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ABSTRACT

The relationship between pesticides in food and the occurrence of attention deficit disorder (ADD) and attention deficit hyperactivity disorder (ADHD) in school age children is considered. Pesticides include chlorinated hydrocarbons and organic phosphates that are commonly present in fruits and vegetables, which are a large part of the diet of children. A literature review considers nutrition, pesticides, diagnosis of learning problems, links between pesticides and learning problems, and treatments for ADD and ADHD. The influence of diet on neurotransmitters is addressed. Medical research is cited that links damage to neurotransmitters in the brain's frontal lobes and ADD/ADHD. Evidence showing that pesticides can damage brain cells is also presented. Problems with the detection of pesticide residues in foods are acknowledged. The treatment of ADD/ADHD has commonly been to medicate the child with stimulant drugs that affect the body's neurotransmitter chemicals, as well as tricyclic antidepressants and tranquilizers. Dietary treatment, behavior modification, and stress reduction therapies may be additional treatment options. Additional questions and implications regarding pesticide use and ADD/ADHD are posed. (Contains 30 references.) (SW)

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The Examination of the Link Between Pesticides in Food
and Learning Disorders in Children

BY

Sue Ellen Raby

A Thesis

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the Faculty of the Dominican College

Department of Education

In Partial Fulfillment

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About the Author

Sue Ellen Raby earned a Bachelor of Arts degree in Biology from Cedar Crest College in Allentown, Pennsylvania; and a multi-subject teaching credential from Dominican College in San Rafael, California. She has been an intermediate grade science and math teacher. For the past four years she taught a self-contained second grade classroom in El Cerrito, California. During this time she observed the many difficulties students have in a classroom today.

Abstract

This study examined the relationship between pesticides in food and hyperactive or attention-deficit disorder in school age children. Pesticides that are established neurotoxins have been used for decades in agriculture and home gardening. The research literature on pesticides in food and their impact on children's behavior was examined. Other literature examined the effect of neurotoxins on the human body. A review of the literature indicates that young children's diets, as compared to adult diets, contain higher percentages of fruits. Other findings indicated that children binge more on fruits and vegetables having as many

as 15 pesticides present on one piece. Young children ingesting foods contaminated by toxic chemicals are more susceptible to cellular damage such as nerve damage, cancers, and liver damage than adults.

Introduction

In teaching, there are always certain students who are unable to pay attention in class, focus on a task, sit still, sit at all. Correspondingly, there seems to be a trend in the medical profession to label these behaviors as hyperactivity, and to treat hyperactivity with Ritalin and other prescription drugs. Some of these students may have food allergies, or be reacting to the neurotoxins increasingly present on the food they are eating. Diet may be a viable way to treat children with attention and learning problems. This study examines the relationship between pesticides in food and children's attention problems in school.

Statement of the Problem

Is there a relationship between pesticides present in foods and an increase in the occurrence of attention-deficit, hyperactivity syndrome in school-age children? Attention-deficit has been characterized by an inability to focus on a task and/or an inability to listen when spoken to directly. Furthermore, the individual fails to give close attention to details, is forgetful, easily distracted, and experiences difficulty in organizing activities. Hyperactivity includes the following symptoms:

the child fidgets or squirms, is unable to remain seated, has difficulty engaging in activities quietly, exhibits excessive talkativeness, and may engage in inappropriate running or climbing (American Psychiatric Association, 1994).

Pesticides include chlorinated hydrocarbons and organic phosphates that are commonly present on fruits and vegetables. For the past several decades certain pesticides have been used as accepted practice in agriculture.

Hypothesis

If it is true that increased pesticide use in food is linked to learning problems in children, then attention to diet that is free from pesticides may alleviate some of the symptoms. Pesticides and herbicides are defined as synthetic chemicals, having no counterparts in nature, that are used to kill insects, weeds, and rodents. Learning problems, as referred to in this paper, span a range of behaviors from being fidgety in class to doing dangerous things in the classroom. The full range of behaviors is present on the Monterey Questionnaire, Appendix A.

Rationale

Dietary Guidelines (Davis and Sherer, 1994) recommend that people eat a variety of foods, maintain a healthy weight and choose a diet with

plenty of vegetables, fruits and grain products. Sugar and sodium should be used in moderation. Carbohydrates, fats and proteins furnish energy. Proteins, minerals and water build and maintain body tissue. Proteins, minerals, vitamins and water regulate body processes. Recommended Dietary Allowances (RDA's) are established by scientists and nutritionists and published by the United States Government. The six classes of nutrients: water, proteins, carbohydrates, fats, minerals and vitamins, are available from six major food groupings (U.S. Department of Agriculture and U. S. Department of Health and Human Services, 1992): (a) bread, cereal, rice and pasta group; (b) vegetable group; (c) fruit group; (d) milk, yogurt & cheese group; (e) meat, poultry, fish, dry beans, eggs and nuts group; and (f) fats and sweets.

