

**The Treatment of Attention Deficit Disorder:
A Review of Current Literature**

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Abstract

A review of treatments for ADHD by literature search reveals that although the use of stimulant medication appears to be the prevalent treatment in the United States at this time, there appears to be several other promising options for reducing the symptomatology of ADHD. Identifying and avoiding food allergens, supplementation for mineral and/or essential fatty acid deficiencies, and neural re-programming treatments are some of those options.

Key Words: Attention Deficit Disorder, Food Sensitivities, Food Allergies, Chiropractic Adjustments, Spinal Manipulations , Nutrition, Minerals, Essential Fatty Acids, Neural Re-Programming.

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a behaviorally defined disorder without specific diagnostic physical signs or laboratory findings, but with tremendous personal and social impact. The disorder was previously described as “minimal brain dysfunction” and was considered to be neurologically based. Blythe and McGlown later felt that these symptoms could be described more precisely as “Organic Brain Dysfunction” (OBD).^{1,2}

The American Psychiatric Association has categorized this disorder into three subgroupings: a) attention deficit with hyperactivity, b) attention deficit without hyperactivity and c) attention deficit residual for adolescents. For the purpose of this paper, subgroups a) and b) will be grouped and referred to as ADHD.

The signs and symptoms of ADHD listed in the Diagnostic and Statistical Manual (DSM IV) are subjective. (See addendum 1) ¹ The most common behaviors fall into three categories: inattention, hyperactivity and impulsive behavior. Children or adults with ADHD may be unable to sit still, plan ahead, finish tasks, or be fully aware of what's going on around them. The disorder has a significant effect on a person's relationships with others, as well as disrupt daily life, consume energy and diminish self-esteem¹.

In 1961, the Food and Drug Administration (FDA) approved Ritalin (methylphenidate hydrochloride) for use in children with behavior problems. In 1975, an estimated 150,000 children in the United States were being prescribed Ritalin to reduce their hyperactivity. By the late 1980's, over 1 million American children used Ritalin on a regular basis. Since then the number has grown to more than 2 million children. The U.S. consumes 80-90% of the total Ritalin consumption in the world.⁴

Attention deficit hyperactivity disorder is one of the most common mental disorders among children. It affects 3 to 5 % of all children, with estimates of 2 million American children. Two to three times more boys than girls are affected.

The number of children on pharmacological agents to treat ADHD and the epidemic proportions of children with this diagnosis warrant a complete examination of this disorder. ⁵ While the use of Ritalin (methylphenidate) is a common treatment for ADHD, examining causative factors and alternative treatments bears investigation.

The purpose of this paper is to review the research on treatment protocols for ADHD.

F. Scope and limitations of Study

The study primarily focuses on articles whose subject matched key words in the literature search. Other key words were searched, but limited information was found initially on treatments such as acupuncture, herbs, and biofeedback . Homeopathic treatments seemed to bring up numerous choices, with none researched in depth, and therefore not included in this review. Some personal interviews were conducted to bring further understanding to the topic, as well as several textbooks.

Materials and Methods

A. The Literature Search

The treatments summarized here to not exhaust all treatment methods, but are those for which key words could be found. A literature search was conducted, using key words listed below. Pub Med , ChiroACCESS, and EbscoHost databases. Initially the search was conducted from 1995 to present, but was later extended to 1990 to present, as well as some “classic” foundational research. Key words used were:

Attention Deficit AND

Nutrition

Food Sensitivities

Minerals

Food Allergies

Essential Fatty Acids

Chiropractic Adjustments

Neural Reprogramming

Spinal Manipulations

Neuro-Developmental Delay

Additionally, informal contacts with people knowledgeable in treatments for ADHD have been utilized to provide additional references.

B. Selection Strategy

Research including case studies and clinical trials were included in the selection strategy. Literature review articles were eliminated from selection. While the search was mostly for current literature, several classic studies provided groundwork for additional testing and were included.

