinding of outcome assessors
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	One of the study authors developed the curriculum

Study name: Tharaldsen (2012)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment- classes were selected by the high school administrator
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires used
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Author developed the intervention

Study name: Viafora (2015)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires used
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Confounded- one instructor. Unclear if authors were involved in the development or implementation of the intervention

Study name: White (2012)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Author reported schools were randomized, but not indicate the randomization procedures
Allocation concealment (selection bias)	Unclear risk	Authors did not report allocation concealment procedures
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires used
Incomplete outcome data (attrition bias)	Low risk	Low attrition
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	Confounded at school level (one school per condition). The author conducted the intervention sessions.

Study name: Wick (2013)

Type of bias	Judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Non-random assignment to condition
Allocation concealment (selection bias)	High risk	No concealment
Blinding of participants and Personnel (performance bias)	High risk	No blinding of participants or personnel
Blinding of outcome assessment (detection bias)	Low risk	Self-report questionnaires used
Incomplete outcome data (attrition bias)	High risk	High attrition (<80%) from treatment group.
Selective outcome reporting (reporting bias)	Unclear risk	Study protocol was not found
Other biases (research allegiance, funding, confounds)	High risk	The author worked in the school in which the study was being conducted. The intervention group was taken from one academic year and the comparison group from the prior academic year (matched).

8.8 COGNITIVE OUTCOMES BY STUDY INCLUDED IN META-ANALYSIS

Study	Measure
Bergen-Cico (2015)	ASRI total regulation
Britton(2014)	YSR attention problems
Chukwu (2015)	MI
Flook (2010)	BRIEF - Teacher Global Executive Composite
	BRIEF – Parent Global Executive Composite
Flook (2015)	DCCS - All trials
	Flanker task
Parker (2014)	Flanker fish task
Powell (2008)	CBPS - concentration/attention skills
Quach (2014)	AOSPAN
Razza (2015)	Pencil-tap - executive function
	HSKT
	Drawing task - focused attention
	Drawing task - lack of attentional impulsivity
Schonert-Reichl (2015)	EF - Flanker switch - response time
	EF - Flanker vs. reverse flanker - response time
	EF- hearts and flowers - response time
	EF- Flanker switch - accuracy
	EF- Flanker vs. reverse flanker - accuracy
	EF- hearts and flowers - accuracy

Note. ASRI = Adolescent Self-Regulation Index; YSR = Youth Self Report; MI = Metacognition Index; BRIEF = Behavior Rating Inventory of Executive Function; DCCS = Dimensional Change Card Sort Task; Child Behavior Profile Scores; AOSPAN = Automated Operation Span Task; HSKT = Head Shoulders Knees and Toes; EF = Executive Function

8.9 ACADEMIC OUTCOMES BY STUDY INCLUDED IN META-ANALYSIS

Study	Measure
Flook (2015)	Grades-Learning
	Grades- Health
	Grades- Socioemotional
	Grades-Cognitive
	Grades-Language
Bakosh (2015)	Grades- Reading
	Grades- Science
	Grades- Math
	Grades- Writing
	Grades- Spelling
	Grades-Social Studies
Schonert-Reichl (2015)	Grades- Math
Smith (2014)	Grades
Wick (2013)	Grades
	Academic credits

