

**THE NUTRITIONAL MANAGEMENT OF
ATTENTION DEFICIT DISORDER,
ATTENTION DEFICIT/ HYPERACTIVITY
DISORDER, AND HYPERACTIVITY**

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ABSTRACT:

The objective of this literature review was to assess the current knowledge on the nutritional management of attention deficit disorder, attention deficit/ hyperactivity disorder, and hyperactivity. This topic was deemed important because of the ever-increasing focus that is being placed on treatment alternatives to prescription medication.

The role of nutrition on behavior is still controversial. As with any treatment of a disease state, the same protocol will not work for each patient. In this realm, the treatment of ADHD, ADD, and Hyperactivity seems to be at the extreme end of the scale. The studies reviewed demonstrate the vast difference in results within the analyzed populations of children. There is a possibility that the varied results that are seen throughout the research are due to the presence of a variety of sub-groups of ADHD that have yet to be identified. When dealing with behavioral science, it can be difficult to isolate the nutrition effect from the placebo effect. Although there appear to be some commonalties that stand out when the research has been sifted; virtually all studies demonstrate that some hyperactive children consistently react with behavioral problems when challenged by specific food additives.

The role of food allergies and sensitivities appears to become one of the prime areas in need of further exploration in the field of ADHD research. The K-P Diet remains controversial but is less so when it is viewed as an alternative that may be beneficial for some types of ADHD, but not as a treatment for all children with ADHD. It appears to be more effective for younger children. The effects of sugar also appear to

be more in the realm of food sensitivity in some individuals, than a specific and consistent hyperactivity causative factor. The elimination of tartrazine and sodium benzoate may also be beneficial.

A 1-2 month elimination diet may be helpful to eliminate the effects of food allergies and sensitivities but should be monitored to ensure adequate carbohydrate and total nutrient intake. It may be beneficial to eliminate those foods and substances with artificial flavoring, artificial coloring and salicylates. While on this diet it may be wise to monitor vitamin C consumption to ensure adequate levels are present. Additional supplementation with the following substances may be helpful: niacin, thiamine, B6, choline, deanol, magnesium, and calcium. Whether the treatment is prescription medication or conservative means, we still don't know why each method works because it comes back to not fully understanding what causes ADHD. The best approach to effective treatment and management of ADHD appears to start with an accurate diagnosis to rule out other disease states or lack of any disease state, including ADHD. Once this has been accomplished a multi-modal approach appears to be most effective. This could include: food allergy and sensitivity assessment, dietary modification, nutritional supplementation, remedial teaching, family counseling, increased physical activity, and neurological and psychiatric treatment.

CHAPTER I- INTRODUCTION:

The role of nutrition in brain function and behavior has become an increasingly important focus of research in the past two decades.(1) This area is as complex as the brain itself and much is still not understood about the complex interactions that occur between food, brain function, and behavior.(1) The condition of Attention Deficit Hyperactivity Disorder(ADHD) is one of the more controversial conditions that have been studied in this area. ADHD continues to receive extensive media coverage as an ever-increasing amount of children are being diagnosed with this condition, and parents look for alternatives to conventional treatment. Many believe that this condition is frequently over-diagnosed and inappropriately managed through conventional therapies.(2) It is projected that there are currently over 2 million children taking the prescription medication, Ritalin.(3)

The role of nutrition in the treatment of Attention Deficit Disorder (ADD), Attention Deficit/ Hyperactivity Disorder (ADHD), and Hyperactivity is as complicated and controversial as might be expected with the combination of two high-profile fields- nutrition and behavioral medicine. The ever-developing body of knowledge in the nutrition field, combined with the current controversy over prescription medication treatment, and the constant search to understand how these affect behavioral hyperactivity in children, leads to a great variety of anecdotes, opinions, extensive research, and much emotion.

This paper will focus on the nutritional factors that may be incorporated or eliminated, in combination with other treatments, to affect a change upon the manifestation of symptoms in the child. A systematic review of the literature on nutritional treatment of ADD, ADHD and Hyperactivity was completed on MEDLINE from 1976 to 2000 using the medical subject headings "nutrition" and "treatment" and "children" and "hyperactivity" and "add". The literature search produced 51 reference articles. The citations were manually searched by title and abstract to find those articles that met the selection criteria.