There are no guidelines that establish the point at which diets become inadequate. Current work is underway to bring school lunches and breakfasts up to these dietary standards. Education and good health are interdependent (Whitfill, 1994). Whitfill also writes that what our children eat is directly linked to their readiness and ability to learn. Young people today are at risk from exposure to radon, pesticides, lead and second-hand tobacco smoke. Minerals and vitamins present in pure foods build healthy bodies .

Background and Need

In her landmark work Carson (1962) documented adverse effects of pesticides and herbicides on the public, and called the American public to action. Between 1947 and 1960 there was a 500% increase in the amount of pesticides manufactured, from 124,259,000 to 637,666,000 pounds. The trend continued to increase, and in 1990 the rate of application rose to well over 9 million pounds applied each year to agriculture alone, according to Rosenfeld (cited in Wiles and Campbell, 1993). The researchers documented the presence of multiple pesticide residues on foods. Tap water is also used in preparing infant formula. Some towns are dealing with the effects of agricultural herbicides in tap water, which compounds the presence of pesticides in the diets of infants and children. Agricultural herbicides are known to be neurotoxins and are carcinogenic.

Information from the work of Carson and Wiles and Campbell indicates that pesticide presence in food has increased dramatically in the past 25 years. It is important to examine the link between chemicals present in foods commonly consumed by children and their relationship to learning problems.

Review of the Literature

An examination of the literature revealed information on the following topics: nutrition, pesticides, diagnosis of learning problems, links between pesticides and learning problems, and treatments. The review includes an examination of studies as well as position papers.

Nutrition

Crews (1989) stresses that children must eat healthy, nutritious foods to grow physically, emotionally, mentally and socially. The eating patterns that are being developed at this age are ones they will maintain throughout the rest of their lives. Foods from each of the food groups are advocated to adhere to a well-balanced diet. Children should eat a well-balanced breakfast before coming to school to help them have the energy needed for interacting with peers, academic work, and physical play. Crews refers to caffeine as the world's most popular drug. This crystalline substance is present in coffee beans, tea leaves, cocoa leaves and hence in chocolate. The caffeine content of chocolate depends on the origin of the cocoa leaf. Cocoa leaves can contain between 0.3% and 1.7% caffeine.

Over the years, several substances that children regularly consume have been studied for possible relationships to hyperactive behavior and attention deficit syndrome. Research on the relationship of food to

behavior began in 1975 with Feingold's work concerning food additives.

Since then the effects of caffeine and sugar have been the subject of many studies with the evidence being inconclusive. Food allergies may be responsible; and any child demonstrating learning disorders, behavioral problems or a neurological disturbance should be evaluated for allergies. Foods may not be the culprit in the allergic response, however. Chemicals found in the home and school also contribute to allergy problems as shown by the work of Vass and Rasmussen, 1984 (cited in Crews, 1989).

Swensson (1990) believes that adequate nutrition is important in creating a healthy body. This is especially important prenatally and in the child's early years. The brain produces personality, imagination, remembering, and thinking, observes Kiester (cited in Swensson, 1990). Nutrient deficiencies can impair these functions. Swensson conducted a study with 17 children that were being recommended for study by the school team for intervention. Before the project started she tested all with the Wide Range Achievement Test (WRAT). Parents of ten of the children were recruited to learn more about nutrition and improve the diets at home. After the project was complete she administered the same test. Results indicated a higher rate of improvement in the scores of the 10 children who changed their diets, compared to the other 7 who did not. A nutrition test was also administered, pre and post, and yielded similar results.

In "Children's Nutrition and Learning" (June 1994, Eric Digest) it was reported that children of all socioeconomic levels are at-risk for poor nutrition. It reviewed research on the link between nutrition and learning from the prenatal through school years. Iron deficiency in infancy, prevalent in the United States, causes loss of IQ points later in life. Several studies indicate a relationship between hunger or poor nutrition and cognitive ability. Skipping breakfast produces an adverse influence on test performance; undernourished children miss more school due to difficulty in fighting infection. The Community Childhood Hunger Identification Project (CCHIP) parent survey found that children in families that reported hunger were more likely to have trouble concentrating. Poor children are more likely to suffer from iron deficiency anemia (Parker, 1989). The coordination of nutrition education in the classroom with school lunches is advocated, as is the offering of only nutritious foods at school. Also, the provision of materials for parents about nutrition to enable them to talk to their children about nutrition are some recommendations made.

