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ORIGINAL RESEARCH

Mindfulness Interventions with Youth: A Meta-Analysis

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Abstract Mindfulness meditation is a well-validated intervention for symptoms of depression and anxiety disorders in adults, with meta-analyses showing moderate effect sizes. This study marks the first published meta-analysis of the burgeoning literature on mindfulness meditation with youth (conducted between 2004 and 2011) and identifies specific outcomes and sub-populations for whom mindfulness may be particularly helpful. Inclusion criteria were peer-reviewed journal articles published in English, study participants under 18 years of age, and a description in the methods section of mindfulness as the chief component of an intervention. A systematic search was conducted, of which upon review, 20 articles met inclusion criteria. Mindfulness interventions with youth overall were found to be helpful and not to carry iatrogenic harm, with the primary omnibus effect size (*del*) in the small to moderate range (0.23, $p < .0001$), indicating the superiority of mindfulness treatments over active control comparison conditions. A significantly larger effect size was found on psychological symptoms compared to other dependent variable types (0.37 vs. 0.21, $p = .028$), and for studies drawn from clinical samples compared to non-clinical sample (0.50 vs. 0.20, $p = .024$). Mindfulness appears to be a promising intervention modality for youth. Although to date the majority of studies on mindfulness with youth engage generally healthy participants recruited from schools, the findings of this meta-analysis suggest that future research might focus on youth in clinical settings and target symptoms of psychopathology.

Keywords Meta-analysis · Mindfulness · Mindfulness meditation · Psychopathology · Youth

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Introduction

Meta-analyses conducted over reports of clinical trials of mindfulness with adults generally show medium effect sizes (de Vibe et al. 2012; Khoury et al. 2013). Despite the existence of a growing literature on mindfulness with youth (e.g., Biegel et al. 2009; Black et al. 2009; Burke 2010; Semple et al. 2010), to date a meta-analysis has yet to be published. Meta-analysis can quantitatively determine the overall effect size of mindfulness for youth, as well as identify specific outcomes and sub-populations for whom mindfulness is particularly helpful. These findings generate recommendations for clinical practice and future research.

Currently, there is a strong national movement in the United States to implement mindfulness interventions with youth (e.g., The Hawn Foundation MindUp (Hawn 2011), Inner Resilience Program (Lantieri and Goleman 2008)) often in school settings. However, there is no statement of the general helpfulness nor for what symptoms and what samples mindfulness would be most helpful. This meta-analysis seeks to answer these questions. We now explicitly address the momentum of the broad national movement by offering a summation of the findings to date on the clinical research on mindfulness with youth.

Derived from the Buddhist contemplative tradition, mindfulness has been described as a state of consciousness in which there is an enhanced attention to moment-to-moment experience (Brown and Ryan 2003). Internal and external sensations (e.g., physical sensations, thoughts) are noticed

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without judgment or elaboration. Kabat-Zinn (1994) defined mindfulness as, "paying attention in a particular way: on purpose, in the present moment, and non-judgmentally" (p. 4). Mindfulness has been described as involving three components: intention, attention, and attitude (Shapiro et al. 2006).

Mechanisms of mindfulness include focused attention, decentering, and emotion regulation (Grabovac et al. 2011; Holzel et al. 2011). Mindfulness exercises teach practitioners to continually bring their attention back to present moment experience, noticing current thoughts, emotions, or body sensations. Mindfulness meditation has been shown to increase attention (e.g., Jha et al. 2007; Brefczynski Lewis et al. 2007). Once an individual's attention is focused on present moment experience, the next step in mindfulness practice is to hold that experience with a stance of curiosity and openness. Thoughts, feelings, and body sensations are noticed and understood to be "just" thoughts, feelings, or body sensations rather than a stable reflection of the self (Coffman et al. 2006). This process of "decentering" allows for an individual to take a self-reflective stance toward their experience, observing rather than judging that experience. Learning to sit with and notice thoughts, feeling, and body sensations teaches engagement with rather than avoidance of experience. Mindfulness interventions therefore also decrease rumination, by stopping cycles of either depressive (e.g., "I'm worthless," "I can't do anything") or anxious (e.g., "I'll never do it right," "Everything is going to fall apart") cognitions (Coffman et al. 2006; Teasdale et al. 1995). Being able to notice one's emotions without reacting ("decentering") allows for improvements in emotion regulation (Bishop et al. 2004; Coffey et al. 2010). Choices can be made about the best way to act, rather than reacting instinctively in the moment, and to employ strategies to modulate overwhelming emotions.

Mindfulness has been formulated and implemented in somewhat different ways by various research teams. Two of the most often-used mindfulness interventions are Mindfulness-Based Stress Reduction (MBSR) and Mindfulness-Based Cognitive Therapy (MBCT). MBSR (Kabat-Zinn 1982; Kabat-Zinn 1990) is an 8-week group intervention that meets once per week for 2.5 h and has one all-day session towards the sixth week. Each session has specific formal mindfulness exercises (e.g., body scan, walking meditation) and encourages informal mindfulness practices outside of session, by bringing mindfulness to daily activities (e.g., showering, eating). Beyond the three mechanisms outlined above (focused attention, decentering, and emotion regulation), specific mechanisms of MBSR also include mindfulness and self-compassion (Carmody et al. 2009; Keng et al. 2012). MBCT, an 8-week manualized group protocol adapted from MBSR and developed by Segal, Williams, and Teasdale (2002), was originally formulated to prevent the relapse of major depression. Research suggests that rumination, a style of thought involving reflecting repeatedly about a particular negative past experience, often precedes and maintains depressive episodes (Nolen-Hoeksema 2000). MBCT uses cognitive techniques to disrupt these patterns by instructing participants to notice and identify thoughts and see them as "just thoughts" (Coffman et al. 2006). Mindfulness practice allows for this decentering by practicing non-judgmentally observing one's thoughts rather than avoiding them or falling into habitual thought patterns (Coffman et al. 2006; Teasdale et al. 1995)

Mindfulness interventions with adults have been shown to be beneficial for a variety of mental health and physical health outcomes, including anxiety, depression, and stress (Baer 2003; de Vibe et al. 2012; Greeson 2009; Grossman et al. 2004; Hofmann et al. 2010; Khoury et al. 2013). Meta-analyses of mindfulness interventions with adults have shown a range of effect sizes (Baer 2003; Bohlmeijer et al. 2010; de Vibe et al. 2012; Grossman et al. 2004; Hofmann et al. 2010; Khoury et al. 2013; Klainin-Yobas et al. 2011), with most studies reporting a medium effect size (Cohen's $d = 0.30–0.60$).