Upon initial review of article abstracts it was determined that 28 were deemed appropriate for the subject matter. The criteria were: articles that addressed the nutritional management of ADD, ADHD, and Hyperactivity. Incorporated were articles from multiple perspectives and populations in order to provide a wide array of viewpoints and reference points, since the nutritional management of disease can be challenging to qualify and quantify. In addition, textbooks that are utilized as physician resources for nutritional management of disease were also incorporated to provide additional background for this paper

CHAPTER II- REVIEW OF LITERATURE:

It has been estimated that between 4%-12% of school-age children in the US suffer from ADHD, although more conservative diagnostic criteria have lowered this number to around 3%.(3) It is also estimated that one out of every five children has some type of behavioral problem.(4) Diagnosing the condition effectively is the first step in approaching the search for a viable treatment.

The symptoms of hyperactivity would appear to be straightforward and relatively obvious. But, the symptoms can include: inattentiveness, distractibility, poor tolerance of frustration, temper tantrums, impulsiveness and liability of mood, anxiety, aggression, cognitive dysfunction, and learning problems.(5) Also included can be: developmentally inappropriate activity levels, poor organization of behavior, and inability to sustain concentration.(6)

The treatment of a disease is often based on a thorough understanding of the causation of the manifesting symptoms. There is an ongoing debate over the myriad of theories on the etiology of ADHD, ADD, and Hyperactivity. The proposed causative factors include: hypersensitivity, allergy, behavioral factors, psychological factors, neurotransmitter dysfunction, genetic factors, perinatal factors, and gender predisposition. (7) In addition, hyperactivity has been theorized to occur from complications during pregnancy, brain damage, smoking during pregnancy, a biochemical basis related to the cerebral neurotransmitters (dopamine and noradrenalin), environmental pollutants such as

lead, exposure to fluorescent lights, minor physical abnormalities, and parental behavior.(5) The actual cause could be a single factor or a combination of factors, and be different for individual child. Typically the etiology of a disease will allow researchers valuable insight into the most effective treatment of a disease. The difficulty here is that these theories are very diverse and none has yet been conclusively shown to be a consistent factor.

The criteria that are utilized for ADHD diagnosis include the following:

A. (Can be either 1 or 2)

1. Inattention

At least six of the following symptoms of inattention have persisted for at least six months to a degree that is maladaptive and inconsistent with the development of the child.

- a. often fails to give close attention to details or makes careless mistakes in school work or other activities
- b. often has difficulty sustaining attention in tasks and play activities
- c. often does not seem to listen to what is being said to him or her
- d. often does not follow through on instructions and fails to finish school work, chores, or duties in the work place (not due to opposition behavior or failure to understand instructions)
- e. often loses things necessary for tasks or activities (for example: school assignments, pencils, books, toys, or tools)
- f. is often easily distracted by extraneous stimuli

- g. is often forgetful in daily activities
- h. often avoids or strongly dislikes tasks such as school work or homework that require sustained mental effort
- i. often has difficulties organizing tasks and activities

2. Hyperactivity and Impulsivity

At least four of the following symptoms of hyperactivity have persisted for at least six months to a degree that is maladaptive and inconsistent with the development level of the child:

- a. often fidgets with hands and feet or squirms in seat
 - b. leaves seat in classroom or in other situations where remaining seated is expected
 - c. often runs about or climbs excessively in situations where it is inappropriate in adolescents or adults
 - d. often has difficulty quietly playing or engaging in leisure activities
 - e. blurts out answers to questions before question is completed
 - f. often has difficulty waiting in lines or waiting turn in games or group situations
- B. Onset is no later than 7 years of age
- C. Symptoms must be present in two or more situations (for example: at school, at work, at home).
- D. The disturbance causes clinically significant distress or impairment in social, academic, or occupational functioning.

E. Does not occur exclusively during the course of a pervasive developmental disorder, schizophrenia, or other psychotic disorder and is not better accounted for by a mood disorder, anxiety disorder, dissociative disorder or personality disorder (in other words, the symptoms are not due to another disorder besides ADD or ADHD).

