Spring 2017

Characterizing Food Selectivity in Children with Autism

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Keywords
picky eating, texture, autism, other developmental diagnoses, food selectivity

Subject Categories
Human and Clinical Nutrition | Speech and Hearing Science | Speech Pathology and Audiology

CHARACTERIZING FOOD SELECTIVITY IN CHILDREN WITH AUTISM

by

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HONORS THESIS

Submitted to the University of New Hampshire

in Partial Fulfillment of the Requirements for the Honors in Major

for the Degree of Baccalaureate of Science

in

Communication Sciences and Disorders

May 2017

Abstract

Food selectivity or “picky eating” affects a large percentage of children on the autism spectrum and as a result can have negative impacts on a child’s health and nutritional status (Cermak, Curtin, & Bandini, 2010). Few studies compare food selectivity in children on the autism spectrum to children with other developmental issues. Such a comparison may reveal how food selectivity presents itself uniquely in children on the autism spectrum. This study examined data from past health records collected from the Seacoast Childhood Development Center (SCDC). Thirty-eight children whose parents were concerned about their diets were taken from a larger sample of 103. In this sample, 13 had autism spectrum disorder (ASD) and 25 had other developmental diagnoses (ODD). Using past health records, food frequency questionnaires, and a classification system created by Berry and Sharp (2016), the study compared food selectivity, textural issues, parental concerns and food preferences among diagnoses. A significantly larger proportion of children in the ASD group were classified as “picky eaters” by their parents, had textural issues and preferred grains when compared to the ODD group. Relationships between food selectivity and diagnosis were insignificant. The Berry and Sharp classification system was only effective in determining children in the severe category. Because modifications had to be made to the classification system in this study, adding a food item column to the Food Frequency Questionnaire given to parents at the clinic could be suggested for the future.

Characterizing Food Selectivity in Children on the Autism Spectrum

Literature Review

Speech language pathologists play an important role in the assessment, diagnosis and therapy of children on the autism spectrum. With every one in 68 children being diagnosed on the autism spectrum (Christensen et al., 2016), these children make up a large percentage of the clients that speech language pathologists work with. As defined by the American Psychiatric Association's Diagnostic and Statistical Manual, Fifth Edition, autism is defined by "deficits in social-emotional reciprocity," "deficits in nonverbal communicative behaviors used for social interaction," and "deficits in developing, maintaining, and understand relationships" ("Diagnostic Criteria," 2016). In addition to these diagnostic characteristics, over 90% of children in a study conducted by Leekam, were shown to have some level of a sensory processing impairment (as cited in Cermak et al., 2010). Food selectivity is a possible outcome of sensory processing impairments (Cermak et al., 2010) and is commonly defined by "food refusal, limited repertoire, and high-frequency single food intake" (Bandini et al., 2010). Food selectivity affects a large percentage of children on the autism spectrum and can have negative impacts on the child's nutritional status (Cermak et al., 2010), as well as parental stress (Kerwin et al., 2005) and mealtime behavior (Curtin et al., 2005). For this reason treatment and therapy for this population can be crucial.

Prevalence

Although it is not unusual for typically developed children to present signs of food selectivity, selective eating has a much higher prevalence in children on the autism spectrum and it is usually presented differently in this population (Bandini et al., 2010). A study conducted by Bandini and colleagues attempted to create a more standardized definition of food selectivity.

The researchers defined food selectivity by "3 domains: food refusal, limited food repertoire, and high-frequency single food intake (HSFI)" (Bandini et al., 2010, p. 260). They then used this definition to compare the prevalence of food selectivity in children with autism and typically developing children (Bandini et al., 2010). The study used a food frequency questionnaire for parents to record the feeding habits of their children ages 3 to 11. In addition to the questionnaire the parents were interviewed, completed a demographic/medical questionnaire and recorded a 3 day food log (Bandini, et al., 2010). Although results showed refusal in both groups, the children on the autism spectrum refused many more foods than did the typically developing children, particularly vegetables. In addition, the children on the autism spectrum refused a larger percentage of foods when comparing foods refused to foods offered. They also had a more limited food repertoire than the typically developing children. Of the total participants, only five children met the criteria for HSFI; four children were on the autism spectrum and one child was typically developing (Bandini et al., 2010).

One study, conducted by Ahearn, took a different approach to determine food selectivity in children on the spectrum. The study consisted of a group of 30 children ages 3 to 14 on the spectrum. In this study, children were offered food and then analyzed based on how many bites of food they accepted. Out of the 30 children only 4 accepted over 60 bites of food. Nine children accepted 31 to 60 bites of food, and 17 of the participants accepted less than or equal to 30 bites with 4 completely refusing all bites. This study further supports the high prevalence of food selectivity among children on the autism spectrum (Ahearn, Castine, Nault, Green, 2001).

Characteristics and Possible Causes of Food Selectivity

There are many factors that may cause a child, particularly on the autism spectrum to reject certain foods, therefore limiting the variety of food items in their diet. Children who are selective eaters may refuse to try new foods or may limit their food choices to a particular texture, smell, taste, temperature or appearance. Food presentation, such as the way food is placed on a plate, as well as the brand of food may also limit a child's diet (Ranjan & Nasser, 2015). Kuschner found that both taste and texture were contributing factors to more restrictive diets in children with autism. In addition they found that children with autism were much less accurate in identifying tastes, which had a correlation with texture acceptance (as cited in Twachtmann-Reilly, Amaral, & Zebrowski, 2008, p.262).

Sensory Over-Responsivity and Restrictive Repetitive Behaviors. It is not certain why food selectivity appears in such a large percentage of children on the autism spectrum, but it is believed that sensory over-responsivity, restrictive and repetitive behaviors, or both can lead to food restriction or food refusal in this population of children. Sensory over responsivity (SOR) is "an extreme over-reaction to sensation from any of the seven sensory systems" (Suarez, Nelson & Curtis, 2014, p.239). Suarez and colleagues had found that children on the autism spectrum who have severe and moderate food selectivity had higher SOR scores compared to those with less severe or no food selectivity (Suarez et al., 2014). Another possible factor is restrictive and repetitive behaviors (RRB) which can play a role in mealtime behaviors that may lead to a selective eating. For example, a child may insist on a particular utensil or dish for every meal or may only eat one type of texture, taste, scent, etc. This is different from SOR in that it is not related to over-responsivity, but rather the need for "consistency" in meals and food items.

The relationship between SOR and food selectivity was investigated by Suarez, Nelson, and Curtis. In this study they surveyed 141 parents of children with ASD both with and without

food selectivity, age's three to nine years old. Using *The Short Sensory Profile* created by Dunn (1999) and the *Red Flags of Sensory Over-Responsivity* created by Miller (2006), the study found that children with severe and moderate food selectivity had higher SOR scores. The researchers found that "for every 10 point increase on the tactile SOR scale, children were 2.66 times more likely to fall into severe food selectivity category" (Suarez, Nelson & Curtis, 2012, p.11). A study conducted by Williams, found that 67 out of 100 surveyed parents with children on the autism spectrum believed their child was a "picky eater." Of these parents the majority believed that their child's eating habits were the result of sensitivity to food texture (as cited in Cermak et al., 2010, p. 239). In contrast, Schreck and Williams (2006) suggested that RRB is responsible for food selectivity in children on the autism spectrum. In this study participants consisted of 138 children diagnosed on the autism spectrum whose ages ranged from four years and five months to 12 years and eight months. In this study, over half of the children refused food with results showing that refusals were not contributed to food texture but food presentation.

Food Selectivity and Age

Children typically begin to show food selectivity at age 18 months and a study conducted by Williams, Gibbon, and Schreck (2005) found that 55% of parents stated their child continued to be a selective eater for over two years. In contrast to these results, Suarez, Nelson and Curtis (2012) found no significant association between food selectivity and age in children ages 3 to 9.

When assessing how food selectivity and SOR are related to age, Suarez, Nelson and Curtis (2014) found that neither food selectivity nor SOR significantly changed with age. In this study participants level of food selectivity and SOR score were compared at two different ages.

The original ages were used from a previous study conducted in which a significant relationship was found between SOR and food selectivity. Children's original ages ranged from 41 to 107 months, while their ages when assessed the second time ranged from 55 to 128 months. A second survey was given to the parents of the original study. This survey consisted of the same questions measuring food selectivity and SOR, but it also included additional questions measuring RRB. The results of this study showed that 60.1% of the children had the same level of food selectivity when reevaluated 11 to 21 months later. Approximately 20% of the participants had an increase in severity of food selectivity, with 12.7% of these children going from typical to moderate food selectivity. When analyzing SOR over time, the results showed that there was not a significant difference between scores. While RRB did show to have a significant relationship with severe food selectivity, when analyzed alongside the SOR, results did not reveal a significant relationship with severe food selectivity (Suarez et al., 2014).

