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Attention Deficit Hyperactivity Disorder and Mindfulness Practice in Children and Adolescents: A Comprehensive Review of Evidence-Based Research

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Attention Deficit Hyperactivity Disorder and Mindfulness Practice in Children and Adolescents:

A Comprehensive Review of Evidence-Based Research

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Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is the most common mental illness in the United States among male and female children and adolescents between the ages of 3 and 17. The emerging fields of neurobiology and neuroimaging have proposed a relationship between mindfulness meditation therapies—initially referred to as mindfulness-based stress reduction (MBSR) and now simply known as mindfulness—and improvements in attention and self-regulation, two major problem areas for ADHD sufferers. Furthermore, recent studies suggest that mindfulness therapies may be effective in reducing symptoms of ADHD in children and adolescents. The purpose of this paper is to review, analyze and synthesize the available evidence-based research that pertains to ADHD and mindfulness among this demographic. My methodology consisted of a comparison and analysis of peer-reviewed research articles, written in English, concerning controlled and non-controlled studies of the effects of mindfulness on children, adolescents, and ADHD individuals. The results suggested improvements in the quality of scientific research into mindfulness among children and adolescents with ADHD, as well as high potential for the application of mindfulness therapies to this population. However, I also identified persistent research flaws; these included small study sample sizes, insufficient random controlled trials, and insufficient focus on children and adolescents formally diagnosed with ADHD. Nonetheless, this research provides early empirical evidence of the efficacy and harmlessness of mindfulness therapies for children and adolescents. This subject warrants further research, incorporating larger, randomized control trials, which should ideally include ADHD children and adolescents of varying developmental levels, ages, gender, races, ethnicities, and socioeconomic backgrounds.

Attention Deficit Hyperactivity Disorder and Mindfulness Practice in Children and Adolescents:
A Comprehensive Review of Evidence-Based Research

Attention Deficit Hyperactivity Disorder (ADHD) is listed as the most common mental illness in the United States among male and female children and adolescents between 3 and 17 years of age (Centers for Disease Control and Prevention [CDC], 2013). The Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders, used globally for the formal diagnosis of ADHD, describes ADHD as a pattern of inattention and/or hyperactivity-impulsivity that interferes with development and shows symptoms in two or more settings (e.g., at home, school, or work); these symptoms negatively impact social, academic or occupational functions (American Psychiatric Association [APA], 2013).

Specific symptoms of ADHD include restless or arousal states, inability to hold attention, focus, or concentration, impulsivity, and behavioral or conduct disorders. All of these symptoms may lead to higher emotional and physical risk for individuals with ADHD. Some of the most common consequences include limited academic development, accidents and injuries, medication and illicit drug abuse, addiction, emotional difficulties, and peer conflicts.

The emerging fields of neurobiology and neuroimaging have proposed a relationship between mindfulness meditation therapies—initially called mindfulness-based stress reduction (MBSR), but now simply known as mindfulness—and improving individuals' attention and self-regulation abilities, two salient problem areas for ADHD sufferers. Using neuroimaging techniques such as electroencephalography (EEG), researchers have begun to explore the neural mechanisms underlying Mindfulness practice (Davidson et al., 2003; Lutz, Slagter, Dunne, & Davidson, 2008) and functional magnetic resonance imaging (MRI) (Farb et al., 2007; Lutz et al., 2008; Farb et al., 2010; Goldin & Gross, 2010). Furthermore, as understanding of ADHD has

evolved through the study of psychoneuroimmunology, genomics and epigenetics, so have the terms, themes, and concepts that allow for effective evaluation, diagnosis, and management. A wide range of interdisciplinary research has incrementally expanded our knowledge of ADHD in children and adolescents.

Since being introduced to the West by Jon Kabat Zinn in 1979, the practice of mindfulness meditation has seen an incremental rise in professional interest for its applicability to ADHD treatment. Research now supports the concept that mindfulness is effective in enhancing attention, self-regulation, as well as emotional and mental flexibility in adults with ADHD. It has also shown to be effective against a host of their associated co-morbidities, such as depression and anxiety (Cassone, 2013; Tang, Rothbart, & Posner, 2012; Teper & Inzlicht, 2013; Flook et al., 2010; Swanson & Volkow, 2009; Zylowska et al., 2008; Schonert-Reichl & Lawlor, 2010; Burke, 2010; Lee, Semple, Rosa, & Miller, 2008; Biegel, Brown, Shapiro, & Schubert, 2009; Broderick & Metz, 2009; Thompson & Gauntlett-Gilbert, 2008; Jha, Krompinger, & Baime, 2007; Tang et al., 2007; Biederman et al., 2004). Although substantial evidence suggests that mindfulness can combat ADHD in adults, evidence is only beginning to suggest that mindfulness therapies and interventions can also be effective at reducing symptoms of ADHD in children and adolescents between the ages of 3 and 17.

Over the past decade, a growing list of mindfulness centers and institutes, researchers, practitioners, and educators have been investigating the relationship between ADHD and mindfulness practices in children and adolescents. The practices under investigation have included: MBSR, which incorporates mindful breathing, sitting, supine walking, and body scan exercises (<http://www.umassmed.edu/cfm/>); mindfulness awareness practices (MAPS) using breath, sitting, walking, sound, play and eating (<http://marc.ucla.edu>); and mindful parenting,

which is often available as school-based therapy and calls on mindfulness interventions from parents and teachers (Van der Oord, S., Bögels, S. M., & Peijnenburg, D., 2012). Other kinds of mindfulness interventions with children and adolescents are school and community-based practices, intended to foster social and emotional learning and inner resilience among children and adolescents by providing them with mindfulness training (Goleman, 2008). These mindfulness practices have demonstrated varying degrees of effectiveness at improving children and adolescents' mental health and well-being.

The purpose of this paper is to review, analyze and synthesize the literature on ADHD and mindfulness meditation in children and adolescents. More specifically, the paper will identify the availability of evidence-based research on mindfulness therapies involving breathing, sitting, and walking on children and adolescents with ADHD. I will focus on research pertaining to three specific aspects of ADHD: attention, self-regulation, and executive function. This review intends to identify new areas of focus for further research into ways that mindfulness can help manage the bio-psycho-emotional-social gaps identified for children and adolescents with ADHD.

ADHD Background

ADHD is a neurobehavioral disorder represented by an array of symptoms which may include restlessness, arousal states, inability to concentrate, as well as impulsivity and behavioral or conduct disorders. These symptoms may lead to higher emotional and physical risk, as well as consequences that include limited academic development, accidents and injuries, excessive medication, illicit drug abuse, addiction, and social conflict (Strine et al., 2006; Biederman et al., 2004).

Childhood mental health problems have been identified as a principal concern among researchers, clinicians, and educators alike because of their persistence into later childhood (Loeber et al., 1993) as well as their correlation with family, peer, and social relationship problems, as well as subpar academic performance and incompleteness of education (Coie & Dodge, 1998; Parke & Slaby, 1983).

In 2011, epidemiologists noted the rise in prevalence of mental health illnesses in children (CDC, 2013). Specifically, one out of every five children was found to have a significant mental health illness that was severe enough to warrant medical attention. Of that, the most prevalent disorder noted was ADHD. Historically, less than 15% of those requiring mental health assistance received it. Those who did receive mental health services did so through their schools (CDC, 2013).