- ADD/ hyperactivity disorder is predominately the inattentive type if criterion A(1) is met but not criterion A(2) for the past 6 months.
- ADD/ hyperactivity disorder is predominantly the hyperactive-impulsive type if criterion A(2) is met but not criterion A(1) for the past 6 months.
- ADD/ hyperactivity disorder is the combined type if both criteria A(1) and A(2) are met for the past 6 months.(4)

The typical age range for referral of a child for assessment is between the ages of 8 and 10.(8) A qualified physician is required to make the diagnosis. These physicians need to ensure the diagnosis is accomplished only via evaluations conducted over two to three visits.(9) Areas to extract information on are: family dynamics, parental expectations, and the school environment.(2) The parents should be carefully screened to ensure they have not already "diagnosed" the child with an attempt to obtain a prescription for stimulants.(2) A complete physical exam, including neurological exam, is in order; as well as a full evaluation of the child's learning capabilities.(2)

Infants that don't like to be held, have poor or irregular sleep, have colic or feeding problems seem to have a higher incidence of hyperactivity.(5) Interestingly, one of the few consistent findings is that the children with ADHD do not appear to be more easily distracted than non-hyperactive children.(8) Some researchers believe there are two sub-types of ADHD: those who present with aggressive symptomology and those whose symptoms are primarily attentional in nature.(8) Some believe the children will just grow out of it, but this theory has failed to be supported.(8)

Between 25-60% of these individuals will drop out of school before high school graduation; the same percentage will have contact with legal authorities; excessive alcohol use will probably be higher; self esteem will probably be lower and interpersonal relationships will probably be more strained.(8) A primary concern is that it appears the interpersonal aggressiveness characteristic is a strong predictor of long-term poor social outcome, when contrasted to other symptoms.(8)

The science of behavioral toxicology is a very difficult science. (10) The inherent challenge when studying the effects of diet is that it can be hard to isolate the nutritional effect from the placebo effect. Another challenge is the difficulty in completely extricating psychotropic agents from the diet. These may include: soft drinks, tea and coffee, all of which usually contain caffeine.(10) Lead has been reported to be a causative factor of hyperactivity, although research performed on rats by Krehbiel showed no demonstrable effect.(11)

Traditional medical treatment centers around a combination of drugs and psychotherapy.(5) The medications include drugs such as: amphetamine, magnesium pemoline (Cylert), and methyl phenidate (Ritalin).(5) Typically only two-thirds of the children with hyperactivity will respond to this medication regimen.(5) Also utilized are tricyclic antidepressants such as amitriptyline hydrochloride (Elavel) and imipramine hydrochloride (Tofranil) which appear to act by potentiating catecholamine transmission.(5) The effect of these medications wears off and the child's behavior immediately returns to the pre-medication baseline within 3-8 hours of ingestion,(depending on the type of medication, dosage, and the individual child).(8) A typical concern is that the children will develop into young adults that feel they need to take a pill to feel normal?(2)

There is danger in utilizing these forms of therapy as the sole modality of treatment.(2) Recent evidence points toward a possible suppression of growth in children treated with stimulants, although a "catch-up" period appears to occur during drug-free periods.(2)(6) Because of this, there is a recommendation of "drug vacations" throughout the course of therapy.(2) These medications do not "cure" hyperactivity, but merely alleviate the primary symptomatology as long as it is exerting a pharmacological effect.(8)

Many types of conservative methods have been implemented in the treatment of ADHD including: megavitamins, caffeine, elimination of fluorescent lighting in the

classroom, and amelioration of allergies.(7) Much of the research in the area of treatment of hyperactivity occurred in the 1970's after Dr. Benjamin Feingold proposed his theory on nutritional management of ADD with hyperactivity. Dr. Feingold of the Kaiser-Permanente Medical Center in San Francisco noted that 30-50 percent of hyperactive children showed significant improvement in behavior when placed on a special elimination diet.(5) This diet is often referred to as the "Feingold Diet", the "Kaiser-Permanente Diet" or the "K-P Diet".(5) Dr. Feingold performed his research between 1972 and 1974 on 194 children with hyperkinesis and learning disabilities.(12) This diet was very controversial at the time it was introduced in his 1975 book: "Why is Your Child Hyperactive?". His theories still remain controversial today. Many conflicting studies were performed based on Dr. Feingold's ideas. The food industry was very concerned, as well as the parents that looked at the food industry as a possible cause of their children's symptoms.(5)

The Feingold (K-P) Diet was designed to eliminate the following foods:

Cereals and grain products: all breakfast cereals with artificial colors or flavors: all cakes, cookies, pastries, sweet rolls, donuts, breads, etc., with artificial flavors or colors (i.e. from the bakery); manufactured pie crusts; frozen baked mixes; prepared poultry stuffing.

