Attention Deficit Hyperactivity Disorder: Traditional Treatments and Alternatives: A Literature Review

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ABSTRACT

Objective: This article provides an overview of the relationship between the current literature and the actual treatment of attention deficit and hyperactivity disorder. Emphasis is given to the use of alternative treatments such as, but not limited to the elimination of food additives, increased outdoor activity in green environments, chelation therapy, etc.

Data Collection: A computer search using PubMed generated articles relevant to m ADHD, ADHD alternatives, and neuroplasticity. Referenced sources were identified from the individual. PubMed searches generated 15,700 articles on ADHD, 53 articles on ADHD alternatives, and 42 articles on ADHD neuroplasticity.

Data Synthesis: Attention deficit hyperactivity disorder affects an estimated 2 million US children. A risk benefit analysis is imperative before long-term medical treatment is initialized.

Conclusion: Much bias exists, complicating the ADHD debate. However, it's important that clinicians put aside their indifferences and inform parents of the literature which exists on both sides of the table. Pharmacologic treatment is effective only in the short term and carries many potentially serious risks. Nonpharmacologic treatment can be effective in the long term without the risks, but is generally time intensive and costly.

Key Indexing Terms: ADHD, ADHD traditional treatments ADHD alternative treatments

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is an increasing problem in the United States. An estimated 3-5% (~2 million) of all children are affected by this disorder (1), and half of all children brought to psychiatric clinics receive the diagnosis. Originally, this was thought to be only a childhood condition, but adult diagnoses have increased over the past decade. It is suggested that up to 60% of childhood ADHD patients maintain symptoms into adulthood (2). Additionally, ADHD is the most frequently treated childhood disorder and the prevalence rate has quadrupled over the past ten years (11). Thorough understanding of the underlying neurophysiology is extremely important, but lacking.

There are several theories on the cause of ADHD. Fortunately for parents, there is little evidence indicating that ADHD is solely a problem of social factors and child-rearing methods. Currently, most research supports a neurobiological or genetic basis for the development of ADHD (7). Other possibilities include environmental agents, brain injury, food additives and sugar.

The purpose of this research effort is to review the standard of treatment for ADHD patients and will include alternative treatments approaches, such as nutrition, behavioral modification, and neurological remodeling. Examination of the long and short-term effects of these approaches may lead to improving outcomes based on an integrated approach to treatment.

DISCUSSION

Attention deficit hyperactivity disorder is a complex disorder. It is four to six times more prevalent in boys, who tend to display primarily behavioral disturbances while girls generally display inattentiveness and have few problems

with other people. The onset of ADHD is typically before the age of seven, however, symptoms can be detected in infants as young as 10 months. Half of all children with ADHD also meet criteria for socially disruptive conduct or oppositional defiant disorder (2).

The Diagnostic and Statistical Manual of Mental Disorders (DSM) IV criteria for diagnosis of ADHD are as follows:

1. Either a or b
    a. Six or more of the following symptoms of **inattention** have persisted for at least six months to a degree that is maladaptive and inconsistent with developmental level:
        i. Often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities
        ii. Often has difficulty sustaining attention in tasks or play activities
        iii. Often does not seem to listen when spoken to directly
        iv. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)
        v. Often has difficulty organizing tasks and activities
        vi. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as school work or homework)
        vii. Often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)
        viii. Is often easily distracted by extraneous stimuli
        ix. Is often forgetful in daily activities
    b. Six or more of the following symptoms of **hyperactivity/impulsivity** have persisted for at least six months to a degree that is maladaptive and inconsistent with developmental level

        Hyperactivity

        i. Often fidgets with hands or feet or squirms in seat
        ii. Often leaves seat in classroom or in other situations in which remaining seated is expected
        iii. Often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)
        iv. Often has difficulty playing or engaging in leisure activities quietly
        v. Is often "on the go" or often acts as if "driven by a motor"
        vi. Often talks excessively

        Impulsivity

        vii. Often blurts out answers before questions have been completed

viii. Often has difficulty awaiting turn
ix. Often interrupts or intrudes on others (e.g. butts into conversations or games)