Although there are varying results on the severity of food selectivity with age, many studies show that it is a chronic problem (Suarez et al., 2014) rather than a temporary one. For this reason it is important that the effects of food selectivity on the nutrition and health status of children are analyzed.

Clinical and Nutritional Characteristics

Studies have shown nutritional concerns can be present in up to 89 percent of children on the autism spectrum (Ranjan & Nasser, 2015). Ranjan and Nasser evaluated the nutritional status of children on the autism spectrum, using existing data from previous literature. The information they collected and assessed included anthropometric data and biochemical data. Anthropometric measures include an individual's "body size, composition, weight, and proportions," while biochemical data includes "nutritional markers and indicators of organ status" and involves the

assessment of blood, urine, and feces. Lastly, they went through previous studies to assess the diet of these children (Ranjan & Nasser, 2015).

The Prevalence of Obesity, Overweight and Underweight. Anthropometric measures have produced different results throughout the literature. The prevalence of underweight, overweight, and obesity among children on the autism spectrum has been found to be inconsistent. Studies conducted by Curtin and colleagues (2005, 2010) show that the prevalence of overweight and obesity in children on the autism spectrum are similar to that of typical developed children (as cited in Ranjan & Nasser, 2015, p.398). In contrast to these findings it has also been found by Egan et al., Xiong et al., Chen et al., and Hyman et al. that there is a higher prevalence, around 13 to 20 percent, of overweight children on the autism spectrum (as cited in Ranjan & Nasser, 2015, p.398). Curtin et al. and Phillips et al. both showed that children on the autism spectrum were twice as likely to be obese (as cited in Ranjan & Nasser, 2015, p.398).

An additional study that was not used in Ranjan and Nasser's review compared 53 children on the autism spectrum with 58 typically developing children, ages 3 to 11. This study also found that the prevalence of overweight and underweight were similar between children in the autism group as well as the typically developed group. The results showed that 22% of the typically developed children were overweight compared to 26% of the children in the autism group. No children in the typical developing group were classified as underweight compared to 2% of the children in the autism group (Bandini et al., 2010). Data from previous literature by Hyman et al. and Phillips et al. also shows that the prevalence of underweight children increases with age, and Curtin et al. and Xiong et al. reported that the prevalence of overweight children on the spectrum also increases with age (as cited in Ranjan & Nasser, 2015, p.398).

Biochemical Status. When looking at the biochemical status of children on the autism spectrum, studies have found different levels of antioxidants A, C, E and the carotenoids among children on the autism spectrum. These vitamins were analyzed in children ages 5 to 18 years old. Results found that older children on the spectrum had higher levels of vitamin C and beta-carotene, with similar levels found in the younger children as well. This study also found Vitamin E and A levels were lower in children on the autism spectrum. Researchers suggested that these results may be due to diet, with adequate levels of fruit and vegetable intake, but poor levels of "whole grain products, plant oils, oil seeds, nuts, fat spreads and dairy products" (Krajcovicova-Kudlackova et al., 2009).

Bandini and colleagues studied the nutritional status of 56 typically developing children with food selectivity and 48 children on the autism spectrum who had food selectivity. The researchers found fiber, vitamin E, vitamin D and calcium were the most frequent vitamins to be found at low levels in all groups. There were a total of eight nutrients that were found to be inadequate among all of the participants with a median of three nutrients being classified as inadequate among the total participants. Children on the autism spectrum seemed to have more vitamin D and calcium inadequacies than did children in the typically developed group. In addition, children on the autism spectrum had more nutrients overall that were classified as inadequate when compared to the typically developed group. With this said, when looking at the groups both together and separately, food refusal was not correlated with inadequate nutrition. On the other hand limited food repertoire was associated with inadequate nutrient intake but, no significant findings were found when comparing food repertoire with nutrition intake in the two groups separately (Bandini et al., 2010).

Although there have been inconsistent results, the vitamins choline and betaine have been found at significantly low levels in children on the autism spectrum. A study that looked at the diets of 288 children on the autism spectrum, found that the majority of children on the autism spectrum were consuming choline levels below the established Adequate Intake (AI) level. While the majority of children were consuming adequate amounts of Betaine, the study found that there was a concern able amount of children who were consuming low amounts. In addition to dietary intake, the study also looked at blood plasma concentrations of these vitamins and found a significant relationship between low levels of intake and low concentrations within the blood. Involved in the metabolism of folate, it is important that this population of children receives intervention to improve the consumption of these vitamins (Hamlin, 2013).

Important minerals have also been found at low concentrations in children on the autism spectrum. Adams and colleagues found that lithium was significantly lower in children on the autism spectrum compared to typically developed children. While not as significant, this study also found that magnesium and calcium may be lower in this population as well (Adams et al., 2011). Additional studies found that the minerals iodine, phosphorus and chromium (Adams, Holloway, George, & Quig, 2006), zinc and selenium (Lakshmi Priya & Geetha, 2011) were all lower in children on the autism spectrum. Iron deficiency is a concern for many special populations, but results are inconsistent among iron concentrations in children on the autism spectrum. In a study of 116 children, 24.1% were found to be iron deficient while 15.5% were found to have iron deficiency anemia (Herguner, Kelesoglu, Tanidir, & Copur, 2012). In contrast, a study conducted by Reynolds and colleagues found that a much lower percentage of children on the autism spectrum were iron deficient. Among the 222 participants in this study,

only 1 of the participants had iron deficiency anemia and less than 2% had low iron intake (Reynolds et al., 2012).

Amino acids have been found in lower concentrations among children on the autism spectrum. One particular amino acid that may be associated with poor dietary intake includes tryptophan (Ranjan & Nasser, 2015), which was found to be much lower in children on the autism spectrum (Adams et al., 2011). In addition, Al-Farsi et al. found lower levels of methionine, while Geier et al. found significantly lower levels of cysteine among children on the spectrum (as cited in Ranjan & Nasser, 2015, p.401). Glutamine was found to be lower in this population of children by Aldred and colleagues (as cited in Ranjan & Nasser, 2015, p.401).

Mealtime Behaviors and Caregiver Stress

In addition to nutritional concerns in children on the autism spectrum, mealtime behaviors and stress during feedings are an additional concern that must be addressed in this population. Refusal of food and selective eating at meals can put stress on families, educators and the children themselves. A stressful environment at mealtimes can create negative associations with feedings and potentially increase the severity of food selectivity or food refusal. Studies have revealed higher levels of negative mealtime behaviors and higher family stress among children on the autism spectrum when compared to typically developed children; negative behaviors and parental stress are most likely associated with higher levels of food selectivity (Curtin et al, 2015; Kerwin, Eicher & Gelsinger, 2005).

Curtin and colleagues (2015) conducted parental surveys on 58 typically developing children and 53 children on the autism spectrum. The surveys assessed food frequency, behaviors during mealtime, the levels of stress among parents at meals, and the extent to which

the child's behavior and food choices affected what the rest of the family eats. The researchers defined "high food selectivity" as a refusing 33% or more of the foods that they were offered. Results revealed that there were a greater proportion of children classified with "high food selectivity" on the autism spectrum than typically developing children. In addition, children on the autism Spectrum had more negative mealtime behaviors than did typically developing children. With more negative behaviors, it is not surprising that the children on the autism spectrum also had parents with higher stress levels. Lastly, it was found that children on the autism spectrum influenced what other family members ate more often than typically developing children. Based on the results of this study, higher food selectivity can be associated with more negative mealtime behaviors (Curtin et al., 2015). Kerwin and colleagues reported that out of 89 children surveyed, 30.3% of their parents reported stress at mealtimes, while 38.2% reported that their "child's eating has negatively impacted their lifestyle (Kerwin et al., 2005).

Many of the negative mealtime behaviors that are demonstrated by children on the autism spectrum stem from the major characteristics that are associated with autism. As mentioned previously sensory over-responsivity and repetitive and ritualistic behaviors (RRB) are both symptoms of autism that may contribute to negative feeding behaviors (Suarez et al., 2014). Twachtman-Reilly, Amaral and Zebrowski linked executive function and planning issues to negative mealtime behaviors as well. The need for routine by children on the autism spectrum can make changing foods at meals a challenge. For this reason many children will insist on one particular food to be served at every meal. Another issue that may be presented due to executive functioning problems is the child's inability to self-monitor whether they are satisfied or still hungry (Twachtmann-Reilly et al., 2008). A study conducted by Kerwin et al. surveying 89 parents of children on the autism spectrum showed that 16.9% of parents believed that their child

was still hungry after eating (as cited in Twachtman-Reilly, 2008). Problems with m*ental flexibility* in the autism population, found by Lopez et al. as well as Ozonoff and Jensen, is also a behavioral concern that may be associated with the need to have food presented in a specific way.