Pesticides

Carson (1962) informed the public of the dangers of herbicides and pesticides. These toxic chemicals are available in supermarkets, garden supply shops and hardware stores in the forms of ant, roach and rodent

poisons, snail bait and weed killers. A number of deaths occurred in Florida because of over-use of parathion, a neurotoxic pesticide. Yet the user is not informed of the consequences of using these methods of pest control. Warnings that are present are printed so small that one needs a magnifying glass to read them. It has been established that death can result from single doses of pesticides if the amount is large enough. All of these chemicals have permeated our soil, water, food, gardens and streams. What are the delayed effects of absorbing small amounts of pesticides? The residues of these chemicals are passed on from mother to offspring and from one organism to another through all the links of the food chains. Residues of insecticides have been found in human milk tested by the Food and Drug Administration. Chlorinated hydrocarbons are able to cross the barrier of the placenta. The average individual starts life with a deposit of chemicals in their system which increases as they age under current agricultural policy. Liver damage is possible at levels that may easily occur in normal diets. Chlorinated hydrocarbons and organic phosphates affect the nervous system. DDT acts on the central nervous system. Evidence points to women and young children being more affected than men.

It is difficult to diagnose pesticide sensitivity because the population is never exposed to only one chemical at a time. Organic phosphates inhibit the enzyme cholinesterase, a protective barrier on

neurotransmitters. This is compounded if the individual has been exposed to a chlorinated hydrocarbon that has injured the liver. Pairs of organic phosphates may interact with one another in such a way as to increase their toxicity or they may interact with various drugs, food additives or other substances that pervade our world. There may be delayed effects from exposure.

Pesticides are very stable and cannot be broken down by ordinary processes. They have permeated our surface waters and underground seas and are as capable of causing genetic damage as radiation. Many of these substances, when ingested by human beings, are stored in our tissues and never excreted or cleansed from our systems.

Graham (1970) examined the organic phosphates of Chlorthion, Demetron, Diazinin, Dimethoate, EPN, Parathion, Phosdrin, Schradan and TEPP. They are cited as a group of chemicals originally developed as chemical warfare agents. They act to inhibit cholinesterase and result in a breakdown of nerve and muscle response. They show potentiation which means, in combination with other chemicals, they can become many times more toxic than indicated by the original components.

The chlorinated hydrocarbons are Aldrin, benzene hexachloride (BHC), lindane, Chlordane, dichloro-diphenyl-dichloroethane (DDD), trichloro-diphenyl-ethane (TDE), dichloro-diphenyl-trichloroethane (DDT), Dieldrin, Endrin, Heptachlor, and Toxaphene. These also act as nerve poisons. They

are stored in the fat of animals and may be released suddenly into other tissues when stress or reduction of food intake depletes fat reserves. The critical areas of the brain may be affected long after initial exposure. These synthetic compounds have been widely used since 1946. Their metabolic and other physiological effects are little understood. The chlorinated hydrocarbons and organic phosphates listed above are considered pesticides to avoid according to Briggs (cited in Graham, 1970).

Buchanan (1984) defined a toxic substance and the criteria for classifying a substance as toxic is questioned in this work. The suggestion is made that behavior change should be considered as a qualification for establishing safety issues surrounding substances to which the public is exposed. Psychologists and behavioral toxicologists should cooperatively develop tests to assess effects of toxic substances on behavior. In this journal article an argument is made to place sugar in this category because over consumption of refined sugar is likely to change the homeostatic balance required for proper metabolism.

Wiles and Campbell (1993) in their report on pesticides and food found the following: (a) By the age of 5, millions of children in the United States have received up to 35 percent of their entire lifetime dose of carcinogenic pesticides; (b) Residues of 2 or 3 (sometimes as many as 8)

pesticides per food are present on items consumed by infants and children;

(c) The special sensitivities of young children to chemical mixtures are not considered or examined by the Environmental Protection Agency (EPA);

(d) The EPA has classified 70 pesticides commonly used on foods as carcinogenic. These calculations exclude milk and water; (e) Pesticide residues in the food supply are seriously under-reported by the Food and Drug Administration (FDA). The FDA laboratories are not using a sufficient number of tests to detect some of the most toxic and widely-used pesticides.

Tolerances for pesticides are established under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), and the Federal Food Drug, and Cosmetic Act (FFDCA). A tolerance is the maximum residue of a pesticide allowed on a food for interstate commerce.

Safe exposure levels to a pesticide is determined by the Environmental Protection Agency (EPA). The EPA assumes that exposure to pesticides occurs evenly throughout life. They also assume, when setting these safe exposure levels, that people consume average amounts of 300 foods derived from a sample of 30,000 individuals. They total the average exposures, average food consumption multiplied by an average pesticide level, from all the food that the pesticide is used on, and then compare the total food exposure to a reference dose. United States Department of Agriculture data indicates that on a per-body-weight basis,

exposure is higher in the first years of life. Early childhood exposure and sensitivity should be taken into account when establishing tolerance levels for carcinogenic and neurotoxic chemicals.

There are many substances to which children are more sensitive than adults. These include, but are not limited to: aspirin which is linked to Reye's syndrome; lead which is linked to deleterious effects on IQ and the nervous system; tetracycline which is an antibiotic linked to defects of teeth and bone development; tobacco smoke which is linked to increased rates of lower respiratory tract infections, asthma, pneumonia and bronchitis.