C. Description of Literature Reviews

Chiropractic Adjustments

In a case study by Phillips⁶, spinal manipulation appeared to be effective in reducing the frequency of ear infections, allergic reactions and headaches, but ineffective at decreasing the severity of ADHD symptoms. When craniosacral therapy was added, a reduction of the ADHD symptomatology was noted.

A case study published by Liesman⁷, results were promising after as little as nine chiropractic adjustments for ADHD behavior. The case involved a 15 year old male with a medical diagnosis of severe ADHD. Examination demonstrated a right low occiput and several areas of subluxation. Hair analysis revealed elevated aluminum (64 ppm) and magnesium was elevated. Treatments included drop-table adjusting and percussion instrument, as well as nutritional supplements of malic acid, magnesium and L-glutathione. The paper was authored in the seventh week of treatment, but was showing marked behavioral and attitude changes

Giesen's study⁸, while not conclusive, suggests that chiropractic manipulation did provide behavioral improvements in five of seven children tested ($p=0.009$). Data collection included parental ratings of activity, motion recorder, electrodermal tests measured autonomic nervous system activity, and X-rays of spinal distortions. Initial chiropractic screening revealed significant subjective, structural, orthopedic and radiologic findings in all but two of the children. Treatments were 3 visits per week for a treatment period of two weeks and during this time, the children were not medicated for ADHD. The study was a single subject research design. Five of the seven participants (71.4%) showed a reduction in overt behavioral activity, as measured by an actometer. Four of the seven (57%) showed improvement in level of autonomic activity, as measured by skin conductance level. Four of the seven (57%) also showed improvement in parental ratings of hyperactivity.

EEG and CEEG (computerized electroencephalography) studies were performed before and after chiropractic adjustments in children with ADHD by Hospers⁹. Upper cervical adjusting reduced non-coherence between right and left hemispheres, as well as increased attention span and improvement of social behavior. This small case study of five subjects warrants further research in this area.

A case study by Barnes¹⁰ included an 11 year old male diagnosed with ADHD. His history includes repeated ear infections, consistent temporomandibular joint dysfunction, heavy metal intoxication, food allergy, environmental sensitivity and multiple levels of structural subluxations. Trace mineral analysis showed low levels of magnesium, selenium and zinc, as well as a copper/zinc imbalance. The patient had a

diminished cervical curve, atlas rotation and a leg deficiency. Primary chiropractic adjustments have been in the upper cervical region with a frequency of twice per week. In a three year case study, the subject has made academic improvements, with teacher and parental assessments on attention span and temper.

Nutritional Supplementation

A 4 month study on docosahexaenoic acid (DHA) supplementation and the effect on the symptoms of ADHD utilized 63 children¹¹. The study concluded that DHA supplementation does not decrease symptoms of ADHD. In this double-blind randomized study, all the participants were using stimulant medication while the study was occurring, and all the participants have low levels of plasma phospholipid contents of DHA. Changes in ADHD symptoms were assessed by the Test of Variables of Attention (TOVA) and the Children's Color Trails test. The Child Behavior Checklist (CBCL) and the Conners' Rating Scales were also used.

Yet another study¹² on the effectiveness of essential fatty acids indicate that ADHD symptoms were significantly lower in the treatment group. This 12 week study was a randomized double-blind placebo-controlled study using both omega 3 and omega 6 fatty acids. The participants received daily doses of EPA 186 mg, DHA 480 mg, alpha- linolenic acid 96 mg, vitamin E 60 IU, cis-linoleic acid 864 mg. The placebo group received olive oil. The study was conducted with 41 children aged eight to twelve years in age, and the measurements utilized the DSM Inattention, Hyperactive-Impulsive global scales, as well as the Conners' Parent Rating Scale. In this study, the use of highly unsaturated fatty acid supplementation was found to be significantly better

than placebo in reducing a wide range of ADHD-related symptoms in children with learning difficulties.