8.10 BEHAVIORAL OUTCOMES BY STUDY INCLUDED IN META-ANALYSIS

Study	Measure
Britton (2014)	YSR Externalizing
Chukwu (2015)	BRI
Flook (2015)	Self Stickers
	Delay - all trials
Haden (2014)	CBCL - Reactive Aggression
	CBCL - Proactive Aggression
	CBCL - Externalizing Behavior
Khalsa (2012)	BASC-2 - School Problems Composite
	BASC-2 - Inattention/hyperactivity
Koenig (2012)	ABC - community (teacher)
Parker (2014)	CBCL- Aggression problems
	CBCL- Attention
Ricard (2013)	YOQ-30.2 - Aggression (student report)
	YOQ-30.2 - Conduct problems (student report)
	YOQ-30.2 - Hyperactivity/distractibility (student report)
	YOQ-30.2 - Aggression (parent report)
	YOQ-30.2 - Conduct problem (parent report)
	YOQ-30.2 - Hyperactivity/distractibility (parent report)
Schonert-Reichl (2010)	TRSC- Aggressive behaviors
	TRSC - Oppositional behavior/dysregulation
Schonert-Reichl (2015)	Behavior- starts fights
	Behavior- breaks rules
Smith (2014)	CHP - Behavior Tracking System
Sibinga (2015)	SCL-90-R - Hostility
	Aggression
Wick (2013)	Absences
	Tardies
	Behavior

Note. YSR = Youth Self Report; BRI = Behavioral Regulation Index; Delay = delay of gratification; CBCL = Childe Behavior Check List; BASC-2 = Behavior Assessment Survey for Children Version 2; ABC = Aberrant Behavior Checklist; YOQ-30.2 - Youth Outcome Questionnaire; TSRC = Teacher Rating Scale of Social Competence; CHP = Challenging Horizons Program; SCL-90-R = Symptom Checklist-90-R

8.11 SOCIOEMOTIONAL OUTCOMES BY STUDY INCLUDED IN META-ANALYSIS

Study	Measure
Bluth (2015)	CAMM
	SCS-SF
	SOC
	PSS
	STAI
	SMFQ
Britton (2014)	STAI - Total Affect Disturbance
	STAI - Positive Affect
	YSR - Internalizing
	CAMS-R - Total
Campbell (2015)	PSS
	I-PANAS-SF - Negative Affect
	I-PANAS-SF - Positive Affect
	DERS – Impulse Control Difficulties
	DERS – Lack of Emotional Awareness
	DERS – Difficulties Engaging in Goal-Directed Behaviors
Deuskar (2007)	TAI
Flook (2015)	TSC – total
Haden (2014)	PANAS – Positive Affect
	PANAS - Negative Affect
	SPPC-GSWS
	CBCL - Internalizing Behavior
Justo (2011)	Coping ability, operability, and persistence
	Self-concept and self-esteem
	Empathy and social skills
Khalsa (2012)	BASC-2 - Anger control
	BASC-2 - Ego Strength
	BASC-2 - Emotional Symptoms Index
	BASC-2 - Internalizing Problems composite
	BASC-2 - Mania
	BASC-2 - Personal Adjustment Composite
	BASC-2 - Text Anxiety
	PSS
	POMS - Total
	IPPA
	RS
Kuyken (2013)	WEMWBS
	PSS – Stress
	CES-D - Depression

Study	Measure
Lau (2011)	MAAS
	FMI
	SPWB
	DASS
	PSS
Mendelson (2010)	EPI - Positive affect
	EPI - Negative affect
	SMFQ
	PIML - Trust in friends
	PIML - Communication with friends
	PIML - Teacher affiliation
	PIML - Dissatisfaction with Teacher
	RSQ = Involuntary engagement
Metz (2013)	Stress level (1-item measure)
	Difficulties in emotion regulation (total score)
	Psychosomatic complaints scales
	Affective self-regulatory efficacy scale
Noggle (2012)	POMS-SF- Total
	PANAS-C Positive affect
	PANAS-C negative affect
	PSS
	IPPA- positive psychological attributes
	IPPA- life purpose and satisfaction
	IPPA- Self confidence during stress
	RS
	STAXI-2 - Inward anger suppression
	STAXI-2 - Outward anger suppression
	STAXI-2 - Anger expression control
	CAMM
Parker (2014)	CBCL - Social Problems
	CBCL - Anxiety boys
	CBCL - Anxiety girls
	SCRS - boys
	SCRS - girls
Potek (2012)	MASC
	PSS
	DERS
	FFMQ
Powell (2008)	Self-confidence
	Social confidence with peers
	Social confidence with teachers
	Communication with peers
	Communication with teachers