De Vibe et al. (2012) reviewed 26 MBSR RCTs and found a moderate overall effect size (Hedges' $g = 0.53$) and similar effect sizes across a range of groups (participants with mild to moderate psychological problems), intervention forms, and outcome measures and settings. Khoury et al. (2013) reviewed 209 controlled and uncontrolled studies using mindfulness-based therapies (MBT; e.g., MBSR, MBCT) and found moderate effect sizes across a range of psychological problems, especially anxiety, depression, and stress. Specifically, there were moderate effect sizes found for pre-post comparisons ($n = 72$; $g = .55$), compared to wait-list controls ($n = 67$; $g = .53$), compared with other active treatments ($n = 68$; $g = .33$), and including other psychological treatments ($n = 35$; $g = .22$). There was no difference found between MBT and traditional CBT or behavioral therapy ($n = 9$; $g = -.07$) or pharmacological treatments ($n = 3$; $g = .13$).

Grossman et al. (2004) reviewed 20 studies using MBSR with both clinical and non-clinical populations and found an effect size of approximately $d = 0.50$ for controlled and uncontrolled studies. Baer (2003) reviewed 22 studies using mindfulness interventions (e.g., MBSR, MBCT) with both clinical and non-clinical populations and found a comparable mean effect size of $d = 0.59$.

Mindfulness interventions have been adapted and tested for youth, including those widely used with adults (i.e., MBSR and MBCT). These interventions have been modified to be developmentally appropriate for child and adolescent populations (e.g., decreasing session length and length of meditation, using more repetition).

MBCT-C is an adaptation of MBCT for children. It has been tested on youth ages 8–14 years (Semple et al. 2006; Semple et al. 2010) and has recently been manualized specifically for anxious children (Semple and Lee 2011). Three

primary modifications from MBCT were made to meet the developmental needs of youth. First, sessions focused upon sensory observation rather than reflection upon abstract or interior experience. Second, due to children's shorter attention span, repetition was employed, length of sessions and length of breath meditation were decreased, while number of sessions and frequency of breath meditation were increased. Third, since children exist within the context of their families, parents were involved in treatment. Parents were trained to support changes in their children by attending an orientation before the start of the program, completing homework with their children, and providing feedback on the intervention (Semple et al. 2006; Semple et al. 2010).

MBSR-T is an adaptation of MBSR for adolescents, and has been tested on youth ages 14–18 years (Biegel et al. 2009). The adaption emphasizes the unique challenges of adolescence, particularly interpersonal and performance challenges. Stress is addressed within the context of specific social issues relevant to adolescents, and a weekly check-in is used to support group cohesion and allow discussion around incorporating mindfulness into daily life (Biegel et al. 2009; Biegel 2009). Modifications in delivery include shortening session length and duration of structured practice, and eliminating the day-long retreat.

Other mindfulness interventions have been developed for specific demographic or clinical populations of youth. The Inner Kids program was developed by Susan Kaiser-Greenland for use from Pre-K through twelfth grade. It emphasizes paying attention to inner and outer experience in addition to compassion (Greenland 2010; Flook et al. 2010). Learning to BREATHE is an intervention developed by Patricia Broderick for adolescents to strengthen emotion regulation, attention, and stress management (Broderick and Metz 2009). Mindful Education (ME) is a preventative intervention developed for the classroom that aims to increase positive emotions, self-regulation, and goal setting (Schonert-Reichl and Lawlor 2010). Meditation on the Soles of the Feet (Singh et al. 2003), is an intervention in which the participant directs his or her attention from an emotionally engaging thought or event to a neutral part of the body—the soles of the feet. It has been used to control aggressive behavior in individuals with autism, conduct disorder, and Asperger's syndrome (Singh et al. 2011a, b).

Overall, the literature on mindfulness can be characterized as most frequently addressing non-clinical populations in school settings (e.g., Flook et al. 2010; Joyce et al. 2010). Some studies have investigated the effects of mindfulness with underserved and low-income populations (e.g., Liehr and Diaz 2010; Mendelson et al. 2010) and a few studies have examined the impact on minority youth in terms of physiological outcomes such as blood pressure (Barnes et al. 2008; Gregoski et al. 2010; Wright et al. 2011). The few studies that use clinical populations have used mindfulness intervention on youth with clinical diagnoses such as learning difficulties (Beauchemin et al. 2008), externalizing disorders (Bogels et al. 2008) including attention deficit/hyperactivity disorder (Oord et al. 2011; Zylowska et al. 2008), internalizing disorders (Semple et al. 2005), substance abuse (Bootzin and Stevens 2005), and mixed clinical samples (Biegel et al. 2009).

The age range of youth participants in mindfulness interventions has spanned from pre-school through high school (e.g., Semple et al. 2010; Sibinga et al. 2011), with the vast majority of intervention conducted with middle and high school students.

Outcomes studied range from measures of general functioning such as academic performance and social skills (e.g., Beauchemin et al. 2008) to psychological symptoms including measures of anxiety (e.g., Liehr and Diaz 2010), depression (e.g., Mendelson et al. 2010), aggressive behavior (Singh et al. 2011a, b), and substance abuse (Bootzin and Stevens 2005; Britton et al. 2010).