The prevalence of ADHD varies widely by country and diagnostic criteria. Whereas the U.S. and other western societies use the DSM-V diagnostic criteria, other societies such as China and Japan often perceive the symptoms of ADHD to be a reflection of less optimal life situations (Dwivedi & Banhatti, 2005). Ethnic and socio-cultural perspectives include rationalizing or correlating childhood trauma and chronic stressful living with symptoms that appear similar to ADHD but are not interpreted as ADHD. Ethnicity and socio-economic belief systems regarding behavior reduce the use of diagnostic criteria and lessen the prevalence of ADHD diagnoses in certain parts of the world. After investigating ADHD in children in more than 50 countries, Dwivedi and Banhatti concluded that the total rate of ADHD in children in other countries was similar to that of the United States (2005).

In the United States, ADHD affects both sexes. However, males are diagnosed between two and six times more than females. The average age of diagnosis is 7; however, children with

severe ADHD are more likely to be diagnosed at a much earlier age and are also more likely to be medicated. ADHD affects an estimated 11% of U.S. children and adolescents between the ages of 3 and 17. Of this 11%, approximately 80% are treated with medication, while approximately 18% do not receive either mental health counseling or medication (CDC, 2013).

The diagnosis of ADHD in children has risen annually by 5% between 2003 and 2011, and the rates are continuing to rise on this trajectory (CDC, 2013). More than one-half of the children living with ADHD live with at least one other major mental health condition or co-morbidity, and continue to experience functional limitations well into adulthood. Among the most common conditions are anxiety, depression, autism and Tourette's syndrome (CDC, 2013). Approximately 60% to 80% of ADHD children continue to experience symptoms well into their adolescence (Biederman, 2005).

Parents of children with ADHD report three times as many peer issues and 10 times as many challenges forming friendships among their children. Because ADHD has a direct relationship to higher levels of attention difficulties, children with ADHD have additional health and safety risks. These risks include increased school absence, sub-academic performance, non-fatal and major injuries, violence, alcohol and substance abuse, traffic violations and motor vehicle accidents. As of 2011, the societal cost of illness for ADHD was approximately \$45 billion or \$15,000 per individual per year (CDC, 2013).

The management of ADHD has been controversial among both the professional and lay communities. Over the past 35 years, ADHD has been researched and clinically addressed primarily through empirical pharmacology and, to a lesser degree, behavioral therapy. Pharmaceutical approaches, which have consisted of several generations of stimulant medications, have been the main forms of ADHD treatment thus far. Over the years, the

pharmaceutical approach has attracted a multitude of criticism due to its questionable efficacy, side effect profiles, and prohibitive financial costs. In a large study published in the *Journal of the American Academy of Child & Adolescent Psychiatry*, researchers reported that while most young people with ADHD benefit from medications in the first year, these effects generally wane by the third year, if not sooner. This study contended that there are no long-term, lasting benefits from taking ADHD medications (Swanson & Volkow, 2009). In recent years, empowered care-seekers have begun to seek better, safer, and more cost-effective adjunct and alternative approaches to ADHD treatment (Zylowska et al., 2008; Smalley et al., 2009; Greydanus, Prat, Sloane, & Rapply, 2003)

ADHD Etiology and Diagnosis

ADHD has been researched rigorously since the early 1980's, when the subject was approached from a more conventional science and pharmaceutical model of inquiry and conventional neurobehavioral modalities (Van de Weijer-Bergsma, Formsma, De Bruin, & Bögels, 2012). However, ADHD research has evolved in recent years to incorporate the latest advances in the fields of neuroscience and neuroimaging. Researchers have identified the neurobiological component of ADHD, and their findings have been supported through neuroimaging.

The current etiology of ADHD from the emerging body of neuroscience includes genetic, neurobiological, and environmental influences. Although the etiology of ADHD is not fully understood, consistent results from family, twin and adoption studies, as well as molecular genetic studies, suggest that ADHD has a high hereditary component. The estimated heritability of ADHD ranges from 75% to 91%. A meta-analysis of seven ADHD linkage studies suggests

that some chromosome regions may harbor ADHD genes, with a region on chromosome 16 identified as having the most consistent linkage evidence (Zhang et al., 2012).

The etiology of ADHD is a functional deficiency of two major monoamines: norepinephrine and dopamine. These monoamines originate from the prefrontal cortex. This is the area of the brain that regulates attention, self-regulation, and executive function, which are also the main deficits in children and adolescents with ADHD. Attention deficits affect individuals' ability to focus and concentrate, while problems with self-regulation result in difficulties with motivation, recall memory, and inhibition of undesirable thoughts and behavior. Problems with executive function affect individuals' reasoning, organization, problem-solving skills, and ability to carry out ideas (Biederman, 2005). Children and adolescents with ADHD exhibit difficulties in all of these areas (Schonkoff, Boyce, & McEwen, 2009; Flook et al., 2010).

Historically, ADHD in children and adolescents has been diagnosed through an empirical approach. This has historically included soliciting clinical histories, parent-child self-reporting, and mental health questionnaires, along with input from educators and psychological professionals. Currently, healthcare providers utilize the DSM-V's clinical criteria to diagnose ADHD in children and adolescents (APA, 2013).

However, the emerging field of neuroscience has begun to use neuroimaging, specifically functional magnetic resonance imaging (fMRI), and single-photon emission computed tomography (SPECT) to assess the functional-physiological aspects of the brain. The imaging serves as an assessment tool that provides objective data for use in diagnosis and management treatment (Paloyelis, Mehta, Kuntsi, & Asherson, 2007). In addition, the emergence of neuro-psych genomics provides deeper understandings of the metabolic pathways that identify DNA neuropathway variances (Burke, 2006).

In this same time period, there has been an emerging field of study in neuroscience, specifically neuroplasticity from the effects of mindfulness. Initially, these research studies investigated formal mindful meditation but have since expanded to other mindful techniques, such as MBSR in adults. Furthermore, using advanced imaging techniques, neuroscience has begun to explore the neural mechanisms underlying mindfulness meditation practice with techniques such as electroencephalography (EEG) (Davidson et al., 2003; Lutz et al., 2008) and functional magnetic resonance imaging (MRI) (Farb et al., 2008; Lutz et al., 2008; Farb et al., 2010; Goldin and Gross, 2010). Whole brain analyses identified increases in the posterior cingulate cortex, the temporo-parietal junction, and the cerebellum in the MBSR group compared with the controls. The results suggest that participation in MBSR is associated with changes in gray matter concentration in brain regions involved in learning and memory processes, emotion regulation, self-referential processing, and perspective taking (Hölzel et al., 2011).

Thus, the literature on the relationship between mindfulness meditation and ADHD in children and adolescents is a fruitful subject for review and analysis. The emerging fields of neuropsychology and neuroimaging have advanced the medical community's understanding of the relationship between mindfulness and attention, self-regulation and executive function—the three mental faculties most negatively affected by ADHD.

