PARENTAL STRESS, PARENTAL FEEDING STYLES, AND CHILD NUTRIENT INTAKE AMONG FAMILIES OF YOUNG CHILDREN WITH AUTISM

by

Oshay S. Johnson

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Oshay S. Johnson

Approved:

Jillian C. Trabulsi, Ph.D.
Professor in charge of thesis on behalf of the Advisory Committee

Approved:

P. Michael Peterson, Ed.D.
Chair of the Department of Behavioral Health and Nutrition

Approved:

Kathleen S. Matt, Ph.D.
Dean of the College of Health Sciences

Approved:

Douglas J Doren, Ph.D.
Interim Vice Provost for Graduate and Professional Education
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ABSTRACT

Autism Spectrum Disorder (ASD) is a neurodevelopmental disability characterized by persistent deficits in social communication and social interaction and restricted, repetitive behavior, interests, or activities. Parents of children with ASD experience higher levels of stress compared to parents of children with typical development (TD) and other developmental disabilities (DD). Among parents of TD children, high parental stress is associated with parental feeding styles, and in turn, certain parental feeding styles are associated with poor child diet and nutrient intake. The purpose of this study was to examine the relationship among parental stress, parental feeding styles, and nutrient intake of children with ASD.

Parents of children at least three years old but less than seven years old, with and without ASD were recruited to participate in this cross-sectional study. Participants completed one study visit to the Energy Balance and Nutrition Laboratory where they completed questionnaires related to parental feeding styles, feeding practices, child mealtime behaviors, parental stress, and adaptive behaviors (only for children with ASD). Child diet and nutrient intake were assessed via a 3-day food record and child physical activity was assessed by a 24-hour physical activity form.

The study received IRB approval in January 2019 and to date, seven children have completed the study, three of whom have ASD. Parental stress scores were higher among parents of children with ASD compared to parents with TD children.
(34.3±14 versus 25.2±12.2, respectively). With respect to parental feeding styles, among parents of children with ASD, two were classified as having an authoritative feeding style and one was classified as having an indulgent feeding style. Among parents of TD children, three parents were classified as having an authoritative feeding style and one parent was classified as having an indulgent feeding style. Children with ASD had higher saturated fat (16.1±12.7 g/d) and lower fiber intake (14.8±7.6 g/d) compared to TD children whose intake of these nutrients were 14.9±13.0 g/d and 16.8±6.9 g/d, respectively.

Given the small sample size, we are underpowered to test the original aims of study and instead provide descriptive data on all outcomes. The study continues to enroll subjects and the study aims will be tested when the goal sample size (N=150) is achieved.
Chapter 1

INTRODUCTION

According to the Diagnostic and Statistical Manual of Mental disorders, key features of autism spectrum disorder (ASD) include: persistent impairment in reciprocal social communication and social interaction, restricted repetitive patterns of behavior, interest or activities’ affects aspects of a child’s social, communication and behavioral domains.\textsuperscript{1} In the United States, the prevalence of children with ASD is 16.8 per 1,000 children.\textsuperscript{2} Studies have shown that parents of children with ASD are more stressed compared to parents of typically developing (TD) children.\textsuperscript{3-5} Stress is recognized as a process that involves stressors, psychological mediators, and the stress response. Stressors are defined as events that pose a challenge; psychological mediators are processes that enable one to evaluate the challenge or threat and the subsequent emotional and/or behavioral response; and the stress response is the emotional response to the stressor.\textsuperscript{6}

Stress is typically measured by questionnaires or by a physiological biomarker such as cortisol. Parenting stress is described as the psychological reaction to the demands of being a parent.\textsuperscript{7} Stress among parents of children with ASD has been associated with the extent or severity of the child’s behavior, intellectual disabilities, feeding difficulties, and gastrointestinal problems.\textsuperscript{5,8-10} Some studies have also
measured cortisol concentrations, a physiological stress biomarker, among these parents and found that parents of children with ASD experience lower circulating levels or blunted cortisol levels compared to parents of TD children and parents of children with other developmental disabilities. Among TD children, the literature shows an association between parental stress and uninvolved as well as authoritarian parental feeding styles, but to our knowledge there is no literature on this association among parents of children with ASD.