Due to shortcomings in the monitoring program of the FDA, the prevalence, levels, and multiplicity of pesticides in our diet is understated. There are discrepancies among the FDA labs in their detection equipment and the number of screens used to detect pesticide residues. When fewer methods and screens are used, the risk of under-representing the residues present in the food rises. One lab used 3 or more detection screens, the other lab used two or fewer screens. The difference in the amount of fruit detected with pesticide residues is significant. Residues were found on 46% of peaches using two or fewer screens, and on 76% of peaches using three or more screens. Of the 15 food samples tested, 12 showed between 4% and 44% more food showing pesticide residues with three or more pesticide detection screens than

with two or fewer screens. The three remaining screened foods showed more of the food showing residues with two or fewer screens with a range of 2% to 10%. The list continues. Fruits and vegetables may have more residues of pesticides than we know, including fruit juices.

Many fruit juices are made from fruits not grown in this country. This means that the fruit used in the juice does not have to meet the same standards as produce grown in the United States. Samples of apple juice from Canada and Argentina were tested for pesticide residues. Residues of the pesticides Alar and benomyl were found in such apple juice. Milk has been found to be contaminated with carcinogenic herbicides at trace levels, atrazine being the most widely used herbicide. The level present is deemed safe by the EPA.

The pesticides used are classified into two groups: carcinogens and neurotoxins. The pesticides most commonly used that are considered neurotoxins are: Endosulfan, Chlorpyrifos, Dimethoate, Diazinon, Parathion, Azinphosmethyl, Acephate, and Carbaryl. The pervasiveness of these in the diets of young children raises the following concerns: that children are routinely exposed to these chemicals; and that overall exposure is greater than the EPA realizes when policy is set to protect human health.

The report concludes with the observation that we are normally exposed to low-level pesticides; it is no longer the exception. Children

can be consuming fruits with as many as eight different pesticides per piece. There are 38 pesticides that regularly appear on between 5 and 21 foods heavily consumed by young children according to the FDA, 1990-1992 (cited in Wiles and Campbell, 1993).

This report argues for preventing risks to children, not managing an accumulation of risks. We need to identify pesticides and other toxins present in foods and phase them out. Currently federal policy allows maximum tolerable levels of exposure to hundreds of pesticides used in thousands of products. These products are then applied to hundreds of crops used for human food or feed for livestock. This presumes that scientists and regulators can assess the risks from the residues of 20,000 differently formulated pesticides accurately. This has not been proven or supported in the literature.

Super Natural Foods, March 1995 Newsletter (citing Environmental Working Group, 1995) cautions that although the USDA report of produce samples taken in 1992 showed lower levels of pesticides than anticipated, the EWG's analysis revealed more toxic residues than were acknowledged.

Diagnosis of Learning Problems in Children

Loney (1980) noted that hyperactive behavior may be variable or situation dependent. Observations have indicated that some drugs have

shown short-term effects on behavior but evidence of improvement in academic performance or long-term effects on behavior is lacking. The presence of hyperkinetic symptoms continues into adolescence and adulthood.

Brenner (1982) studied 100 children with hyperkinesis and cerebral dysfunction. Pharmacologic doses of thiamine, calcium pantothenate, pyridoxine, and a placebo were given in three-day trials. Results indicated that although the hyperkinetic cerebral dysfunction disorder is multifactorial, a significant number are caused by deficiencies in vitamins or dependence upon pharmacological substances.

Martin and Martin (1984) observed that hyperactivity articles abound in the literature in medical, psychological, penal, educational, governmental and sociological reports and journals. Upon reviewing research on the treatment of hyperactivity since 1975, the following range of modalities have been explored: (a) behavior management; (b) diet/allergy therapy; environmental control; (c) drug therapy; and (d) relaxation/biofeedback. They recommend a team approach to the assessment, diagnosis, treatment and management of hyperactivity. The team should include a pediatrician, school psychologist, teacher, parents and a social worker. This way the whole problem can begin to be treated instead of just medicating the child.

Shaughnessy & Scott (1985) noted subjectivity in the diagnosis of children as hyperactive and different forms of hyperactivity. Some types of hyperactivity include: (a) the child who is in constant movement, (b) the child who is able to control impulses in school but not at home, (c) the child who is upset by a change in routine, and (d) the child whose behavior gradually changes for the worse over time. The authors suggest some ways to improve the situation that include examination of diet and emotional world; assessing the duration, frequency and intensity of the behavior; trying preventive measures; use of medication; investigating behavior modification; and structure of the child's environments.

Attention Deficit Disorder is defined (Morriss, 1990) as an early childhood condition that is characterized by inattention/distractibility, impulsivity and hyperactivity. This condition was previously referred to in the literature as learning disabled, brain damaged or minimal brain-dysfunction, hyperkinetic or hyperactive. Children with Attention Deficit Disorder (ADD) have problems with normal selective attention. Selective attention works with other cognitive processes such as memory and language processing to permit successful classroom learning and social interaction.

