

Radical Changes in Our 21st Century Diet:
The Importance of Returning to a Whole Foods Diet

Chapter : Sugar

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Introduction

In my current profession as a primary-care physician specializing in natural approaches to health, I routinely recommend dietary approaches to patients to cure specific illnesses and to prevent future disease. I have found that dietary changes alone are often all that are required for an individual to return to a state of good health. Unfortunately, I have also learned over the years that while diet affects the health of children, many young parents are not only uninformed regarding proper nutrition for their children, but many also seem to be completely unaware that there is a correlation between diet and health. All too often the parents' health is suffering as a result of poor dietary considerations as well.

I am perhaps too young to fully understand how our country came to embrace the diet that is typical today. In my research and through discussions with those of prior generations, I have come to suspect, however, that much changed after the Second World War. Prior to WWII, women were primarily responsible for their children's nutrition. Mothers were expected to pass down cooking skills to their daughters. That tradition changed during the war. Women were utilized as an available labor source in large numbers and the prevalent notion of women as housekeepers and cooks began to change. After the War ended, many women realized that they preferred working outside of the home, and they began the trend of two income households that is almost universal today. Women certainly cannot be faulted for seeking conveniences to make life easier at home. A large part of that convenience relates to food.

Throughout the 1950's and advancing each decade since, our fast-food corporations, food technology scientists, and agro-conglomerate businesses have sought to meet the needs of a hungry, time-starved population. No longer are women expected to prepare meals from staples such as flour, meat, and sugar. Instead, almost every imaginable foodstuff can be found in a box, frozen, or canned, and ready to heat at a moment's notice.

The mothers of the 1950's, the last children to have been raised exclusively on home-cooked, whole-food meals, are now 70-80 years old. Their children, the first generation to be raised partially on processed foods, are now 50-70 years old. And the post-war grandchildren of the parents of the fifties, raised almost entirely on processed foods, are now 30-40 years old. Today's young parents are four generations removed from a diet that went largely unchanged for millennia. I suspect there are few 20-year-olds today, men or women, who could manage to cook more than a single meal solely from the staples common to every American household only 50 years ago. As I stated previously, most young adults seem completely unaware that there might even be a correlation between diet and health, especially the health of their children.

I see a tremendous amount of unnecessary illness in children. For example, frequent ear infections cause children severe pain and many missed days of school. Children are routinely treated with repetitive rounds of antibiotics, which often lead to the surgical

placement of tubes in the tympanic membrane. There is substantial preliminary evidence that tympanostomy tubes may cause hearing loss in children, which may then lead to impaired language development. These treatments are the first line of defense against ear infections, even though there is solid evidence that dietary intolerance accounts for 86% of the cases of otitis media in children. Cow's milk has been shown to be the causative factor in eight of ten ear infections. Most parents have never been informed of the relationship between milk allergy and ear infection, though an 80% association would indicate that milk avoidance should be the primary intervention for recurrent otitis media. Unfortunately, it is not.

It might interest the reader, however, to know that most school districts have relationships with the Federal government to provide milk to all students. It does not take much investigation to discover that the beneficiary of this policy is the milk industry itself, which gains financially through artificial price supports. The milk industry is a primary lobby to the Federal government for the school lunch program. In addition, to ensure consumption of milk at school, most mothers need a physician's letter to remove their children from the mandatory milk requirement. I have signed this form myself many times and have been angered by its implications.

Another learning challenge of many young students is attention-deficit, hyperactivity disorder (ADHD). Parents, teachers, and school administrators can all attest to the difficulty in properly instructing students unable to focus their attention on the task of learning. The increase in the number of prescriptions for drugs such as Ritalin to school-aged children is growing at an exponential rate. There are many theories about why we are seeing such an increase in ADHD. A few health professionals are focusing on dietary considerations. One group of substances under close scrutiny is the food dyes common in many foods. In my practice, I have personally seen tremendous symptomatic improvement in children when food dyes are removed from the diet.

