

# the ADHD

## REPORT

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## Mindfulness as an Intervention for ADHD

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“Mindfulness” is a meditation practice that has surged in popularity in recent years. Derived from Buddhist tradition, mindfulness was introduced to Western medicine by Jon Kabat-Zinn in the 1970s, primarily as a method of reducing stress, which was then coming to be recognized as a contributor to medical illness. Since that time, mindfulness has been applied to address a broad array of conditions and problems, including depression, anxiety, chronic pain, stress, eating disorders, emotional dysregulation, sexual dysfunction, substance abuse, and ADHD. Mindfulness programs are now offered in public schools, hospitals, clinics, universities, corporate settings, and prisons. References in the scientific literature have skyrocketed from virtually none at all in the year 2000 to 758 indexed in PubMed in 2015. Further, mindfulness is popular with the lay public: A nationwide survey in 2007 revealed that more than 20 million people practiced some form of meditation weekly, a number which is likely to be much higher today (Barnes, Bloom, & Nahin, 2008). In the following, we review the literature concerning the nature and efficacy of mindfulness as a context for consider-

ing its potential utility as an intervention for ADHD.

### THE NATURE OF MINDFULNESS

The basis of Buddhist mindfulness meditation was that mental suffering is caused by mistaken representations of reality, constructed based on knowledge of past experiences and the anticipation of the future (Thera, 1962). Mindfulness is therefore a practice that helps one to disengage from these distractions and limit the scope of attention to what is happening in the present moment. Observing the present moment and the mind’s reactions without elaborating on them may free one from the usual patterns of emotional reactivity. Mindfulness meditation offers a systematic approach to managing behavioral concerns through changing the awareness of, and relation to, thoughts, rather than changing thought content itself (Omidi, Mohammad-

khani, Mohammadi, & Zargar, 2013). As defined by Jon Kabat-Zinn (2011), mindfulness is “paying attention in the present, on purpose, and without judgment.” In mindfulness practice, the individual is guided to focus attention on the breath and to increase sensory and somatic awareness, as well as to observe incoming thoughts and feelings, accept them without judgment, and then disengage from them. In other words, during mindfulness practice one brings awareness to the current experience—observing and attending to the changing field of thoughts, feelings, and sensations from moment to moment. The natural tendency during this process is to experience mind-wandering or rumination. Mindfulness therefore teaches meditators to orient themselves to this experience in a way that allows them to maintain an attitude of curiosity, rather than self-judgment or self-criticism, toward the

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variables, and difficulties in quantifying meditation practice that occurs outside the formal practice periods.

### **RATIONALE FOR USE OF MINDFULNESS IN ADHD**

ADHD is a behavioral disorder associated with cognitive impairments and structural and functional brain alterations involving multiple brain regions, including the anterior cingulate cortex (ACC), dorsolateral prefrontal cortex (PFC), striatum, and cerebellum (Rubia, Alegria, & Brinson, 2014). Increased rates of comorbid psychiatric symptoms and secondary impairments such as work or relationship difficulties are commonly reported (Barkley, 2002; Kessler et al., 2006). Cognitive deficits in executive functioning, including attention, working memory, and inhibition (Seidman, 2006), have been widely noted, as have difficulties in arousal, motivation, and emotional regulation (Nigg & Casey, 2005). Many of these differences can be categorized as self-regulatory impairments (Barkley, 1997) and may be subject, in part, to change through training of awareness and self-regulatory abilities.

#### **Regulation of Attention**

Mindfulness meditation is a self-regulatory practice that is multifaceted but appears to improve self-regulation of attention and emotion (Teasdale, Segal, & Williams, 1995). The practice involves decreasing arousal and training attention to the present experience with an open, curious, and accepting stance. The rationale for using a mindfulness-based approach in ADHD is built on several levels of potential impact, including behavioral symptoms of inattention and impulsivity, associated neurocognitive deficits of attention and inhibition, and secondary impairments of stress, anxiety, and depression. The primary practice (sitting or walking meditation) involves three steps: (1) bringing attention to an “attentional anchor” (usually a sensory input such as breath), (2) noting that distraction occurs and letting go of the distraction, and (3) refocusing or reorienting attention back to the attentional anchor. This sequence is repeated many times during the course of meditation practice. As attention is

stabilized in the primary practice, open awareness or “hovering attention” is introduced and other aspects of attention may be emphasized. In between sessions, the participants are asked to “pay attention to attention” and bring their attention to the present moment frequently throughout their daily routine (informal practice). These activities are likely to engage diverse aspects of attention (e.g., alerting, orienting, and conflict resolution), meta-cognition, inhibition, and working memory.

