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Review: Effectiveness of mindfulness in improving mental health symptoms of children and adolescents: a meta-analysis

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Background: Mindfulness-based interventions (MBIs) are increasingly used in the management of various mental health disorders in children and adolescents. However, there is limited evidence about the efficacy of various interventions used. **Method:** A systematic review was performed to examine the effects of different MBIs on mental health symptoms and quality of life in both clinical and nonclinical samples of children and adolescents using data from only randomized control trials. The studies were also assessed for quality. Based on the type of MBI, study population, and control arm we had three comparisons for meta-analyses. **Results:** Fifteen studies were included in the qualitative analysis but only 11 trials with comparable interventions and controls were included for meta-analyses. Mindfulness-based stress reduction/mindfulness-based cognitive therapy arm was more effective than nonactive control in the nonclinical populations. Acceptance commitment therapy was comparable to active treatments in patients in the clinical range. Other MBIs were also effective improving anxiety and stress but not depression in nonclinical populations compared to nonactive control. **Conclusions:** Mindfulness-based interventions can be effective in children and adolescents with mental health symptoms. As there were significant limitations these results must be interpreted with caution.

Key Practitioner Message

- MBIs are a useful addition to the armamentarium for the treatment of children and adolescents
- The methodological rigor of the studies evaluating the impact of MBIs is improving
- Acceptance commitment therapy and MBSR appear to fulfill the criteria for empirically supported therapy in young people
- Further studies focusing on the process of change and mediators of positive outcomes are necessary
- Publication bias is an important limitation in this area of research.

Keywords: Meditation; mindfulness interventions; yoga; therapy; RCTs

Introduction

Mindfulness as conceptualized in Western Psychology is paying attention in a particular way, on purpose, in the present moment, and nonjudgmentally (Kabat-Zinn, 2005). It has also been described as the observation of internal or external experiences that arise in a moment with an attitude of acceptance (Baer, 2003). That is, perceptions, thoughts, emotions, or sensations such as sight or sounds are noticed without evaluation as good or bad (Marlatt & Kristeller, 1999). This decentered perspective of just observing the experiences without judgment (Burke, 2009) reduces rumination (Coffman, Dimidjian, & Baer, 2006) and improves emotional regulation (Coffey, Hartman, & Fredrickson, 2010).

Although there is general consensus that mindfulness refers to sustained attention to the present moment, there is no conclusive operational definition (Malinowski 2008). Mindfulness is practiced differently in different mindfulness-based interventions (MBIs) depending on the evolution of each MBI and the patient population that was initially targeted. The majority of MBIs are brief (around eight sessions), group-based, and involve meditation principles and practice (Strauss, Cavanagh, Oliver, & Pettman, 2014). The more popular MBIs are mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1982), mindfulness-based cognitive therapy (MBCT; Segal, Williams, & Teasdale, 2002), dialectical behavior therapy (DBT; Linehan, 1993), and acceptance commitment therapy (ACT; Baer, 2003; Hayes & Wilson, 1993).

In MBSR the main focus is on the practice and refinement of mindfulness techniques such as body scan, sitting mediation, mindfulness of movement, and hatha yoga (Kabat-Zinn, 1990). Hatha yoga involves mindful breathing, postures, and stretches (Kabat-Zinn, 1990). MBSR was initially conceived to relieve the stress and pain associated with illnesses. The MBSR therapists were expected to be dedicated and experienced practitioners of mindfulness mediation themselves (O'Brien, Larson, & Murrell, 2008). MBCT was developed for prevention of relapses of major depression in adults, and basically includes the core curriculum of MBSR with

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the addition of cognitive strategies for depression (Segal et al., 2002). The automatic, ruminative depressive thoughts are challenged with mindful awareness of thoughts, feelings, and behavior. Mindfulness techniques are taught as tools to stay present and not get entangled in the cycle of negative thoughts (O'Brien et al., 2008).

Dialectical behavior therapy and ACT are considered to be multicomponent interventions. Some authors have argued that DBT and ACT should not be classified as MBIs (Zoogman, Goldberg, Hoyt, & Miller, 2014) while others have included them (Chiesa & Malinowski, 2011, Simkin & Black, 2014).

Dialectical behavior therapy is based on biosocial theory and was developed to treat patients with borderline personality disorder who struggle with emotional and behavioral regulation. Acceptance and staying in the present moment without judgment are the main concepts around which the skills taught in this therapy modality revolve (such as mindfulness, distress tolerance, and emotional regulation; Linehan, 1993).

ACT is based on functional contextualism and relational frame theory (Hayes, 2004). The goal of ACT is for greater psychological flexibility which help individuals interact with the present moment to behave in a value driven manner (Hayes,Strosahl, & Wilson, 1999). Four of its six processes: diffusion, acceptance, present moment awareness, and self as context are directly based on mindfulness practices (Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Despite the differing theoretical frameworks, the techniques of DBT and ACT and in fact, MBSR and MBCT all share the focus of acceptance and mindfulness.

Previous studies on MBIs have included yoga (Zoogman et al., 2014).Traditionally yoga has been described to have eight limbs, Yama (ethical principles), Niyama (self-observances), Asana (postures), Pranayama (breath control), Pratyahara (turning inward), Dharana (concentration), Dhyana (meditation), and Samadhi (self-realization; Bonura, 2011). Asana is commonly incorporated in various interventions in the west. During various Asanas the practitioner maintains focus on the physical experience and changes in breathing (Brisbon & Lowery, 2011). This present focused sensory awareness resonates with the concept of mindfulness (Khanna & Greeson, 2013).

MBIs are increasingly used in treating mental health symptoms of children and adolescents. Two previous reviews (Burke, 2009; Harnett & Dawe, 2012) reported that MBIs can be successfully modified to be acceptable in children and adolescents (youth) in different settings. However, most studies identified in those reviews were pilot studies of poor quality.