Other behavioral concerns discussed include fear and anxiety, which Morris and Klein as well as Swigert associate with negative mealtime experiences such as certain medical or physical issues that interfere with feedings (as cited in Twachtman-Reilly, 2008). While these medical issues may no longer persist during feedings, negative emotions may continue to be associated with feeding time. Lastly, social issues may contribute to negative mealtime behavior. A child's inability to follow appropriate social rules at meals and social demands in different environments may lead to inappropriate eating behaviors and food refusal (Twachtman-Reilly, 2008). For example in a study of 100 participants on the autism Spectrum ages 22 months to ten years, 35.5% of parents stated that "people and situations" affected their child's eating behaviors, while 41% reported that "different settings" affected eating behaviors of their children (Williams, Dalrymple & Neal, 2000).

Assessment and Treatment

The assessment process of feeding issues in children on the autism Spectrum is a crucial step before implementing therapy. Screening tools, observations and interviews are all important components in determining the contributing factors of a child's food selective and negative mealtime behaviors. Interviews and observations can allow for assessment in different settings, while screening tools such as The Screening Tool of Feeding Problems, developed by Matson & Kuhn can identify negative feeding behaviors (as cited in Twachtmann-Reilly et al., 2008, p.266). Assessments for sensory processing such as The Sensory Profile created by Dunn

(1999)and the Oral Sensory-Motor Analysis created by Boshart (1995/1997) can help to identify if sensory over responsivity puts a child at risk for feeding issues (as cited in Twachtmann-Reilly et al., 2008).

Studies have tested different therapy techniques for food acceptance in children on the autism Spectrum. One study applied feeding treatments to six children with autism. They used a *non-removal of the spoon* technique in which the therapist presented food in a plastic spoon to the child. If the food was not accepted within five seconds the food continued to be presented in front of the child until accepted. If the child expelled the food, they were presented with the food again. The *physical guidance* technique involved applying pressure to the child's jaw if the food that was presented was not accepted. The children were placed into either the *single-item* group, in which they only received one item of food at a time, or the *multi-item* group in which the children were presented with three foods from one single food group at a time. Eating criteria required to present another food item consisted of more than 80% acceptance of that food, less than 20% expulsion of the food and less than 20% disruption in food intake. Results suggested that while single food presentation produced successful treatment results more quickly, the presentation of multiple foods at a time was more effective in the generalization of food acceptance. Researchers suggested that the presentation of single foods at one time in therapy should be used when a child needs immediate treatment to gain weight fast (Ahearn, 2002).

Buckley, Strunk, and Newchok (2005) introduced another therapy technique in which a reward is withheld if the child does not consume the undesirable food and returned when the food is consumed. The researchers conducted a case study using this technique on a five year old boy on the autism spectrum. The study involved two different treatments. The first treatment involved a differential reinforcement of alternative behavior (DRA) combined with a response

cost (RC); this involved providing reinforcement, removing the reinforcement if the child did not take a bite of food, and returning the reinforcement once the child took a bite. The second treatment involved a non-contingent presentation of preferred materials (NCR) combined with an RC; this treatment involved providing reinforcement, removing the reinforcement if the child did not take a bite, and returning the reinforcement whether the child took a bite or not (Buckley, Strunck & Newchok, 2005). Results showed that there was an increase in swallowing and consumption of food for both treatments, but the NCR with RC treatment appeared to be more effective. The NCR with RC treatment also reduced negative feeding behaviors more quickly. The study concluded that NCR with RC treatment was an effective treatment and better alternative to DRA with RC.

Gradually increasing the volume of food presented to a child is another therapy technique that has been studied. Paul, Williams, Riegel, and Gibbons (2007) conducted a study in which very small amounts of food was presented to two children, ages five and three and a half with food selectivity. Children were instructed that they could play after they took a bite of food. Once they took a bite without rejecting the food they could leave the therapy room and play for five minutes. After each play session the child was given a bite of food about the size of a pea. After accepting the food in three of the four sessions, the volume of food was increased to a half spoonful and then eventually to a full spoonful.The treatment was successful in increasing the food repertoire consumed by both participants. Both children had severe food selectivity and significantly improved their food acceptance. Results show that the number of times food was offered to the children before they accepted it decreased, meals were eaten faster throughout therapy, negative feeding behaviors decreased and treatment was generalized into the home (Paul et al., 2007).

Many of the case studies mentioned above incorporated the *escape-extinction technique* into the treatment of food selectivity. This technique blocks the child from demonstrating negative feeding behaviors that the child uses in attempt to leave the meal. Piazza and colleagues studied the effect of this technique with and without the combination of positive reinforcement. In addition, they also studied the effect of positive reinforcement by itself. The results revealed that positive reinforcement had no effect on the treatment of food refusal, while escape extinction showed an increase in food intake with and without the presence of positive reinforcement. While escape extinction was effective independently of positive reinforcement techniques, the combination of both did have a positive effect on therapy for some of the participants by reducing negative behaviors and upset (Piazza, Patel, Gulotta, Sevin & Layer, 2003).

There have been studies conducted that do not use escape extinction. Tanner and Anderone (2015) investigated the effect of *graduated food exposure* which could potentially be used in place of extinction therapy, a process that is not pleasant for the child or the therapist. These researchers tested *graduated food exposure therapy* on a three year old child on the autism spectrum using a 12 step hierarchy. The 12 steps of the hierarchy ranged from being able to tolerate the food within the therapy room, to being able to tolerate the food by just kissing it, to being able to lick the food, and eventually to being able to take full bites and consume all food presented. In addition to this hierarchy being implemented in the therapy sessions, the 12 steps were also implemented in the home with the intent of generalizing food acceptance. The results showed that after nine months and 100 sessions of therapy the child increased his food intake from four items of food to over 50 items, with 27 of those items being consumed both within and

outside of therapy. While some food selectivity and negative feeding behavior persisted, therapy was overall successful (Tanner & Anderone, 2015).

Sequential oral sensory (SOS) approach is a popular treatment technique used by many therapists (Peterson, Piazza & Volkert, 2016). Described by Boyd as well as Toomey and Ross (2010 & 2011), the SOS approach uses six sequential steps to desensitize an undesirable food that is refused by a child. These steps start out with exposing the child to the sight of the food, the smell and how it feels in their hands. Once they progress through these steps, they are exposed to the taste of the food with the last step being the consumption of the food. If a child does not complete a step or becomes too distressed the therapist moves back down to the previous step (as cited Peterson et al., 2016, p.486). Peterson, Piazza, and Volkert compared the effectiveness of an applied behavior analysis (ABA) approach with a modified version of the SOS approach. While results may have been affected by the nature of the experiment, researchers found that the ABA treatment group increased their food acceptance a significant amount, while the SOS treatment group showed no increase in food acceptance. Because SOS has been shown to be ineffective, but still remains a popular choice of technique, further studies need to be conducted on the effectiveness of this study in treating food selectivity (Peterson et al., 2016).

Food selectivity in children can lead to serious nutritional deficiencies and clinical health issues (Ranjan & Nasser, 2015). In addition, children with food selectivity can demonstrate negative feeding behaviors at meals which can lead to increased stress among family, educators and the children themselves (Curtin et al., 2015; Kerwin et al., 2005; Twachtmann-Reilly et al., 2008). Health professionals, such as speech language pathologists, occupational therapists, and dieticians can play a crucial role in the prevention and treatment of food selectivity in the

pediatric population, a population that is vulnerable to delays in growth and development. More information should be collected on how food selectivity specifically presents itself in children on the autism spectrum.

Specific Aims and Rationale

The purpose of the following study was to characterize food selectivity in children on the autism spectrum. While there have been a number of studies that have compared food selectivity in children on the autism spectrum and typical developed children, not many studies have compared food selectivity in children on the autism spectrum with children who have other developmental diagnoses. Comparing these two populations can determine if food selectivity presents characteristics unique to the autism population, information which is important in improving treatment approaches. There have also been few studies that have analyzed food selectivity in terms of severity among children on the autism spectrum.