Zinc is a co-factor for neural metabolism and is necessary for fatty acid absorption and metabolism. It is also needed for the production of melatonin, which helps regulate dopamine function. As such, the relationship of zinc to essential fatty acids and amphetamine was examined by Arnold, et. al.¹³ Six - twelve year old boys had zinc assay on red cells, urine and hair and were categorized as adequate, borderline zinc or zinc deficient. Three treatment conditions included d-amphetamine, Efamol (320 mg gamma-linolenic acid) or placebo. Efamol had no effect on the subjects with adequate zinc nutrition, but was almost as effective as d-amphetamine in the subjects with borderline zinc nutrition. Essential fatty acids appear to benefit ADHD by improving or compensating for borderline zinc nutrition. It also appears that zinc nutrition may be important for treatment of ADHD even with pharmacological treatments.

Dykman¹⁴ reported on the effects of a glyconutritional (saccharides) and a phytonutritional product (flash-dried fruits and vegetables) on the symptoms of ADHD. Seventeen children were recruited from a parent support group. Five of the children were not on methylphenidate, but the remaining twelve children were. The glyconutritional supplement was given for six weeks, and the phytonutritional supplement was added to the diet after three weeks. The glyconutritional supplement decreased the number and severity of ADHD symptoms, while the phytonutritional supplement provided little reduction of symptoms.

Magnesium has been shown to create neurological problems when deficient. Koziolec and Starobrat-Hermelin¹⁵ examined hair, red cell and serum magnesium of 116 children with ADHD and found 95% deficient in magnesium. Seventy-five children were then given 6 months of magnesium supplementation (200 mg/day). The supplementation group significantly decreased their Conners parent and teacher ratings compared to the control group.

Nutrition/Diet

Feingold¹⁶ hypothesized that ADHD, as well as other learning disabilities could be eliminated or reduced by eliminating certain substances from the diet, such as food colorings, preservatives, and salicylates. In 1973, Feingold proposed a diet to remove allergy provoking foods and food additives from the diet. Much research has been done on his diet, including the NIH, and research indicates it has a positive effect on some children.

Crook¹⁷ hypothesized that repeated antibiotic use (primarily for otitis media) alters intestinal flora and allows yeast overgrowth. This creates what is known as “leaky gut syndrome” and allows absorption of food antigens. Further literature review in this subject is warranted. Some of the original work in questioning the role of sugar in the diet was examined by Wolraich¹⁸, et al with the conclusion that neither sucrose nor aspartame is a major cause of hyperactivity. Studies on behavior and diet have typically had limitations in the length of time (1-2 hours) or a limited amount of sucrose being tested. The Wolraich study looked at behavior in school-age and preschool children on diets high in sucrose, aspartame or saccharin and evaluated a wide range of

behavioral measure and cognitive tests. The children were placed on diets in which all sweeteners were replaced with the above three being evaluated.

Jones¹⁹ found that sucrose ingestion may cause up to a ten-fold increase in epinephrine levels in children, resulting in difficulty concentrating, irritability and anxiety.

A study done by Boris²⁰ evaluated 26 children meeting the criteria for ADHD. All subjects completed a 2 week open elimination diet to identify whether foods or artificial ingredients caused behavioral reaction. Eliminated foods consisted of dairy products, wheat, corn, yeast, soy, citrus, egg, chocolate, and peanuts. All artificial colors and preservative were prohibited. All of the children reacted to three or more items. At the conclusion of the 2 week elimination diet, nineteen of 26 children or 73% showed improvement on this diet (parents completing a Conners' Parent Rating Scale⁴⁸ form). Of the nineteen that responded well in the elimination diet, it was noted that 79% (15 of 19) were atopic, (history of asthma, eczema, seasonal rhinitis, urticaria, or perennial rhinitis). In the seven who did not respond to the elimination diet, five were nonatopic. Atopic subjects were more likely to respond to the elimination diet. The difference of behavior between the placebo and the elimination diet was substantial with behavior difference as measured by the Conners' hyperactivity index.