Fruits: almonds; apricots; berries- blackberries, blueberries, boysenberries, gooseberries, raspberries, strawberries, cherries, currants- grapes and raisins or any products made of grapes (e.g. wine, wine vinegar, jellies); nectarines; oranges; peaches.

Vegetables: tomatoes and all tomato products; cucumbers (pickles)

Protein sources: meats, bologna, luncheon meats, salami, frankfurters, sausage, meat loaf, ham, bacon, pork, all barbecued types of chicken, all turkey prepared with basting (called "self-basting"). Frozen fish fillets that are dyed or flavored.

Dairy products: Manufactured ice-cream or ice-milk products unless label specifies no synthetic coloring or flavoring; colored cheese (i.e. processed, or yellow, or orange); all instant breakfast drinks and preparations, flavored yogurt; prepared chocolate milk; colored butter.

Beverages: cider; wine; beer; diet drinks; tea, hot or cold; all carbonated beverages except 7-UP.

Miscellaneous: sherbets, ices, gelatins, puddings with artificial flavor or coloring; powdered pudding, Jell-O, drink mixes; all dessert mixes; all manufactured candy- hard or soft; oleomargarine; prepared mustard; all mint-flavored and wintergreen-flavored items; gum; oil of wintergreen; cloves; jams or jellies made with artificial colors or

flavors and fruits not allowed; soy sauce, if flavored or colored; cider vinegar; wine vinegar; commercial chocolate syrup; barbecue flavored potato chips; catsup; chili sauce.

Sundry items: aspirin, bufferin, excedrin, alka-seltzer, empirin compound, anacin; vitamins; all toothpaste and toothpowder, all mouthwashes; all cough drops; all throat lozenges; antacid tablets; perfumes.(5)

The list is quite comprehensive and can be difficult to follow, simply by trying to exclude such a wide diversity of products from a typical diet. This program is designed to eliminate foods containing synthetic food coloring, synthetic flavors, and naturally occurring salicylates.(7) Dr. Feingold points to the increasing addition of these substances to our food supply being correlated with the increasing incidence of ADHD.(7) When controlled studies were performed it appears that this diet does not have the dramatic effect many may hoped it would. Many parents may be attracted to this type of therapy because of the relative ease of implementation; but, this combined with a positive expectation may increase the possibility of the placebo effect.(7)(10) The role of diet appears to often effect a partial change versus the all or nothing response.(13) It appears that whole food allergens can cause a reaction as often as artificial food coloring.(13)

In a study conducted in New Zealand (1978) to asses the effects of the therapies suggested in the Feingold Diet, it was determined that some children can benefit dramatically from dietary modification.(14) The study was limited in that there were

only ten children included. The dietary modification included removal of all artificially colored and artificially flavored foods including: commercial baked products containing artificial colors and flavors, luncheon meats, sausage, commercially smoked fish, poultry processed by fast food chains, margarine, flavored cheese, flavored yogurt, artificially flavored and colored breakfast cereals and pasta products, commercial packet puddings, ice cream, manufactured confectionery, cordials, soft drinks, instant drinks, alcoholic beverages, artificial essences and flavoring, commercial sauces, soups and stock.(14) Also excluded were the use of highly perfumed toiletries such as shampoo, talcum powder, perfume, toothpaste, aerosol sprays, aspirin and colored medication.(14)

There are also foods that are high in natural salicylates and were initially eliminated. They include: almonds, apples, apricots, berry fruits, capsicum, cucumber, grapes, grape products, kiwi fruits, melons, nectarines, oranges, passionfruit, peaches, plums, prunes, tamarilloes, tomatoes, and tomato products; with a cautious use of grapefruit, lemons and limes.(14) Vitamin C supplementation was not recommended unless there was an intake below 40mg per day, since high intake levels can reduce renal clearance of salicylates.(14)

The response by the children varied greatly, with five of the most hyperkinetic children showing well established and maintained improvement.(14) All of these five children were able to discontinue their medication utilization by the third week without any relapse.(14) This is typical of many dietary interventions. The results can vary

widely in both absolute effectiveness and degree of effectiveness. The remaining children had either some benefit or no apparent benefit from the dietary modification.