A comprehensive review of the neuropsychological effects of mindfulness training (Chiesa, Calati, & Serretti, 2011), as well as reviews of studies intended to elucidate the neural mechanisms of mindfulness (Holzel et al., 2011; Tang, Holzel, & Posner, 2015) suggest that mindfulness may improve attention, working memory, and other executive functions in healthy adults. This possibility is further supported by fMRI studies of mindfulness practitioners, which implicate activation of the anterior cingulate cortex and medial frontal cortex, regions known to enable executive attention and control (Holzel et al., 2007). Although computer-based training of attention and working memory has not proven effective in children with ADHD (Rapport, Orban, Kofler, & Friedman, 2013), it is possible that the repeated self-directed refocusing of attention that occurs in formal mindfulness practice, and in informal practice throughout the day, will prove to be more effective in strengthening the mediating neurocircuitry.

No neuroimaging studies have yet been conducted of the effects of mindfulness in ADHD. However, one study examined psychophysiological concomitants of attention during a go/no-go task in 50 adult patients who were randomly assigned to MBCT or wait-list control. Event-related potentials (ERPs) showed increased amplitude of indices of error monitoring (Pe) and inhibitory control (NoGo-P3) in the mindfulness group (Schoenberg et al., 2014). However, mindfulness was not associated with clinical improvement in ADHD symptoms in this study. Recommendations for parallel research in adolescents with ADHD were recently proposed by Sanger and Dorjee (2015).

### **Emotion Regulation**

Emotion regulation is proposed as another central mechanism or an outcome of mindfulness practice (Brown & Ryan, 2003). Emotion regulation deficits are implicated in ADHD (Hulvershorn et al., 2014), and the disorder is associated with increased rates of comorbid psychiatric disorders, such as anxiety, depression, oppositional defiant disorder, and substance abuse (Biederman et al., 2004; Kessler et al., 2006). During mindfulness training, participants learn to reduce arousal through breathing and relaxation exercises and to bring an openness and acceptance to their emotional experiences. This practice teaches engagement in emotional states in a way that is neither avoidance, flooding, nor dissociation but rather “mindfully observing and being with the emotion.” In addition, shifting attention to a neutral focus (breath or soles of the feet) can be used to disengage from particularly intense emotional states. Reduction in negative affective reactivity and volatility in response to aversive visual stimuli (Arch & Craske, 2006) and emotionally provocative events (Broderick, 2005) have been reported with the induction of a mindfulness state. Frewen and colleagues (2008) showed that mindfulness training was associated with decreases in frequency and perception of difficulty in letting go of irrational automatic thoughts. A small study indicated that a mindfulness-based intervention reduced aggressive behavior in adolescents with a history of conduct disorder (Singh et al., 2007).

These results are consistent with the hypothesis advanced by Tang, Hölzel, and Posner (2015) that mindfulness acts by strengthening prefrontal control mechanisms and thus down-regulating activity in regions, including the amygdala, that mediate affect processing. Cited in support of this hypothesis are fMRI studies that show increased dorsolateral prefrontal activity during an emotional Stroop task following 6 weeks of meditation training (Allen et al., 2012) and during a task in which subjects expected to see negative images (Lutz et al., 2014). Further, MBSR was reported to decrease amygdala activity in adults with social anxiety disorder (Goldin, 2010). These findings, taken to-

gether, suggest that mindfulness practice may have the potential to improve emotional functioning in ADHD and potentially decrease vulnerability to other psychiatric symptoms.

### **MINDFULNESS-BASED TREATMENT OF ADHD**

We begin this section with studies of mindfulness programs in school-based and clinic-based programs for youth, followed by studies that have specifically enrolled individuals diagnosed with ADHD. Studies enrolling children and adults with ADHD are listed in Tables 1 and 2, respectively.