Wallis (1994) notes that the symptoms of Attention-Deficit Hyperactive Disorder (ADHD) is one of the fastest-growing diagnostic categories for adults. As many as two-thirds of ADHD children continue

to have symptoms as adults. Positive aspects of the condition are creativity, spontaneity, alertness, and decisiveness. But people with ADHD do not function well in standard schools or typical office jobs.

Researchers suspect a defect in the frontal lobes of the brain as responsible for the ADHD symptoms. This area is rich in the neurotransmitters dopamine and norepinephrine. These neurotransmitters are influenced by drugs like Ritalin. Researchers agree that the condition is inherited. The pace of American life is "ADD-ogenic", meaning the fast pace of life in the United States supports distractibility, spontaneity and creativity. It becomes pathological when the traits are so extreme they interfere with an individual's life. ADHD definitely has the ability to disrupt lives. Children with the disorder have fewer friends, parents are unable to control their ADHD children, school is difficult. Between the ages of 5 and 7, as many as 66% of ADHD children are hostile and defiant. Continuing to ages 10 or 12, these children run the risk of developing "conduct disorder". Psychologists define this disorder as lying, stealing, running away from home and the possibility of running into trouble with the legal system. As adults, at least 25% will experience substance abuse problems if they have been previously treated only with stimulant medication. Among those who had been treated with medication plus additional measures the rate falls to 20%, this is still high. The best known therapy remains stimulant drugs, Ritalin being the most often

selected. Adult hyperactives have successfully self-medicated through the consumption of caffeine, sometimes as many as 40 cups of coffee per day.

Is ADHD a brain disorder or a personality type? There may be evolutionary reasons for the traits common to ADHD or ADD to be so common in the United States. We are a nation of immigrants who risked everything to begin anew in a different country. Characteristics like risk taking, impulsiveness and high energy are highly represented in the U. S. gene pool. Impulsiveness is a survival skill if you are a hunter, but a problem if you are a farmer. Modern society favors the farmer mentality by rewarding those who meet deadlines, develop plans, and plod through schedules. There is still a need for the hunter in society for careers such as: entrepreneurs, police detectives, emergency-room personnel, Wall Street analysts and race car drivers.

Links Between Pesticides and Learning Problems

Fishbein and Meduski (1987) state that as understanding of neurochemistry has advanced, a significant relationship between diet and brain function has been established. Excess or deficiency in certain dietary components contribute to the functioning of the central nervous system and therefore have effects on behavior. Dietary factors are the base of all biochemical reaction and physiological functions in the body,

including the brain. Each branch of behavioral science relies on investigation of biochemical influences. Psychopharmacology studies chemical compounds. Chemical compounds change biochemical reactions in a body and produce changes in mood, levels of awareness, and modify behavior. Discoveries in this area include the influence alcohol has on aggression and depression; how anti-depressants work and how opiates and hallucinogens affect perception and mood. Psychoneuroendocrinology studies the relationship between hormones and brain physiology. Advances in these fields can be credited to the discovery of anti-psychotic and antidepressant drugs in the late 1950's according to Green and Costain (cited in Fishbein and Meduski, 1987). Previous researchers documented the discovery of specific receptors for opioid substances in the brain; and the isolation of brain peptides, which behave like natural opiates.

Diet has an effect on neurotransmitters. These chemical messengers are located in axon terminals and provide neurons, nerve cells, the means to communicate with each other. Neurotransmitters are responsible for cognition, emotion, mood and behavior. Some neurotransmitters are synthesized with essential amino acids.

Research supports the hypothesis that toxic trace elements can directly influence behavior by impairing brain function, influencing neurotransmitter production and utilization, and altering metabolic

processes. Since 1969, the research has also found that refined or simple carbohydrates such as white rice, sugar, white flour, cakes, candies, sodas, and potato chips disrupt normal brain function in susceptible individuals and can create or aggravate learning disorders. Further studies have documented that behavioral disturbances including; depression, violence, irritability, and irrationality normalize following refined carbohydrate-free diets.

Zametkin (1990) observes that many children are not outgrowing attention deficit-hyperactivity disorders and that research is supporting a relationship between a metabolic dysfunction in the brain and these problems.

Morriss (1990) suggests numerous pathways of causes of ADD: heredity, neurologic disorders associated with an affective disorder (depression), fetal injury, childhood brain injury (exposure to toxins). Hyperactivity became associated with brain function after the 1918 encephalitis epidemic. Doctors observed hyperactive behavior patterns in children following recuperation from encephalitis. Ebaugh first described this and termed it Post-encephalitic Behavior Disorder.

Pescara-Kovach & Alexander (1994) did not find evidence to support a link between diet and behavior. The research that Feingold and Connors had done in regards to a diet free of food dyes and additives was reviewed. Reviewing studies using uncontrolled clinical trials and controlled

clinical trials of the substances in question, the results were inconclusive. Feingold had claimed dramatic improvements in behavior in almost 50% of patients, but this was not substantiated by other researchers with a control diet also in place.