An interesting component of the study was that the children that had improved were then challenged with samples of the offending foods. All five children developed symptoms including: hyperkinesia, aggression, tantrums, screaming spells, disobedience, depression and sleeplessness.(14) These symptoms occurred within two to three hours and lasted from three to twenty-four hours after the challenge.(14) The two children who demonstrated no benefit from the dietary modification also showed no exacerbation of symptoms when challenged by the food.(14)

These authors note that the management of hyperkinetic children by either drug therapy or behavioral modification hasn't been uniformly successful either.(14) In concluding the research the authors also note that the five children that responded were off all other therapy and doing well.(14) An interesting side-note was the caution of supplementing Vitamin C over 40 mg per day since it appears to diminish the renal clearance of salicylates in higher doses. (14) Unfortunately, the small sample size of this study doesn't allow the authors to project the results to the larger population to determine what percentage of the diagnosed population may benefit from this therapy.

Two studies conducted by Egger involved placing severely hyperactive children on an oligoantigenic diet.(3) In the first study, the diet consisted of lamb, chicken, potatoes, rice, banana, apple, brassica family vegetable, calcium gluconate at 3g/day, and

a multiple vitamin. Out of 76 children, 62 improved and 21 achieved a normal range of behavior.(3) In a second study by Egger, 185 children with hyperkinetic syndrome were placed on a oligoantigenic diet consisting of two meats(lamb and chicken), two carbohydrates(potatoes and rice), two fruits(bananas and pears), vegetables(cabbage, sprouts, broccoli, cucumber, cauliflower, celery, and carrots), supplements(calcium, magnesium, zinc, and some basic vitamins), and water. Behavior improved in 116 of these children.(3) There is a relationship between brain function and nutrition and between brain function and allergic reactions, although it still does not seem to be well understood.(15)

One of the most irritating substances seems to be the artificial dye tartrazine. This is the chemical constituent of the most commonly used yellow dye. (16) The issue with tartrazine is not one of food allergy, but one of food sensitivity. In this discussion the author also suggests the elimination of salicylate products such as oil of wintergreen.(16) The food allergy response is characterized as immediate and the signs and symptoms are atopic regardless of the type of allergen, with the reaction being IgE mediated and therefore antibodies to the offending food should be clearly demonstrated (such as in a positive skin test.)(16) There is a delayed type of allergic response involving atopic and gastrointestinal symptoms.(16) This response is generally thought to be lymphocyte mediated, although a specific mechanism has not been determined.(16)

The symptoms of food sensitivity, as compared to food allergies, are more variable and can include: only behavior, and vague complaints such as chronic aches,

pains, and fatigue.(16) The key point is that the reaction is thought to be not an allergic response, but a reaction to the chemicals contained in the foods. Possibly this is due to an inherited biochemical predisposition. A challenge is that in some children there appears to be an all-or-nothing response while in others there is a threshold response.(17) The effect of artificial food dyes on ADHD is primarily pharmacological, although the reaction could occur as a combination of both a pharmacological and immunological reaction.(18)

Wender makes the point that in most of the studies that refuted Feingold's theories, the food that was used as a challenge substance contained only artificial food colorings and not salicylates or artificial flavorings.(16) In a study of 51 school-age children and 10 preschool children, improvement was seen in the food-additive-free diet as compared to a control diet, but only when the additive free diet followed the control diet.(16) Other challenge studies of a total of 90 children demonstrated no behavioral changes in double-blinded trials.(16) An interesting finding was the occurrence of short-lived (one hour) symptoms of irritability and inattentiveness upon artificial food color challenging, although these symptoms did not appear to effect behavior or learning.(16) Although this author does not consider these symptoms to be part of the condition, these terms are utilized in other characterizations of hyperactivity.(5) The author concludes that the only effect appears to be the short term pharmacological effect with no long-term behavioral effects caused by food coloring alone.(16) The author states that he would recommend the Feingold diet to his patients because it is nutritious and will do no harm and possibly some good, even if it is due to the placebo effect.