The overall effectiveness of mindfulness with youth has yet to be assessed through a comprehensive meta-analysis. Black et al. (2009) conducted a literature review of treatment efficacy for sitting-meditation interventions for youth, including studies that used transcendental meditation (TM), MBSR, MBCT, as well as other adaptations of mindfulness meditation. Median effect sizes for psychosocial/behavioral outcomes (e.g., anxiety) ranged from $d = 0.27$ to 0.70 and median effect sizes for physiologic outcomes (e.g., heart rate) ranged from $d = 0.16$ to 0.29. These effect sizes were slightly smaller than those shown in adult samples (e.g., Grossman et al. 2004). Burke (2010) completed a qualitative review of 15 studies examining mindfulness interventions with children that showed a range of effect sizes from small to large ($d =$ 0.20–1.40). The broad range of effect sizes represented among the studies in these two literature reviews suggests that a systematic meta-analysis would be helpful to inform for which outcomes and for which youth mindfulness is most helpful. Black et al. (2009) and Burke (2010) have provided useful general estimates of the efficacy of mindfulness interventions for youth. However, given the increasing rate of publication in this area, a current and comprehensive meta-analysis that could include aggregated omnibus effect sizes and formal tests of statistical moderation of effect sizes would be welcome. Treatment and future research may be guided by a quantitative synthesis of the field to date.

In this study, we conducted a meta-analysis of all published studies to date on mindfulness with youth (study participants under 18 years of age). Specifically, over these studies we quantitatively assess: (a) Effect Size: What is the overall effect of mindfulness with youth? (b) Treatment Moderators: In what form of delivery and for whom (i.e., sample origin [clinical vs. non-clinical], session length, treatment frequency, etc.) is mindfulness most helpful? (c) Outcomes: For which outcomes (i.e., psychological symptoms, attention, social functioning) is mindfulness the most helpful?

Given the lack of data currently on mindfulness with youth, there was not sufficient power to examine specific sub-populations (e.g., teenagers, middle school students) and interventions (e.g., MBCT-C). This meta-analysis was an exploratory analysis focusing exclusively on youth and looking at mindfulness interventions.

Method

Inclusion and Exclusion Criteria

For inclusion in this study, the article needed to be published in a peer-reviewed journal in English. Conference papers and unpublished dissertations were excluded. Study participants were under 18 years of age at initial assessment (if study included a range of ages, e.g., 13–21, it was included as long as the range began with 17 or below and did not exceed 21).

For inclusion in the meta-analysis, the study must have used mindfulness as the chief component of an intervention (rather than descriptive studies on mindfulness as a trait) and needed to be a mindfulness-based intervention (e.g., MBSR or MBCT) and not concentration-based (e.g., Transcendential Meditation). Studies were included if the intervention had a yoga component in conjunction with mindfulness, since mindful movement through yoga is a key component of many mindfulness interventions (e.g., MBSR). The study was also included if the intervention consisted of only one part of a multi-component mindfulness intervention (e.g., Breathing Awareness Meditation from MBSR). Novel and codified multi-component interventions in which only one part of the intervention was mindfulness (e.g., Dialectical Behavior Therapy (DBT) (Linehan 1993a, b); Acceptance and Commitment Therapy (ACT) (Hayes et al. 1999)) were excluded. Studies where both parents and children received the intervention were included as long as the intervention involved components delivered to the children and parents separately (e.g., Bogels et al. 2008). Studies were excluded if they did not report sufficient data for the computation of within-study effect size variance (e.g., single case studies were excluded as lack of variability precludes estimate of effect size standard deviation). All study designs (e.g., RCTs, pre-post design) were included, except for single-subject design.

All of the studies included in the meta-analysis identify the intervention as "mindfulness" and are empirical studies. Generally speaking, the intervention literature on mindfulness with youth is in an emergent state. As such, at the present time there is insufficient power to examine the specific subtypes of mindfulness interventions. To meet inclusion criteria into the current study, a study must have reported use of mindfulness as defined as "paying attention in a particular way: on purpose, in the present moment, and non judgmentally" (Kabat-Zinn 1994) and used mindfulness as the primary intervention, rather than a sub-component as in DBT.

Search Strategies

A systematic search for published articles on mindfulness interventions with youth through July 2011 was conducted of 10 electronic databases (PsychINFO, MEDLINE, JSTOR, Social Work Abstracts, SocINDEX with full text, ERIC, Sociological Abstracts, Scopus, Web of Knowledge, and Cochrane) over key terms (mindfulness, MBCT, MBSR, mindfulness-based cognitive therapy, mindfulness-based stress reduction, child, adolescent, youth, student, school, young people). Reference lists of quantitative studies, literature review articles, and meta-analyses were inspected for additional articles.

Moderator Analyses

Moderators were coded across studies in order to characterize differences in study samples, delivery method and to test for potential moderations. These moderators included publication year, number of participants, mean age, percent female, percent racial / ethnic minority, sample origin (e.g., clinical vs. non-clinical sample), treatment type (e.g., MBSR, MBCT), treatment length (total weeks), treatment frequency (number of sessions per week), session length (minutes per session), control group type (active vs. wait-list), instructor training (experienced vs. trained for study), outcome variable type (e.g., measure of psychological symptoms, objective measures), recommendation of outside practice, study design (controlled vs. pre-post design), and the two Jadad et al. (1996) study quality criteria relevant to psychological interventions (i.e., randomization, reporting of study attrition). Samples were categorized as "clinical" if participants were included on the basis of specific psychiatric conditions or the sample was drawn from a clinical setting (e.g., psychiatric outpatients).

Coding Procedures Moderator and effect size coding was completed by two doctoral students, with any disagreements discussed and a consensus reached. In those studies that did not report data necessary to compute exact effect sizes for all reported measures and subscales, study authors were contacted directly requesting pre- and post-test means and standard deviations. Where data remained missing at the time of analysis, conservative assumptions were made (e.g., effect size assumed to be equal to zero when significant differences were not found) as has been employed elsewhere (Baardseth et al. 2013). This conservative assumption was applied to at least one measure in seven studies and to a total of 18 effect sizes across all studies.

Data Analysis

Becker's (1988) *del* served as the primary effect size used in effect size aggregation and omnibus analyses. *Del* is a measure of the difference in pre-post effect sizes between groups, in this case comparison between mindfulness interventions and alternative treatments. Use of *del* compares the change over time in the two groups, which is typically the outcome of interest. It also allows for the inclusion of studies lacking a control group with *del* for these studies computed based on an imputed control group effect size (imputed from a sub-omnibus analysis using only active control group effect sizes).