2. Some hyperactive, impulsive or inattentive symptoms that caused impairment were present before 7 years of age
3. Some impairment from the symptoms is present in two or more settings (e.g., at school or work and at home)
4. There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning
5. The symptoms do not occur exclusively during the course of a pervasive develop mental disorder, schizophrenia, or other psychotic disorder, and are not better accounted for by another mental disorder (e.g., mood disorder, anxiety disorder, dissociative disorder, personality disorder.) (1)

Many barriers exist in the adequate diagnosis and treatment of attention deficit hyperactivity disorder (ADHD). These barriers include racial, gender, and economic disparities and occur at multiple levels, such as obtaining evaluations from parents, diagnosis from the provider, and treatment. Furthermore, there are vast differences between the American Academy of Pediatrics guidelines and pediatricians' practice patterns (4).

Many pediatricians are reluctant to perform adequate work-ups on patients due to these services being nonreimbursable. Additionally, patients do not often demonstrate signs of inattention and hyperactivity while at the doctor's office, forcing the pediatrician to rely on the verbal statements given by the patient's teachers. Many times, parents bring their children for ADHD evaluation asking for stimulant medications because they were persuaded to do so by school educators. Educators and parents often have little accurate knowledge about ADHD. According to the authors of one study, educators and parents may believe that ADHD is not a real problem, is over diagnosed, or is the result of familial environment or other lifestyle factors, such as diet. They also may not be aware of effective treatment options. This situation has led to many difficulties in the treatment

of ADHD (4).

Froelich et al found that 3.3% of all children have received an ADHD diagnosis and have received medication without actually meeting the DSM-IV diagnosis criteria. However, discrepancies exist between the guidelines of the American Academy of Pediatrics, which recommends both caregiver and teacher reports be used in the informed clinical diagnosis and the DSM-IV, which does not (9).

The causal factors of ADHD remain heavily debated. Many researchers continue to search for a biological basis, such as delayed brain development. In fact, children with ADHD have been shown to possess delayed brain development relative to the population at large. However, it is speculated that these changes may be related to the pharmacological treatments, which are also implicated in stunted growth.

The anatomic evidence of ADHD exists within the anterior cingulated gyri, left lateral frontal lobe and basal ganglia. Nigrostriatal, or frontostriatal, networks and closely interconnected structures have also been found to differ in those with ADHD. These areas are responsible for executive function and are located in the brain's dopaminergic pathways, specifically the mesolimbic and nigrostriatal dopaminergic systems. These systems may be those that underlie decisions and the processing of reward information, predicting and detecting rewards and signaling alerting and motivating events. (10)

Pisecco et al investigated the effects of academic self-concept. It was found that much research supports a reciprocal relationship between academic self-concept and achievement. Children with learning disabilities typically view their academic skills as lacking relative to their peers. A self-perpetuating cycle develops in which those children attribute their poor outcomes to their skills and are unlikely to view future academic

achievements as possible, and therefore, give up. Furthermore, children with learning disabilities are more likely to display disruptive behavior, especially those with reading problems. This behavior may gain acceptance from a subset of their peers (7).

Pharmacologic Interventions

Pharmacotherapy is the primary treatment of ADHD and psychostimulants have been determined to be the drug of choice (5). Between 600,000 and 1 million school children in the United States are prescribed stimulant medication each year. Studies indicate that 70-80% of all children on prescribed stimulant therapy respond positively. However, more than 35% of children on placebo also respond favorably. Furthermore, 25-40% of ADHD diagnosed children show no response to any medication (11).

The mechanism of these drugs is largely unknown. Ritalin has been prescribed for over 50 years despite this lack of understanding (11). Until recently, it was believed that these drugs were effective due to a release of norepinephrine from subcellular particles in sympathetic nerve endings and chromaffin cells. The norepinephrine directly stimulates alpha- and beta-adrenergic receptor sites in the cerebral cortex and reticular activating system (2). It is now known that Ritalin and other stimulants interfere with the reuptake of dopamine by blocking dopamine transporters (11).