The effect of parental stress on parental feeding styles is relevant due to the association between feeding styles and child nutrient intake. Among TD children, studies have found that parental feeding styles are associated with child nutrient intake. Studies have also found that inadequate nutrient intake is more prevalent among children with ASD compared to TD children. Inadequate nutrient intake among children with ASD has been associated with feeding difficulties and disruptive mealtime behaviors. To our knowledge the relationship between parental stress and parental feeding styles is unknown. Moreover, there is no literature on the relationship between parental feeding styles and child nutrient intake among parents of children with ASD. Based on the literature among parents of TD children, it is proposed that in children with ASD, there is a linear relationship between parental stress, parental feeding styles, and nutrient intake.

Given these knowledge gaps, the primary purpose of this study is to evaluate the association between parental stress and parental feeding styles in parents of children with ASD compared to TD children. The secondary purpose is to evaluate the
association between parental feeding styles and child nutrient intake among parents of children with ASD.
Chapter 2

LITERATURE REVIEW

2.1 Autism Spectrum Disorder

ASD is characterized by persistent deficits in social communication and social interaction and restricted, repetitive behavior, interests, or activities.1 ASD is manifested by deficits in nonverbal communicative behaviors, deficits in developing, maintaining and understanding relationships, highly restricted, fixated interests that are abnormal in intensity and focus, and hyper- or hypo reactivity to sensory input.1 Most parents of children with ASD begin to recognize developmental difficulties during the preschool aged years3 and diagnosis of ASD typically takes place during this time frame.15 According to the Center for Disease Control and Prevention (CDC), the mean age of diagnosis for children with ASD is approximately 4 years of age.1 There is no cure for ASD, rather the symptoms and behaviors are managed. According to the CDC Autism and Developmental Disabilities Monitoring (ASSM) Network, the prevalence of ASD in the United States 1 in 59 U.S children.2

2.2 Stress and Autism Spectrum Disorder

Studies have shown that parents of children with ASD experience higher levels of stress compared to parents with TD children and parents of children with other
Dabrowska and Pisula compared parental stress among parents of children with ASD, Downs Syndrome, and TD children (n=162) and found that parents of children with ASD had higher stress scores in 8 out of the 11 different areas of the Questionnaire of Resources and Stress (QRS) compared to parents of typically developing children and in 3 out of the 11 areas among parents of children with Downs Syndrome. Another study of children with developmental disabilities (n=99) found that 45% of the families of children with ASD reported significant levels of parental stress compared to 22% of the families of children with other developmental disabilities.

With respect to feeding difficulties/difficult mealtime behaviors, a study of children with ASD with and without food selectivity found that parents of children with food selectivity reported more stress than parents of children without food selectivity. Additionally, a study of parental stress, co-parenting quality, and feeding challenges among parents of children with ASD found that difficult feeding behaviors (difficult mealtime behavior, mealtime rigidity, and food refusal) was associated with parenting stress. Stress among parents of children with ASD has been shown to be associated with behavioral and emotional problems, intellectual abilities, adaptive behaviors, gastrointestinal problems, and feeding problems. Valicenti-McDermott et al. examined the relationship between parental stress and gastrointestinal problems, sleep disturbances, and behavioral issues and found that parents of children with ASD that reported higher levels of stress also reported their children had more gastrointestinal issues (abdominal pain, vomiting, constipation, and irregular bowel
patterns) and behavioral problems. No association was found between parental stress and sleeping patterns.\(^5\)

