CHAPTER 16

Mindfulness Training for Children and Adolescents

A State-of-the-Science Review

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Over 30 years of accumulated scientific research has shown that mindfulness training can benefit adults in numerous ways. Those who are healthy and those with psychiatric and physical health conditions often experience reductions in mental and physical health symptoms, as well as enhanced well-being (see Parts IV and V, this volume). Consequently, several versions of mindfulness training, including mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990) and mindfulness-based cognitive therapy (MBCT; Teasdale et al., 2000) have earned the designation of "probably efficacious" treatments (Baer, 2003) and have more recently received high (3+ out of 4) *quality of research* and *dissemination* scores as designated by the U.S. Department of Health and Human Services (USDHHS) National Registry of Evidence-Based Programs and Practices (Substance Abuse and Mental Health Services Administration, 2013).

Research on mindfulness training for children and youth has a much shorter history. As of 2013, less than 5% of the over 2,600 scholarly publications on mindfulness pertain to children and adolescents (Black, 2010, 2013). Yet a cursory Internet search indicates that organizations delivering mindfulness training to this population are growing in the United States and around the world. Given the paucity of empirical evidence to parallel this accelerating trajectory of program delivery, the prevailing rationale must be that what is good for adults must also be good for *youth*—a term I use in this chapter to refer collectively to children and adolescents.

However youth live in cognitive, emotional, social, and behavioral worlds that are qualitatively different from those of adults. Consequently, scientific evidence indicating that mindfulness training is beneficial for adults may not generalize to youth.

Additional evidence is needed to determine whether mindfulness training might benefit youth in the same or different ways than have been found to help adults in the various areas of enhanced human health and reduced psychological suffering.

My aim in this chapter is to (1) present a state-of-the-science review of the available empirical evidence on mindfulness training for youth, spanning kindergarten to late adolescent years; (2) provide a discussion on the aggregate evidence and note the most promising and replicated findings that suggest outcomes that yield "probably efficacious" treatment effects; and (3) note limitations in this compendium of literature, and highlight future directions needed to advance the field of research.

Review of Research on Mindfulness Training for Youth

Review Methodology

The terms *child, youth*, and *adolescent* were used to search the most comprehensive mindfulness database available (i.e., Mindfo) that warehouses over 3,000 empirically based mindfulness references, pulling from literature searches conducted every month from PubMed, Ovid, PsycINFO, Web of Science, and Google Scholar (Black, 2013). Mindfo searches the aforementioned databases with the following search terms: *mindfulness, mindfulness meditation, mindfulness-based*, and *mindfulness training*, as well as combinations of these terms. Additionally, citations are received from authors in the scientific community, and table of content searches are conducted for topic-specific journals (e.g., *Mindfulness*). Inclusion criteria for this review included samples under age 19 years (two studies with participants 19 years and older were included given that the vast majority of the sample was under age 19 years), and the study must have tested a mindfulness-based intervention. Excluded were etiological and conceptual studies, as well as articles not written in English.

The current search scanned articles published between January 1966 and March 2013. The year 1966 was selected as a start date because this was when the first empirical paper on mindfulness training appeared. In addition to the computer-assisted searches, bibliographies of previous review papers on the topic (Black, Milam, & Sussman, 2009; Burke, 2010) were scanned to crosscheck for comprehensiveness.

Results of the Review

Table 16.1 presents the sample characteristics, intervention type, study design, treatment modality, and findings for all studies included in the review. The 41 included studies comprised 13 experimental trials (i.e., randomized controlled trials) and 28 quasi-experimental trials (i.e., seven nonrandomized controlled trials, 15 cohort studies, and six case studies). The first-ever study on the topic was published in 2002, indicating a relatively short (11 year) publication history. Training was administered as early as the kindergarten years, and delivery occurred most often in schools (n = 18), followed by clinics (n = 15), homes (n = 4), correctional facilities (n = 2), and community locales (n = 1). The majority of studies (n = 32; 78%) administered training to youth at risk for a prespecified health condition (e.g., heightened blood pressure, psychiatric disorder, conduct problems, drug use), while nine studies intervened

with "healthy" youth, indicating that the majority of research is based on *secondary* rather than *primary* prevention of health risk outcomes.

The majority of mindfulness training programs were adapted from the MBSR and MBCT interventions, originally developed for the adult population. Other studies administered select components of these programs or provided mindfulness training in tandem with other psychotherapeutic modalities not part of the original MBSR family of interventions. Where indicated, most all studies reported that adaptations to the adult program were needed for the intervention to be suitable for youth. Examples of adaptations included shortening both the program and the individual training sessions, making didactic instruction relevant for the developmental needs of children, modifying intervention activities (e.g., focusing attention on a stuffed animal rising and falling on the belly), and reducing or omitting home mindfulness practice time.