Rather than go into the chemistry behind such improvements, I would like only to include another potential cause of ADHD, that of sugar and other sweeteners, and to appeal to the reader's intuition. Does it make sense for school-aged children, who have difficulty with focused attention, to be consuming the quantities of sugar that are common today? Has not every parent, teacher, and school administrator noticed a direct correlation between sweeteners and a high-energy state in young children? Furthermore, should our schools be reliant on income, which is generated from the sale of foods and beverages with high sweetener content, at the cost of managing the resulting behavioral changes with Ritalin?

I have been compelled to build upon my nutritional expertise by gathering research that supports my hypothesis that proper nutrition for school-aged children has not only foundational importance for proper growth and health maintenance, but also has immense benefits toward academic achievement and social advancement for those suffering under the ills of the current, typical American diet. There is plenty of research available

relating the effects of diet on our health, but there are limited studies relating diet to cognitive benefits.

Chapter 1:
Changes in Consumption of Sugar in The United States

There is evidence of primitive sugar production as far back as 12,000 years ago. By 8,000 B.C.-6,000 B.C., sugar manufacturing appeared throughout regions of China and the Middle East, where soil conditions were right for sugar cane growth. Sugar was not introduced to the European Continent until around 700 A.D., when Arabian armies brought sugar cane across the northern coast of Africa. From there, sugar entered other areas of the Mediterranean, and strongly influenced regional cuisine of the day. At that time, sugar was a luxury only the very wealthy could afford. Because of its scarcity and high cost it was referred to as "white gold." By the 16th century, sugar was still so rare that one teaspoon cost the equivalent of five dollars in today's money.ⁱ

Sugar is produced through a purifying process that separates 99.9% pure sucrose from sugar cane or the sugar beet. Initially, the plants are washed, shredded, crushed, and rolled to extract the cane juice. The cane juice was then "clarified" by the addition of lime. After evaporation and centrifugation, it was further refined through the addition of sulphur dioxide, phosphoric acid, and decolorizes. These processes remove all the phyto-nutrients, including the vitamins and minerals. Because of the complex refining process, sugar production was severely limited in the United States until the Industrial Revolution of the late 18th and early 19th centuries.ⁱⁱ However, with the advent of new technologies, production grew quickly. The following chart shows that the consumption of sugar had already reached approximately 56 lbs (2.45 ounces per day)/per person in the United States by the turn of the 20th century.

THE CONSUMPTION OF SUGAR IN THE UNITED STATES

Per Capita Consumption (Pounds —Raw Value)

<u>Years</u>	<u>Yearly Average</u>	
1880-1890	44	
1890-1900	56	
1900-1910	65	
1910-1920	82	
1920-1930	100	
1930-1937	95	(Note: Decrease due to the Depression.)
1939	103.2	

There has been no more significant change in the diet of humans throughout our

evolution than the advent of agriculture. Before agriculture, some 12,000 years ago, the lifestyle of the earth's inhabitants was that of 100% hunters and gatherers. Agriculture had spread to such a degree that, by 1500 A.D., only 1% of the world's population was hunters and gatherers.ⁱⁱⁱ

“Generally, in most parts of the world, whenever cereal-based diets were first adopted as a staple food, which replaced the primarily animal-based diets of hunter-gatherers, there was a characteristic reduction in stature, a reduction in life span, an increase in infant mortality, an increased incidence of infectious disease, an increase in diseases of nutritional deficiencies (i.e., iron deficiency, pellagra), and an increase in the number of dental caries and enamel defects. There is now substantial empirical and clinical evidence to indicate that many of these deleterious changes are directly related to the predominately cereal-based diets of these early farmers. Since 99.99% of our genes were formed before the development of agriculture, from a biological perspective we are still hunter-gatherers.”^{iv}

In 1993, Phillips stated that starchy legumes have been consumed by humans since the earliest practice of agriculture 12,000 years ago and have been ascribed medicinal and cultural, as well as nutritional, roles. They are an important component of the diet in the developing countries in Africa, Latin America, and Asia, where they are especially valuable as a source of dietary protein to complement cereals, starchy roots and tubers. Legumes contain 20-30% protein, and legume starch is more slowly digested than starch from cereals and tubers and produces less abrupt changes in plasma glucose and insulin levels. Starchy legumes are also valuable sources of dietary fiber.