### 2.3 Stress and Cortisol

There is a growing body of research measuring the physiological aspect of stress in parents of children with disabilities, especially among parents of children with ASD.\(^7,11,17\) One of the most common methods of measuring physiological stress is the biomarker cortisol. Cortisol is a steroid hormone produced in the adrenal gland and released by the joint actions of corticotropin-releasing hormone (CRH) and adrenocorticotropic hormone. Cortisol is released in a diurnal pattern such that it rises shortly after awakening (the cortisol awakening response, CAR) and then declines throughout the day; additional cortisol may be released later in the day in response to stress.\(^11,18,19\) This pattern may be disrupted in parents of children with ASD; studies have shown that these parents may experience blunted cortisol concentrations or hypocortisolism.\(^11,17,18\) For example, a study conducted among 91 mothers of children with developmental disabilities (including Down syndrome, ASD, Prader-Willi syndrome, and William syndrome) found that 63% of mothers had significantly lower mean cortisol concentrations and blunted pattern of release compared to 37% of mother’s with higher cortisol concentrations and a steeper pattern of release.\(^11\) Mothers with a blunted pattern of release had significantly higher Parenting Stress Index (PSI) stress scores, lower mindfulness scores and perceived health status, lower body mass index, and their medical histories were more likely to include anxiety disorders compared to mothers with higher/steeper release cortisol concentrations.\(^11\)
Another study evaluated the perceived health and physiological responses to acute stress stimuli in caregivers of children with ASD.\textsuperscript{20} This study found that caregivers of children with ASD displayed lower cortisol and Immunoglobin A (IgA) concentrations at all measured times compared to parent of children without ASD but no differences were found in area under the curve (AUC) cortisol concentrations between the two groups. The AUC cortisol was inversely related to caregiver burden. Finally, caregivers perceived the acute stress stimuli (a set of cognitive tasks) as more stressful than controls, indicating a different perception to the same stress event and greater frustration.\textsuperscript{20} Finally, a study evaluating cortisol and alpha-amylase concentrations among 19 mother-father dyads of children with ASD found that maternal and paternal morning cortisol concentrations were significantly lower compared to reported averages.\textsuperscript{7} Taken together, these studies demonstrate that at the group level, lower concentrations of cortisol and a blunted cortisol rise are present in parents of children with ASD and other developmental disabilities, particularly parents with older or adult children. Additionally, caregivers of children with ASD had higher scores for perceived stress, depression, and anxiety compared to parents of children without ASD and parents of children with other developmental disabilities.\textsuperscript{9,19}

### 2.4 Parental feeding styles

There are several different ways in which parental feeding styles have been categorized. Parental feeding styles has been described based on demandingness and responsiveness.\textsuperscript{21} Demandingness is defined as how much the parent demands or encourages the child to eat and responsiveness is defined as how the parent encourages
the child to eat.\textsuperscript{21,22} Other researchers have categorized parental feeding style into four types: authoritarian, indulgent or permissive, uninvolved, and authoritative.\textsuperscript{21,23,24} Parents with an authoritarian feeding style (high demandingness/low responsiveness) may demonstrate controlling characteristics such as, restricting the child from eating particular kinds of food and forcing the child to eat others.\textsuperscript{21,23} Parents with an indulgent or permissive feeding style (low demandingness/high responsiveness) provide little to no structure allowing the child to determine their dietary intake.\textsuperscript{21} Parents that exhibit an uninvolved feeding style (low demandingness/low responsiveness) have decreased control and involvement in feeding their child.\textsuperscript{21} Lastly, an authoritative feeding style (high demandingness/low responsiveness) involves the parent encouraging the child to consume healthy foods but also giving the child some options.\textsuperscript{21,25}