Study Design Characteristics

Of the 13 randomized controlled trials (RCTs), almost half (n = 6) included an active control condition, while the remaining trials implemented a wait-list, treatment-as-usual, or presumed inert (e.g., silent reading) condition as a comparison group. Active control conditions included health education only (n = 3), health education or Botvin Lifeskills Training (n = 1; two control groups included within this study; Botvin, Eng, & Williams, 1980), arts and crafts (n = 1), and problem solving (n = 1). Of the seven nonrandomized controlled trials (NCTs), two (29%) used an active control condition, namely, health education (n = 1) and arts and crafts (n = 1). NCTs with inactive control conditions included wait-list (n = 4) and unspecified (n = 1) conditions. The 20 remaining quasi-experimental studies comprised small-cohort and single-case study designs, which indicates that almost half of the available literature is limited by lack of appropriate controls to account for artifactual effects on observed outcomes.

Neurocognitive Outcomes

Mindfulness training includes the practice of sustained and nonjudgmental attention to present moment experience—a type of attention that is not bound to habitual, discursive thinking, as is common in daily life. Repeated practice of directing attention in this manner is thought to "strengthen" associated neurocognitive capacities much in the same way that exercise strengthens muscle fibers associated with the specific physical targets of strength training. Therefore, the practice of intentionally directing this form of attention should strengthen the development of executive networks that oversee higher-order control of attention and awareness.

Executive function refers to the "higher order, self-regulatory, cognitive processes that aid in the monitoring and control of thought and action [including] inhibitory control, planning, attentional flexibility, error correction and detection, and resistance to interference" (Carlson, 2005, p. 595). In brief, it is an umbrella term for the system that coordinates attention, planning, decision-making, self-regulation, and goal-directed behaviors (Suchy, 2009), and is associated with brain activity in the posterior medial frontal cortex and the lateral prefrontal cortex (Ridderinkhof, Ullsperger, Crone, & Nieuwenhuis, 2004).

TABLE 16.1. Description of Studies Examining Mindfulness Training among Youth

Study	Age ($M \pm SD$), age range, or grade	N	Program origin/ sample	Study design/ location	Control group	Data points	Treatment duration	Observed changes
Barnert et al. (2014)	14–18 y	29	MM/ incarcerated males	Cohort/ corrections	None	Pre Post	60 min, 1 time/w for 10 w + 7 h retreat	MT group showed improvement in self-regulation at posttest; mindfulness, impulsivity, and perceived stress scores improved but did not reach significance.
Barnes et al. (2004)	12.3 ± 0.6 y	73	MBSR/ healthy, majority AA	RCT/ school	HE	Pre Post	10 min, 2 times/ day for 12 w	MT group showed lowered resting systolic blood pressure, afterschool ambulatory systolic and diastolic blood pressure, afterschool heart rate, and nighttime heart rate compared to controls.
Barnes et al. (2008)	15.0 ± 0.7 y	66	MBSR/AA with eBP	RCT/ school	HE	Pre Post	10 min, 2 times/ day for 12 w	MT group showed lower systolic blood pressure and heart rate during school, and nighttime urinary sodium excretion rate and sodium content compared to controls.

Beauchemin et al. (2008)	13–18 y	34	MBSR/ learning disabled	Cohort/ school	None	Pre Post	5–10 min, 5 d/w for 5 w	MT associated with reduced trait and state anxiety scores at posttest, and teacher ratings of decreased problem behavior.
Bei et al. (2012)	13–15 y	10	MBCT/poor sleepers	Cohort/ school	None	Pre Post	90 min, 1 time/w for 6 w	MT associated with objective and subjective improvements in sleep quality with effect sizes ranging from small (e.g., total sleep time) to large (e.g., sleep onset latency and sleep quality); small effect size for improvement in anxiety symptoms.
Biegel et al. (2009)	15.4 ± 1.2 y	102	MBSR/ outpatient psychiatry	RCT/clinic	TAU	Pre Post 3-m FU	120 min, 1 time/w for 8 w	MT group showed self-reported improvements in anxiety, depressive symptoms, somatization, self-esteem, mental health, and sleep quality relative to controls; clinicians rated higher DSM Global Assessment of Functioning and diagnosis change for MT group compared to controls at posttest and 3-m FU.

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TABLE 16.1. *(continued)*

Study	Age ($M \pm SD$), age range, or grade	N	Program origin/ sample	Study design/ location	Control group	Data points	Treatment duration	Observed changes
Black & Fernando (in press)	K–grade 6	409	MM/low SES ethnic minority	Cohort	None	Pre Post 7-w FU	15 min, 3 times/w for 5 w	MT associated with teacher-reported improvements in classroom behavior of their students (i.e., paying attention, self-control, participation in activities, and caring/ respect for others) that lasted up to 7-w FU.
Bogels et al. (2008)	11–17 y	14	MBCT/ external disorder	NCT/clinic	WLC	Pre Post 2-m FU	90 min, 1 time/w for 8 w	MT associated with improvements in personal goal attainment, social and attention problems, self-control, sustained attention, and mindfulness relative to controls at posttest and FU.
Britton et al. (2010)	16.4 ± 1.3 y	55	MBSR/drug abuse	Cohort/ clinic	None	Pre Post 3-m FU 12 m	10 min, 6 times/w for 6 w	Female MT completers showed reduced substance use and substance-related problems at 20-week FU; frequency of MT practice correlated with improved sleep quality and substance use resistance self-efficacy.