Starchy legumes should be a valuable component of a healthy diet, but their consumption is constrained, according to Phillips, by low yields, the lack of convenient food applications, and flatulence.^v That is an unfortunate evaluation of such an important food source but a viewpoint held by most of the medical and nutritional communities of developed countries. That view is particularly true here in the United States, where our diet has been steadily moving away from such whole foods as legumes, fresh fruits and vegetables, and nuts and seeds, and toward ever more processed foods. In addition, most of these processed foods contain added sweetener.

Dr. Sabin, the renowned scientist and inventor of the Polio vaccine, wrote in the June 28, 1947 issue of the *Journal of the American Medical Association*: "I offer the following explanation: Advanced sanitation and hygiene are, as a rule, to be found in the wealthier countries. Advanced sanitation and hygiene have helped prevent such diseases as typhoid fever, cholera, malaria, and tuberculosis, because the environment has been controlled by purification of water and milk, by drainage of swamps, by proper sewage disposal, and the organisms responsible for these diseases have been "kept away from our doors." The fact that polio has not been prevented by advanced sanitation and hygiene indicates that its incidence is controlled and influenced by factors quite different from the

factors that bring about the spread of typhoid and the other diseases. One of the unfortunate evils that accompany wealth is the consumption of sugar in the form of luxury foods such as ice cream, candies, soft drinks, cakes, pies, pastries, and the like. The poorer countries cannot afford such luxury foods, sanitation or hygiene. That is how I would explain the greater incidence of polio in countries with advanced sanitation and hygiene.”^{vi}

Refined sugar was introduced to Japan after the U.S. Civil War, and the Japanese used it as a medicine. By 1906, 45,000 acres of sugar cane were cultivated in Japan. As the Japanese consumed more sugar, the onset of "western" diseases began to increase. In 1960, Sakurazawa, a renowned Japanese physician noted, "No Western doctor can cure diabetes, even thirty years after the discovery of insulin." In 1964, Sakurazawa, now more convinced of the detriments caused to our health by sugar said, "I am confident that Western medicine will admit what has been known in the Orient for years: sugar is without question the number one murderer in the history of humanity-much more lethal than opium or radioactive fallout. Sugar is the greatest evil that the modern industrial civilization has visited upon the countries of the Far East and (Africa genocide)...foolish people who give or sell candy to babies will one day, to their horror, have much to answer for."

Dr. Sakurazawa's comment will sound like hyperbole to many. However, in the 19-year period from 1979-1998, the total deaths caused by opiates and related narcotics in the United States was found to be 22,735, according to the Centers for Disease Control.^{vii} But in one year, 1999, diabetes directly killed 68,396 Americans, making it the sixth leading cause of death.^{viii} (In addition, diabetes is believed to be under-reported on death certificates.) According to data from the Third National Health and Nutrition Examination Survey, about 16 million people in the United States have diabetes, and over 5 million of these people are unaware that they have the disease. Each year, an estimated 12,000–24,000 people become blind because of diabetic eye disease, more than 38,000 people begin treatment for kidney failure, and about 86,000 others undergo diabetes-related amputations of the lower extremity. The direct and indirect costs of diabetes are estimated at nearly \$100 billion a year.^{ix}

Sadly, soft-drink consumption has also now become common-place among American toddlers. About one-fifth of the nation's one-and two-year-olds now drink soda. "In one of the most despicable marketing gambits," Michael Jacobson, author of "Liquid Candy," a 1999 study by the Center for Science in the Public Interest, reports, "Pepsi, Dr. Pepper and Seven-Up encourage feeding soft drinks to babies by licensing their logos to a major maker of baby bottles, Munchkin Bottling, Inc."^x A 1997 study published in the *Journal of Dentistry for Children* found that many infants were indeed being fed soda in those bottles.^{xi}