Medication Management

A study referred to as "The Multimodel Treatment Study of Children with ADHD" (MTA) was published in the Archives of General Psychiatry²¹. It is considered the largest treatment study of ADHD ever conducted. 579 children ages 7 to 9.9 diagnosed with ADHD. The study randomly assigned participants into 1 of 4 treatments;

medication management (methylphenidate), behavioral (parent training, child-focused treatment and a school-based intervention), combined treatment, and community care (parents were provided a list of community mental health resources and made their own treatment arrangements). Outcomes that were assessed were: ADHD symptoms, aggressive and oppositional behavior, internalizing symptoms, social skills, and parent-child relations. Results from this indicated that medication management alone was superior to behavioral treatment alone. Combined treatment and medication management treatment did not differ significantly. It is interesting to note that the acceptance /compliance rate for the medication management treatment was higher (78% completed treatment as intended) and behavioral treatment (63% complied with treatment as intended).

A 1995 study on the long-term effects of methylphenidate hydrochloride (Ritalin) was performed on rats and mice²². Methylphenidate hydrochloride was administered for 2 years at doses of 0, 100, 500, and 1000 ppm in the feed. An increase in benign tumors of the liver and increased liver weights were observed in male and female mice at the high doses. An increase in hepatoblastomas was also seen in high dose male mice. It was not found to be mutagenic in the Salmonella assay test. Increased incidences of neoplasm were not seen in rates. There was a notable decrease in mammary gland fibroadenomas in female rats.

Movement/Reflexes

Various perceptual motor programs have been developed over the years to alleviate learning disabilities or to enhance performance through movement patterning. One of these is Brain Gym® from Educational Kinesiology developed by Paul Dennison.

Simple body movements are designed to integrate the hemispheres of the brain, access parts of the brain previously inaccessible, and enhance performance.

A study examining neural repatterning movements and the effect on response times by Siff and Khalsa was done utilizing work by Dennison.²¹ Ten men and two women were randomly assigned to each of 3 conditions, control, a series of movements (midline, ocular focusing, and postural positioning) or repatterned (the above movements preceded by homolateral and contralateral arm and leg movements). Each participant was pretested on simple choice response-time tasks. Statistical analyses indicated significant difference in improvement between the groups on the 4-choice task with the repatterned group showing greater change than the movement only.

Primitive reflexes normally disappear within the first 6 to 12 months of life in an infant. Any remaining beyond this point are said to be aberrant and are evidence of a structural weakness or immaturity within the central nervous system. A term referred to as neuro-developmental delay (NDD) is used to describe when a child exhibits a cluster of aberrant reflexes. It is felt that this poor organization of nerve fibers can effect areas of functioning, including gross and fine muscle coordination, sensory perception, and cognition. The organization INPP²⁴ has pioneered research into neuro-developmental delay (NDD). INPP creates and administers programs for NDD related conditions such as dyslexia, dyspraxia and attention.

In Reflexes, Learning and Behavior,²⁵ Goddard delves further into neural reprogramming. Primitive reflexes including Moro, Spinal Galant, Asymmetrical Tonic Neck, appear to be linked to hyperactivity, mood swings, behavioral outbursts, and

learning difficulties. The books outlines tests to determine if the primitive reflex is still present, rating for the severity of the reflex, and some remediation techniques. The treatments include a reflex stimulation/inhibition program which allows the brain the experience the movements that should have been made in early months of development. The premise is that it creates a bridge and facilitates more efficient transmission and execution of message between the brain and the body. Much of the research done in this area looks at reading or writing abilities. McPhillips assessed a primary reflex intervention program on the effects of reading and reported significant decrease in the level of reflexes and improved reading ability using the Neale analysis.²⁶

A double-blind, placebo controlled study of 9 - 12 year old boys diagnosed with ADHD found those undergoing the Interactive Metronome training program showed significant pattern of improvement in attention, coordination, control of aggression/impulsivity, reading and language processing²⁷. Interactive Metronome®^{28, 29} uses head phones along with hand and foot sensors to coordinate movements to computer-generated musical beats. The auditory feedback system progressively challenges participants to improve their motor planning, sequencing, timing and concentration.

