



Use of the Transcendental Meditation Technique to Reduce Symptoms of Attention Deficit Hyperactivity Disorder (ADHD) by Reducing Stress and Anxiety: An Exploratory Study

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This exploratory study tested the feasibility of using the Transcendental Meditation® technique to reduce stress and anxiety as a means of reducing symptoms of ADHD. Students ages 11-14 were taught the technique, and practiced it twice daily in school. Common ADHD inventories and performance measures of executive function were administered at baseline and three months later. Results showed statistically significant reductions in stress, anxiety, and improvements in ADHD symptoms and executive function.

Attention Deficit Hyperactivity Disorder (ADHD) is now among the most prevalent chronic health conditions affecting school-aged children. Almost 4.5 million children between ages 4 and 17 are diagnosed with the disorder, and almost half of these children are on ADHD medication. The majority of those on medication remain on it in adulthood (Center for Disease Control and Prevention [CDC], 2005).

Seventy-five to 85% of the time, ADHD is complicated by other emotional or behavioral disorders. An anxiety disorder is present in as high as 40% of ADHD children (Costello, Mustillo, Erkanli, Keller, & Angold, 2003; Pliszka, 2000). Side effects

of the ADHD medication can further compound the problem by causing or exacerbating emotional disorders. Consequently many children on ADHD medication are taking multiple drugs that include treatment for anxiety or other mood disorders, though most of those drugs are not FDA approved for use with children.

The long-term health effects of ADHD medications are not fully known; however, evidence suggests risks of cardiac disorders and sudden death, liver damage, and psychiatric events. The side-effects and long-term health outcomes associated with ADHD drug treatment potentially have important health implications for the millions of children (CDC,

2005). In 2006 the FDA required manufacturers to place warning labels on ADHD medications, listing the potential serious health risks. Most recently the British National Institute for Health and Clinical Excellence issued guidelines stating that first-line treatment for ADHD should be training and behavioral interventions, with drug treatment being reserved as a last resort for severe symptoms or impairment (National Institute for Health and Clinical Excellence, 2008). This statement may be the first signs of reversing the approach of drug treatment as initial standard of care.

Further, recent long-term follow-up studies of the original studies (The MTA Cooperative Group, 1999) concluded that medication alone or medication in combination with behavior therapy was superior to behavior therapy alone. The follow-up studies found that after three years of treatment there were no significant differences in behavioral symptoms among any of the three treatment groups (Jensen, et al., 2007). The authors concluded that the earlier advantage seen with medication treatment was no longer apparent 36 months later. Follow-up also showed that children in the medication study groups had significantly higher rates of delinquency, substance use, and stunted physical growth (Jensen, et al., 2007; Molina, et al., 2007).

In light of the growing concerns about the safety of ADHD medication, their actual effectiveness, and potential long-term health risks, the need to find effective non-drug interventions is becoming paramount. The purpose of this exploratory study was to obtain pilot data to assess the feasibility of using the Transcendental Meditation technique to reduce stress and anxiety as a means of reducing the symptoms of ADHD. The primary hypotheses were the following: 1) children with ADHD could learn and regularly practice the Transcendental Meditation technique, and 2) regular practice of the technique would reduce stress-related problems and symptoms associated with ADHD. The secondary hypothesis was that TM practice could potentially enhance executive function.

Stress, Anxiety, and ADHD

ADHD is associated with impaired executive function, specifically brain circuitry governing behavior (Bush, et al., 2005; Durston, et al., 2004; Zametkin, et al., 1993). Dysfunction of these circuits leads to impulsivity and lack of normal social inhibition. It also leads to impaired working memory, inability to focus attention, and impaired temporal organization.

Stress interferes with executive function and behavior regulation (McEwen, 1998). Stress-impaired executive function is associated with impaired working memory, impaired impulse control,

and lack of mental flexibility and coping strategies. Stress also dramatically compromises selective attention and the ability to sustain attention (Lupien, et al., 2005). Recent research sheds light on the relationship between stress and ADHD. Vance, et al., demonstrated dysfunction of the right prefrontal regions of the brain in ADHD children (2007). This region is responsible for developing coping strategies, influencing the ability to handle stress. Chronic acute stress damages the body's ability to return to non-stress levels, leading to chronically elevated levels of cortisol, a biochemical marker of stress. In children with ADHD high cortisol levels impair executive function, self-regulation, and letter knowledge (Blair, Grange, & Pazza, 2005).