After reviewing the impact of sitting meditation on youth, Black, Milam, and Sussman (2009) concluded that it appears to improve physiological, psychological, and behavioral conditions. A recent review on Meditation and Mindfulness in Clinical practice (Simkin & Black, 2014) provides a comprehensive conceptual and research overview of this area. The studies of varying quality on different meditative and movement techniques reported in this review showed positive effects on anxiety, depressive, other negative effects, and somatic functioning. However, it did not include several recent randomized control trials (RCTs).

A recent meta-analysis on youth (18 or lesser at the beginning of the study; Zoogman et al., 2014) included 20 studies conducted up to 2011 that used a mindfulness intervention, nonetheless they excluded concentration meditations (e.g., transcendental meditation (TM)] and multicomponent interventions such as ACT & DBT. Studies of yoga and mindfulness were also included in this review (Zoogman et al., 2014). They included all study designs in addition to RCTs. They found that MBIs were more effective in improving psychological outcomes (ES 0.37) compared to physiological (ES 0.23) and cognitive outcomes (ES 0.28). The improvements were greater in the clinical population than nonclinical populations.

The current article is a more recent review following Zoogman et al. (2014), including studies published until January 2014. It is also unique in that it focuses on RCTs only, investigating the impact of MBIs on mental health symptoms in children and adolescents. In addition to yoga, we decided to include DBT and ACT as they both encourage the development of an attitude of nonjudgment and acceptance of the present moment which for this article is how we conceptualized mindfulness. In addition, they include techniques of mindfulness as a substantial component in their treatment package.

The purpose of this systematic review is to evaluate the quality and effectiveness of MBIs in treatment of mental health problems in clinical and nonclinical settings among children and adolescents, based on RCTs in this area.

Method

Selection of studies

We searched the following databases MEDLINE, EMBASE, CENTRAL, Psych INFO, CINAHL, openDOAR in January 2014. We created a systematic search strategy for the following terms 'mindfulness', 'meditation', 'dialectical behavior therapy', 'ACT', 'MBSR', 'MBCT', 'Children and Adolescents', and 'randomized controlled trials' firstly for MEDLINE and then adapted it according to each database (see Appendix S1, for the search strategy used for each database).

The initial search identified 1601 records (following de-duplication). The authors KK and SK examined the abstracts of 1601 records independently and selected studies using the following criteria.

Inclusion criteria

1 Randomized controlled trial,
2 Children OR adolescents,
3 Mindfulness-based interventions (MBIs),
4 Compared to any control condition,
5 Used standardized outcome measures of mental health symptoms stress, anxiety or depression,
6 Clinical and nonclinical samples.

Exclusion criteria

1 Studies using concentration techniques for meditation such as mantra or TM,
2 Studies that did not report any of the mental health symptoms of interest such as depression, anxiety, or stress.

All decisions on the inclusion and exclusion were based on the consensus between the authors KK and SK. Disagreements were resolved by discussion with RK.

Data extraction

The outcomes of interest for this review were stress, anxiety, depressive symptoms, and quality-of-life indicators from validated scales. Two reviewers K.K. and R.K. independently extracted the data. Relevant data for each measure was entered into Comprehensive Meta-Analysis version 2.2.048 (CMA). We examined pretest and posttest scores between groups to assess the effectiveness of MBIs and follow-up effects. If sufficient data were not available in the article, the authors were consulted and additional information requested.

Effect size

Effect sizes (ESs) of Hedges' g were calculated using CMA. This is a variation of Cohen's d that corrects for biases due to small sample sizes (Hedges & Olkin, 1985). If the studies did not report means and standard deviations, other statistics (χ^2, *T*, *F*) were converted into Hedges' *g*. The magnitude of Hedges' *g* may be interpreted using Cohen's convention as small (0.2), medium (0.5), and large (0.8; Cohen, 1988).For the analysis, we assumed the correlation between pre- and posttreatment measures r =0.7 based on Rosenthal's recommendation (Rosenthal, 1993). This approach has been used in a previous meta-analysis (Hofmann, Sawyer, Witt, & Oh, 2010).

Coding of study quality

We assessed the quality of each study using criteria based on the review of empirically supported psychotherapies (Chambless & Hollon, 1998) and the Cochrane Collaboration criteria to assess the methodological validity of the study (Higgins & Green, 2006). This approach has previously been used in a systematic review of mindfulness interventions in adults (Bohlmeijer, Prenger, Taal, & Cuijpers, 2010).We added the criteria of blind outcome assessment to Bohlmeijer's criteria, as it is an important factor to consider in psychotherapy trials. Two authors KK and SK assessed the quality of the studies. Wherever there was a difference of opinion it was resolved by further discussion with RK and consensus.

1 Participants' symptoms were evaluated either using clinical interview or standardized scales with good reliability and validity,
2 Intervention standardized in delivery using a manual or a structured approach,
3 The therapists were adequately trained to offer the treatment,
4 Treatment fidelity assessed (i) by supervision of therapists or (ii) recording of sessions, or (iii) by screening for protocol adherence,
5 The study had *N* of 50 or more, as this allows detection of standardized *ES* of 0.8 or larger assuming a statistical power of 0.8 and alpha of 0.05,
6 Patients randomized using appropriate randomization techniques,
7 Allocation concealed,
8 Blind outcome assessment,
9 Low risk of attrition bias.

The studies were assessed to be of high quality if they fulfilled 8–9 criteria, medium 5–7 criteria, and low if four or fewer criteria were met (Bohlmeijer et al., 2010).

Publication bias

We intended to use funnel plot to evaluate the risk of publication bias, but were unable to use that due to fewer studies in each comparison. Hence, we employed the Egger's test (Egger, Davey Smith, Schneider, & Minder, 1997) to evaluate the risk of publication bias. In this regression equation where the dependent variable is the standardized *ES* and the independent variable is the precision of the *ES*, if the intercept (bias) value is too far from zero, it indicates a potential source of publication bias.