2.5 Parental stress and Parental Feeding Styles

Parental stress along with other risk factors such as, depression may influence the parent-child feeding dynamic.\textsuperscript{22} Among TD children studies have shown a relationship between parental stress and parental feeding styles. With respect to stress in particular, a study of the Special Supplemental Nutrition Program for Women Infant and Children (WIC) program participants revealed that maternal stress was significantly associated with forceful and uninvolved feeding styles. This study also evaluated the relationship between maternal depression, maternal anxiety and parental feeding styles and found that maternal depression was associated with indulgent and uninvolved feeding styles and maternal anxiety was associated with restrictive feeding
practices and uninvolved feeding styles.\textsuperscript{23} In addition, a study conducted among preschool aged children attending a Head Start program found that parents with an uninvolved feeding styles were likely to report higher levels of stress and less likely to report positive emotions.\textsuperscript{22} Furthermore, the result of another study showed that women with an authoritarian style had a higher perceived stress score compared to women with an indulgent style.\textsuperscript{25} Taken together, these studies highlight an association between parental stress and parental feeding styles in general populations of children; however, there is a gap in the literature and little is known about the relationship between parental stress and feeding styles among parents of children with ASD.

\subsection{2.6 Autism Spectrum Disorder and Nutrient Intake}

Inadequate nutrient intake is more common among children with ASD compared to children without ASD. Several studies have compared nutrient intake between children with ASD and TD children and found that children with ASD have lower intakes of Vitamin A, D, iron, folate, and calcium compared to age-matched controls.\textsuperscript{12,13,26} Lockner et al. found that in pre-school aged children, 52\% (n=20) of the children with ASD had intakes of Vitamin A below the Estimated Average Requirement (EAR) compared to 20\% (n=20) of children without ASD.\textsuperscript{12} In addition, Bandini et al. demonstrated that Vitamin D, Vitamin A, and calcium intakes were lower among children with ASD compared to TD children.\textsuperscript{13} Among children with ASD, 10\% had inadequate intake of Vitamin A, 79\% had inadequate intake of Vitamin D, and 64\% had inadequate intake of calcium.\textsuperscript{13} In comparison, children
without ASD had adequate intake of Vitamin A, 55% had inadequate intake of Vitamin D, and 42% had inadequate intake of calcium.\(^{13}\) With respect to biomarkers of nutrient status, Guo et al. found that serum retinol levels and 25-hydroxy(OH) Vitamin D levels were lower in children with ASD compared to children without ASD.\(^{14}\) Among children with ASD, there are a number of factors that are associated with inadequate nutrient intake such as; difficult mealtime behaviors, gastrointestinal problems, and limited food repertoire.\(^{5,13,16}\) Research has shown an association between parental feeding styles and dietary/nutrient intake among parents with TD children but this information is lacking in the literature among parents of children with ASD.

### 2.7 Parental Feeding Styles and Nutrient Intake

The relationship between parental feeding styles and child dietary intake has been extensively studied among TD children. Hennessy et al. evaluated the relationship between parental feeding styles and child intake of low nutrient dense (LND) foods. This study found that a permissive feeding style was positively associated with a higher child intake of LND foods.\(^{23}\) This same study looked at the relationship between feeding practices and child food intake in the presence of various feeding styles and found that in the presence of a permissive feeding style, higher levels of monitoring were associated with a higher child intake of LND foods.\(^{23}\) A similar study was conducted in preschool aged children and found children of parents with a permissive feeding style consumed evening foods with a higher energy density and these children also had lower intakes of fruit, 100% fruit juice, vegetables, and
dairy products compared to those whose parents had an authoritarian feeding style.\textsuperscript{24} A study of participants of the Houston Head Start program found that authoritative feeding was positively associated with consumption of dairy and vegetables and authoritarian feeding was negatively associated with vegetable intake.\textsuperscript{25} Moreover, a study conducted among immigrant parents and their children found that an indulgent parental feeding style was associated with low intake of whole grains and vegetables.\textsuperscript{27} Taken together, studies among parents of TD children demonstrate an association between parental feeding styles and child dietary intake. However, there is a gap in the literature examining this relationship among parents of children with ASD. There is a paucity of data on the relationships between parental feeding styles, parental stress, and actual nutrient intake in children with ASD.
Chapter 3

AIMS

The overarching purpose of this cross-sectional study is to examine the relationships among parental stress, parental feeding styles, and nutrient intake in children with Autism Spectrum Disorder (ASD) compared to typically developing children (TD).

