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Mindfulness Meditation Training for Attention-Deficit/Hyperactivity Disorder in Adulthood: Current Empirical Support, Treatment Overview, and Future Directions

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Abstract

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Research examining nonpharmacological interventions for adults diagnosed with attention-deficit/hyperactivity disorder (ADHD) has expanded in recent years and provides patients with more treatment options. Mindfulness-based training is an example of an intervention that is gaining promising preliminary empirical support and is increasingly administered in clinical settings. The aim of this review is to provide a rationale for the application of mindfulness to individuals diagnosed with ADHD, describe the current state of the empirical basis for mindfulness training in ADHD, and summarize a treatment approach specific to adults diagnosed with ADHD: the Mindful Awareness Practices (MAPs) for ADHD Program. Two case study examples are provided to demonstrate relevant clinical issues for practitioners interested in this approach. Directions for future research, including mindfulness meditation as a standalone treatment and as a complementary approach to cognitive-behavioral therapy, are provided.

Keywords: attention-deficit/hyperactivity disorder, ADHD, mindfulness meditation training

Attention-deficit/hyperactivity disorder (ADHD) is a developmental condition that continues into

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Author Manuscript Author Manuscript Author adulthood for the majority of cases (Barkley, Murphy, & Fischer, 2008). Prevalence rates of ADHD in adulthood are estimated to be 5% in the US and other countries (Willcutt, 2012). This often lifelong condition is characterized by pervasive impairment in multiple domains, including but not limited to academic, occupational, relational, mental health, and self-concept (Matheson et al., 2013; Stein, 2008). Pharmacotherapy (e.g., stimulant medication) is a mainstay of treatment; however, many patients continue to experience impairment or insufficient symptom reduction despite treatment (Safren, Sprich, Cooper-Vince, Knouse, & Lerner, 2010; Wilens, Biederman, & Spencer, 1998; Wilens, Spencer, & Biederman, 2002). In addition, in clinical practice some patients desire to minimize use of medications, and seek alternative or complementary approaches.

Relative to many other forms of psychopathology in adulthood, there has been less research on the effectiveness of nonpharmacological treatment options and fewer empirically-based treatment guidelines for clinicians treating ADHD in adults. Among available nonpharmacological treatment options, mindfulness meditation training has received increasing clinical interest and empirical support. The aim of this review is to (a) provide a rationale for the application of mindfulness to individuals diagnosed with ADHD, (b) describe the current state of the empirical basis for mindfulness training in ADHD, (c) summarize a specific mindfulness meditation program designed for adults diagnosed with ADHD, and (d) discuss future clinical and research directions in this area. Two case study examples are also provided to demonstrate particular clinical issues relevant for practitioners. First, however, we provide a brief introduction of mindfulness.

Mindfulness Training: General Overview

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Mindfulness-based interventions are part of a “third wave” or “third generation” of behavior therapy (Hayes, Follette, & Linehan, 2004; Hayes, Luoma, Bond, Masuda, & Lillis, 2006). Mindfulness meditation training is derived from the long-standing Eastern tradition of Vipassana meditation and is often defined as adopting a nonjudgmental attention to one’s experience(s) in the present moment (Kabat-Zinn, 1990). While defining mindfulness as a construct is challenging and the field of clinical psychology is yet to reach an operationalization that fully addresses the complex Buddhist phenomenology from which it is derived (Grossman, 2008, 2011; Kang & Whittingham, 2010), mindfulness has been widely described in the literature as a psychological process (or practice of such) with two components:(a) orienting one’s attention purposefully to the present moment and (b) approaching one’s experience in the present moment with curiosity, openness, and acceptance (Bishop et al., 2004). Another commonly cited definition conceptualizes mindfulness as a trait or set of skills such as being nonreactive, observing with awareness, acting with awareness, describing with awareness, and adopting a nonjudgmental approach towards one’s experience (Baer et al., 2008). Mindfulness training is thought to activate and strengthen such facets either via formal meditation practice or informal practice (e.g., “turning on” a mindful mind state in the midst of daily activities). Thus, trait-based mindfulness characteristics may be malleable and implicate mindfulness training for those low in this trait. Consistent with this, adults with ADHD are lower in trait mindfulness (Smalley et al., 2009).

Initially developed for clinical application as Mindfulness-Based Stress Reduction (MBSR) over 30 years ago for chronic pain (Kabat-Zinn, 1982; Kabat-Zinn, Lipworth, & Burney, 1985), mindfulness has since been adopted for various mental health conditions, such as eating disorders, anxiety disorders, depression, and substance use (Bowen et al., 2014; Brewer, Mallik, et al., 2011; Evans et al., 2008; Goldin & Gross, 2010; Kristeller & Wolever, 2011; Segal, Williams, & Teasdale, 2002; Wupperman et al., 2012) and has been proposed to be an approach that targets transdiagnostic processes across various forms of psychopathology (Greeson, Garland, & Black, 2014). Systematic reviews and meta-analyses indicate that, despite the need for more methodologically rigorous trials, mindfulness-based treatments are effective for a variety of mental health treatment targets (Bohlmeijer, Prenger, Taal, & Cuijpers, 2010; Chiesa & Serretti, 2011, in press; Fjorback, Arendt, Ornbol, Fink, & Walach, 2011). One recent meta-analysis of 209 treatment studies indicated that mindfulness-based therapies yield moderate effect sizes in within group pre-

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post comparisons, comparisons with waitlist control groups, and when compared to other active comparison groups, while not differing from behavioral and pharmacological interventions (Khoury et al., 2013).

Rationale for Mindfulness-Based Treatment for Adults Diagnosed with ADHD

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Studies of mindfulness in non-ADHD samples support its application to ADHD, particularly based on the purported impact of mindfulness training on attention regulation, executive functioning, and emotion regulation. At the intervention level, mindfulness meditation practices involve focusing attention on a particular object (e.g., one's own breath) and returning to this object after becoming distracted. This is proposed to improve attentional control abilities (Keng, Smoski, & Robins, 2011). That is, this practice requires top-down regulation of attention and conflict detection, which can be thought of as a regulatory approach to attention that improves executive processes (Chiesa, Calati, & Serretti, 2011). Since poor attentional functioning is a core symptom cluster of ADHD (American Psychiatric Association, 2013) and executive functioning deficits in ADHD are common (Barkley, 1997; Boonstra, Oosterlaan, Sergeant, & Buitelaar, 2005; Hervey, Epstein, & Curry, 2004), any treatments that purportedly strengthen these processes seem appropriate for ADHD. While many studies have measured the impact of mindfulness training in experienced meditators (e.g., Brewer, Worhunsky, et al., 2011; Taylor et al., 2013), even brief training with meditation novices yields improvements in attention. For example, one study assessed the impact of five days (20 minutes per day) of meditation against relaxation (Tang et al., 2007). Post-treatment effects indicated that the meditation group performed significantly better on conflict detection during an attentional task than the relaxation group. Similar findings have been reported following four days of meditation training (20 minutes per day) on visuo-spatial processing, working memory, and executive functioning against an active treatment comparison group (Zeidan, Johnson, Diamond, David, & Goolkasian, 2010).

Neuroimaging studies suggest that mindfulness meditation engenders neuroplastic changes in brain areas associated with attentional functioning typically impaired in ADHD. For instance, Hölzel and colleagues (2011) discuss the role of the anterior cingulate cortex, which is involved with executive/attentional processes via detection of conflicting incompatible incoming information. Given that this region is also involved with attentional processing in ADHD (e.g., Cubillo, Halari, Smith, Taylor, & Rubia, 2012; Passarotti, Sweeney, & Pavuluri, 2010), it represents a potential target for mindfulness training in ADHD samples.