Broderick & Metz (2009)	16–19 y	137	MBSR/ healthy females	NCT/ school	HE	Pre Post	32–43 min, 2 times/w for 5 w	MT group reported improvements in tiredness, aches/pains, negative affect, sense of calmness, relaxation, and self-acceptance relative to controls.
Coholic et al. (2012)	8–14 y	21	MM/ behavior concern	NCT/ school	Arts and crafts	Pre Post	120 min, 1 time/w for 12 w	MT youth self-reported improved emotional reactivity (i.e., improved ability to regulate the speed and intensity of negative emotional response) relative to controls.
Dellbridge & Lubbe (2009)	17 y	1	MBSR/ healthy females	Case/home	None	Qual	? min, 5 times over 10 w	MT associated with qualitative reports of increased task orientation, personal growth, and self-regulation of attention.
Flook et al. (2010)	7–9 y	64	MBSR/ healthy	RCT/ school	Silent reading	Pre Post	30 min, 2 times/w for 8 w	MT group showed increased behavioral regulation, metacognition, and executive function relative to controls; The largest improvements found for those with low executive function at baseline.

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TABLE 16.1. *(continued)*

Study	Age ($M \pm SD$), age range, or grade	N	Program origin/ sample	Study design/ location	Control group	Data points	Treatment duration	Observed changes
Gregoski et al. (2011, 2012)	15.1 ± 0.7 y	166	MBSR/AA with eBP	RCT/ school	LifeSkills training and HE	Pre Post	10 min, 7 times/w for 12 w	MT group showed improved hemodynamic function (i.e., systolic blood pressure, diastolic blood pressure, and heart rate) and a trend for sodium handling compared to controls; Only MT reduced blood pressure in those who reported high social stress from exposure to discrimination.
Haydicky et al. (2012)	12–18 y	60	MM/ learning disabled	NCT/clinic	WLC	Pre Post	90 min, 1 time/w for 20 w	MT group improved on parent-rated externalizing behavior, oppositional defiant problems, and conduct problems compared to controls.
Hilt & Pollak (2012)	9–14 y	102	MM/healthy	RCT/ community	Problem solving	Pre Post	One-time 8-min audio	MT and distraction training both reduced state rumination after negative mood induction compared to the problem-solving group.

Himelstein et al. (2012)	14–18 y	32	MBSR/ incarcerated; ethnic minority	Cohort/ corrections	None	Pre Post	60 min, 1 time/w for 10 w	MT associated with improvements in self-reported perceived stress and self-regulation.
Joyce et al. (2010)	10–12 y	141	MBSR/ healthy	Cohort/ school	None	Pre Post	Ten 45-min lessons	MT associated with reduced emotional and behavioral problems and depressive symptoms.
Kerrigan et al. (2011)	13–19 y	10	MBSR/AA high risk	Cohort/ clinic	None	Qual	"Standard MBSR" for 8 w	MT associated with qualitative reports of greater awareness and acceptance of thoughts and feelings, reduced stress and hostility, and increased relaxation.
Lau & Hue (2011)	14–16 y	48	MBSR/low achieving	NCT/ school	Unspecified	Pre Post	120 min, 1 time/w for 6 w + retreat	MT group self-reported reduced depression and stress combined score, increased mindful presence and personal growth compared to controls.
Lee et al. (2008)	9–13 y	25	MBCT/ learning delayed	RCT/clinic	WLC	Pre Post	90 min, 3 times/w for 12 w	MT group showed lower Child Behavior Checklist total score and externalizing problems compared to controls.

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TABLE 16.1. *(continued)*

Study	Age ($M \pm SD$), age range, or grade	N	Program origin/ sample	Study design/ location	Control group	Data points	Treatment duration	Observed changes
Liehr et al. (2010)	9.5 ± 1.6 y	18	MBSR/ ethnic minority	RCT/ school	HE	Pre Post	15 min, 5 times/w for 10 w	MT group self-reported reduced depressive and anxiety symptoms compared to controls.
Mendelson et al. (2010)	Grades 4–5	98	MM/ethnic minority	RCT/ school	WLC	Pre Post	45 min, 4 times/w for 12 w	MT group reduced problematic involuntary responses to social stress and subcales of rumination, intrusive thoughts, and emotional arousal ($p < .01$) compared to controls.
Napoli et al. (2005)	Grades 1–3	194	MBSR/ healthy	RCT/ school	TAU	Pre Post	45 min, bimonthly for 24 w	MT group self-reported decreased test anxiety scores and increased selected visual attention, and had fewer teacher-rated problems in attention and social skills compared to controls.
Ott (2002)	9 y	1	MBSR/ GERD, nausea	Case/clinic	None	Qual	10 min, twice daily for ? w	MT associated with self-reported improvements in GERD symptoms, medication use, and sleep disturbances.

