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ABSTRACT OF THESIS

NUTRIENT AND MEDICATION INTAKE OF CHILDREN WITH NEURODEVELOPMENTAL DISORDERS

The incidence of autism continues to rise with no cure or understanding of the cause of the disorder. Approximately one in 150 children will be diagnosed with an (ASD) Autism Spectrum Disorder although recent prevalence data suggest one in 91. The objective of the study is to assess medicinal intake regarding prescription and nonprescription medications of children with Autism Spectrum Disorders and its affect on their nutritional status compared to age, and sex matched healthy children. The study included families of children with autism in which they completed questionnaires and 24-hour recalls. There were 26 children used within the questionnaire and 13 were utilized in the 24-hour recall, ranging in age from 2-11. Results demonstrated that children with autism were not deficient in relation to vital nutrients needed for neurological function. Prescription and nonprescription medications also did not pose many side effects; however, there was slight weight gain in their utilization. Information from the assessments of the child's nutritional needs and drug nutrient interaction will allow parents, paraprofessionals and healthcare professionals to provide education to families.

KEY WORDS: Autism, CAM, prescription, nonprescription, nutrition

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December 2, 2009

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NEURODEVELOPMENTAL DISORDERS

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THESIS

Cristina Elizabeth Hiten

The Graduate School
University of Kentucky
2009

NUTRIENT AND MEDICATION INTAKE OF CHILDREN WITH
NEURODEVELOPMENTAL DISORDERS

THESIS

A thesis submitted in partial fulfillment of the
requirements for the degree of Master of Sciences
College of Agriculture
at the University of Kentucky

By

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Chapter 1: Introduction

First described in the scientific literature in 1943 by Dr. Leo Kanner, autism was reported in relation to a child's inability to relate themselves to their surroundings. The American Psychiatric Association describes autism as a neurodevelopmental disorder with characteristics of impaired reciprocal social interaction, impaired verbal and nonverbal communication, and appearance of repetitive stereotypic activities, behaviors, and interests, which can range from mild to disabling (1). Autism usually begins during infancy, at the latest, in the first three years of life. Because of its links to genetics and neural development and the abnormalities related to social interaction, autism offers a vast array of opportunities for health professionals and beyond to study (2).

The hallmark feature of children with autism includes impaired social interaction. Parents are usually the first to recognize the symptoms. As early as infancy, a baby with autism may be unresponsive to people or focus on one item for long periods. They may fail to respond to their name and avoid eye contact. They have the tendency to misunderstand social cues, such as facial expressions or tone of voice. Many children with autism have a reduced sensitivity to pain; however, they are abnormally sensitive to touch, sound, or other stimulation involving the senses (3).

Children with autism tend to have an oral motor deficit, which affects the musculature of the mouth. This includes the jaw, lips, as well as the tongue. The causes of oral motor disorders include incorrect motor programming. This happens

when the brain sends a message to the muscles of the mouth, but the muscles do not receive the message or it is misinterpreted causing the muscles to not move at all or move incorrectly. The second is low muscle tone, where the muscles of the jaw, lip, or tongue are weak. This can lead to difficulty drinking from a straw or frequent spilling of liquids when drinking due to a weak lip (4) creating situations that are of major concern to dietitians and nutritionists.

The weakness of muscles from the jaw, lip, or tongue can have an impact on the ability to chew and swallow food. Weak musculature may also affect the ability to remove food from silverware along with the prevention of losing food from the mouth. Weak musculature can impact the gag reflex resulting in episodes of choking, possibly leading to a child's willingness to eat altogether, creating a feeding disorder. When a child is faced with unsuccessful eating patterns due to choking, gagging, or spending long amounts of time at the table, their motivation when eating is reduced (4).

ASDs, similar to other neurodevelopmental disabilities are not "curable." Even though outcomes and characteristics change over time, most children with ASDs will remain within the spectrum through adulthood and regardless of intellectual function, will experience problems with employment, mental health, independent living, and social relationships. Therefore, it is vital that goals are set to minimize the core deficits, such as maximize independence and quality of life and alleviate family distress. It is also noted that socialization should be promoted along with educating family and friends regarding these goals (5).

Autism is a common condition listed in a group of developmental disorders also known as the autism spectrum disorders (ASDs). Within the autism spectrum disorders are Asperger syndrome, Rett syndrome, childhood disintegrative disorder, and pervasive developmental disorder-not otherwise specified, referred to as PDD-NOS (3).

Autistic Disorder

The child has delays or abnormal functioning in social interaction, language, or play by age three. As far as social interaction, in order to be diagnosed, a child must meet at least two of the following characteristics described by the DSM IV (2):

- Impairment in the use of nonverbal behaviors, such as eye-to-eye gaze
- Failure to develop peer relationships
- Lack of seeking to share enjoyment with others
- Lack of social or emotional reciprocity

Pertaining to communication, at least one of the following will occur:

- Delay in, or total lack of, spoken language
- Inability to initiate or sustain a conversation with others
- Repetitive use of language
- Lack of make-believe or imitative play

Behavior will manifest by one of the following:

- Preoccupied with one or more patterns of interest
- Adherence to nonfunctional rituals or routines
- Repetitive motor mannerisms
- Preoccupation with parts of objects

Asperger

There is no clinically significant delay in language, cognitive development, or development of self-help skills. Diagnosis regarding social interaction and behavior are viewed the same as autistic disorder, however, there are no clinically significant delays regarding language in the communication field.

Rett

There is normal prenatal development within this category and apparent normal development for the first five months with a deceleration of head growth between 5 and 48 months. Within the field of social interaction, there is a loss of social engagement seen early in the course even though social interaction develops later. At a communication level, the child has severely impaired expressive and receptive language development along with severe psychomotor retardation. Behaviorally, children with Rett's Disorder have a loss of previously acquired hand movements that serve purpose, along with poor coordinated gait or trunk movements.

Childhood Disintegrative Disorder (CDD)

Normal development for at least the first two years of birth is seen with CDD along with a significant loss of previously acquired skills before age ten. When viewing social, communication, and behavior, the diagnosis of CDD coincides with autistic disorder.

Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS)

This category of autism is used when pervasive impairment in social interaction and communication along with the presence of stereotyped behaviors of interest when criteria are not met for a specific disorder.

Therapies

No cure is available for children with autism; however, many therapies and behavioral interventions have been designed to remedy specific behaviors. Health professionals recommend that intervention should begin as early as possible. The National Institute of Neurological Disorders and Stroke lists the following interventions.

- Educational/behavior interventions
 - Highly structured and skill-oriented training sessions to help children develop language and social skills
 - Includes family counseling for parents as well as siblings of children with autism
- Medications
 - Doctors often prescribe antidepressant medication in an effort for children with autism to handle symptoms of possible anxiety, obsessive-compulsive disorder, and even depression.
 - Drugs typically used for treating children with attention deficit disorder are sometimes used in an effort to decrease hyperactivity and impulsivity
- Other therapy
 - Parents are told to use caution when considering other therapies not recommended by their physician due to the lack of research

Etiology

Etiology of autism remains unsolved. Current hypotheses include genetic abnormalities (6), abnormal brain development (7), maternal and perinatal factors (8), environmental insult (9) and a few others.

Prevalence of Autism

Prevalence is a measure used to identify a number of cases of a disease or condition in a defined group of people over a defined period of time. Through monitoring those with Autism Spectrum Disorders, it is possible to find out whether the prevalence is increasing, decreasing, or demonstrating no change (10).

Due to the changing criteria when diagnosing children with autism, it has presented to be a challenge in getting an accurate number, as one must consider those on all aspects of the spectrum. Another issue when gathering data is that the United States has not had a population-based system to track the full ranges of ASDs over time. Autism and related disorders are diagnosed through behavioral observation of development, which makes describing the population even more difficult, especially with changing criteria (10).

Currently, 1 in 150 children are diagnosed with autism. Although recent studies put the rate at one in 91 (11), boys are four times more likely to be diagnosed with autism than girls with 1 in 94 boys on the spectrum. Sixty-seven children are diagnosed each day with a new case diagnosed every 20 minutes. More children will be diagnosed with autism this year than with AIDS, diabetes and

cancer combined which makes autism the fastest growing developmental disability in the United States (12).

An estimated economic cost associates autism with approximately 90 billion dollars a year and is expected to double in the next decade. These costs include education as well as treatment to help reduce the symptoms of the disorder. Knowing the prevalence of ASDs can allow providers to plan for the funding and resources. These may include therapy, trained teachers, health care providers, and related service professionals. This knowledge can also raise awareness and educate those with children who have been newly diagnosed (10).

Medicinal Impact

Of the many etiological theories regarding autism, nutrition and medication use can play an active role in a child's life. For example, a child with an iron deficiency may have symptoms of irritability, reduced ability to learn, as well as a short attention span. All of which are characteristics of a child with autism (13).

Data suggests that approximately 58 percent of patients with a diagnosis of autism receive some type of pharmaceutical treatment. The use of age data suggests that approximately 70 percent of children with autism spectrum disorders ranging from 8 years old and up will receive some form of psychoactive medication in a given year. Although there is no real medication treatment guideline regarding autism spectrum disorders, the use of medications has substantially increased over the years. Aman and others in 2005 reported large increases in medication use from 1993-2001 (14). The drug class showing the largest increase was

antidepressants. Another study suggested that the most commonly prescribed medications were 66 percent antipsychotics, 32 percent antidepressants and 17 percent stimulants (15).

Antipsychotics, the highest rated prescribed medication, had an increased number of office visits within the United States by youth. This increase was approximately 201,000 in 1993 to 1,224,000 in 2002. From 2000 to 2002, the number of visits for antipsychotic treatment was significantly higher for male youth than female youth as well as higher for white non-Hispanic youth than for youth of other racial or ethnic groups. The majority of diagnoses were disruptive behavior disorders (37.8%), mood disorders (31.8%), pervasive developmental disorders or mental retardation (17.3%), and psychotic disorders (14.2%) (16).

Almost all medications have side effects appearing to be endless with a tendency to influence nutrition. In the use of atypical antipsychotics, such as Clozaril, Zyprexa, Risperdal, Seroquel, Abilify, and Geodon, children are more prone to weight gain. The most common side effects with antipsychotics include dry mouth, photosensitivity, as well as constipation. The less common side effects include diarrhea, nausea, headache, sleeplessness, and weakness. Many of these side effects can affect a child with autism who is already impaired due to their disorder (17) and interfere with nutritional status.

Complementary and Alternative Medicine

Some parents resort to non-traditional treatment options such as complementary and alternative medicine (CAM) therapies. Examples of CAM that impact nutrition status include therapeutic doses of vitamin, mineral or herbal supplements, restrictive diet patterns, and non-traditional medical procedures such as chelation therapy.

Utilization of CAM often represents an attempt by parents to gain a sense of control over their child's chronic illness or disability and improve their child's quality of life (18). Actual benefits of these therapies are complicated to assess in a research setting. Efficacy research studies regarding most CAM alternatives suffer from difficulty in developing a placebo, inability to mask single or double blind, lack of availability of valid outcome measures, and small treatment effects which require long-term trials with large numbers of patients (19).

Although national estimates indicate approximately 2% of all typical children receive CAM (20), studies in children with autism indicate a much higher utilization rate. Levy (21) and colleagues in 2003 indicate 31.7% of children with autism were receiving some type of CAM therapy. Of these children, 16.9% were receiving a biological treatment with no nutritional basis in theory (including vitamin supplements), 15.5% were using a biological treatment with some nutritional basis in theory (including a gluten and casein free diet or secretin administration), and 8.8% were using a nutritional treatment that had potentially harmful biological implication (including chelation, and cod liver oil administration).

Between 1990 and 1997, the estimated expenditure on CAM in the United States increased by 45.2% to 21.2 million dollars and to 90 million dollars by 2001. There are numerous views why parents are choosing to use CAM for their children with autism. One reason for utilizing CAM may be that even though many treatments, both conventional and unconventional, have been explored, there still is not one single intervention that has been proven in eliminating the core symptoms of ASD. In addition, families turn to CAM due to the fact that many children with ASD do not have the access to treatments in their area (22).

Parents also have reported that they seek out CAM because they want more emotional and physical comfort and feel that those who provide CAM have a more hands-on approach to care. Individuals feel that simpler and less invasive approaches to treatment are important for the health and well-being of their child. The use of a more “natural” remedy rather than a “manufactured” or “artificial” approach could prove to be more beneficial. These alternative therapies, such as vitamin mega doses, do not require prescriptions, approvals from insurance, constant visits to the doctor’s office or specialists, have lesser side effects and are cost effective and easily accessible (22).

Internet use for Health Information

Computer literate patients are now more than ever seeking to take control of their health through the use of the Internet in an effort to seek out information related to illness and treatment. Despite the concerns regarding the integrity of the health information, Americans are using the Web in retrieving information in an

effort to gain knowledge in understanding and managing their diagnosis. The National Telecommunications and Information Administration indicated that in the year 2000, 44% of individuals had access to the Internet. This percentage increased during the year 2002 to 54% and was projected to exceed 80% by the year 2005. The number of Internet users within the United States is estimated to be between 122 million and 166 million. With this increase in Internet use, there is evidence that it is increasing within certain populations such as the poor, the less educated, the elderly, as well as minority groups (23).

In a study conducted in England, the views of parents concerning their perceptions of the process of being diagnosed of an autistic spectrum disorder were reviewed. At the time of diagnosis, most of the parents preferred quicker results and an easier process. They also requested greater professional training regarding ASD, specifically regarding information possessed by the professionals. The idea of information sheets at the time of diagnosis would have been useful, especially in an effort to prevent parents from finding information via unreliable sources (24).

Autism leads to developmental delays and nutrition can be an intervening factor in slowing the poor outcomes of cognitive and physiological delay. Prescription and non-prescription medication use has been on the rise and plays an important role including the aspect of nutrition. Many of the medications children with autism are taking, have a positive correlation with nutritional intake. Medications influence appetite, metabolism of nutrients, as well as their nutritional status in general (13). Parents, who have not been educated on the role of

medication use and its affect on nutrition, seek interventions and information from less than credible sources. It is important for parents to realize that they can influence their child's nutritional status, allowing the child to realize the importance of eating well and staying healthy.