Studies on mind-wandering also implicate application of mindfulness for ADHD patients. The phenomenon of mind-wandering has many similarities with and can be incorporated with models of cognitive control (Smallwood & Schooler, 2006). Mind-wandering is associated with neural networks of the brain involved with self-referential processing, also known as the default mode network (Christoff, Gordon, Smallwood, Smith, & Schooler, 2009; Mason et al., 2007; Raichle et al., 2001). The default mode network is implicated in ADHD (Fair et al., 2010) and is associated with poorer attentional regulation in ADHD (Castellanos et al., 2008). Further, pharmacological interventions that improve ADHD symptoms normalize activity within this network (Liddle et al., 2011; Peterson et al., 2009).

One proposed mechanism of mindfulness is reduced activity and altered connectivity in this network (Sood & Jones, 2013). For instance, in one study, central areas of the default mode network (i.e., medial prefrontal and posterior cortices) were deactivated across different types of meditation exercises among experienced meditators relative to meditation-naïve participants (Brewer, Worhunsky, et al., 2011). Further, this study indicated stronger functional connectivity between regions involved in self-monitoring and cognitive control (i.e., the posterior cingulate, dorsal anterior cingulate, and dorsolateral prefrontal cortices). Similar differential connectivity between default mode network regions (i.e., dorsomedial prefrontal cortex and right inferior parietal lobule) have emerged in other studies comparing experienced and beginner meditators during a restful state brain scan (Taylor et al., 2013). These findings are consistent with another study of meditation practitioners in which periods of self-reported mind-wandering were associated with default mode activity (Hasenkamp, Wilson-Mendenhall, Duncan, & Barsalou, 2012). Given these findings, one potential pathway that mindfulness may have its impact in ADHD patients is improvement in mind-wandering via the default mode network.

Mindfulness training is also proposed to improve emotion regulation (Chambers, Gullone, & Allen, 2009; Gratz & Tull, 2010). It teaches patients to observe emotional states as temporary and passing phenomenon that can be responded to in a nonreactive or compassionate manner. Mindfulness as an emotion regulation strategy therefore helps patients resist impulsive urges to act out on emotions—this emotional impulsivity is implicated in ADHD (Barkley, 2010). Although not a core diagnostic feature, difficulties in emotion regulation have been identified in ADHD and often contribute to significant impairment (Barkley & Fischer, 2010; Barkley & Murphy, 2010; Mitchell, Robertson, Anastopolous, Nelson-Gray, & Kollins, 2012). Accordingly, any treatment that purportedly strengthens the ability to regulate emotions seems appropriate for application. Studies show that even short-term training has yielded improvements in emotional functioning among healthy, meditation novices. For example, a group that received five days of meditation training (20 minutes per day) reported improvement on measures of anxiety, depression, anger, and stress-related cortisol in comparison to an active treatment group (Tang et al., 2007). In another study, those who received five weeks of mindfulness training (5-16 minutes per day) exhibited shifts in frontal electroencephalographic asymmetry patterns associated with positive, approach-oriented emotions in comparison to a waitlist group (Moyer et al., 2011).

Neuroimaging studies have also demonstrated that overlapping brain regions are implicated for emotion dysregulation in ADHD (Barkley, 2010) and mindfulness meditation. In one review, the prefrontal cortex (including dorsal and ventro-medial regions), hippocampus, and amygdala were associated with improvement in emotion regulation after mindfulness training (Hölzel et al., 2011). These regions are also identified as involved in emotional functioning in individuals diagnosed with ADHD (Barkley, 2010). Similar to the impact of mindfulness on attentional processes, given that a purported mechanism of change in mindfulness training overlaps with features that are identified in ADHD and are associated with similar areas of the brain, there is a rationale for a mindfulness-based approach to treatment for ADHD.

Review of ADHD and Mindfulness Treatment Outcome Studies

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In this section, we provide a review of mindfulness-based treatment outcome studies administered to children, adolescents, and adults diagnosed with ADHD. Treatment studies that included samples diagnosed with ADHD in the English language (including abstract-only) were identified by searches of PubMed and PsycINFO using the following search terms: “attention deficit hyperactivity disorder,” “ADHD,” and “ADD,” in combination with “mindfulness” and “meditation.” In addition, references of publications were reviewed to identify other treatment studies. This review did not include dissertation studies[1,2]. No restrictions were placed on date of publications. This search was conducted on August 10, 2014.

Child and adolescent ADHD treatment studies

Applications of mindfulness training to child and adolescent samples with ADHD have been delivered in different formats (i.e., the child or adolescent receives training only, or caregivers receive concurrent mindfulness instruction as well). In one of the earliest studies with ADHD adolescents, a group of 15-18 year-olds ($n = 8$) received mindfulness training as part of a feasibility study that also included a separate group of adults with ADHD (Zylowska et al., 2008). Although feasibility measures indicated good attendance and high satisfaction with the treatment among the adolescents, there was a tendency for poorer compliance with at-home practice compared to adults.

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Pre-post improvements in self-reported ADHD symptoms and test performance on four out of 12 diverse tasks measuring attention, working memory, and cognitive inhibition were noted in a pooled sample of adolescents and adults with no significant age effects on the measured outcomes. Although these findings are promising, limitations include a lack of a control group, a small sample of adolescents, and atypical characteristics of the sample (e.g., high IQ and socioeconomic status).

Another treatment outcome study of an adolescent-only intervention (i.e., without any concurrent parent groups) included mindfulness training integrated with additional treatment modalities as well. Haydicky and colleagues assessed the impact of a 20-week mindfulness training program that integrated elements of cognitive-behavioral therapy (CBT) and mixed martial arts in an adolescent male sample (ages 12-18) diagnosed with a learning disorder ($n = 60$) (Haydicky, Wiener, Badali, Milligan, & Ducharme, 2012). This treatment was compared against a waitlist control group. A subgroup analysis on participants with co-occurring ADHD indicated improvement on parent-rated externalizing behavior, particularly oppositional defiant problems and conduct problems for the treatment group ($n = 14$) relative to the waitlist subgroup with co-occurring ADHD ($n = 14$). ADHD symptom change did not differ between groups according to both parent report and self-report. Changes in parent report of executive functioning and social problems did not differ between groups either, nor did self-reported externalizing and social problems. In a different subgroup analysis, males with elevated inattentive ADHD symptoms in the treatment group ($n = 15$) improved on parent-rated social problems relative to the waitlist group ($n = 18$), but not on parent report of executive functioning, externalizing symptoms, or ADHD symptoms. Self-report measures of externalizing symptoms, social problems, and ADHD symptoms did not differ either. In another subgroup analysis, males with elevated hyperactive-impulsive ADHD symptoms in the treatment group ($n = 12$) improved on parent-rated social problems and monitoring skills (a component of executive functioning) relative to the waitlist group ($n = 17$). Null differences emerged on one of two subscales measuring parent-rated executive functioning symptoms. In addition, this analysis did not yield any statistically significant differences between groups on parent report of externalizing problems or ADHD symptoms, or self-reported externalizing problems, social problems, or ADHD symptoms. Change in self-reported oppositional defiant behaviors approached statistical significance ($p < .10$) for the treatment group. In addition to small sample size for the ADHD group, lack of random assignment to treatment conditions, a heterogeneous intervention (i.e., mindfulness was a component of an intervention that introduced other treatment modalities), and lack of an active treatment comparison group, this was a selected sample of male adolescents diagnosed with a learning disorder and comorbid ADHD.

Finally, one recent study assessed the impact of mindfulness training for four 8 year-old boys with ADHD following a multiple baseline design (Carboni, Roach, & Fredrick, 2013). Participants exhibited greater on-task behavior following the intervention based on descriptive visual analysis of observational data. Though parent and teacher ratings indicated decreases in hyperactive behaviors, changes in inattention were not observed. Although this study demonstrates the potential to administer a mindfulness-based intervention in a school setting, future studies would have to address issues such as sample size, inclusion of females, and observational raters blind to treatment status.