Chronic stress can originate not only from emotional causes but can also result from physical origins. A study of premature birth and birth weight showed an association between physical stress and risk of ADHD. Danish researchers found that babies born prematurely had up to 70% greater risk of ADHD. Similarly, babies born of low birth weight had 50-90% greater risk of ADHD, depending on the weight at birth (Linnet, et al., 2006).

Early experiences of stress are believed to affect the level of responsiveness of the hypothalamic-pituitary-adrenal axis and the autonomic nervous system. Young children exposed to chronic stress can become conditioned to higher levels of adrenaline. This raises the "set point," making these children more vulnerable to stress, resulting in situations more easily triggering stress responses.

Stress Management as a Treatment Option

There has been little investigation of effective stress management techniques for children with ADHD. Most research on ADHD and stress management focuses on parents and their interaction with the child. One study of a stress management program for ADHD children examined its effectiveness in improving self-concept, locus of control, and acquisition of appropriate coping strategies. The study compared a therapist-led, group, stress management program; stress-management techniques taught by the parents using provided workbook and videotapes; and a control group with no intervention. In acquisition of coping skills, there were no significant changes in any of the three groups. Children in the therapist-led group did report more appropriate coping strategies (Gonzalez, 2002).

Meditation

Meditation is becoming common as a means of coping with stress and improving psychosocial factors. Although there are many forms of meditation, researchers generally classify them into two categories: techniques of concentration or

techniques of contemplation (Shapiro, 1982). Each of these techniques uses different processes, and thus has different effects (Orme-Johnson, & Walton, 1998). In meditation practices involving concentration, such as Zen meditation, the practitioner focuses on something specific such as an event, image, or sound, trying to direct all of his or her attention to a single focal point. Contemplative techniques include mindfulness meditation practices, a secularized version of Vipassana or Insight meditation. The goal is to be aware of any and all thoughts and sensations while trying not to judge or become actively involved in the thoughts (Shapiro, 1982). This type of mindfulness-based stress reduction (MBSR) technique can be practiced throughout daily activity.

Coupled with cognitive behavioral therapy, MBSR treatments have been studied for depression relapse, borderline personality disorder, and anxiety disorders (Segal, Williams, & Teasdale, 2002). Recent research of a MBSR technique showed decreases in perceived stress and symptoms among a clinical population with stress-related problems, illness, anxiety, and chronic pain (Carmody & Baer, 2007).

There is a growing body of research on the beneficial effects of meditation not only as a stress-coping mechanism, but also in improving brain function. Research suggests that meditation can change neural activity (Newberg et al., 2006), alter dopamine levels in the brain (Jevning, 1978; Kjaer et al., 2002) and change EEG patterns (Travis, 2001; Travis & Wallace, 1999).

Researchers are just beginning to explore the use of meditation for attention and ADHD symptoms. A study of Sahaja Yoga meditation as an intensive family treatment program with children with ADHD found improvements in children's ADHD behavior, self-esteem, and relationships with their families (Harison, Manocha, & Rubia, 2004). In non-ADHD subjects Mha, Krompinger and Baine (2007) found that MBSR may improve attention-related neural responses. A recent feasibility study of ADHD adults and adolescents using MBSR noted improvements in ADHD symptoms based on self-report and improvements on performance measures of attention (Zylowska, et al., 2007).

The Transcendental Meditation Technique

The Transcendental Meditation (TM) technique is neither a technique of contemplation or of concentration. It is a technique of "effortless transcending" (Travis, et al., 2002). It does not involve directing the attention or controlling the mind. The technique is practiced sitting with eyes closed, once in the morning and once in the afternoon, for 10-20 minutes each session depending

on the age of the practitioner. During the meditation session the active mind settles down to a silent yet fully awake state of awareness; transcending conscious thought to experience consciousness itself (Travis & Pearson, 2000). The mind is alert while the body gains a unique and deep state of rest and relaxation, creating a state called "restful alertness" (Roth, 1994). Deep rest is reflected by markedly decreased metabolism including heart rate, respiration rate, and blood flow to the limbs (Dillbeck & Orme-Johnson, 1987; Jevning, Wallace, & Beidebach, 1992; Orme-Johnson, 1973; Wallace, 1970). At the same time mental alertness is maintained, as measured by EEG and PET (Travis & Wallace, 1999; Yamamoto, Kitamura, Yamada, Nakashima, & Kuroda, 2006). Transcendental Meditation is characterized by activation in frontal and parietal attentional areas of the brain responsible for attention, executive function, and emotional stability (Dixon, et al., 2005; Fergusson, 1993; Gaylord, Orme-Johnson, & Travis, 1989; Newberg, et al., 2006; So & Orme-Johnson, 2001).