In order to compute *del*, Cohen's (1988) *d* and the variance of *d* were first computed for treatment and control conditions separately using standard methods (Cooper et al. 2009). Next, *d* and its variance were converted to Hedges' *g* (and variance of *g*), in order to correct for bias. Lastly, *del* was computed by subtracting the control group's standardized mean change score (*g*) from that of the treatment group. The variance of *del* was computed by summing the variance of *g* for the two groups. For studies lacking an active control group, the omnibus control group *g* was used to compute *del*. For studies in which treatment and active control groups were not reported separately, *g* as computed from between-group tests (e.g., ANOVA) were used in place of *del*.

Effect Size Aggregation All studies reported data from multiple measures yielding a total of $k = 138$ effect sizes. To address dependency among effect sizes (e.g., aggregating within studies prior to omnibus analyses) we followed procedures recommended by Gleser and Olkin (2009) using the MAd package (Del Re and Hoyt 2010) in the R statistics program (R Development Core Team 2010). A correlation of $r = .6$ was assumed between subscales of a single measure for aggregation and a correlation of $r = .5$ was assumed between outcome measures within a given study (see Wampold et al. 1997 for a rationale).

Omnibus and Moderator Analyses Omnibus analyses were conducted using the MAd and metafor packages (Del Re and Hoyt 2010; Viechtbauer 2010) based on recommended procedures (Hedges and Olkin 1985; Cooper et al. 2009) using restricted maximum likelihood estimation, in which each study contributes a single effect size (*del*) which is weighted based on the inverse of its variance. In omnibus analyses, studies were treated as random effects based on the assumption that there was significant theoretical heterogeneity between the studies (different populations, different treatment types, different lengths of treatment). *Q* statistics were computed using random effects models and served as the statistical test of whether study effect sizes exhibited greater heterogeneity than expected by chance alone.

Further, five separate sub-meta-analyses were conducted using effect sizes from only objective measures (psychophysiological measures, attention and behavioral tasks), only non-objective (teacher-, parent-, or child-report) measures, psychological symptoms (e.g., anxiety, aggression), measures not of psychological symptoms (all measures that were not coded as a measure of psychological symptoms, including measures of social skills, well-being, attention, psychophysiological outcomes, etc.), and measures of mindfulness and attention (e.g. objective attention tasks, self-report mindfulness inventories).

Moderator tests were conducted using two distinct methods. For categorical moderators, a weighted least squares approach was used (Hedges and Olkin 1985; Borenstein et al. 2009) employing the MAd package (Del Re and Hoyt 2010). For continuous moderators, meta-regression was conducted using restricted maximum likelihood (REML) estimation found in the metafor package (Viechtbauer 2010). In order to assess potential publication bias, a funnel plot was constructed using the metafor package (Viechtbauer 2010).

Results

Literature Search Results (Fig. 1)

From the 28 quantitative studies, 2 used mindfulness as one component of a multi-component intervention in which one part was mindfulness (2/28, 7 %), 1 had parts of the intervention involve both children and parents together (1/28, 4 %), 1 only had data available that combined adolescent and adult participants together (1/28, 4 %), 1 reported unique outcome measures for each participant thus precluding estimate of within-study effect size variance (1/28, 4 %), and 3 (3/28, 11 %) reported effect sizes that were determined to be statistical outliers when compared to other included studies based on standard methods for identifying outliers in meta-anlayses (Hedges and Olkin 1985). A total of 20 articles (20/28, 71 %) remained for data analysis.

Overview of the Literature

The 20 studies of mindfulness interventions with youth that met inclusion criteria are summarized in Table 1. The age range was 6–21 years old. Most interventions were conducted in schools. Several intervention types were used, including 3 studies using Mindfulness-Based Stress Reduction, 3 using Mindfulness-Based Cognitive Therapy for Children, 5 using one component of Mindfulness-Based Stress Reduction, and 9 using another type of mindfulness intervention. Most studies used non-clinical samples, with four studies using clinical samples. Dependent variables included a variety of outcomes, including measures of psychological symptoms (e.g., anxiety, depression), measures of general functioning (e.g., social

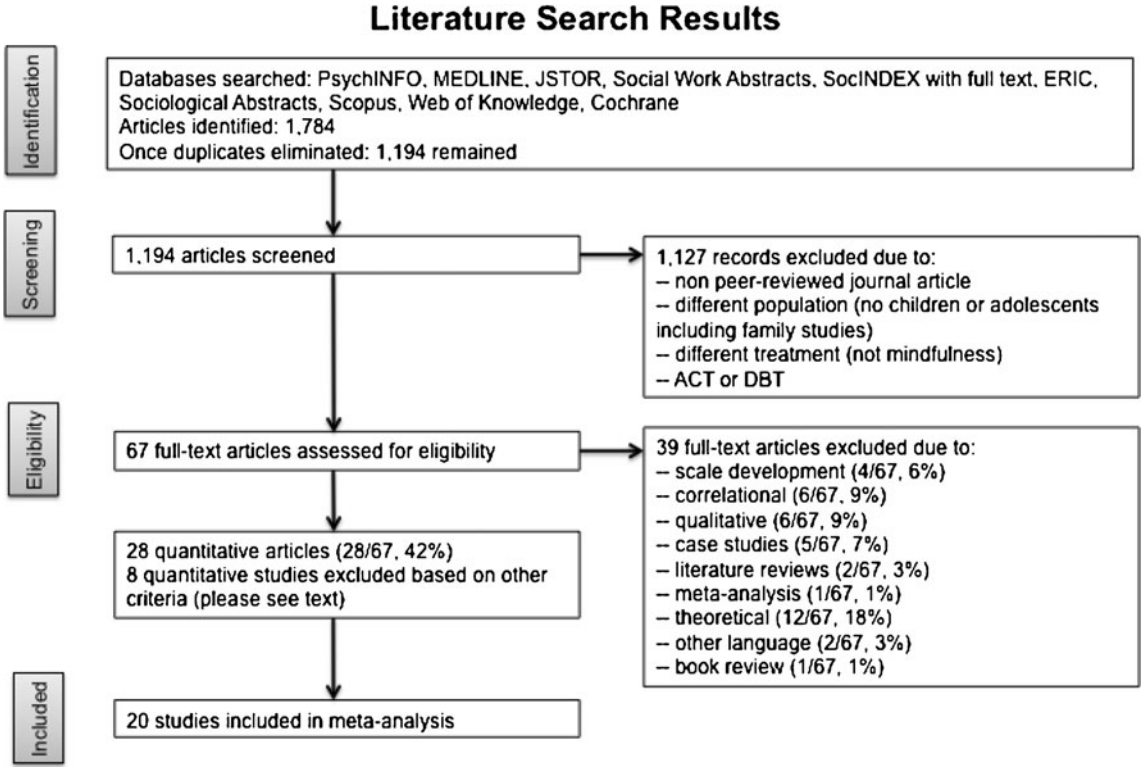

Fig. 1 Literature search results

skills, quality of life) and measures of mindfulness and attention.