The purpose of the study is to assess medicinal intake regarding prescription and nonprescription medications of children with Autism Spectrum Disorders and its affect on their nutritional status compared to age, and sex matched healthy children. The information gathered will be used in educating parents who have children with autism and practitioners in order to answer questions and/or clarify misconceptions they may have with a newly diagnosed child.

Chapter 2: Literature Review

Theories Surrounding Autism

The theories about the cause of autism are endless without any concrete answers. Parents at times are feeling overwhelmed by new studies and suggestions as they will do whatever it takes to make their child autism free. The impairments of a child with autism affect their nutrient intake and eating behaviors. Some of them generally eat only specific foods, have hypersensitivities to texture, temperature, color and/or smell, and have a hard time transitioning due to the inability to accept a change in environment. Many children with autism have normal growth parameters; however, their dietary patterns place them at risk for marginal to inadequate nutrient intake. Resistance to vitamin and mineral supplementation is very common as well (25). Many experts combine environmental and genetic factors as the cause. As the debate on the cause of autism heats up, many have become passionate regarding the issue as they have a family member or know of someone linked to autism.

Vaccinations

One theory commonly discussed for the cause of autism is vaccines. Vaccines and autism have been linked twice with the first regarding the Mumps-Measles-Rubella (MMR) vaccine. The vaccine may cause intestinal problems leading to autism's development. The MMR vaccine does not contain thimerosal, currently but does contain three live viruses and is given around the same time that autism becomes evident in a child that is diagnosed. The concern became apparent when a British gastroenterologist, Dr. Andrew Wakefield, found a link between the measles

virus in the gut and autism. The theory entails that certain children have a predisposition to immune issues causing environmental toxins to attack a child's immune system early on. Furthermore, the child develops a leaky gut, the immune system is weaker, tissue damage is worse, and the autoimmune reaction starts. When the immune system is overwhelmed, the child suffers from the effects of autism (26).

A second theory is linking thimerosal, a mercury-based preservative that was used between the late 1980s to 2003. The type of thimerosal used is cleared from the body within six weeks, rendering it harmless. There are researchers however, that feel that some babies during that period were genetically incapable of clearing the doses from their body. Many discussions on the Internet link the recent rise in autism cases to thimerosal. The discussion continues and the removal of thimerosal from vaccines has not lowered the autism vaccine connection. For some parents who are concerned about the effect of thimerosal, vaccines are now available, thimerosal-free (27).

Brain Size

Researchers have found a difference between autistic brains and the typical brain in which autistic individuals tend to have a larger brain. They have also found that they are programmed differently. The University of Pittsburg has ongoing research regarding the issue. A University of Louisville researcher, Manuel Casanova, may have found a link between autism, ADHD, and dyslexia. A decade ago, Casanova and his colleagues earned a National Institute of Health EUREKA

prize valued at \$888,000 in the form of a grant. His research identified differences in brain tissue known as cortical cell minicolumns. These minicolumns connect brain signals, which in turn process information. In people who have autism, there was an abundance of short connectors, and deficiencies of long ones were found. Those that are considered long are those that process complex information (28).

Analyzing MRI brain scans of fifteen dyslexic patients, Casanova discovered that the dyslexic brains were exactly the opposite of the autistic brains. It was found that the autistic brains were larger with the dyslexic brains smaller and with fewer wrinkles. The dyslexic brains also had an abundance of long connections between the cortical cell minicolumns, at the expense of short ones. Casanova is following up with research through a clinical trial using high frequency magnetic waves. This would in turn help those with dyslexia to make the short connections, allowing them to read easier. Already utilizing a similar therapy using low magnetic waves on autistic individuals, he has found success. If this is utilized and proven beneficial, this could lead to treatment that does not involve the use of prescription medication (28).

Genetics

Autism is also considered to have a genetic component. Studies have shown that parents who have autistic family members are more likely to have autistic children. Families with one autistic child are at an increased risk of having more than one autistic child (26). Research has focused on genetic causes due to the rise of families who have multiple children with the disorder. Approximately, 10

percent of autism cases have a known genetic cause. Boston researchers think there might be a gene glitch that accounts for 1 percent of the disorder. The finding was a segment of chromosomes that were either missing or duplicated in people with autism. This segment includes genes that are linked to brain development as well as various developmental disorders. In some cases, the gene was inherited in others, a result of random genetic accident (29).

Dr. Andrew Zimmerman, director of the Kennedy Krieger Institute's Center for Autism & Related Disorders in Baltimore, Maryland, predicted that children who were newly diagnosed would be tested for the defect located on chromosome 16; however, more DNA samples are needed to potentially reveal other gene variations in relation to autism. When the biological pathways are determined, scientists will have a better understanding when it comes to designing drugs to target chemicals in the brain (29) that will not impede nutrition status while treating autism.

A study conducted at the Children's Hospital Boston by Dr. David Miller, scanned all 46 chromosomes from DNA samples from 1,441 children with autism or related disorders. They also scanned DNA samples from most parents and 2,800 other people, not known to have autism. Researchers found a 25-gene segment of chromosome 16 was missing in five children with autism with none of their parents demonstrating the missing link, demonstrating that some cases are not genetically inherited, but a random accident during sperm and egg formation. Additionally, seven autistic children had chromosome 16 duplication with all but one parent having the same duplication (29).

Serotonin

The imbalance of serotonin in the body is believed to cause many of the characteristics noted in autism. Serotonin is responsible for regulating many functions within the body such as mood, sleep, speech, body temperature, appetite, and sensory integration. Low levels of serotonin can also affect migraines, depression, PMS, insomnia, obsessive-compulsive behavior and panic attacks. If there is an imbalance, one can imagine the impact it must have on an individual. When an imbalance occurs, the neurotransmitter, serotonin, does not properly carry the message to the appropriate area of the brain. The serotonin instead is prematurely taken away for reuse in the re-uptake process thus not allowing the brain to receive and make sense of an incoming message. Serotonin is synthesized in the chromaffin cells of the gut, specifically 80 percent (30).

The chemicals and neurotransmitters have a vital role in the function of the brain and the rest of the body as examples such as dopamine, serotonin and norepinephrine are dependent on proper digestion. When these neurotransmitters are not functioning properly, the likelihood of a malfunctioning digestion system increases. Children with autism tend to pose issues regarding digestion and stool abnormalities and have chronic indigestion and gas. In a group of randomly selected autistic children, 40 percent were found to have bulky, odorous, loose stools or diarrhea. Many parents also report that their child appeared to have worsening behavioral symptoms due to gastrointestinal problems (30).

Gastrointestinal Tract

Gastrointestinal examinations on children with autism found that signs of chronic inflammation in the gut, esophagus, stomach, and duodenum are seen. Due to enzymatic deficiencies, many children have trouble digesting and absorbing carbohydrates, which could potentially be linked to the loose stools and gas. When children with autism have digestive difficulties, it is noted that behavior changes occur such as aggression, irritability, as well as the potential for waking up during the night (30).

Scientists have begun to make a connection to the gut and brain in relation to autistic-type behavior within a laboratory setting through compounds produced in the digestive system. This could prove that the brain function in an autistic child could be altered through what they eat. The University of Western Ottawa investigated the “gut-brain” connection due to families reporting increased improvements in behavior once their diet was modified, removing wheat and dairy products. Dr. Derrick MacFabe, director of a research group at UWO in London, Ontario, was interested in finding a link between certain compounds produced by bacteria within the digestive system. These compounds usually occur during early childhood infections. The bacteria produce propionic acid, a short chain fatty acid. The bacteria are found in dairy and bread products (31).

In order to test their theory, researchers gave the compound to rat’s brains. The rats immediately began to demonstrate repetitive behavior as well as hyperactivity and impaired social behavior. These behaviors are typically seen in

children with autism. The rat's brains were reviewed under a microscope and inflammatory responses were seen just as those in the brains of children with autism. Dr. Martha Herbert, assistant professor in neurology at Harvard Medical School, states that parents should monitor what they feed their child in an effort to determine which foods trigger their reactions and proceed to remove them if necessary. Herbert recommends a balanced diet, not only of bread and cheese, but also of all food groups. The recommendation is that if the child is sensitive to certain foods in relation to their immune system, which can affect brain function, that the food should be removed (31).

There is also the hypothesis regarding a child with autism having a "leaky gut." The theory centers on the integrity of the intestinal mucosal lining also referred to as the intestinal mucosal barrier. In children with autism, there is the theory that the intestinal mucosa is abnormally penetrable. During the digestion process, natural foods, such as cow's milk and bread, are able to enter the blood through the leaky mucosa, inducing antigenic responses as well as interfering with the central nervous system. A defect in the passage of neuroactive peptides of food origin are found within the blood then travel into the cerebrospinal fluid, interfering with the central nervous system (32).

A relationship is hypothesized between the behavior of children and adults with autism and food reactivity and sensitivity. Gluten and casein contain peptides, which are suggested in playing a role in the origin of autism. These substances may have a physiological and psychological effect due to the excessive opioid activity

linked to these peptides. Research through Millward et al. has found that those with autism had abnormal levels of peptides in the urine as well as cerebrospinal fluid. When high levels of peptides deposit into the urine, a small portion of the excess peptides cross into the brain. This crossing leads to interference of signal transmission as well as a disruption in normal activity (33).

One study by Knivsberg et al., 2002 argued that peptides from gluten and casein have a negative pharmacological effect on behaviors such as social interaction, learning, and attention. If children and adults with autism were placed on a diet that was appropriate, it would aid them in cognitive functioning, brain maturation, social interaction, and learning. If the theory is true regarding a gluten free and/or casein free diet, then the symptoms associated with autism should be reduced (34).

Elder et al. in 2006 conducted a study looking at the gluten-free, casein-free diet in autism. Fifteen children diagnosed with ASD ranged in age from 2-16 years. Purposive sampling from the Center for Autism and Related Disabilities and/or Child Psychiatry Services at the University of Florida's Department of Psychiatry and Brain Institute chose them. The sample consisted of three girls and twelve boys. A research assistant trained in videotaping techniques, video-taped each child interacting with their primary care-taking parent during 15 minute sessions. Trained coders used the video footage to obtain behavioral counts of the parent and child. Status of subjects was unknown to coders with regard to the treatment phase.

Symptoms that were measured included social responding, non-speech vocalizations, social initiating, and intelligible words spoken (35).

Results showed that parents of seven children reported that there were marked improvements in the child's language along with decreased hyperactivity and tantrums. Parents of nine of the children decided to keep the child on the GFCC diet even when there was not empirical support for its continuance. A larger scale study would be beneficial for further research (35).

The nutrition connection to autism is further theorized in discussions that excess dietary iron is responsible for the increased rates of autism and allergies. Enzyme therapy, vitamin therapy, and the ketogenic diet are also included in the debate and as subjects of studies. In some cases of autism, food allergies or sensitivities, which lead to behavioral issues, appear to be involved with autism (36).

Complementary and Alternative Medicine

“Biological treatments” or “biomedical treatments” are also part of the discussion that supports a nutrition metabolic interaction. These treatments are proposed to alter physiology or change the symptoms of autism by manipulating metabolic processes. Typically, they are administered via parenteral, oral, or topical modes and exclude treatment involving prescription medications used to treat traditional behavior or medical disorders. Many complementary and alternative medicines are not “biological,” however; they have the ability to alter physiological processes such as touch, manipulation, movement, or other senses. Some medical

practitioners have formulated a group called Defeat Autism Now! otherwise known as DAN. There are suggestions from the DAN! practitioners to use nutritional supplementation which include, special diets, avoidance of allergenic foods, treatment of bacterial/yeast overgrowth, and detoxification of heavy metals (21).

Complementary and alternative medicine are defined by the National Center for Complementary and Alternative Medicine, as “a group of diverse medical and health care systems, practices, and products that are not presently considered to be part of conventional medicine” (5). Immune factors have been studied regarding some cases of autism specifically using complementary and alternative medicine as a hypothesis. The assumption is that the symptoms of autism are linked to brain damage secondary to immunologic response to infection or autoimmunity and immune deficiency. Although evidence for an immune deficit in children with autism is inconsistent, several CAM therapies connect immune mechanisms in an effort to justify their use (21).

The use of CAM in children has become more prevalent. A study of families in the Washington, D.C. area found that 40 percent of parents reported using CAM themselves and 21 percent used CAM with their children. CAM has also been utilized in children with chronic illnesses including cancer and cystic fibrosis (37). The use of CAM, specifically, in children with autism spectrum disorders, is very common. One study found that by the time the clinical population received a formal diagnosis suspecting ASD, one third of the population had already been given some form of complementary and alternative therapy. A survey later found that 92

percent of parents who responded had used CAM therapies on their child with ASD. Surveys also indicated that only 36 to 62 percent of caregivers who used CAM informed the primary care physician (5).

Healthcare providers need to realize the importance of the use of CAM and recognize how to evaluate the evidence of its effectiveness. This should include peer-reviewed studies with diagnosed, study populations, random double-blind study, adequate sample size, the use of a control, and validated outcome measures (5). They also need to familiarize themselves with current therapies available to parents of children with autism through various sources such as the Internet, alternative health practitioners, and medical and informational meetings. Another issue needing to be addressed is the doctor-patient relationship as it relates to parental beliefs regarding the cause of autism. Parents of children with autism have little confidence that most doctors know enough to treat children with autism. Some physicians are unwilling to participate in treatment regimens that are not evidence based. Parental concerns about treatment or complaints worsen and cause them to begin seeking advice from individuals with little to no knowledge (38).

An example of CAM therapy is categorized as “biological.” These examples include dietary restriction of food allergens, detoxification therapies such as chelation, gastrointestinal treatments, and dietary supplement regimens that supposedly work on immune factors. These supplements include vitamin A and C, vitamin B₆ and magnesium, folic acid, folinic acid, vitamin B₁₂, dimethylglycine and trimethylglycine, carnosine, omega-3 fatty acids, inositol, various minerals, and others (5).