Studies involving mindfulness for children or adolescents with ADHD samples, along with their parents who separately receive mindfulness training, yield promising preliminary results. An interesting clinical case study indicated improvement in compliance with parental requests in two children with ADHD following mother and child training in mindfulness (Singh et al., 2010). Other available studies that involve parent training as well were conducted with an eight-week child and parent mindfulness program, called MYmind (Bögels & Restifo, 2014). In one of the earliest group studies MYmind, it was administered in a group format for 14 adolescents with externalizing disorders and a parallel mindfulness group for their parents ($n = 14$) (Bögels, Hoogstad, van Dun, de Schutter, & Restifo, 2008). In the adolescent group, self-reported improvements emerged for

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In another study of the MYmind program for adolescents aged 11-15 years with ADHD ($n = 10$) and their parents ($n = 11$) (van de Weijer-Bergsma, Formsma, de Bruin, & Bogels, 2012), within group assessments were conducted immediately after treatment, eight-week follow-up, and 16-week follow-up. Various reporting sources (i.e., adolescent, maternal, paternal, and tutor) were considered for different outcomes, including attention problems, externalizing behavior, internalizing behavior, executive functioning, mindfulness, parental stress, parental overreactivity, fatigue, and happiness. At post-treatment, statistically significant improvements emerged for externalizing behavior (paternal report), parental stress (paternal report), and parental overreactivity (maternal report). Attention problems (paternal report), internalizing problems (paternal report), metacognition (a component of executive functioning, paternal report), and behavioral regulation (a component of executive functioning, tutor report) approached significance (p's < .10). At eight-week follow-up, improvement in attention problems was significant according to adolescent report and was maintained for paternal report. In addition, improvements were noted according to paternal report for externalizing behaviors, metacognition, behavioral regulation, and parental stress. Trends also emerged for externalizing behaviors (adolescent report) and internalizing problems (paternal report) (p's < .10). At 16-week follow-up, only adolescent ratings were collected. Among six outcome variables, none were statistically significant, but improvements in externalizing behaviors approached statistical significance ($p < .10$, large effect size). Two computerized sustained attention tasks were also administered at post-treatment and both follow-ups. On one of these tasks, a visual sustained attention task, adolescents exhibited an improvement in reaction speed, which was not maintained at either follow-up. On another task, an auditory sustained attention task, the number of false alarm responses reduced significantly, which was maintained for both follow-up assessments and approached significance (p's < .10). At eight-week assessment, the number of misses improved, though this was not sustained at 16-week follow-up. Interestingly, many maternal ratings did not indicate improvements on the majority of measures included in the study.

In a study of the MYmind program with children aged 8-12 diagnosed with ADHD ($n = 22$) and their parents ($n = 21$), a within-group waitlist design to control for the effects of time and repeated measurement was conducted (van der Oord, Bogels, & Peijnenburg, 2012). Inattentive and hyperactive-impulsive symptoms improved at post-treatment and eight-week follow-up for parent ratings of child behavior and parent ratings of their own behavior. Teacher ratings of inattention improved at post-treatment, but not follow-up. Teachers did not report a statistically significant

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change in hyperactive-impulsive symptoms. While parent ratings of mindfulness improved at post-treatment but not follow-up, parental stress and overreactivity improved only at follow-up. Parental permissiveness ratings did not change. These findings are promising, though sample representativeness (e.g., high caretaker educational attainment and externalizing comorbidity) may limit the generalizability of these findings.

Finally, in a study by Haydicky and colleagues, the MYmind program was administered to adolescents (ages 13-18) diagnosed with ADHD ($n = 18$) and a separate group for their parents ($n = 17$) (Haydicky, Schecter, Wiener, & Ducharme, in press). This was a within-groups design that included multiple assessments: 4 weeks pre-treatment (baseline), pre-treatment, end of treatment, and six-week follow-up. Parent and adolescent ratings of inattentive, hyperactive-impulsive, conduct disorder, oppositional defiant disorder, depressive, anxiety, and internalizing symptoms were considered. In addition, functional impairment was measured (i.e., parent report of learning, executive functioning, and peer relations problems, and adolescent report of learning and family relations problems). Pairwise comparisons of pre- and post-treatment indicated an improvement in conduct disorder symptoms (parent report) and peer relations (parent report), while inattentive symptoms (parent report) approached statistical significance ($p < .10$). While these findings were no longer significant at follow-up, pairwise comparisons of pre-treatment and follow-up indicated improvement for adolescent report of depression, anxiety, and internalizing symptoms. Parent report of depression approached statistical significance ($p < .10$). Additional ratings of parenting stress, family functioning, and mindfulness were considered. Among the 12 parental stress outcomes, pairwise comparisons indicated that two improved at post-treatment and three improved at follow-up. Among the six family functioning outcomes, comparisons indicated no change at post-treatment and one variable (parent reported conflict intensity) approached statistical significance ($p < .10$) at follow-up. Mindful parenting improved at post-treatment but not follow-up, while parental acceptance improved only at follow-up.

Overall, these findings in child and adolescent samples are promising and demonstrate that mindfulness meditation training in this ADHD population is feasible and acceptable. However, methodological issues pertaining to small samples, the use of multiple outcome variables, a lack of active treatment comparison groups (or any comparison group in most studies), a lack of accounting for the effects of pharmacotherapy, atypical sample composition (e.g., high IQ and parental education levels), and short follow-up assessment periods (i.e., none beyond 16 weeks) limit generalizability and indicate the need for larger, more methodologically-rigorous trials.

Adult ADHD treatment studies

Studies in adult ADHD samples also provide promising preliminary support for mindfulness meditation training. In one within-subjects study, an eight-week group mindfulness program modified for ADHD patients, called the Mindful Awareness Practices (MAPs) for ADHD Program, was administered to a sample of adults ($n = 24$) and adolescents with ADHD ($n = 8$) (Zylowska et al., 2008). Pre- and post-treatment assessments revealed improvement in self-reported inattentive, hyperactive-impulsive, depressive, and anxious symptoms. In addition, among 12 different laboratory-based cognitive task variables, significant improvements emerged on two indices of conflict detection and two indices of set-shifting. Retention rates were high with the majority (78%) of participants completing the treatment. Participants reported significant practice outside of weekly sessions and overall high satisfaction with the treatment. Improvements in ADHD, anxiety, and depressive symptoms were sustained at the three-month follow up (Zylowska, Smalley, & Schwartz, 2009). As mentioned above, limitations included a lack of a control group and atypical sample characteristics, such as somewhat higher IQ and socioeconomic status than most typical ADHD studies. Additionally, several adults were diagnosed with "probable ADHD," which was defined as falling one symptom or other criterion short of a full *DSM-IV* diagnosis.

In a separate study in which the MAPs for ADHD Program was administered, adults with ADHD were stratified by ADHD medication status and otherwise randomized into a treatment condition (n

= 11) or waitlist control condition (n = 9) (Mitchell et al., in press). Assessments prior to and following the eight-week period included self-report, clinician ratings, laboratory tasks of executive functioning, and electronic diary measures. Regarding the latter, participants were provided with an electronic diary for a two day period prior to and following the eight-week period. These experimenter-prompted electronic diary assessments included in-the-moment measures of ADHD and executive functioning symptoms. Results indicated null findings on four laboratory tasks assessing executive functioning, which may have been a function of the study design (e.g., no medication washout period for the 55% of the sample that was already taking a medication for ADHD prior to study enrollment) and deserves consideration in future research. However, the treatment group did yield improvement in ADHD and executive functioning symptoms assessed via questionnaires, electronic diary, and clinician rated interviews. In addition, self-reported emotion dysregulation improved as well. Effect sizes for all statistically significant findings were large. Similar to Zylowska et al. (2008), the majority of participants completed the treatment, completed homework exercises, and reported high treatment satisfaction. Although this study included a sample that appeared to be generalizable in some aspects (e.g., annual income for the treatment group was ≤ US$25K for 46% of the sample and US$25-50K for 27% of the sample), they tended to be highly educated (e.g., 73% of the treatment group had earned an undergraduate or graduate degree). Other limitations included a small sample, need for control of concurrent medication use, and a lack of an active treatment comparison group.