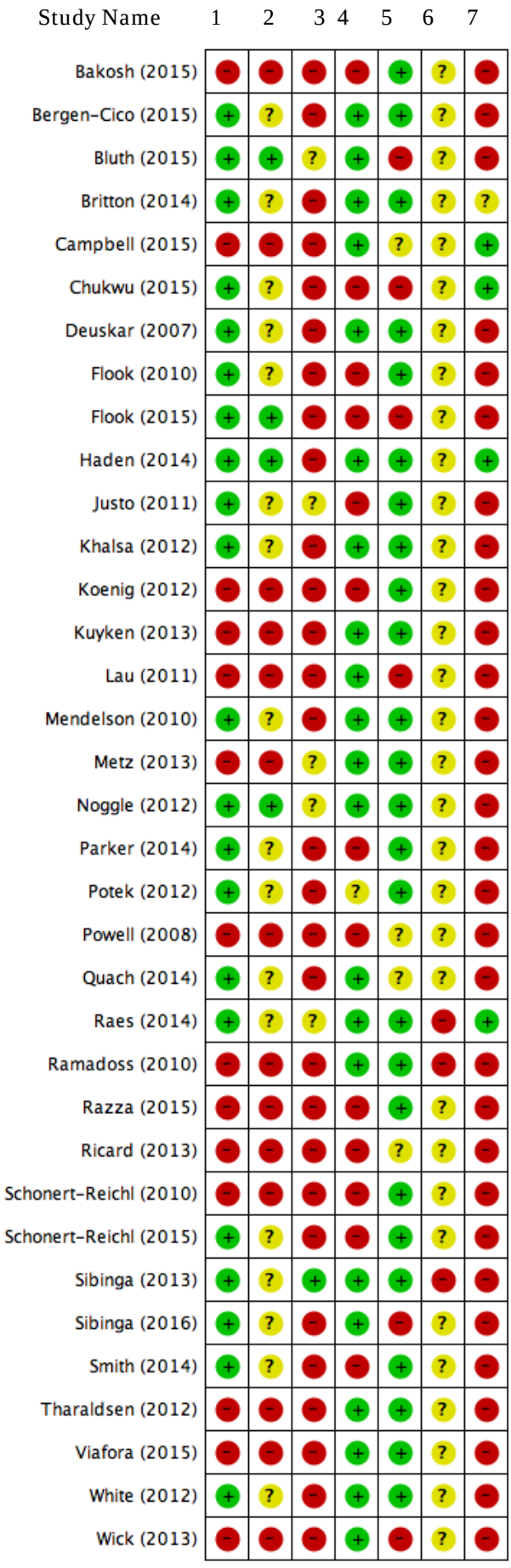
Study	Measure
	Self-control
	Contribution
	Eye contact
	SDQ
Quach (2014)	PSS
	SCARED
Raes (2014)	DASS-21-D- Depression only
Ramadoss (2010)	TSCS-13
Razza (2015)	CBQ attentional focusing
	CBQ inhibitory control
	Toy wrap - effortful control
	Toy wait - effortful control
Ricard (2013)	YOQ somatic student report
	YOQ social isolation student report
	YOQ depression/anxiety student report
	YOQ somatic parent report
	YOQ social isolation parent report
	YOQ depression/anxiety parent report
Schonert-Reichl (2010)	RI - optimism subscale
	PANAS - positive affect
	PANAS - negative affect
	TRSC - Social-emotional competence
Schonert-Reichl (2015)	IRI -empathic concern subscale
	IRI -perspective/taking subscale
	RI- optimism subscale
	RI- Emotional Control
	SDQ - School self-concept
	MASC
	Social Goals Questionnaire- Social responsibility
	SPQC - Depressive symptoms subscale
	SGQ - goals
	SGQ- trustworthy
	SGQ- Helpful
	SGQ- Takes others' views
	SGQ- Kind
	SGQ- Liked by peers
Sibinga (2013)	Mindfulness- Observe
	Mindfulness- w/o judgement
	Mindfulness- Act with awareness
	MASC – anxiety
	SCL-90-R- anxiety