Meta-Analysis of Data from Active Control Groups

Twelve of the 20 studies (60 %) compared the treatment group to a control group receiving some alternative treatment (e.g., other school classes, health education classes). The remaining studies reported comparisons to a no-treatment control group ($k=2$) or did not include a control group ($k=6$). To compute comparable effect sizes for these 8 studies (i.e., effect sizes reflecting the gains for the mindfulness treatment group relative to active controls), it was necessary to use an imputed "active control" effect size in computing *del*. We estimated this active control effect size by meta-analyzing the pre-post control group effect sizes from 7 of the 12 studies with active control groups (the remaining 5 studies reported statistics from between-group tests only and thus pre-post control group effect sizes could not be computed). This meta-analysis yielded an average effect size of $g=0.083$ [−0.060, 0.227], reflecting statistically non-significant but numerically modest improvement among active controls from pre- to post-treatment assessments, averaged across dependent variables.

Omnibus Analyses

The primary omnibus analysis was conducted using all effect size types, aggregated first within studies, using the methods described above for computing *del* for paired group and treatment only designs (see Table 2). The primary omnibus effect size was significantly different from zero ($del=0.227$, 95 % CI [0.148, 0.305], $p<.0001$), indicating that on average, the mindfulness condition in the included studies showed significantly greater improvement on outcome measures than the active control conditions. As *del* is in essentially the same unit as Cohen's (1988) d, this effect would be considered small, but it is nonetheless noteworthy as it reflects the superiority of the mindfulness intervention over active control groups. Table 2 displays this omnibus effect size and Table 1 displays individual effect sizes and confidence intervals for all $k=20$ studies included. As this dataset was the most complete representation of study effect sizes, moderator tests were conducted using this aggregation. The Q statistic for the primary omnibus analysis was not significant ($Q(19)=14.73$, $p=.740$), indicating that studies did not show greater between study variation from the omnibus effect size than would be expected by chance alone.

As shown in Tables 3 and 4, five continuous moderators and seven categorical moderators were tested. Table 1 reports study-level effect sizes and coding for a sub-set of moderators tested. For continuous moderators, the slope coefficient (B_1) is used as the significance test, with 95 % confidence intervals containing zero indicating a non-significant result. For categorical moderators, the Q statistic (here a Q_{Between}) for each moderator serves as the test of moderation, with a significant Q indicating that the moderator accounts for significant

Table 1 Effect sizes aggregated across all dependent variable types and study characteristics for included studies

Study	Outcome types	*del*	CI	*N*	Design type	Sample origin	Outside practice	Instructor experience	Tx length (wks)	Intervention type
Barnes et al. (2004)	Obj, Psych	0.20	[−0.17, 0.56]	73	RCT	Non-clinical	Yes	Trained	12	Part of MBSR
Barnes et al. (2008)	Obj	0.13	[−0.47, 0.72]	66	RCT	Non-clinical	Yes	Trained	12	Part of MBSR
Beauchemin et al. (2008)	Psych	0.62	[0.08, 1.16]	34	Tx only	Clinical	No	Trained	5	Other
Biegel et al. (2009)	Psych	0.56	[0.23, 0.89]	102	RCT	Clinical	Yes	Experienced	8	MBSR
Bogels et al. (2008)	Obj, Psych, Mind	0.24	[−0.57, 1.06]	14	Tx only	Clinical	Yes	Experienced	8	MBCT
Broderick and Metz (2009)	Psych	0.28	[−0.01, 0.56]	120	OCT	Non-clinical	No	Experienced	5	Other
Flook et al. (2010)	Mind	0.11	[−0.29, 0.51]	64	RCT	Non-clinical	No	Experienced	8	Other
Gregoski et al. (2010)	Obj	0.23	[−0.01, 0.47]	166	RCT	Non-clinical	Yes	Trained	12	Part of MBSR
Huppert and Johnson (2010)	Mind	0.00	[−0.29, 0.29]	155	RCT	Non-clinical	Yes	Experienced	4	MBSR
Joyce et al. (2010)	Psych	0.11	[−0.18, 0.41]	175	Tx only	Non-clinical	No	Trained	10	Other
Lee et al. (2008)	Psych	0.21	[−0.56, 0.99]	25	Tx only	Non-clinical	Yes	Experienced	12	MBCT
Liehr and Diaz (2010)	Psych	1.14	[0.20, 2.09]	18	RCT	Non-clinical	No	Experienced	2	Other
Mendelson et al. (2010)	Psych	0.22	[−0.13, 0.56]	97	RCT	Non-clinical	No	Experienced	12	Other
Napoli et al. (2005)	Obj, Psych, Mind	0.28	[0.05, 0.51]	228	RCT	Non-clinical	No	Experienced	24	Other
Schonert-Reichl et al. (2010)	Psych, Mind	0.21	[0.01, 0.41]	246	RCT	Non-clinical	Yes	Trained	10	Other
Semple et al. (2005)	Psych	0.16	[−0.58, 0.91]	4	Tx only	Clinical	Yes	Trained	6	Other
Semple et al. (2010)[a]	Psych, Mind	0.16	[−0.50, 0.81]	25	RCT	Non-clinical	Yes	Experienced	12	MBCT
Sibinga et al. (2011)	Psych	0.23	[−0.57, 1.03]	26	Tx only	Non-clinical	Yes	Experienced	9	MBSR
White (2011)[a]	Mind	0.01	[−0.39, 0.40]	155	RCT	Non-clinical	Yes	Experienced	8	Part of MBSR
Wright et al. (2011)	Obj, Psych	0.26	[−0.04, 0.56]	121	RCT	Non-clinical	Yes	Trained	12	Part of MBSR

Note: *Obj* = objective measures, *Psych* = measures of psychological symptoms, *Mind* = mindfulness-related measures (e.g., attention), *RCT* = randomized controlled trial, *OCT* = open-controlled trial (no randomization), *Tx* = treatment, *Tx only* = treatment only design, *del* = effect size (Becker 1988), *CI*=95 % confidence interval, *N* = study sample size, *MBSR* = mindfulness-based stress reduction, *MBCT* = mindfulness-based cognitive therapy, *Tx length (wks)* = length of treatment in weeks; [a] = Included non-active control group, imputed control group *g* used in effect size computations

heterogeneity among effect sizes. Only one moderator—sample origin—was found to significantly moderate study effect size ($Q(1)=5.07$, $p=.024$). For this moderator, studies drawing participants from a clinical sample ($k=4$) reported significantly higher effect sizes ($del=0.500$) compared to those drawn from non-clinical samples ($del=0.197$).