Unfortunately there are many side effects associated with psychostimulants. Children often experience anorexia and abdominal discomfort, as well as insomnia, headaches, irritability, and anxiety. Pulse and blood pressure must be monitored because they tend to rise with the introduction of psychostimulants (2, 11). Despite these risks, and the risk of sudden cardiac death, the American Academy of Pediatrics recommends against routine electrocardiogram (ECG) testing, stating that the risk is small, affecting

only two children in every million taking ADHD medications. The American Heart Association maintains its stance, stating that it is reasonable for clinicians to consider obtaining ECG testing prior to beginning ADHD medication treatment, especially when risk factors exist (6).

In addition to side effects, there are other limitations to stimulant medications. Due to the short length of action, parents must carefully time administration so that the desired effects can be achieved while the child is at school or on overnight trips. Tics, Tourette's Syndrome, and negative physiological side effects similar to those seen in amphetamine use have also been documented (11).

Growth retardation is also reported, although the relationship is controversial (2). It has been found that children taking stimulants are consistently about two centimeters shorter than expected. However, children tend to "catch up" by adulthood, possibly due to the cessation of stimulant medication before the closure of growth plates. Clinicians are encouraged to chart growth twice a year. If concerns arise, clinicians should consider stopping stimulant medication on the weekends and/or during the summer, a "medication vacation" of sorts (6, 11).

No medication to date has been shown to produce long-term improvement in children with ADHD. Often, after the cessation of medication, children revert back to their symptomatic state (11). Current ADHD treatment produces only partial benefits, perhaps due to the limited scope of a singularly pharmacologic intervention (3,6). Additionally, many studies on medication cover only short-term usage, and many children take these drugs far longer than studied. One popular study, the Multimodal Treatment Study of Children with ADHD, is an exception to most pharmacologic ADHD

studies. This study followed the treatment of 579 children over three years and followed up eight, 10, and 12 years after study treatment ended. The study showed that children on medication with or without psychosocial therapy improved more than children who did not take medication at 14 and 24 months. However, after this point, the advantage diminished completely by 36 months (6).

Nonpharmacologic Interventions

Biofeedback/neurofeedback has shown significant long-term improvement on behavioral and neuropsychological measures, as well as increased cortical arousal in certain children (2, 11). This process works by encouraging the child to modify brainwave activity to improve attention, reduce impulsivity, and control hyperactive tendencies. Several studies have shown neurofeedback to be effective in up to 80% of children treated and also showed that the results were long lasting. Improvements were seen in IQ tests, standardized tests of achievement, and teacher/parent ratings of behavior (11).

In 2002, Monatra demonstrated that those treated with neurofeedback had greater attentiveness and less hyperactivity/impulsiveness at home, when compared to those on medications, specifically Ritalin. Teacher reports supported these findings. When those on medication experienced a "medication vacation," those who had underwent neurofeedback showed sustained results, while those on medication reverted back to inattentiveness and hyperactivity/impulsiveness. In addition, those in the neurofeedback group whose parents used constant reinforcement strategies at home showed a significant reduction in symptoms at one-year follow-ups than those on medication alone (12).

Neurofeedback has been shown to be the treatment of choice when medication is

ineffective or has unacceptable side effects. However, it does have its limitations. For long-term change, 40-60 sessions may be necessary over a six-month period. Many parents may be unable to afford the cost or time of such treatment. However, considering the long-term benefit to the individual who does not "outgrow" ADHD, neurofeedback is a cost-effective alternative to the long-term use of medications. Furthermore, specific guidelines have been developed to determine appropriate candidates (2, 11).

Behavioral techniques can be used to address issues with time management, problem resolution, prioritization, and socialization (2). Classroom interventions and parent training have been shown to help children with ADHD better manage behavior, with or without medication (6). Unfortunately, many children do not respond well to this type of treatment for a variety of reasons. For one, it is difficult to generalize treatments to several situations. It is also difficult to enforce training in the same way at home and in the classroom, as training requires a very high degree of cooperation from both parents and teachers (11).