Pace et al. (2013)	13–17 y	71	MM/foster care, most AA	RCT/clinic	WLC	Pre Post	60 min, 2 times/w for 6 w	MT group showed number of meditation practice sessions inversely correlated with changes in C-reactive protein levels.
Schonert-Reichl & Lawlor (2010)	9–13 y	246	MM/healthy	NCT/ school	WLC	Pre Post	45 min, 1 time/w for 9 w	MT group showed self-reported improvements in optimism, teacher-reported domains of socioemotional and attention/ concentration competence compared to controls.
Semple et al. (2005)	7–8 y	5	MBCT/ anxiety	Cohort/ school	None	Pre Post	45 min, 1 time/w for 6 w	MT associated with teacher-rated improvements in adaptive functioning and total internalizing and externalizing problems.
Semple et al. (2010)	9–13 y	25	MBCT/ academic problems	RCT/clinic	WLC	Pre Post 3-m FU	90 min, 1 time/w for 12 w	MT group showed fewer attentional problems up to 3-m FU compared to controls; In children with elevated levels of anxiety or behavior problems at baseline, the MT group showed decreased anxiety and behavior problems.
Sibinga et al. (2008)	13–21 y	5	MBSR/AA HIV+	Cohort/ clinic	None	Qual	120 min, 1 time/w for 8 w + 3-h retreat	MT associated with self-reported qualitative improvements in positive attitude, behavior regulation, and self-care.

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TABLE 16.1. *(continued)*

Study	Age ($M \pm SD$), age range, or grade	N	Program origin/ sample	Study design/ location	Control group	Data points	Treatment duration	Observed changes
Sibinga et al. (2011)	16.8 ± ? y	33	MBSR/HIV+ at risk	Cohort/ clinic	None	Pre Post	? min, 1 time/w for 9 w	MT associated with reduced hostility, general discomfort, and emotional discomfort; qualitative improvements observed in relationships, schoolwork, physical health, and stress.
Singh et al. (2007)	13.3 ± 0.6 y	3	MM/ conduct disorder	Case/ school	None	Pre Post 6-m FU	15 min, 3 times/w for 4 w	MT associated with decreased aggressive behavior/ bullying at posttest and FU.
Singh et al. (2010)	10–12 y	2	MM/ADHD	Case/home	None	Pre Post 6-m FU	? min, 1 time/w for 12 w	MT associated with maternal report of improved child compliance to parent requests.
Singh, Lancioni, Manikam, et al. (2011)	14–17 y	3	MM/male, autism	Case/home	None	Pre Post 3-y FU	30 min daily for 5 d	MT associated with decreases in sibling- and parent- reported aggressive behavior at posttest and FU.

Singh, Lancioni, Singh, et al. (2011)	13–18 y	3	MM/male, Aspergers	Case/home	None	Pre Post 4-y FU	15 min twice daily for 5 d	MT associated with decreases in sibling- and parent- reported aggressive behavior at posttest and FU.
Tan & Martin (2013)	14–17 y	10	MBSR/ psychiatric outpatient	Cohort/ clinic	None	Pre Post 3-m FU	60 min, 1 time/w for 5 w	MT completers showed improvement in psychological distress, self-esteem, mindfulness, psychological flexibility, and parent-rated child behavior at posttest. At FU, psychological distress decreased from posttest, and all other outcomes maintained their improved posttest levels.
van der Oord et al. (2012)	8–12 y	22	MBSR/ ADHD	NCT/clinic	WLC	Pre Post 2-m FU	90 min, 1 time/w for 8 w	MT group showed parent- and teacher- rated improvements in ADHD symptoms of inattention and hyperactivity/ impulsivity; Parent-rated improvements were maintained at FU. Self-reported levels of child mindfulness increased at posttest.

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TABLE 16.1. *(continued)*

Study	Age ($M \pm SD$), age range, or grade	N	Program origin/ sample	Study design/ location	Control group	Data points	Treatment duration	Observed changes
Waltman et al. (2012)	14–17 y	7	MM/ disruptive behavior disorder	Cohort/ clinic	None	Pre Post 1-m FU	60 min, 2 times/w for 7 sessions	MT program completers showed improvement in residential treatment compliance scores at posttest; 50% of completers showed continued improvement at FU.
van de Weijer-Bergsma et al. (2012)	11–15 y	10	MBSR/ ADHD	Cohort/ school	None	Pre Post 2-m FU 4-m FU	90 min, 1 time/w for 8 w	MT associated with improvement in externalizing problems (by father report at posttest), attention problems (by self-report and father-report at 2-m FU), metacognition and behavioral regulation (by father-report at 2-m FU), and computerized attention test speed and false alarms (at posttest).

van de Weijer-Bergsma et al. (2014)	8–12 y	199	MBSR/ healthy, ethnically diverse	RCT/ school	WLC	Base Pre Post 7-w FU	30 min, 2 times/w for 6 w	MT group showed child-reported improvements in analysis of emotions, rumination, and parent-reported excessive somnolence compared to controls; poorest scoring children at baseline showed the most improvement.
Zylowska et al. (2008)	15.6 ± 1.1 y	8	MBSR/ ADHD	Cohort/ clinic	None	Pre Post	150 min, 1 time/w for 8 w	MT associated with improvements in ADHD inattention and hyperactivity, attention conflict test, Stroop color–word test, and digit span test; however, youth results could not be independently extracted from those of adults.