Another recently published study employed a mindfulness intervention in a sample of 26 adults diagnosed with ADHD randomized to a mindfulness group and 24 to a waitlist control group (Schoenberg et al., in press). The mindfulness training integrated elements from Mindfulness-Based Cognitive Therapy (MBCT; Segal, et al., 2002) and the MAPs for ADHD Program (Zylowska et al., 2008). Approximately half of the sample received medication for ADHD. Self-report of ADHD symptoms (inattentive symptoms, hyperactive-impulsive symptoms, and ADHD Index), mindfulness, and quality of life improved for the mindfulness group, but not the waitlist control group. For the mindfulness group, these improvements at post-treatment corresponded with enhanced event-related potential amplitudes as an index of performance monitoring biomarkers of ADHD. Specifically, decreased hyperactive-impulsive symptoms and increased acting with awareness (a mindfulness measure subscale) were associated with enhanced error processing. Decreased inattentive symptoms corresponded with enhanced inhibitory control event-related potentials concomitant to a continuous performance task. The authors concluded that mindfulness training has comparable modulation on event-related potential amplitudes to pharmacotherapy. Limitations included a lack of an active treatment comparison group and reliance on self-report scales to assess ADHD symptoms. As with the other studies, concurrent medication was not controlled in the study design and about 55% of the sample received medication for ADHD. However, there were no group differences in distribution of those taking medications, medication status remained stable from pre- to post-assessments, and medication status was entered as a covariate in the primary analyses.

Another pilot study administered a modified 10-week MBCT in a sample of 11 adults with ADHD (Hepark, Kan, & Speckens, 2014). Pre-treatment and post-treatment comparisons indicated improvements in self-reported total ADHD symptoms, trait mindfulness, and quality of life. In addition, laboratory task performance on the one of the three outcome measures of executive functioning (i.e., conflict detection) improved. Participants did not report any significant changes in self-reported anxiety or depression. Although this study included a small sample size and lack of a treatment comparison group, a mindfulness-based intervention was associated with improvement in ADHD symptoms and was a feasible treatment approach in an adult ADHD sample, which is consistent with studies by Zylowska et al. (2008), Mitchell et al. (in press), and Schoenberg et al. (in press).

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In addition to mindfulness-based group training, three studies included mindfulness training as a component of a modified Dialectical Behavior Therapy group skills training program for adults diagnosed with ADHD (Hesslinger et al., 2002; Hirvikoski et al., 2011; Philipsen et al., 2007). In addition, one case study (Mitchell, Nelson-Gray, & Anastopoulos, 2008) employed a similar approach in an individual therapy setting. Among the treatment studies, self-reported ADHD symptoms improved when assessed in a within-groups (Philipsen et al., 2007) or between-groups design (Hesslinger et al., 2002; Hirvikoski et al., 2011). In addition, self-reported depressive symptoms improved in two of these studies (Hesslinger et al., 2002; Philipsen et al., 2007). Although these studies involved interventions that included other treatment modalities, mindfulness was well-liked and was as one of the most useful components of the training (Philipsen et al., 2007).

One recent pilot randomized trial assessed the impact of a modified Dialectical Behavior Therapy skills training program for college students with ADHD in comparison to a skills handout condition that targeted organization, time management, and stress management (Fleming, McMahon, Moran, Peterson, & Dreessen, in press). Self-reported executive functioning and trait mindfulness improved for the DBT group relative to the control group at both post-treatment and three-month follow-up. Self-reported inattention did not significantly differ at post-treatment, but was statistically significant at three-month follow-up. Self-reported quality of life was higher for the DBT group at post-treatment, but did not differ at three-month follow-up. The omission, commission, and response time standard error indices from the Conners' Continuous Performance Test (Conners, 1995) were also considered. With the exception of the DBT group outperforming the control group on omission errors at three-month follow-up, group differences did not emerge. No group differences emerged when anxiety, depression, or GPA were considered.

Finally, similar to studies of modified DBT skills training that incorporate mindfulness as a component of treatment, Pettersson and colleagues recently compared a cognitive-behavioral skills training that included mindfulness delivered via two different modalities (i.e., internet only and internet/weekly group therapy) against a waitlist control group (Pettersson, Soderstrom, Edlund-Soderstrom, & Nilsson, in press). The group that received the internet only intervention reported relatively greater improvement in total ADHD symptom severity than the waitlist control group at post-treatment. These changes for the internet only condition were maintained at six-month follow-up. No other significant group differences emerged among the three groups for self-reported ADHD symptoms, self-reported depression, self-reported quality of life, and clinician ratings of occupational performance. Although findings from studies that assessed mindfulness in the context of additional skills training are promising, they involve a treatment that also introduces CBT skills and therefore do not address the extent to which mindfulness impacts symptom change independent of another treatment modality.

Overall, promising preliminary results have emerged across studies assessing mindfulness in adult ADHD samples. Particularly promising are approaches that aim to enhance ecological validity of outcome measures by incorporating ecological momentary assessment, and inclusion of electrophysiological measures to assess potential biomarkers. Limitations include small sample sizes, a lack of active treatment comparison groups, a lack of control for the effects of pharmacotherapy for ADHD, and long-term follow-up beyond three months for either most or all of the studies reviewed. In addition, some studies included additional treatment modalities not specific to mindfulness training interventions. Future studies are required to address limitations of these studies (summarized below in the Future Directions section). In sum, existing studies support the acceptability and feasibility, and preliminary effectiveness use of this approach in the treatment of ADHD in adulthood. We now provide a description of a mindfulness-based treatment for ADHD in adulthood.

Mindfulness Meditation Training for Adult ADHD: The Mindful Awareness Practices (MAPs) for ADHD Program

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The MAPs for ADHD Program is based on established mindfulness training programs, including MBSR (Kabat-Zinn, 1990), MBCT (Segal et al., 2002), and the Vipassana meditation tradition, with modifications made for older adolescents (15-18 years-old) and adults diagnosed with ADHD. Originally described by Zylowska and colleagues (Zylowska et al., 2008; Zylowska et al., 2009) as a group-based intervention, the training is now expanded on in a self-help book that can also be used by clinicians working with ADHD individuals (Zylowska, 2012).

The MAPs for ADHD Program consists of eight weekly group mindfulness training sessions that last 2.5 hours each. Sessions typically begin with a brief mindfulness meditation, review of lessons from the previous week and at-home practice, introduction and practice of new material, review of the next week's at-home practice, and a brief meditation before dispersing. Throughout each session, group members are active in discussing the topics and participate in meditation exercises. See Table 1 for a summary of session-by-session content covered in MAPs for ADHD Program. In addition, a look inside the self-help book and examples of MAPs exercises and formal mindfulness practices can be accessed at this journals website (insert link: Look inside The Mindfulness Prescription Book: http://en.calameo.com/read/0000392570bf0e177d7dc ; Tables and Guided meditations; http://www.shambhala.com/MindfulnessPrescription).

Table 1

Summary of the initial[1] Mindful Awareness Practices (MAPs) for ADHD Program

Session Theme	Topics Discussed [2]	In-Session Mindfulness Meditation Exercises	At-Home Assignments
1. Introduction to ADHD and Mindfulness. Re-framing of ADHD	- ADHD psychoeducation - Defining mindfulness - Discussion of individual experiences with ADHD - How purposefully changing one's awareness can change the quality of their experience - Directions on the basics of sitting meditation (e.g., posture)	- Mindful Eating - Mindfulness of Breath	- Formal: Daily 5 minute Mindfulness of Breath exercise - Informal: Mindful awareness of a routine daily activity (e.g., eating or brushing teeth) - Informal: Telephone Breath exercise (involves taking a breath every time the phone rings) to improve awareness of breath in daily life
2. Mindful	- Discussion of common	- Mindfulness of	- Formal: Daily 5 minute

Open in a separate window

Note.