Specific Aim 1: Determine the relationship between parental stress and parental feeding styles. We hypothesize that parents of children with ASD who report high stress scores will also score high for a permissive/indulgent or authoritarian feeding style as it has been shown in parents of TD children that parents with high perceived stress scores also score high for permissive/indulgent or authoritarian feeding styles.21,22,28,29

Specific Aim 2: Determine the relationship between parental feeding styles and nutrient intake in children with ASD. We hypothesize that the nutrient intake of children with ASD whose parents score high for a permissive/indulgent or authoritarian feeding style will have a diet higher in saturated fat and sugar, and lower in Vitamin A, Vitamin D, Vitamin C, calcium, folate, fiber, and B-vitamins. The literature shows that among TD children, parents with permissive and authoritarian
feeding styles their children have higher intakes of low nutrient but high energy dense foods.\textsuperscript{23,25-27}
Chapter 4

METHODS

This study (protocol, procedures, questionnaires, informed consent and assent) were reviewed and approved by the Institutional Review Board (IRB) at the University of Delaware prior to study initiation.

4.1 Subjects

Subjects were recruited from the Autism Delaware Network and greater Newark area using IRB approved advertisements in newspapers, Craigslist, medical practices, and childcare centers. Approximately 150 children, 75 with ASD (physician diagnosed) and 75 TD children ≥2 and <7 years-old will be enrolled. Exclusion criteria include children with a medical issue known to affect food intake, nutrition, or weight status (e.g., swallowing difficulty, Crohn’s disease, cystic fibrosis), genetic disorders, two or more food allergies (physician diagnosed), or any significant cardiac, respiratory, endocrinologic, hematologic, gastrointestinal, or other systemic diseases.

4.2 Study Visit Procedures

Initial interviews were conducted via telephone to determine initial interest and preliminary eligibility. Once the parent expressed interest in participating, a study visit was scheduled. A blank copy of the informed consent was mailed/emailed to interested subjects prior to their scheduled appointment. At the study visit, the
informed consent and child assent process were conducted and participants (children) were enrolled if the parent consented and child expressed assent to participate. The study consists of one study visit to the Energy Balance and Nutrition Laboratory (EBNL) at the University of Delaware; subjects also completed a 3-day diet record and 24-hour physical activity questionnaire.

4.3 **Anthropometric Measurements**

Weight is measured using a digital scale accurate to 0.1 kilograms, height is measured using a stadiometer accurate to 0.1cm, and waist circumference is measured using a non-elastic tape measure accurate to 0.1 cm.

4.4 **Child Demography and Medical History**

Demographic data includes parent/child race and ethnicity, parent education level, number of people living in the home, and household income. Data on medical diagnosis, medication, supplement use, and special diet use were also collected.

4.5 **Parent Feeding Style Questionnaire**

Parental feeding style was assessed using Caregiver’s Feeding Styles Questionnaire, a 19-item instrument that has been validated in pre-school aged children. This instrument measures the parent’s overall feeding pattern using two dimensions (demandingness and responsiveness). A cross classification of high and low scores on these two dimensions categorizes the four feeding styles (authoritarian,
authoritative, indulgent, and uninvolved). The instrument includes 7 child-centered and 12 parent-centered items measured on a 5-point Likert Scale.\textsuperscript{21}

4.6 Parental Stress Questionnaire

Parental stress was assessed using the Parental Stress Index-Short Form (PSI-SF); this is 36-item, self-report assessment of parental stress and includes questions related to the behavior of the parent and child and the interactions between them.\textsuperscript{30} The PSI-SF consists of three domains related to parental distress (PD), parent-child dysfunctional interaction (P-CDI), and difficult child (DC). The PSI-SF has been used to measure perceived stress in several studies among parents of children with ASD.\textsuperscript{5,8,10} The PSI-SF scores between the 16\textsuperscript{th}-84\textsuperscript{th} percentiles are considered normal scores, above the 85\textsuperscript{th} percentile indicate elevated perceived stress, and a score above the 90\textsuperscript{th} percentile is classified as a clinically significant.\textsuperscript{30}