Note. *N* = 40 studies. Light gray indicates randomized controlled trial (RCT); dark gray indicates nonrandomized controlled trial (NCT); WLC, wait-list control; TAU, treatment as usual; HE, health education; MBSR, mindfulness-based stress reduction; MBCT, mindfulness-based cognitive therapy; MM, mindfulness meditation (program used mindfulness components drawn from MBSR and related programs); eBP, elevated blood pressure; y, year(s); m, month(s); w, week(s); h, hour(s); Base, baseline; Pre, pretest assessment; Post, posttest assessment; FU, follow-up assessment; Qual, qualitative interview assessment.

Executive function positively correlates with school readiness, prosocial behavior, and enhanced academic achievement (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Bull, Espy, & Wiebe, 2008). Conversely, impairments in childhood executive function are typically identified by poor impulse control, lagged working memory, failure to complete tasks, and disruptive behavior (Anderson, 2002). Therefore, mental training that bolsters executive function may support positive neurocognitive changes in the developing brains of youth. A recent review indicated that attention training methods, including mindfulness training, can improve executive function in children from preschool up to age 7, especially among those with the poorest scores on executive function (Diamond & Lee, 2011).

Evidence for Mindfulness Training

In the current review, three RCTs assessed outcomes that served as proxies for neurocognitive function (see Table 16.1). The aggregated evidence from these experimental studies indicates that among youth ages 6–13, mindfulness training (i.e., mindfulness-based cognitive therapy for children [MBCT-C], Mindful Awareness Practices [MAPs] program, and the Attention Academy Program [AAP]) can produce immediate improvements in measures of executive function, with one study indicating effects lasting up to 3 months in youth with academic problems.

Administering a randomized cross-lagged design with a wait-list control group, Semple, Lee, Rosa, and Miller (2010) tested the effect of MBCT-C among inner-city ethnic/minority youth (ages 9–13 years) with academic problems and elevated levels of anxiety. Parents rated their child's attention using the Attention Problems subscale from the Child Behavior Checklist (Achenbach, 1991). Youth who completed eight or more treatment sessions had fewer parent-rated attention problems than controls, and the improvement persisted at 3-month postintervention follow-up. The clinical significance of this treatment effect was moderate in size (Cohen's $d = 0.42$).

Flook and colleagues (2010) randomized 64 ethnically diverse schoolchildren to the MAPs program or to a silent reading control group. Parents and teachers completed the Behavior Rating Inventory of Executive Function (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) to assess the executive function of the children. Results showed that children with poorer initial executive function showed improved parent- and teacher-reported scores on overall executive function, metacognition, and behavioral regulation after MAPS training compared to controls, with a small effect size (partial $\eta^2 = 0.20$).

Napoli, Krech, and Holley (2005) randomized 194 schoolchildren in grades 1 through 3 to AAP or to class time as usual. Teachers rated children with the Attention Deficit Disorder with Hyperactivity (ADD-H) Comprehensive Teacher's Rating Scale (ACTeRS; Ullmann, Sleator, & Sprague, 1988), and children completed the Test of Everyday Attention for Children (TEA–Ch; Manly, Robertson, Anderson, & Nimmo-Smith, 1998). At posttest, results showed child improvement on the Attention subscale of the ACTeRS ($d = 0.49$) and increased Selective Attention scores on the TEA–Ch ($d = 0.60$) compared to controls.

Given this experimental RCT evidence examining the impact of mindfulness training on neurocognitive outcomes, such training may be considered "probably efficacious" for improving certain executive function measures, especially those of attention in younger youth. This determination is based on that fact that at least two RCTs have shown that mindfulness training outperforms an active or wait-list control group on outcome measures of attention (criteria based on Division 12 Task Force on Promotion and Dissemination of Psychological Procedures [TFPDPP], 1995). However, the outcomes used to date have been self-or second-person reports, and more objective measures of executive function are needed. Aside from assessing executive functioning more directly, such measures sidestep the potential biasing effect that knowledge of group allocation may create in self-, parent, and teacher reports.