Tantilla et al measured the effect exercise had on dopaminergic activity in children with ADHD. At least four other studies have examined the effects of exercise on ADHD children with mixed positive and null results. These studies are all in response to the anecdotal reports from parents and teachers that exercise favorably benefits children with ADHD. Tantilla's results encourage further investigation into the favorable effects exercise has on dopaminergic activity and possible effects on the symptoms of ADHD (13).

Many speculate over the quality of a child's diet and its effect on ADHD symptomatology. Several studies have discovered that children with ADHD have lower

serum levels of long-chain omega-3 fatty acids than non-ADHD children, possibly due to a deficient dietary intake or increased metabolism. Regardless, this lower level could have implications regarding an increased likelihood to an inflammatory state, as well as the quality of phospholipid membrane properties, including cerebral grey matter (14).

Omega-3 fatty acids are essential during all parts of the life cycle, but are especially crucial during the last trimester of pregnancy and the first two years of childhood. During this time the brain undergoes rapid growth that essentially sets the stage for the rest of life. Docosahexaenoic acid (DHA) is necessary for the development of sensory, perceptual, cognitive, and motor neural systems during this period. Fortunately, DHA can be supplied in the colostrum and breast milk, but supplies rely on maternal dietary intake. Many infant formulas do not contain adequate DHA and EPA supplementation, if any at all (15).

The effects of insufficient DHA/EPA intake during brain development can be seen in children with developmental coordination disorder (DCD). This disorder consists of core motor deficits with associated learning and behavior difficulties that mimic those of ADHD. A double-blind random-controlled trial failed to demonstrate that children with DCD experienced improved motor skills after supplementation with a mixed omega-3/omega-6 supplement. However, these children showed three times the normal gains in reading skills and twice the normal gain in spelling competency, as well as noticeable improvements in behavior (15).

When considering the effects of omega-3 levels on children with only ADHD, it was found that ADHD children have lower concentrations of total omega-3 fatty acids, specifically DHA in comparison to controls. It was also found that low omega-6 levels

tended to correlate more with physical deficiencies, while omega-3 deficiencies correlated with behavioral issues such as conduct disorder, hyperactivity-impulsivity, anxiety, temper tantrums, sleep difficulties, and learning problems. Low omega-3 levels were found to be associated with a range of behavior and learning problems, regardless of the clinical diagnosis (15).

It has been found that activities performed in natural green environments significantly reduce symptoms of ADHD. Stephen Kaplan, environmental psychologist, speculated that activities which demanded direct focus and the elimination of unwanted stimuli quickly led to a state of fatigue. This fatigue leaves a child susceptible to display the symptoms of ADHD. Kaplan argues that natural environments engage the mind effortlessly and allow the mind to be more directed and focused when returning to structural activity such as school. (5,16)

CONCLUSION

Investigating attention deficit hyperactivity disorder is not an easy task. Much information and misinformation exists, exacerbated by much bias. However, in the best interest of the children to which this disorder affects, it is crucial that health care professionals put aside their personal interests and biases to deliver all the available information to the caretaker, so that a well informed decision can be made.

It is clear that pharmacologic treatment, namely Ritalin, is effective at improving the symptoms of ADHD. However, the benefits of ADHD pharmacology rarely, if ever, extend beyond the cessation of treatment. Furthermore, many side effects exist in association with pharmacologic management. Some of these side effects, such as cardiovascular insufficiency, can be devastating. Others, such as stunted growth, seem

less threatening, but it is questionable if stunted development is limited to vertical height, i.e. brain development.

Another serious cause for concern is the fact that no pharmacologic treatment has been found to produce long-term effects. Considering the percentage of children who continue to experience symptoms into adulthood, it is important to find treatments that are not only effective while the child is at school, but also encourage development of skills that will properly equip the child for adulthood.

Several nonpharmacologic treatments have shown promising results, especially in the long-term without negative side effects. Biofeedback, a method of training the brain to respond in a more appropriate manner is one such treatment. It is safe and has been proven effective in the long-term. Unfortunately, treatment is intensive and many patients may not be able to devote the necessary time or money.