Meta-analyses comparing the Transcendental Meditation technique to other relaxation techniques found that for reducing trait anxiety in adults the TM technique had an effect size almost twice that of any other technique (Orme-Johnson & Walson, 1998; Eppley, Abrams, & Shear, 1989). The use of the Transcendental Meditation technique for stress reduction in adolescents showed improvement in school behavior, decreased absenteeism and rule infractions, and reduced suspensions due to behavior-related problems (Barnes, Bauza, & Trieber, 2003). Middle school students practicing the technique showed increased emotional regulation, and improved well-being (Rosaen & Benn, 2006). The practice of the Transcendental Meditation technique in elementary and secondary schools is associated with improved academic performance (Nidich & Nidich, 1989). The technique is also associated with accelerated cognitive development, improved concept learning, and improved focus and attention in children (Dixon, et al., 2005; Warner, 2005).

The predominant theory of ADHD holds that ADHD is a disorder affecting multiple executive functions, with poor inhibitory control being the most important executive deficit (Barkley, 1997). Stress compromises all of the major executive functions, including behavioral and cognitive inhibition, working memory, and flexible shifting or transitioning. It is likely that the improved behavior of adolescents practicing the Transcendental Meditation technique reflects, in part, increased inhibitory control secondary to normalization of the stress response.

This study was the first systematic exploration of the effects of Transcendental Meditation on the specific neuro-developmental disorder of ADHD. Given the effect of stress on executive function, attention, mood, and self-regulation, it is reasonable to explore non-drug approaches to stress reduction as a means of improving ADHD symptoms. Transcendental Meditation's reported effects on factors associated with ADHD (e.g., stress, cognitive function, behavior regulation) makes it a potentially useful technique for managing the disorder. The fact that the technique does not require concentration, controlling the mind, or disciplined vigilance of the thought process makes it especially suited for ADHD children. Additionally, it is learned quickly and easily. The practice is effortless and only involves two 10-20 minute meditation sessions each day.

Methods

Overall Study Design

A private K-12 school for children with language-based learning disabilities with 235 students agreed to participate in this study. Thirty-two students were in middle school grades, and 11 of these were diagnosed with ADHD. A randomized controlled study would have only 5-6 subjects in each group. Since this was an exploratory study, we chose to use a pretest-post test design with a single cohort. The subjects served as their own controls. Because ADHD most often involves not only attention problems, but behavioral and executive function problems, we selected a number of instruments to identify the variables that might be influenced most by the intervention.

Subjects

Participation in the study was restricted to students ages 11-14 with pre-existing diagnoses of ADHD made by a physician or psychologist. Information about the study and about the Transcendental Meditation technique was presented to the parents and students. Thirteen students volunteered to participate. Parents or guardians were requested to complete a brief history form indicating diagnoses, comorbidities, and medications.

Eleven of the volunteers had a current ADHD diagnosis. All eleven were entered into the study. One month after the start of the study, one student indicated that she preferred to meditate at home rather than at school. Due to the inability to reliably monitor compliance, she was dropped from the study. The final cohort was 10 students ages 11-14, nine boys and one girl. Four students were Caucasian, six were African American. All had a diagnosis of ADHD, six with inattentive-type and four with combined-type. Six students had comorbidities including general anxiety disorder,

dysthymia, obsessive compulsive disorder, pervasive developmental disorder, sleep disorders, and tics. Eight students were taking stimulants (e.g., Concerta, Ritalin); three of those were also on other medications such as mood stabilizers (e.g., Zoloft, Welbutrin, Risperdal). By virtue of attending the school, all students had language-based learning disabilities. Half of the students were private-pay, and half were on financial scholarship provided by the District of Columbia for students needing assistance that the District school system does not provide.