Aggregate findings from quasi-experimental studies generally support findings from the three RCTs outlined earlier, in that mindfulness training was found to be associated with various improvements in self-, parent, and teacher reports, as well as objective measures of attention, with improvements commonly of medium-to-large effect size, maintained in some cases up to 2 months postintervention. There is indication from at least one study that the lowest performing youth on neurocognitive performance measures may benefit most from mindfulness training (e.g., Flook et al., 2010). Child self-reported changes in dispositional mindfulness scores on the Mindful Attention Awareness Scale for Adolescents (MAAS-A; Brown, West, Loverich, & Biegel, 2011) have improved simultaneously with postintervention improvement on parent- and child-rated self-control, as well as attention task performance (Bögels, Hoogstad, van Dun, de Schutter, & Restifo, 2008; van der Oord, Bögels, & Peijnenburg, 2012), suggesting that changes in the active ingredient of training, mindful attention, may partially drive improvements in executive function.

Psychosocial Outcomes

Positive emotions such as joy, hope, and pride are positively associated with academic interest and achievement (Pekrun, Goetz, Titz, & Perry, 2002), whereas negative emotions such as anger, sadness, and anxiety are associated with poorer academic performance, including lower high school completion rates (Pekrun et al., 2002; Roeser, Eccles, & Freedman-Doan, 1999). Greater emotion regulation skills predict children's academic success and productivity in the classroom and on standardized tests, even after researchers control for IQ (Graziano, Reavis, Keane, & Calkins, 2007). To address the importance of socioemotional factors on child development and academic success, the field of study that has emerged—social and emotional learning (SEL)—theorizes that children require socioemotional skills for optimal learning, academic achievement, interpersonal relationships, and health.

SEL skills include recognition and management of emotions, empathy, and maintenance of positive interpersonal relationships (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). Developing these skills can provide a foundation for prosocial behaviors, academic achievement, emotional health, and adaptive conduct (Greenberg et al., 2003; Steinberg, 2009). A recent meta-analysis of 213 school-based

SEL interventions targeting youth from kindergarten through high school (Durlak et al., 2011) showed that SEL programs significantly improved prosocial attitudes and behavior, as well as academic test scores and course grades.

Mindfulness training is relevant to this discussion of SEL because the former also aims to develop competence in certain social and emotional faculties. For example, mindfulness training fosters self-awareness of cognitions and emotions, regulation of them, and the cultivation of kindness toward the self and empathy for others. Research findings among adults offer support for the proposal that mindfulness practice can impact psychosocial variables, including socioemotional outcomes. Experimental and correlational studies collectively show that mindfulness training is associated with improvements in emotion regulation, emotional well-being, interpersonal relationships, and stress reduction (in this volume, see Arch & Landy, Chapter 12; Parker, Nelson, Epel, & Siegel, Chapter 13; Shapiro & Jazaieri, Chapter 15; Lynch, Lazarus, & Cheavens, Chapter 18; see also Black, 2014; Black, Sussman, Johnson, & Milam, 2012). There is also indication of increases in neural activity and gray-matter volume in regions implicated in socioemotional functioning, including the frontoinsular, prefrontal, and limbic regions (see Hölzel et al., 2011, for review).

Evidence for Mindfulness Training

In this review, nine RCTs assessed psychosocial outcomes of mindfulness training (see Table 16.1). The aggregate evidence from these experimental studies indicates that in youth ages approximately 6 to 18, mindfulness training can produce immediate improvements in depressive symptoms, anxiety symptoms, rumination, externalizing problems, and prosocial skills, with one study indicating some effects lasting up to 3 months postintervention among youth in an outpatient psychiatry clinic. Several of these studies are highlighted below.

Biegel, Brown, Shapiro, and Schubert (2009) randomized 102 children to MBSR + treatment at usual (TAU) or TAU only in an outpatient psychiatric clinic. Participants completed a self-report survey at preintervention, postintervention, and 3-month postintervention follow-up. Results indicated that the MBSR group showed significant improvements in anxiety symptoms (d = 0.70), perceived stress (d = 0.89), self-esteem (d = 0.59), depressive symptoms (d = 0.95), and interpersonal sensitivity (d = 0.82) at postintervention compared to controls. These medium-to-large effect sizes persisted at the follow-up assessment. MBSR participants were also more likely to show diagnostic improvements in mental health (as rated by treatment allocation-blinded clinicians) over the course of the study, as compared to controls (54 vs. 2%, respectively), especially among those with mood disorders at preintervention assessment. Dosage of sitting mindfulness practice was significantly associated with postintervention and follow-up improvements in depressive and anxiety symptoms, as well as diagnostic change.

In another RCT (Liehr & Diaz, 2010), 18 minority youth in the Mindful Schools program reported significantly reduced depressive symptoms and a trend toward a decrease in anxiety symptoms at postintervention compared to those in a health education condition. Semple and colleagues (2010) reported RCT results indicating that

among youth with clinically elevated levels of anxiety at preintervention, mindfulness training produced significant reductions in anxiety symptoms at postintervention. Perhaps this is because a separate RCT showed that even a brief, single-session of mindfulness training can get youth out of a ruminative state after a negative mood induction compared to problem-solving techniques (Hilt & Pollak, 2012); also in youth, rumination has been found to have a strong positive association with anxiety (Muris, Roelofs, Meesters, & Boomsma, 2004).