Mindfulness Meditation Background

From a historical perspective, mindfulness meditation refers to the ability to maintain stability, awareness, and control of negative emotions, as well as cultivate virtuous qualities and higher cognition (Thera, 1962). For the past 20 years, Kabat-Zinn's "landmark definition" has characterized mindfulness as paying attention on purpose, in the present moment, and non-judgmentally (Black, 2011; Kabat-Zinn, 1994). Thus, mindfulness could be described as an

orientation to experiencing each moment in a non-judgmental observation; it can be conceptualized as a process of relating openly with experience (Bishop et al., 2004).

However, there is currently no one true conceptual or operational definition of mindfulness. Mindfulness can be a state, trait, process, and/or intervention in a multitude of physical, neurobehavioral, psychological, psychiatric disorders with a focus historically on stress management (Vago & Silbersweig, 2012).

Mindfulness meditation is currently evolving into an understanding of self-awareness, attention, self-regulation, executive function, and higher cognition through the physical, psychological, neuro-behavior-biological or mind-body connection (Smalley et al., 2009). Mindfulness meditation is believed to foster insight, curiosity, loving-kindness, and compassion. Mindfulness is typically cultivated in formal meditation practices, such as sitting meditation, walking meditation, or mindful movements (Kabat-Zinn, 1990), and has been reported to produce beneficial effects on a number of psychiatric, functional somatic, and stress-related symptoms. For this reason, mindfulness has been increasingly incorporated into psychotherapeutic programs (Baer, 2003). This paper defines mindfulness meditation as sitting or walking meditation, with the major focus on the breath.

Operational Definition

With the rapid advances in mindfulness and psycho-neuro health and research, there remain various and inconsistent interpretations of the definition of mindfulness. Developing an operational definition of mindfulness allows investigators to develop theoretical concepts, frameworks, and tools of measurement for use in research. Bishop et al. proposed the operational definition of mindfulness to consist of two constructs: first, that it involves self-regulation of attention that is based on increased awareness of the present moment; and, second, that it

involves experiential observation of the present moment through curiosity, openness and acceptance (2004).

With this understanding, mindfulness may be thought of as a metacognitive skill, which is the realization that one becomes the observer rather than the observed. Metacognition involves both attention and self-regulation, both of which are important for analyzing the effects of ADHD (Bishop et al., 2004). Mindfulness is believed to enhance the brain's neuroplasticity, resulting in improved attention, self-regulation, and executive function—the three mental faculties most affected by ADHD (Tang et al., 2007).

Emerging Definition of Mindfulness

One emerging theoretical framework merges the ancient and contemporary models of mindfulness. The fundamental principles of both the ancient and contemporary models of mindfulness emphasize reducing suffering and cultivating a general sense of well-being. These two models merge in a theoretical framework that emphasizes three constructs: self-awareness, self-regulation and self-transcendence (S-ART). S-ART applies the notion that our cognitions, perceptions, and emotions of our everyday experiences may be misinterpreted. Under this framework mindfulness may be able to decrease these misinterpretations through the development of self-awareness, self-regulation and transcendence (Vago & Silbersweig, 2012).

Mindfulness and Neuroplasticity

Further evidence suggests that mindfulness practice is associated with neuroplastic changes (brain changes that occur in response to experience) in the anterior cingulate cortex, insula, temporo-parietal junction, fronto-limbic network, and default mode network structures (Davidson & Lutz, 2008). Lazar et al., found that mindfulness produces physiological and

structural changes in several areas of the brain including the prefrontal lobe that is associated with ADHD (2005).

The different mechanisms of neuroplasticity range from the growth of new connections to the creation of new neurons. Davidson & Lutz (2008) contend that when the framework of neuroplasticity is applied to meditation, the mental training of meditation is fundamentally no different than other forms of skill acquisition that can induce plastic changes in the brain.

Whole brain analyses identified increases in the posterior cingulate cortex, the temporo-parietal junction, and the cerebellum in the mindfulness group compared with the controls. In particular, Hölzel et al. (2011) contend that participation in mindfulness is associated with changes in gray matter concentrations in brain regions involved in learning and memory processes, emotion regulation, self-referential processing, and perspective-taking.

In this way, recent studies suggest that meditation-based training is effective at improving cognitive skills and can produce lasting changes in brain and cognitive functions. The technique of mental training enhances neuroplasticity in the attentional networks, leading to superior attention and executive control processing—traits that are ordinarily impaired in ADHD individuals.

Types of Meditation

Meditation may be divided into two broad categories: concentrative meditation, such as transcendental meditation, and mindfulness meditation such as Vipassana or Samadhi meditation. Vipassana fosters insight and is considered the inward way to the higher consciousness, while Samadhi fosters curiosity, kindness, and compassion (Lutz et al., 2008). The mindfulness meditation discussed in this review originates from the Vipassana practices formally introduced to North America in 1979 by Jon Kabat-Zinn through the MBSR program he

helped pioneer. Historically, MBSR was the first formal western mindfulness meditation program that was developed and introduced to the public. This meditation program influenced all subsequent mindfulness practice in the West.

To date, there are over 20,000 individuals who have completed the MBSR program and thousands of professionals who have completed the instructor program to become mindful meditation instructors and mentors (<http://www.umassmed.edu/cfm>). Many of these professionals have gone on to expand MBSR and develop similar mindfulness meditation programs based on its core principles.

While ADHD is characterized by attentional challenges, mindfulness enhances an individual's ability to pay attention to the present moment (Smalley et al., 2009). Adults with ADHD who have participated in mindfulness therapies have shown demonstrable improvements in characteristic problem areas (Flook et al., 2010). Thus, the research suggests that mindfulness is an effective intervention for ADHD in adults. Because ADHD is a childhood neurodevelopmental, behavioral disorder beginning at the age of 7 or earlier, it is logical that the next step in research would be to examine the effect of mindfulness on ADHD in children and adolescents. Over the past ten years, mindfulness meditation practice and research in children and adolescents has advanced significantly. There has been a convergence in the field of psychology, neuroscience, genomics, and psychiatry in the research on the relationship between ADHD and mindfulness in children and adolescents (<http://www.umassmed.edu/cfm/>; <http://mindfulness.ucsd.edu>; Zylowska, Smalley, & Schwartz, 2009; Baer, 2003).

Additionally, researchers have concluded that the mechanisms noted work with one another to promote self-regulation (Hölzel et al, 2011). In this regard, mindfulness has been found to be an effective modality for individuals experiencing anxiety and depression and who

exhibit similar symptoms to ADHD, such as frequent lapses in self-regulation and attention. Comparative and randomized control trials studying the effects of mindfulness-based cognitive therapy or interventions in anxious-depressive individuals have shown this type of therapy to be as effective as conventional cognitive behavioral therapy (Semple, Lee, Rosa, & Miller, 2010). Cumulatively, mindfulness meditation has been noted to improve attention and self-regulation among anxious-depressive individuals.

Over the past two decades, researchers have paid an increasing amount of attention to adult mental illness and mindfulness, yet there remains very little research on behavioral disorders and mental illness in children and adolescents. Although Kabat-Zinn & Kabat-Zinn introduced the principles of parent-child mindfulness in 1997, only since 2004 have researchers inquired with any rigor into the effects of mindfulness and children and adolescents. Thus, a review is necessary in order to provide a comprehensive overview of the literature on the use of mindfulness training to help children and adolescents with ADHD.