#### **School-Based Programs**

Many mindfulness skills programs have been launched in schools. Studies to date, reviewed by Tan and Martin (2015), have yielded promising results. These studies have typically assigned entire classes or entire schools to either receive the mindfulness intervention or to serve as an untreated control group. Of six studies, three enrolled samples of fewer than 25 children, but showed positive changes compared to an untreated comparison group. Three larger scale studies enrolled samples ranging from 155 to 522 adolescents (Huppert & Johnson, 2010; Lau & Hue, 2011; Metz et al., 2013). With one exception (Huppert & Johnson, 2010), these studies reported variously that mindfulness training brought about reduction in depression, anxiety, or stress, or increases in affect regulation and well-being, compared to the control group.

A recent study of the effects of mindfulness on working memory may have particular implications for youth with ADHD, who often have deficits in working memory. Quach, Mano, and Alexander (2015) randomly assigned 198 adolescents at a public middle school to receive mindfulness meditation training, hatha yoga, or wait-list control. The meditation and yoga groups met for 45 minutes/week for 4 weeks. In addition, students in both intervention groups received CDs with audio recordings which they were encouraged to practice using for 15–30 minutes daily. Results showed that only the mindfulness group improved on a computerized test of working memory (Automated

Operational Span Task). This study is particularly important because the use of the hatha yoga intervention serves as at least a partial control for therapist attention and support; the lack of improvement in this group thus suggests that positive changes in the mindfulness group cannot be attributed to these nonspecific therapeutic factors. Also noteworthy in this study is the use of an objective outcome measure.

#### **Mindfulness in Clinic-Referred Youth**

Apart from the studies of ADHD and other externalizing disorders described below, the literature on the application of mindfulness interventions for children or adolescents with mental health conditions is limited (see review by Tan & Martin, 2015). One very small open trial of MBCT reported improvement in adolescents ( $n = 6$  completers) with residual depressive symptoms (Ames, Richardson, Payne, Smith, & Leigh, 2014).

Biegel, Brown, Shapiro, and Schubert (2009) conducted a randomized controlled trial of MBSR compared to treatment as usual (TAU) in a mixed outpatient sample of 102 adolescents (14–18 years). Results showed significantly greater reduction in anxiety, depression, and somatic distress, as well as increased self-esteem and sleep quality in the MBSR group, as assessed by clinicians blind to treatment assignment.

Tan and Martin (2012a) developed a 5-week group intervention based on MBSR principles titled “Taming the Adolescent Mind” (TAM). Following a promising pilot study (Tan & Martin, 2012b), they conducted an RCT in which 108 adolescents with mixed mental health conditions were randomized to receive either TAU or TAU plus the manualized TAM program (Tan & Martin, 2015). Adolescents who received TAM reported greater reduction in mental distress, which was maintained at 3-month follow-up, and which was consistent with their parents’ report of improved psychological functioning. At follow-up, the adolescents in the TAM group also reported greater self-esteem and psychological flexibility.

*Youth with ADHD* (see Table 1). In what appears to have been the earliest

published study of meditation in youth with ADHD, Harrison and colleagues (2004) showed improvement in ADHD symptoms in a sample of 32 children, 4–12 years, compared to a waitlist control ( $n = 15$ ). A subsequent uncontrolled trial of transcendental meditation in 10 young adolescents (11–14 years; (Grosswald, Stixrud, Travis, & Bateh, 2008) similarly yielded improvement in ADHD symptoms.

#### **Parallel Training of Youth with ADHD and Their Parents**

Most studies of mindfulness in youth with ADHD have examined the effects of providing mindfulness training to parents simultaneously with the training of their offspring (see Table 1). The rationale for this approach, as outlined by Haydicky, Shecter, Wiener, & Ducharme (2015), is that parents of children with ADHD experience greater stress and that high parental stress is associated with high levels of conflict in the home, both of which may lead to worse psychological and physical health of adolescents. In addition, parents of children with ADHD are more likely to be over-reactive and controlling and to provide less parental support. Given the reciprocal nature of these parent and adolescent interactions, a treatment that targets both parent and child or adolescent behaviors is warranted.

In programs that use this approach, parents and youth are seen in parallel group sessions. The opportunity to learn the strategies in parallel with their children may also have primary benefits for the parents, who often have their own attentional difficulties, and it may enable them to help their offspring practice the techniques at home. In both groups, core mindfulness concepts are emphasized, including awareness and acceptance of internal and external experiences, letting go, and being present in the moment. Both groups also participate in the mindfulness exercises, including the body scan, breathing, and sitting meditation. In the programs that incorporate CBT, cognitive distortions are identified and the ways in which these influence reactions are explored.