Chelation

Chelation is a controversial treatment for children with autism and other disorders. The treatment was originally for children with lead poisoning where a child is dosed with several chemicals that bind and excrete mercury and other toxic heavy metals. However, chelation therapy can also bind and remove essential nutrients such as iron, chromium, selenium, and calcium from the body. The therapy has caused controversy even though some experts have recommended chelation. There are studies showing increased exposure to mercury and other heavy metals however, few studies have been conducted demonstrating improvements using this therapy and reports of at least two deaths have resulted.

Recommendations to minimize the stress of chelation, if used, include the use of multivitamin and mineral supplements in an effort to replace lost nutrients. One example is the use of cilantro extract, which has been suggested as causing a naturally binding effect to toxic heavy metals such as mercury and lead. The evidence is not strong for this CAM product, although practitioners are beginning to recommend the herbal extract to patients undergoing chelation therapy (39).

Vitamin B₁₂

Vitamin B₁₂ deficiency has been known to impair nervous system development; this is according to the theory that impaired intestinal absorption of the vitamin results in impaired nerve function, specifically. The dietary form of vitamin B₁₂ is absorbed in the ileum of the small intestine. The ileal mucosa in autistic patients has the potential to interfere with transport process in the ileal absorptive cells. When absorption is inhibited, the vitamin B₁₂ in the blood is low, interfering with the formation of myelin. Myelin is needed for normal conduction of action in nerve fibers. Researchers observed that vitamin B₁₂ absorption was reduced in all eight autistic individuals participating in a study (32).

Vitamin B₆ and Magnesium

Studies indicate that vitamin B₆ as well as magnesium supplements have a positive impact on autism spectrum disorders. Magnesium levels in the blood were found to be lower in children with autism and it has been reported that magnesium supplementation has been beneficial to those with ADHD. Some children with autism may suffer from anxiety or depression. Vitamin B₆ has the ability to increase GABA and serotonin in the blood as well as reduce dysphoric or unhappy mental status (40).

Minor side effects of CAM and medications include nausea, diarrhea, or hyperactivity. Nausea can result if the medication is taken on an empty stomach; therefore compounding nutritional concerns. Research reports indicate that a small number of children who took very large doses of B₆ suffered from peripheral neuropathy, causing numbness of the hands and feet. Dr. Bernard Rimland of the

Autism Research Institute recommends that children receive approximately 8mg of vitamin B₆ per pound of body weight each day or 500mg for a 60-pound child (41).

Research indicates that 50 percent or more of those treated with supplements made significant improvements. Some of whom have been only on the supplements within a matter of days. A major study conducted in 1968 revealed that of 16 children with autism, 75 percent of them made dramatic improvements due to the intake of vitamin B₆. Three of the participants spoke for the first time. Other changes included better eye contact, greater interest interacting, and fewer outbursts consisting of temper or emotion. Although participants were not cured, their ability to function increased. The study overall demonstrated that through the use of vitamin B₆ along with normal doses of magnesium that a person with autism could have better control, behaviorally, than with prescribed medication. A survey from the Autism Research Institute found that parents felt the supplementation was beneficial with 50 percent seeing improvements utilizing the B₆ and magnesium combination, while 45 percent saw no effect and 5 percent stated their child became worse (42).

Omega-3 Fatty Acids

Another supplement suited for possible beneficial effects revolved around omega-3 essential fatty acids. Omega-3 fatty acids are among the most commonly used complementary and alternative medication therapies, currently used by 28.7 percent of children with autism (43). However, many modern diets tend to be deficient in omega-3 fatty acids and in the 1970s, it was discovered that omega-3

fatty acids were essential to human health. Omega-3 has the ability to affect the structure of brain cells and affect the way the brain cells work; therefore, supplementation has been proven beneficial in patients with depression, schizophrenia, and postpartum depression (44).

Two cases have been published with families noting large improvements in the core feature of autism when supplemented (43). There have been minimal studies demonstrating the success of omega-3 supplementation; however, research has shown that children with autism tend to have lower levels of the omega-3 fatty acids versus typical children, suggesting that normalizing the omega-3 fatty acid levels could lead to improvements in symptoms seen in children with autism (44).

Folic Acid and Vitamin B₉

Folic acid has made it into the literature as a possible nutrient involved in autism. An increased use of folic acid is recommended during pregnancy in the prevention of neural tube defects, however, researchers question if there are downsides to the increased amount. Normal fetal development apart from closure of the neural tube, depends on folate intake, however, scientists are wondering if the increased intake of folic acid has a link to autism (45).

Vitamin B₉ or folate is critical to brain function and synthetically can be found in fortified food and supplements. Folinic acid, a derivative product, can be processed more rapidly into a specific type of foliates which can be directly transported to the brain. Folinic acid can be used to increase glutathione, an antioxidant, in the brain of children with autism. It also has the ability to increase

the level of dopamine that may prove to be beneficial in children with autism. Critical in cell production and maintenance, folic acid can help prevent DNA changes that can lead to cancer. Folate is also useful in treating conditions such as depression. Persons with depression are more likely to have low levels of folate and taking a supplement may reduce depressive symptoms in some cases. Along with taking vitamin B₉, the addition of B₆ and B₁₂ can play a role in the treatment of depression (46).

Of all B vitamins, people are the most deficient in B₉. When deficient, an individual may notice slow physical growth, tongue inflammation, loss of appetite, gingivitis, forgetfulness, diarrhea, shortness of breath, mental sluggishness, and irritability. Long-term use of antibiotics has the ability to deplete levels of vitamin B₉ in the body. It is found naturally in dark leafy greens such as spinach as well as beets, lima beans, white beans, soybeans, Brussels sprouts, avocados, milk, and orange juice. Folate is more effective when taken with vitamin C. One researcher found that 250 mcg per pound of body weight daily resulted in improvement for some children with autism. At the Autism Research Institute, 48 percent noted improvements compared to 44 percent who saw no effect and 8 percent who stated their child became worse (41).

Vitamin C

Vitamin C has many vital functions, including a cofactor in the conversion of tyrosine to dopamine, an antioxidant, and it regulates cellular immune function. The use of supplementation of vitamin C increases a calming effect, through the

brain's response to the neurotransmitter dopamine. The reduced behavior was noted with people and when tested on animals. This same behavior can be noted among those with autism spectrum disorders. Children with autism are also deficient in vitamin C as they have lower levels in their body than the typical child does. Another theory is antioxidant benefits. It has been thought that children with autism have a difficult time managing free radicals in their body. Free radicals have the ability to cause damage to the immune system as well as the brain and other parts of the body. Vitamin C has the ability to protect against the effects of free radicals decreasing potential damage (47).

Another effect of vitamin C is its use among those who suffer from schizophrenia or depression. It has been shown to have a beneficial effect on the patient's symptoms. Persons with autism have been linked to having depression as well as an inability to function socially and high doses of vitamin C have been shown to aid in those symptoms. A study conducted in 1991, using adults and adolescents with autism found that a dose of 8,000 mcg of vitamin C a day demonstrated increased improvement. In 1993, another study was conducted in order to find out whether vitamin C would be beneficial for those with autism. The results showed that although vitamin C was not as effective as the use of vitamin B₆, a high dose could potentially prove to be beneficial. A 2004 study was conducted in which the gastrointestinal problems seen in children with autism were improved as well as their sleeping patterns, when using vitamin C (41).

Researchers from the Autism Research Institute found that 46 percent of parents thought that vitamin C demonstrated improvement in their child while 51 percent saw no change and 2 percent saying their child grew worse. Since vitamin C is a water-soluble vitamin, it can be taken in rather large doses without any serious side effects. However, in high doses, it can act as a laxative, leading to dehydration. The tolerance of vitamin C is different from person to person and other medical conditions should be taken into account before starting a patient on supplementation (47).

Dimethylglycine (DMG)

Dimethylglycine (DMG) is a dietary supplement that also has been reported to be beneficial in children with autism (48). Studies have typically been informal, however, adding the supplement has suggested improving speech and other factors when taken with vitamin B₆ and magnesium. DMG has also demonstrated the ability to suppress seizures in people with epilepsy. There are clinical trials that suggest the enhancement of muscle energy and decreased factors that contribute to muscle cramping. There are studies that link DMG to the immune system as it has the potential to ward off Salmonella. Other claims to DMG include improvement in eye contact, frustration tolerance, speech, social behavior, and aggression (49).

On the other hand a study conducted by Kern et al., examined the effectiveness of DMG. The study used thirty-seven children between the ages of 3 and 11 who had a diagnosis of autism and/or pervasive developmental disorder. The participants were gender and age matched and assigned randomly to receive

placebo or dimethylglycine for 4 weeks. Assessments were conducted using two behavioral measures, the Vineland Maladaptive Behavior Domain and the Aberrant Behavior Checklist. Overall improvement was measured regarding all aspects of behavior for groups, placebo and supplement. The findings demonstrated that the use of the supplement was not significantly different in children observed who received the placebo (48).

Medications and Autism

Medications can have multiple effects on the body's absorption, retention, metabolism, as well as nutrient status. Adverse reactions can be provoked in combination with certain foods having the ability to influence appetite, by either repressing it or artificially stimulating it. Certain medications have the ability to increase the absorption of nutrients, or more commonly, decrease absorption, which can sometimes lead to clinical deficiencies. Medications can also induce mineral and vitamin deficiencies by their mode of action and transport (50).

Drugs affect our use of food just as food affects the use of drugs. Food is capable of affecting drug absorption in a number of ways. Food can impact subsequent distribution and metabolism of drugs. Vitamins can interfere with drug effectiveness, especially if taken in large doses. However, large doses of certain vitamins have the ability to counter certain toxicity conditions or a specific secondary deficiency induced by a genetic disease (50).

The treatment of autism includes not only behavioral therapy modifications, but pharmacologic therapy. There has been a lack of data in the use of medications in those with pervasive developmental disorders. Within the last 10 years, clinical research has increased in an attempt to provide data regarding efficacy and safety as a way to support the use of these medications. There is increased evidence that atypical antipsychotics have the ability to treat symptoms associated with PDDs including aggression, self-injury, and irritability while data for others are limited (51).

Antidepressant medications, selective serotonin-reuptake inhibitors, are primarily used to treat anxiety, depression, or other obsessive-compulsive symptoms in patients with PDD. They are typically prescribed for those who exhibit severe behavioral problems including irritability and aggression. Medications for those with seizures or mood disorders are prescribed anticonvulsants. Those with attention deficit disorders are given stimulant medications. Other medications include beta-adrenergic blocking agents, alpha-adrenergic agonists, mood stabilizers, anticholinesterase inhibitors, anxiolytics, and naltrexone (52). In autism, all of these symptoms may be present.

Atypical Antipsychotics

Atypical antipsychotics have gained popularity as a new treatment option for those with PDD, which include Risperidal, Zyprexa, Seroquel, Geodon, Abilify, and Clozaril. Risks do appear such as weight gain and an increased risk for metabolic syndrome (51). Metabolic syndrome is a combination of risk factors that include

insulin resistance, hypertension, abnormal blood lipids, and abdominal obesity that has the ability to increase an individual's risk for developing heart disease (53).

Antipsychotic drugs work by influencing how information is transmitted between brain cells. An adult brain has over 10 billion nerve cells called neurons with each neuron containing a fiber called an axon. Axons are responsible for transmitting information to other neurons and they make contact with other neurons in the body. As information travels down the axon, an electrical impulse occurs. When this impulse reaches the end of the axon, a small amount of neurotransmitter is released allowing information to be passed to the next cell down the line. There is a receptor at the receiving cell that detects the neurotransmitter causing the message to be received generating a new impulse. Sometimes there is excessive activity of the cells sensitive to the neurotransmitter, specifically dopamine; therefore, antipsychotic drugs block receptors so that communication between groups of cells is reduced (54).

Risperidal (risperidone)

Risperidone was the first atypical antipsychotic to be rigorously studied demonstrating consistent efficacy (51). It is thought to work by muting the impact of dopamine and serotonin, the brain's key chemical messengers. Side effects related to nutrition include, abdominal pain, constipation, diarrhea, decreased activity, increased sleep, indigestion, nausea, over activity, sleepiness, vomiting and weight gain. Evening primrose causes an interaction with risperidone as well (55).

One study, conducted by Research Units on Pediatric Psychopharmacology Autism Network, lasted eight weeks and evaluated the safety and efficacy of risperidone in children with autism. A total of 101 patients were enrolled with 49 being assigned to risperidone and 52 assigned a placebo. After the eight-week treatment period, those treated with risperidone had significantly decreased their irritability score compared with those who took the placebo. However, the most common side effect was increased appetite, lethargy, and sedation, all of which having the potential to effect nutrition. Those on risperidone experienced an average weight gain of 5.1 +/- 3.6 kg over 6 months or 11.22 +/- 7.92 pounds. This was a significant gain versus those receiving the placebo. A separate study found that risperidone had a 2.7 kg versus 1kg weight gain where increased appetite, tachycardia, and increased systolic pressure were reported. Weight gain was also evident in a study conducted by Luby et al. in which a 2.96 kg +/- 2.53 kg weight gain was observed (56).

Zyprexa (olanzapine)

Zyprexa is another type of antipsychotic used for children with autism. Zyprexa works by opposing the action of serotonin and dopamine. Their nutritional side effects include abdominal pain, constipation, dehydration, drowsiness, dry mouth, fever, increased appetite, indigestion, insomnia, nausea, restlessness, weight gain, dental pain, diabetes, sleepiness, sore throat, swelling of arms and legs, thirst, and vomiting. Sometimes Zyprexa can cause drowsiness, impairing judgment, thinking and motor skills and drinking plenty of fluids is recommended while taking

this medication. Avoidance of alcohol should be noted as, in combination, a drop in blood pressure could occur (55).

In a study utilizing Zyprexa, the most prominent adverse events were increased appetite and weight gain in 6 subjects and sedation in 3 subjects. The mean weight gain increased from 137.5 pounds at baseline to 155.9 pounds after 12 weeks of treatment. In another study comparing Zyprexa to haloperidol, weight gain was significantly higher in Zyprexa ranging from 5.9 to 15.8 pounds versus -5.5 to 8.8 pounds in those taking haloperidol. Another study involving 11 subjects demonstrated a weight gain of 7.5 pounds (56). Kemner also noticed a weight gain during their 12-week open-label trial of 25 children with autism. There were a reported 14 cases each of weight gain, general weakness, and increased appetite. The average weight gain was 5.8 kg or 12.76 pounds (51).