In 1976 Salzman studied 31 patients with a failure to respond to behavior modification therapy and found that the K-P Diet had a positive response in 15 of 18 who had an allergic reaction to artificial colors.(5) A comprehensive study by Harley in 1978 assessed 36 hyperactive boys and 10 pre-school children with findings that the K-P Diet helped the pre-school boys but not the school-age children.(5) In 1978 Williams reported that there were mixed results with the utilization of the K-P Diet.(5) In 1978, Levy reported on a study of 22 children with clinically diagnosed hyperactivity. The children showed a 25 percent reduction in their symptoms as rated by their mothers.(5) The younger children seemed to respond better.(5)

In 1979, Tryphonas and Trites investigated the effect of allergies on behavior in 90 hyperactive children. It was determined that within the hyperactive group there was a significant association between the number of allergies and teacher's scores of hyperactivity.(5) A 1979 study by Kershner and Hawke concluded that a high protein-low carbohydrate diet would have a greater effect on behavior improvement than would vitamin supplementation.(5) It is possible that children under the age of 5 respond better to the K-P Diet and that these children may improve more on a diet lower in carbohydrates and higher in protein.(5) A 1979 single-subject reversal design study demonstrated a reduction of seizures while the child was on the K-P Diet, but no effect on reduction of hyperactivity.(19)

It is important to know whether the diet is effective; but more critically we need to know if it is safe for children. An Australian study of 22 children was designed and implemented to assess the possible adverse nutritional effects of a modified version of the Feingold Diet. Dumbrell reported that not only was the diet nutritionally sound, but that there was an overall improvement in the child's food intake when they were placed on the test diet.(20) One of the greatest benefits of the diet was that complex carbohydrate foods replaced more of the highly refined and less nutritious foods.(20) Another benefit the researchers found was that the modified Feingold Diet was much more balanced than the typical diet of these children.(20) One of the areas of concern is that the elimination of citrus fruits would lead to a vitamin C deficiency; although this was found to not be the case.(20) Amazingly, another Australian study determined that the low-salicylate diet reduced sore throats in children totally independent of their vitamin C consumption.(21)

The complexities in analyzing the effects of diet, while trying to factor in or out the effects of other substances in the diet, is a monumental task. This becomes a primary critique, both for and against research results. As an example, Rippere criticizes C. Keith Conners, a major detractor of the K-P Diet. Conners tested the K-P Diet and found it lacking.(18) Rippere's critique of Conners research includes the following points: active placebos (such as chocolate) were used while it was implied they were inert, the dosing of food dyes was inadequate to stimulate symptoms (effects of exposure are thought to be cumulative), a cytotoxic allergy test is not effective because the reactions are typically not allergy mediated, the rating system introduces selective bias due to the end of week timing, and Conners conclusions of the results are erroneous.(18)

A study done by Egger in England in 1985 involved placing 76 children on a well balanced but limited diet. There was a behavioral improvement in 82% of the subjects.(22) The students were also then challenged with foods that typically provoke symptoms. The symptoms occurred in 8% of the food challenges.(22) The foods that caused the greatest reactions were tartrazine(yellow dye #5) and sodium benzoate.(22)

Essential amino acids such as phenylalanine and tyrosine, and essential fatty acids such as evening primrose oil have not been shown to be beneficial in current research studies.(23) Caffeine apparently has some benefit by calming some children and causing improvements in general behavior and impulsivity.(23) The vitamin B complex appears to need more research on the baseline nutriture, but studies point toward benefit in increasing the levels of niacin(500-2,000 mg 3 times daily), thiamine(100 mg 4 times daily), and Vitamin B6(20 to 30 mg/kg/d if blood serotonin is low).(23) Abnormal levels of the neurotransmitter acetylcholine is thought to be a possible complicating factor.(23) Choline and Deanol(a salt of dimethylaminoethanol) have been supplemented with positive results.(23)

A 1998 study by Dykman utilized a glyconutritional supplement containing food-grade polysaccharides.(24) The authors decided to conduct this study based on the subjective improvement of ADHD symptoms of patients who were utilizing these supplements. The supplements contained: galactose, glucose, mannose, N-acetylneuraminic acid, fructose, N-acetylgalactosamine, N-acetylglucosamine, and

xylose. An additional phytonutritional supplement was added which contained lesser amounts of the above nutrients along with flash dried broccoli, Brussels sprouts, cabbage, carrot, cauliflower, garlic, kale, onion, papaya, pineapple, tomato, turnip, and aloe vera gel in a base of vegetable gelatin. Parents and teachers were asked to assess the behavior of the children.