Far more resources have been put toward marketing and sales of often times

inappropriate foodstuffs than on the impact of nutrition on our health. In 1975, more than ten years after Sakurazawa's strongly worded comments, Gortner, a western-trained physician, examined the state of nutrition in the United States. He wrote, "Only a few medical studies of nutritional status have been conducted on a national or even a regional basis. These extend back less than two decades, though dietary information is available back to the 1930's and statistical data on use of food in the United States can be found beginning with 1909." ^{xii}

Modern science has unraveled many of the complex processes of our metabolism. When we eat, the process of digestion converts food into glucose, which is carried in the blood to the pancreas, where the increased blood glucose level stimulates the production of insulin. The insulin is then carried through the blood to the liver, where excess glucose is converted to glycogen, which is stored in the liver. Consumption of refined sugar products over-stimulates the pancreas, which causes over-production of insulin and converts too much glucose into glycogen. Over time, as the pancreas tires of producing insulin to counteract the consumption of excess dietary sugar, the insulin supply becomes inadequate in this manner, and the liver can no longer effectively convert excess glucose to glycogen. Our blood sugar begins to rise significantly. This condition is known as diabetes.

The only country where actual statistics relate diabetes to the consumption of sugar is Denmark. *{This is an amazing fact given the thousands of research studies completed every year!}* In 1880, the average Danish citizen consumed over 29 pounds of refined sugar annually (compared to 44 pounds in the United States). At that time, the recorded death rate from diabetes was 1.8 per 100,000. In 1911, 31 years later, consumption more than doubled to 82 pounds per person/year, and the death rate from diabetes rose to 8 per 100,000. In 1934, sugar consumption rose to 113 pounds per person and the death rate from diabetes rose to 18.9 per 100,000. Before World War II, Denmark had a higher consumption of sugar than any other European country. It is interesting to note that people in Denmark also have cancer rates higher than other countries in Western Europe. The following table shows the extreme differences in sugar consumption in various parts of the world, and it should be readily noted that the countries with the lowest sugar consumption are also the most lacking in sanitation and hygiene. ^{xiii}

SUGAR CONSUMPTION BY GEOGRAPHICAL DIVISIONS

(Crop Year Sept. 1, 1938, to Aug. 31, 1939)

Per Capita Consumption (Pounds —Raw Value)

Sweden	119.3	China	3.2
Australia	114.5	Java	11.6
United Kingdom	112.6	Other Asia	13.0
United States	103.2	Rumania	14.6

Canada	102.9	Spain	17.2
Holland	89.4	Egypt	20.4
Switzerland	85.1	Italy	21.3
Argentina	71.0	India	24.3
Germany	63.3	Poland	29.8
Brazil	51.7	Mexico	37.1

[Beyond the scope of this paper, but interesting nonetheless: In 1966 Ziegler looked at sugar consumption as a possible cause of accelerated growth related to the fields of nutritional physiology and medical history.^{xiv} It might appear to some observers that there is indeed a direct relationship between per capita consumption of sugar and mean height of the population. I found no other research to support or disprove this thesis.]

The United States government acts through long-standing legislative action to support the production of sugar by U.S. farmers. The following represents only a small portion of that governmental legislation. Two points should be noted in review of the legislation. First, Title II has been in effect since 1949. Second, the commodity price for raw cane sugar will not be allowed to fall below 18 cents per pound but ensures an abundance of sugar on the world market, thus keeping the true cost of sugar artificially low. That represents a vast difference in cost to the consumer as compared to the \$565.00 per pound cost (in today's dollars) that sugar commanded in the 16th century. (One pound of sugar equals 113 teaspoons.)

Further evidence that increased consumption of sugar is due in part to its decreased cost was found when Drewnowski, et al, examined the association between diet quality and estimated diet costs. They found that diets high in fat, sugar, and grains were associated with lower diet costs. Each additional 100g of fats and sweets was associated with a 0.05–0.40 per day reduction in diet costs. In contrast, each additional 100g of fruit and vegetables was associated with a 0.18–0.29 per day increase in diet costs. From these findings they concluded that diets high in fats and sweets represent a low-cost option to the consumer, while healthier diets cost more.^{xv}

SEC. 901. SUGAR PRICE SUPPORT.