Geodon (ziprasidone)

A third type of atypical antipsychotic used is Geodon, working the same way as it opposes the action of serotonin and dopamine. Geodon is typically prescribed when other medications have proven to be inadequate. Nutritional side effects include, abdominal pain, constipation, diarrhea, drowsiness, dry mouth, indigestion, nausea, bleeding gums, coordination problems, difficulty swallowing, high blood sugar, increased sensitivity to sound or touch, involuntary or jerky movements, low blood sugar, muscle pain and weakness, thirst, vomiting and weight gain. The medication may cause drowsiness, which can impair judgment, thinking, and motor skills (55).

A study using 12 subjects was reviewed. Transient sedation was the most common adverse event with a mean change in weight being -5.8 pounds. The weight loss was linked to a number of subjects who were switched from other drugs that had caused substantial weight gain. The weight gain noticed in previous therapy was 9.1 to 45.5 kg (56). Cohen et al. conducted a 6-month study and found that eight patients lost weight at -5.95 +/- 0.45 kg, however, one patient gained 4.5 kg and another had stable weight post treatment (52).

Seroquel (quetiapine)

Seroquel is another medication used to combat delusion, hallucinations, disrupted thinking, and loss of contact with reality. It is the first in a new class of antipsychotics. It works by diminishing the action of dopamine and serotonin. Nutritional side effects include abdominal pain, constipation, diminished movement, drowsiness, dry mouth, indigestion, tremor, uncontrollable movements, weakness, difficulty breathing, loss of appetite and weight gain. This medication also tends to cause drowsiness, impairing judgment, thinking, and motor skills. It can also increase the effects of alcohol (55).

There are not many published studies regarding Seroquel, however, Martin and colleagues conducted a 16-week study in six children and adolescents with autism. Three subjects withdrew due to sedation and one dropped out due to a possible seizure. Increased appetite and weight gain, 2 to 18 pounds, was reported. It was concluded that Seroquel was poorly tolerated in this group. In another study,

significant improvement was noted with adverse reaction being mild, which included sedation, sialorrhea, and weight gain (56).

Possible Weight Gain

It is not surprising that weight gain is seen in these studies regarding the medications prescribed. Children on psychiatric drugs can easily gain a substantial amount (57). The most concerning aspect of these drugs is that they are not yet approved for children. The drugs also include a long list of side effects ranging from abnormal limb and body movements, seizures, and rapid heart beat. At times, the drugs are prescribed “off label.” Antipsychotics were also the highest earning class of drugs last year bringing in approximately 14.6 billion dollars (58) and raising doubts about its misuse to fuel the profit margin especially with autism being the fastest growing disorder.

In one study, children gained up to 20 pounds leading them into obesity within 11 weeks. The percent range of those who became obese was between 10 and 36 percent. The study involved 205 New York City area children ranging in age from 4 to 19 who had been recently prescribed one of the antipsychotic drugs. Those drugs prescribed included Abilify, Risperdal, Seroquel, and Zyprexa. Of the four, Zyprexa and Seroquel, not yet approved for children, had the worst side effects regarding weight and cholesterol. However, a government advisory panel voted in favor of dosing it for children with the drug companies making “off label” recommendations (57).

Dr. Christopher Varley has noticed growth in patients between visits. Although weight gain is seen as a possible side effect for antipsychotic drugs, a new study is finding that the older children and teens are more prone to the weight gain than adults. Increases in blood fats including cholesterol were also viewed in not only adults but children as well. Weight gain is seen as a contributing factor and there is increased worry that the children will be more prone to heart disease as they get older (57).

Drug makers state that the drugs do pose problematic side effects but emphasize the overall benefit of the patient coping with various behaviors. The new class of drugs is overall safer than its predecessors, which at times caused permanent involuntary muscle twitches and tics. The number of children using these drugs has increased substantially to more than 2 million annually (57).

Johns Hopkins brain scientists, however, think they have found the reason for weight gain, as they believe they have found the connection between antipsychotics and brain chemicals that trigger appetite. Previous research had found a particular enzyme, AMPK, was increased in brain cells, acting as the control lever for appetite in mice and essentially humans. There was a suspicion that AMPK would spike when antipsychotic medications were taken, causing the brain to overact. In order to prove this, the Johns Hopkins team injected mice with Clozaril, Zyprexa, and Risperdal. The mice that were given Clozaril had quadrupled their levels of AMPK compared to pre-drug use. Histamine, a cell-signaling protein, is also being studied as it relays information from cell to cell. Typically, it is used to trigger

allergy symptoms, however, it activates AMPK the same way Clozaril does. When given Clozaril to mice, without a histamine receptor, they found no heightened AMPK activity. This could be a potential breakthrough in researching weight control and possibly aid in creating drugs that suppress appetite safely (59).

Dietitians have the ability to play an important role in weight control in those taking antipsychotics. A research team from Universite Laval's Faculty of Medicine and Robert-Giffard Hospital demonstrated weight gains as much as 30 kilos in one month. Therefore, their idea was to design a special weight control program. A psychiatrist and kinesiologist supervised the researchers. The effectiveness of the program was used on a group of 59 patients suffering from schizophrenia and psycho-affective or bipolar disorders having used antipsychotic medications for an average of three years (60).

A 90-minute session regarding healthy eating and physical activity was implemented. The participants then took part in two one-hour workout sessions once a week for an 18-month period. Exercises included aerobic and muscle building supervised by the kinesiologists. At the end of the study, those who were in the weight control program saw their average weight, waist size and body mass index decrease by 4 percent or more. The levels of HDL cholesterol went up 21 percent while LDL cholesterol decreased by 14 percent. Triglycerides also decreased by 26 percent (60).

Nutrition plays a vital role in the medication use of children with autism. Already suffering from a long list of behavior and feeding issues, medications should allow individuals to have a level playing field. The decision for parents on what medications to dose is a difficult one as research is of top priority. Therefore, much research needs to be conducted to obtain answers, scientifically, rather than through other measures.

Chapter 3: Research Objectives

The objectives of the study are fourfold:

1. To assess the nutritional intake of children with autism in comparison to the typical child
2. To examine the sources parents use to collect information regarding drugs, prescription and nonprescription
3. To determine the extent to which parents use complementary and alternative medicine as intervention
4. To examine the amount of weight gain due to the use of prescription medications

Hypotheses

H1: Parents will use complementary and alternative medicine more than prescription drugs in the treatment of a child with autism

H2: Over half of the parents will note a weight gain of four pounds or more in their child in relation to prescription drug use

H3: More than half of the parents will utilize the Internet as their only source of information when researching various drugs both prescription and nonprescription

H4: Children with autism will demonstrate deficiency in vitamin B₆, magnesium, calcium, and vitamin B₁₂ compared to the typical child

Chapter 4: Methodology

The study has been approved through the Institutional Review Board at the University of Kentucky and all study administrators have completed the research integrity training. Consenting families received an initial consultation in the research office located in 212 Funkhouser Building. Study consent forms were explained and parents were given time to ask questions before being enrolled in the study. Anthropometric measurements were taken of the child including a height, weight, head circumference, waist to hip ratio, and triceps skin fold measurement. A comprehensive nutritional health history along with a prescription and nonprescription history for the child were obtained. These histories recorded maternal and perinatal patterns, oral health, history of chewing and swallowing problems, medication and supplement use, and gastrointestinal symptoms.

A 24-hour recall of the child examined was recorded. A 24-hour recall is a method of dietary assessment in which an individual is asked to remember everything eaten within the last 24 hours. The items are to be very specific regarding amounts and types of foods. The individual gathering the data analyzes the information. Several problems occur when using this method of data collection. The first is an inability to remember, specifically, the kinds and amounts of foods eaten. The second is difficulty in determining whether the day represents a typical day in their life. The third is the tendency to over report low intakes and under report high intakes of food. The use of food frequency and 24-hour recall questionnaires aid in improving accuracy (25).

The multiple pass method was used to administer the 24-hour recall. This method allows the interviewer to trigger memories in the individual that recall what foods they have eaten in a specific period. In a 5-Step Multiple Pass Method, the first step includes having the individual list all the foods they have eaten in no particular order, specifying a 24-hour time frame, midnight to midnight for instance. One food per line typically is written. The next step is to allow individuals to recall or remember foods forgotten that may have been eaten within the 24-hour period giving participants time to respond. The third step includes asking about special occasions or functions that they might have attended. This could include a specific meal or snack and activities with the family. It is oftentimes beneficial to give some examples of activities. Next, go back through the foods obtaining details such as the brand name of the food, how it was prepared, with or without bones or skin, frozen, raw or canned, and how much was eaten. The last step is to have the participant look over the recall to see if anything else needs to be added (61).

An abbreviated questionnaire regarding medications currently taken by the child was completed. A more thorough questionnaire concerning medications and the use of complementary and alternative medicines (CAM) was administered to a wide pool of families via listservs, which include families who have children with autism including The KYautism, Autism Society of the Bluegrass, and FEAT. The questionnaire focused primarily on parental perceptions of the success or failure of the medication, side effects such as weight gain or weight loss, decreased appetite, and recommendation of nonprescription drugs and its effects within the last two years.

The electronic program, SurveyMonkey, created structure for the questionnaires. The survey was divided into several constructs when analyzing the results. The first construct regarded the use of prescription and nonprescription drug within the last two years. Two years was utilized in order to give the most recent drug utilization. This is due to children with autism being prescribed a variety of drugs as well as parents trying various over the counter products. The second construct enabled parents to choose from a listing of the top prescription and nonprescription options mostly used in children with autism. If a drug was not listed as an option, the parent had the opportunity to list what their child was taking. The third construct focused on any type of side effects that they noticed in taking either prescription or nonprescription drugs.

The next construct questioned the effectiveness of the prescription and nonprescription drug as well as if the prescription drug caused any weight gain. The responses were listed on a Likert-like scale. The last construct was in reference to the initial recommendation of the nonprescription drug as well as the likelihood that the parent reported its use with a healthcare professional, primarily the child's physician.

The questionnaire was pre-tested with a total of 10 families and graduate students, within the Nutrition and Food Science Department, in an effort to determine the validity of the questions. Data gathered within the SurveyMonkey questionnaire in regards to prescription use was ranked according to the top prescriptions utilized today as reported by various research articles where limited

studies have been conducted regarding their use. The top complementary and alternative medicines were analyzed for parents' report of their effectiveness on the child along with the impact of the medication on nutritional intake. This data allowed for the collection of the parent's perceptions of the various medications used within the two-year period.

The 24-hour recall regarding nutritional information was collected from children with autism and compared to the intake of typical children reported under the United States Department of Agriculture between 2005-2006. The data was utilized as a comparison between children with autism and typical children, specifically looking at essential vitamins and minerals. These levels were compared to the recommended dietary allowance (RDA) or adequate intake (AI) in an effort to see where each child lies in nutritional status. This will also allow us to recognize if there is a significant difference between the nutritional intake and nutritional deficiency, specifically in regards to a child with autism.

Statistical Analysis

Data was analyzed using the statistical package for the social sciences, otherwise known as SPSS 16.0. Statistical tests were applied, specifically regarding the nutritional intake of typical children versus the child with autism. The nutrients that were analyzed include those in direct relation to autism spectrum disorders as previously mentioned, such as vitamin B₆, magnesium, calcium, etc. Significance was assumed at the .001 level.

Subjects

In regard to the online survey through SurveyMonkey, 26 parents completed the questionnaire. The children represented all ages of autism spectrum disorders and their parents or caregivers were sent questionnaires via listserv. Some of the subjects were recruited to participate at an annual fall festival for children with autism as well. All children in the study population had a diagnosis of autism, Asperger syndrome or pervasive developmental disorder – not otherwise specified from a certified physician or clinician. The results were tested for frequency in regards to the five constructs reported earlier. Relationships were analyzed and the results are to follow.

The total number of responses regarding 24-hour recalls was 15; however, the quantity of children used was 13. The age category had to be taken out as p-values were giving the same results across the board. Typical children were matched from the USDA nutritional intake survey by age and gender to the children with autism (62). In analyzing the data, each vitamin and mineral was categorized by the recommended daily allowances as below normal, normal, or above normal levels. The nutritional status was then reviewed in the child with autism and the typical child, found within the USDA study. Proper RDAs for males and their age ranges were maintained and taken into consideration. The data was then analyzed using SPSS version 16.0.

Inclusion Criteria – Experimental Study Population

- Male or female children between the ages of 1-14 years old with a clinically documented diagnosis of autism, Asperger syndrome, or pervasive developmental disorder – not otherwise specified, and their parents or legal guardians
- Children were healthy and had no other medical diagnosis that would impact nutrition status
- Children and their parents or legal guardians must be a resident of the State of Kentucky
- Children were not institutionalized but lived in the family home

Inclusion Criteria – Control Study Population

- Male or female children between the ages of 1-14 years old with no suspected or clinically documented diagnosis of autism, Asperger syndrome, or pervasive developmental disorder – not otherwise specified and their parents or legal guardians

Chapter 5: Results

The first section of review pertains to the constructs. Data was collected from parents who have children with autism. The survey was made available through SurveyMonkey and sent out to three various autism society listservs. A fall festival for children with autism was also held in an effort to obtain data from those parents in attendance. The questionnaire regarded the use of prescription and nonprescription drugs pertaining to specific drugs used, their side effects, the quantity used, and the source of information for utilizing the drugs. Responses were analyzed and evaluated based upon frequency.