Several uncontrolled studies with small samples ( $n < 15$  parent-child pairs) have assessed the benefits of an

8-week manualized modified MBCT program (*My Mind*) in children with externalizing problems (Van der Oord, Bögels, & Peijnenburg, 2012) and in adolescents with ADHD (Bögels, 2008; Van de Weijer-Bergsma, Formsma, de Bruin, & Bögels, 2012), with inconsistent results across studies. Parent ratings of attention and impulsivity were significantly improved in the study by van der Oord and colleagues (2012), but were not improved in the study by Bögels (2008). Improvements were only marginally significant for fathers, and not for mothers, in the study by van der Weijer-Bergsma and colleagues (2012). On the other hand, whereas Bögels (2008) reported significant adolescent self-reported improvement in ADHD symptoms, as well as in functional measures (social problems, attainment of personal goals, subjective happiness, and mindful awareness) that were maintained at 8-week follow-up, adolescent self-report was unchanged in the study by van der Weijer-Bergsma and colleagues (2012). Ratings by teachers were unchanged (Van der Oord et al., 2012). The small sample sizes, as well as differences across studies in the measures used, undoubtedly contributed to the variance in results.

The most recent study of the *My Mind* program was conducted by Haydicky and colleagues (2015) and employed a design that compared change during treatment to a pre-treatment 4-week, waitlist period in all the same participants. This study enrolled 18 adolescents (13–18 years of age) with ADHD and 17 parents and found significant reductions in parent-rated peer-relational problems, as well as in parenting stress, with a trend toward improvement in parent ratings of adolescents' conduct problems (effect size = 0.70). However, parent-rated DSM-IV inattentive symptoms and oppositional symptoms did not decrease significantly. Adolescent self-ratings did not improve immediately post-treatment, but self-ratings of internalizing symptoms were significantly improved at 6-week follow-up, with effect sizes greater than 1.0 (Haydicky et al., 2015). This report is also noteworthy for its detailed description of the *My Mind* intervention with adolescents and with their parents.

### Parent Training Only

Bögels and colleagues (2014) enrolled 86 parents in an intensive *Mindful Parenting* program, based on an adaptation of MBSR and MBCT (see Table 1). All parents were experiencing parent-child relationship problems. Approximately half of the target children had ADHD; diagnoses in the remainder included autistic spectrum disorder ( $n = 15$ ), anxiety, depression, ODD, conduct disorder, learning disorder, and one child with schizophrenia. Children ranged in age from 2 to 21. The treatment was administered in 8 3-hour group therapy sessions, with 8 to 14 parents in each group, and a follow-up 8 weeks later. A pre-treatment wait-list assessment was obtained for 23 parents for whom a group was not immediately available. In addition to general meditation practices such as breathing, yoga, and body scan, parents were helped to become aware when they reacted to their child in an automatic, mindless manner, as when stressed or preoccupied, or influenced by their own upbringing or their previous experiences with the child. They were encouraged to use the breathing space to delay reacting to their child automatically, and to respond with acceptance of the child and of themselves. Results showed improvements following treatment in parent-rated child internalizing (medium effect size of .45) and externalizing (small effect size of .31) psychopathology, that were maintained at follow-up. Significant improvements were also seen in parental psychopathology (medium effect sizes of .43 to .50), parental stress, and parental child-rearing scales (small to medium effect sizes). Parental externalizing psychopathology also decreased during the wait-list period.

*Summary.* In summary, several programs to train adolescents in mindfulness have been developed, administered, and tested in public school settings, with evidence of change from pre- to post-treatment. Benefits have also been shown for mindfulness compared to wait-list controls in studies of outpatient adolescents with heterogeneous mental health conditions.

Most studies of mindfulness training in youth with ADHD have been conducted with adolescents in the context

of parallel training of their parents. Some have yielded promising results in terms of improvements in ADHD symptoms and in other externalizing behaviors, internalizing symptoms, and functional measures, whereas others have not. However, sample sizes have been small, totaling just 45 children and 40 adolescents across studies. Further, raters, who are largely limited to parents, have not been blind. In addition, although some studies employed within-group wait-list controls, none have included a control condition for the non-specific effects of therapy (therapist support, attention, etc). As noted by Tang and colleagues (2015), it is also important for future studies to compare individuals with the predominantly inattentive and combined presentations of ADHD, which may be differentially receptive to and responsive to mindfulness-based interventions.

