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"Additional Analysis of Previously Collected Data: Food Choices in Children with Autism"

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Abstract

The objective of this study was to look at children with autism and their food choices based on previously collected data. The previously collected data includes a caregiver survey to determine food acceptance level (e.g. severe, moderate, typical), and a caregiver reported food inventory. The caregiver reported food inventory was used to see what specific foods children with autism are eating and in what food categories (e.g. dairy, fruits, vegetables, protein, and carbohydrate). Per previously literature, it is researched that children with ASD tend to have more food selectivity than typically developing children (Suarez, Nelson, & Curtis, 2012). There is also literature to support that children with ASD have sensory over-responsivity (SOR), specifically tactile defensiveness (Miller, Anzalone, Lane, Cermak, & Osten, 2007). These two factors have show to correlate with sever to moderate food selectivity. Children with autism who have food selectivity are at risk for poor nutrition (Cornish, 1998; Dovey, Staples, Gibson, & Halford, 2008; Herndon, DiGuiseppi, Johnson, Leiferman & Reynolds, 2009), as well as, lack of quality of life surrounding meal times (Ausderau, & Juarez). Therefore, knowing what foods children with autism are eating based on their food selectivity level is important. It is important because it can inform caregivers and clinicians and in turn, possibly decrease the risk for nutritional deficits and increase quality of life surrounding meal times.

Additional Analysis of Previously Collected Data: Food Choices of Children with Autism

People with autism exhibit dysfunction in social interactions, communication, and have behaviors that can be restricted, repetitive, or stereotyped that can range from mild to severe (American Psychiatric Association, 2012). Autism prevalence is increasing. It is currently estimated that approximately 1 in 88 children, 8 years of age, are affected (Center for Disease Control & Prevention, 2012b). Parents of children with autism report many challenges with the children's daily activities, behavior, and communication (Cermak et al., 2010). These daily activity challenges are of concern because they these can impact health (Cermak et al., 2010). Specifically, when children with autism have difficulty with the daily activity of eating, it can threaten nutrition and family mealtime satisfaction (Cermak et al., 2010). As early as 1979, there were reports of meal time difficulties in children with autism including: an increase in food selectivity, refusing foods, and meal time disruptions (Ahearn, Castine, Nault, & Green, 2001; DeMeyer, 1979). These behaviors were reported in up to 90% of children with autism (Ahearn, Castine, Nault, & Green, 2001; DeMeyer, 1979) and more specifically, children with autism experience food selectivity about 40-60% of the time. Food selectivity in children with ASD has the potential to threaten optimal nutrition and decrease quality of life due to dysfunctional mealtime behaviors (Ahearn, Castine, Nault, & Green, 2001; DeMeyer, 1979).

Food selectivity is frequently defined as having a restricted variety of accepted foods, but there is some discrepancy in the literate regarding the operationalization of

food selectivity. Bandini and colleagues (2010) investigated three constructs related to food selectivity: restricted variety of foods accepted, food refusal as a percentage of foods offered, and eating a particular food with high frequency. They found that only the restricted variety was associated with nutritional deficits in children with autism. Field and colleagues, (2003) defined food selectivity as a refusal to eat developmentally appropriate food (Field et al., 2003). Suarez, Nelson and Curtis (2012) operationalized food selectivity as severe (acceptance of less than 10 foods), moderate (acceptance of 11-20 foods), and typically selective (acceptance of 20+ foods).

In addition to uncertainty with the precise definition of food selectivity, the cause of this dysfunction is not clear. One study suggests that sensory factors such as smell, texture, color, and temperature can contribute to food selectivity (Schreck & Williams, 2006). For example, a child might only eat foods of the same texture, color, flavor of a particular plate or with a particular utensil (Schreck & Williams, 2006). The connection between sensory factors and food acceptance suggests the possibility that Sensory Over-Responsivity is a factor that influences the presence of food selectivity in children with autism.