Several additional sub-meta-analyses were conducted using subsamples of the data that were of theoretical interest. Results from these analyses are also presented in Table 2. Sub-analyses (with the exception of examining measures of mindfulness and attention) also used an imputed control group *g* in the calculation of *del* for studies designs lacking an active

Table 2 Primary and sub-omnibus analyses

Measure type	*k*	*N*	k_{Effects}	*del*	95 % CI	*p*	*Q*	*Qp*
All measures	20	1772	138	0.227	[0.148, 0.305]	<.0001	14.731	0.740
Objective measures	6	624	42	0.230	[0.099, 0.361]	0.0006	0.216	0.999
Non-objective measures	19	1716	96	0.255	[0.172, 0.339]	<.0001	17.832	0.467
Psychological symptoms	15	1197	42	0.373	[0.253, 0.494]	<.0001	13.493	0.488
Not psychological symptoms	15	1573	96	0.207	[0.122, 0.293]	<.0001	11.782	0.624
Attention and mindfulness measures	6	807	15	0.280[a]	[0.069, 0.490]	0.009	11.904	0.036*

Note. Studies were modeled as random effects; *Q_p<.05; *k*=number of studies; *N* = number of participants in omnibus analysis; $k_{Effects}$ = number of effect sizes included in omnibus analysis; *del*=effect size (standardized mean difference controlling for pre-intervention scores and control group pre-post change; Becker 1988); *p* = probability value for omnibus *del*; *Q* = homogeneity test for omnibus *del*; Q*p* = probability value for *Q*-statistic (significant *p* indicating more heterogeneity than would be expected by chance alone); *DV* = dependent variable; [a] = effect size represents a combination of *del* (for *k*=4 studies) and *g* (for *k*=2 studies) due to insufficient data to compute control group *g*

Table 3 Continuous moderators predicting variation in aggregated effect sizes across combined dependent variable types

Moderator variable	*k*	B_0	B_1	95 % CI (B_1)	$z(B_1)$	*p*
Age	20	0.110	0.009	[−0.016, 0.035]	0.713	0.476
Sample size	20	0.266	0.000	[−0.001, 0.001]	−0.475	0.634
Percent female	20	0.151	0.001	[−0.002, 0.005]	0.805	0.421
Percent racial/ethnic minority	15	0.142	0.001	[−0.001, 0.004]	1.024	0.306
Publication year	20	0.316	−0.018	[−0.055, 0.02]	−0.932	0.351
Tx length (wks)	20	0.226	0.000	[−0.015, 0.015]	0.022	0.983
Tx freq (per wk)	20	0.203	0.002	[−0.012 ,0.017]	0.296	0.767
Tx total time (mins)	20	0.194	0.000	[0.000, 0.000]	0.541	0.589

Note. Continuous moderators were tested using the primary omnibus dataset (all effect sizes aggregated, first within scale, then within study); *k* = number of studies; B_0 = intercept; B_1 = slope; $z(B_1) = z$ statistic for B_1; *p* = probability value for continuous moderator (significant *p* value indicating significant moderation effects); *Tx length (wks)* = length of treatment in weeks, *Tx freq (per wk)* = frequency of treatment in times per week, *Tx total time (mins)* = total direct instructional time in minutes (i.e., does not include home practice time)

control condition. In these sub-analyses, the following number of studies used this imputed control group *g*: objective measures ($k = 1$), non-objective measures ($k = 8$), measures of psychological symptoms ($k = 7$), and measures not of psychological symptoms ($k = 4$).

All sub-analyses yielded significant omnibus effect sizes. Of note, the omnibus effect sizes found in these sub-analyses were roughly of the same magnitude as the primary analysis omnibus, with the exception of measures of psychological symptoms. The difference between the omnibus effect size found for psychological symptoms (*del* = 0.373) and measures not of psychological symptoms (*del* = 0.207) was found to differ significantly from zero (difference between *del*s = 0.166, [0.018, 0.314], $p = .028$), indicating outcome variable type significantly moderated the observed effect size.

As both outcome type and sample origin were found to significantly moderate the observed treatment effects, it was of interest to determine whether these moderations are confounded, with one or the other driving the observed effect for both. For example, it may have been that outcome type was

Table 4 Categorical moderators predicting variation in aggregated effect sizes across combined dependent variable types

Moderator variable	*k*	*del*	95 % CI	*Q*	*df*	*p*
Sample origin				5.072	1	0.024*
Clinical	4	0.500	[0.250, 0.750]	1.485	3	0.686
Non-clinical	16	0.197	[0.115, 0.280]	8.174	15	0.917
Outside practice				0.357	1	0.550
Recommended	13	0.208	[0.108, 0.308]	7.741	12	0.805
Not recommended	7	0.257	[0.130, 0.384]	6.633	6	0.356
Instructor previous experience				0.033	1	0.855
Experienced	13	0.234	[0.125, 0.343]	11.910	12	0.453
Trained for Study	7	0.219	[0.107, 0.332]	2.788	6	0.835
Intervention type				0.318	3	0.957
One component of MBSR	5	0.193	[0.044, 0.342]	1.192	4	0.879
Other type of mindfulness	9	0.241	[0.135, 0.347]	6.849	8	0.553
MBCT	3	0.199	[−0.228, 0.626]	0.027	2	0.986
MBSR	3	0.245	[0.035, 0.455]	6.343	2	0.042*