[1]This table reflects the initial MAPs for ADHD Program tested by Mitchell et al. (in press) and Zylowska et al. (2008); see Zylowska (2012) for content additions and modifications to the eight-week training sequence.

[2]Topics for each session involve a review of the previous session content and experience with at-home assignments. For formal at-home mindfulness meditation practices, patients are encouraged to vary exercises and are allowed to pick a different exercise than the one "assigned" in session to foster curiosity in developing an individualized mindfulness meditation routine.

The mindfulness training in MAPs for ADHD was modified to meet the unique challenges presented by many individuals diagnosed with ADHD in a number of ways.

First, ADHD psychoeducation is provided in the initial two sessions. This includes didactic material and discussion about the clinical symptoms, neurobiology, etiology, and the dimensional nature of ADHD. ADHD is presented as a neurobiologically-based disorder associated with impairment on the extreme end of a continuum of normal functioning. That is, although ADHD is typically discussed as a categorical diagnosis, symptoms of ADHD can be considered from a dimensional perspective (Frazier, Youngstrom, & Naugle, 2007; Levy, Hay, McStephen, Wood, & Waldman, 1997). Participants are encouraged to reflect on their own cluster of symptoms in a non-judgmental way and become "experts in their own ADHD." In this context, the participants are encouraged to identify their individual areas of relative strengths and weaknesses. As the program proceeds, the instructor makes references to common ADHD patterns and invites participants to have a curious and kind attitude for self-observation. Consequently, we suggest that the instructor has a good working knowledge of both ADHD as well as mindfulness practice. Alternatively, two instructors, each with their relative expertise are recommended.

Second, the duration of formal sitting meditations is shorter compared to similar mindfulness-based programs. Whereas 45 minute exercises may be practiced in MBSR or MBCT, participants in the MAPS Program practice sitting meditations ranging in duration from 5 to 15 minutes. In MAPs, the duration of these sitting meditations are gradually increased (i.e., approximately 5 minutes for

sessions 1-2, 10 minutes for sessions 3-5, and 15 minutes for sessions 6-8). In addition, greater flexibility is provided for walking meditations as a substitute for sitting versions. The rationale for adapting the length of time of formal meditation and greater emphasis on walking meditations is based on clinical features of ADHD, including restlessness and frequent urges to move. Longer meditations that require sitting still may otherwise be discouraging and impact treatment adherence for individuals with ADHD.

Third, mindful awareness in daily activities is emphasized via informal mindfulness exercises. Such exercises typically include at-home assignments to mindfully observe a daily experience, often a routine behavior. For example, when a formal exercise called mindfulness of breathing is introduced, in addition to the 5 minute sitting daily practice, the participants are also asked to briefly notice their breath many times throughout the day. Reminders such as visual cues (e.g., a Post-It note with the word "breathe" on it) or calendar reminders are encouraged to help participants engage in the formal and informal practice. The emphasis on informal practice helps patients become less distracted and more alert to both their inner state and their outside environment throughout their daily lives. This is in contrast to how ADHD symptoms are often expressed in everyday life (Knouse et al., 2008). Also, a greater emphasis on informal mindfulness exercises than other existing mindfulness programs allows patients more opportunities to engage in and understand mindfulness, even when formal exercises are not practiced. For example, a patient may forget or feel too busy to complete an exercise lasting 5 to 15 minutes. Clinically, knowing that consistent application of new behavioral techniques can be challenging for this population, it was anticipated that ADHD patients will be more likely to struggle with compliance with daily formal meditations and that an emphasis on other forms of practice are important to maintain motivation.

Fourth, didactic visual aids are encouraged to assist instructors in explaining both ADHD and mindfulness concepts. For example, a visual of blue sky with clouds is used to explain mindfulness of thoughts. Here, the blue sky represents open awareness and white clouds represent mental contents such as thoughts, images, memories, urges, etc. While ADHD is often subjectively described as having "too many thoughts" (thus having many clouds crowding the blue sky), the visual encourages the participants to notice moments of "space" between them. Such awareness can later be utilized for self-redirecting or self-coaching.

Fifth, loving-kindness meditation exercises are included at the end of each session. This type of meditation exercise involves developing a kind, compassionate view of oneself and others. This is relevant to adults with ADHD on many levels, including observations that ADHD symptoms are associated with patterns of negative automatic thinking that are typically characterized by depression (Mitchell, Benson, Knouse, Kimbrel, & Anastopolous, 2013). This practice of self-acceptance or self-compassion can be an important aspect of perceived well-being. In addition, loving-kindness exercises can foster positive emotion development that may counteract the impact of negative emotions (Garland et al., 2010).

Sixth, elements of CBT are discussed during the final session as helpful in maintaining mindfulness practice. The participants are encouraged to use a calendar and reminder systems (e.g., visual cues or auditory alarms) for mindfulness practice. Although this is an application of skills that are also taught in manualized cognitive behavioral approaches (e.g., Safren, Perlman, Sprich, & Otto, 2005; Solanto, 2011), these skills are introduced in the context of supporting mindfulness practice. Explicit instruction and demonstration of these cognitive-behavioral strategies are not provided as they are in the manualized CBT interventions for adult ADHD. However, based on our experience in clinical practice, mindfulness training can be combined with more explicit discussion of CBT techniques. We elaborate on this point below (see Future Directions section).

Case Study Examples

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We provide two examples of patients who completed MAPs for ADHD with differing outcomes to illustrate how patients might respond in different ways. Both patients participated in the same group. Patient #1 was a Black female in her mid-30's. She presented for therapy primarily due to ongoing difficulties with time management at work (e.g., she was frequently late to her current and past jobs, which regularly elicited negative feedback), and difficulty with task completion and restlessness at home. These behaviors were also preceding arguments with her partner and negatively impacting their relationship to the extent that they recently sought couples therapy. Patient #1 also indicated that her awareness of these difficulties throughout her life had a negative impact on her self-esteem. At the time of the intake, she was working as a personal trainer and in an administrative position at a local university. She stated that she sought out jobs such as being a personal trainer or police officer in the past to allow for an outlet for her physical restlessness. Prior to starting MAPs, a thorough evaluation was conducted, which included the Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Williams, & Gibbon, 2002) and the Conners' Adult Diagnostic Interview for DSM-IV (CAADID; Epstein, Johnson, & Conners, 2000). She met criteria for ADHD, combined typed; major depressive disorder, recurrent, in partial remission; and a lifetime (not current) diagnosis of post-traumatic stress disorder. These diagnoses were consistent with past assessments, including when she was first diagnosed with ADHD in her late 20's. At the start of treatment, she had been taking prescriptions for citalopram (Celexa) and lamotrigine (Lamictal) over the past year, and had started a trial of lisdexamfetamine dimesylate (Vyvanse) approximately one month prior.

Patient #2 was a White female in her mid-40's. She presented for treatment following persistent difficulties with inattention that were negatively impacting her at work, including negative feedback from her supervisors and colleagues regarding difficulty with task completion, careless errors, and time management. She had been fired from previous jobs due to excessive difficulties with time management, which she was concerned would occur again. In addition to work, Patient #2 reported that her partner was frustrated with her difficulties focusing and task completion at home, which typically resulted in arguments. Results of a thorough evaluation, which included the SCID and CAADID, indicated diagnoses of ADHD, predominantly inattentive type and dysthymic disorder. She was not receiving any kind of pharmacotherapy at intake or throughout her participation in the MAPs for ADHD Program.