Title II of the Agricultural Act of 1949 (7 U.S.C. 1446 et seq.) (as amended by section 701 of this Act) is further amended--

(1) in the matter preceding subsection (a) of section 201 (7 U.S.C. 1446), by striking 'honey, and milk' and inserting 'honey, milk, sugar beets, and sugarcane' and

(2) by adding at the end the following new section:

SEC. 206. SUGAR PRICE SUPPORT FOR 1991 THROUGH 1995 CROPS.

(a) IN GENERAL- The price of each of the 1991 through 1995 crops of sugar beets and sugarcane, respectively, shall be supported in accordance with this section.

(b) SUGARCANE- The Secretary shall support the price of domestically grown sugarcane through no recourse loans at such level as the Secretary determines appropriate, but not less than 18 cents per pound for raw cane sugar.

(c) SUGAR BEETS- The Secretary shall support the price of each of the 1991 through 1995 crops of domestically grown sugar beets through no recourse loans at such level for each such crop as the Secretary determines reflects--

(1) an amount that bears the same relation to the support level for the crop of sugarcane under subsection (b) as the weighted average of producer returns for sugar beets bears to the weighted average of producer returns for sugarcane, expressed on a cents per pound basis for refined beet sugar and raw cane sugar, for the most recent 5-year period for which data are available; plus

(2) an amount that covers sugar beet processor fixed marketing expenses.

(d) Adjustment in Support Price-

(1) IN GENERAL- The Secretary may increase the support price for each of the 1991 through 1995 crops of domestically grown sugarcane and sugar beets from the price determined for the preceding crop based on such factors as the Secretary determines appropriate, including changes (during the 2 crop years immediately preceding the crop year for which the determination is made) in the cost of sugar products, the cost of domestic sugar production, and other circumstances that may adversely affect domestic sugar production.^{xvi}

Currently, Americans consume about 64 pounds of sugar per person per year, according to the USDA's Continuing Survey of Food Intake of Individuals, which is considered the standard for food consumption data. Perhaps somewhat surprisingly, sugar consumption has decreased from a peak of approximately 102 pounds per person in 1970. That trend is deceiving, though often quoted by the American sugar industry in an effort not to be linked to the accelerating epidemics of obesity and diabetes found in the United States.

During this same period, the U.S. Department of Agriculture food consumption tables show that the consumption of High Fructose Corn Syrup (HFCS) has increased more than 1000%. Overall, the total caloric sweetener levels have increased 30% from 1970 to 2000 due entirely to the increased consumption of corn sweeteners found in over 90% of processed American foods.^{xvii} That represents a 463% increase in corn sweetener consumption in less than 30 years and a total of 48.5 teaspoons of sweetener per person, or .43 pounds per day.

USDA CALORIC SWEETENER FOOD SUPPLY AND AVAILABILITY

Pounds per person, per year:

	1970	1999	% Change
Purified Sugar	102	69	-32%

Corn Sweetener	19	88	+463%
All Other	1	1	0
TOTAL	122	158	+30%

Converted to teaspoons per person, per day:

	1970	1999	% Change
Purified Sugar	32	21	-35%
Corn Sweetener	6	27	+450%
All Other	0.5	0.5	0
TOTAL	38	48.5	+28%

To understand the role that corn sweeteners play in the current typical American diet, it is helpful to understand the tremendous increase in corn refinement technology that has occurred since the U.S. Civil War. According to the Corn Refiners Association, corn refining began in the United States with the development of the process for cornstarch hydrolysis. Prior to this time, the main sources for starch had been wheat and potatoes. In 1844, the Wm. Colgate & Company began operating the first dedicated cornstarch plant in the world. By 1857, the cornstarch industry reached significant proportions in the U.S., but starch was still its only product. The industry's largest customer was the laundry business.

The next major event in the history of corn refining was the production of dextrose from cornstarch in 1866. Dextrose is a form of sugar. Corn syrup technology advanced significantly in 1921 with the introduction of enzyme-hydrolyzed products. In the mid-1950's, the technology for commercially preparing products such as malt dextrin syrups was developed. The purification and crystallization of dextrose meant that for the first time corn-based sweeteners could compete in some markets that had been the sole domain of the sugar industry.