Methodology

The review and analysis began with 150 articles. Of these, 50 articles focused on ADHD and mindfulness in children, with specific focus on attention, self-regulation, and executive function in relation to mindfulness practice. The mindfulness practices discussed in these articles were based on original MBSR principles developed by Kabat-Zinn and emphasized focusing on the breath while sitting or walking.

The research methodology consisted of five major components: inclusion and exclusion criteria, research population, key words, primary and secondary sources within specialized data bases, and division into specific time periods based on the development of the research.

To be included in this review, all articles selected were evidence-based, peer-reviewed research studies, written in the English language. I gave some initial attention to articles on mindfulness research in adults, but I specifically focused on articles pertaining to the study of ADHD and mindfulness in children and adolescents. I excluded literature that focused on the movement aspects of mindfulness training, such as yoga and Tai chi. I also excluded articles about concentrative meditation practices such as Transcendental Meditation, as well as non-English research or any unpublished articles (e.g., dissertations and conference papers).

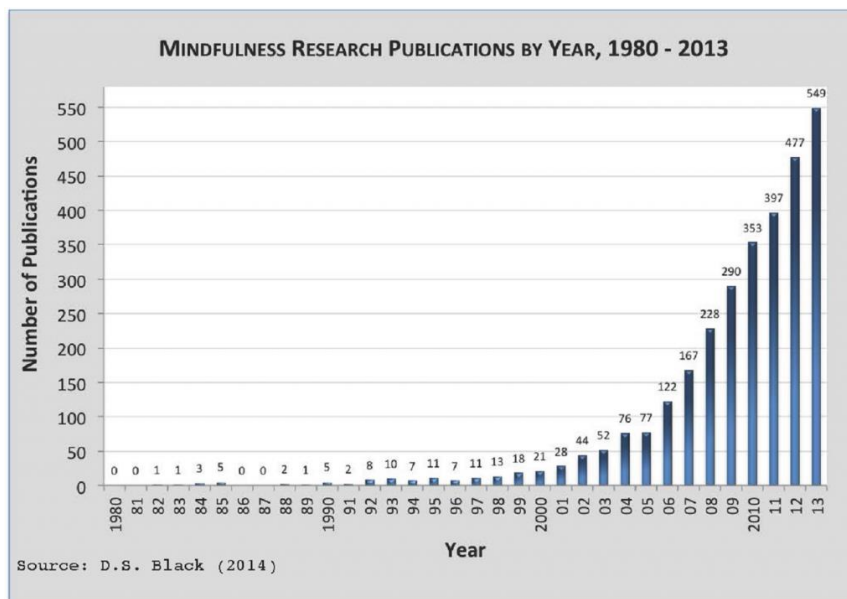


Figure 1. Mindfulness Research Publications

Population and Time Lines

Methods consisted of searching primary and secondary sources on ADHD and mindfulness with initial articles assessing adults, and later articles assessing children. The initial research articles (1982-2002) explored the principles and evidenced-based findings on the effects of mindfulness on the major areas of cognitive functioning affected by ADHD in adults, such as

attention and self-regulation. This research in adults began with the work of Jon Kabat-Zinn in the late 1970's.

Initial research (1979-2002) focused on core principles of mindfulness and attention. More recent research (2008-2015) focused on expanding the existing behavioral therapy for children with ADHD to incorporate mindfulness interventions that could be implemented by both parents and children. Beginning in 2004, the research in mindfulness and its effects on ADHD among children and adolescents became more prolific and in-depth. In addition, there are a plethora of research studies independent of one another on both ADHD and mindfulness.

The research on children and adolescents with ADHD and contemporary mindfulness meditation in children and adolescents has been emerging for well over a decade. The literature review population consists of male and female children and adolescents between the ages of 3 and 17. This research in children and adolescents began to emerge in 2004 and extends to the present. All ground breaking, rigorous research articles that pertain to ADHD in children and adolescents, and mindfulness meditation date from 2004 to 2015.

Key Words

Over the past decade, as the scientific understanding of mindfulness has evolved and expanded, so has the range of possible keywords by which to search for relevant articles. A number of neuroscience and psychology terms, combined with keywords related to mindfulness, resulted in a robust and refined list of articles.

Key words used to drive the research included ADHD, mindfulness, meditation, children, youths, and adolescents. Within the results for these keywords searches, I searched for words pertaining to specific aspects of ADHD. For example, searches on executive function and executive cognitive function led to additional searches on self-awareness, self-regulation, self-

control, emotional behavior regulation, and impulsivity. In addition, searches on neuroscience led to neuro-developmental, neurobiology, neuro-imaging, and neuro-psychology. Searching on mind body stress management and MBSR, led to numerous keyword searches on the topic of mindfulness: mindful, mindfulness, mindfulness meditation, mind-body cognitive therapy, mindfulness-based interventions, MAPS, meditation, movement, and contemplative therapies.

Specific Databases and Evaluation Methods

The search strategy included comprehensive electronic database searches for peer-reviewed work published from 2004 until 2015. The electronic databases specialized in the topics of medicine, nursing, neuroscience, psychology, neurobiology, social science, and contemplative studies. The databases included PsychINFO, Medline, Cochrane, Pub Med, Wiley, Sage, Science Direct, and the newly-founded American Mindfulness Research Association (AMRA) formerly called Mindfulness Research Guide (MRG). AMRA is a comprehensive electronic database that provides information on past and current scientific findings in the science of mindfulness. I used online libraries, publishing warehouses, and the JabRef open-source bibliography reference manager in the research article data abstraction process. Both national and international research articles in English, as well as articles translated into English, were accepted and included in the literature review.

Several systemic reviews included in the search (Black, Milam, & Sussman, 2009; Biegel et al., 2009; Burke, 2010; Semple et al., 2010) led to additional pertinent primary research articles. The articles were first selected due to their subject matter of ADHD and mindfulness meditation among children and adolescents. They were then synthesized and analyzed according to their main concepts and themes within this topic. Three main themes emerged: attention, self-regulation and executive function. The articles were categorized according to these shared sub-

topics. Subsequently, these articles were further synthesized, analyzed, and compared based on their evidence-based findings and outcomes, as well as checked for any significant omissions.

Results

ADHD and Mindfulness

In adults, mindfulness training has been shown to be effective at improving attention, self-regulation, and executive function (Jha et al., 2007; Tang et al., 2009). The practice of mindfulness meditation traditionally involves continuously focusing on one's breathing; if the practitioner becomes distracted in thought from time to time, they need only to refocus their attention on breathing (Davidson et al., 2003). Mindfulness personality traits consist of openness, conscientiousness, extraversion, and agreeableness (Baer, 2009; Brown & Ryan, 2003). As the ADHD personality is more unconstrained and more drawn to novelty-seeking and harm-avoidance than the non-ADHD personality, mindfulness may ameliorate the symptoms of ADHD by promoting self-directedness and self-transcendence. Brain imaging of the pre-frontal cortex has shown structural changes showing increased attention abilities in ADHD individuals following mindfulness training (Flook et al., 2010; Davidson et al., 2003; Hölzel et al., 2011; Lazar et al., 2005).