Psychiatric disorders are present in a high percentage of patients claiming food intolerance. When 18 self-proclaimed food intolerant patients were evaluated, several disorders appeared, those being; hypochondriacal neurosis, phobias and hysterical personality disorder according to Pearson, Rix & Bently (cited in Pescara-Kovach & Alexander, 1994). Other research has shown high scores for hypochondriasis, hysteria, and nonspecific reactions such as; confusion, headache, fatigue and loss of concentration among patients claiming food intolerance. In Groth-Marnat (1990) hysteria and hypochondriasis are defined. Hysteria is a condition in which patients have specific physical complaints with defensive denial of emotional or interpersonal difficulties. Hypochondriasis is present in patients that have a high concern with illness and disease who also are likely to be egocentric, immature, pessimistic and passive aggressive.

Elderkin (1994) states that although fruits and vegetables are an important part of any healthy diet, something as simple and nutritious as an apple may be contaminated by any one (or more) of 34 different pesticides.

Duke researchers have tested nerve gas pills, insect repellents and insecticides given to U.S. troops during the Gulf War and have discovered nervous system damage in laboratory animals. It is now believed that these pills and insecticides may be related to the mysterious ailments that 37,000 veterans of this war are experiencing. Understanding how this occurs will give legitimacy that the ailment is in the veteran's bodies, not their heads (Marin Independent Journal, 1995).

Medical Treatment

Firestone, Crowe, Goodman and McGrath (1986) state that improvement in academic performance, although initially found in a medicated group of hyperactives, was not confirmed at a 2-year follow up. This suggests that stimulant medication helps in the short-term for problems of attention, hyperactivity and behavioral disturbance in certain children. When pre-and post intervention comparisons among subjects remaining throughout the duration of the study were analyzed, the differences disappeared.

In Newsweek, 1990 a report stated that studies performed on adults hyperactive since childhood indicated reduced activity in the brain centers responsible for controlling attention and movement. These adults were also parents of hyperactive children. Finding an effective treatment is imperative since many individuals do not outgrow the problem. Up to 60%

of hyperactive children become hyperactive adults.

Barkley (cited in Morriss, 1990) states that stimulant drugs work well on attention span and impulse control. The drugs used energize inhibitory brain mechanisms. Children who receive stimulants improve in the areas of play, social conduct and compliance to commands and rules. This results in a reduced level of supervision, commands, and punishment from the adults in these children's lives. Stimulant drugs effect little improvement in academic achievement or performance. Other treatments are recommended if academic achievement and long-term social adjustment are goals of therapy also.

Medications frequently used in the treatment of ADD are the stimulant medications of Ritalin, Dexedrine and Cylert, the tricyclic antidepressants of Tofranil and Norpramine and the major tranquilizers (neuroleptics) of Mellaril, Thorazine, Haldol, and Stelazine. Caffeine and Clonidine are also occasionally implemented. Caffeine is used as a cup of coffee or can of caffeinated soda. This dosage provides between 100 to 300 mg. of caffeine. Ritalin, Cylert, Dexedrine, Tofranil and Norpramine are believed to affect the body's neurotransmitter chemicals. Deficiencies in these may be the cause of ADD.

Caffeine is a central nervous system stimulant. Studies that looked at caffeine as a therapy for hyperactivity yielded conflicting results. Ross and Ross, 1982 (cited in Morris, 1990) reviewed 11 studies involving

coffee treatment for hyperactives. Some studies showed therapeutic effects, others did not. The main conclusion was: caffeine treatment is not as effective as traditional stimulant medications such as Ritalin, Dexedrine, Cylert. The effect is short term and dosage is difficult to control.

In 1937 Bradley reported in the literature that Benzedrine, a stimulant drug, calmed hyperactive post-encephalitic children. This observation substantiated that there were organic factors related to the cause of hyperactive behavior.

There are numerous factors to consider when a child is suggested to benefit from medication: (a) the age of the child; (b) have other therapies been used?; (c) Drugs should not be the first therapy utilized by a family doctor; (d) how severe is the behavior?; (e) will the family be able to afford medication, commit time to follow-up visits?; (f) are parents responsible enough to follow dosage requirements?; (g) is family philosophically in agreement with drug therapy?; (h) is there any drug-abuse in the family?; (i) is there any other neurological disturbance in the child? (j) does the child tend to be anxious or fearful?; (k) does the physician have the time to follow-up, monitor this case?; (l) what are the child's feelings about medication?; (m) has a thorough physical and psychological examination been performed? He does not recommend the use of medication alone.