SOR is defined as a faster, more intense, and longer lasting response to sensation, inconsistent with the demands of the environment (Miller, Anzalone, Lane, Cermak, & Osten, 2007). It is reported that SOR can interfere with appropriate functional responses, which can include eating (Miller, Anzalone, Lane, Cermak, & Osten, 2007). The inappropriate responses to sensation can seem to be willful. However, there is some evidence that they are not. It may be that these responses stem from automatic and unconscious physiological reactions to different sensations (Miller, Anzalone, Lane,

Cermak, & Osten, 2007). The behaviors associated with SOR can vary from being active, negative, impulsive, or aggressive to more passive withdrawal or avoidance of sensations (Miller, Anzalone, Lane, Cermak, & Osten, 2007). Some emotional responses include, irritability, moodiness, inconsolability, and poor socialization (Miller, Anzalone, Lane, Cermak, & Osten, 2007). Someone who has SOR can seem to be controlling or rigid (Miller, Anzalone, Lane, Cermak, & Osten, 2007). At a young age, certain rigid behaviors that can come about during meal time including when, where, and what types of food are eaten (Kral, Eriksen, Souders, & Pinto-Martin, 2013). All of these factors can contribute to the ability of children with autism to eat a variety of foods. The supporting research shows that therefore, the child will be more reluctant to try foods with different textures, colors, and flavors (Cermak, Curtin, & Bandini, 2010). For example, it was found that some children who showed signs of tactile defensiveness on Dunn's (1999) Sensory Profile ate less fruits and vegetables and were more likely to gag on food (Smith, Roux, Naidoo, & Venter, 2005). Therefore, children with ASD who exhibit signs SOR may be at an increased risk for food selectivity.

Food selectivity, possibly at least partially resulting from SOR, can have different consequences. For example, food selectivity correlates with inadequate nutrition (Cornish, 1998; Dovey, Staples, Gibson, & Halford, 2008; Herndon, DiGuiseppi, Johnson, Leiferman & Reynolds, 2009). For instance, for children with ASD, food selectivity, along with concerns about dietary intake is a primary reason for referral to a dietary service (Bowers, 2002). Children with food selectivity can eat as few as 5 different foods (Cermak, Curtin, & Bandini, 2010), increasing the risk for poor nutrition (Cermak, Curtin, & Bandini, 2010). A similar study with children with ASD ages 2-12,

showed inadequate self-feeding skills, increase food avoidance behaviors, and increased food nephobia compared to age and sex related typically developing children (Martins, Young, & Robson, 2008). Another study used a 3 day food record to examined the diets of children with ASD ages 3-11. The data showed that there were low amounts of vitamin D, calcium, and vitamin A in a child with ASDs' diet compared to a typically developing child (Zimmer et al., 2012). All of this evidence shows that children with ASD are at risk for poor dietary intake and quality. This can have an impact on their neurodevelopment and growth in the present and future (Kral, Eriksen, Souders, & Pinto-Martin, 2013). This issue of poor nutrition and quality of life in children with ASD is important and this study aims to help provide relief to parents and children with ASD by exploring what exactly children with autism eat.

In addition to the nutritional implications of food selectivity this issue also has the potential to impact quality of life due to dysfunction in social aspects of eating. If a family is having a hard time with mealtimes because their child is disruptive and reluctant to try new foods, this can affect the families overall quality of life. According to a study on eating challenges during family mealtimes, disruptions can happen when the child requires more supervision and assistance, needs a separate meal, or that the atmosphere is stressful because of the amount of attention the child requires (Ausderau, & Juarez). Children can experience a range of eating and meal time challenges which can then lead to rigid food routines and exhaustive work by the family members (Ausderau, & Juarez). One study suggests that mealtime is an important family routine that can be correlated with many positive results (Gillman, Rifas-Shiman, Frazier, et al., 2000; Eisenberg, Olson, Neumark-Sztainer, Story, & Bearinger, 2004; Stanek, Abbott, & Cramer, 1990;

Fiese, & Schwartz, 2008). For example, Fiese suggests that 72.8% of school-aged children eat dinner with at least one parent almost every night of the week. Therefore, mealtime can provide an opportunity for a daily structured routine for families that often supports larger goals and communication in that family (Fiese, Foley, & Spagnola, 2006; Evans, & Rodger, 2008). DeGrace found that in families with children with ASD, similar to families with typically developing children recalling daily events and planning for the future were common mealtime conversations. When there is an additional strain due to the child's feeding challenges, further disruption to the family's ability to engage in mealtime routines can be predicted (Ausderau, & Juarez). In another study of family routines and rituals among children with ASD, 92% of participants considered dinner time as the most stressful part of their day. One mother even described it as "hell on earth," (Marquenie, Rodger, Mangohig & Cronin, 2011). Another study done by Bagby et al., found that for families with children with ASD, mealtimes focused on meal prep and sensory experiences of the child, limiting opportunities for sharing meaningful experiences. Finally, in a survey of family mealtimes with children with ASD, 65% of parents said that their child's disruptive mealtime behaviors required so much attention that the child was the biggest focus of mealtime, limiting the participation and engagement of other family members (Marquenie, Rodger, Mangohig & Cronin, 2011). Constant mealtime battles and stressful mealtimes can directly affect a child and families quality of life.