Mindfulness meditation may also contribute to the improvement of regulation of attention, and may be used concomitantly with established evidence-based treatment to enhance attentional processing (Cassone, 2013; Jha et al., 2007; Semple 2010; Tang et al., 2007). Studies in adults with ADHD show improved attention, focus, and inhibition of automatic responses—major deficits among ADHD individuals—as a result of mindfulness meditation (Van der Oord, Bögels, & Peijnenburg, 2012; Van der Hurk, Giommi, Gielen, Speckens, & Barendregt, 2010). Initial conceptual frameworks are now emerging as to how and why mindfulness-based practices

may promote the overall health and well-being of children and adolescents (Davidson R.J., Dunne J., Eccles J.S., Engle A., Greenberg M., Jennings P. and Vago D., (2012); Zelazo & Lyons, 2012)

Van de Weijer-Bergsma et al. (2012) contend that ADHD may be categorized in terms of deficits in behavior, neuropsychological functions, and brain functions. This study suggests that mindfulness may aid in improving deficits in these three levels of functioning resulting from ADHD. Mindfulness practices can decrease behavioral deficits such as chronic lack of attention, hyperactivity, and age-inappropriate impulsivity by improving attention control and reducing the frequency of automatic responses. Neuropsychological deficits, such as sub-par achievement in attention, inhibition and recall-memory tasks, also improve as a result of mindfulness therapy, because these therapeutic practices increase working memory and cognitive control. Furthermore, brain deficits, such as reduced structure and function in the frontal-parietal and frontal-striatal neural networks of the brain's pre-cortex, also respond to mindfulness practices. Neuroimaging shows that mindfulness practices augment positive structural and functional brain changes within the pre-cortex neural networks (Lazar et al., 2005; Hölzel et al., 2011). Thus, van de Weijer-Bergsma et al. conclude that mindfulness may be efficacious in the treatment of ADHD.

In addition, an emerging body of research has demonstrated the effectiveness of mindfulness in children and adolescents. However, evidence based on mindfulness studies suggests that children and adolescents possess developmental differences that require a modified approach to mindfulness instruction. Thompson and Gauntlett-Gilbert (2008) suggest that children and adolescents can benefit from training in mindful meditation. At the same time, they note that children and adolescents are not small adults, but rather a unique sub-population that

presents unique functional aspects and challenges within their development stages (Thompson & Gauntlett-Gilbert, 2008). Likewise, Jha et al. (2007) assert that teaching mindfulness to children and adolescents is not the same as teaching mindfulness to adults, and recommend that mindfulness training for children be age-appropriate.

Additionally, research has shown that mindfulness teaching requires different techniques with those who are well, as opposed to individuals struggling with mental illness (<http://marc.ucla.edu>). Since 2003, research has been emerging regarding mindfulness training for children and adolescents with certain psychological and psychopathological illnesses. Historically, these studies have been limited by their small sample sizes and areas of focus. However, one of these areas of focus is mindfulness for children and adolescents with ADHD (Van der Oord et al., 2012; Grossman, Niemann, Schmidt, & Walach, 2004; Singh et al., 2010; Zylowska et al., 2008; Semple, Reid, & Miller, 2005).

A number of studies have emerged regarding the subject of mindfulness in ADHD children and adolescents in a school-based context and parent/child training programs. The school setting provides easy access with little to no cost to children and adolescents, and offers integrative and preventive measures for optimizing overall health, resulting in a higher emotional intelligence and well-being.

Mindful Awareness Practices (MAPS) was developed by the Mindful Awareness Research Center (MARC), a group of professional researchers and clinicians from the University of California, Los Angeles (<http://marc.ucla.edu>). MAPS for children and adolescents with ADHD modified the meditation practice to support the needs of this sub-population. The meditation began with 5 minutes of sitting, with an option to walk if a child felt restless. The 5 minutes increased to 20 minute per session over the course of 8 weeks. As ADHD individuals

are often more visually perceptive, MAPS for ADHD offers practitioners this option: instead of using breathing as the focus point, participants can visualize a blue sky and clouds, which represents the space of awareness in which one's thoughts, feelings and sensations drift.

Neurologic and genetic research has revealed a strong relationship between genetics and ADHD. Current research focuses on gene-behavior-brain pathways (Smalley et al., 2009). The high heritability of ADHD (between 70% and 90%) has also been shown to be one of the main contributing factors for low outcomes for behavioral parent training, historically the most favorable behavioral training for children with ADHD (Sonuga-Barke, Daley, & Thompson, 2002; Van den Hoofdakker et al., 2010; Biederman et al., 2004; Polderman et al., 2007).

The treatment options for children and adolescents with ADHD have been medication and behavioral therapy. The behavioral therapy typically utilized for children with ADHD is behavioral parent training. This involves parents working with the children's innate ways of learning, helping the children develop coping methods with which to manage their ADHD. Although helpful, this type of therapy is limited in its outcome for both child and parent.

These limited outcomes have motivated researchers in childhood ADHD and mindfulness to focus on parent-child relationships. This type of research has two goals in mind: to assist both parent and child with the management of ADHD and its corollary problems; and to utilize mindfulness to help the parent function better as a parent (Van der Oord et al., 2012).

Four rationales have been identified as limiting factors thus far in the parent-child approach to ADHD behavioral training. First, parents may be distracted by the child's conduct. Second, ADHD is a highly inherited trait, and therefore parents may have their own ADHD challenges, which limit their ability to assist the child. Third, parents often have learned or conditioned automatic responses, and have formed opinions and judgments toward their child's

ADHD, which in turn produces their own dysregulation and impulsivity responses (Dumas, 2005; Van der Oord et al., 2012; Singh et al., 2010). Fourth, parents of children with ADHD have been shown to have more elevated stress levels (Deault, 2010), which adds the risk of rejection, control, and reactivity to their children (Bögels, Hoogstad, Van Dun, De Schutter, & Restifo, 2008).

However, Van der Oord et al. (2012) found that mindfulness training with children with ADHD, in conjunction with mindful parenting, resulted in measurable improvement in regards to their children's ADHD behavior, according to self-reporting from study participants. The study also revealed children and parents self-reported higher levels of mindful awareness based on testing administered before and after the study. Furthermore, the parents who participated in the mindful parenting training showed a decrease in their reactionary responses and over all stress levels, according to post-study test scores. However, teachers' pre- and post-test scores did not concur with the parent-child scores, and the study was not able to clearly discern the determining differences in outcome measures (Van der Oord et al., 2012).

However, van de Weijer-Bergsma (2011) found that when parents of ADHD children are trained in mindfulness practices and practice mindfulness meditation with their children, the children's ADHD symptoms improve (Bögels et al., 2008; Kabat-Zinn & Kabat-Zinn, 1997). Mindfulness may in fact promote behavioral modification in parents, reduce their negative automatic responses, produce more functional parenting, and improve their children's ADHD deficits (Cassone, 2013). Cassone further contends that parent-child mindfulness training and parent behavioral therapy combined may offer the most optimistic changes for improving children's ADHD deficits (2015). This combination is particularly effective when both the parents and children have symptoms of ADHD, because while mindfulness improves self-

regulation, the behavioral training teaches parents how to modify their own dysfunctional parenting patterns.