Kinsbourne (1994) noted that most controlled studies of diet have not found significant adverse effects of high levels of sugar and aspartame in consumption by ADD or ADHD subjects. This study contained 48 subjects of average academic skills. Pre-school and school-age individuals were studied. In the pre-school age group, 48% were boys; in the school-age group, 78% were boys. In the pre-school group, no psychiatric disorders were identified. In the school-age group, five of the sugar-sensitive subjects met the criteria for ADHD. Two of those five also met criteria for oppositional-defiant disorder. Two other children met criteria for oppositional-defiant disorder alone. These groups were exposed to carefully monitored, high sucrose, aspartame or saccharin diets. The results do not support the hypothesis that diets high in either sucrose, aspartame, or saccharin have adverse effects on the behavior or cognitive functioning of children.

Ciaranello (1993) has identified linkage between ADHD and a specific defined genetic abnormality. ADHD is strongly associated with generalized resistance to thyroid hormone. The phenotype for this characteristic was linked to the human thyroid receptor beta gene on chromosome 3. Subsequent studies have indicated in familial and sporadic cases of generalized resistance to thyroid hormone, more than 30 mutations in exons 9 and 10 of the beta gene.

In this study, 104 members of 18 families were studied using criterion based, structured interviews. 49 subjects had generalized resistance to thyroid hormone, 55 did not. The likelihood of having ADHD was 15 times higher for adults with generalized resistance to thyroid hormone. It is unlikely that a substantial number of patients have generalized resistance to thyroid hormone, but studies of thyroid function should be taken in these patients. It is possible that they have less overt thyroid related cases of the disorder.

Wiles and Campbell (1993) state that young children are receiving a disproportionately high dose of neurotoxic and carcinogenic chemicals (pesticides) in food and water. The cancer risk from these chemicals is disproportionately accumulated in the early years of life. Are children exceeding their lifetime "safe" dosage before the age of 10?

Summary

In this paper, attention deficit disorder (ADD) and attention deficit hyperactive disorder (ADHD) were defined as learning problems. Pesticides were defined as chlorinated hydrocarbons and organic phosphates, residues of which are commonly present on fruits and vegetables. There are problems with the detection of residues present on foods, the reliability of the current testing methods, and the determination of a safe exposure level for multiple pesticide consumption.

Information about food groupings and the nutrients provided by each group was presented. The required daily allowances (RDA's) necessary for a healthy body, who determines these, and how they are determined was covered. Diet has been shown to influence neurotransmitters. High carbohydrate foods such as; refined flours and sugars and potato chips have been shown to inhibit neurotransmitters in susceptible individuals.

There is medical research supporting the thesis that ADD and ADHD may be caused by damage to neurotransmitters in the frontal lobes of the brain. Evidence was presented that shows pesticides as causing damage to brain cells. People with thyroid hormone deficiencies are more likely to be diagnosed with ADD or ADHD, so this organic cause should be explored with these cases. These syndromes are genetically passed on according to existing research.

Pesticides are routinely used by farmers and agribusiness on food crops, by homeowners on their gardens and in their homes, by municipalities in their parks and roadside landscaping. They have been in wide use since the 1940's. The residues of pesticide chemicals do not break down by normal means and are found in fat cells, bone marrow, and breast milk. Under stress these residues are released into the blood stream from the fat cells or bone marrow. Pesticide residues are present on most fruits and vegetables.

Children consume a higher percentage of fruits and vegetables per body weight than adults. An infant's diet is comprised of breast milk, cereal and fruit. We are feeding our infants and children a higher percentage of pesticides than we are our adult population.

The treatment of ADD and ADHD has commonly been to medicate the child with stimulant drugs that affect the body's neurotransmitter chemicals; such as, Ritalin, Cylert or Dexedrine. However tricyclic anti-depressants and tranquilizers also are commonly used. More researchers are recommending that dietary treatment, behavior modification, and stress reduction therapies be considered in addition. The opinion is common that these modalities be explored before any medication is considered. This has been due to the observation that although medication affects the behavior of the child, it does not address academic progress or social interaction skills.

In conclusion, researchers agree that ADD and ADHD are learning problems. There is general agreement that many of these cases are due to damage to the frontal lobes of the brain. Pesticides have been proven to be carcinogenic and neurotoxic. The neurotoxic pesticides cause damage to neurotransmitters by inhibiting nerve synapses and transmission. Pesticides have been in the environment for five decades. Current ingestion of these occurs daily on fruits and vegetables grown by conventional means.

Discussion

If it is true that increased pesticide use in food is linked to learning problems in children, then attention to diet that is free from pesticides may alleviate some of the symptoms. There appears to be a link in the consumption of pesticide residues and possible damage to neurotransmitters and areas in the frontal lobes of the brain. Neurotransmitters are responsible for behavior so damage to them would adversely affect behavior.

Results would indicate a direct relationship between diet and behavior. Many children are consuming a lot of produce containing a variety of toxic chemicals. The ability to detect pesticide residues on fruits and vegetables is limited, so United States citizens are not sufficiently informed about the risks they are taking by consuming conventionally grown produce.