Note. Three additional categorical moderators assessed were not displayed above. These included the two Jadad et al. (1996) study quality criteria relevant to psychological interventions (i.e., randomization, reporting of study attrition) and study design (controlled vs. pre-post designs). None of these study characteristics significantly moderated treatment effects (for randomization: $Q = 0.688$, $p = .407$; for reporting of study attrition: $Q = 1.27$, $p = .260$; for controlled vs. pre-post design: $Q = .002$ $p = .965$). *k* = number of studies within each level of categorical moderator; *del* = effect size for studies within a given category level; *Q* for categories represents $Q_{Between}$ and tests whether moderator accounts for significant variability between studies; *Q* for levels of categorical moderators tests whether significant variability exists between studies included in a given level; *p* = probability value for either *Q* statistic (significant *p* value indicating either significant moderator effects or significant remaining heterogeneity in effect sizes)

*$p < .05$

only a significant moderator because studies drawn from clinical samples included more of these measures and clinical samples generally showed larger effects. However, in a multivariate meta-regression model that included both type of outcome and sample origin as predictors, each was shown to uniquely predict effect sizes when the other was simultaneously controlled. The intercept in this model was significantly different from zero (B=0.182, [0.095, 0.270], p<.0001). Type of outcome (coded as psychological symptoms=1, not psychological symptoms=0) and sample origin (coded as clinical sample=1, non-clinical sample=0) each uniquely predicted effect sizes (Bs=0.160 and 0.273, 95 % CIs=[0.024, 0.300] and [0.066, 0.481], ps=.021 and .010, for outcome type and sample origin, respectively).

A significant Q statistic was found for a sub-analysis using only attention and mindfulness measures ($Q(5)$=11.904, p=.036; Table 2) as well as for the MBSR level of the intervention type categorical moderator ($Q(2)$=6.343, p=.042; Table 4). Although it is possible these represent true heterogeneity in effect sizes, the mindfulness and attention measures sub-analysis used by far the smallest number of effect sizes of any sub-analysis (k=10), a small number of studies (k=6), and should likely be interpreted cautiously. Similarly, the MBSR level of the intervention type categorical moderator included a small number of studies (k=3) and intervention type itself was not a significant moderator of between-study heterogeneity.

Lastly, a funnel plot with standard error on the vertical axis and effect size on the horizontal axis was constructed based on data used in the primary omnibus analysis and inspected for outliers indicative of publication bias. No studies were outside of the 95 % confidence interval of expected deviations from the omnibus effect size nor did there appear any obvious gaps in the distribution of studies. This provides evidence against the possibility that the observed effect is due primarily to publication bias.

Discussion

Our meta-analysis over reports of mindfulness interventions with youth (2004–2011) shows an overall small effect size over a broad range of sub-samples and outcomes (del=0.227) for treatments employing mindfulness with youth when compared to active alternative treatments. The effect size for clinical samples was in the moderate range and nearly three times the magnitude of that found with non-clinical samples, suggesting that mindfulness may be particularly beneficial for clinical populations. With respect to specific outcomes, mindfulness most robustly addressed symptoms of psychopathology, with nearly twice the general effect size found for these measures compared to other outcome types. Further, a multivariate meta-regression analysis including both outcome type (psychological symptoms vs. other outcome types) and sample origin (clinical vs. non-clinical) as simultaneous predictors found both symptoms of psychopathology and clinical samples to uniquely predict effects, ruling out the possibility that either effect was being driven by confounding with the other.

Universal Effect Size

We found a universal, non-specific effect size for mindfulness interventions (del=0.227), with these interventions consistently outperforming active control conditions. There was no significant moderation associated with most aspects of study design or delivery system of mindfulness (outside practice, instructor previous experience, session length, treatment frequency, treatment length, intervention type, age, sample size, percent female, percent racial/ethnic minority, publication year), with the exception of sample origin (clinical vs. non-clinical sample). There was no differential effect for most dependent variable types demonstrated by the similar omnibus effect sizes for the sub-meta-analyses (objective measures, non-objective measures, attention and mindfulness measures). It was found, however, that measures of psychological symptoms yielded higher effects than other outcome types. It is important to note that for the sub-omnibus analysis for attention and mindfulness measures, mindfulness interventions were shown to directly increase mindfulness and attention (del=0.280). While mindfulness interventions effect on mindfulness and attention in youth has been shown in individual studies (Huppert and Johnson 2010; Bogels et al. 2008; Napoli et al. 2005; Semple et al. 2010; Zylowska et al. 2008), this is the first time this has been demonstrated in a meta-analysis.

The absence of significant moderation (except for sample origin and outcome type) is in contrast to a literature that theorizes a differential effect for various moderators, such as outside practice (Huppert and Johnson 2010) or experience of teacher (Kabat-Zinn 1990, 2003). It is feasible that moderators may exist on acquisition of mindfulness by youth, but that we are not able to detect this effect due to the limited number of studies available for meta-analysis. However, it also may be the case that in the acquisition of mindfulness by youth there exist fewer moderators then in the acquisition of mindfulness by adults. Youth may learn more quickly, requiring fewer sessions and less practice; issues of instructor expertise may be less prescient to teaching youth mindfulness.

Significant Moderators: Sample Origin and Outcome Type

The two significant moderators found in our study—clinical samples showing higher effects than non-clinical samples (del=0.500 vs. del=0.197), measures of symptoms showing higher effects than other dependent variables (del=0.373 vs.

del = 0.207)—offer a convergent picture, suggesting that mindfulness interventions for youth may be most effective when applied in clinical samples or when aimed at symptoms of psychopathology. It also may be true that mindfulness interventions for youth have a stronger effect on reducing negative symptoms than on increasing positive functioning.

While these significant moderator tests may need to be interpreted somewhat cautiously, especially given the small number of studies using clinical samples ($k = 4$) and the non-significant Q-statistic from the primary omnibus analysis, we offer three interpretations on the relatively greater effect of mindfulness interventions on clinical samples. First, clinical samples have more space for significant improvement than non-clinical samples given their more severe baseline symptomatology. Other short-term modalities (e.g., Cognitive-Behavioral Therapy and Interpersonal Psychotherapy) have also shown stronger effects for subjects with more severe baseline depression symptomatology (e.g., Mufson et al. 2004). As mindfulness interventions included in this meta-analysis were similarly short-term, it is perhaps unsurprising that this similar pattern of results was found.