There were four specific aims of this study. The first aim was to compare parental concerns among the ASD group and the ODD group. The second aim of the study was to compare the prevalence and severity of food selectivity among the ASD and ODD group. Both the opinions of whether parents believed their child was food selective/picky and the classification given using Sharp and Berry's system (2016) was considered. Listed in the children's medical history, the prevalence of issues with food texture among both groups was studied. The study also examined what food groups were more common among both populations of children and what food groups were lacking. In the discussion, the classification system created by Sharp and Berry was assessed in its effectiveness at determining the severity of food

selectivity in the pediatric population, specifically when used in the SCDC at the University of New Hampshire.

Methods

Participants

The data collected for this study was obtained from existing health records that were collected through the SCDC located on the University of New Hampshire's campus in Durham, NH. This clinic assesses children less than six years of age, who show some developmental concern. The data was collected from health charts dating back to 2013. The SCDC requires parents and guardians of each child assessed to fill out a packet of past and current health history. Two forms from this packet of past health records were used in this study (See Appendix A and Appendix B). The first form used in this study was the Child's Health History: Eating and Growing form which contains information about the child's weight, height, past feeding history, and past or current health issues and concerns (as seen in Appendix A). On the health history form the parents were required to check "yes" or "no" to a question asking whether or not they were concerned about their child's eating habits. If they checked "yes" they were then prompted to fill out the second form used in this study: the Food Frequency Questionnaire (as seen in Appendix B). This form required parents to estimate the number of servings per week their child consumes of a particular food item and whether or not they believe their child eats more or less than the typical serving. Only children whose parents completed the Food Frequency Questionnaire were included in this study. Those children whose parents only filled out a portion of the Food Frequency Questionnaire, leaving the form incomplete, were taken out of the study.

Out of the 103 participants who visited the SCDC between July 2013 and December 2016, there were 38 participants whose parents were concerned about their child's eating habits and who completed the Food Frequency Questionnaire. Their ages ranged from 15 months to 71 months, with a mean age of 44 months. Out of the 38 participants, 30 (78.9%) were males and 8 (21.1%) were females. Participants were diagnosed with a range of developmental disorders and psychiatric disorders, including attention deficit hyperactivity disorder (ADHD), attention deficit disorder (ADD), mood disorders, global developmental delays, anxiety disorders, speech and language disorders, adjustment disorders, motor delays, behavioral disorders and Autism Spectrum Disorder. There was one participant who did not have a diagnosis. Because this participant was classified as having temperamental differences, they were still included into this study. Participants were classified into two groups based on their diagnoses. These two groups were Children Under Age 6 w/ a Diagnosis of Autism (ASD Group) and Children Under Age 6 w/ Other Developmental Diagnosis (ODD Group). Any child with a diagnosis of autism was placed into the ASD group whether or not they only had a diagnosis of autism or if they had another developmental disorder and a diagnosis of autism.

Thirteen children had a diagnosis of autism, while 25 children had another developmental diagnosis. Among the children on the autism spectrum, 10 (76.9 %) of the children had a global developmental delay as well. In the ODD group nine (36%) of the children had global developmental delay, three (12%) children had a language or speech delay, five (20%) children had psychological disorders (mood disorder, adjustment disorders, ADHD/ADD), one (4%) child had a behavioral disorder, and one (4%) child had a fine and gross motor delay. Some children had more than one disorder which included ADHD and a speech and language disorder, ADHD and global developmental disorder, ADD and global developmental disorder, a

developmental and speech disorder (Childhood Apraxia of Speech), and a developmental and behavioral disorder. The mean age in the autism group was 43.8 months, while the mean age in the other developmental diagnosis group was 45.8 months. There were ten (76.9%) males and three females (23.1%) in the autism group. In the other developmental group there were 20 (80%) males and five (20%) females.

Procedure

In order to preserve anonymity among the participants a member of the SCDC team, with access to the information, conducted an initial review of all the health records. This faculty member selected only those children who parents checked yes next to the statement “I am concerned about my child’s eating and growing” on the given Child’s Health History: Eating and Growing form. All children whose parents checked yes on this form and also filled out the Food Frequency Questionnaire were included into this study. Once again, those participants who had an incomplete Food Frequency Questionnaire were not included into the study. The faculty member assigned a chart number to each participant so that the researcher could reference a particular participant if needed. Once charts were de-identified and assigned a chart number by the faculty member, the researcher was able to collect data from the forms and write all needed information into separate spreadsheets.

All names, addresses, date of birth and any other information that could potentially identify the child were not included into the chart. All information was saved on a password protected computer and all data collected was protected under the Health Insurance Portability and Accountability Act (HIPAA). Families who attend the SCDC received and signed a notice of privacy practices acknowledging that information collected may be used for research purposes if confidentiality procedures are followed as per the International Review Board. Because all

data collected was from existing health records, in which receiving authorization from families was impractical, a Waiver of Authorization and Consent was presented by the IRB. Because participants were de-identified and all information was securely protected, there were minimal risks posed to the participants by this research.

Data that was collected by the researcher included 1) the child's demographics (diagnoses, age, and gender) 2) information related to feeding and swallowing (picky eating, chokes/gags on food, has trouble eating textures or chunky foods, and has trouble taking liquids) 3) information related to possible GI problems (has frequent diarrhea, has frequent vomiting) 4) health information that may cause the child to be on a special diet (allergies an diabetes) 4) the child's complete food intake listed on Appendix B. The Food Frequency Questionnaire listed 29 food items from all five food groups, in addition to snacks, sweets and beverages. Next to these items parents recorded how many servings per week they believed their child consumed. A reference for a typical child serving was provided. Using this reference parents could then circle whether they believed their child ate more or less than the typical child serving. In addition to the data collected above, parents were given the question "What would you like the most help with as far as eating concerns?" While this question was not offered to all parents because of a change in the *Food Frequency Questionnaire*, responses of those who did complete this question were still considered in the discussion.

After data was collected and entered into the master spread sheet, the researcher then entered each group, the ASD and the ODD group, into separate spreadsheets containing the data which would be analyzed. These spreadsheets included 1) participant's chart number 2) whether or not they were considered a picky eater 3) the most prevalent food group in their diet 4) the most lacking food group in their diet 5) how many total food groups their diet consisted of 6) the

severity of their food selectivity 7) concerns stated by their parents (if question was offered) 8) any feeding issues 9) their age and 10) their gender.

A child was considered a picky eater if their parent responded “yes” on the Child’s Health History: Growing and Eating form. This question was separate from that which asked if the parent had concerns about their child’s eating habits. Therefore, a parent could state that they were concerned about their child’s eating behaviors without stating on the form that they believed their child was a picky eater. In this study the food groups that were used to classify the child’s diet consisted of the fruits, vegetables, meats/beans, grains, and dairy. The fruit and vegetable groups consisted of fresh, frozen, dried, canned, raw and cooked fruits and vegetables. Potatoes, which may be considered a starchy vegetable, were classified as a vegetable. The meat/bean group consisted of all proteins including all kinds of cooked meats, meat dishes, deli/luncheon meats, eggs, beans, nuts and nut butters. The dairy group consisted of milk, cheese and dairy substitutes, such as soy milk. Grains consisted of pastas, rice, breads, baked goods, and granola bars. Muffins, croissants, and biscuit like food items were also considered to be part of the grain group. On the other hand baked desserts, donuts, Danishes, sweet rolls, and pastries, such as cookies and cake, were all classified as snacks and sweets. The snack/sweet group was not considered a food group. Ice cream, chips, French fries, chocolate, candies and snack crackers were all included into this group as well. Beverages, such as fruit juice and any sweetened beverages were not considered to be a food group as well.

The severity of food selectivity was determined using the classification system created by Sharp and Berry (2016). A child could be classified into one of three categories which included severe food selectivity, moderate food selectivity and mild food selectivity (See Appendix C). Children with severe food selectivity were required to reject at least one of the food groups or

accept five or fewer food items. Sharp and Berry stated that children in the severe food selectivity group were at risk for a micronutrient or macronutrient deficiency. Children classified with moderate food selectivity are less likely than those in the severe category to have a nutrient deficiency but due to a lack of variety in their diet these children have an increased risk. In order to be classified in the moderate food selectivity group a child must consume "two or fewer" food items and accept at least one item across the five food groups" (Sharp & Berry, 2016). The last category is *mild food* selectivity which puts a child at the least risk for a nutrient deficiency. A child was classified into this category if they ate "three or more" food items from all food groups. The criteria which separated a child from having a mild food selectivity or no food selectivity was whether or not "more than half of items [fell] into one food group" (Sharp & Berry, 2016).