ADHD symptoms over the course of treatment were assessed with a self-report version of the Current ADHD Symptoms Scale (Barkley & Murphy, 2006), which was modified to asses symptoms in the past week on a scale of 0 ("not at all or rarely") to 3 ("very often"). Although total DSM-IV ADHD symptom severity scores started at the same level (i.e., total ADHD symptom severity scores were 34 for both patients), Patient #1 reported an increase in symptoms at week 3 and week 4 (see Figure 1). Despite that symptom severity scores decreased at weeks 5 and 6, they began to increase week-by-week from that point until the end of treatment. At the conclusion of treatment, Patient #1 yielded symptom severity scores similar to week 1. Patient #2, in contrast, reported a decrease in symptom severity scores at weeks 2 and 3, which held consistent by week 4. By week 5 and 6, she noticed an increase in symptoms, which then gradually decreased over the course of weeks 7 and 8. Whereas the symptom severity score was 33 for Patient #1 at post-treatment (item average of 1.83 with response options ranging from 0 to 3), Patient #2 yielded a score of 8 (item average of 0.44 with response options ranging from 0 to 3). The change in ADHD symptom severity scores for Patient #2 is greater than 30% symptom reduction criterion used in treatment outcome studies to classify treatment responders (e.g., Safren et al., 2010; Solanto et al., 2010).

Figure 1

Total DSM-IV ADHD symptom severity ratings over the course of MAPs for two patients. Patients completed a measure of the severity of each of the 18 DSM-IV ADHD items on a scale of 0 ("never or rarely") to 3 ("very often").

No medication changes occurred for Patient #1 over the course of MAPs; however, environmental factors may have exacerbated the increase in ADHD symptoms. Around weeks 3 and 4, Patient #1 indicated that she and her partner unexpectedly found themselves caring for the child of a close friend for the next few months. Consistent with this, Patient #1 reported an increase in stress at

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home, particularly since this occurred in the context of Patient #1 and her partner frequently arguing. Patient #2 did not report any major changes in her environment over the course of treatment.

At the end of treatment, both group members were asked about their experiences with MAPs. Patient #1 indicated that she learned about not responding to herself in harsh, judgmental ways (e.g., being overly critical of herself when she noticed symptoms of ADHD). Further, she believed that the treatment itself helped her notice how the ADHD symptoms impacted her and others around her, and that she "realized (she) was acting on automatic pilot" much of the time. This awareness of ADHD symptoms also translated into her emotional functioning as well. For instance, she recalled that the RAIN exercise taught in session 6 (see Table 1) was particularly helpful in realizing how frustrated she felt. She reported that mindful awareness of her emotions (i.e., viewing her emotions as transient, observing without responding to various aspects of her emotional experience physically and cognitively, and practicing not identifying with the emotional experience [in other words, "I am not my emotion"]) not just made these emotional experiences more tolerable, but defused their impact.

Patient #2 also indicated that she felt mindfulness training helped her become more aware of her own behavior in a way similar to Patient #1. Patient #2 reported that she first started noticing this greater awareness of her behavior around week 5 and stated "(MAPs) forced (me) to take time, not go on autopilot, and attend to what's going on… which includes noticing how you're reacting." She also indicated that learning how to apply mindfulness in the context of emotions was helpful in de-intensifying her emotional experiences and refocussing her attention on tasks that she would have otherwise put off. As opposed to Patient #1, Patient #2 also noticed that participating in a group in general was helpful as well as it allowed her to "see everyone was struggling," which helped her feel less isolated in her own challenges.

It is interesting to note that both patients reported increased awareness of their ADHD behaviors. At a general level, this awareness may confound self-report ratings. That is, greater awareness of ADHD symptoms may result in temporary symptom increase, which could be an indication of response to treatment since many informal mindfulness exercises emphasize enhanced awareness of ADHD behaviors. However, symptom increase, of course, can also be an indication of poor response to treatment. Use of collateral reporting sources would be helpful to address this issue. Another issue worth highlighting is selection of treatment outcomes variables. Although Patient #1 did not report a decrease in ADHD symptom severity at the level that Patient #2 reported, Patient #1 went from a score of 19 in the moderately to severely depressed range at week 1 on the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) to a score of 6 in the non-depressed range at week 8—this change in depressive symptoms also exceeds 30% symptom reduction. Clinicians should consider multiple targets in treatment, particularly comorbid conditions such as with this example. ADHD is commonly comorbid with mood disorders (Sobanski, 2006), and mindfulness-based treatments have been shown to have a protective impact on the re-emergence of depressive episodes and reduction of residual depressive symptoms in patients with major depressive disorder (Fjorback et al., 2011). For example, one controlled study of MBCT has demonstrated effectiveness for preventing depressive episode relapse while allowing patients to reduce their use of antidepressant medication (Kuyken et al., 2008). In the case example of Patient #1, there was a reduction in residual depressive symptoms. At a broader level, if ADHD is considered as a risk factor for depression, mindfulness training may be implicated to reduce complications that emerge with this comorbidity. Other treatment targets may be less symptom oriented. For example, in the case of Patients #1 and #2, both reported relational difficulties. It would have been helpful to assess the impact of MAPs in a functional domain that both reported was impacted by their ADHD symptoms. As in the above depression study, potential reduction of medication, while maintaining improvement in functioning, may also be another worthwhile target.

Recent Adaptations to the MAPs for ADHD Program

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The description and case examples above describe the initial MAPs for ADHD Program. Recent additions have been proposed in Zylowska (2012), further adapting useful concepts from other mindfulness-based approaches to adult ADHD. We summarize some of these additions below to stimulate further discussion of mindfulness-based approaches in ADHD.

Values Incorporation of individualized values, similar to values work in Acceptance and Commitment Therapy (Hayes, Strosahl, & Wilson, 2012) can be helpful in adult ADHD, especially as patients often express concerns of being over-committed and having trouble prioritizing. Values are the overarching principles that guide action and are different from behavioral goals. That is, values are never fully attainable (e.g., "I want to be a loving parent"), but provide guidance. In contrast, goals are more explicit and attainable (e.g., "I will pick up my child at 3pm on Wednesday's"). In MAPs, values can be used to encourage mindful observation of one's behavior and guide prioritization of actions. Using values, patients can assess how aligned their actual behavior is with what matters most in their lives.

Acceptance-Change Strategies An additional adaptation to MAPs, primarily a training in self-awareness and experiential acceptance, involves adding selected mind-body change strategies to encourage patients to further explore re-direction (or self-regulation) should they recognize they are distracted or engaged in a maladaptive behavior. This greater emphasis on combining acceptance and change perspectives is consistent with "third wave" behavior therapies, such as Dialectical Behavior Therapy (Linehan, 1993) and Acceptance and Commitment Therapy (Hayes et al., 2012). These strategies involve teaching patients that although change strategies are adaptive at times, radical acceptance of a situation, an emotional state, a thought, or a physical sensation is often called for as well. Patients are taught that this acceptance-change dialectic can be synthesized. In practice, several strategies are introduced to help patients consider this dialectic and use mindfulness to consider how to approach situations with greater awareness of how acceptance and change may be applicable.

One example includes use of a self-coaching voice: an inner voice that can stress the importance of being fully present and accepting of one's reactions in a nonjudgmental, kind, and curious way and then guide the behavior in the desired direction. Thus, the self-coaching voice balances the perspectives of acceptance and change. The self-coaching voice can also be helpful in activating willingness to tackle a difficult or avoided task. For example, for an adult ADHD patient who is attempting to organize a desk, this person may use a mindfulness-based self-coaching voice to remind him or herself that "I'm noticing the urge to put this off, though I know I can do it right now." Thus, the urge to avoid is accepted, while a change-oriented perspective is also emphasized.