Results

The search identified 1601 studies, of which 15 fulfilled the inclusion criteria (see Prisma flowchart in Figure 1). Eleven studies with a total of 1454 participants were included in the meta-analysis. Ten of the included studies were conducted in the United States, two in Australia, and one each in Belgium, Sweden, and Sri Lanka. Two studies (Evans, Cousins, Tsao, Sternlieb, & Zeltzer, 2011; Malboeuf-Hurtubise, Achille, Sultan, & Vadnais, 2013) with published protocols fit our inclusion criteria but have not been completed, and hence not included in this review.

Characteristics of the included studies are shown in Table 1. Modified MBSR was the most common type of intervention used in five studies, followed by ACT which was used in three studies. We found no study on DBT that fulfilled our inclusion criteria. Although studies presented in this review have been grouped according to their use of the same therapy, they all used different modifications of the therapy thus no two studies using identical interventions (Figures 2–4).

Effectiveness

There were three separate comparisons for meta-analyses based on study grouping according to the type of MBI used in the study (Table 2).

MBSR/MBCT compared to nonactive treatment control in nonclinical populations (five studies) 6–12 week duration (659 participants)

We combined studies using MBSR and MBCT as they have similar principles and use similar techniques. The MBSR/MBCT arm was more effective in improving stress [*ES* = 0.31 (95% CI: 0.05, 0.57); I^2 = 0%;3 studies], anxiety [*ES* = 0.96 (95% CI: 0.55, 1.37); I^2 = 0%; 3 studies], and depression[*ES* = 0.42 (95% CI: 0.22, 0.62); I^2 = 0%; two studies].

ACT compared to active treatment control in clinical populations (three studies) 10–20 week duration (263 participants)

ACT was comparable to active treatments in the management of anxiety [*ES* = 0.02 (95% CI: −0.32, 0.37); Swain, Hancock, Dixon, Koo, & Bowman, 2013] depression (*ES* = 0.57 (95% CI: −0.01, 1.14); I^2 = 65%; three studies] and quality of life [*ES* = 0.38 (95% CI: −0.04, 0.79); I^2 = 22%; two studies).

Other MBIs compared to nonactive treatment control in nonclinical populations (three studies) 2–12 week duration (196 participants)

Other MBIs were significantly more effective in improving stress symptoms [*ES* = 0.67 (95% CI: 0.14, 1.20); I^2 = 52%; two studies] and anxiety [*ES* = 0.87 (95% CI: 0.35, 1.40); I^2 = 0%; two studies] but not depression [*ES* = 0.42 (95% CI: −0.04, 0.88); I^2 = 0%; three studies] in nonclinical populations compared to nonactive controls.

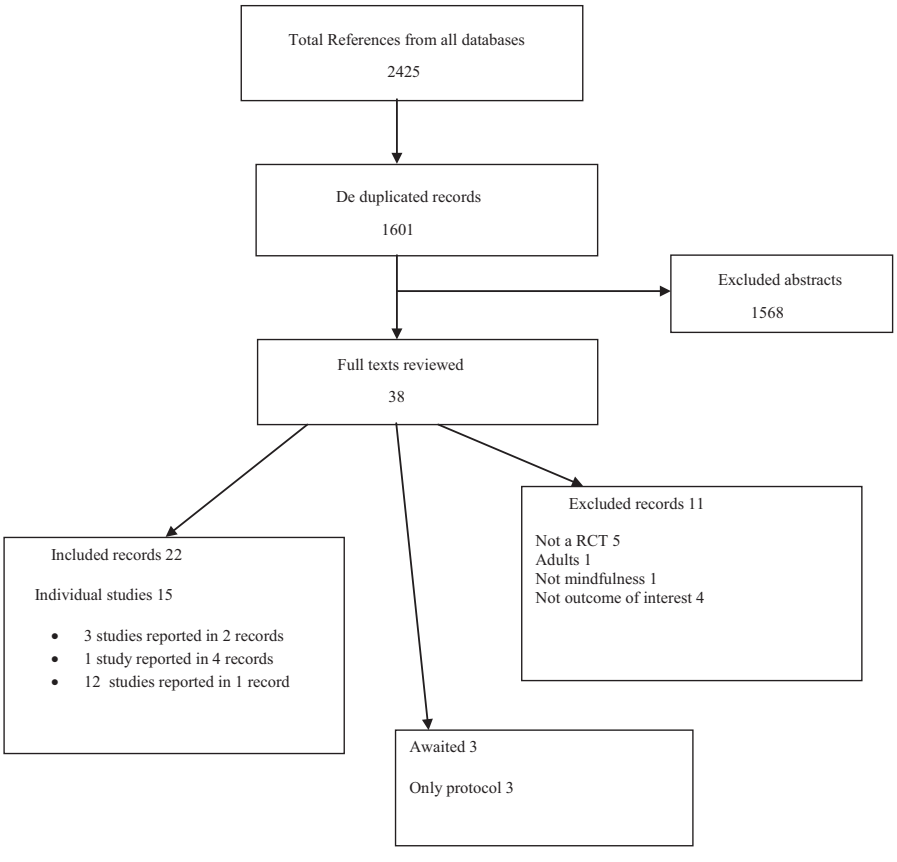


Figure 1. PRISMA flowchart

Publication bias

We employed the Eggers test for comparisons with at least three studies as that is the minimum to generate valid *p* values. The results indicated that publication bias was likely across all comparisons (see Table 2 for further details).

Quality of studies

The quality of interventions was mostly good (see Table 3 for details).

Discussion

This review examined 15 RCTs evaluating the effectiveness of MBIs in improving mental health symptoms in children and adolescents. We excluded studies using mantra meditation and TM as per Zoogman et al. (2014) review, as they are concentration-based rather than mindfulness-based. We decided to include ACT as ACT aims to increase contact with the present moment through the process of mindfulness (Hayes, 2004). Mindfulness techniques are integral to most components of ACT. We found no DBT study that fulfilled our criteria.