Food selectivity is a significant problem in children with autism but little is known about which foods children with food selectivity are including in their mealtime repertoires. This information could be useful in supporting treatment that helps facilitate

dietary diversity in children with autism. Therefore, this study has several primary research questions. First, what types of food are children with food selectivity choosing to eat. Specifically, do children in the severe, moderate and typically selective groups have the same number of fruits, vegetables, dairy food items, proteins and carbohydrates, as a percentage of their total diets? Also, within these food categories, which are the most common foods accepted by children with severe food selectivity?

Methods

This study obtained information from a previous two-part study that used an electronic survey methodology to gather the views of the caregivers of children with ASD (Suarez et al.,2012). The first study (time 1) used a survey that included a question to inquire about the child's food acceptance. Also, this survey included a 19-item scale to measure SOR (Suarez, Nelson, Curtis, 2013). Parents who expressed willingness to participate in an additional survey (time 2) were contacted by email. The follow up survey for the second study (time 2) included 65 questions, that used the same question to characterize the child's food selectivity level and the 19-item scale to measure SOR (Suarez, Nelson, & Curtis, 2013). The first part of the study used a sample provided by Autism Speaks Interactive Research Network, which emailed a participation invitation to randomly selected parents of children with autism in their database.

The total number of responses was 141 participants for the first survey (time1) (Suarez, Nelson, & Curtis, 2013). Those participant responses were described in the first study done by Suarez,et al. (2012) (Suarez, Nelson, & Curtis, 2013). A subgroup of the first sample in the first study(time 1) (n=114) stated that they would be willing to contacted again, in which they provided an email address (Suarez,

Nelson, & Curtis, 2013). For the second study, this group of 114 parents were contacted again 20 months later. A number of 52 responded to the invitation to complete the second survey for the second study (time 2) (Suarez, Nelson, & Curtis, 2013). For all survey and participation information the Human Subjects Institutional Review Board at Western Michigan University approved the study protocol for the initial follow-up survey (Suarez, Nelson, &Curtis, 2013) as well as this extended analysis of the previously collected data.

Description of Participants

The participants in this study were parents or caregivers of children with autism. 52 responded to the invitation to complete the second survey for the second study (time two) after an initial questionnaire was sent out (study one and time one) (Suarez, Nelson, & Curtis 2013). Those fifty-two caregivers were surveyed (second study and time two) 20 months after completing the initial questionnaire (study one and time 1). The demographic characteristics of these parents and caregivers include: 98% female, 94% obtained some college education, and 96% are Caucasian.

Instrumentation

Survey information regarding the demographic characteristics was obtained during the original (time 1) study (Suarez et al., 2012), and participants for the second study (time 2) were asked to provide their names to make sure the repeated measures matched the original study (time 1) information and data (Suarez, Nelson, & Curtis, 2013). The data pertaining to the demographic included the gender, education level, race, and ethnicity of the caregiver (Suarez, Nelson, & Curtis, 2013). Gender and age of the child was also collected to gain more information about the child (Suarez, Nelson, & Curtis, 2013). Lastly, parents were asked to provide information regarding whether their children

had been diagnosed with ASD, and, in addition, to provide the source of the diagnosis (e.g. pediatrician, psychologist, or interdisciplinary team) (Suarez, Nelson, & Curtis, 2013).

Defining food selectivity-Parent Questionnaire.

Identical to the first survey done in the first study (time 1), parents were asked to choose a category representing how many foods their child accepts as part of his or her normal diet (i.e. less than 5, 6-10, 11-20, 21-30, and 31+) (Suarez, Nelson, & Curtis, 2013). Analysis of food selectivity level, as operationalized in the original research (Suarez et al., 2012), was classified categorically (i. e. severely selective as acceptance of less than 10 foods, moderately selective as acceptance of 11-20 different foods, and typically selective as acceptance of 21 of more different foods) (Suarez, Nelson, & Curtis, 2013). A previous study done by Cornish (1998) supports this operationalization due to their analysis of nutritional adequacy at these three different levels and discovered that children eating less than 20 different foods are at risk for nutritional deficits; Cornish also determined severe nutritional concerns for children who eat less than 8 foods (Suarez, Nelson, & Curtis, 2013).

Defining SOR scale.