Study	Measure
	SCL-90-R- somatization
	SCL-90-R- hostility
	Depression
	Perceived Stress
Sibinga (2015)	CDI-S
	STAXI-2 - temperamental expressivity
	STAXI-2 - reactive expressivity
	DES - interest
	DES - enjoyment
	DES - sadness
	DES - anger
	DES - guilt
	DES - contempt
	DES - fear
	DES - self-hostility
	DES - shame
	DES - shyness
	CSE
	MASC – anxiety
	CPSS
	MCS - Awareness
	MCS - Distraction
	MCS - Preventing negative emotions
	MCS- Constructive self-assertion
	SCL-90-R- life satisfaction
	CPSS
	CAMM
	AFQY = Avoidance Fusion Questionnaire for Youth
	SCS-C
	FBS- perceived Stress
	SCSI- frequency
	SPPC-GSWS
Tharaldsen (2012)	MCS- Awareness
	MCS-Distraction
	MCS- Preventing negative emotions
	MCS- Constructive self-assertion
	SCLR-90-R- Life satisfaction
	GSI
Viafora (2015)	CAMM
	AFQY
	SCS-C
White (2012)	Perceived stress- Feel bad scale
	Schoolagers coping strategies- frequency subscale

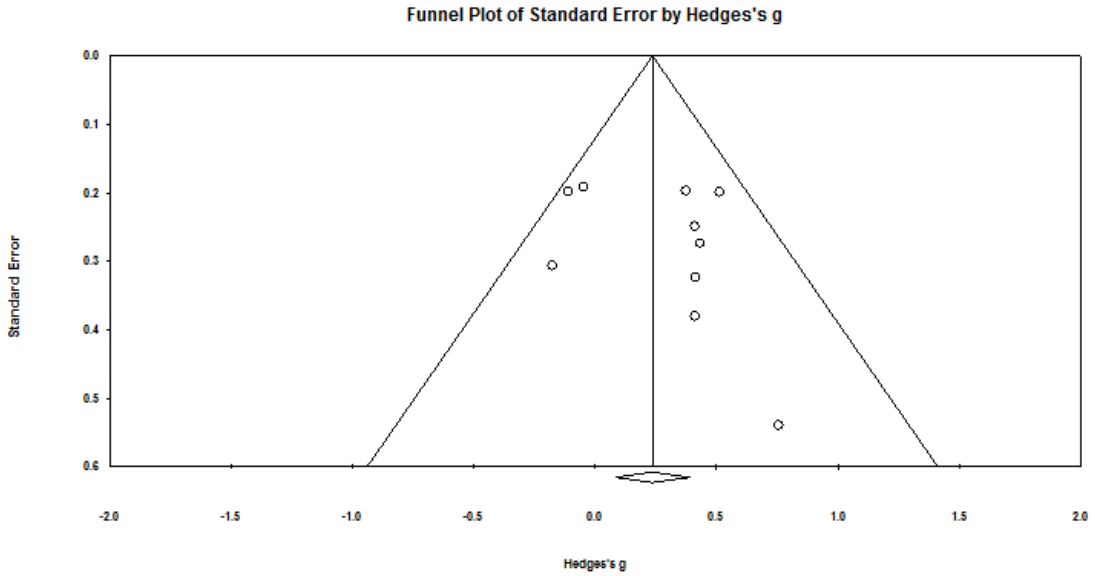
Study	Measure
	GSWS
	MTACA- health self regulation subscale