Due to the nature of the *Food Frequency Questionnaire,* the Sharp and Berry classification system had to be modified to classify the participants in this study. In this study severity was determined by the number of servings that a parent recorded on the *Food Frequency Questionnaire.* Because some food groups only had one or two food items listed on the questionnaire, such as dairy, fruits, and vegetables, severity could not be determined by the food items listed. For example, the vegetable food group only consisted of vegetable salads or raw vegetables and cooked vegetables (fresh, frozen or canned). If severity of food selectivity was determined by the food items listed on the Food Frequency Questionnaire, all children would be classified as having moderate food selectivity, because they would only be consuming two items in the vegetable food group (Sharp & Berry, 2016).

If a child had zero servings for any of the five food groups they were classified as having severe food selectivity. If the parent recorded two or fewer servings for an entire food group,

they were classified as having moderate food selectivity. It is important to note that a child had to consume two or fewer servings in an entire food group and not in a food category in order to be classified in the moderate category. For example, a child would be classified as having moderate food selectivity if they consumed one serving of red meat and one serving of chicken. They could also be classified in the moderate group if they consumed only two servings of red meat per week. Lastly a child was classified into the mild food selective category if they consumed at least three servings of one food group and if more than half of the total food items consumed fell into one food group. If the child didn't meet both of these criteria they were classified as having no food selectivity.

Because the forms were completed by parents and responses were not monitored, some responses had to be left to the subjective judgement of the researcher. If a parent wrote "occasionally" in the 'serving' column for a food on the Food Frequency Questionnaire it was considered to be equivalent to zero servings; this was also the same for parents who wrote "rare" for number of servings. If a parent wrote a specific food name under the serving column for a particular food item, the researcher counted it as one serving. For example chart number 1634 had "mac n cheese" written in the serving column for pastas; this counted as one serving. In addition, the written response "yes" was considered to be one serving and the written response "just tried" was counted as zero servings.

Other considerations to be made were based on how specific foods should be classified. For example, thickeners added to liquids for children who had swallowing issues were not considered to be part of any food group. The parent of chart 1506 listed yogurt in the row titled ice cream; in this specific case the researcher classified yogurt to be in the dairy food group, even though the parent considered it to be similar to ice cream which is a snack. If a child had a food

allergy or intolerance, such as lactose intolerance, a zero in the dairy food group was disregarded. It can't be determined whether or not this child consumed milk substitutes because the parent may not have considered soy or almond milk to be part of the dairy food group. Lastly, the form or texture of food was also disregarded when determining servings and severity. If a child only consumed vegetables when blended into smoothies, this was still considered as a serving or servings of vegetables.

Data Analysis

Data was analyzed in four different ways to evaluate the specific aims of the study. The first analysis examined the entire population of children who had visited the SCDC and whose parents had filled out the first Child's Health History: Eating and Growing form. Among the total population, the prevalence of children whose parents were concerned and who had filled out the Food Frequency Questionnaire was recorded and analyzed for each diagnoses. The second, third and fourth analyses only examined the participants whose parents showed concerns about their child's eating habits and had filled out the food frequency questionnaire. The severity of food selectivity and the number of children considered by their parents to be picky eaters was compared in each diagnosis group in the second analysis. On the Child's Health History: Eating and Growing form parent's had the option to check 'yes' or 'no' to a question asking if they believed their child was a "picky eater " or, in other terms, food selective. The third analysis investigated whether diagnosis was related to feeding problems associated with textures. Finally, the fourth analysis examined the relationship between diagnoses and the food groups that were most prevalent and most lacking. To test for significance in the data, chi squares at a 95% confidence interval were used.

Results

Parental Concerns and Diagnosis

The analyses conducted in this study consisted of data collected only from those participants whose parents were concerned with their child's eating habits and who had filled out the food frequency questionnaire. Out of a total of 103 children, 38 children had parents who were concerned about their eating habits. Out of the 103 children, 41 were on the autism spectrum, 60 were diagnosed with other developmental delays and two were found to have typical variations of development. The 2 children with typical variations were included into the other developmental diagnoses group this analysis. Out of the 41 children on the autism spectrum, 13 (31.7%) children had parents who were concerned about their diet. Twenty-five children out of the 62 children (40.3%) with other developmental delays had parents with concerns about their child's diet. While mean values show that a larger proportion of children with other developmental delays had concerned parents, a Chi-Square analysis showed there was no significant difference (χ^2= .787, p = .375).

Diagnosis and Food Selectivity

Mean values indicated that the majority of children in the ASD group had some level of food selectivity. When compared to children in the ODD group, mean values suggested that a larger proportion of children in the ASD group were food selective. Out of the 13 children on the autism spectrum, nine (69.2%) were food selective, while four (30.8%) of the children had no level of food selectivity. In comparison, out of the 25 children in the ODD group, 13 children (52%) were food selective and 12 (48%) children had no level of food selectivity. Despite these values, a Chi-Square analysis revealed that the difference in food selectivity between diagnoses was insignificant (χ^2= 1.042, p = .307).

The mean values also revealed that a larger proportion of children in the ASD group had severe food selectivity when compared to children in the ODD group. Out of the 13 children in the ASD group, seven (53.85%) were classified with severe food selectivity, and two (15.38%) were classified with moderate food selectivity. In comparison, out of the 25 children in the ODD group, only seven (28%) were classified with severe food selectivity, five (20%) were classified with moderate food selectivity, and one (4%) was classified with mild food selectivity. Two separate Chi-Square analyses were conducted when examining a relationship between severity and diagnoses. The first Chi-Square was a four-way analysis conducted to determine if severe, moderate, mild and no food selectivity was disproportionately related to diagnosis. The analysis showed an insignificant difference (χ^2= 2.773, p = .428). A two way Chi-Square analysis was also conducted to determine if severe food selectivity alone was disproportionately related to diagnosis. The Chi-Square revealed that the relationship between severe food selectivity and diagnosis was insignificant (χ^2= 2.455, p = .117).

Diagnosis and Picky Eating

The study examined the relationship between diagnosis and "picky eating." All 13 (100%) of the children in the ASD group were classified by their parents as a "picky eater." This proportion is much larger than the 19 out of 25 (76%) children in the ODD group who were classified by their parents as a picky eater or food selective. A Chi-Square test indicated that the difference in parental responses about "picky eating" among diagnoses were statistically significant (χ^2 = 3.705, p = .054).

Diagnosis and Texture

When examining the relationship between diagnoses and feeding concerns associated with food texture, mean values show that a larger proportion of children on the autism spectrum

had issues with the texture of food when compared to children with other developmental diagnoses. Ten (76.9%) out of the 13 children in the ASD group had textural issues with food, while only 12 (48%) out of the 25 children in the ODD group had issues with food texture. When conducting a Chi-square, values approached significance suggesting a possible relationship between diagnosis and textural issues ($\chi^2 = 2.94$, $p = .087$).

Diagnosis and Food Groups

Diagnosis and Preference Food Group. The preference of a food group was analyzed among both diagnosis groups. Preference group was determined by the food group with the greatest number of servings listed. Among the 13 children in the ASD group, seven (53.8%) preferred grains, two (15.4%) preferred meats, two (15.4%) preferred dairy, one (7.69%) preferred fruits, and one (7.69%) preferred fruits and dairy equally. In contrast, in the ODD group, the most preferred food group was meats. Seven (28%) out of the 25 children in the ODD group preferred meats, six (24%) preferred dairy, six (24%) preferred grains, three (12%) preferred vegetables, one (4%) preferred fruit, one (4%) preferred fruits and vegetables, and one (4%) preferred meat and dairy. A Chi-Square analysis was conducted on each food group to determine if there was a significant difference between food group preference and diagnosis. Each analysis was conducted independently and did not take into consideration those children who preferred two food groups equally. The Chi-Square analysis conducted on the grain food group revealed a disproportionate relationship approaching significance, with a greater proportion of children in the ASD group preferring the grain food group ($\chi^2 = 3.385$, $p = .066$). Insignificant results were produced for the meat food group ($\chi^2 = 1.218$, $p = .27$), the dairy group ($\chi^2 = .107$, $p = .740$), the vegetable group ($\chi^2 = 2.325$, $p = .127$) and the fruit group ($\chi^2 = 0.495$, $p = .482$).