The SOR scale was based on cross-referencing of items from two clinical respected sources (i.e. Dunn, 1999;Miller, 2006) (Suarez, Nelson, & Curtis, 2013). This SOR scale included 19 items, which asked about examples of tactile, visual, auditory, and vestibular processing deficits (Suarez, Nelson, &Curtis, 2013).

Food inventory.

A food inventory was included in the second survey and is the primary focus of this study. This questionnaire asked: "Over the past month and week, which food items has your child eaten? (Suarez et al., 2012) The food inventory included 106 different food items. These food items were listed categorically, starting with dairy products (e.g cheese-mayonnaise/salad, yogurt, ice cream), then vegetables (e.g. green bean, broccoli) and then fruits (e.g. apples,tangerines/clementines) then protein (e.g. chicken, eggs) and ended with carbohydrates (e.g. bread, crackers).

Data Analysis

Data was analyzed using an ANOVA to determine if there was a difference in the severe, moderate and typically selective groups on the percentage of the total diet or each food group (e.g. the percentage of carbohydrates in proportion to the total number of food accepted). The fruits and vegatables accepted by the severely selectivity group were described.

Results

The first research question was, what percentage of the total diet of the children with autism was fruit, vegetables, protein, and carbohydrates for the severe, moderate, and typically developing selective groups? Table 1 below, shows the mean and standard deviation of percentages each group in each food group by food selectivity group. The mean or most shows the percentage of the amount of foods eaten in that food group (dairy, fruit, vegetables, protein, and carbohydrates) for each selective

type (severe, moderate, typical). For example, in the severe selective type in the dairy food group the mean percent of foods eaten is 15%.

Table 1: **Means and Standard Deviations for Percentages of Total Foods of Each Food Category Accepted by Severely, Moderately and Typically Selective Children**

Percentage of foods	Mean	St. Deviation
% Dairy Severe	16%	.09115
Moderate	12%	.06685
Typical	1%	.04301
Total	12%	.07236
%Vegetable Severe	1%	.08297
Moderate	13%	.10069
Typical	15%	.07056
Total	12%	.09007
% Protein Severe	19%	.10318
Moderate	24%	.10379
Typical	25%	.03985
Total	23%	.08974
% Fruit Severe	11%	.09432
Moderate	14%	.11357
Typical	20%	.08265
Total	15%	.10412
% Carbohydrates Severe	46%	.13893
Moderate	33%	.12041
Typical	28%	.08968
Total	35%	.13757

Next these ANOVA was used to determine if there was a significant difference in the percentage of total diet for each food category, depending on membership in the severe, moderate, or typically developing selective groups. To answer this question, in the dairy food category the F value is 3.381 and the P (Sig.) value is .042, in the vegetable food category the F value is 3.241 and the P value is .048, in the protein food category the F value is 2.053 and the P value is .139, the fruit food category the F value is 4.021 and the P value is .024, and in the carbohydrate food category the F value is 10.312

and the P value is .000. There is a significant difference in percentage of total foods accepted in the dairy, vegetable, fruit and carbohydrate categories. These differences were explored further.

Table 2: **Differences between the Severe, Moderate and Typically Selective Children in the Percentages of Foods Accepted in Each Category.**

Percentage of food	**F**	**Sig.**
% Dairy		
Between Groups	3.381	.042**
% Vegetables		
Between Groups	3.241	.048**
% Protein		
Between Groups	2.053	.139
% Fruit		
Between Groups	4.021	.024**
% Carbohydrates		
Between Groups	10.317	.000**

Table 3: **Exploration of Which Food Selectivity Levels Differ in Percentage of Food Categories Accepted**

Dependent Variable	(I) Severe/Mod/Typ	(J) Severe/Mod/Typ	Sig.
% Dairy	Severe	Moderate	.375
		Typical	.038*
	Moderate	Severe	.375
		Typical	.809
	Typical	Severe	.038*
		Moderate	.809
% Vegetable	Severe	Moderate	.200
		Typical	.053*
	Moderate	Severe	.200