Pesticide residues have been shown to cause cancer in some people. Are neurotoxins causing brain and nerve damage in children and adults? Is this reversible, avoidable or inevitable? We are poisoning ourselves and our children. Psychiatric tests that indicate food sensitive people as hysterical pose a question to me. The medical profession does not seem to acknowledge that people are reacting to these poisons. If someone is sensitive and does react, this is termed hysterical or hypochondriacal. I would pose that the people that remain in denial of a serious dietary

problem are the psychiatrically disturbed ones who are imposing a death wish on the planet. Pesticide residues are found in today's food supply, as many as 34 pesticides are still used in the United States. We import up to 25% of our produce from countries who use all of these products. Some of the pesticides used by foreign countries have been banned in the United States for agricultural use. Since the FDA is unable to detect residues accurately, when we purchase imported produce the chances of our consuming toxic chemicals rises.

More children in the United States are dying from cancer than any other disease. A quarter of a century ago, cancer among children was rare. The public is tolerating cancer-causing agents in the environment. The stability that an ADD or ADHD diagnosis has now developed may be due to continued consumption of substances that are inhibiting neurotransmitters from functioning properly.

Biological control of pests is possible. Consumption of foods free from toxic chemicals is possible. Consumer demand for produce free from herbicides and pesticides will increase the availability of these foods.

Since 1984, treating the whole problem instead of just medicating the child has been advocated by researchers. The whole problem includes making our diet safe for human consumption. More research is needed on how to inform and empower the public to make healthy choices.

National policy should not be based on the hope that pesticide effects can be comprehensively studied or understood. A preventative approach to pesticide use and regulation would be much more cost-effective in these challenging economic times. The possible combinations of pesticide residues in food overload any possible research into the determination of their effects. Certainly there are many possibilities for research, the amounts of time and money available to study each individual pesticide may be limited. The combinations possible then to study two pesticides together and their effects on the physiology of humans makes analysis difficult. Consider then, that we have been ingesting as many as 8 pesticides per fruit in recent years, that our grandparents were consuming contaminated milk, the contaminants crossed placental lines into our parents developing nervous systems, our parents then consumed foods treated with herbicides and pesticides and these contaminants found their way into fat cells for use during times of stress. How do you study this? At what cost? Consider a generation of students free from pesticide influence. Research into how to accomplish this is needed.

Could the increasing number of adults diagnosed with ADD or ADHD have any link to the increased number of neurotoxins in the food supply? Or could it have anything to do with advancing age, increased stress and burning fat cells that are loaded with pesticides that destroy

cholinesterase which affects the ability of neurotransmitters to function efficiently?

Further research is needed in these areas as well as the effects of high carbohydrate foods on behavior and personality. Some research has been done on the effects on behavior of high-sugar consumption foods. No information was available on binge consumption of foods high in sugar.

The work of Wiles and Campbell (1993) has alerted United States citizens to the presence of multiple pesticide residues on foods, that these residues are carcinogenic and neurotoxic. Carson (1962) alerted the public to the fact that fish, birds, and humans were dying from over-use of these substances. She also wrote about the stability of these chemicals and their ability to lodge in bone marrow and fat cells. Graham (1970) informed us that many of currently used pesticides were in fact developed as chemical warfare agents. When did the United States Government declare war on its' own populace? Why are we so complacent?

Nancy Reagan urged us to JUST SAY NO to drugs. Our children are dying, our adults and children are experiencing damage to brain cells according to research done by Carson, a 1990 Newsweek article and the work of Wiles and Campbell. Are we willing to explore the possibility of "just saying no" to toxic chemical residues on our food?

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APPENDIX

THE MONTEREY QUESTIONNAIRE*

Student: _____

Date: _____

Please rate the degree of each behavior for this student

NOT AT ALL

VERY MUCH

1. Fidgety/squirmy	1	2	3	4	5	6	7	8	9	10
2. Out of seat	1	2	3	4	5	6	7	8	9	10
3. Easily distracted	1	2	3	4	5	6	7	8	9	10
4. Difficulty waiting turn	1	2	3	4	5	6	7	8	9	10
5. Blurts out answers	1	2	3	4	5	6	7	8	9	10
6. Difficulty following instructions	1	2	3	4	5	6	7	8	9	10
7. Difficulty staying on task	1	2	3	4	5	6	7	8	9	10
8. Fails to finish work	1	2	3	4	5	6	7	8	9	10
9. Difficulty playing quietly	1	2	3	4	5	6	7	8	9	10
10. Talks excessively	1	2	3	4	5	6	7	8	9	10
11. Interrupts and butts in	1	2	3	4	5	6	7	8	9	10
12. Difficulty in listening	1	2	3	4	5	6	7	8	9	10
13. Loses things/disorganized	1	2	3	4	5	6	7	8	9	10
14. Impulsive (does dangerous things)	1	2	3	4	5	6	7	8	9	10
15. Work habit problems at school	1	2	3	4	5	6	7	8	9	10
16. Social Behavior problems at school	1	2	3	4	5	6	7	8	9	10

*Morris, 1990.