Procedure

Six weeks before the start of the intervention, two teachers and two administrators at the school were instructed in the Transcendental Meditation technique in order to lead the students in twice daily meditation sessions at the school. Following completion of baseline assessments, students were provided the standard course of instruction in the Transcendental Meditation technique (see below).

Over the 3-month study period, subjects participated in customary follow-up checks of correct meditation. Students meditated at school in a group for 10 minutes twice each day, once in the morning and once in the afternoon. Parents were encouraged to have students continue regular meditation at home on weekends and holidays. Home compliance was not rigorously monitored.

Instruments

Data collection was divided into two categories to correspond to the primary and secondary hypotheses: 1) measures of stress, anxiety, ADHD symptoms as reported by parent, teacher, and student inventories, 2) measures of executive function as measured by parent and teacher inventories, and by performance tests. Anecdotal information was collected by informal video interviews at pre- and post-test times.

Measures of stress, anxiety, and ADHD symptoms. Teachers and parents completed the Achenbach Child Behavior Checklist (CBCL) inventory, which is validated as diagnostic of ADHD based on the DSM-IV criteria. The CBCL is one of the most widely-used measures in child psychology, assessing behavior and social competency. It is composed of 112 items, each differentiating clinical from non-clinical children ($\alpha = .78-.97$, $r = 0.95-1$). Summarized in two categories: Syndrome Scales and DSM-Oriented Scales, the CBCL provides eight symptom subscale scores and a Total Problem score.

Students completed the self-administered Achenbach Youth Self-Report (YSR) and the Revised Children's Manifest Anxiety Scale (RCMAS) to assess overall behavioral and emotional

functioning. The YSR is a companion to the CBCL, providing parallel measures from the teachers, parents, and students. Like the CBCL the YSR has 112 items measuring eight subscale symptoms categorized under Syndrome Scales and DSM-Oriented Scales, and a Total Problem score ($\alpha = .71-.95$; $r = .47-.79$). The RCMAS is a 37-item self-report instrument assessing the level and nature of anxiety in children and adolescents ($\alpha = .83$, $r = .60-.88$; $p < .01$).

Measures of executive function. Teachers and parents completed the Behavior Rating Inventory of Executive Function (BRIEF). The BRIEF consists of 86 items in eight non-overlapping clinical scales. These scales form two broader indices: Behavioral Regulation and Metacognition. These two indices are combined to create an overall Global Executive Composite score. The BRIEF assesses behavior regulation and executive functioning ($\alpha = .80-.98$, $r = .82$ for parents, $r = .88$ for teachers).

Four performance tests were used to measure different aspects of executive function. The Cognitive Assessment System (CAS) Expressive Attention, Delis-Kaplan Executive Function System (D-KEFS) Verbal Fluency test, Tower of London (TOL), and Connor's CPT II.

The CAS Expressive Attention subtest is a color-word interference test similar to the Stroop. It measures higher level complex attention and ability to inhibit ($r = .83-.93$). Names of colors are presented in ink colors of either the name of the color or a different color. When the color of ink is different from the color name the task requires attention, inhibiting the reflexive response, and cognitive processing (switching) to say the correct color.

The D-KEFS Verbal Fluency subtest measures the ability to generate words fluently, generate words in categories, and shift attention by switching from one category to another ($r = .54-.73$). The student is asked to list as many words as possible starting with a certain letter, to name as many items in a category, and to name items switching from one category to another.

The TOL measures higher order problem-solving, and is used to evaluate executive function difficulties (Move Score $r = .80$, $p = .001$; Correct Score $r = .42$, $p = .06$). Subjects are shown a configuration of colored balls stacked on pegs. The subject executes a sequence of moves that transforms his or her board to match the displayed configuration with the balls arranged on designated pegs.

The Connors' Continuous Performance Test (CPT) II is a computerized test that measures sustained attention. The subject is presented stimuli on a computer screen (e.g., a letter or asterisk) and is asked to respond by pressing a button only when

detecting a specified letter after seeing another specified letter.

Intervention: The Transcendental Meditation Technique

During the course of instruction in Transcendental Meditation the student learns how to let the mind move from the active focused levels of thinking to silent, expanded levels of wakefulness at the source of thought, without concentration or effort (Travis, 2001). The practice of the technique involves two components: a suitable sound ("mantra") specifically chosen to facilitate the process of settling the mind; and a precise yet effortless technique for using the sound which leads to the experience of quieter and quieter aspects of his or her awareness. The technique is taught by certified Transcendental Meditation teachers.