Most studies included in our review showed positive outcomes for MBIs on stress, anxiety, depressive symptoms, and quality of life in both clinical and nonclinical samples. This is similar to other reviews (Black et al., 2009; Simkin & Black, 2014; Zoogman et al., 2014).

Chambless and Hollon (1998) defined 'empirically supported therapies' as those demonstrating statistically significant results in at least two good quality RCTs in two independent research settings. ACT and MBSR appear to fulfill those criteria in children and adolescents. It is encouraging that patients in both ACT and MBSR arms continued to be stable or improve during 3- and 6-month follow-ups. In our review ACT was used in clinical population while MBSR was more commonly used in nonclinical populations. Whether there is differential response to different MBIs in different patient population requires further exploration.

As noted by Chiesa and Malinowski (2011), MBIs are a heterogeneous group derived from different philosophical and theoretical constructs. Each type of intervention delivered in different formats, involving different components in addition to mindfulness may work through different processes and may be variably effective in different samples and settings. Hence, we grouped our comparisons based on the type of intervention, control (active or inactive), and clinical or nonclinical population. This is in contrast to the review by Zoogman et al. (2014) that combined results from studies using different types of interventions. Such heterogeneity limits external validity. However, there was variability of interventions even within our groupings, so this is a caveat in this area of research.

In our review MBIs were comparable to active interventions and better than nonactive controls in most studies. While this is encouraging, there is not enough evidence to conclude that the effectiveness is mediated by the mindfulness component. Investigating processes of change is necessary to draw such conclusions. Five

Table 1. Study characteristics

Study ID	Sample characteristics	*N*	Age	Intervention	Control	Outcome measures	Quality	Between groups *ES* pre-post Hedges *g* (95% CI)	Between groups *ES* pre-FU Hedges *g* (95% CI)
Biegel, Brown, Shapiro, and Schubert (2009)	Clinical 49% depression 30.4% anxiety	102	14–17 73% female	MBSR 8 120 min Plus TAU	TAU Individual/group Therapy/ medicines	GAF PSS SCL-90 – anxiety SCL-90 – depression	Medium	8 weeks Stress 0.54 (0.25, 0.84) Anxiety 0.30 (0.02, 0.58) Depression 0.64 (0.36, 0.93) QOL 0.94 (0.65, 1.24)	3 months Stress 0.80 (0.51, 1.09) Anxiety 0.55 (0.27, 0.84) Depression 0.71 (0.42, 1.0) QOL 1.4 (1.16, 1.79)
Salamon , Hainsworth, Ladwig, Davies, and Weisman (2013)	Clinical Chronic pain	6	12–18 75% female	MBSR 6 90 min+ parent	Psycho-education	NA	Low	6 weeks	
White (2012)	Nonclinical School setting	155	8–11 100% female	MBSR (yoga) 8 60 min + HW	Waitlist	FBS	Medium	8 weeks Stress 0.29 (0.02, 0.62)	
Potek (2012)	Nonclinical School setting	30	14–17 48.4% female	MBSR 6 45 min + HW	Waitlist	MASC PSS	Low	6 weeks Stress 0.44 (0.25, 1.14) Anxiety 1.19 (0.44, 1.94)	
Sibinga et al. (2013)	Nonclinical School setting	41	12.5 (m) All boys	MBSR 6 45 min	Health Topics	PSS MASC SCL-90 Depression	Medium	12 weeks Stress 0.23 (0.37, 0.84) Anxiety 0.29 (0.32, 0.91) Depression 0.36 (0.25, 0.97)	3 months Anxiety 0.23 (0.38, 0.85)
Semple, Lee, Rosa and Miller (2010)	Nonclinical Reading difficulty	25	9–13 60% female	MBCT-C 12 90 min + HW	Waitlist	MASC CBCL	Medium	12 weeks Anxiety 0.89 (0.07, 1.7)	
Raes, Griffith, Van der Gucht, and Williams (2014)	Nonclinical School setting	408	13–20 64% female	MBSR and MBCT 8 100 min	No treatment control	DASS	High	8 weeks Depression 0.42 (0.22, 0.64)	
Hayes, Boyd and Sewell (2011)	Clinical Depression	38	12–18 71% female	ACT	TAU (CBT/family)	RADS	Medium	Variable Depression 1.05 (0.36, 1.74)	3 months Depression 6.64 (4.99, 8.3)
Swain et al. (2013)	Clinical Anxiety	193	7–17 58% female	ACT + parent 10 90 min	CBT + parent and waitlist	CHQ MASC CDI	High	vs. waitlist 10 weeks Anxiety 0.73 (0.37, 1.09) Depression 0.19 (0.16, 0.54) QOL 1.16 (0.77, 1.52) vs CBT 10 weeks Anxiety 0.02 (0.32, 0.36) Depression 0.17 (0.17, 0.52) QOL 0.26 (0.08, 0.61)	3 months vs. CBT Anxiety 0.23 (0.11, 0.58) Depression 0.20 (0.14, 0.55) QOL 0.30 (0.04, 0.65)

Table 1. (continued)