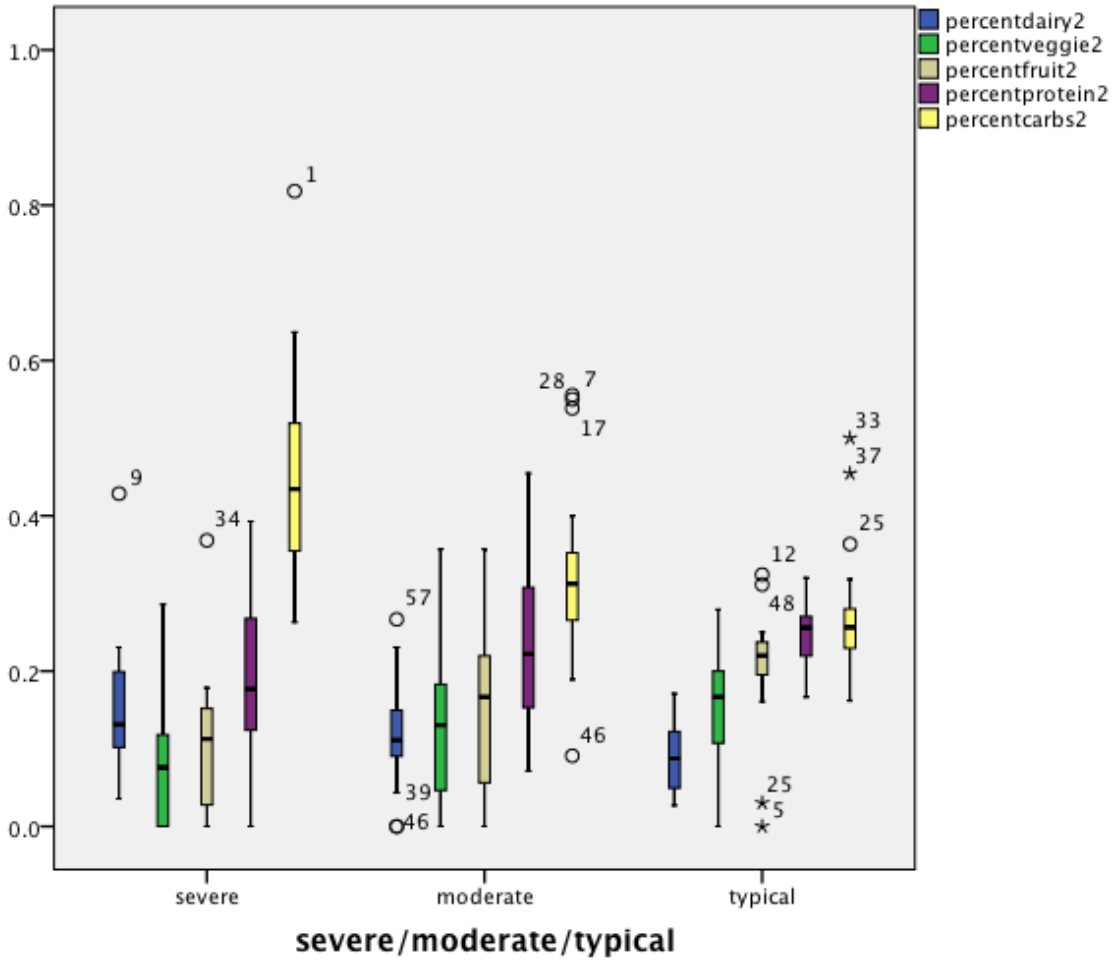
		Typical	1.000
	Typical	Severe	.053*
		Moderate	1.000
% Protein	Severe	Moderate	.376
		Typical	.181
	Moderate	Severe	.376
		Typical	1.000
	Typical	Severe	.181
		Moderate	1.000
% Fruit	Severe	Moderate	.682
		Typical	.021*
	Moderate	Severe	.682
		Typical	.288
	Typical	Severe	.021*
		Moderate	.288
% Carbohydrates	Severe	Moderate	.006*
		Typical	.000*
	Moderate	Severe	.006*
		Typical	.633
	Typical	Severe	.000*
		Moderate	.633

Table 3 contains an exploration of which food selectivity levels differ in percentage of food in each categories. The severe and typical groups accepted a significantly different percentage of dairy and fruit items. The severe and moderate and severe and typical

groups each accepted a significantly different number of carbohydrates as a percentage of their total diets. The box plot (Figure 1) visually depicts these relationships.

Figure 1:

Title (Box Plot)



To describe this box plot, the severe, moderate, and typical selective groups are at the bottom and the total percentage of foods for each food category is along the left side. In the severe selective group, the two food groups eaten the most are dairy and carbohydrates, with carbohydrates being high. The two food group eaten the least are vegetables and fruit. The protein food group is eaten more than fruits and

vegetables, however, less than carbohydrates. In the moderate selective group, dairy foods are eaten the least and carbohydrates are once again eaten the most. Fruits, vegetables, and protein are all eaten more than dairy, however, less than carbohydrates. Lastly, in the typical selective group, fruit, protein, and carbohydrates are eaten the most with dairy being eaten the least. In this group, vegetables are eaten more than dairy, however, less than fruit, protein, and carbohydrates.