The course involves one meeting of individual instruction followed by a meeting each day for the next three days to verify correct practice and provide additional information. Each meeting is approximately one hour each day. All 11 children in the group were able to learn the Transcendental Meditation technique, and practice it successfully, as evidenced during the morning and afternoon meditation sessions and by responses to TM course assessment questionnaires.

The Transcendental Meditation teacher observed group meditations several times a week for the first two weeks. Over the rest of the study period the TM teacher met with students individually an average of three times. During these meetings the teacher used a standard procedure for assuring correct, effortless meditation.

During the study period students meditated in a group at the beginning of the first period in the morning and the beginning of the last period in the afternoon each school day. Meditation sessions were led by school faculty instructed in the TM technique. Three months after instruction, post testing was administered.

Statistical Analysis

To reduce the number of statistical tests, the variables were grouped into two conceptual categories to correspond to the hypotheses. One grouping was stress, anxiety, and ADHD symptoms. This group included the relevant variables from the YSR, RCMAS, and CBCL. The second grouping was measures of executive functioning, which included the responses from teachers on the BRIEF and the data from the performance tests. Analysis was conducted on measures for which we had complete data ($N=10$). Parent inventories and CPT scores were not included because fifty percent of the parent post-test inventories were not returned, and thirty percent

of students had already left school for summer break at the time of CPT post testing.

We used raw scores for all analyses except performance tests, which were converted to standard scores using look-up tables provided in the test manuals. Standard scores were used for the performance measures in order to change all variables to a common direction of improvement. We applied repeated measure MANOVAs to test for significant pre-posttest differences in the two data groupings categories. Since these findings are considered exploratory, we used MANOVAs to avoid conducting multiple t-tests. Additionally, since stress or anxiety was part of multiple instruments, MANOVA analysis was determined appropriate. Because we had directional hypotheses, all tests of significance were one-tailed *t* tests.

Results

Stress, Anxiety, and ADHD Symptoms

From the YSR the variables selected for analysis were Anxious/Depressed, Withdrawn/Depressed, Affective Problems, Anxiety Problems, Attention Problems, ADHD Problems, and Total Problems (Table 1). Added to these variables was the single result of the RCMAS. The analysis yielded significant improvement of symptoms from pre-test to post- test as reported by student inventories, $F(1,9) = 4.7, p = .0285$. The same measures analyzed from the YSR were selected for analysis of the teacher reported CBCL. Teacher results corroborated student reported reductions in symptoms, $F(1,9) = 6.5, p = .0155$.

Table 1

Stress, Anxiety, and ADHD Symptoms

Symptom	Student					Teacher				
	Pre-test		Post-test			Pre-test		Post-test		
	Mean	SD	Mean	SD	ES	Mean	SD	Mean	SD	ES
Anxious/Depressed	5.7	3.6	2.7*	3.7	.8	10.2	6.4	5.6*	3.6	.7
Withdrawn/Depressed	4.8	2.7	3.9**	3.0	.3	4.3	3.8	3.6	4.0	.2
Affective Problems	5.8	3.4	4.1*	2.5	.5	5	3.7	3.6	3.6	.4
Anxiety Problems	3.2	2.0	1.6**	1.9	.8	3.7	3.5	2.1	2.4	.5
Attention Problems	7	4.0	5.2*	3.5	.5	23.6	10.5	22	11.0	.2
ADHD Problems	5.4	2.9	4.3	2.7	.4	12.4	5.7	11.7	5.7	.3
Total Problems	52.5	25.6	40*	27.4	.5	63.1	24.8	56*	31.2	.3

* $p \leq .05$. ** $p < .005$.

Executive Function

The BRIEF includes 3 composite measures: Behavioral Regulation Index, Meta-cognition Index,

and General Executive Composite. The Global Executive Composite is composed of the Behavioral Regulation Index and the Metacognition Index. A repeated measures MANOVA of the General Executive Composite indicated significant improvement in executive function from pretest to post test, $F(1,9) = 5.5, p = .022$. Thus, repeated measures MANOVA were conducted on the scales comprising the two indices. These MANOVAs also were statistically significant: Behavioral Regulation Index (Inhibit, Shift, and Emotional Control), $F(1,9) = 23.7, p < .00001$; and Metcognition Index (Initiate, Working Memory, Planning, Organize Material, and Monitoring), $F(1,9) = 13.7, p = .0025$. Table 2 presents the pre- and post-test means, standard deviations, and effect size for the individual scales associated with each index.