Study ID	Sample characteristics	*N*	Age	Intervention	Control	Outcome measures	Quality	Between groups *ES* pre-post Hedges *g* (95% CI)	Between groups *ES* pre-FU Hedges *g* (95% CI)
Wicksell, Melin, Lekander, and Olsson (2009)	Clinical Idiopathic pain	32	10–18 78% female	ACT 10 60 min Parent group	MDT	SF-36 CES-DC	Medium	10 weeks Depression 0.66 (0.14, 1.48) QOL 0.76 (0.05, 1.58)	6 months Depression 0.60 (0.20, 1.41) QOL 0.71 (0.10, 1.53)
Mendelson et al. (2010)	Nonclinical School setting	96	9–10 61% female	Yoga 48 45 min	Waitlist	RSQ SMFQ	Low	12 weeks Stress 0.89 (0.46, 1.3) Depression 0.13 (0.55, 0.28)	
Napoli, Krech, and Holley (2005)	Nonclinical School setting	228	6–10 53% female	AAP 12 45 min	Control	TAS	Low	24 weeks Anxiety	
Liehr and Diaz (2010)	Non clinical Summer camp	18	9.6 (m) 29% female	Mindfulness 10 15 min	Health education	STAI-C SMFQ-C	Low	2 weeks Anxiety 0.50 (0.41, 1.47) Depression 1.05 (0.09, 2.01)	
Noggle , Steiner, Minami and Khalsa (2012)	Nonclinical School setting	51	*M* = 17 57% female	Yoga 30 40 min	Physical education	PSS POMSF-anxiety POMSF-depression	Medium	10 weeks Stress 0.35 (0.25, 0.96) Anxiety 1.04 (0.40, 1.68) Depression 0.49 (0.12, 1.1)	
Catani et al. (2009)	Posttsunami refugee camp	31	8–14 53% female	Meditation 6 60–90 min	Narrative exposure	UPID	Medium	2 weeks Anxiety 0.13 (0.56, 0.83) QOL 0.23 (0.46, 0.93)	6 months Anxiety .10 (0.59, 0.81) QOL 0.23 (0.47, 0.94)

N, number; (m) mean; pre, preintervention; post, postintervention; FU, follow up; TAU, treatment as usual; GAF, global assessment of functioning; PSS, Perceived Stress Scale; SCL-90, symptom checklist 90-revised anxiety and depression subscales; parent, parent sessions included; NA, not applicable; HW, home work; FBS, Feel Bad Scale; MASC, Multidimensional Anxiety Scale for Children; DASS, Depression Anxiety Stress Scale; RADS, Reynolds Adolescent Depression Scale; CHQ, Child Health Questionnaire; CDI, Childhood Depression Inventory; MDT, multidisciplinary treatment; SF-36, The Short Form-36 Health Survey; CES-DC, Center for Epidemiological Studies Depression Scale for Children; SMFQ-C, The Short Mood and Feelings Questionnaire – child version; RSQ, Response to Stress Questionnaire; STAI, The State Anxiety Inventory for Children; POMSF, Profile of Mood States-Short Form; UPID, UCLA PTSD Index for DSM-IV; AAP, Attention Academy Program; TAS, Test Anxiety Scale; CI, confidence interval.