General Research

Performing SPECT scans since 1990 on ADD patients has provided Amen the background for Healing ADD.³⁰ Based on alterations in SPECT images, Amen concludes that there are six distinct types of ADD and their treatments are distinctly different also. He found decreased activity in SPECT imaging in the prefrontal cortex during concentration of “classic” ADD patients. His recommendations for treatment

are Adderal, or L. tyrosine, a low carbohydrate diet, and regular exercise. Conversely Amen found the “over-focused” ADD patient has overactivity in the anterior cingulate gyrus during concentration on SPECT imaging. He found that Ritalin made these patient more aggressive, but St. John’s Wort, Risperdal (an anti-psychotic), Tryptophan, 5-HTP and Inositol are recommended. See addendum 2 for more details on the six categories and treatments.

Discussion

The current research literature is showing promising results for non-pharmaceutical approaches to treating ADHD, and better understanding of mechanism, causal factors and co-morbidity relationships in ADHD.

The literature examining chiropractic spinal adjustments and behavioral symptoms of ADHD is quite limited but the research available does show measurable behavioral and symptomatology changes.

Nutritional studies are quite extensive. There are conflicting results reported in the studies by Voight and Richardson. Voight concluded that supplementation with docosahexanoic acid (DHA) does not decrease symptoms of ADHD, but all participants were using stimulant medication and were not separated or examined for levels of plasma phospholipid content. Richardson’s study was conducted for a longer period of time (12 weeks) and more carefully categorized children by the plasma phospholipid level. This study showed positive changes in ADHD symptoms.

The Arnold study opens up the question of essential fatty acid deficiency alone or the combination of that and zinc nutrition. Essential fatty acid supplementation alone has little effect when the subjects had adequate zinc nutrition, but had marked effects when the subjects had deficiencies or marginal zinc levels. Essential fatty acids appears to be beneficial even with stimulant treatment. This research examines the more challenging interdependencies of zinc nutrition and essential fatty acid levels.

Examining the role of magnesium also appears to have significant reduction in behavioral symptoms. Six months of magnesium supplementation at 200 mg per day showed statistically significant results in children with magnesium deficiencies.

Food and it's relationship to ADHD has been examined in numerous studies. The Feingold diet has been shown to reduce symptomatology in some children with ADHD. Crook's work examines causal relationships for food interactions in children with ADHD. He hypothesizes the link between the incidence of otitis media, candida overgrowth, excessive usage of antibiotics and behavioral symptoms in ADHD.

The Wolraich study concluded that neither sugar nor artificial sweeteners are a cause of hyperactivity, contrast with the results of Jones work showing that sugar ingestion can cause up to a ten-fold increase in epinephrine levels in children. The implications of this work show the significance of the delayed immune response and recognizing the time parameters as well as utilizing measurable physiological changes rather than immediate behavioral measures.

Building on the Feingold work, Boris found substantial positive behavior differences with a multiple item elimination diet. Most studies on food or food additives have used single item challenges, with failure to demonstrate decreased hyperactivity. Boris found most children reacted to a minimum of 3 foods and when tested this way, produced a greater effect. He found a link to atopic symptoms as well, and the results indicate that atopic children with ADHD had a significantly more beneficial response to the elimination diet than nonatopic children.

Research in neural reprogramming has been examined and has been found to have positive effects on the symptomatology of ADHD. This work may benefit those children that have overlapping symptomatology such as learning disabilities and gross motor developmental delays.