Note. CAMM = The Child and Adolescent Mindfulness Measure; SCS-SF = Self-Compassion Scale-Short Form; SOC = Social Connectedness; PSS = Perceived Stress Scale; STAI = State-Trait Anxiety Inventory; SMFQ = Short Mood and Feelings Questionnaire; YSR = Youth Self Report; CAMS-R = Cognitive and Affective Mindfulness Scale; I-PANAS-SF = International Positive Affect and Negative Affect Scale; DERS = Difficulties in Emotion Regulation Scale; TAI = Teacher Anxiety Inventory; PANAS = Positive and Negative Affect Scale; SPPC-GSWS = Self Perception Profile for Children Global Self Worth; TSC = Teacher-rated social competence; CBCL = Child Behavior Checklist; BASC-2 = Behavior Assessment Survey for Children Version 2; POMS = Profile of Mood States; IPPA = Inventory of Positive Psychological Attitudes; RS = Resilience Scale; WEMWBS = Warwick-Edinburgh Mental Well-being Scale; CES-D = Center for Epidemiologic Studies Depression Scale; MAAS = Mindfulness Attention Awareness Scale; FMI = Freiburg Mindfulness Inventory; SPWB = Scales of Psychological Well-being; DASS = Depression Anxiety Stress Scales; EPI = Emotional Profile Inventory; SMFQ = Short Mood and Feelings Questionnaire – Child Version; PIML = People In My Life; RSQ = Response to Stress Questionnaire; STAXI State-Trait Anger; Expression Inventory-2; SCRS = Self-control Rating Scale; MASC = Multidimensional Anxiety Scale for Children; FFMQ = Five Factor Mindfulness Questionnaire; SDQ = Strengths and Difficulties Questionnaire; SCARED = Screen for Child Anxiety and Related Emotional Disorders; DASD-21-D = Depression Anxiety Stress Scales - depression; PSS-10 = Perceived Stress Scale-10; TSCS-13 = Tangney's Self-Control Scale; CBQ = Children's Behavior Questionnaire; YOQ = Youth Outcome Questionnaire; RI = Resiliency Inventory; TRSC = Teacher Rating Scale of Social Competence; IRI = Interpersonal Reactivity Index; SPQC = Seattle Personality Questionnaire for Children; SGQ = Social Goals Questionnaire; BC = Brief COPE; CRSQ = Children's Response Style Questionnaire; CSE = Coping Self-Efficacy; CDI-S = Children's Depression Inventory-Short Form; DES = Differential Emotions Scale; CPSS = Children's Post-Traumatic Symptoms; MCS = Mindful Coping Scale; SCL-90-R = Symptom Checklist-90-Revised; AFQY = Avoidance Fusion Questionnaire for Youth; SCS-C = Self-Compassion Scales-Children; FBS = Feel Bad School; SCSI = Schoolagers Coping Strategies Inventory; MTACA = Mindfulness Thinking and Action Scale for Adolescents.