Another example involves the use of reinforcing imagery, body posture adjustment, or movement. Imagery can be used to cope with feeling overwhelmed, agitated, or restless which are negative affective states frequently experienced by patients with ADHD. Imagery can be incorporated with formal sitting meditations to notice and accept emotions in that moment and then shift attention to less emotionally provocative (i.e., neutral) or relaxing stimuli, thus a change-oriented strategy is adopted. For example, imagery of a mountain can be used to cultivate feeling more stable, firm, and grounded despite being in the midst of a stressful or distracting situation. In addition to the formal practice, posting pictures of the such imagery content (e.g., a picture of a mountain and putting it next to one's work space) can also serve as a reminder of one's inner resources (e.g., seeing oneself as strong or focused) and capacity to change. The picture can be a visual cue to "check-in" on one's emotions throughout the day further triggering both self-awareness and acceptance of how a patient is feeling at the particular moment as well as an opportunity for a change or shift in behavior. Similarly, patients are taught about the mind-body connection and how body posture adjustment can be used to enhance awareness and acceptance, and instill a particular mental state or a skill. For example, a patient can notice with awareness his orher automatic tendency to be passive, unassertive, or appear uninterested and what is the body posture, eye contact, and demeanor associated with such reactions. To learn assertiveness or to project engagement, the patient can imagine speaking assertively and practice sitting or standing up straight and moving their hand in a decisive "no!" gesture. The movement can help the person tap into the assertive energy in their body and note the corresponding mind-body shift with full awareness. In reference to engagement in an interpersonal interaction, this type of strategy may be helpful to those patients who endorse ADHD symptoms such as not seeming to listen when spoken to directly.

The final example involves the modified use of a mnemonic for informal mindfulness practice often used in MBSR called S.T.O.P. In this practice, each letter stands for a step in "turning on" a mindful state in the middle of daily activities.

S = Stop

T = Take a breath

O = Observe in the present moment

P = Proceed

In the updated MAPs for ADHD Program, S.T.O.P. is used throughout the training to progressively introduce awareness of sounds, breath, body sensations, thoughts, feelings, and actions in daily life. The last step, "P" for "Proceed," is also emphasized as an opportunity to evaluate the moment and choose how change and acceptance should be applied before proceeding. For example, in the midst of an activity, adults with ADHD can check and see if their intention to engage in a behavior matches their current placement of attention. Alternatively, they may observe that they are now distracted and off-task from their intended action. Such a check-in allows an opportunity for re-direction and sets the foundation for engagement in more purposeful behavior.

Willingness and Reward for Task Completion Patients are also taught about willingness and use of reward. In terms of willingness, mindfulness can be applied informally to ask oneself if he or she is willing to change a behavior. Although most adult ADHD patients might report wanting to complete more tasks, it may be just as skillful to adopt a curiosity fostered in mindfulness training to ask and consciously decide whether or not to engage in behavior change. Perhaps it is just as important at times to re-evaluate (or evaluate if it has not been considered previously with full awareness) a goal and choose not to work on it at that particular time. Perhaps a patient is not willing to put in the effort required for the task and attempting to complete this task without such a full acknowledgement will lead to failure. When a patient decides they are not willing to put forth the effort, for example, a mindful attitude involving being self-compassionate and non-judgmental for feeling unwilling can be adopted and represent a new way to approach a dilemma that might typically result in shame, resentment, oppositionality, or chronic avoidance. Alternatively, full acknowledgement of unwillingness at one time may also enable a choice of full willingness at another time.

In terms of reward, mindfulness can be used to deepen awareness of how it feels to complete a task. The patient is encouraged to notice his thoughts, emotions, and body sensations at that moment. Such awareness can be discussed as savoring or taking in a sense of mastery with full awareness and is often more rewarding than a patient's typical response to themselves "while on automatic pilot." Such awareness may improve the memory of personal successes and serve as a motivator in the future.

"Mindfulness Buddy." A final example includes the use of a "mindfulness buddy" to support mindfulness practice—similar to having an "exercise buddy" to keep one motivated for physical exercise. A support strategy similar to "mindfulness buddy" has been utilized in the child and adolescent mindfulness program (Bögels & Restifo, 2014) in which parents participating in the program form a dyad and text each other once per day to prompt an awareness of breath at that

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moment. Eliciting other such social support strategies might involve having regular discussions about experiences with mindfulness exercises, sharing mindfulness readings, or practicing formal mindfulness exercises together outside of the weekly group trainings. The ultimate goal is to assist with compliance either while participating in the MAPs for ADHD Program or afterwards. Clinicians may encourage group members to establish such support with other group members, friends or family members outside the program, or seeking support elsewhere in the community (e.g., online communities that promote mindfulness meditation training).

Future Clinical and Research Directions

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Overall, studies reviewed in this article provide evidence for the feasibility and acceptability of mindfulness meditation training for ADHD, and promising preliminary evidence for treatment efficacy. Larger randomized controlled trials are indicated to extend these initial findings and address methodological limitations. Although some controlled studies included mindfulness practice, it was a component of a treatment that also introduced other modalities (e.g., Hesslinger et al., 2002; Hirvikoski et al., 2011; Philipsen et al., 2007) and the contribution of mindfulness training itself is not clear. Among studies that involved administration of a mindfulness-only intervention (e.g., Mitchell et al., in press; Schoenberg et al., in press; Zylowska et al., 2008), a number of issues need to be considered in future research that builds on these findings, including power calculation for primary outcome variables, sample size and composition, randomization, blinded clinician assessments, active treatment comparison groups, long-term follow-up assessments, training of instructors, and adherence to manualized treatment materials. Related to sample composition, although mindfulness meditation training appears to improve outcome in non-ADHD samples that are diverse racially and educationally, low or predominantly low socioeconomic status, and are incarcerated (Bowen et al., 2014; Davis et al., 2014; Leonard et al., 2013), this has yet to be demonstrated in an ADHD sample—future ADHD studies should expand sample diversity to inform generalization. In addition, although some studies have included potential mechanisms of change as treatment outcome variables (e.g., executive functioning and emotion dysregulation), future studies need to examine these variables as mediators. Future studies should also consider how such mediators are associated with one another as well. For example, Teper and colleagues propose how mindfulness training enhances emotion regulation via improvements in cognitive control (Teper, Segal, & Inzlicht, in press).

There are other potential processes through which mindfulness meditation training has an impact that may implicate ADHD, such as decentering from maladaptive cognitions, which involves changing one's relationship with thoughts. Instead of viewing thoughts in terms of rationality or accuracy as in traditional cognitive therapy, thoughts are seen as an impermanent mental phenomena that are frequently inaccurate representations of reality (Keng et al., 2011). These maladaptive negative automatic cognitions are associated with ADHD after accounting for comorbidity with depression and after partialing out the impact of depressive symptoms (Mitchell et al., 2013). Consequently, mindfulness could help adults with ADHD diminish the impact of negative cognitions. Furthermore, this type of metacognitive awareness that mindfulness purportedly elicits may also be expanded beyond cognition to observing one's own body, emotional reactions, overt behavior, and environmental feedback with greater awareness, which can lead to improved overall self-monitoring and self-regulation (Zylowska et al., 2009). Consistent with this, Hölzel and colleagues (2011) propose that body awareness is one mechanism in which mindfulness has an impact.

Outcome measures less susceptible to demand characteristics may also inform future mindfulness-based research in ADHD samples. A number of studies reviewed in this paper relied heavily on retrospective self-report. In addition to the use of active treatment comparison conditions, blinded clinician ratings, use of other reporters, laboratory tasks, and "in-the-moment" assessment of

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symptoms via ecological momentary assessment, biological markers and brain activity measurements may be informative as well. For instance, frontal brain electroencephalogram (EEG) asymmetry in the alpha band is associated with ADHD symptoms and is consistent with the motivational dysfunction hypothesis involving abnormal behavioral approach (Keune, Wiedemann, Schneidt, & Schonenberg, in press). If this is a reliable marker of ADHD symptoms and underlying dysfunctional behavioral approach, this is relevant to future studies of mindfulness for ADHD since alpha asymmetry has been used as an outcome measure in mindfulness studies of non-ADHD samples (reviewed in Keune et al., in press). Another example includes assessment of the default mode network, which is another promising target for mindfulness (Sood & Jones, 2013) and is implicated in ADHD (Castellanos et al., 2008; Fair et al., 2010) (see Rationale for Mindfulness-Based Treatment for Adults Diagnosed with ADHD section above). Finally, although laboratory tasks are promising as they are less subject to demand characteristics, the ecological validity of some are questionable in ADHD (Barkley & Fischer, 2011; Barkley & Murphy, 2011; Brown, 2008) and therefore studies should consider issues pertaining to relationship with daily functioning.