Studies to date have variously included mindfulness intervention for youth only, training for parents in parallel with their children/adolescents; and parent mindfulness alone. These alternative approaches might be usefully compared systematically in future work. Further, it will ultimately be important to compare the benefits of mindfulness training against those of traditional parent behavioral management training, and medication, already shown to be effective in the treatment of ADHD.

### Adults with ADHD

The first major study of mindfulness in adults with ADHD was an open trial of 24 adults (plus 8 adolescents) conducted by Zylowska and colleagues (2008). In addition to formal practice, the program emphasizes "mindfulness awareness practices" (MAPs) in everyday life (see Table 2). Mindfulness training, in groups, was associated with significant improvement in both self-reported and non-blind clinician-reported ADHD symptoms, as well as in executive function, depression, and anxiety. The manual from that study was subsequently published as a self-help guide (Zylowska, 2012). Similar results were reported in more recent studies of mindfulness, compared to wait-list controls, by Mitchell and colleagues (2013) in a

TABLE 1. Mindfulness Studies of Children and Adolescents with ADHD

#	Study	Sample Size		Age Range (years)	Duration	Follow-up	Therapy	Outcome Measures	Effect Size for ADHD Symptoms	Results
		Controls	Intervention							
1	Harrison et al., 2004	Wait-list controls	32	15	6 weeks	none	Sahaja Yoga Meditation	<ul style="list-style-type: none"> <li>• CPTQ</li> <li>• BSS</li> <li>• CPRS</li> <li>• BIOS</li> </ul>	Not available	<ul style="list-style-type: none"> <li>• Core symptoms improved</li> <li>• Reduced associated symptoms</li> <li>• Improved parental relationship, sleep &amp; school performance</li> </ul>
2	Grosswald et al., 2008	None	10	None	3 months	none	Transcendental Meditation	<ul style="list-style-type: none"> <li>• BRIEF</li> <li>• CAS</li> </ul>	High teacher-reported BRIEF, behavior regulation index = .5, high-est size for "shift" & "WM" = .6 each High cognitive performance: CAS (expressive attention & accuracy) = .8 each	<ul style="list-style-type: none"> <li>• Improved stress, anxiety, ADHD symptoms &amp; school performance</li> </ul>
3	Bögels et al., 2008	Wait-list controls	4	10	8 weeks	8 weeks	<i>My Mind</i> (Modified MBCT)	<ul style="list-style-type: none"> <li>• YSR</li> </ul>	Small-large, e.g., YSR total = .9, with large sizes for externalizing = 1.2 & attention = .9	<ul style="list-style-type: none"> <li>• Children's personal goals, attention, awareness, impulsivity, being attuned, social problems, happiness improved</li> <li>• Internalizing &amp; externalizing problems improved maintained</li> <li>• Program completion (vs. drop-out) showed more improvement</li> </ul>
4	van der Oord et al., 2012	Wait-list controls	11 parents (+ children)	22 parents (+ children) - WLC	8 weeks	8 weeks	<i>My Mind</i> (Modified MBCT)	<ul style="list-style-type: none"> <li>• DBDRS</li> </ul>	Small-large, parent-reported ADHD symptoms: e.g., reduction of inattention = .8, hyperactivity/impulsivity = .56. Large, parental overactivity = .85	<ul style="list-style-type: none"> <li>• ADHD symptoms (parents &amp; children) reduced</li> <li>• Reduced parent stress</li> <li>• Teacher ratings not significant</li> </ul>
5	van der Weijer-Bergsma et al., 2012	None	Adolescents (n = 10), their parents (n = 19) & tutors (n = 7)	None	8 weeks	8 & 16 weeks	<i>My Mind</i> (Modified MBCT)	<ul style="list-style-type: none"> <li>• YSR/CBCL/TRF</li> <li>• BRIEF</li> <li>• MAAS</li> </ul>	Small-large, e.g., attention of fathers = 1.5 & adolescents = .9; large, metacognition for fathers = 1.8; large fathers' parenting stress = 1.1	<ul style="list-style-type: none"> <li>• Behavioral issues &amp; symptoms improved + maintained till 1st (not 2nd) follow-up</li> <li>• Reduced: stress in fathers &amp; overactivity in mothers</li> </ul>
6	Bögels et al., 2014	Wait-list controls	53	23	8 weeks	8 weeks	Mindful parenting (adapted from MBCT & MBSR)	<ul style="list-style-type: none"> <li>• CBCL</li> <li>• Dutch Parenting Stress Inventory</li> <li>• Child Rearing Behavior Inventory</li> </ul>	Child: Internalizing .45, externalizing .31 Parent: externalizing: small-medium Parental psychopathology .43-.50 Child Rearing: small-medium	<ul style="list-style-type: none"> <li>• Improved parent-rated child internalizing &amp; externalizing symptoms</li> <li>• Improved parental psychopathology parental stress, &amp; parental child-rearing scales (small to medium effect sizes)</li> <li>• Parental externalizing psychopathology also decreased during the wait-list period</li> </ul>
7	Haydicky et al., 2015	TBD	18 children, 17 parents	TBD	8 weeks	6 weeks	<i>My Mind</i> (Modified MBCT)	<ul style="list-style-type: none"> <li>• Conners</li> </ul>	Large, self & parent reported: ADHD symptoms .62 & child externalizing .70	<ul style="list-style-type: none"> <li>• Improved behavior + attention &amp; parental stress</li> </ul>