Diagnosis and Least Preferred Food Group. The least preferred food group was classified as the food group that had the lowest amount of weekly servings consumed by a child. The fruit and vegetable group had the highest frequency of least preferred foods among both diagnoses. Among the children in the ASD group, vegetables were the least preferred food among five (38.6%) of the children, fruits were the least preferred food among four (30.8%) of the children, and dairy was the least preferred food among only one (7.7%) of the children. One (7.7%) child disliked fruits, vegetables and meats, one (7.7%) child disliked vegetables and grains, and one (7.7%) child disliked fruits and vegetables. Among the ODD group eight (32%) children consumed the lowest amount of servings in the vegetable group, six (24%) children in the fruit group, one (4%) child in the grain group, and one child in the meat group. Three (12%) children lacked both fruits and vegetables; two (8%) children lacked fruits, vegetables and dairy; one (4%) child lacked meats and grains; one child lacked grains and dairy, and one child lacked meats, grains and dairy. There was one (4%) child in the ODD group who lacked all food groups except meats. There were no significant differences between diagnoses and least preferred food group among the fruit ($\chi^2 = .0117$, $p = .914$), vegetable ($\chi^2 = .1076$, $p = .743$), grain ($\chi^2 = .608$, $p = .435$), or meat ($\chi^2 = .169$, $p = .681$) food group. There is suggestive evidence that a larger proportion of children in the ODD group lacked the dairy food group ($\chi^2 = 2.994$, $p = .084$). Chi square analyses looked at the total children who disliked each individual food group; it did not take into consideration those children that had two least preferred food groups.

See Appendix D and E for graphs and figures on the results.

Discussion

Discussion of Results

While mean values suggested a greater proportion of parents who had children with other developmental issues showed concerns, statistical values indicated that the difference in proportions between the ASD group and the ODD group were not significant. Therefore, the proportion of parents who had concerns in the ASD group was relatively the same to the parents who had concerns in the ODD group. It was hypothesized that a greater proportion of parents with children on the autism spectrum would have concerns about their child's eating. An explanation for this insignificant difference may be found in the analysis of diagnoses and parents who believed their child was a "picky eater." A statistical analysis showed that there were a greater proportion of children on the autism spectrum classified by their parents as "picky eaters" than children with other developmental diagnoses. This suggests that while mean values showed that there was more parental concerns about diet within the ODD group, many concerns may have not been related to food selectivity but rather other feeding issues such as swallowing problems or GI issues. When looking at the children in the ODD group who were not classified by their parents as "picky eaters," many of them had feeding issues related to diarrhea, vomiting, allergies, swallowing issues, overeating issues, and problems with gagging or choking when eating.

Similar to what previous literature has found (Bandini et al., 2010), it was hypothesized that when compared to children with other developmental diagnoses, a greater proportion of children on the autism spectrum would be food selective and therefore be classified as "picky eaters" by their parents. The results comparing diagnoses and "picky eating" align with what was hypothesized by the researcher as well as previous literature. Williams reported that 67 out of 100 parents with children on the autism spectrum had reported that their child was a picky eater (as cited in Cermak et al., 2010). In this study, 100% of the children on the autism spectrum were

classified as picky eaters by their parents compared to 76% of the children with other developmental diagnoses.

While significant differences were found between diagnoses and parental classification of food selectivity among children, there were surprisingly no significant differences between diagnoses and researcher classification of food selectivity in terms of the Sharp and Berry (2016) classification system. Although the mean values indicated that a larger proportion of children on the autism spectrum were food selective and had more severe food selectivity, there was no statistical significance. Due to past research suggesting that food selectivity is much higher in children on the autism spectrum when compared to typically developing children (Bandini et al., 2010) the results found in this current study were unexpected. It was predicted that food selectivity would be a characteristic more unique to children on the autism spectrum not only when compared to typical developing children, but when compared to children with other developmental diagnoses as well.

One possibility that may explain these results is that the parents of the children had more concern about their child's diet and eating habits than what the Sharp and Berry (2016) classification system suggested. The difference between parental beliefs and the level of food selectivity that the researcher classified the child as could be due to limitations in the study. Out of the 25 children in the ODD group, there were nine (36%) children who were classified as food selective by their parents but were not classified as food selective by the researcher. In the ASD group there were four (30.8%) children who were classified as picky eaters by their parents but were considered to not have any level of food selectivity by the researcher. In addition, there were also children who were classified as food selective by the researcher but were not classified

as food selective by their parents. In the ODD group there were a total of three (12%) children who had moderate food selectivity but were not classified as “picky” by their parents.

One important finding in this study, that showed results approaching significance, was that children on the autism spectrum had much more textural issues than children in the ODD group. Many past studies, such as that by Whitley, have shown similar results when comparing children on the spectrum with typically developing children (as cited in Cermak et al., 2010). The results found in this study strengthen the association with texture and autism even more, because the population of children on the spectrum was compared to children who have other developmental diagnoses. While it may be expected that the ODD group would have issues with texture as well, the results suggest that this is a characteristic that is more unique to children on the autism spectrum. While a significant relationship between food selectivity and textural issues cannot be linked to either diagnosis, a significantly higher proportion of children on the autism spectrum with textural issues may suggest that sensory issues play a larger role in food selectivity among the autism population than it does among those with other developmental diagnoses. This may further confirm what previous research has suggested in that common autism symptoms, particularly sensory over-responsivity, may be a cause of food selectivity in children on the autism spectrum (Suarez et al., 2014). This finding may have future implications on what feeding therapy strategies should be used with the autism population.

This significant relationship between texture and the autism diagnosis could also explain why there was a significant preference for grains among the ASD group. While a significant relationship cannot be determined between food selectivity and texture, a preference for grains may suggest that children on the autism spectrum prefer soft and smooth foods such as pastas and breads. Raw vegetables and fruits tend to be crunchier and have more of a rough texture

which a child on the spectrum may have an over responsive reaction to. Further support of this theory can be found in the Food Frequency Questionnaire that was filled out by the parent of chart number 1498. In the comment section of the questionnaire the parent stated that the child only consumed fruits and vegetables in the form of smoothies, which may make the texture of these food groups more tolerable. Future research may want to investigate if there was a significant difference between those children who ate soft cooked vegetables versus those children who ate crunchy raw vegetables. This may further reveal if texture rather than taste affected food preference among both diagnoses. While similar proportions of children from both diagnoses disliked vegetables and fruits, it would be of interest to determine if there was a difference in whether or not texture had an influence on the disliking of these food groups. While a greater proportion of children in the ODD group were lacking dairy, results were approaching significance and no real conclusions can be made as to why this occurred.

Limitations

One limitation that may explain why a disparity between parental classification and researcher classification occurred is that the chart developed by Sharp and Berry (2016) was modified to fit this study. The classification system is based on the number of different food items consumed by a child within a single food group. Because the Food Frequency Questionnaire given to parents did not include the number of different food items consumed, food severity was determined by servings consumed per week in each food group. The problem with this modification is that parents may have identified their child as being food selective if they only eat one or two food items in a food group, but the classification system may identify this child as having no food selectivity because the child eats an adequate amount of servings of that one particular item. For example, the only fruit that a child may consume is applesauce.

While a parent may classify this as “picky eating,” according to the classification system this child may meet the criteria for no food selectivity because they eat adequate servings of applesauce. While a child may consume an adequate amount of servings they may have a limited variety. This limitation may explain why there was only one child who was classified as having mild food selectivity, a category that was much harder to define. This limitation may increase the proportion of children who are not food selective in both groups. With this said, if more children were identified as food selective in both groups, it is unlikely that the results would show much more significance.

In the ODD group, three (12%) children were classified as food selective even though their parents did not believe that they were a “picky eater.” A limitation of this study is that the classification system does not take other feeding issues into consideration. The three children, who were classified as food selective despite their parents believing otherwise, all had other feeding issues. Two of the children had moderate food selectivity in addition to swallowing disorders, while the third child had mild food selectivity and issues with overeating. The two children with swallowing issues may have been classified as food selective not because of selectivity toward sensory properties, but because of reasons associated with their swallowing difficulties. Despite their swallowing difficulties, these two children were still considered to be food selective in the study because it is not certain if these problems coexisted or not.

The third child, whose parent reported them as not food selective, despite the researcher classifying them with mild food selectivity, had issues with overeating. It could be likely that the child has food selectivity but was not considered to be a selective eater by the parent because of their issue with overeating. The child was also classified with mild food selectivity, showing that they consume diverse foods across all food groups but show a preference for one particular food

group or food type. The rationale behind classifying this one participant with mild food selectivity was that the participant consumed more than half of her total servings of food in the dairy group. While the participant consumed adequate servings for the other food groups, she showed a preference for the dairy group, putting her in the mild category and at low risk for a nutrient deficiency.