Modifications to mindfulness interventions for adult ADHD such as MAPs should also be considered to target common concerns that arise in clinical practice and the treatment literature, such as sustained change after the intervention has ended. The use of a “mindfulness buddy” (see above), smartphone applications, or online community support to encourage compliance with mindfulness exercises, for example, may be fruitful. In addition, clinicians may want to consider elements of MAPs that may be modified to meet the needs of individual patients. For instance, practical strategies to support ongoing practice after the program is discussed formally in the final session (e.g., use of reminders) may be discussed earlier in the program to target adherence over the course of the training program.

An additional consideration for future research involves investigation of the optimal amount of formal meditation practice in and out of the classroom. For example, while keeping the amount of sessions in MAPs similar to other mindfulness treatment programs, MAPs shortened the length of time for formal meditation practices in session and at-home (starting with 5 min and increasing up to at least 15 min). Although this adaptation was based on clinical features of ADHD that may otherwise interfere with mindfulness practice, the modification offers a “lower dose” of formal mindfulness practice in comparison to more traditional mindfulness programs. To examine this issue, studies should measure the amount of time individuals with ADHD practice mindfulness and examine how this is associated with treatment outcome. While the amount of at-home practice has not been consistently predictive of outcomes in mindfulness-based interventions, more recent studies in non-ADHD samples indicate that time spent engaged in formal mindfulness practice is associated with various outcomes, including working memory capacity (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010). Future studies should also consider the quality of mindfulness practice in conjunction with the amount of time practicing as well (Goldberg, Del Re, Hoyt, & Davis, 2014).

One particular area for future research involves how to incorporate mindfulness with CBT, which is an efficacious treatment for adult ADHD (see Knouse & Safren, 2010; Mongia & Hechtman, 2012, for reviews). Although studies of mindfulness as a standalone treatment are warranted from a scientific perspective (e.g., to isolate the unique impact of mindfulness) and may be called for in clinical practice, CBT techniques are regularly integrated with mindfulness meditation training for other forms of psychopathology (e.g., MBCT for depression relapse prevention; (Segal et al., 2002). Such a combination may be clinically meaningful in ADHD as well and allow for greater treatment options.

The integration of mindfulness and CBT can be beneficial in a number of ways. First, integrating mindfulness may be beneficial for those considered nonresponders in CBT treatment outcome studies in adult samples, which range from 33% to 58% of participants in some studies (e.g., Safren et al., 2005; Solanto, 2011). Future studies should consider adaptive treatment designs to improve response to treatment, such as sequential multiple assignment randomized trials (Lei, Nahum-Shani, Lynch, Oslin, & Murphy, 2012). In addition, mindfulness meditation training may confer additional benefits among those who are responsive. Further, the MAPs Program introduces material explicitly focusing on emotional functioning in ADHD, which is a unique contribution relative to most CBT-based treatments for this population. This extends the focus of treatment to incorporate ADHD phenotypes such as emotion dysregulation, which has been shown to improve following MAPs (Mitchell et al., in press). Relatedly, given the effectiveness of mindfulness training for other disorders (e.g., mood and anxiety disorders), mindfulness training may be especially beneficial for adults diagnosed with ADHD and a comorbid psychiatric disorder.

Mindfulness may also enhance patient learning of CBT strategies in session by providing techniques that help patients manage stress, focus in the session, cope with distractions, and manage overall negative affect. For example, a patient may arrive late to a session, report feeling overwhelmed by having to rush to therapy, and may find it difficult to focus on the content of the session because of the physiological arousal that is involved with feeling rushed. A mindfulness of breath exercise at the start of each session, for example, may help patients feel calmed, centered, and oriented to the purpose of the session.

One area that would need to be resolved while integrating mindfulness with CBT for adults with ADHD would be how cognitions are approached. Adult ADHD CBT treatments include cognitive therapy modules primarily based on traditional cognitive therapy techniques that emphasize changing the content of negative thinking (see Knouse & Mitchell, in press, for an exception). Mindfulness, however, focuses less on changing the content of thinking and places greater emphasis on observing cognitions and changing one's relationship with those cognitions. While one could argue that nonjudgmental or compassionate thoughts at the content-level are encouraged in mindfulness training, overall cognitions are not directly challenged or labeled as "thinking errors" in need of a "rational" counterpoint as it is in more traditional applications of CBT. Rather, when patients adopt a mindful awareness of these cognitions, they are taught to view these cognitions with openness, curiosity, and without judgment. Mindfulness training involves asking patients to notice how they are responding to these impermanent events and to use mindfulness practice to choose whether or not to engage with cognitions. Therefore, how patients relate to their thoughts is the emphasis, rather than the content of the thoughts themselves. Reviews suggest that mindfulness training increases metacognitive awareness, which involves re-perceiving or decentering from thoughts and viewing them as passing mental events (Keng et al., 2011). MBCT (Segal et al., 2002) is an example of a behaviorally-based therapy that adopted a mindfulness perspective for targeting cognitions.

Of note, top-down effects (e.g., cognitive reappraisal involving active reinterpretation of emotional stimuli which results in modifying emotional impact) have been proposed early on in treatment for short-term mindfulness practitioners and bottom-up effects (e.g., regulation of emotions without cognitive reappraisal in the presence of emotionally provocative stimuli) have been proposed among more experienced practitioners (Chiesa, Serretti, & Jakobsen, 2013). These top-down and bottom-up effects dependent on one's amount of mindfulness practice, along with corresponding differential impact on separate brain regions, should be considered in future studies. Such effects in ADHD samples have yet to be considered.

Finally, one way which the MAPs Program can be modified includes individual therapy settings. Although the MAPs Program has been studied only as a group intervention, in our experience the approach is adaptable for individual therapy cases as well. Here, however, we focused on the group training format that has been examined in some of the preliminary treatment outcome studies for adults.

Conclusions

Go to:

Overall, current empirical studies support the rationale for application of mindfulness to ADHD, show that mindfulness is a feasible and well-accepted intervention in ADHD samples, and provide

Author Manuscript Author Manuscript Author Manuscript Author promising preliminary support for its efficacy. However, more methodologically rigorous trials are needed, particularly larger randomized controlled trials and assessment of long-term effects with ecologically valid measures. In addition to being a standalone treatment, mindfulness can be integrated with CBT for adults diagnosed with ADHD, which is an area that warrants future treatment development. We describe a particular mindfulness training program for ADHD in adulthood in an attempt to stimulate further interest and discussion among clinicians and researchers, and ultimately to provide patients with more effective treatment options.

Acknowledgments

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Footnotes

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[1]Additional studies have also considered treatments that are included within the category of or overlap with meditation-based interventions, including transcendental meditation and yoga-based interventions (Abadi, Madgaonkar, & Venkatesan, 2008; Grosswald, Stixrud, Travis, & Bateh, 2008; Haffner, Roos, Goldstein, Parzer, & Resch, 2006; Harrison, Manocha, & Rubia, 2004; Jensen & Kenny, 2004; Mehta et al., 2011; Mehta et al., 2012). Although there are similarities, these interventions differentiate from mindfulness meditation training programs. Given that the focus of this article is on mindfulness meditation, we do not explore these related treatments further.

[2]Unpublished dissertation abstracts also provide support for the application of mindfulness for ADHD (Alfano, 2009; Evans, 2008; Kratter, 1983; Moretti-Altuna, 1987; Rynczak, 2013; Uliando, 2010), although they are not reviewed here given that our review was restricted to peer-reviewed publications.

Declaration of Interests

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