Note. AAQ: Acceptance and Action Questionnaire; AAQoL: Adult ADHD Quality of Life Questionnaire; ANT: Attitudes towards Neuroleptic Treatment; ARS: ADHD Rating Scale; ASRS: Adult ADHD Self-Report Scale; BAI: Beck Anxiety Inventory; BDI: Beck Depression Inventory; BRIEF: Behavior Rating Inventory of Executive Function; BSS: Behavioral Surveillance Survey; CAARS: Conners' Adult ADHD Rating Scales; CAARS-INV: Conners' Inventory; CAARS-SV: CAARS Screening Version; CAS: Cognitive Assessment System; CBCL: Child Behavior Checklist; CDI: Children's Depression Inventory; CPRS: Conners' Parent Rating Scales; CPT: Continuous Performance Task; DBDRS: Disruptive Behavior Disorders Rating Scale; DEFS: Deficits in Executive Functioning Scale; DEFS: Difficulties in Emotion Regulation Scale; ERP: Event-Related Potential; FAD: Family Assessment Device; FFMQ: Five Facet Mindfulness Questionnaire; FFS: Flinders Fatigue Scale; GSES: General Self-Efficacy Scale; IC: Issues Checklist; IM-P: Interpersonal Mindfulness in Parenting; KIMS: Kentucky Inventory of Mindfulness Scale; MAAS: Mindful Attention Awareness Scale; MHC-SF: The Mental Health Continuum-Short Form; OQ: Outcome Questionnaire; PANAS-X: Positive and Negative Affect Schedule; PSI: Parenting Stress Index; QALY: Quality-Adjusted Life-Year; RCADS: Revised Children's Anxiety and Depression Scale; RCMAS: Revised Children's Manifest Anxiety Scale; SCS-SF: Self-Compassion Scale-Short Form; SHS: Student Health Services; SIPA: Stress Index for Parents of Adolescents; STAI-T: State-Trait Anxiety Inventory; TCI: Temperament and Character Inventory; TIC-P: Trimbos/IMTA questionnaire for costs associated with psychiatric illness; TRF: Teacher's Report Form; WRI: Wender-Reimherr Interview; YSR: Youth Self Report