4.7 3-Day Diet Record

A 3-day diet record form was completed which collects all food and beverage intake (type and amount) for two-week days and one weekend day.\textsuperscript{31} Food and beverage intake was analyzed utilizing Nutrient Data Systems software for Research (NDSR; Minneapolis, MN).
4.8 **Vineland Adaptive Behavior Scale**

Adaptive behaviors in children with ASD were assessed using the Vineland Adaptive Behavior Scale-Domain-Level Parent/Caregiver Form. This questionnaire consists of 297-items that are categorized into four domains: communication, daily living skills, social skills, and motor development. Parents were asked to only complete the communication, daily living skills, and social skills sections.

4.9 **Physical Activity**

Physical activity is assessed using the Previous Day-Physical Activity Recall Questionnaire (PD-PAR). The PD-PAR is a validated questionnaire that requires recall of the previous day’s activities from 6:00am to 12:00am and their relative intensities. The questionnaire is divided into 30-minute intervals and includes a numbered list of activities that children typically engage in. These activities are grouped into several categories (eating, sleeping/bathing, transportation, work/school, spare time, play/recreation, and exercise workout).

4.10 **Data Analysis and Statistics**

The sample size to date (N=7) is too small for normality testing, but variable distributions will be examined when the study is complete. Continuous variables are reported as minimums, maximums, and means (95% CI). Categorical variables are reported as number and percentage.

Dependent variables of interest include: nutrient intake (specifically energy, fat, protein, carbohydrate, calcium, iron, vitamin D and vitamin C intake), parent feeding
style (scores for authoritarian, indulgent or permissive, uninvolved, and authoritative feeding styles), parent feeding practices (controlling, emotional, encouragement, and instrumental), mealtime behavior scores, and parental stress scores.
Chapter 5

RESULTS

5.1 Parent and Child Characteristics

Parent and child demographic characteristics are summarized in Table A1. The study has enrolled seven children to date. Three children (43%) have ASD and four (57%) children have typical development (TD). Among the children with ASD, two are male and one is Hispanic. The mean age of the children with ASD is 5.6±0.7 years. Among TD children, two are male and three of the children are white or Caucasian and one child is black or African American. The mean age of the TD children is 4.3±0.7 years.

Among the parents of children with ASD, the mean age is 43±5.3 years and one parent completed four or more years of college. Among the parents of TD children, the mean age is 35.5±1 year and three parents completed four or more years of college.

5.2 Parent and Child Anthropometry

Parent and child anthropometric data are summarized in Table A2. Among children with ASD, all children (N=3) children were classified as normal weight and among TD children, three were classified as normal weight and one was classified as overweight. Waist circumference data was also collected but one child (ASD) refused to have this measurement taken. For the two children with ASD for whom the waist
circumference measure was obtained, the mean waist circumference was 57.3±1.8 cm and among TD children the mean waist circumference was 55±3.2 cm.

Among parents of children with ASD, one mother was classified as having a normal BMI, one mother was classified as overweight, and the other was classified as obese. The mean waist circumference of parents of children with ASD was 93.5±18.4 cm. Three of the parents with TD children were classified as obese and one was classified as having a normal BMI. The mean waist circumference among parents of TD children was 101.5±20.3 cm.

5.3 Vineland Adaptive Behavior Scale

Adaptive behaviors data among children with ASD are summarized in Table A3. The mean Adaptive Behavior Composite (ABC) score was 63.7±8.5. The mean score for the communication domain was 55.7±15.7, the daily living domain mean score was 68±13.9, and the socialization domain mean score was 66.3±4.5. Parents of TD children were not required to complete this questionnaire.