The next development involved the enzyme process that changed dextrose to fructose, another form of sugar. The first commercial shipment of high fructose corn syrup (HFCS) took place in 1967. The fructose content of the syrup was around 15 percent. Further research enabled the industry to develop the first commercial shipment of HFCS-42 (42 percent fructose syrup) a year later. Further refinements in the process were developed in the late 1970's, and by the 1980's; HFCS became the sweetener of choice for the soft drink industry in the U.S.^{xviii}

It should come as no surprise that the increasing consumption of sugar and related products has been directed towards children. Eric Schlosser, author of the New York Times bestseller, *Fast Food Nation*, states:

In 1978, the typical teenage boy in the United States drank about seven ounces of soda every day; today he drinks nearly three times that amount, deriving 9 percent

of his daily caloric intake from soft drinks. Soda consumption among teenage girls has doubled within the same period, reaching an average of twelve ounces a day. A significant number of teenage boys are now drinking five or more cans of soda every day. Each can contains the equivalent of about ten teaspoons of sugar. These sodas provide empty calories and have replaced far more nutritious beverages in the American diet. About twenty years ago, teenage boys in the United States drank twice as much milk as soda; now they drink twice as much soda as milk. "America's schools now loom as a potential gold mine for companies in search of young customers. 'Discover your own river of revenue at the schoolhouse gates,' urged a brochure at the 1997 Kids Power Marketing Conference. 'Whether it's first-graders learning to read or teenagers shopping for their first car, we can guarantee an introduction of your product and your company to these students in the traditional setting of the classroom.'"^{xxix}

The largest soda drinks are 64 ounces. These are the “Big Gulps” that almost all convenience stores sell. They are 5.33 times larger than a 12 oz can of soda. Each of these “Big Gulps” contains approximately 61.29 teaspoons of HFCS. It takes less than two of these large sodas to provide over one pound of sugar/sweetener. To put that into perspective, consider sitting down to a plate of 133 cubes of sugar instead of those two big gulps. You would actually be eating fewer calories! Now, imagine serving that plate of sugar to your children.

Gillis, et al, sought to identify particular foods or food groups that may be associated with obesity in children and adolescents and to determine if consuming food away from home (FAFH) has an effect on the nutritional quality of their diets. She found that obese children and adolescents consumed significantly more servings of meat and alternatives, grain products, FAFH, sugar-sweetened drinks and potato chips which contributed to a higher calorie, fat and sugar intake compared to non-obese children and adolescents. Sugar-sweetened drinks were only significantly greater in boys. Furthermore, the consumption of meat servings, sugar-sweetened drinks and FAFH were positively correlated with percent body fat. Obese children and adolescents, she concluded, need to limit their access to food consumed away from home and sugar-sweetened drinks, as there is a relationship between these foods and body fatness.^{xx}

Health & Human Services Secretary Tommy G. Thompson concurs when he states that, "Obesity and diabetes are among our top public health problems in the United States today."^{xxi} A report in the October, 2002 Journal of the American Medical Association found that 30.5% of Americans are obese, up from 22.9% a decade ago, and nearly two-thirds of the U.S. population are overweight. Obesity raises the risk of

heart disease, cancer, diabetes, high blood pressure, angina, and lung disease, among other ailments.

In 1999, ADD/ADHD was considered the leading mental health problem among children in the United States according to the Southern Medical Journal. This was a subjective assessment, but one that recognized a widespread disorder that deserves our fullest scrutiny not only to treatment protocols of ADHD, but also to understand the underlying causative factors. Prevalence estimates for ADHD and ADD are between 3% to 7% of school-aged children.^{xxii} Wender and Solanto tried to link an increase in aggressive behavior in ADHD children to sugar ingestion. They compared 17 ADHD children with 9 normal children to assess the affects of sugar ingestion. They provided sugar or placebo challenges as part of a high carbohydrate breakfast. Inattention increased only in the ADHD group following sugar ingestion. The ADHD children showed no change following placebo, and the control group showed no change at all. According to this study, sugar ingestion will exacerbate inattentiveness in some ADHD children.