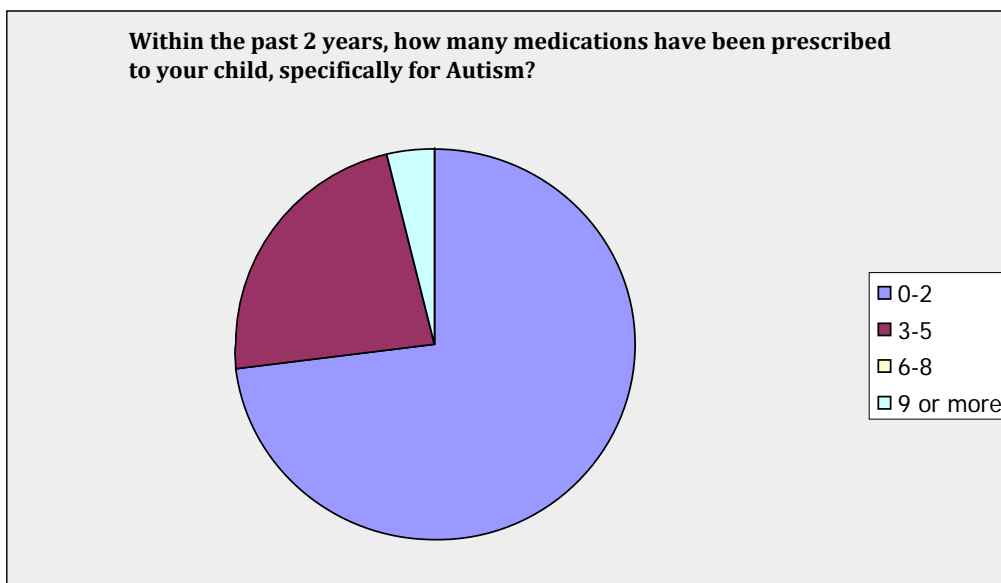
Construct 1: Prescription and Nonprescription Drugs and Number Used

Table 5.1: The Quantity of Prescription Medications Prescribed to a Child with Autism

Within the past 2 years, how many medications have been prescribed to your child, specifically for Autism?		
Answer Options	Response Percent	Response Count
0-2	73.1%	19
3-5	23.1%	6
6-8	0.0%	0
9 or more	3.8%	1
Answered question		26
Skipped question		0

Of the 26 people who responded, all 26 were utilized. Table 1a indicates that the percentage of those using 0-2 medications was 73% (n=19). Of the 26 participants, 23% used 3-5 medications (n=6). Within the category of 6-8, the responses were 0% (n=0). Those who used 9 or more medications yielded 3.8% (n=1).

Figure 5.1: The Quantity of Prescription Medications Prescribed to a Child with Autism



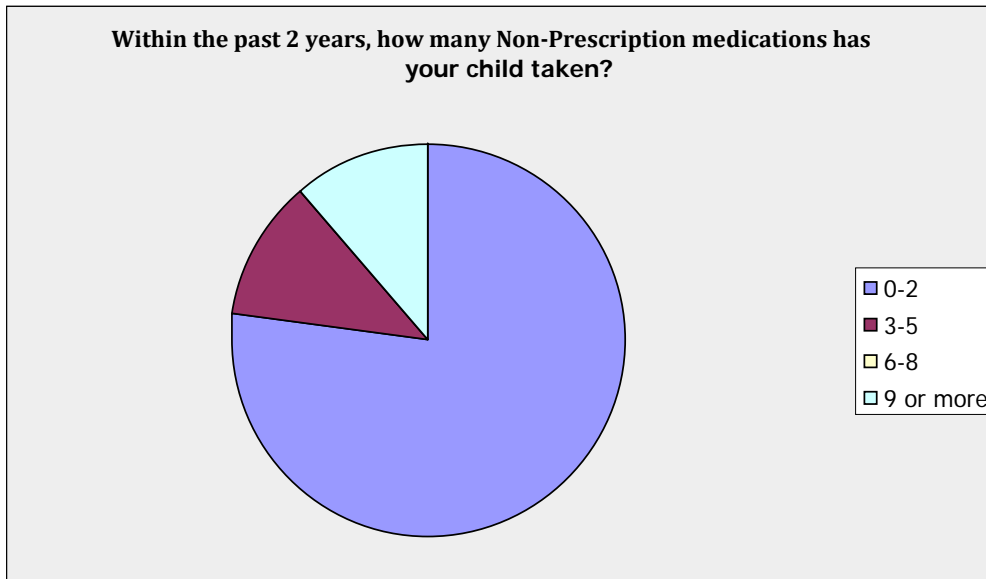
Visually, it is seen that 0-2 medications make up over half of the graph, with 3-5 medications next and 9 or more medications representing the smallest amount.

Table 5.2: The quantity of nonprescription medications used in a child with autism

Within the past 2 years, how many Non-Prescription medications has your child taken?		
Answer Options	Response Percent	Response Count
0-2	76.9%	20
3-5	11.5%	3
6-8	0.0%	0
9 or more	11.5%	3
<i>Answered question</i>		26
<i>Skipped question</i>		0

Of the 26 participants who responded 76.9% (n=20) used 0-2 nonprescription drugs. The percentage of those who used 3-5 nonprescription drugs was 11.5% (n=3). Those who used 6-8 yielded 0% (n=0). Parents who used 9 or more were 11.5% (n=3).

Figure 5.2: The Quantity of Nonprescription Medications Used in a Child with Autism



Visually, over half of the parents use 0-2 nonprescription medications, while the next two portions are the same size with 3-5 and 9 or more being utilized.

Construct 2: Prescription and Nonprescription Drugs and the Specific Ones Used

Table 5.3: Prescription Medications Used By Children with Autism

Answer Options	Yes	No	Rating Average	Response Count
Risperdal (Risperidone)	4	19	1.83	23
Zyprexa	0	21	2.00	21
Geodon	1	20	1.95	21
Zoloft (Sertraline)	0	21	2.00	21
Adderall (Amphetamine)	3	19	1.86	22
Ritalin (Methylin)	3	20	1.87	23
Strattera	0	21	2.00	21
Concerta	2	20	1.91	22
Effexor (Venlafaxine)	0	21	2.00	21
Buspar (Buspirone)	0	20	2.00	20
Medications Not Listed Above				14
Answered question				26
Skipped question				0

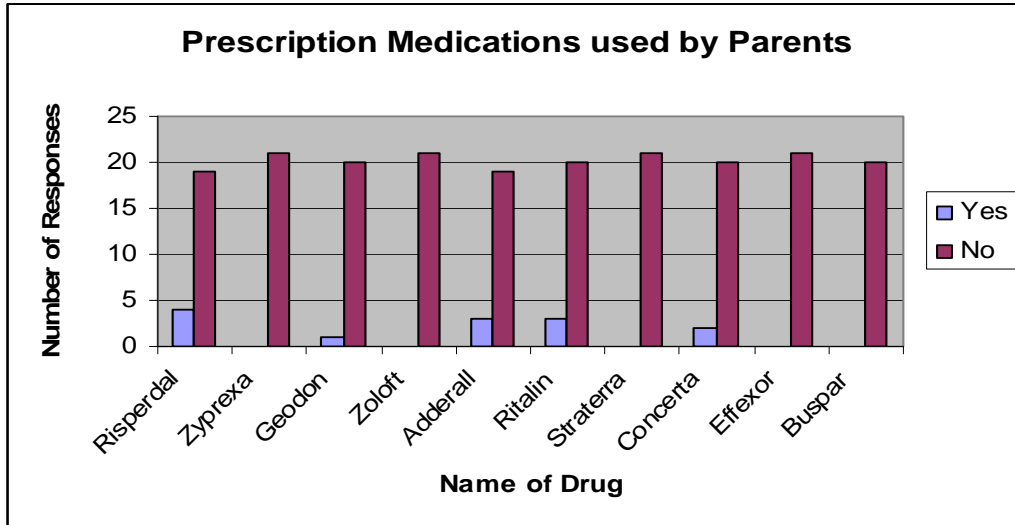
Within the table, of the 26 respondents all responses were reviewed. The response rate within the table gives an average rating regarding the yes and no responses with yes equaling 1 and no equaling 2. The responses are then reported as an average rating. Parents were also given the opportunity to list medications not given as an option within the questionnaire.

Of the 26 participants, a total of 23 responses were analyzed with (n=4) using Risperdal and (n=19) not using the drug. The average rating was 1.83 meaning that more of the responses were closer to 2 representing a no response value. Out of the 26 participants, 21 were analyzed as (n=0) used Zyprexa and (n=21) not using the medication. This yielded a 2.00 average rating. The participants who used Geodon were (n=1) with (n=20) not using the drug. With 21 parents responding, the average rating was 1.95. Of the 21 respondents, (n=0) did not respond to using Zoloft and (n=21) reported not using Zoloft. The average rating thus yielded 2.00. In regards to the use of Adderall, (n=3) used the medication whereas (n=19) do not. The number of total respondents was (n=21) with an average rating of 1.86. Those who utilized Ritalin were (n=3) while the majority (n=20) did not use the drug. The total number of respondents to this drug was (n=23). Straterra yielded (n=0) responses for using the drug while (n=21) responded to not using the drug. The response count was (n=21) with a rating average of 2.00.

The response count regarding Concerta yielded (n=22) as (n=2) stated that they use Concerta versus (n=20) not using the drug. The rating average is 1.91. The response count with Effexor was (n=21) with an average rating of 2.00 as (n=0) did not respond to using the drug with (n=21) not using Effexor. Buspar yielded similar results with (n=20) as a response count giving an average rating of 2.00. Those who responded to using the drug was (n=0) while (n=20) do not use the drug. There were (n=14) participants who responded that they used medications that were not

listed. Those include Lexapro, Abilify, Vyvanse, Celexa, Prozac, Topamax, Lamictal, Miralax, Trileptal, and Focalin.

Figure 5.3: Prescription Medications Used By Children with Autism



Visually, the majority of the respondents (n=19) do not use prescription medications. Those who do not use prescription medications visually represent the shorter sections of the graph.

Table 5.4: Nonprescription Medications Used by Children with Autism

Which Non-prescription medications, if any, has your child taken?				
Answer Options	Yes	No	Rating Average	Response Count
Vitamin B6	3	22	1.88	25
Magnesium	5	20	1.80	25
Folic Acid	4	20	1.83	24
Calcium	4	20	1.83	24
Vitamin B3	3	21	1.88	24
Vitamin C	4	21	1.84	25
Zinc	3	20	1.87	23
Vitamin A	3	21	1.88	24
Ginkgo Biloba	1	23	1.96	24
Dimethylglycine	3	21	1.88	24
Non-prescription medicine not listed above				13
Answered question				26
Skipped question				0

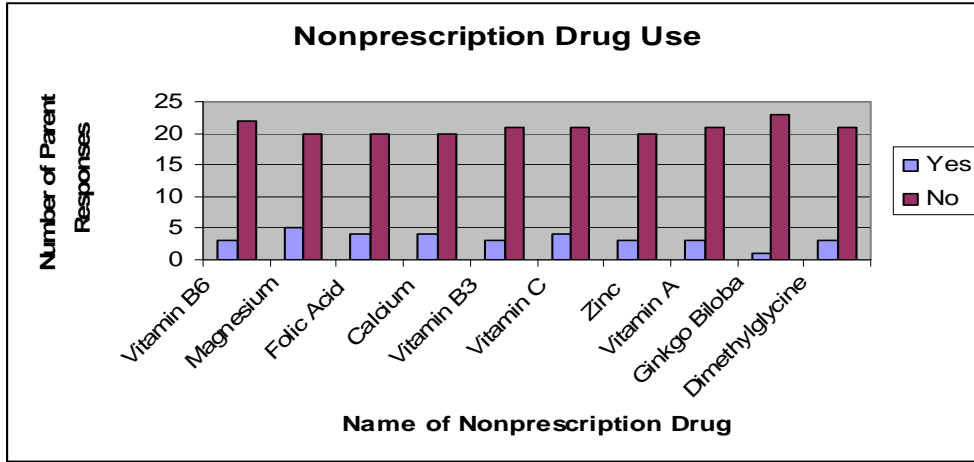
The total number of participants was 26 with all 26 responses recorded. If a parent did not use any of the supplements listed within the questionnaire, they had the ability to write in the ones they have given their child within a two-year period. The rating average reflects a 1 for a yes response and a 2 for a no response.

Vitamin B6 was used by (n=3) parents while (n=22) responded to not using the supplement. This yielded a response count of (n=25) giving an average rating of (n=1.88). Magnesium had a response count of (n=25) with (n=5) using the supplement and (n=20) not using it. With folic acid (n=4) parents reported use of

the supplement while (n=20) did not. This had a response count of (n=24) with an average rating of (n=1.83). Parents' response to calcium had a (n=24) response count with (n=4) using the supplement while (n=20) did not. The rating average was 1.83. Vitamin B3 yielded a response count of (n=24) with (n=3) stating that they used the vitamin while (n=21) did not. The rating average was 1.88. A response count of (n=25) represented vitamin C with (n=4) stating they used the vitamin while (n=21) did not. The rating average was 1.84. Zinc, with a response count of (n=23) had a rating average of 1.87 as (n=3) utilized the drug while (n=20) did not. In regards to vitamin A, there was a response count of (n=24) with an average rating of 1.88. The number of parents who use vitamin A was (n=3) while (n=21) did not. Ginkgo biloba had a response count of (n=24) with an average rating of 1.96. Those who used ginkgo biloba were (n=1) while (n=23) did not use the herbal supplement. Dimethylglycine (DMG) had a response rate of (n=2) yielding a rating average of 1.88. The number of those who stated they used the herbal supplement was (n=3) and (n=21) who did not. There were (n=13) respondents who listed other nonprescription drugs.. Some of the nonprescription drugs that were used were a multivitamin, vitamin K, cod liver oil, medium chain triglycerides, as well as trimethylglycine.

In construct two every parent reported use of at least one nonprescription medication with their child. However, the responses indicated that non prescription medication was not used by the majority of parents with their child.

Figure 5.4: Nonprescription Medications Used By Children with Autism



Visually, the majority of parents approximately (n=19) and up did not report use of nonprescription medications for their child with autism. Those who do use nonprescription drugs, represent the shorter bars.