Table 2

Teacher Behavior Rating Inventory of Executive Function (BRIEF)

Scale	Pre-Test		Post Test		Effect Size
	Mean	SD	Mean	SD	
Behavioral Regulation Index (BRI)	54.1	16.9	46.4*	13.2	.5
Inhibit	19.0	6.9	17.1*	6.5	.3
Shift	18.5	5.3	15.5	3.9	.6
Emotional Control	16.6	6.7	13.8*	4.3	.4
Metacognition Index (MI)	94.8	32.1	85.3	23.2	.4
Initiate	15.1	3.7	13.2*	3.2	.4
Working Memory	22.8	4.2	20.1*	5.3	.6
Plan/Organize	21.8	4.4	20.6	5.5	.3
Organization of Materials	14.6	4.9	13.2	5.0	.3
Monitor	20.4	5.9	18.2*	4.5	.4
General Executive Composite (GEC)	151.6	37.7	131.7*	33.1	.5

* $p \leq .05$

The performance measures analyzed were the CAS and the D-KEFS (Table 3). The CAS scores of Expressive Attention and Accuracy Ratio were combined with the D-KEFS scores for Category Fluency and Category Switching. A repeated measures MANOVA yielded a significant improvement in scores on these performance measures from pre to posttest, $F(1,9) = 5.0, p = .026$.

Since all of the subjects had language based learning disorders, the Letter Fluency trial of the D-KEFS Verbal Fluency test and the Tower of London were omitted from analysis. Performance on the Letter Fluency condition is dependent on vocabulary knowledge and spelling ability. A review of measures of executive function used for assessing ADHD suggests that tests of letter fluency are not reliable for distinguishing ADHD from controls because of the confounding presence of learning disorders.

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Similarly, the Tower of London has been found to be less consistent than other measures in distinguishing specific effects associated with ADHD from those related to learning disorders (Sergeant, Geurts, & Oosterlaan, 2002).

Table 3

Performance Measures

Measure	Pre-Test		Post Test		Effect Size
	Mean	SD	Mean	SD	
CAS Expressive Attention	36.10	10.63	44.70*	13.59	.8
CAS Accuracy	37.70	2.21	39.40*	1.27	.8
D-KEFS Category Fluency	25.10	7.83	28.70	7.61	.5
D-KEFS Category Switching	8.30	3.19	9.60	2.63	.4

* $p \leq .05$

Discussion

Even though the majority of subjects in the study were taking medication for ADHD and comorbidities, they were still experiencing cognitive and psychosocial symptoms extensive enough to present problems in school and at home. An effective non-pharmacological option that can improve these symptoms would provide a valuable treatment option, whether alone or as an adjunct to medical and behavioral interventions. Because the Transcendental Meditation technique does not require focus or concentration, it seems well suited for children struggling with ADHD. This study indicates that children with ADHD can successfully learn the Transcendental Meditation technique and practice it on a regular basis.

We hypothesized that the Transcendental Meditation technique would have a positive effect on stress, anxiety, and ADHD symptoms. Results support to this hypothesis, showing significant pretest-post test improvements. The student ratings of positive effects were corroborated by the teacher ratings with high levels of confidence. Our secondary hypothesis was that the Transcendental Meditation technique would improve executive function. Statistically significant improvements were noted on both the teacher rated BRIEF and on the performance tests.

Stress and anxiety can overwhelm and lessen the effectiveness of the individual. Anxiousness contributes to poor impulse control, inability to sustain attention, impaired working memory, and lack of cognitive flexibility. This raises the question as to whether, in some cases, it is the symptoms of stress and anxiety that are being diagnosed as ADHD. Whether these problems are a result of ADHD or are the cause of ADHD-like symptoms, this study suggests that reducing stress and anxiety by the Transcendental Meditation

technique can potentially improve ADHD symptoms and executive functions.

These results are consistent with previous research on the Transcendental Meditation technique showing reduced anxiety, increased emotional regulation, and improved social behavior in non-ADHD students. Improved executive function noted in our study is also consistent with research on the TM technique showing increased frontal brain coherence, which is associated with more effective executive functioning, improved attention, greater emotional stability, and decreased anxiety.