Thus, the research suggests that a mindfulness practice does have a beneficial effect on children and adolescents with ADHD. The following sections explore more specific research on the effect of mindfulness practice on the three major components of ADHD: deficiencies in attention, self-regulation, and executive function.

Attention

Research has theorized that mindfulness training enhances self-regulation and attention (Bishop et al., 2004; Grossman et al., 2004). Several studies in mindfulness have demonstrated a correlation between mindfulness and attention among children and adolescents (Bögels et al., 2008; Napoli, Krech, & Holley, 2005; Semple et al., 2010; Zylowska et al., 2008). Moreover, studies in mindfulness throughout the past decade have shown mindful meditation to produce enhanced sustained attention, working memory, and academic performance in children and adolescents (Semple et al., 2005; Beauchemin, Hutchins, & Patterson, 2008; Schonert-Reichl & Hymel, 2007; Flook et al., 2010).

Barkley (2010) asserts that ADHD correlates with deficits in inhibition, attention control, self-directed speech, rule-following, self-motivation and self-awareness. ADHD involves challenges in these areas that monitor behavior. Appropriate attention and emotional skills enable one to manage life optimally. These skills help individuals develop the ability to be attentive and motivated, work with others, and regulate undesirable emotional responses, especially when challenged or frustrated (Broderick & Jennings, 2012).

Mindfulness meditation improves attentional control, one of the main problem areas of ADHD (Tang et al, 2007), because mindfulness meditation reduces attentional difficulties (Keng,

Smolski, & Robins 2011). Lazar (2005) used neuroimaging to study a group of experienced mindfulness practitioners, who demonstrated increased cortical thickening in the region of the right pre-frontal cortex and right anterior insula—areas of the brain that have been shown to be associated with sustained attention and awareness. In the conclusion of her study, she contended that mindfulness training improves awareness and helps orient attention.

Mindfulness meditation has two main components: being in the present with the self and mindful emotional acceptance (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008).

Meditation practitioners know the importance of being present with one's conscious field in a non-judgmental state. They also know the importance of avoiding distractions by attending to the point of focus (breathing). Mindfulness training provides the skill set for attention and self-regulation.

Thompson and Gauntlett-Gilbert suggest a number of specific ways that mindful techniques can be applied to ADHD children and adolescents. For example, as the children sit and breathe, they can be asked to notice their thoughts, feelings, body sensations, and behaviors. Whenever they find their minds wandering, the children can be trained to visualize their thoughts as a puppy running away. Each time the puppy runs away, they can imagine themselves bringing the puppy home (Thompson & Gauntlett-Gilbert, 2008). These techniques assist ADHD children and adolescents with attention and self-direction by helping them take control of their thoughts.

Mindfulness meditation also helps prevent excessive mind-wandering, distractibility, and daydreaming, which are common symptoms of ADHD. 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). Self-referential processing is implicated in ADHD and is associated with difficulties regulating attention among

ADHD individuals (Christoff et al., 2009; Castellanos et al., 2008). Mindfulness meditation is responsive to this default mode as it lowers activity and improves brain connectivity (Christoff et al., 2009). Improved connectivity enhances self-monitoring and cognitive control in both novice and expert meditators, as evidenced through neuroimaging studies (Taylor et al., 2013). In other studies, participants have reported that mindfulness meditation has helped reduce mind-wandering (Hasenkamp et al., 2012). Lazar (2005) contends that mindfulness training also helps individuals stay alert and in control of their attention.

Attention is the core foundation for neuro-cognition and psychological function (Cooley & Morris, 1990; Napoli et al., 2005). Through the Attentional Academy program, Napoli et al. used an integrative program of mindfulness and relaxation with 194 children suffering from high anxiety in grades 1–3. Participants showed an increase in selective attention and decreases in both test anxiety and ADHD behavior. Post-treatment testing showed reduced levels of self-reported anxiety. The teachers also reported improved attention and social skills (Napoli et al., 2005). The strengths of the study included a moderate sample size and rigorous methodology. The study's major weakness was the way the children's treatment combined mindfulness with relaxation, making it difficult to discern the effects of each activity individually.

Recently, mindfulness has been integrated into school programs, and research has shown that mindfulness improves the social and emotional development of children and adolescents (Jennings, Frank, Snowberg, Coccia, & Greenberg, 2013). Semple et al. (2005) undertook a school-based study on the feasibility and acceptability of a modified mindfulness-based cognitive therapy course, which was administered to five children ages 7–9. After the course, the children showed enhanced attention and performance and exhibited fewer behavioral problems. However, this study's weaknesses included its small sample size, lack of a control group, and

possibly subjective reporting method. At the same time, other mindfulness studies have shown enhanced sustained attention, working memory, and academic performance in children and adolescents receiving mindfulness training (Semple et al., 2005; Schonert- Reichl & Hymel, 2007; Beauchemin et al., 2008; Flook et al., 2010). In addition, Bögels et al. (2008) reported significant increases in self- and parent-reported measures of sustained attention, happiness, and mindful awareness. Finally, ongoing studies at Deakin University in Australia and at the University of Pennsylvania (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010) are looking into the effects of mindfulness on attention and working memory in children with ADHD.

Overall, mindfulness fosters attention and awareness of the present moment. As children and adolescents with ADHD experience deficits in attention control, mindfulness training helps them achieve present moment awareness.

Self-Regulation

Mindfulness meditation has also been found to improve self-regulation (Chambers, Gullone, & Allen, 2009) as mindfulness is a state that has been shown to correlate with self-regulation and self-direction (Brown & Ryan, 2003; Smalley et al., 2009). In fact, mindful meditation is a self-regulatory practice that is multifaceted but appears to improve self-regulation of attention and emotions (Black et al., 2009; Bishop, 2004). Part of mindfulness meditation practice is to experience the present moment in a non-judgmental state, rather than in a state of constantly responding to stimuli. Self-regulation through mindfulness may lower the reactionary state that triggers loss of self-control, which is often noted in patients with ADHD (Barkley, 2010).

Through neuroimaging, Hölzel et al. have shown that ADHD and mindfulness both affect certain areas of the brain that are involved in self-regulation. Their study consisted of 16 adults

participating in an MBSR program. The participants showed enhanced and measureable changes in the area of the brain associated with learning and memory processes, emotion regulation, self-referential processing, and perspective-taking. Thus, although the sample was small, their study suggests that mindfulness training may positively affect self-regulation (Hölzel et al., 2011).

The “MindUp” program, which began as a school pilot project to study peer acceptance, was a research program for adults and children that utilized mindfulness in conjunction with the principles of social and emotional learning (SEL). After 5 months of the program, participants showed improvement in the areas of attention, focus, self-regulation, self-control, behavior, and metacognitive skills such as planning and organization (Schonert-Reichl & Lawlor, 2010). A later study in a mindful education, which involved elementary school students and utilized a non-control pre- post-teacher report design, showed improvements in higher levels of executive function and self-regulation as well as improved saliva cortisol measurement and diurnal sleep (Schonert-Reichl K., Lawler M., 2010). As with Hölzel’s research from 2011, these studies are adding to the concept that mindfulness training has a positive effect on children and adolescents.