**TABLE 2. Mindfulness Studies of Adults with ADHD**

#	Study	Controls	N intervention	N control	Age Range	Duration	Follow-up	Therapy	Outcome Measures	Effect Size for ADHD Symptoms	Results
1	Zylowska et al., 2008	None	24 adults; 8 adolescents	None	Adults 48.5 (10.9) Adolescents 15.6 (1.1)	8 weeks	none	Modified Mindful Awareness Practices (MAP)	• BAI • BDI • CDI • RCMAS • ANT	Not available	<ul style="list-style-type: none"> <li>• Conflict attention, set-shifting improved</li> <li>• Adult anxiety &amp; depression improved</li> </ul>
2	Smalley et al., 2009	Non-ADHD	51	54	43.1 (5-8)	TBD	none	Mindfulness training	• KIMS	Mindfulness = .89 (significant: acting in awareness 1.35, non-judgmental acceptance .62), less novelty-seeking .91, more self-directed .62, and less self-transcendent .62	<ul style="list-style-type: none"> <li>• ADHD associated with lower attention and thus trait mindfulness</li> <li>• Mindfulness training will help</li> </ul>
3	Mitchell et al., 2013	Wait-list controls	11	9	18–50	8 weeks	none	Zylowska's MAP	• CAARS/DSM	High, self-report: inattention 1.66, hyperactivity/impulsivity 1.76 Clinician report: inattention = 3.14, hyperactivity/impulsivity = 1.35 Functioning = 1.52, DEFS = 2.67	<ul style="list-style-type: none"> <li>• Improved symptoms: attention, hyperactivity, emotional dysregulation</li> </ul>
4	Schoenberg et al., 2014	Wait-list controls	26	24 WLC	18–65	12 weeks	none	Modified MBCT	• CAARS • OQ • KIMS • ERP amplitude	Not available	<ul style="list-style-type: none"> <li>• Correlated improved inhibition &amp; hyperactivity/impulsivity</li> <li>• Comparable performance monitoring as medication</li> </ul>
5	Edel et al., 2014	Skills training	39	52	33.8 (10.1), 36.7 (10.1)	13 weeks	none	Modified MBSR	• WRI	Small-medium: WRI total = .49, highest inattention subscore .49	<ul style="list-style-type: none"> <li>• Symptom improved in both, no inter-group differences; BPD included in one group + non-random</li> </ul>
6	Bueno et al., 2015	ADHD & HC that did not get mindfulness training	21 ADHD; 8 HC	22 ADHD; 9 HC	18–45	8 weeks	none	Zylowska's MAP	• BDI • STAI-T • ASRS • PANAS-X • AAQoL • ANT • CPT II	Medium to high; e.g., high (greater than .8) for QoL, inattentive, positive affect, self assurance, attentiveness, psychology health	<ul style="list-style-type: none"> <li>• QoL, affect, attention improved for intervention. No significant difference between ADHD &amp; HC intervention groups</li> </ul>

Note. AAQ: Acceptance and Action Questionnaire; AAQoL: Adult ADHD Quality of Life Questionnaire; ANT: Attitudes towards Neuroleptic Treatment; ARS: ADHD Rating Scale; ASRS: Adult ADHD Self-Report Scale; BAI: Beck Anxiety Inventory; BDI: Beck Depression Inventory; BRIEF: Behavior Rating Inventory of Executive Function; BSS: Behavioral Surveillance Survey; CAARS: Conners' Adult ADHD Rating Scales; CAARS-INV: Conners' Inventory; CAARSS-SV: CAARS Screening Version; CAS: Cognitive Assessment System; CBCL: Child Behavior Checklist; CDI: Children's Depression Inventory; CPRS: Conners' Parent Rating Scales; CPT: Continuous Performance Task; DBDRS: Disruptive Behavior Disorders Rating Scale; DEFS: Deficits in Executive Functioning Scale; DERS: Difficulties in Emotion Regulation Scale; DTS: Davidson Trauma Scale; ERP: Event-Related Potential; FAD: Family Assessment Device; FFMQ: Five Facet Mindfulness Questionnaire; FFS: Finders Fatigue Scale; GSES: General Self-Efficacy Scale; IC: Issues Checklist; IM-P: Interpersonal Mindfulness in Parenting; KIMS: Kentucky Inventory of Mindfulness Scale; MAAS: Mindful Attention Awareness Scale; MHC-SF: The Mental Health Continuum-Short Form; OQ: Outcome Questionnaire; PANAS-X: Positive and Negative Affect Schedule; PSI: Parenting Stress Index; QALY: Quality-Adjusted Life-Year; RCADS: Revised Children's Anxiety and Depression Scale; RCMAS: Revised Children's Manifest Anxiety Scale; SCS-SF: Self-Compassion Scale-Short Form; SHS: Student Health Services; SIPA: Stress index for Parents of Adolescents; STAI-T: State-Trait Anxiety Inventory; TCI: Temperament and Character Inventory; TIC-P: Trimbos/IMTA questionnaire for costs associated with psychiatric illness; TRF: Teachers Report Form; WRI: Wender-Reimherr Interview; YSR: Youth Self Report

small sample ( $n = 20$ ) and by Bueno and colleagues (2015) in a larger sample ( $n = 43$ ). The latter study also reported significant improvement on two computer-based attention tasks (Attentional Network Task and Conners' CPT II) in the mindfulness-trained group. Effect sizes in all these studies were large.