Conclusions

Further research into the inter-dependencies of these variables should be examined. While all non-compliant behavior appears to be diagnosed as “Attention -Deficit Disorder”, there appears to be subcategories as proposed by Amen and certainly overlapping categories with autism, learning disabilities, fine and gross motor disabilities.

Research in which these categories can be identified, separated and then tested with diet, magnesium, zinc or essential fatty acid supplementation, neural re-programming, herbal and pharmaceutical supplementation is warranted.

Addendum One

Attention Deficit Hyperactivity Disorder

A. Inattention: Six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

- a) often fails to give close attention to details or makes careless mistakes in schoolwork, work or other activities
- b) often has difficulty sustaining attention in tasks or play activities
- c) often does not seem to listen when spoken to directly
- d) 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)
- e) often has difficulty organizing tasks and activities
- f) often avoids, dislikes or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)
- g) often loses things necessary for tasks or activities (e.g. toys, school assignments, pencils, books or tools)
- h) is often easily distracted by extraneous stimuli
- i) is often forgetful in daily activities

B) Hyperactivity/Impulsivity Six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

- a) often fidgets with hands or feet or squirms in seat
- b) often leaves seat in classroom or in other situations in which remaining in seat is expected
- c) often runs about or climbs excessively in situation which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)
- d) often has difficulty playing or engaging in leisure activities quietly
- e) is often "on the go" or often acts as if "driven by a motor"
- f) often talks excessively
- g) often blurts out answers before questions have been completed
- h) often has difficulty awaiting turn
- i) often interrupts or intrudes on others (e.g. butts into conversations or games)

C). Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years.

D) Some impairment from the symptoms is present in two or more settings (e.g., school or work and at home)

E) There must be clear evidence of clinically significant impairment in social, academic or occupational function.

F) The symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia or other Psychotic Disorder and are not better accounted for by another mental disorder (e.g., Mood Disorder, Anxiety Disorder, Dissociative Disorder or a Personality Disorder).

Addendum Two

Treatment Summary from Healing ADD ³⁰

ADD Type	Type 1 Classic ADD Inattentive, distractible, disorganized, hyperactive, restless and impulsive	Type 2 Inattentive ADD distracted with low attention span, no hyperactivity, sluggish or apathetic	Type 3 Overfocused ADD excessive worrying, argumentative and compulsive; often gets locked in a spiral of negative thoughts
Diet	higher protein, lower carbohydrate	higher protein, lower carbohydrate	lower protein, lower carbohydrate
Exercise	intense aerobic	intense aerobic	intense aerobic
Herbs, supplements	L-tyrosine	L-tyrosine	St. John's Wort, 5-HTP, L-tyrosine, Inositol
Medications	stimulants such as Adderal, Ritalin, Dexedrine and Cyclert	stimulants such as Adderall, Ritalin, Dexedrine, and Cyclert	serotonin-enhancing meds such as Effexor, Zoloft, Paxil, Prozac, or Luxox

ADD Type	Type 4 Temporal ADD Quick temper and rage, periods of panic and fear, mildly paranoid	Type 5 Limbic ADD moodiness low energy, socially isolated, chronic low-grade depression, frequent feelings of hopelessness	Type 6 Ring of Fire ADD angry, aggressive, sensitive to noise, light, clothes and touch; often inflexible, experiencing periods of mean, unpredictable behavior and grandiose thinking
Diet	higher protein, lower carbohydrate	higher protein, lower carbohydrate	higher protein, lower carbohydrate
Exercise	intense aerobic	intense aerobic	intense aerobic
Supplements	GABA, ginkgo biloba, phosphatidyl serine, vitamin E, Piracetam	DL-phenylalanine, L- tyrosine, SAME	GABA, omega-3 fatty acids
Medication	anticonvulsants such as Depakote, Carbatrol, Topamax, Gabatril, Lamictal, Dilantin	stimulating antidepressants (Norpramin, Wellbutrin)	anticonvulsants listed for type 4 or Antipsychotic Risperdal or Zyprexa

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