Given the experimental RCT evidence to date that has examined the impact of mindfulness training on psychosocial outcomes, it may be concluded that such training is "probably efficacious" for reducing anxiety and depressive symptoms among normative youth (i.e., ages approximately 9 to 18) given that at least two RCTs have shown that mindfulness training outperformed an active or wait-list control group on self-report measures of anxiety and depressive symptoms (TFPDPP, 1995). Aggregate findings from quasi-experimental studies mainly support findings from the previously noted RCTs, in that mindfulness training has been associated with improvements in self- and parent-reported measures of youth anxiety, negative affect, hostility, prosocial skills, and externalizing behavior in clinical and healthy samples of youth (e.g., Black & Fernando, in press; Sibinga et al., 2011; Tan & Martin, 2013). There is initial evidence that some of these psychosocial improvements are associated with increases in dispositional mindfulness (Brown et al., 2011; see, e.g., Tan & Martin, 2013).

Psychobiological Outcomes

A psychobiological perspective on stress can guide our understanding of how mindfulness training may get "under the skin" to modulate biological markers implicated in health and disease states. When the brain receives signals that a stressor exists, it activates a cascade of biological responses in an attempt to meet the demand. The sequence is elaborate and only briefly discussed here (for a review, see Glaser & Kiecolt-Glaser, 2005). First, the hypothalamic–pituitary–adrenal (HPA) axis is activated, and adrenocorticotropic hormone is secreted by the brain's pituitary gland. This hormone circulates in the peripheral blood and triggers the adrenal gland to release additional hormones into circulation—cortisol, adrenaline, and noradrenaline—in order to modulate cardiovascular output, energy, cognition, and behavior. HPA by-products help regulate the sympathetic–adrenal–medullary (SAM) axis inflammatory response to stress, coordinated by the immune system.

This biological cascade initiated by an acute stressor provides energy needed to combat or escape a stressor and promotes immunity against infection and injury (Chrousos & Gold, 1992). Acute stress responses are adaptive to survival; however, chronic stressors represent evolutionarily recent challenges that drive a prolonged and repetitive biological response cascade that can disrupt the ongoing health of the organism. Research has linked chronic stress exposure to cardiovascular disease (e.g., Black & Garbutt, 2002; Everson-Rose & Lewis, 2005) and reduced immunocompetence in adults (Kiecolt-Glaser, Dura, Speicher, Trask, & Glaser, 1991; Kiecolt-Glaser, Glaser, Gravenstein, Malarkey, & Sheridan, 1996; Uddin et al., 2010).

The developing nervous and immune system is sensitive to the psychobiological artifacts of early life stressors (Andersen & Teicher, 2008). Research shows that early childhood exposure to psychosocial stressors, such as physical or sexual abuse or parental loss, predicts changes in the expression of genes for glucocorticoid receptors that are involved in the regulation of the stress hormone cortisol (McGowan et al., 2009). Such exposure alters brain regions critical to stress reactivity and emotion regulation (Hanson et al., 2010). Childhood stressors also predict long-term dysregulation of the HPA axis and neuropeptide function that are important to development of later-life psychopathology such as anxiety and mood disorders (Bremner et al., 2003; Heim & Nemeroff, 2001; Tyrka et al., 2008).

Training in mindfulness appears to encourage stress reduction by curtailing stress-inducing mental "time travel" (e.g., rumination on the past, fear-laden thoughts about the future), which may foster relaxation and promote approach and acceptance stress-coping strategies rather than avoidance strategies. Mindfulness training may also alter brain structure and function in a manner that helps to buffer against dysregulated stress reactivity. For example, evidence indicates that mindfulness training and meditation can (1) activate neural structures that regulate the autonomic nervous system in a manner that increases opportunities for relaxation (Hölzel et al., 2010; Lazar et al., 2000), (2) reduces perceptions of psychological stress (de Vibe, Bjørndal, Tipton, Hammerstrøm, & Kowalski, 2012), (3) boosts immune function parameters (Davidson et al., 2003; SeyedAlinaghi et al., 2012), and (4) attenuates biomarkers of inflammation (Black et al., 2012, in press; Creswell et al., 2012)—all possibly indicative of a healthy psychobiological profile.

Most studies linking mindfulness training to psychobiological outcomes have focused on adults. However, such training may show similar effects in youth. Children experiencing traumatic stress or low socioeconomic status show elevations in cortisol and other markers of a dysregulated HPA axis (Cicchetti & Rogosch, 2001; Lupien et al., 2005; Tarullo & Gunnar, 2006) that can persist into adulthood (Bremner et al., 2003; Tyrka et al., 2008). Thus, equipping children to manage stress early in life through mindfulness training may help them to regulate psychobiological stress reactivity.