Second, the three largest studies that used psychiatric samples were all adolescent samples. One small study ($n = 4$; Semple et al. 2005) was also included in this category that used a younger sample (mean age = 7.5 years), but this study likely had little effect on the sub-omnibus effect size given its small size. Adolescents' stage of cognitive development, with the strengthening of meta-cognitive and abstract thinking skills (e.g., Schneider and Lockl 2002; Piaget 1969), may allow them to benefit more from mindfulness interventions than younger children. Supporting this contention, sample age, tested as a continuous moderator, showed a numerically positive effect on overall effect size ($B_1 = .009$), although this relationship failed to reach statistical significance ($p = .476$).

Another potential reason for the differential effect favoring clinical samples might be that mindfulness teaches less pathological uses of attention. Underlying some psychopathology is an unhealthy self-focused attention (Ingram 1990), often involving rumination. Mindfulness interventions break ruminative attentional patterns, teaching attention that is "reflective, open-minded, and experiential" (Baer 2009, p. 18; Campbell et al. 2012). In mindfulness, thoughts and sensations are noted without attributing them to fundamental aspects of the fixed self (Baer 2009).

Possible Mechanisms: Attention and Mindfulness

The universal, broad, and consistent effect size points to a foundational improvement in psychological functioning that mindfulness interventions may be accessing. In that the sub-omnibus analysis for attention and mindfulness measures was significant and roughly the same magnitude as the overall global effect, we speculate that attention may be the internal psychological mechanism that transmits the effects of mindfulness interventions based upon previous research showing attention to improve through mindfulness practice (see Davidson and Goleman 1977; Cahn and Polickh 2006) including in children (e.g., Napoli et al. 2005; Flook et al. 2010). A direct test of mediation was not possible due to a lack of reported associations between changes in mindfulness and changes in other outcomes in the included studies. However, previous research has shown the effect of meditation on attention (e.g., Jha et al. 2007; Brefczynski Lewis et al. 2007). Concentration meditation has been shown specifically to modify systems of attention in adolescents (Baijal et al. 2011).

Clinical Practice and Research Implications

Greater effect sizes were shown: (a) in clinical sample as compared with non-clinical samples and (b) on symptoms of psychopathology as compared with the other dependent variables. Taken together, it appears that mindfulness interventions may be particularly helpful in treating youth with current symptoms of psychopathology. To date the overwhelming majority of studies have focused on school-based settings, providing mindfulness to increase attention and positive psychological and academic outcomes. The current meta-analysis suggests that mindfulness as treatment for psychopathology in youth demands further investigation in the form of controlled clinical trials in clinic settings.

The broad and non-specific effects of mindfulness suggest its use in multiple settings for multiple outcomes, given that mindfulness most likely engages a form of executive functioning in youth. The meta-analysis is perhaps most helpful in identifying promise of mindfulness for symptom reduction in youth in clinical settings, with high levels of symptomology, as this population has yet to benefit from the broadening dissemination of mindfulness.

The current state of the literature on mindfulness with youth is such that a common definition of "mindfulness" (Kabat-Zinn 1994) is often used, specifically "paying attention in a particular way: on purpose, in the present moment, and non judgmentally" (p. 4). In practice, however, there is a broad range of translational technique, which is to say a lack of uniformity in implementation which is not extensively reported in the research literature. To investigate and then resolve differences on the literature on mindfulness, it is recommended that data be collected on currently running interventions, perhaps in the form of effectiveness rather than efficacy trials, and published in peer-review scholarly journals to provide opportunity to compare interventions.

Limitations

There were five primary limitations in this study. First, as in the conducting of any meta-analysis over clinical trials, there

exists substantial variation among interventions, although in our study, this heterogeneity was both coded through moderators and tested statistically with the Q statistic and the moderator tests. Second, the overall number of studies in this meta-analysis was small ($k=20$). The small k decreases statistical power (and thereby the ability to detect moderators) and makes estimates of effect sizes less stable (i.e., less reflective of the true population value). In addition, the k for clinical samples was small ($k=4$). Third, the comprehensive literature search for this meta-analysis was conducted in July 2011. Given the high rate of publication in the area of mindfulness (Brown et al. 2007), it is likely publications in the prior two years have been missed. Nonetheless, the present study's non-significant Q statistic and the random effects modeling make it more plausible that the current findings represent the expected effects in this larger potential population of studies. Fourth, while addressed statistically, the studies vary methodology (e.g., control groups, sample origins and demographics, random assignment, random sampling), which limits both internal and external validity. Our use of an imputed active control group g, although requiring additional statistical assumptions, does address some of the more troubling between-study variations (i.e., lack of control conditions). Fifth, the current meta-analysis examined clinical trials within the field of psychology to maintain a general uniformity in general design, level of analysis, and form of assessments and outcomes. Although there indeed exists research on mindfulness in marketing, education and sociology, and some other fields, in the current study specifically analysis at the level of the individual (rather than classroom, group or community level measures or interactions) with customary related standard assessment formed the focus. Within these limitations, many of which apply to meta-analysis generally, the study marks the first published meta-analytic report of mindfulness with youth, providing information to inform practice and future research.

Future Directions

The findings from this meta-analysis suggest that future research might focus on mindfulness interventions with clinical samples of youth as well as examine the effects of these interventions on symptoms of psychopathology. Mindfulness might be investigated as adduced to treatment-as-usual and tested across inpatient and outpatient settings.

In terms of policy we propose four key points. First, mindfulness can safely be used with youth to address a broad range of social and emotional targets. Second, mindfulness can be integrated into a broad range of settings for youth, to include community, youth programs, and schools. Third, the mass dissemination of mindfulness could allow data collection in order to find which form of mindfulness helps with specific outcomes or to determine that many forms are equally helpful. Fourth, existing evidence suggests that mindfulness shows particular promise for youth who suffer with high levels of symptomology, such that policy might fund reasoned implementation, adaptation, and testing of mindfulness for youth with high levels of symptomology, in such settings as clinics, hospitals, and homeless shelters.

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