Langseth and Dowd found that 74% of 261 hyperactive children in their study had abnormal sugar metabolism. These children displayed reactive hypoglycemia, or low blood glucose levels, after eating refined sugar. What happened metabolically was that the large ingestion of sugar caused a surge of insulin to be released by the pancreas. This caused, in reaction, a significant decrease in blood sugar levels accompanied by a surge in the epinephrine levels.^{xxiii} It was thought that perhaps the epinephrine, also known as adrenaline, was the causative factor.

Girardi found that sugar ingestion triggered other metabolic abnormalities in ADHD children. His team at Yale gave a standardized oral glucose challenge to 17 children with ADHD and 11 control children and compared the results. Baseline and oral glucose-stimulated plasma glucose and insulin levels were similar in both groups, including the glucose level bottoming out at 3-5 hours after oral glucose ingestion. This drop in glucose stimulated a rise in plasma epinephrine and norepinephrine in both groups. However, the rise in the ADHD children was nearly 50% lower than in the control children. Both groups showed deterioration on the continuous performance test in association with the late fall in glucose and rise in epinephrine. However, the drop in test scores in ADHD children was significantly greater. ADHD children also had quicker reaction times than normal children, which corresponds with impulsivity. This study suggests that children with ADHD have a general impairment of hormone regulation. It appears that sugar may accentuate this defect.^{xxiv}

There is another effect of eating refined sugar. Table sugar depletes nutrients. It provides no nutritional benefit other than calories, but it requires many other nutrients to process through our metabolic pathways, thereby depleting the child's nutritional base. For example, excessive soda consumption in childhood can lead to calcium deficiencies and a greater likelihood of bone fractures later in life.

In 1985, Wolraich published the most influential study demonstrating that sugar plays no role in ADHD. Wolraich's team examined 16 hyperactive children in a hospital setting

for three days. The researchers manipulated the sugar content of their diet, but found no effects on behavior or learning. The same group later published a review article and concluded, “the few studies that have found effects

have been as likely to find sugar improving behavior as making it worse.”^{xxv}

There have been many critiques of Wolraich’s study from so many different sources it is difficult to assign credit. However, it has been noted that 16 boys is a very small sample size. If even 10% of the ADHD population is sugar sensitive, and the number is very likely much less, a sample of 16 boys may not contain a single child who was sugar sensitive. A “hospital setting” is also not a normal environment for young boys. Just because a child can maintain himself in a controlled environment such as a hospital doesn’t mean that he would function the same way at school or at home. And “three days” is also a very short time. If the effects of sugar were additive, say over the course of a week, then the study would miss this process. For example, as in the case of nutrient deficiency leading to bone fracture, if a child’s ADHD is caused or exacerbated by a lack of certain nutrients, this would not necessarily happen during a three-day test in the hospital.

In 1994, Milich examined 31 children whose mothers felt they were sugar sensitive. He gave all 31 children a sugar-free drink. However, he told only half of the mothers that their child’s drink contained sugar. The mothers who thought that their child had received the sugar drink all rated their child as being more hyperactive. These mothers also were more critical of their children and hovered over them more. Milich concluded that the parental expectations about the affects of sugar are the cause of the perception that sugar makes children more hyperactive.^{xxvi} Interestingly, though, is the fact that Milich was also the co-principal investigator on a study entitled, "The Effects of Refined Sugar on Behavior in Hyperactive Children." The study was sponsored by a grant from the Sugar Association.^{xxvii}

While there is no concrete evidence that sugar causes ADHD, the evidence against this notion is also not very strong either. As previously described, ADHD children frequently have abnormal sugar metabolism. Eating sugar does affect learning and behavior negatively, particularly after a low protein carbohydrate meal, even in normal children. And the metabolism of sugar drains the body’s reserve of other vital nutrients. It is very likely that the medical researchers are correct, that sugar ingestion does not cause ADHD. However, it is clear that refined sugar does exacerbate some of the ADHD symptoms such as inattentiveness and possibly aggression in many children.

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