Construct 3: Prescription and Nonprescription Side Effects

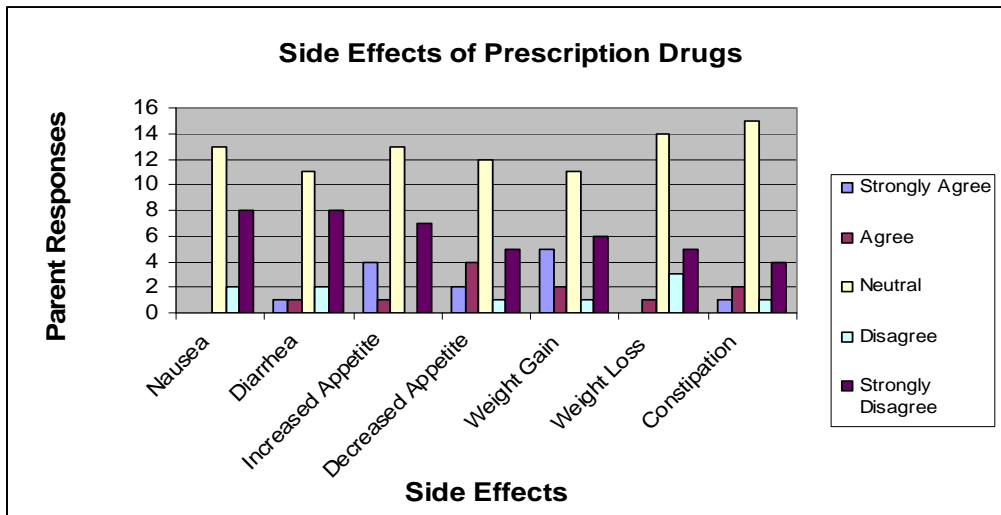
Table 5.5: Prescription Drug Side Effects

I have noticed side effects in the use of those medications?							
Answer Options	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Rating Average	Response Count
Nausea	0	0	13	2	8	3.78	23
Diarrhea	1	1	11	2	8	3.65	23
Increased Appetite	4	1	13	0	7	3.20	25
Decreased Appetite	2	4	12	1	5	3.13	24
Weight Gain	5	2	11	1	6	3.04	25
Weight Loss	0	1	14	3	5	3.52	23
Constipation	1	2	15	1	4	3.22	23
Answered question							26

When analyzing the rating average within the chart listed above, strongly agree represents the value of 1, agree is 2, neutral is 3, disagree is 4, and strongly disagree represents 5. Nausea yielded a response count of (n=23) with a rating average of 3.78. Responses for strongly agree and agree were not stated, however, a neutral response yielded the most responses with (n=13). There were (n=2) responses for disagree and (n=8) for strongly disagree. Diarrhea had a response count of (n=23) with an average rating of 3.78. Those who strongly agree and agree were (n=1) while the majority responded as neutral (n=11). The next highest response was (n=8) as strongly disagreed while only (n=2) disagreed. Those that noticed an increased appetite were (n=25) with a rating average of 3.20. Those who strongly agreed with the statement were (n=4) while only (n=1) agreed. The majority of responses were neutral (n=13) with no one responding to disagree and only (n=7) strong disagreeing. Those responding to a decreased appetite were (n=24) with a rating average of 3.13. Those who strongly agreed were (n=2) with (n=4) agreeing. The majority of respondents were neutral (n=12) while only (n=1) disagreed with the rest of the respondents (n=5) stating they strongly disagreed with noticing a decrease in appetite. In regard to weight gain, (n=25) was the response count with an average rating of 3.04. Those who strongly agreed to noticing weight gain were (n=5) with (n=2) agreeing. The majority of respondents (n=11) were neutral with only (n=1) disagreeing and (n=6) strongly disagreeing to noticing weight gain. Weight loss yielded a response count of (n=23) with a rating average of 3.52. The majority of respondents (n=14) were neutral with their response while no one responded to strongly agree there was (n=1) who agreed

that weight loss was noted. Those who disagreed with the presence of weight loss were (n=3) while those strongly disagreeing were (n=5). Constipation yielded a response count of (n=23) with a rating average of 3.22. The majority answered neutrally (n=15) with only (n=1) strongly agreeing and (n=2) agreeing to noticing constipation. In regards to parents who disagree the number of respondents was (n=1) while (n=4) strongly disagreed.

Figure 5.5: Prescription Drug Side Effects



The figure above represents the side effects noted by parents when the child with autism took prescription drugs, the majority of respondents, (n=11), felt that the side effects were not an issue with their child as their response was neutral. The next portion of the graph illustrates the response of strongly disagree while the rest of the parents who utilized the nonprescription drugs did notice side effects.

Table 5.6: Nonprescription Drug Side Effects

What side effects, if any, have you noticed in the use of Non-Prescription medicine?							
Answer Options	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Rating Average	Response Count
Nausea	0	0	15	2	9	3.77	26
Diarrhea	0	1	13	1	10	3.80	25
Increased Appetite	0	0	14	1	10	3.84	25
Decreased Appetite	0	0	14	1	10	3.84	25
Weight Gain	0	1	13	1	10	3.80	25
Weight Loss	0	0	14	1	10	3.84	25
Answered question							26
Skipped question							0

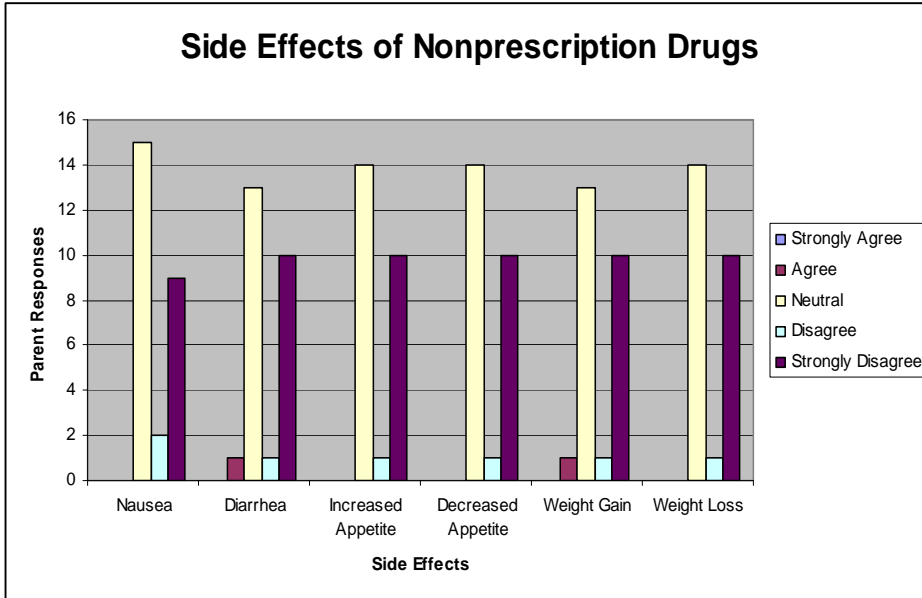
Side effects pertaining to nonprescription drug use were analyzed. The rating average is the same as the previous construct. Strongly agree is listed as a 1, agree is a 2, neutral is 3, disagree is 4, and strongly disagree is 5. The table gives a rating average for each of the side effects to show how close to one or other end of the Likert scale the reporting fell. For example, the rating average for nausea is concentrated.

Nausea in nonprescription drug use had a response count of (n=26) yielding a rating average of 3.77. There were no responses to strongly agree or agree. The majority of the responses fell under neutral (n=15) with only (n=2) disagreeing and (n=9) strongly in disagreement. Diarrhea had a response count of (n=25) with a rating average of 3.80. No one responded with strongly agree and only (n=1) agreed

that diarrhea was a side effect. The majority (n=13) were neutral while only (n=1) disagreed with (n=10) strongly disagreeing. Increased appetite had a response count of (n=25) with an average rating of 3.84. No one responded to strongly agree or agree, however, the majority (n=14) responded to neutral. Only (n=1) disagreed that their child's appetite decreased with the use of the medication and (n=10) strongly disagreed. Those who reported noticing a decrease in appetite were (n=25) which yielded an average rating of 3.84. None of the respondents strongly agreed or agreed that there was decreased appetite. The majority (n=14) were neutral in their response with only (n=1) disagreeing and (n=10) strongly disagreeing.

Weight gain in relation to nonprescription drug use had a response count of (n=25) with a rating average of 3.80. No one responded to strongly agree while only (n=1) responded with agree. The majority of respondents (n=13) were neutral while (n=1) disagreed and (n=10) strongly disagreed. Weight loss yielded a response count of (n=25) with a rating average of 3.84. There were no responses to strongly agree or agree. The majority of participants (n=14) were neutral while only (n=1) disagreed and (n=10) strongly disagreed.

Figure 5.6: Nonprescription Drug Side Effects



The figure above shows the majority of parents responded neutrally when noticing side effects of nonprescription drugs. Those who strongly disagreed had the next highest levels. The smallest bars on the graph represent those who strongly agreed or agreed.

Table 5.7: Weight Gain in Prescription Drug Use

If there was weight gain, approximately how many pounds were gained within a year of its use?		
Answer Options	Response Percent	Response Count
0-3	57.1%	12
4-6	14.3%	3
7-9	9.5%	2
over 10	19.0%	4
Answered question		21
Skipped question		5

In table 3c, in the range 0-3 pounds, 57% of the respondents reported weight gain in the child (n=12). In the range of 4-6 pounds, 14.3% (n=3) noticed weight gain. Those who reported seeing a weight gain of 7-9 pounds were 9.5% (n=2). A weight gain of over 10 pounds was seen by 19% (n=4). The data show weight gain was experienced in every category across prescription drug use.

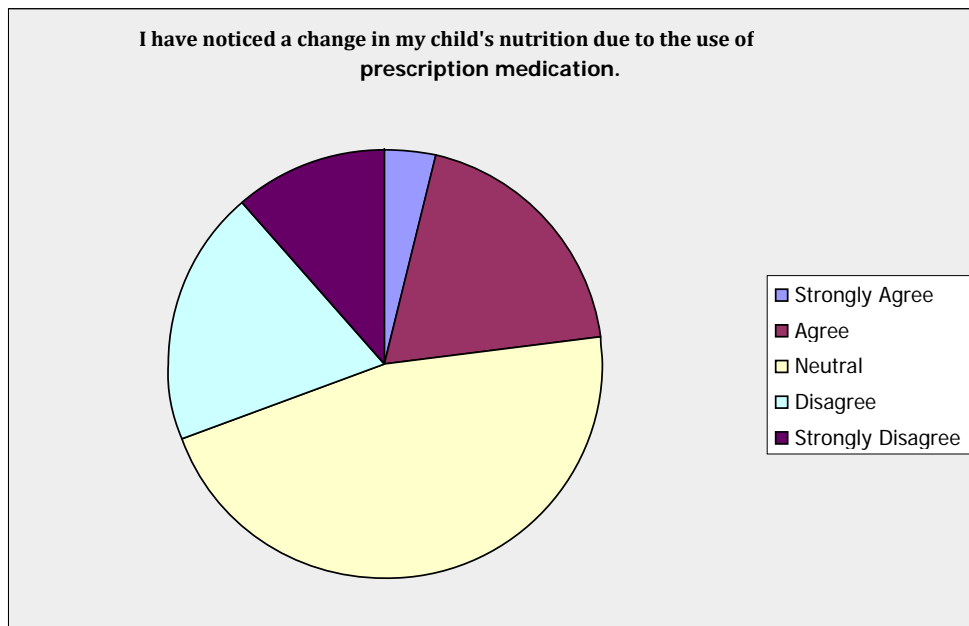
Construct 4: Prescription and Nonprescription Change in Nutritional Status

Table 5.8: Changes in Nutritional Status with Prescription Medication

I have noticed a change in my child's nutrition due to the use of prescription medication.		
Answer Options	Response Percent	Response Count
Strongly Agree	3.8%	1
Agree	19.2%	5
Neutral	46.2%	12
Disagree	19.2%	5
Strongly Disagree	11.5%	3
What were the changes you noticed?		8
Answered question		26
Skipped question		0

Regarding nutritional status in prescription drug use, 3.8% strongly agreed to noticing a change (n=1). Those who agreed were 19.2% (n=5). Those who disagreed were 19.2% (n=5) and those who strongly disagreed were 11.5% (n=3). The majority of parents were neutral with 46.2% (n=12). The questionnaire contained a section in which parents were to report specifically the changes that they noticed. The responses varied and included that the child had fewer meltdowns, stopped hitting others, and became calmer. Other responses included weight gain, poor eating habits, starving all the time, greater appetite, altered food taste, and eating less as behaviors parents felt were induced by medications.

Figure 5.7: Changes in Nutritional Status with Prescription Medication



Less than half of the respondents felt neutral when viewing the nutritional status in the utilization of prescription medication. Those respondents who agreed and disagreed were very similar in size, whereas, those who strongly agreed that they saw changes in nutritional status represented the smallest portion of the pie chart.

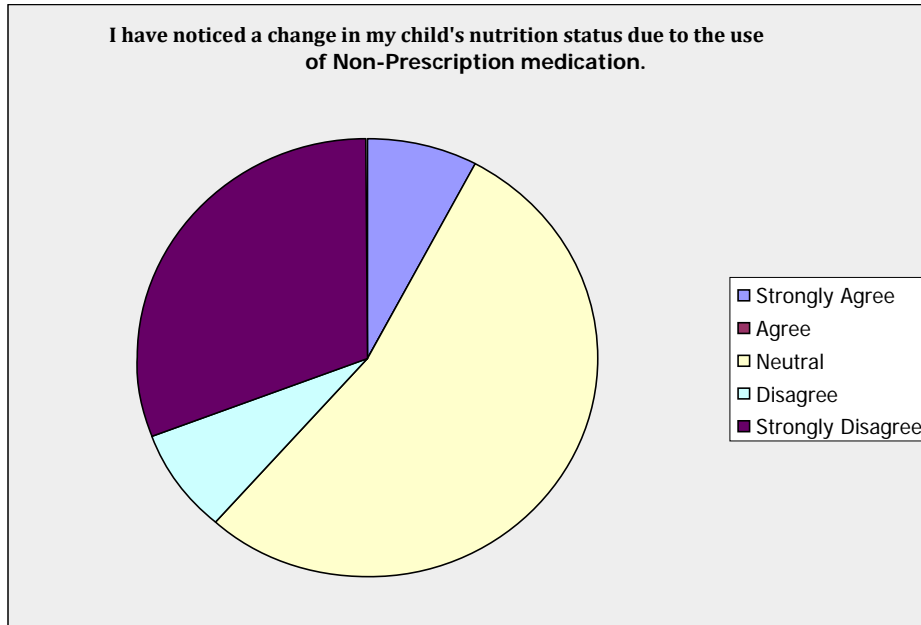
Table 5.9: Changes in Nutritional Status with Nonprescription Medication

I have noticed a change in my child's nutrition status due to the use of Non-Prescription medication.		
Answer Options	Response Percent	Response Count
Strongly Agree	7.7%	2
Agree	0.0%	0
Neutral	53.8%	14
Disagree	7.7%	2
Strongly Disagree	30.8%	8
What changes were noticed specifically, if any?		3
Answered question		26
Skipped question		0

In the table, when viewing a change in nutritional status in nonprescription drug use, 7.7% strongly agreed (n=2). There were no respondents within the agree category. The majority of the responses fell within neutral at 53.8% at (n=14). Those who disagreed resulted in 7.7% (n=2) while 30.8% strongly disagreed (n=8). There were (n=3) who noted specific changes. The changes noticed specific to the nutritional status and medication were similar to those mentioned previously and

included fewer outbursts, increased appetite, poor eating habits, hungry all the time, altered food taste, as well as eating less.