Out of the 38 participants in the study there was only one participant who was classified in the mild category. This may be the result of limitations within the classification system. While those participants who fell into the severe food selective category were clearly identified, it was difficult to determine if a participant fell into the mild food selective category or had no food selectivity at all. The only defining characteristic between the two categorizations was if the child consumed more than half of their total servings in a single food group they were classified into the mild category. While a classification in the mild food selective category may suggest a strong preference for a particular food type or food group, it can be called into question whether or not the mild category represents true food selectivity. Many young children show preferences for a specific food but are not at any risk for a nutrient deficiency. Further research and evaluations of the classification chart may need to be conducted in order to clearly identify the population of children that fall into the mild category and what the rationale is for doing so.

An additional limitation includes the sample size. The small sample size could have had an effect on the significance of the results, particularly the differences found between the severities of food selectivity. It could be predicted that if the sample size was larger, there might have been a significantly larger proportion of children on the autism spectrum that were food selective or who fell into the severe category. Collecting data from parental responses is another limitation. The food frequency questionnaire was based on parent’s estimations of how many

servings their child had per week. For this reason, the number of servings recorded were not completely accurate. Although there was a column on the questionnaire that served as a reference for a typical serving size, determining exactly what one serving of a particular food is can be difficult. In addition, recalling on average how many servings a child has over the span of a week can be a challenge as well.

Future Research

One area for future research may be to compare food selectivity in children of different ages. It is of interest to examine if food selectivity in a child improves and becomes less severe as a child ages. One suggestion may be to give the same health history form and food frequency questionnaire to the same subjects to determine how their food selectivity had changed in the past couple of years. A longitudinal study could also be conducted to determine if age had an effect on food selectivity in children in the ASD group and the ODD group. It may also be of interest to see if these children were receiving feeding therapy and whether or not the therapy was effective in increasing their food acceptance. Additional research should investigate whether severity of food selectivity had an effect on the nutritional and clinical status of these children. Knowing the nutritional status of a child can determine if the food selectivity classification accurately matches the rationale and nutritional risk described by Sharp and Berry (2016).

A further investigation on the relationship between texture, food selectivity, and diagnosis is also of interest. With a better understanding of texture and its relationship to food selectivity among children on the autism spectrum, we can better understand if food selectivity is associated with the common characteristics and symptoms of autism. Knowing this information can give us a better understanding of what therapy should be used to treat feeding issues in this population. Lastly, it is suggested that the food frequency questionnaire provided at the SCDC be

improved with an additional column that includes the different types of foods consumed by the child rather than just numbers of servings per week. With this information, children can be more accurately classified into food selective categories.

Conclusions

Children on the autism spectrum are more likely to be classified by their parents as "picky eaters" compared to children with other developmental issues. When compared to the ODD group children in the ASD group were also more likely to have textural issues and prefer grains. Although mean values indicate that a greater proportion of children in the ASD group are food selective and fall into the severe category, relationships between food selectivity and diagnosis were insignificant. The Sharp and Berry (2016) classification system proved to be effective in determining severe food selectivity but it was less effective in determining the moderate, mild and not food selective categories. Modifications had to be made in order to use the classification system at the Seacoast Childhood Development Clinic. Adding a food item column to the food frequency questionnaire given to parents at the clinic could be suggested for the future.

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Appendix A

Child's Health History: Eating and Growing Form

CHILD'S HEALTH HISTORY

Eating and Growing

Child's Current Height: _____ **Child's Current Weight:** _____

It is easy to tell when my child is hungry.	Yes	No	I am concerned about my child's eating and growing.	Yes	No
It is easy to tell when my child is thirsty.	Yes	No	***If yes, please complete* Food Frequency Questionnaire *(blue form) in packet.***		

My Child:

Takes a multi-vitamin.	Yes	No	Has frequent constipation	Yes	No
Is fed by a tube	Yes	No	Has frequent diarrhea	Yes	No
Is a picky eater	Yes	No	Has frequent throwing up/ vomiting	Yes	No
Eats things that are not food (e.g., paint or dirt)	Yes	No	***If yes, to any of the above please describe frequency:***		
Chokes on foods	Yes	No			
Gag on foods	Yes	No			
Has trouble eating textured or chunky foods	Yes	No	Is on a special diet Yes No ***If yes, please describe:***		
Uses a: bottle sippy cup open cup					
Has trouble taking liquids. Check all that apply:	Yes	No			
water juice formula / milk					
Other (list):					

Hearing History

Hearing is important to your child's development, especially learning and talking. We recommend a hearing test prior to the evaluation.

- If your child has had a hearing evaluation done by an audiologist within past 6 months, **Please complete a medical release.**
- If not, or the results were incomplete, we will discuss available options at the time of scheduling.

Has your child had any history of ear infections or problems?

Yes No If yes, please describe:

Do you have any concerns about your child's hearing/ listening behaviors?

Yes No If yes, please describe:

Has your child ever:

Seen an Ear, Nose & Throat Doctor? Yes No

Had a hearing test with an Audiologist? Yes No

Date:_____

approximate (mm/yyyy)

Please Check all that Apply to Your Child's Health:

Illnesses:	**Chronic Conditions**	**Developmental Concerns:**
Chicken Pox	Allergies (list):	Attention Problems
Ear Infections	Asthma	Developmental Delay
Head Injury or Other Injury	Diabetes	Emotional Concerns
Measles	Eczema	Hearing Problem
Mumps	Epilepsy / Seizures	Social Problems
Pneumonia	Heart Condition	Speech Problems
Rubella (German Measles)	Other (*please list*):	Temper Tantrums
Strep Throat		Vision Problems / Wears Glasses
Tonsillitis		Other (*please list*):
Whooping Cough		
Other (*please list*):		

Appendix B

Food Frequency Form

Child's Name:_____ Date of Birth:

Food Frequency Questionnaire

Please complete **ONLY** if you are concerned about your child's eating and growing and you checked the box on page 5 of the Application.

This questionnaire will give us information about your child's eating habits. Accurate and thoughtful responses will allow us to estimate your child's intake of certain nutrients.

- Recall the times during **the past week** when your child ate, and what he/she had.
- Include snacks and "nibbles" as well as meals and beverages.
- If you eat out regularly, remember to include those foods too.
- Be sure to answer every item on this form. If your child did not eat a food listed below – or eats it less than once a week – write a "0" in the space provided. Please do not leave blanks.
- Circle whether the servings are more or less than a typical serving.

Food Item	**Number of Servings per Week**	**Typical Child Serving**	**My Child Eats More or Less than a Typical Serving (Circle)**	
Red meat (beef, pork and ham, veal, lamb)		2 oz.	More	Less
Meat dishes (casseroles, tacos, pizza, meat sauce)		½ cup casserole, 1 taco or pizza slice	More	Less
Chicken or turkey (circle: roasted or fried)		2 small pieces	More	Less
Fish or shellfish, (Including canned tuna)		1/4 can (2 oz.)	More	Less
Bacon, sausage		1 piece	More	Less
Luncheon meats (Salami, bologna, hot dogs, etc. including turkey and chicken varieties)		1 piece/slice	More	Less
Low fat luncheon meats (at least 95% fat free)		1 piece/slice	More	Less
How many of the above servings are from fast food restaurants? (McDonald's, Taco Bell, etc.) _____				
Eggs		1 egg	More	Less
Milk (circle type: skim, 1%, 2%, whole)		1/2 cup (4 oz.)	More	Less
Cheese		1 ounce/slice	More	Less
Ice Cream		1/2 cup (1 scoop)	More	Less
Fruits, fresh, frozen, dried, or canned		1 whole small piece or 1/4-cup cut-up fruit	More	Less
Fruit juice		1/2 cup (4 oz.)	More	Less

Vegetable salads or raw vegetables		1/2 cup	More	Less
Cooked vegetables (fresh, frozen, or canned)		1/4 cup	More	Less
Spaghetti, noodles or other pastas		1/2 cup	More	Less
Rice		1/3 cup	More	Less
Potatoes		1/2 cup or 1/2 potato	More	Less
Bread, bagels, rolls, tortillas, English muffins, etc.		1 piece		
Biscuits, bakery muffins, croissants, Pancakes, or waffles		1 piece or slice	More	Less
Cold or hot breakfast cereal (circle sweetened or unsweetened)		1 med. bowl	More	Less
Granola bars, sport bars		1 bar	More	Less
Nuts, nut butters (like peanut butter)		2 Tbsp.	More	Less
Chips or French fries		10 pieces	More	Less
Baked dessert &pastries (cake, cookies, etc.)		1 slice or 2 cookies	More	Less
Donut , Danish, sweet roll		1 piece	More	Less
Chocolate or candy bars		1 candy bar	More	Less
Snack crackers (example: Goldfish, Cheetos or similar snacks)		1/3 cup	More	Less
Sweetened beverages, not including diet drinks (soft drinks, fruit drinks, etc.)		1 large glass, 1 can	More	Less
Are there any other foods your child routinely eats? Please list.				
Are there any foods your child refuses to eat? Please list.				
What would you like the most help with as far as eating concerns?				