Evidence for Mindfulness Training

In this review, four RCTs assessed psychobiological outcomes (see Table 16.1). Three of these studies examined the effects of a breathing awareness meditation (BAM; Session 1 from MBSR) against active health education control conditions on cardiovascular outcomes in mainly African American youth, with mean ages ranging from 12.3 to 15.1 years (range = 12 to 18 years; Barnes, Davis, Murzynowski, & Treiber, 2004; Barnes, Pendergrast, Harshfield, & Treiber, 2008; Gregoski, Barnes, Tingen, Harshfield, & Treiber, 2011). All three studies had adequately sized samples (range = 66 to 166 participants) with training administered approximately 10 minutes daily for 12 weeks. The aggregate evidence from the three studies indicates that in the mainly African American youth with normotensive or elevated blood pressure, mindfulness training produced immediate postintervention improvements in systolic

blood pressure (SBP; daytime SBP d = 0.57–0.81), diastolic blood pressure (DBP; daytime DBP d = 0.41–1.03), and heart rate (HR; daytime HR d = 0.18–0.51). No studies have yet to provide follow-up data, so longer-term effects of such training are unknown.

A separate RCT allocated 71 foster care youth ages 13–17 to either a 6-week program including aspects of mindfulness practice (cognitive-based compassion training; CBCT) or to a wait-list control (Pace et al., 2013). Between-group effects were not significant for C-reactive protein levels (an inflammatory biomarker); however, youth in the CBCT group showed pre- to postintervention reductions in morning salivary C-reactive protein, and this reduction was significantly moderately correlated with the number of homework practice sessions, indicating a health-relevant dosage effect of practice time.

Given the experimental RCT evidence to date that has examined the impact of mindfulness training on physiological outcomes, it may be safe to say that such training is "probably efficacious" for improving systolic blood pressure, diastolic blood pressure, and heart rate in normotensive and high-normotensive African American youth (approximately 12 to 18 years of age) given that mindfulness training outperformed active control conditions in at least two RCTs (criteria based on Division 12 TFPDPP; 1995). Aggregate findings from quasi-experimental studies (see Table 16.1) indicate that mindfulness training was also associated with improvements in self-perceived stress, involuntary reactions to stress, calmness, and relaxation.

Next Steps in Mindfulness Research with Youth

The first review of mindfulness training for youth, published in 2009, documented 10 intervention studies (Black et al., 2009). This review yields four times that number of studies now published, indicating a growing interest in mindfulness training for youth and scientific evaluation of such programs. The currently available studies support the conclusion that mindfulness training is efficacious for some neurocognitive, psychosocial, and psychobiological outcomes, and that this training approach is feasible and acceptable for diverse groups of youth, with no published reports of treatment contraindications. Anecdotes from psychiatric clinical practice suggests that sensory exposure activities used in mindfulness training might aggravate symptoms in youth with a history of bodily trauma (e.g., sexual abuse), but published evidence is needed to address this claim. This is an exciting time for research exploration in this area, yet limitations of the extant research should be considered in order to strengthen the evidence base underlying mindfulness training for youth. Based on the current state of the research, I offer several recommendations for future research.

First, 68% of studies reviewed are quasi-experimental, cohort, and case studies, making much of the available evidence vulnerable to numerous validity threats. More studies are needed that use stringent study designs with active and structurally equivalent control conditions. Second, the majority of studies had sample sizes with less than 40 participants, and assessed multiple outcomes. Future studies will benefit from larger sample sizes, both to power statistical analyses adequately and to aid

in generalizability of the obtained findings. Third, more research is needed to test training effects on objective outcomes. Many outcomes reviewed here were based on self- or second-person reports of a subjective nature, which, although informative, are limited by possible response biases and retrospective memory biases, and do not inform about neural and other biological markers of mental and physical health states.

Fourth, mechanisms of action linking mindfulness training to health outcomes are not well understood. More studies are needed to measure training-related change mechanisms. For example, a small number of the studies reviewed here (e.g., Barnert et al., 2014; Bögels et al., 2008) assessed changes in trait mindfulness with scales such as the validated MAAS-A (Brown et al., 2011). Moreover, mindfulness practice time is important to capture because this measure can inform the dosage needed for bringing about significant intervention effects.

Fifth, mindfulness training is highly variable across studies. Research is needed to determine the specific mindfulness practices (e.g., sitting meditation, body scan, movement meditations) and program delivery aspects (e.g., duration of training, level of teacher training) that best fit the needs of youth and induce the largest intervention effects. Also, careful session-by-session descriptions of mindfulness training programs in publications will aid in replication, as will publicly available manualized curricula.

In conclusion, interest in mindfulness training for youth continues to grow, and a stronger evidence base is needed if this training is to demonstrate value in engendering health and preventing disease in youth. High-quality evidence on mindfulness training for youth is relatively sparse, based on an array of training programs, and many studies are plagued by methodological weaknesses. However, evidence is strengthening in specific areas, especially in executive function, depressive and anxiety symptoms, and cardiovascular physiology. Carefully conducted research in the years ahead will offer a more definitive answer as to whether mindfulness training for youth significantly improves neurocognitive, psychosocial, and psychobiological functioning, and beneficially alters developmental trajectories within these important domains.

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