5.4 Parental Stress Index

Parental stress scores among children with and without ASD are summarized in Table A4. Parental stress scores range from 0 to 100. The mean parental distress (PD) score among parents of children with ASD was 34.3±14 compared to 25.2±12.2 among parents of TD children. Among parents of children with ASD, the mean parent-child dysfunctional interaction (P-CDI) score was 31.7±3.2 compared to 17±6.2 among parents without children with ASD. The mean difficult child (DC) score among parents of children with ASD was 43.3±3.8 compared to 22±9.3 among parents with
TD children. Lastly, the mean total stress score among parents of children with ASD was 109.3±17.4 compared to 65±26.2 among parents of children without ASD. Scores for the parental stress index range from 0 to 120.

5.5 Behavioral Pediatrics Feeding Assessment Scale

The data for mealtime behaviors is summarized in Table A5. The mean total frequency score among children with ASD was 77.3±29.7 and the mean total problem score was 11.3±12. In comparison, the mean total frequency score among children without ASD is 78.3±29.5 and the mean total problem score is 3.25±2.5. Scores for the behavioral pediatrics scores range from 35 to 175. Total frequency scores that are greater than 84 are significantly higher than the normative mean.

5.6 Parental Feeding Styles

The data for parental feeding styles is summarized in Table A6. Among parents of children with ASD, two of the parents were categorized as having an authoritative parental feeding styles and the other was classified as having an indulgent parental feeding style. Among parents of children without ASD, three of the parents were categorized as having an authoritative parental feeding style and one was categorized as having an indulgent parental feeding style.

5.7 Parental Feeding Practices

The data for parental feeding practices are summarized in Table A7. The mean scores for controlling, prompting/encouragement, instrumental, and emotional feeding practices among parents of children with ASD were 3.8±0.5, 4.3±0.3, 2.2±0.6, and
2.1±0.1 respectively, compared to parents of TD children who mean scores were 4.05±0.4, 4.5±0.2, 2.1±0.5, and 2.0±0.1 respectively. Scores for parental feeding practices range from 1 to 5.

5.8 Nutrient Intake

The data for nutrient intake is summarized in Table A8. Total energy intake for children with ASD was 1287±492 kcal/d compared to 1343±504 kcal/day for TD children. Saturated fat intake was children with ASD was 16.1±12.7 g/d compared to children without ASD whose intake was 14.9±13 g/d. Fiber intake of children with ASD and TD was 14.8±7.6 g/d and 16.8±6.9 g/d, respectively. Two of the children with ASD had intakes below the DRI’s for niacin, calcium, and folate. Among TD children, one child had intakes below the DRI’s for vitamin C and vitamin A and three (75%) had intakes below the DRI for calcium. All children in this present study (N=7) had intakes below the DRI’s for vitamin D and fiber.

5.9 Physical Activity

The data for total energy expenditure is summarized in Table A9. Total energy expenditure for the one with ASD was 1155±0 kcal/day compared to 1180±457.8 kcal/day among TD children. Physical activity data is missing for one child with ASD as the parent did complete the questionnaire.
Chapter 6

DISCUSSION AND CONCLUSION

This study received IRB approval in January 2019 and to date has enrolled 7 subjects. Given the small sample size, the study is currently underpowered to test the original aims of study; instead, descriptive data on all outcomes are provided. The study continues to enroll subjects and the aims will be tested when the goal sample size (N=150) is achieved.