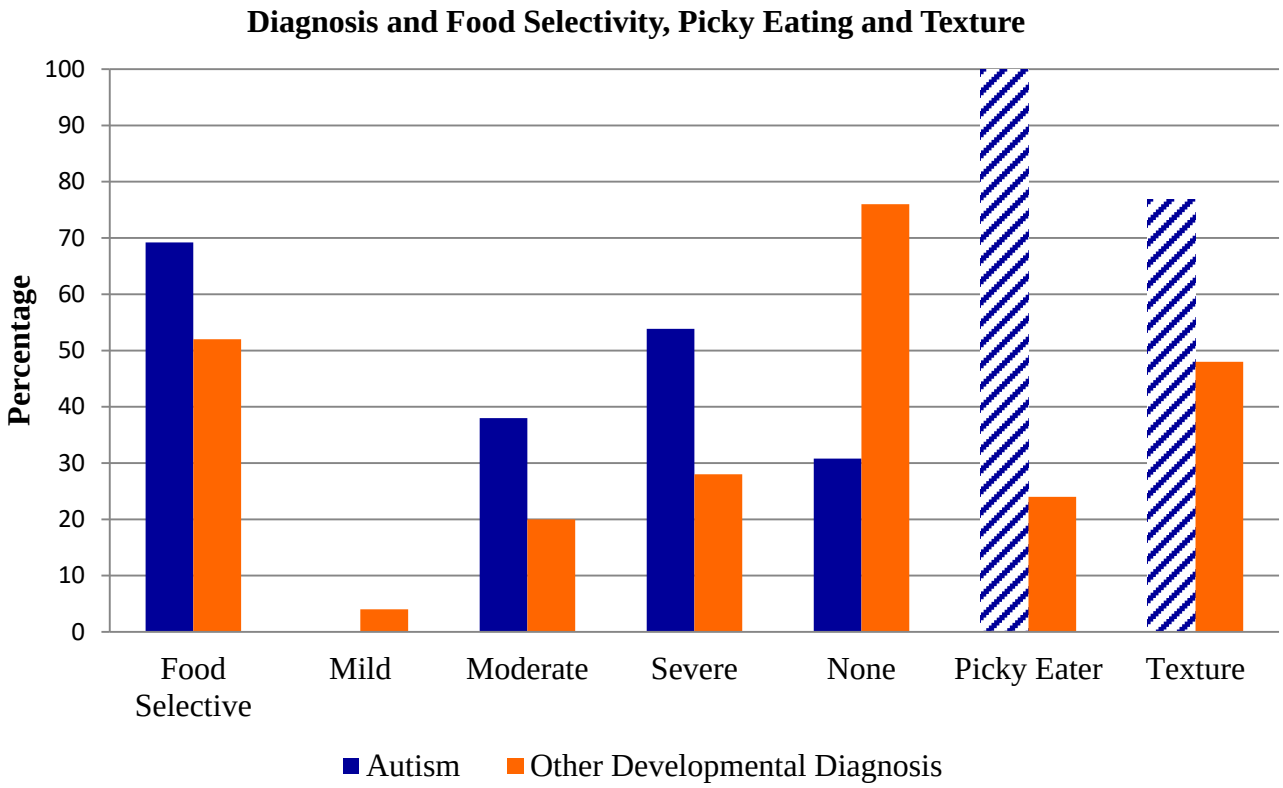
Appendix C

Sharp and Berry Classification Chart (2016)

Category	Criteria	Rationale
Severe Food Selectivity	• Complete rejection of one or more food groups	Increases the risk of micro- and/or macronutrient deficiency (e.g., scurvy; iron deficiency anemia; kwashiorkor)
	• Accepts five or fewer total food items	Further narrowing of the diet would eliminate additional food groups
Moderate Food Selectivity	• Consumes two or fewer items in one or more food groups	Reflects a diet that may lack diversity of nutrient-dense foods; further restriction increases likelihood of nutrient deficiency
	• Regularly (weekly) accepts at least one item across the five food groups	Decreases likelihood of being diagnosed with a nutrient deficiency; however, intake may be limited to a handful of preferred items or involve high intake of a single food group
Mild Food Selectivity	• Diet involves at least three or more items from each good group (15 total foods); more than half of items fall into one food group	Suggests low probability of nutrient deficiency while recognizing child may show preference for a certain food group (e.g., grains)
	• Consistently (daily) accepts foods from all five food groups	Indicates the child maintains a consistent degree of dietary diversity

Appendix D

Diagnosis, Food Selectivity, Picky Eating and Texture

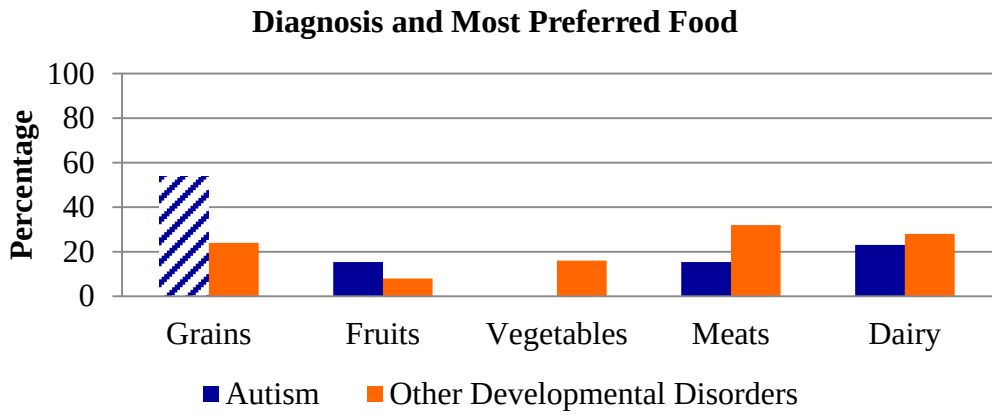


	ASD	ODD
Food Selective	9, 69.2%	13, 52%
Not Food Selective	4, 30.8%	12, 48%
Mild	0, 0%	1, 4%
Moderate	2, 38%	5, 20%
Severe	7, 53.85%	7, 28%
Picky Eater	13, 100%	19, 76%
Non-Picky Eater	0, 0%	6, 24%
Texture	10, 76.9%	12, 48%

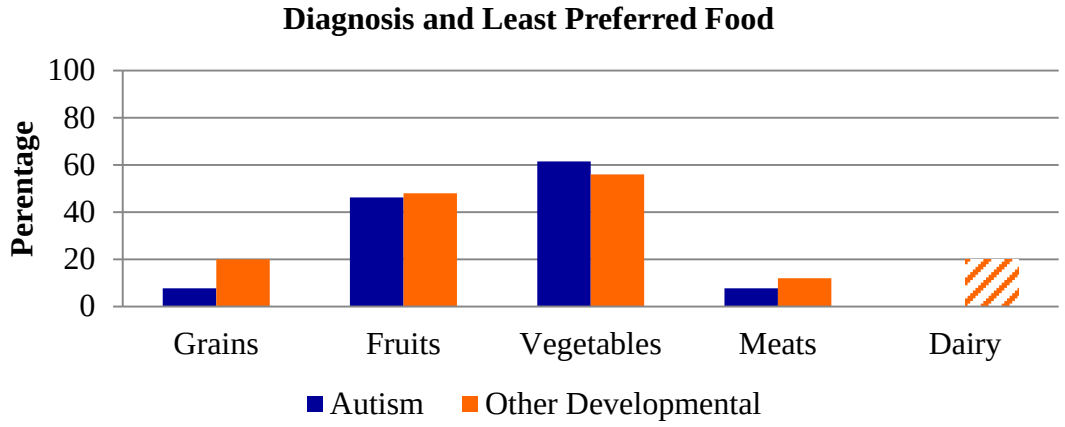
*Stripes represent statistical significance

Appendix E

Diagnosis and Food Preferences



	ASD	ODD
Grains	7, 53.8%	6, 24%
Fruits	2, 15.4%	2, 8%
Vegetables	0, 0%	4, 16%
Meats	2, 15.4%	8, 32%
Dairy	3, 23.1%	7, 28%



	ASD	ODD
Grains	1, 7.7%	5, 20%
Fruits	6, 46.2%	12, 48%
Vegetables	8, 61.5%	14, 56%
Meats	1, 7.7%	3, 12%
Dairy	0, 0%	5, 20%