Learning to Breathe (L2B) was a mindfulness program for youths that was founded on the principles of SEL, or social emotional learning; the program shares many of the core principles of MBSR in that it aims to improve stress management in both students and teachers (Broderick & Metz, 2009). The main goal of L2B was to promote stress management by facilitating emotional self-regulation and attentional skills while reaching out to adolescents with an approach of non-judgment and loving-kindness (Broderick & Frank, 2014). Participants in the initial pilot study exhibited improved spatial working memory and emotional self-regulation, as well as fewer signs of anxiety and depression (Broderick & Metz, 2009). A larger study using the L2B program demonstrated improvements in self-awareness, attitudinal mood, emotional self-

regulation and clarity (Metz et al., 2013). In 2014, Broderick and Frank showed that L2B participants demonstrated measurable improvements in areas of attitudinal mood and affect, emotional self-regulation, composure, and self-acceptance. Qualitative acceptability measures revealed that the mindfulness class helped to relieve stress and that students favored continuing the class. This understanding further supports utilizing mindfulness meditation in the treatment of children and adolescents with ADHD.

Executive Function

The mental processes that make up executive functioning are fundamentally the same as the mental processes that are involved in self-regulation. These processes are: inhibition, working memory, self-awareness, resistance to distraction, emotional self-control, and self-motivation (Barkley, 2010). Executive function is also termed self-control, and is used to inhibit inappropriate feelings and to deflect uncontrolled behaviors—a process that is needed for intellectual performance and regulation of emotion (Compton et al., 2008). Executive function, otherwise known as executive cognition, has been described by neuroscience as a behavior that correlates present actions to optimal behavioral outcome. Neuroimaging has found that executive function is associated with the anterior cingulate cortex (ACC) in conjunction with the dorsolateral prefrontal cortex (DLPFC) (Kerns et al., 2004).

Executive function is a central component related to an individual's capacity to adaptively regulate his/her thoughts, emotions, instincts, and actions (Tang, et al., 2012; Posner & Rothbart, 1998). A key aspect of executive function is the ability to mediate conflict between competing emotions or response tendencies, which plays a large role in planning, goal-setting, and delayed-reward behaviors. This aspect of executive function has been measured consistently both in cognitive studies (Tang et al., 2012; Miller & Cohen, 2001) and through the use of

questionnaires (Rothbart, 2007). Difficulties with this aspect of executive function are a major factor in ADHD.

Executive function is divided into two categories: behavioral regulation and meta-cognition (Goia, Isquith, Guy, & Kenworthy, 2000; Smidts & Huizinga, 2011). One study used a scale called the Behavior Rating Inventory of Executive Function (BRIEF); they measured the behavioral regulations, including attention and self-regulation, and metacognition including working memory, organizing, planning and carrying out tasks. Although the BRIEF index identifies both behavior and meta-cognition in all children and adolescents, it is a reliable instrument for ADHD children because it assesses a child's and adolescent's EF deficits that are particular to ADHD.

The current research in mindfulness and ADHD focuses on the way in which mindful breathing, sitting, and walking positively affect executive function. Mindfulness practices involve structural activities that require individuals to exercise volitional control over their physical and mental processes (Mind and Life Education Research Network [MLERN], 2012). Mindfulness meditation has been shown, through behavioral research and statistical analysis, to enhance executive function in ADHD in children and adolescents (Jha et al., 2007). In recent years, mindfulness meditation has been found to help regulate mental activity (Teper & Inzlicht, 2013; Oberle, Schonert-Reichl, Lawlor, & Thompson, 2012; Flook, 2010; Zelazo & Lyons, 2012).

Grosswald et al. (2008) studied the effects of mindfulness training on the families of ADHD adolescents between the ages of 11 and 15 who had exhibited deficits in executive functioning. While the adolescents showed improvements after 8 weeks of training, the improvements decreased 16 weeks after the training ended. Similar results were observed for the

parents, with the fathers initially exhibiting reduced stress and the mothers initially exhibiting reduced overactive responses. This study adds to the emerging body of evidence that indicates the effectiveness of mindfulness training for adolescents and parents of adolescents with ADHD. The study also highlights the importance of continued maintenance strategies in order for the training to be effective in the longer term (Van de Weijer-Bergsma et al., 2012).

Flook et al. (2010) studied the effects of MAPS (mindfulness awareness practices) on behavior and executive function in elementary school children. Their randomized control trials with the InnerKids Program consisted of 64 student participants from 7 to 9 years of age and examined the effects of mindfulness on executive function. The parent-teacher rating scores showed improvement in behavior, self-regulation and executive function. Specifically, the study revealed through multivariate analysis of covariance on teacher and parent reports that mindfulness improved executive function at a higher rate among children who entered the program with poor executive function abilities (Flook et al., 2010).

Oberle et al., (2012) investigated the correlation between the executive control process of inhibition and self-reported dispositional mindfulness. The study utilized the mindfulness attention awareness scale (MASS), which is a self-reported scale used to measure dispositional mindfulness (Brown & Ryan, 2003). A cortisol saliva test was used as an indicator for the neuroendocrine status of homeostasis. The researchers considered factors such as developmental age and gender. The hierarchal regression analysis revealed increased self-reported mindfulness attention that correlated with higher scores on the inhibitory control task which is considered a predictor of executive functioning (Oberle et al., 2012).

In this way, mindfulness meditation has been shown to affect both the behavior and meta-cognition aspect of executive function. Because impaired executive function is a major

component of ADHD, mindfulness meditation can be an effective therapeutic intervention for ADHD sufferers.

Conclusion

Strengths of Research

The research into the effects of mindfulness practice on children and adolescents with ADHD is still in its early stages (Ott, 2002; Burke, 2010; Greco & Hayes, 2008). However, the research so far has shown early evidence that mindfulness practice may be effective for managing ADHD symptoms in this population. Although the research on ADHD and mindfulness in children and adolescents has developed slowly, there has been a momentous increase in research since 2008. Reasons for this increase include a public increase in awareness of the effect of ADHD on children and adolescents, concern about the use and safety of pharmaceuticals among children and adolescents, and increased clinical application of psycho-neuro-science. There has also been a paradigm shift in the public and professional approach to thinking about ADHD, from an approach that emphasizes ADHD as a disease that must be “cured” to an approach that emphasizes managing symptoms while maintaining individuals’ physical and emotional health.

One major advancement in the research occurred in 2003, when Bishop et al. proposed an operational definition of mindfulness in order to measure mindfulness more objectively and provide a more quantifiable understanding of the efficacy of mindfulness. Although this operational definition of mindfulness has not been fully embraced by the mindfulness community, it has allowed researchers an opportunity to begin to validate the concept of mindfulness in their research. This operational definition has led to additional research in the area of non-pharmaceutical treatments for ADHD in children and adolescents.