Figure 5.8: Changes in Nutritional Status in Nonprescription Medications



Approximately half of the parents were neutral regarding nutritional status in nonprescription medication use. The next largest portion consisted of responses within the category of strongly disagree. Those who disagreed as well as strongly agreed had similar feelings as depicted by the portions in the chart.

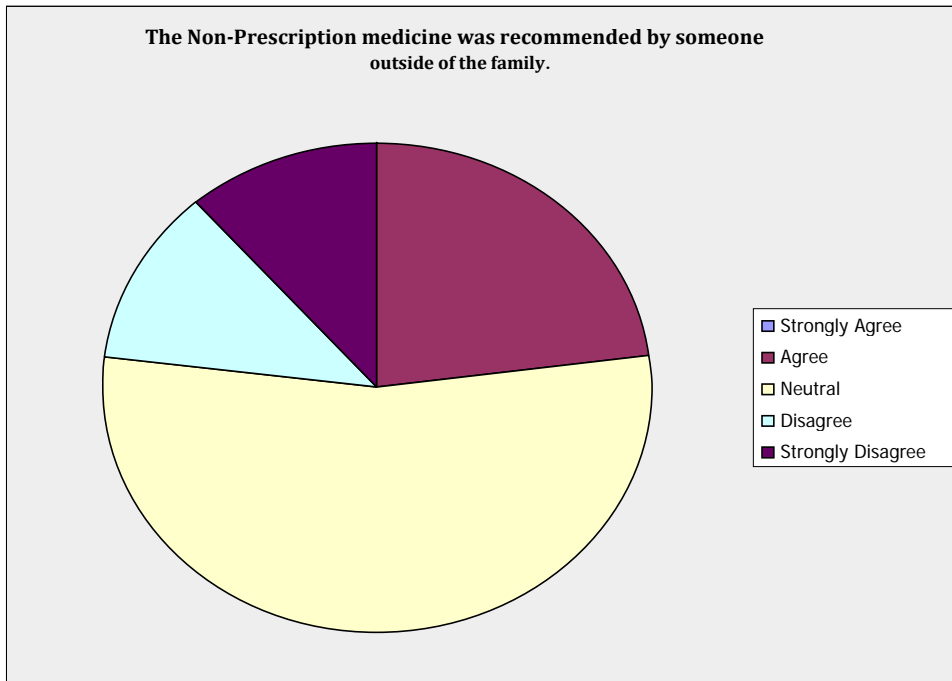
Construct 5: Source of Information for Prescription and Nonprescription

Table 5.10: Nonprescription Medicine Recommended by Outside Family Members

The Non-Prescription medicine was recommended by someone outside of the family.		
Answer Options	Response Percent	Response Count
Strongly Agree	0.0%	0
Agree	23.1%	6
Neutral	53.8%	14
Disagree	11.5%	3
Strongly Disagree	11.5%	3
Who recommended the non-prescription medication or how did you find out about it?		5
Answered question		26
Skipped question		0

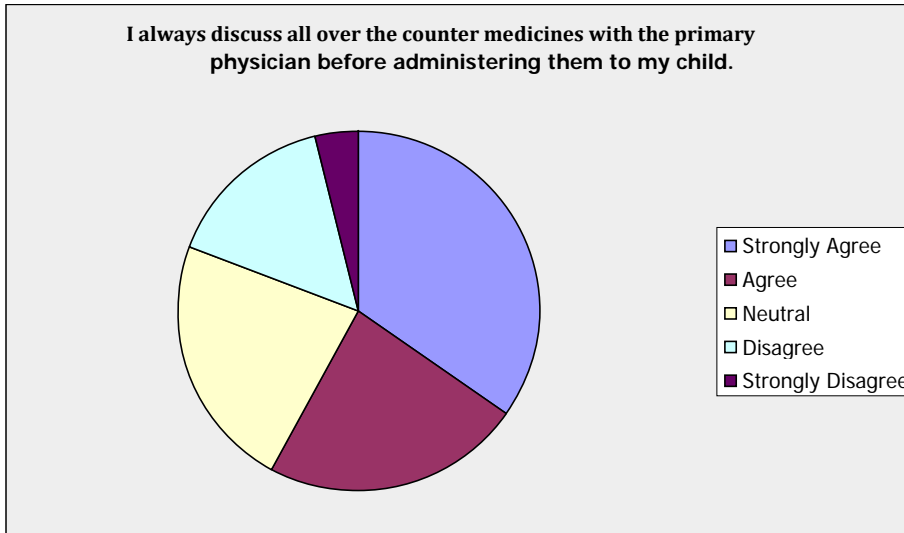
The table indicates that of the 26 respondents, no one strongly agreed to receiving recommendations outside of the family. Those who agreed to the question were 23.1% (n=6). The majority of parents were neutral, 53% (n=14). Those who disagreed and strongly disagreed answered the same at 11.5% (n=3). The option to respond as to who recommended the medication was given. Parents stated that recommendations were given by DAN! doctors, autism literature, the Internet, as well as Yahoo! groups.

Figure 5.9: Nonprescription Medicine Recommended by Outside Family Members



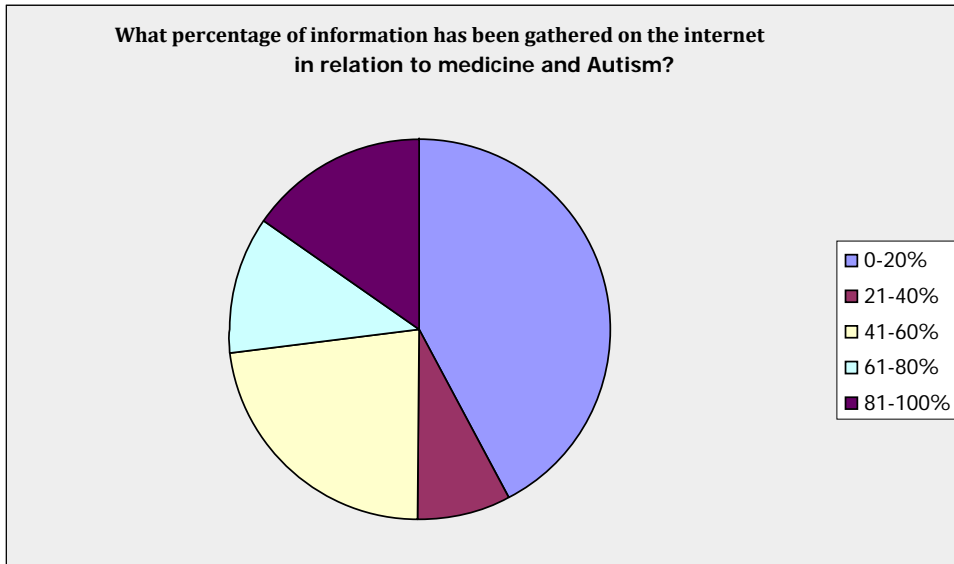
Slightly over half of the respondents were neutral in relation to the recommendation of nonprescription medicine from members outside of the family. The next largest portion was in agreement that they received recommendations from someone outside of the family outside of the family. Those who disagreed and strongly disagreed were similar in the volume of the response.

Figure 5.10: Discussion of Over the Counter Medicines with Primary Care Physician



The chart shows that a majority of parents discussed all over the counter medicine with their primary care physician. The next portion shows that they also discussed all medication use with their physician. There is also a large portion who feel neutral regarding the question and the smaller portions of the pie chart do not discuss all over the counter medicines. Based on the chart representation more families agreed that they discussed over the counter medications with their doctor.

Figure 5.11: Information Gathered on the Internet Related to Medicine and Autism



Visually, approximately 0-20% utilized the Internet as a source when gathering data about medicine and what to give their child. The next portion that was rather large in size was the neutral category at 41-60%. Those who used the Internet 81-100% of the time were next as the smallest portions and represented 61-80% and 21-40%.

Nutritional Intake & 24-Hour Recalls

The 24-hour recalls were collected from parents who have a child with autism and were analyzed for significance at a p-value of <0.001. The recommended dietary allowances and recommended intakes were viewed in relation to the intake of a child with autism versus a typical child. A child could have fallen within three categories, either below the recommended intake, recommended intake, or above the recommended intake. The children were categorized either as a typical child or a child with autism. A total of 13 participants were used. Two of the children were

disregarded as they fell above the age parameters of the RDA & AI used within the USDA study. Typical children were matched from the USDA nutritional intake survey conducted in 2005-2006, which was categorized by age and gender. The results were utilized in the comparison of children with autism and the recommended dietary intakes. The micronutrients were selected based on the literature, which reports these micronutrients as ones more likely to be deficient in children with autism.

Originally, age was analyzed for significance, however, when analyzing age and nutrients, all p-values were the same at all levels indicating that children were eating some of the same foods in a given day. Therefore, all nutrients were averaged in order to compare the data effectively allowing for status and nutrients to be analyzed.

Table 5.11: Comparison of Nutritional Allowances of Typical Children versus Children with Autism in Males Ages 2-11

(n=13)

	RDA & AI	Typical Child	Child with Autism	p-value: status & nutrients
Vitamin A	300 µ/day	624	589.89	---
Vitamin B ₆	0.5 mg/day	1.63	1.92	---
Vitamin C	15 mg/day	81.8	82.69	---
Calcium	500 mg/day	2034	1092	---
Iron	7 mg/day	14.2	17.57	---
Magnesium	80 mg/day	221.5	279.1	---
Vitamin B ₁₂	0.9 µ /day	1.21	3.24	---
Folate	150 µ /day	141.5	278.1	0.157

Mg = milligrams µ = micrograms

RDA = recommended dietary allowance AI = adequate intake

--- Nutrients are considered a constant

Significance was analyzed at a p-value of 0.001; however, the only nutrient that yielded a p-value was folate at 0.157 demonstrating no significance. The other nutrients yielded a constant, which appears as no change across nutrient intake.

Chapter 6: Discussion

Construct 1: Prescription vs. nonprescription drugs and number used

The results indicate that within the past two years, the majority of parents used 0-2 drugs, both prescription and nonprescription. It seems as though many families utilized CAM, however, they tried a smaller amount than reported in a 2004 dissertation by Hires at the University of Kentucky. It was expected that complementary and alternative medicine would be utilized more; however, only three participants had utilized nine or more CAM. Many families have been known to try a variety of drugs and supplements in treating a child with autism. At the time of the study families might have been reducing their exploration of specific CAM. The research demonstrated that approximately 92 percent of parents used CAM therapies on their child with ASD (5), which was different to the result found in this study. However, on that construct everyone reported using at least one prescription or nonprescription medication. When majorities of families are trying nine or more different drugs, there should be cause for concern, especially if those drugs are not discussed with a physician.

The hypothesis (H1) tested if parents used complementary and alternative medicine more than prescription drugs in the treatment of a child with autism. The hypothesis was rejected as the utilization of CAM, specifically when three or more drugs were used, only 23 percent of families stated they used CAM. In the use of prescription medication, only 26.9 percent of parents stated they used the medication, specifically when three or more were used.

Construct 2: Prescription and nonprescription drugs and the specific ones used

Since the majority of participants were using only 0-2 drugs in treating their child's symptoms, the types of drugs used were limited and few. However, when prescription drugs were examined, the majority of children were taking Risperidal. This drug is the most widely used drug for children with autism to treat symptoms such as aggression, irritability, and self-injury (51). There are also many other options besides the ones listed in which parents admitted that their child took. Some of these drugs are used for constipation, depression, as well as anxiety.

There appeared to be a wider range of use in complementary and alternative medicines. Those that were used varied across the board with magnesium, folic acid, calcium, and vitamin C being the most utilized. This agrees with other studies that reported CAM use (29) However, vitamin B₆, vitamin B₃, zinc, and DMG were not too far behind. The extent of how the child has changed from starting the CAM is unclear, because parents using CAM do not obtain blood levels of the micronutrients used to see if their child is truly deficient and needs the supplemental vitamins and minerals and record keeping about behaviors pre and post CAM are sporadic and anecdotal.

Parents should also be mindful of what the child eats on a regular basis and work with a dietitian who can aid the child in trying new things. This will also be an important time to discuss with the dietitian the role vitamins and minerals have on the body. Many B vitamins, for instance, are water-soluble, meaning that the body utilizes what it needs and then excretes the rest. There are doctors who are telling

parents to take these supplements whether in pill or cream form without knowing a child's deficiency levels or telling the parent how it is utilized in the body, reiterating why it is important to discuss nutritional related material with a dietitian.

Construct 3: Prescription and nonprescription side effects

Side effects affect every medication available. Complementary and alternative medicine does not have a notable effect because there is no research evidence to confirm a dose response. Therefore, the reported side effects were minimal when analyzing parent's responses. The majority of parents, regarding the side effects in prescription drug use stated they felt neutral or strongly disagreed.

The response regarding weight gain was analyzed as many of the prescription drugs taken by children with autism caused increased appetite, leading to increased weight. However, the responses were split as five strongly agreed versus six who strongly disagreed. This could be due to the child's pattern and behavior during mealtime or parents positive or negative denial of the value of these drugs when treating autism symptoms. Some children with autism will only eat five foods in a given day versus a child who will eat just about anything or have more of a craving for fast food chicken nuggets and French fries. Therefore, weight gain and increased appetite can be seen in some children, but not necessarily all and this goes back to their original eating patterns and behaviors, which were not assessed.