Omega-3 fatty acid supplementation, specifically DHA, has also been shown to reduce the behavioral symptoms of ADHD. Long-term supplementation with omega-3 is very plausible, and should be considered as part of a healthy lifestyle if only due to the cardiovascular benefits it provides. The modern American diet tends to be severely lacking in omega-3 and instead places an emphasis on omega-6 consumption that creates a pro-inflammatory state leading to many detrimental health effects. This lack of omega-3 may be part of the cause in the development of ADHD, as omega-3 fatty acids are imperative to human brain development.

Clearly, the topic of ADHD is not yet a closed book. Further research into the underlying pathophysiology is imperative. Without this understanding, it will be difficult to develop a truly effective treatment. Until then, caregivers should be fully informed of all available research so that they may make a decision in the best interest of their child.

REFERENCES

1. National Institute of Mental Health. Attention Deficit Hyperactivity Disorder (ADHD). www.nimh.nih.gov April 3, 2008
2. Pary, R., Lewis, S., Matuschka, P.R., & Lippmann, S. (2002). Attention-Deficit/Hyperactivity Disorder: An Update. Southern Medical Journal. Vol 95, No. 7.
3. Patel, K., & Curtis, L.T. (2007). A Comprehensive Approach to Treating Autism and Attention-Deficit Hyperactivity Disorder: A Prepilot Study. The Journal of Alternative and Complementary Medicine. Vol 13, No. 10
4. Foy, J.M., & Earls, M.F., (2009). A Process for Developing Community Consensus Regarding the Diagnosis and Management of Attention-Deficit/Hyperactivity Disorder. Pediatrics. Vol 115. No. 1.
5. Harvard. (2006). Attention Deficit Disorder: Old Questions, New Answers. Harvard Mental Health Letter. Feb 2006.
6. Harvard. (2008). Treating ADHD in Children and Adolescents. Harvard Mental Health Letter. Vol 25. No. 4
7. Daley, D. (2006). Attention Deficit Hyperactivity Disorder: A Review of the Essential Facts. Child: Care, Health & Development. 32, 3, 193-204
8. Pisecco, S., Wirsters, K., Swank, P., Silva, P., & Baker, D.B. (2001). The Effect of Academic Self-Concept on ADHD and Antisocial Behaviors in Early Adolescence. Journal of Learning Disabilities. Vol 34, No 5.

9. Froehlich et al (2007). Prevalence, Recognition, and Treatment of Attention-Deficit/Hyperacticity Disorder in a National Sample of US Children. Achives of Pediatric Adolescence Medicine; Vol 161, No 9.

10. Schuck, S.E.B., & Crinella, F.M. (2005). Why Children with ADHD Do Not Have Low IQs. Journal of Learning Disabilities. Vol 38, No 3.

11. Fox, D.J., Tharp, D.F., and Fox, L.C. (2005). Neurofeedback: and Alternative and Efficacious Treatment for Attention Deficit Hyperactivity Disorder. Applied Psychophysiology and Biofeedback; Vol 30, No 4.

12. Monastra, V.J., Monastra, D.M. & George, S. (2002). The effects of stimulant therapy, EEG biofeedback and parenting style on the primary symptoms of attention-deficit/hyperactivity disorder. Applied Psychophysiology and Biofeedback, 27, 231-249.

13. Tantilla, M., Kesick, C.M., Hynd, G.W., Dishman, R.K. (2001). The effects of exercise on children with attention-deficit hyperactivity disorder. Medicine and Science in Sports and Exercise

14. Germano, M., Meleleo, D., Montofano, G., Adorni, L., Negroni, M., Berra, B., & Rizzo, A.M. (2007). Plasma, red blood cells phospholipids and clinical evaluation after long chain omega-3 supplementation in children with attention deficit hyperactivity disorder (ADHD). Nutritional Neuroscience. Vol 10, 1-9

15. Kidd, P.M., (2007). Omega-3 DHA and EPA for Cognition, Behavior, and Mood: Clinical Findings and Structural-Functional Synergies with Cell Membrane Phospholipids. Alternative Medicine Review. Vol 12, No 3.

16. Kuo, F.E., & Taylor, A.F. (2004). A Potential Natural Treament for Attention-Deficit/Hyperactivity Disorder: Evidence From a National Study. American Journal of Public Health. Vol 94, No 9.