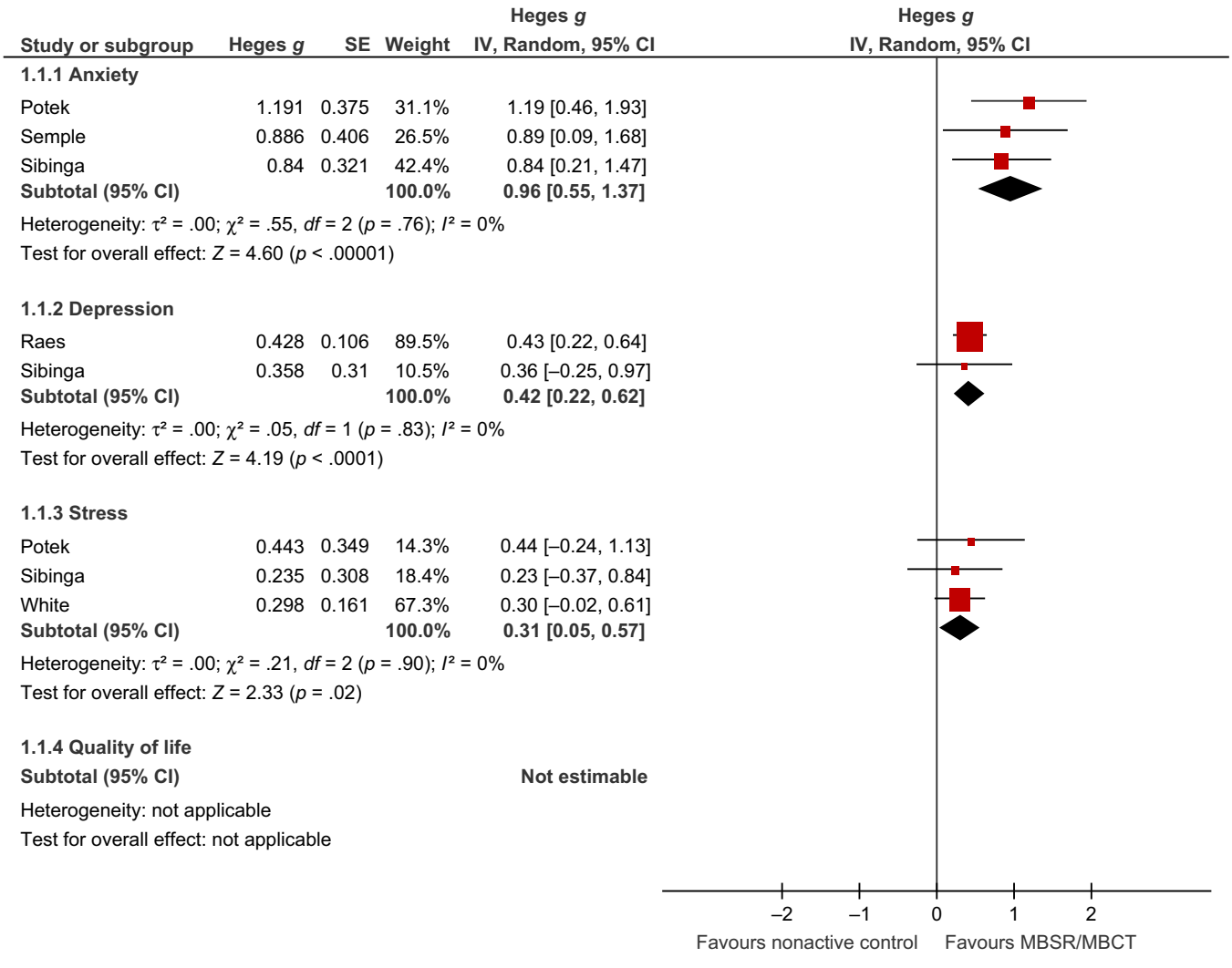
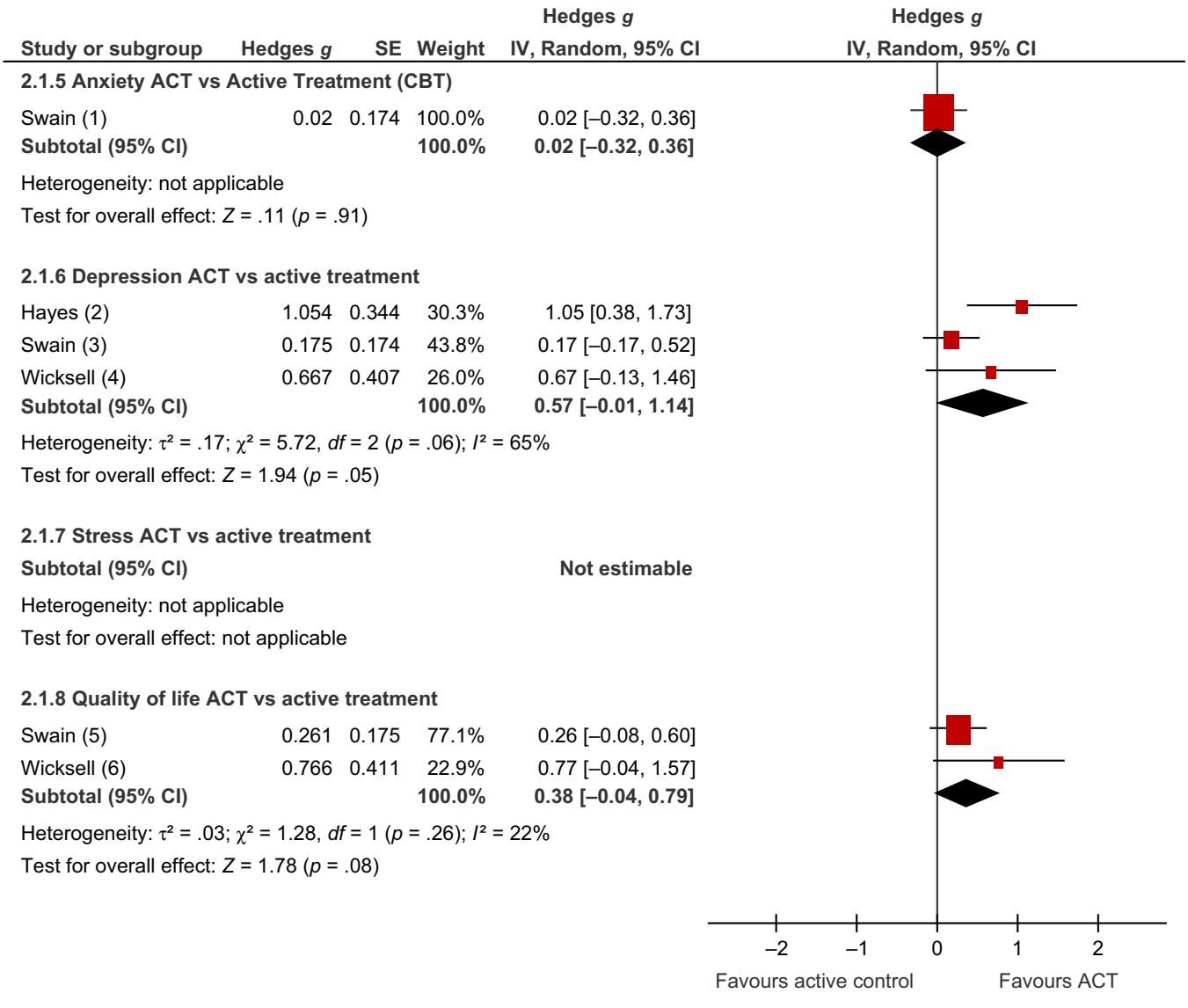


Figure 2. Mindfulness-based stress reduction/mindfulness-based cognitive therapy versus nonactive control (nonclinical population)

studies (Noggle et al., 2012; Potek, 2012; Salamon et al. 2013; Sibinga et al., 2012; Swain et al., 2013; Swain, Hancock, Hainsworth, & Bowman, 2015), used a mindfulness measure to evaluate the quality of the participants' mindfulness, with mindfulness scores not significantly different between arms in any study. In Sibinga et al. (2012) improvement in mindfulness scores across the intervention and control arms correlated with improvement in anxiety scores. This raises some important questions about how the different components of the interventions mediate the outcomes of interest. Swain et al. (2015) examined the ACT hexaflex model as a mediator for therapeutic change in the adolescent subarm of the full study (Swain et al., 2013).Acceptance and diffusion, mindfulness/self as context, and valued living/committed action, were measures at multiple time points. Both ACT and CBT produced changes in process measures. Findings demonstrated limited support for the ACT hexaflex, with indirect effects of acceptance and diffusion. There was a lack of support for ACT and CBT operating through different processes. Swain et al. (2015) suggest perhaps that there is a need to turn investigation to the overarching mediators for the behavioral and cognitive therapies (Swain et al., 2015). It is clear that future research focusing on assessing mindfulness as a mechanism of change is required, particularly in youth.