To answer our third questions, which vegetables and fruits are kids eating who are in the severe category eating. After looking at the data collected there were a total of ten vegetables eaten and a total of twelve fruits eaten. The vegetables go as follows of most frequently eaten to least frequently eaten: broccoli, potato, carrots, green beans, corn, cucumber, cauliflower, celery, and sweet potato. The fruits go as follows from most frequently eaten to least frequently eaten: apple, banana, grapes, apple sauce, strawberries, orange, pears, melon, peaches, raisins, blue berries, and mixed fruit.

Discussion

The overarching goal of this study was to determine what kids with autism and food selectivity choose to eat. Specifically, to see if there is a significant difference in the severe, moderate and typical food selectivity groups in the percentage of their total diet of fruit, vegetable, dairy, protein and carbohydrate consumption. Results indicated that children with severe food selectivity ate significantly more dairy and carbohydrates than the moderate and typical groups and significantly less fruit and vegetables. In addition , through analysis of the food inventories, we were able to describe which fruits and

vegetables the severe food group accepted.

The second research question this study aims to answer is: Was there a significant difference in the percent of total diet for each food category depending on membership in the severe, moderate, and typically developing selective groups? The results show that there is a significant difference in the selective groups in the dairy, vegetable, fruit, and carbohydrate food groups. Also, in the dairy food group there was a significant difference in the severe and typical selective group. The fruit group showed a significant difference between the severe and typical groups. The carbohydrate group showed significant differences between the severe and moderate and the severe and typical selective groups. However, the protein and fruit food groups showed no significant differences between selective groups.

The last research question this study aims to answer is: What vegetables and fruits are children with autism in the severe selective food group eating? The results show that there are a total of ten vegetables eaten and a total of twelve fruits eaten. The vegetables go as follows of most frequently eaten to least frequently eaten: broccoli, potato, carrots, green beans, corn, cucumber, cauliflower, celery, and sweet potato. The fruits go as follows from most frequently eaten to least frequently eaten: apple, banana, grapes, apple sauce, strawberries, orange, pears, melon, peaches, raisins, blue berries, and mixed fruit.

These findings can be set in the context of the literature review. There are two main concerns around food selectivity in the literature: the lack of nutrition in the diet of the child with autism (Cermak, Curtin, & Bandini, 2010) and the quality of meal time

interactions between caregivers and their child with autism (Ausderau, & Juarez). Children with food selectivity can eat as few as 5 different foods (Cermak, Curtin, & Bandini, 2010), increasing the risk for poor nutrition (Cermak, Curtin, & Bandini, 2010). This lack of nutrition could be due to the decrease in the percentage fruits and vegetables in the context of the total diet and the significant increase in thecarbohydrates food group in the diet of a child in the selective category.

The second concern is the decreased quality of life for the caregivers and children with autism and food selectivity. For example, in a survey of family mealtimes with children with ASD, 65% of parents said that their child's disruptive mealtime behaviors required so much attention that the child was the biggest focus of mealtime, limiting the participation and engagement of other family members (Marquenie, Rodger, Mangohig & Cronin, 2011). For children with ASD, 92% of participants considered dinner time as the most stressful part of their day.

The results of this study provide some insight into which fruits and vegetables children with severe food selectivity eat. This information could inform which fruits and vegetables are likely to be accepted and should be introduced to lead to a more enjoyable meal and create a better quality of life for caregivers and children.

This insight is not only important to the caregivers and children with autism but also to clinicians who are working with these children. This study allows for greater insight and knowledge into what children with autism and food selectivity are eating for more effective treatment. Specifically, the information about what foods the children in the severe group are eating in the fruits and vegetable food groups is important and can inform clinicians and caregivers about what food they

could introduce first that their child might be more inclined to try without anxiety and stress.

Some limitations in this study include that the caregiver was providing a subjective report of what their child was eating and the autism diagnosis was not independently verified. The study sample contained mostly caucasion, educated participants which does not accurately represent the population of people with autism This decreases the generalization of the findings.

In conclusion, this study provides information about what kids with autism and severe food selectivity are eating. This information is important for caregivers and children with autism but also for clinicians. This knowledge and information can help inform treatment as well as improve the well being and quality of life of the caregivers and their children.

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