Along with the operational definition, there is now a proposed theoretical framework for mindfulness (Vago & Silbersweig, 2012). This framework is an important advancement because it has helped structure the way researchers identify specific constructs of mindfulness. Through these constructs inter- and intra-disciplinary research is converging. In other words, psychologists, neuroscientists, social scientists, and educators are exploring the ways in which mindfulness affects ADHD in children and adolescents. This convergence of disciplines has also allowed for effective interdisciplinary teams that are beginning to collaborate in the investigation of ADHD among children and adolescents. The importance of this collaborative approach is evident in that together these researchers can contribute to a larger, more informed body of knowledge about what were once separate aspects of disorders. Whereas an attention disorder was once viewed as disruptive behavior, researchers can now understand that “attention disorder” may be as much a psycho-neurobehavioral problem as it is a behavioral “conduct” disorder (Cassone, 2013).

Another strength of the advancements in this research is the ways in which research has begun to incorporate child, parent, and teacher training. Children and adolescents are no longer viewed as the sole problem. Rather, because ADHD is almost 90% hereditary, the research now highly suggests that parents also be trained in mindfulness so that they might better self-regulate in order to assist the child. In the same light, teachers are no longer trained to work with “disruptive” children; rather, they are trained to use mindfulness to assist struggling children and adolescents (van de Weijer-Bergsma et al., 2012; van der Oord et al., 2012).

Finally, the concept of SEL, or social emotional learning, is now taking hold because researchers are becoming more aware of the importance of the relationship between one’s environment and one’s awareness of self. When ADHD children and adolescents become more

aware of their own thoughts and feelings, they can be more present and aware of their environment (Lantieri & Goleman, 2008; Vago & Silbersweig, 2012). They become more invested in their world and begin to have more purpose, self-direction, and personal goals for their lives. The research on mindfulness and ADHD in children and adolescents clearly emphasizes how important it is for young people with ADHD to connect the self to the world in which they must participate.

Weaknesses and Gaps

Five major weaknesses in the research into ADHD and mindfulness in children and adolescents are apparent. The limited number of published, peer-reviewed articles on this topic is the first major weakness. The topic of ADHD and mindfulness is greatly under-represented in the literature, even though the individual issues of ADHD, mindfulness, and children and adolescents' health are written about profusely.

Second, the studies that do address the topic of mindfulness and ADHD in children and adolescents, do not consistently identify which participants have clinical ADHD diagnoses. As ADHD often shares a dual diagnosis (co-morbidity) with other psychopathologies such as anxiety, depression, and sensory disorders, it is important to structure studies to specifically test the effect of mindfulness on ADHD.

Third, studies are inconsistent in their focus on ADHD children and adolescents of various developmental stages. None of the studies in this review closely examined the differences in their subjects' brain maturation, personality development, and emotional and intellectual development. The research also neglected to look at age-appropriate development (such as ages 3–5); these ages are of particular importance because they represent formative years that are a pivotal time in the brain's structural and functional maturation (Piaget, 1975).

Fourth, the number of follow-up studies is minimal. None of the research alludes to any replicated studies or discusses any follow-up studies investigating the long-term effects of mindfulness training.

The fifth major limitation of the studies under review consists of their methodologies. The majority of the studies were not random-controlled trials and did not include control groups. Typically, study participants consisted of volunteers rather than being selected by the researchers; specific selection would have allowed for a more stringent inclusion enrollment. Overall, the studies did not investigate heterogeneous groups of participants. This lack of heterogeneity was often not accounted for but was most likely a variable that affected the results. The studies did not take into account variations in gender, race, ethnicity, intellectual development, and socioeconomic level, and were thus not particularly generalizable.

In other studies, the majority of participants demonstrated higher than average IQ levels. Not only did this lean toward bias and limitation, a number of researchers (Baer & Krietenmeyer, 2006, Baer, 2009 De Bruin, Zijlstra, Van de Weijer-Bergsma, & Bögels, 2011) have found that meditation practitioners often exhibit elevated intellectual performance. In fact, De Bruin et al. (2011) suggest that higher intelligence is a necessary element of self-awareness and an essential component of meditation. Thus, the seeming success of mindfulness practice on ADHD participants could have been due to the fact that the higher affective domain of the participant was drawn to the mindfulness training (Baer, 2009).

Additionally, many of the studies used quasi-experimental, wait-listed control groups, and self-reports that lacked third party validation and pre/post design methods. Parents were often not screened for ADHD themselves, and thus, the validity of their self-reports and mindful interventions with children may not have been reliable. In many cases, parents' self-reports were

not consistent with the teachers' reports, and no explanation for the incongruity was provided. Furthermore, the studies' use of semi-structured diagnostic interviews to gather data lent itself to possible subjective interpretations.

The types of mindfulness interventions investigated in the studies were, themselves, inconsistent. They varied and, at times, researchers utilized mixed interventions. For example, Napoli et al. (2005) modified standard MBSR techniques and included additional relaxation practices for children. Because of this combination, they could not clearly discern which techniques contributed to their results.

Future Research

Further research in the area of ADHD and mindfulness in children and adolescents must utilize the most rigorous methods available to the scientific community: quantitative and qualitative randomized controlled trials. These randomized control trials must address the weaknesses apparent in prior research. They must control individual variables such as the race, gender, and ethnicity of participants, and account for co-morbidities and heterogeneous diagnoses. Researchers must also administer consistent types of mindful interventions while ensuring that study participants represent a heterogeneous sampling of individuals formally diagnosed with ADHD in a clinical setting.

As leaders, Doctors of Nursing Practice (DNPs) are ideal advocates for the healthcare needs, safety, and well-being of children and adolescents. DNPs' direct access to public-community health centers, schools, clinics, hospitals, detention centers, and personal and medical homes positions them as major leaders in healthcare. DNPs also have direct access to children and adolescents and their parents and teachers.

Despite decades of lower socioeconomic initiatives, children of all races and ethnicities continue to receive fewer mental health care services (Centers for Medicare and Medicaid Services [CMS], 2014). As mindfulness interventions are clinically effective, cost-effective, and time-responsive, they are a viable way for children and adolescents with ADHD to attain higher levels of health and well-being.

The future of research in the area of mindfulness and ADHD in children and adolescents must become an integral part of the DNP's professional role. DNPs are leaders in health care and as such have a great potential for furthering this research. The DNP's leadership role is to encourage involvement in both direct and indirect research into ADHD and mindfulness among other nurses as well as professionals in other disciplines. This research can range from developing mindfulness programs and curricula to designing and implementing further studies into the effects of mindfulness on ADHD.

DNPs are ideal candidates for furthering rigorous controlled studies using scientific methodologies in parent-child-teacher programs and in conjunction with educational processes such as MAPS, SEL, and mindful education. Insisting on rigorous methodological approaches and evidence-based mindfulness practices will allow for quality improvement, safety, and results that are both reliable and generalizable.

A number of professional researchers (Baer, 2003; Carmody, Baer, Lykins, & Olendzki, 2009; Grossman et al., 2004; Ludwig & Kabat-Zinn, 2008) contend that mindfulness is an effective method that helps professionals meet the demands of their respective fields. In fact, in 2012, research showed that effective nursing mindfulness-based interventions promote advanced care and patient safety (Brady, O'Connor, Burgermeister & Hanson, 2012). Thus, DNPs are ideal candidates for using their own professional training in mindfulness to teach their clients

mindfulness practices. Cultivating the skills of mindfulness in patients has the potential to become a part of the healing culture of the nurse-patient relationship.

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