The largest study to date examined the effectiveness of a 12-week adapted MBCT in adults with ADHD who were randomly allocated to MBCT ( $n = 55$ ) or wait-list ( $n = 48$ ) (Hepark et al., 2015). MBCT yielded greater improvement in self- and clinician-rated ADHD symptoms, as well as greater improvement in executive functioning and mindfulness skills. No improvement was observed for internalizing symptoms.

Finally, in the only active comparator trial to date, Edel, Höltel, Wassink, & Juckel (2014) compared mindfulness ( $n = 39$ ) to DBT ( $n = 52$ ) in adults with ADHD. Assignment was non-random, however, and as a result the DBT group included proportionately more adults with comorbid borderline personality disorder. Mindfulness was superior, with a moderate effect size.

Smalley and colleagues (2009) found, interestingly, that adults with ADHD ( $n = 105$ ) had lower trait mindfulness than healthy controls, suggesting that they may be particularly well positioned to benefit from mindfulness training.

## CONCLUSIONS AND IMPLICATIONS

Mindfulness is a meditation practice that has become popular in recent years to promote general well-being and reduction of stress, as well as to more specifically target a range of clinical psychiatric diagnoses and conditions. Mindfulness has been succinctly described as “paying attention in the moment, on purpose, and without judgment” and is believed to act therapeutically by increasing the control of attention, the regulation of emotions, and the awareness of self.

Despite great promise, mindfulness is still an early stage of development as a clinical science. In particular, there is a dearth of randomized controlled trials which include active comparison groups to control for the nonspecific effects of treatment. Effect sizes may therefore be

much larger than can be attributed specifically to the effects of the mindfulness intervention. Currently, the evidence is sufficiently robust to indicate the efficacy of MBCT only with respect to preventing relapse in depression.

Mindfulness may have utility as a treatment or adjunct to treatment in ADHD, particularly with respect to increasing the volitional control of attention and improving emotional self-regulation. Studies of mindfulness in youth with ADHD so far have largely been conducted with adolescents in a group context, incorporating parallel mindfulness training for their parents. Sample sizes have been small and studies have not included randomized assignment to a control condition. Results across studies have been variable, both with respect to immediate benefits and to follow-up, but they suggest potential for reduction of the primary ADHD symptoms of inattention and hyperactivity. A larger, transdiagnostic study of an intensive *Mindful Parenting* program yielded robust benefits with respect to parent-rated externalizing and internalizing psychopathology.

As of this writing, there have been several studies of mindfulness in adults with ADHD which have yielded positive results with respect to primary symptoms as well as comorbid internalizing problems. However, as in studies of youth, study methodology has thus far relied upon wait-list controls and non-blind assessors.

Studies in healthy adults have adduced support for positive effects of mindfulness on laboratory measures of attentional processes and affective reactivity. Neuroimaging studies, also in healthy adults, have shown corresponding increases on fMRI in activation of brain regions known to mediate these functions, including ACC and PFC, areas which have also been shown in other research to be deficient in ADHD. To date, however, no neuroimaging studies of the effects of mindfulness have been undertaken in individuals with ADHD.

Current results suggest that an optimal intervention for adult ADHD may be generated through a combination of mindfulness therapy and cognitive-behavioral therapy for executive dys-

function. On the one hand, mindfulness may help adults with ADHD to focus attention volitionally, thus reducing the commonly reported experience of “racing thoughts” and the feeling of being “overwhelmed” by demands. On the other hand, there is evidence that cognitive behavioral therapy is effective in fostering development of specific executive self-management skills, including time management, organization, and planning (Safren et al., 2010; Solanto et al., 2010). Indeed, it may be that the increased ability to focus and also let go of emotionally distressing thoughts, as a result of mindfulness practice, may assist the individual in the implementation of the strategies learned in cognitive behavioral therapy.

Although results so far are promising — indeed exciting — considerably more research is needed to investigate and validate the benefits of mindfulness-based interventions in ADHD. To this end, future research might fruitfully incorporate the following:

- use of randomized controlled trials with inclusion of an active attention control intervention;
- comparison with other treatment modalities, particularly pharmacotherapy, and currently practiced behavioral and cognitive-behavioral interventions in children and adults with ADHD, respectively;
- follow-up for periods up to a year to assess maintenance of benefits; and
- concomitant structural and functional neuroimaging to identify neural substrates of clinical benefits and mechanisms of action of mindfulness in ADHD.

We look forward to continued developments in this field.

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