It is difficult to compare the ESs from our review with previous publications on this topic. While some reviews (Baer, 2003; Burke, 2009; Harnett & Dawe, 2012; Zoogman et al., 2014), included studies which were not RCTs, others (Hofmann et al., 2010; Vollestad, Nielsen, & Nielsen, 2012) calculated ESs for within group differences, or calculated composite ESs across different outcomes (Black et al., 2009; Zoogman et al., 2014)) unlike our review, making it difficult to compare our results.

Bohlmeijer et al. (2010) found a relationship between the quality of the study and the ES. We were unable to perform a sensitivity analysis as we derived data by assuming the correlation between pre- and posttreatment measurements of r = .7, based on Rosenthal's recommendation. (Rosenthal, 1993).Though fewer studies seriously limit our evaluation for publication bias; our analyses indicate that publication bias is likely across all comparisons. This is a significant limitation of our study. Writing to experts in this area about knowledge of unpublished studies could have helped address this issue to some extent.



Footnotes

(1) ACT vs CBT

(2) ACT Vs treatment as usual

(3) ACT vs CBT

(4) ACT Vs multi-disciplinary team treatment

(5) ACT vs CBT

(6) ACT Vs multi-disciplinary team treatment

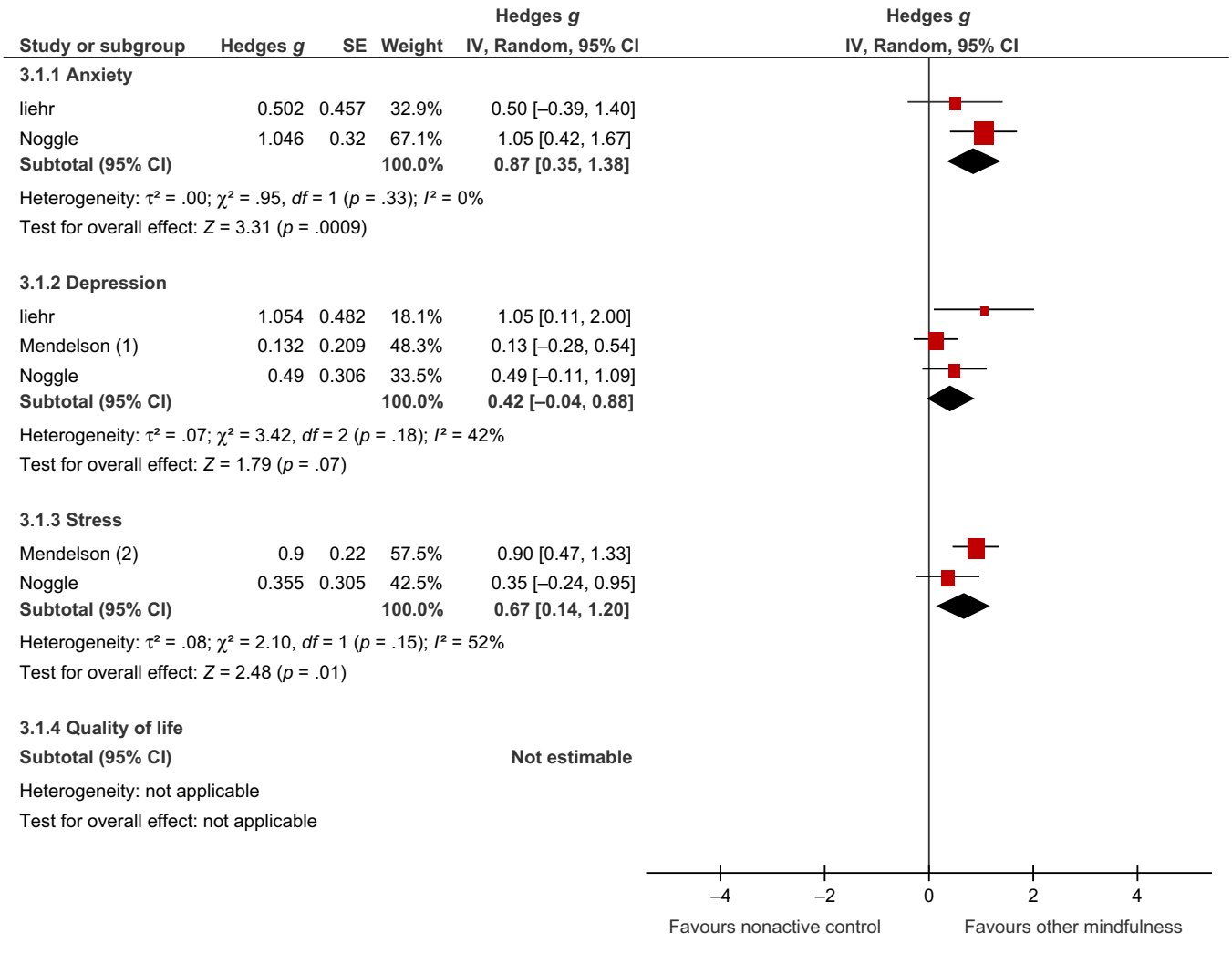
Figure 3. Acceptance commitment therapy (ACT) versus active control (clinical population)

The quality of the studies as measured by the criteria for this study was mostly medium to high. This is in contrast to findings in previous reviews (Burke, 2009; Harnett & Dawe, 2012). However, blind outcome assessment was absent in most studies, and the clustered nature of the data was not accounted for in some studies; thus precluding a high score.

From the studies available it was not possible to conduct a moderator analysis to determine the characteristics of the MBIs that predicted positive outcomes which limits our ability to understand the influence of different variables on the effectiveness of mindfulness.