The study was not done as a double-blind experiment- the parents knew of the medication, but the teachers did not. The manufacturer of the utilized supplements also subsidized the study. There was not a correlation between the teachers and the parent's ratings, although there was correlation within each group.(24) The groups were divided into three: one with no medication, another with full medication, and a third with a reduction in medication during the study. There was a reduction in symptoms in all three groups. The authors conclude that there was a significant reduction in the number and severity of ADHD symptoms.(24) This extrapolation of the data is a little extreme since there was no control group to help factor out the placebo effect. One can only wonder if a control group involved in the study and on medication would also have a reduction in symptoms. The authors stated the parents didn't want this, and the authors thought it was unethical until it was shown that the supplements had a beneficial effect.(24) Since it was yet to be demonstrated if the treatment was beneficial ,the authors would not have been withholding appropriate treatment. This study would have greatly credibility with the incorporation of a control group.

A study by Hanley in 1996 addressed one of the possible causative factors of ADHD- maternal phenylketonuria(MPKU).(25) The authors found that early and adequate nutritional intervention with a low phenylalanine diet might modify, and in some instances prevent, fetal phenylalanine embryopathology leading to problems such as ADHD.(11)

Mineral levels that are too high or too low have been shown to cause a variety of disease states. The minerals that have possibly been implicated in affecting ADHD are: calcium, copper, iron, magnesium, manganese, and zinc.(23) Of these, it appears that magnesium supplementation of 400 mg daily can be beneficial; possibly calcium at a dose of 1 G daily; and iron at 30 mg twice daily, if deficient.(23)

In 1989, Kaplan reported on the results of a study designed to examine the relationship of both sugar and overall dietary intake to hyperactivity.(26) Most previous studies in this area have focused primarily on only sugar intake and have only demonstrated a weak association at best.(26) In this study 24 ADHD and 27 non-ADHD pre-school aged boys were included. None of the children participating in the study were on medication, which is atypical in this type of study. For five of the ADHD children and 3 of the non-ADHD children, there appeared to be a correlation between behavior and sugar intake. There appeared to be no difference in diets between the hyperactive and non-hyperactive groups.(26) The authors concluded that within each of these groups there appeared to be individuals who had sensitivities or reactions to some food substances.(26) The authors suggest looking into individual differences versus group

nutrient intake differences. Can a child's diet be modified without a placebo effect occurring? Probably rarely, since the dietary modifications will inevitably involve changes in management of the child.(27)(28)

The treatment of ADHD is usually multi-faceted, incorporating multiple modalities to effect the greatest change. Other forms of treatment that are incorporated are: remedial teaching, family counseling, and pediatric, neurological and psychiatric treatment.(17) Also suggested are measures such as: increasing parent tolerance, allowing more physical activity, and tutoring.(2)

In 1976 the American Academy of Pediatrics issued a report stating that the use of mega-vitamins to treat learning disabilities was not valid.(15) In 1976 the National Advisory Committee on Hyperkinesia and Food Additives recommended that the K-P Diet not be utilized because reduced carbohydrate and essential vitamin consumption was likely to be curtailed.(19) An NIH consensus development conference recommended that a 1-2 month trial of the K-P Diet is reasonable after a thorough evaluation of the child and family.(29) (30) The concern is that when the initial diet regimen fails, the family will continue on a ever progressing elimination diet that may lead to nutritionally inadequate diets.(29) Although this diet represents minimal risk, a well intentioned (but not well informed) parent could cause damage to the child's health. One of the greatest concerns of clinicians is that the parents may delay appropriate treatment while trying a variety of unproven methods.(27)(17)

CHAPTER III- DISCUSSION:

The role of nutrition on behavior is still controversial. The many studies that have been conducted in this area are often contradictory and the authors appear to have difficulty determining which assessment tools to use. The public passion behind this topic is exemplified in the recent Federal Trade Commission charge against a nutritional supplement manufacturer. The company, Natural Organics, Inc., claimed that its product Pedi-Active A.D.D. would improve the attention span and scholastic record of children with ADHD and those having difficulty focusing on school work.(31) The company stated it had submitted over 200 studies, including 18 double-blind studies, and these studies were disregarded.(32)

As with any treatment of a disease state, the same protocol will not work for each patient. In this realm, the treatment of ADHD, ADD, and Hyperactivity seems to be at the extreme end of the scale. There is no single answer for every child. Even the prescription medications won't work for each child. There is a possibility that the varied results that are seen throughout the research are due to the presence of a variety of sub-groups of ADHD that have yet to be identified.(2)

A major concern is that a majority of the studies that contradict the Feingold Diet are financed by the Nutrition Foundation, which is funded by major food manufacturers such as Coca Cola, Nabisco and General Foods.(3) These companies have a variety of products, but virtually all of their products would be contraindicated in the Feingold Diet.

The studies done in Canada and Australia appear to be more favorable and other countries have already significantly restricted food additives because of the harmful effects.(3)

When dealing with behavioral science, it can be difficult to isolate the nutrition effect from the placebo effect. The expectations of the parents cannot be discounted, and may become a large bias when the interpretation of their child's behavior is utilized as one of the measurement tools of successful treatment. This bias can occur simply because the parent wishes to find a less severe treatment alternative than prescription medication. Some parents may experience guilt associated with the daily administration of psychotropic medication to their children. Others may simply be looking for a more effective alternative. As the parent modifies the diet of the child, in the case of an elimination diet, it can be difficult to factor out the effect of managing the child differently on a new diet or any new regime. The incentive for a positive result is much greater than for a negative result.

The studies reviewed demonstrate the vast difference in results within the analyzed populations of children. This can only be accounted for by a great diversity of causative and reactional factors. Although there appear to be some commonalities that stand out when the research has been sifted; virtually all studies demonstrate that some hyperactive children consistently react with behavioral problems when challenged by specific food additives; the design of the studies is extremely varied without consistency in methodology; and the inconsistent statistical group results ignore the significance of

the individual results.(3) It appears that the research reveals problems with diagnostic heterogeneity, inconsistent experimental findings, and severely limited conclusions regarding the etiology, nature, and treatment of ADHD.(8) Possibly the best future course of action would be to determine and study the sub-groups as the cumulative knowledge about biochemical and neurological function increases.(8) This is proposed because there appears to always be a subgroup of children that not only respond to the treatment, but more importantly respond negatively to the food challenge after the treatment.

The role of food allergies and sensitivities appears to become one of the prime areas in need of further exploration in the field of ADHD research. The K-P Diet remains controversial but is less so when it is viewed as an alternative that may be beneficial for some types of ADHD, but not as a treatment for all children with ADHD. It appears to be more effective for younger children. The effects of sugar also appear to be more in the realm of food sensitivity in some individuals, than a specific and consistent hyperactivity causative factor. The elimination of tartrazine and sodium benzoate may also be beneficial.

A 1-2 month elimination diet may be helpful to eliminate the effects of food allergies and sensitivities but should be monitored to ensure adequate carbohydrate and total nutrient intake. It may be beneficial to eliminate those foods and substances with artificial flavoring, artificial coloring and salicylates. While on this diet it may be wise to monitor vitamin C consumption to ensure adequate levels are present. Additional

CHAPTER IV- CONCLUSION:

Whether the treatment is prescription medication or conservative means, we still don't know why each method works because it comes back to not fully understanding what causes ADHD.(2) The best approach to effective treatment and management of ADHD appears to start with an accurate diagnosis to rule out other disease states or lack of any disease state, including ADHD. Once this has been accomplished a multi-modal approach appears to be most effective. This could include: food allergy and sensitivity assessment, dietary modification, nutritional supplementation, remedial teaching, family counseling, increased physical activity, and neurological and psychiatric treatment.

The greatest concern in the final analysis is that the children who do not get effective treatment have a much higher chance of falling behind academically, functionally, and socially.(2) The true societal cost of this is beyond measure.