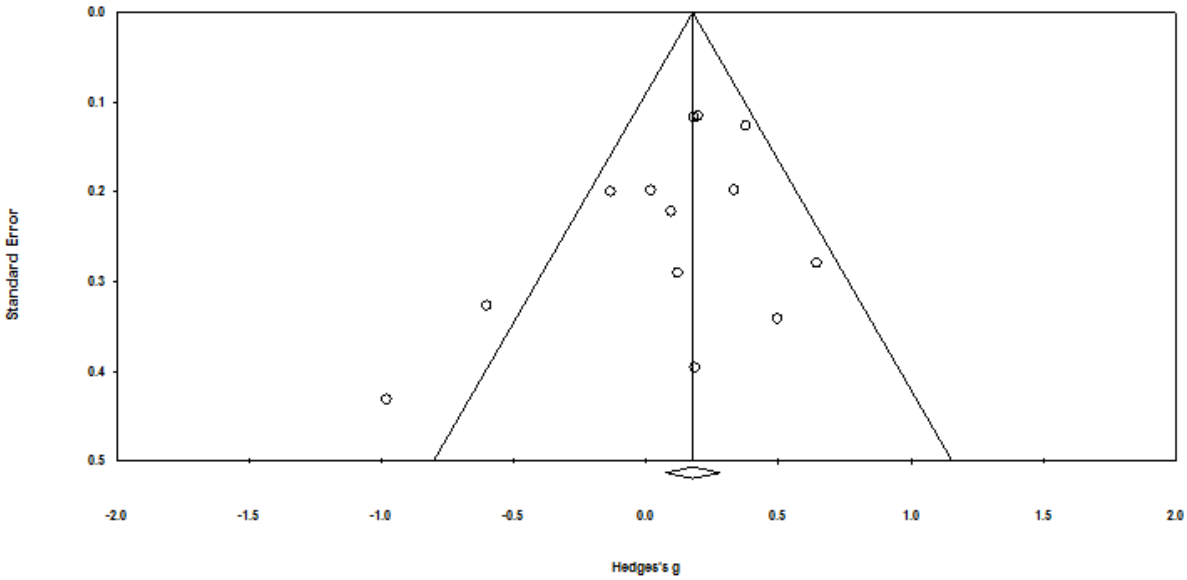
8.12 RISK OF BIAS BY STUDY



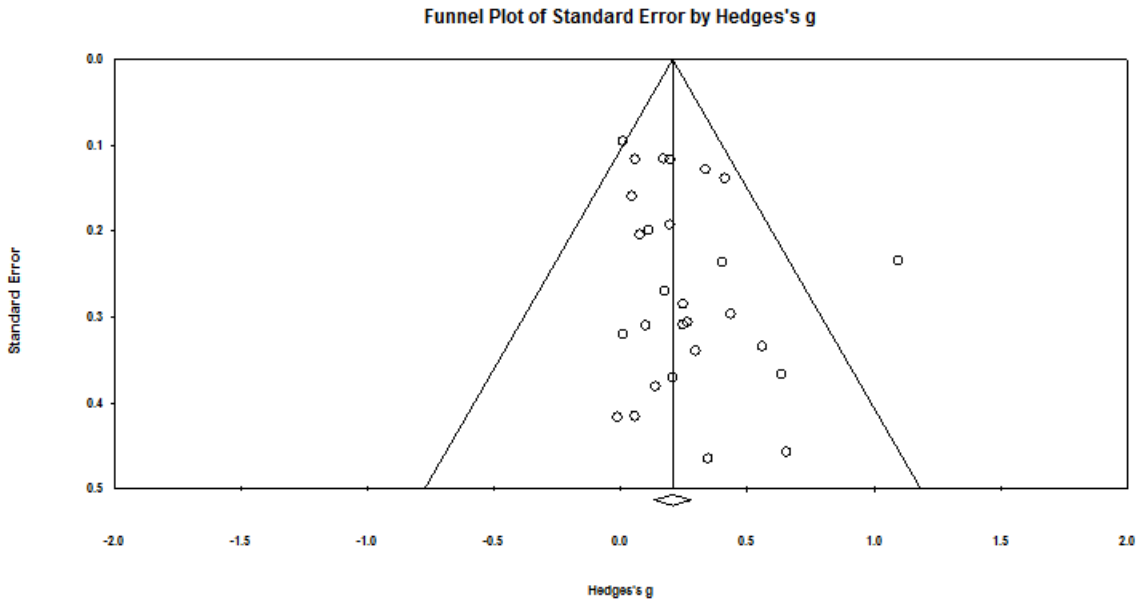
8.13 FUNNEL PLOTS



Cognitive Outcomes: Funnel Plot of Standard Error of Hedges' g



Behavioral Outcomes: Funnel Plot of Standard Error of Hedges' g



Socioemotional Outcomes: Funnel Plot of Standard Error of Hedges' g

CampbellCollaboration

About this review

With the diverse application and findings of positive effects of mindfulness practices with adults, as well as the growing popularity with the public, MBIs are increasingly being used with youth. Over the past several years, MBIs have received growing interest for use in schools to support socioemotional development and improve behavior and academic achievement.

This review examines the effects of school-based MBIs on cognitive, behavioral, socioemotional and academic achievement outcomes with youth in a primary or secondary school setting. MBIs are interventions that use a mindfulness component, broadly defined as "paying attention in a particularly way: on purpose, in the present moment, non-judgmentally", often with other components, such as yoga, cognitive-behavioral strategies, or relaxation skills training.

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