Future research

Future studies should employ larger sample sizes for greater power and analysis of process measures such as mindfulness measures, use active control and waitlist control arms, employ blind outcome assessment, have multiple informant assessment, and include measures for quality of life and functioning in addition to standardized symptom scores. Further research focusing on assessing mindfulness as a mechanism of change and



Footnotes

(1) Hedges *g* computed using endpoint score

(2) Hedges *g* computed using endpoint score

Figure 4. Other mindfulness-based interventions versus nonactive control (nonclinical population)

Table 2. Effectiveness of mindfulness-based interventions (MBIs)

Outcome	Effect Size Hedges g (95% CI)	*Z* score	I^2 (%)	*p* value	Eggers intercept (bias)	*p* value	Publication bias
MBSR/MBCT vs. inactive control							
Anxiety 3 studies	0.77 (0.20, 1.34)	2.65*	46	.008	1.69	.746	Likely
Depression 1 study	0.43 (0.22, 0.64)	4.05**	NA	.0001			
Stress 3 studies	0.33 (0.04, 0.62)	2.20*	0	.03	0.278	.765	Likely
QOL	Not reported						
ACT vs. active control							
Anxiety 1 study	−0.02 (−0.32, 0.37)	0.12	NA	.91			
Depression 3 studies	0.58 (−0.01, 1.18)	1.92	66	.05	3.31	.316	Likely
Stress	Not reported						
QOL 2 studies	0.39 (−0.05, 0.83)	1.72	25	.08			
Other MBIs vs. inactive control							
Anxiety 2 studies	0.89 (0.37, 1.42)	3.32**	0	.0009			
Depression 3 studies	0.38 (−0.29, 1.05)	1.12	70	.26	[a]		
Stress 2 studies	−0.29 (−1.53, 0.95)	0.46	91	.65			
QOL	Not reported						

QOL, Quality of Life; I^2, index of heterogeneity

[a]Not done as endpoint score was used in one of the studies making it different from the other two studies in the comparison.

*$p < .05$, **$p < .005$.

Table 3. Quality of included studies

Study ID	Structured scales	Manual	Trained therapist experience	Measures to assess treatment fidelity	Adequate sample size (*N*)	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome assessment (attrition bias)
Biegel et al. (2009)	Yes	Yes	Trained in MBSR	Yes	Yes (102)	Not reported	Not reported	Blinded	Low risk
Salamon et al. (2013)	Yes	Yes	Trained in MBSR 11 years	Not reported	Small (6)	Not reported	Not reported	Not blind	High risk
White (2012)	Yes	Yes	Not reported	Journal maintained by therapist Intervention checklist monitored by research assistants	Yes (155)	Not reported	Not reported	Not blind	High risk
Potek (2012)	Yes	Yes	MBSR trained and Certified Yoga instructor	Supervision from a MBSR practitioner	Small (30)	Not an acceptable method	Not reported	Not blind	Low risk
Sibinga et al. (2012)	Yes	Yes	Mindfulness teaching >10 years	Not reported	Small (41)	Acceptable method	Concealed	Some objective measures	Low risk
Semple et al. (2010)	Yes	Yes	Mindfulness teaching >10 years	Sessions videotaped Reviewed by therapists	Small (25)	Not reported	Concealed	Not blind	Low risk
Raes et al. (2014)	Yes	Yes	'Experienced' mindfulness trainers	Therapist discussed sessions to check adherence to protocol	Yes (408)	Acceptable method	Concealed	Not blind	Low risk
Hayes et al. (2011)	Yes	Yes	Psychologists 2.5 day ACT training and other resources	External consultant supervision	Small (38)	Acceptable method	Concealed	Not blind	Unclear

Table 3. (continued)

Study ID	Structured scales	Manual	Trained therapist experience	Measures to assess treatment fidelity	Adequate sample size (*N*)	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome assessment (attrition bias)
Swain et al. (2013)	Yes	Yes	Psychologists >10 years CBT 1–3 years ACT	Rating of video recording Therapist adherence scale Therapist competence scale	Yes (193)	Acceptable method	Low risk	Ratings verified	Low risk
Wicksell et al. (2009)	Yes	Yes	Therapists trained in CBT and ACT	Therapist discussed sessions to check adherence to protocol	Small (32)	Not reported	Concealed	Not blind	Low risk
Mendelson et al. (2010)	Yes	Yes	Not reported	Attendance alone monitored No measure of Tx fidelity	Yes (96)	Not reported	Not reported	Not blind	High risk
Napoli et al. (2005)	Yes	No	Mindfulness teaching >15 years	Not reported	Yes (228)	Not reported	Not reported	Not blind	High risk
Liehr and Diaz (2010)	Yes	Yes	Not reported	Not reported	Small (18)	Not reported	Not reported	Not blind	Low risk
Noggle et al. (2012)	Yes	Yes	Certified Yoga instructors with >500 hrs teacher training	Not assessed	Yes (51)	Acceptable method	Concealed	Not blind	Low risk
Catani et al. (2009)	Yes	Yes	Masters in counseling >760 hrs of training	Therapist filled check list Observation of sessions Supervision	Small (31)	Acceptable method	Concealed	Not blind	Low risk

N, number.

understanding the underlying neurophysiological processes is required.

Limitations

The results of our meta-analysis have to be interpreted with caution. Most studies were performed without blinding, one-third of the studies were rated to be of poor quality, the studies using MBSR used different modifications, there is significant heterogeneity in some results, and a wide confidence interval range. The studies included different age groups and used different rating scales. Further, the studies using ACT used participants with different disorders. These factors make it difficult to estimate comparative effectiveness in this review. Publication bias is another important limitation.

Conclusion

Mindfulness-based interventions appear useful in improving stress, anxiety, and depressive symptoms and quality of life in children and adolescents in both clinical and nonclinical samples. MBSR and ACT satisfy the criteria for empirically supported therapy in this population. Large scale empirical research is required to further improve our understanding on the impact of mindfulness interventions on young people and assessing mindfulness as a mechanism of change.

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Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Search strategy used for databases.

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