The amount of weight gain noticed was asked of parents in an effort to see just how many pounds were added. The majority of parents listed 0-3 pounds (n=12), whereas the remaining families (n=9) listed an increase in weight beginning at 4 pounds or more. Other studies compared specific weight gain in children on psychoactive drugs and reported higher weight gain numbers than this current study (57). The 0-3 pound range would be expected to be high, as some families may not have seen a gain due to their child not taking the drugs that impact weight gain. Knowing that children suffer from potential weight gain, information on how to cope with the side effects should be given. Seeking out a nutritionist can have added benefit to the child as suggestions can be made on what to feed a child who feels as though they are starving.

The hypothesis (H2) tested if over half of the parents will note a weight gain of four pounds or more in their child in relation to prescription drug use. The hypothesis was rejected as 57.1 percent of parents noted a weight gain of 0-3 pounds, whereas only 42.8 percent noted a weight gain of four pounds and over. Despite this result it is clear that weight gain remains an issue in care of the child with autism who is prescribed psychoactive medications.

Construct 4: Prescription and nonprescription change in nutritional status

A small number of families felt that the use of the prescription medication changed their child's nutritional status (n=6). These results held true as approximately the same amount had noticed an increase in weight (n=5). The majority of parents did not notice a change in nutritional status regarding the intake

of prescription and nonprescription drugs, a change in nutritional status. A change in nutritional status pertaining to CAM occur naturally in the foods that we eat, however, if a child was deficient, a change in nutritional status should be noted. The results demonstrated that the children with autism do not necessarily have a deficiency as the research demonstrated which is contrary to the report from Rimland who found recommends doses of various nutrients in relation to children with autism.

Construct 5: Prescription and nonprescription source of information

The results regarding who recommended nonprescription medicine, specifically by someone outside of the family was noted. The responses were split as six parents had taken advice from a non-family member while six stated that they did not. The majority of the parents did speak with their physician (n=15), while less than that did not speak with their physician (n=5). Within this study, the results contraindicated what typically occurs in parents when they are trying various methods of treatment as much of the research states that a doctor is not consulted. There is a possibility that more and more parents are taking advice to speak with a healthcare professional, knowing the various consequences that exist or in the case of families working on autism they consider the DAN doctor who may be the one prescribing the CAM as the consulting doctor and not their family doctor. This would be a limitation in the questionnaire development where the question could have been stated to exclude the DAN doctor as the physician to whom the CAM was reported.

The majority of parents are using the Internet at least 20 percent of the time (n=11), however, 15 percent obtain almost all of their information from the internet. It causes concern as to what website the parent is visiting and what the source of the information he or she is reading. Parents are able to access all levels of quality regarding the Internet. Therefore, it is vital that parents research reputable sites. The hypothesis (H3) tested if more than half of the parents will utilize the Internet as their only source of information when researching various drugs both prescription and nonprescription. The hypothesis was accepted because a greater percentage of parents used the Internet as their only source (0-20 percent) and as their chief source of information (57.7 percent).

Nutritional Intake and 24-Hour Recalls

The 24-hour recalls were utilized in an effort to see whether children with autism demonstrated a deficiency regarding certain vitamins and minerals. Although, this does not test a deficiency as a whole, it does look at a day's intake to see if there is any correlation. The results were then tested against a typical child as well as the recommended dietary allowances. As a whole, the majority of children with autism did not demonstrate a deficiency in the foods eaten.

The majority of the responses yielded constants meaning that the relationships remained the same at either level of status in relation to the intake of nutrients. However, it is noted that a typical child did not meet the recommended dietary allowances of folate, whereas a child with autism did. Most children with autism are on a gluten-free/casein-free diet, which limits what they eat. Folate is

found within green leafy vegetables and is a food group that can be resourceful if on a GFCF diet. The typical child, however, is more than likely not on a GFCF diet unless they have Celiac's disease. This will allow for more options when deciding what to eat.

The hypotheses (H4) tested if children with autism will demonstrate a deficiency in vitamin B₆, magnesium, calcium, and vitamin B₁₂ when compared to the typical child. The hypothesis was rejected as it was found that a child with autism receives above normal levels of the specific nutrients studied. However, the typical child had lower levels of folate in the diet.

Chapter 7: Limitations

Several limitations are to be noted within the study. The first involves the sample size. Although this was a decent sample size to work with, some potential error could have been eliminated if more parents had participated. However, sometimes having a child with autism can be time consuming, which is a potential reason for not participating. A larger sample would have been good when working with the 24-hour recalls. When separating the recalls based on age, the sample for each range became smaller not allowing us to toss out participants who may have had a substantially higher or lower amount of certain nutrients. When one child had a large intake of magnesium for example and another has a small intake, the results can be skewed. It would have been better if the highs and lows were taken out to obtain more accurate results, however, the sample size did not allow for that.

The sample population could have been larger as well. The medication questionnaire was distributed via a total of three listservs, however, a response of only 26 was collected. Many of the listservs included members of approximately 100-200 families. The question arises of why there were very few responses knowing the total amount of members? Reasoning could lead one to the belief that there is a population that feels nutrition is an important component in the life of a child with autism. Therefore, the family member wishes to aid those involved in the study to find more research regarding the topic. There are also those who simply did not make the time, although there may have been conscious efforts to reply. The selection bias might have skewed the reporting of CAM because more parents who

do not believe in CAM use might have chosen to participate. Whatever the selection bias if this occurred, it can be expected that a larger number of families would have generated more diverse results across the prescription and non-prescription use construct.

In addition, 24-hour recalls only provide what the intake was for that child on a specific day, regardless of the situation. It may not demonstrate a typical day where the family may have been pressed for time and had to go through a fast food drive-thru or mom did not have enough time to cook when she cooks six out of the seven nights a week. In order to have even more specific results regarding typical intake, the researcher could use food frequency questionnaires that list in great detail how often a person eats certain foods from the food guide pyramid in a given month.

The survey did not allow for a “non-applicable” response for parents who do not utilize prescription or nonprescription drugs. Therefore, the response labeled “neutral” was used. All of these factors could have enabled greater significance, however, when replicating the process an individual can take into consideration all of the limitations.

Another limitation was in regard to the 24-hour recalls. Originally, age was to be a factor when analyzing the data; however, it was found that when analyzing age all the p-values were the same on all levels. This could possibly be due to the children ingesting most of the same foods. The sample size could also play a role in which a larger sample could have yielded greater results. When reviewing the diets, only one child was on a GFCF diet, allowing for the remaining children to have more flexibility with their food choices.

Chapter 8: Conclusions and Recommendations

The need for creating educational material for not only healthcare professionals but parents is great regarding information on nutritional supplementation. The supplements and their side effects pose complications that must be considered when assigning prescription medication to children with autism. Prescription and nonprescription drug use influence the nutritional status of a child with autism, specifically the implication of weight gain. Laboratory analyses from children with autism have shown high excretion and deficiency rates for certain vitamins and minerals. The healthcare provider should include these observations in the assessments that are used to determine the protocol of care for medical nutrition therapy.

There are varying treatment options available that aid in managing the behavioral symptoms of autism. A major concern is the source of information that parents use. In addition, is the family reporting to their doctor the over-the-counter treatments being used on their child? Some of the CAM used has been understudied and claims have been made for treatments that help control behavioral symptoms. These treatments are not evidence based but anecdotal information proliferates on the Internet and among parent support groups.

The objectives of this study were fourfold with the first assessing the nutritional intake of children with autism in comparison to the typical child. It was found when analyzing 24-hour recalls all of the nutrients, except folate, gave a p-

value of 0.157, which has no significance. All other nutrients were considered constant when analyzed meaning that nothing changed in relation to the responses.

The second objective was to examine the means by which parents collected their data regarding prescription and nonprescription drugs. The data did show that parents utilized the internet, but it could not be determined to what extent and which websites were viewed in an effort to gather information. Approximately, 15 percent used the internet 81-100 percent of the time when gathering information on autism and medicine. Again, the content and quality of the sites were not discussed and if replicating the study, a researcher should find out the specific websites being utilized. Therefore, in this study less than half of the parents utilize the internet as their only resource when researching medicine and autism.

The third objective was to examine the extent to which parents use complementary and alternative medicine as an intervention. It was found that parents used the same amount of CAM as they did prescription alternatives, as they answered another research question. However, some parents did utilize nine or more CAM, showing that the use of CAM is fairly extensive but not as widespread as previous studies suggest (5). Further research studies are needed to gather data from a larger group of parents who have children with autism to confirm the extent of CAM usage.

A fourth objective was to examine weight gain. Many children with autism have succumbed to increases in weight due to the side effects of atypical antipsychotics. It was found that the majority of children taking prescription

medications included Risperidal, an atypical antipsychotic that causes increased appetite leading to weight gain. However, how substantial was the weight gain? Most of the parents noted a weight gain in the range of 0-3 pounds with less than half noting a 4-pound or more weight gain. This was dependent on the types of medications that were utilized as not all parents were giving their children atypical antipsychotics. Also, if the children were also on disordered eating patterns the weight gain may have been seen as beneficial and not an issue.

These findings demonstrate that more work is to be done when reviewing the types of drugs prescribed to address symptoms in a child with autism. Parents should be mindful of all alternative therapies but use outside sources and references with caution as they will find that some sources are not as reliable as others. The role that nutrition plays in a child with autism is important. The research data showed deficiencies in a number of vitamins and minerals. If parents can be educated on the foods that have nutrient value for their children's diet minus the supplementation, children will be able to utilize those nutrients more effectively than using a pill. Dietitians hold the key to feeding a child that may have food aversions as well as teaching parents how to implement a variety of foods into the family diet. Combating the side effects of atypical antipsychotics and nutrient medication interactions can also be of value when discussed with a dietitian.

Nutrition can be of great assistance to parents who have a child with autism, as there are some vitamins and minerals that aid in neurological development. It is vital to find out which nutrients a child is deficient in before supplementation. It is also important to try to utilize foods that naturally contain the vitamins and minerals. Through more research and in cooperation with parents who have children with autism, healthcare professionals may be able to find one more the link in the puzzle of autism.

Appendices:

Prescription and Complementary and Alternative Medication Questionnaire

Dear Participant:

The Department of Nutrition and Food Science at the University of Kentucky has developed a survey instrument to gather information regarding the use of prescription and non-prescription medication in regards to children with autism spectrum disorders. This information will then be compared to the nutritional status of children with autism versus typical children. After reviewing the information provided, please answer the questions to the best of your ability. It will take no more than 15 minutes to complete the questionnaire. If you are unaware of all of the medications that your child takes, it is advised that you have them with you in order to complete the survey accurately.

To the best of our knowledge, there are no risks or harm associated with this study. Your responses, in combination with those of other participants, will help us understand how prescription and non-prescription medications affect the nutritional status of children with autism.

Your responses will be kept confidential and will only be used for this study. As indicated above, your information will be combined and reported with responses from other participants taking part in the study.

If you decide to take part in the study, it should be because you really want to volunteer. Your participation in this study is voluntary and you may decline to participate.

If you have any questions about the study or the procedures, you may contact the primary researcher, Dr. Hazel Forsythe, via email (nfshazel@email.uky.edu) or call (859-257-4146). In addition, if you have any questions about your rights as a volunteer in this research, contact the staff in the Office of Integrity at the University of Kentucky at 859-257-9428 or toll free at 1-866-400-9428. If you agree to participate, please begin the survey.

Thank you for your participation.

1. Within the past 2 years, how many medications have been prescribed to you child, specifically for autism?
 - a. 0-2
 - b. 3-5
 - c. 6-8
 - d. 9 or more

2. What are the names of the medications used by your child in regard to question number one?

	Yes	No
Risperdal		
Zyprexa		
Geodon		
Zoloft		
Adderall		
Ritalin		
Strattera		
Concerta		
Effexor		
Buspar		
Medications not listed above		

3. I have noticed side effects in the use of those medications?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Nausea					
Diarrhea					
Increased Appetite					
Decreased Appetite					
Weight Gain					
Weight Loss					
Constipation					

4. If there was a weight gain, approximately how many pounds were gained within a year of its use?
 - a. 0-3
 - b. 4-6
 - c. 7-9
 - d. Over 10

5. I have noticed a change in my child's nutrition due to the use of prescription medication.
 - a. Strongly agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

What were the changes you noticed?

6. The prescription medication has been effective with my child.
 - a. Strongly Agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly Disagree

How do you feel it was effective? How do you feel it was ineffective?

7. Within the past 2 years, how many non-prescription medications has your child taken?
 - a. 0-2
 - b. 3-5
 - c. 6-8
 - d. 9 or more

8. Which non-prescription medications, if any, has your child taken?

	Yes	No
Vitamin B6		
Magnesium		
Folic Acid		
Calcium		
Vitamin B3		
Vitamin C		
Zinc		
Vitamin A		
Ginkgo Biloba		
Dimethylglycine		
Non-prescription medicine not listed above		

9. The non-prescription medicine was recommended by someone outside of the family
- a. Strongly agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly disagree

Who recommended the non-prescription medication or how did you find out about it?

10. What side effects, if any, have you noticed in the use of non-prescription medicine?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Nausea					
Diarrhea					
Increased Appetite					
Decreased Appetite					
Weight Gain					
Weight Loss					

11. I have noticed a change in my child's nutrition status due to the use of non-prescription medication.

- a. Strongly agree
- b. Agree
- c. Neutral
- d. Disagree
- e. Strongly Disagree

What changes have you noticed, specifically, if any?

12. The non-prescription medicine has been effective with my child

- a. Strongly agree
- b. Agree
- c. Neutral
- d. Disagree
- e. Strongly disagree

What changes were noticed, specifically, if any?

13. I always discuss all over the counter medicines with the primary physician before administering them to my child.
- a. Strongly agree
 - b. Agree
 - c. Neutral
 - d. Disagree
 - e. Strongly disagree
14. What percentage of information has been gathered on the Internet in relation to medicine and autism?
- a. 0-20%
 - b. 21-40%
 - c. 41-60%
 - d. 61-80%
 - e. 81-100%

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