Compared to other meditation techniques, the Transcendental Meditation technique may be particularly suited to children with ADHD. It is easy to learn and is learned in less than an hour. The technique does not involve controlling the mind; and it requires no other time investment than the 10-15 minute sessions twice a day. Yet changes in the brain are seen within a short time (Travis & Arenander, 2006). Different meditation techniques have different effects. A study of the effects of mindfulness meditation in adults and adolescents with ADHD (Zylowska, et al. 2007), showed improvements in attention and inhibition among the adolescents. However, that study did not show improvements in anxiety or depression. In contrast, these improvements were seen in our study of the Transcendental Meditation technique. In addition, the TM practice was associated with improved executive function.

The current findings suggest that TM may be a beneficial intervention for students with ADHD, and that it can be practiced comfortably within the typical school day. Studies on student learning have emphasized the importance of “downtime” for integrating new learning. Therefore, two periods a day of deep mental rest would be expected to improve learning and retention in all students.

The findings of this study also have promising implications for what is commonly referred to as the “epidemic of student stress,” which manifests as affective disorders, problems with behavioral control, substance abuse, and self-injury. Since students with ADHD experience higher levels of stress than typical students, a technique that can help normalize their stress response and provide increased self-control would be extremely valuable. Moreover, studies on aggression have consistently found that states of deep relaxation are incompatible with anger and aggression. Therefore regular periods of “de-stressing” can potentially improve the ability of ADHD students to inhibit the tendency to act impulsively, and enhance their ability to think before they act.

The Transcendental Meditation technique can be done anywhere one can sit and close the eyes. Therefore it is portable, and a personal means of self-regulation for ADHD children. To maximize the benefits, the recommended routine is one meditation session in the morning and one in the late afternoon, every day. Incorporating the TM program in a school setting, as was used for this study, provides an excellent means of maintaining regularity, benefiting not only the students but also the school. Teachers' anecdotal comments revealed that teachers were able to teach more and students were able to learn more because they were less stressed and anxious.

With recent research showing reduced ability to cope with stress and slower brain development in ADHD children, a technique that can positively affect both of these factors can be a valuable resource for treatment of ADHD. The technique does not conflict with other cognitive or behavioral approaches, or with medication. With less stress and anxiety, the child may be more responsive to other interventions, potentially increasing their effectiveness.

As in most studies of ADHD, our subjects had comorbidities and learning disorders. ADHD rarely appears in isolation. Seventy-five to 85% of ADHD diagnoses include one or more comorbidities, and 20-30% exhibit learning disorders. Therefore, an argument can be made that the sample reflects a common ADHD population.

This was an exploratory study, with a small number of subjects and no control group. Also, there was no control for differences in medication. Therefore we cannot propose a cause and effect relationship. However, we administered objective performance tests of attention and executive function to support self-report inventories that are commonly used to diagnosis ADHD. The data showed within-study corroboration of results. These results suggest that further research is warranted to assess the impact of Transcendental Meditation practice as a potential treatment option for ADHD, either alone or as adjunct treatment. It would be most important to replicate these results with a control group. Further study of improvements in brain coherence and brain development could provide insight into the underlying mechanisms of observed changes.

Conclusions

Medication for ADHD can improve the symptomatology of the disorder for some children, or be marginally or not effective for others; and it can cause life threatening complications. Even for those children who have improvement in symptoms, the improvement is often insufficient. Additionally, it can be hard to obtain consistent drug action throughout the day and into the evening for

homework. Importantly, medication does not treat the underlying pathophysiology. The Transcendental Meditation technique is an easily learned and practiced technique. This research suggests that the technique has potential to improve attention, behavior regulation, and executive function by naturally reducing stress and anxiety and improving brain functioning.

This research was the first systematic study of the effects of the Transcendental Meditation technique on the symptomatology of ADHD. The results of this exploratory study indicate that Transcendental Meditation practice 1) can be learned and successfully practiced by children with ADHD, 2) has the potential to reduce stress, anxiety, and stress related ADHD symptoms within three months, and 3) may contribute to improved behavior regulation and executive function.

This research provides encouraging indication that the Transcendental Meditation technique may have potential as an effective non-pharmacological intervention for managing the stress and anxiety associated with ADHD and impaired executive function, and may have a positive impact on behavioral symptoms associated with the disorder.

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