A focus of this study was parental stress. Among parents of TD children, there is an association between high parental stress scores and parental feeding styles (e.g. indulgent, uninvolved, and authoritative\textsuperscript{21,22} and these particular feeding styles are associated with poor child nutrient intake.\textsuperscript{24,27} To our knowledge, this is the first study to examine the relationship among parental stress, parental feeding styles, and nutrient intake among parents of children with ASD. In this current study, total parental stress scores were higher among parents of children with ASD compared to parents of children without ASD. Parental stress scores for each domain (parental distress, parent-child dysfunctional interaction, and difficult child) were also higher among parents of children with ASD compared to parents with TD children. These findings are consistent with other studies involving parents of young children ASD.\textsuperscript{5,9,10}

Another focus of the present study was parental feeding styles and parent feeding practices. Five parents (ASD=2; TD=3) were classified as having an
authoritative feeding style (high demandingness/high responsiveness) and two parents
(ASD=1; TD=1) were classified as having an indulgent feeding style (high
demandingness/low responsiveness). None of the mothers in this study were found to
have an authoritarian or uninvolved feeding style. To our knowledge, this is the first
study to examine parental feeding styles among parents of children with ASD;
therefore, it is difficult to compare these findings to the work of others. With respect to
parent feeding practices, scores for controlling and prompting/encouragement were
lower among parents of children with ASD compared to parents with TD children.
This finding is consistent with the literature. Kral et al. compared child eating
behaviors and parent feeding practices among parents of young children with and
without ASD and found that parents of children with ASD have lower controlling
feeding scores compared to parents with TD children and higher
prompting/encouragement instrumental, and emotional feeding scores compared to
parents with TD children. In our study we also found that instrumental and
emotional feeding practice scores were higher among parents of children with ASD
compared to parents of TD children.

With respect to nutrient intake of children with ASD in the present study, our
data showed that intakes of total energy, vitamin A, vitamin C, B-vitamins, fiber and
folate were lower among children with ASD compared to TD children. Moreover,
intakes of saturated fat, calcium, and vitamin D were higher among children with
ASD. In reviewing the diet records, we noted a higher intake of dairy products in
children with ASD which could be one possible explanation for this latter finding.
Poor nutrient intake in children with ASD is consistent with the literature. For
example, Lockner et al. reported that intakes of vitamin A, vitamin C, and folate were lower in children with ASD compared to aged-matched healthy controls. In addition, Catro et al. found that Vitamin D intake was higher among children with ASD compared to TD children and that calcium intake was lower among children with ASD. Frequency of nutrient inadequacy in children with and without ASD was also examined. The results of this study showed that among children with ASD, two were inadequate in at least three nutrients (calcium, folate, and niacin) and among TD children, three children (TD) were inadequate for at least one nutrient (calcium). These findings must be interpreted with caution due to the small sample size of the present study.

The major strength of this study was the use of validated questionnaires, diet assessment methods, the measurement of adaptive behaviors among children with ASD, and the combination of these high-quality measures in a single study. While a focus of this study is the influence of parental stress on parent feeding practices and ultimately child food/nutrient intake, we are also capturing information on adaptive behaviors of children with ASD as these could influence other factors such as, feeding behaviors or dietary intake. The major limitation of this study is the small sample size (N=7); it is underpowered for testing the original aims of this study. However, the study continues to enroll, and the original aims will be tested when a total of 150 children have completed the study. With a greater sample size, the relationship among parental stress, parental feeding styles, and nutrient intake can be determined. Another limitation of this study is the assessment of stress via the Parenting Stress Index-Short Form (PSI-SF) as it only measures perceived stress or one’s feelings or
thoughts about how much stress they are under given a certain circumstance. Future studies should consider measuring a biomarker of stress such as, cortisol via hair or saliva as it may be beneficial to also measure physiological stress to determine if an individual is experiencing stress at the biological level.
REFERENCES


12. Lockner, D, Crowe T, Skipper B. Dietary intake and parents' perception of mealtime behaviors in preschool-age children with autism spectrum disorder and


Appendix A

TABLES

Table 1. Demographic Characteristics of Children and Parents

<table>
<thead>
<tr>
<th></th>
<th>ASD (N=3)</th>
<th>TD (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child Age, mean±SD</strong></td>
<td>5.6±0.7</td>
<td>4.3±0.7</td>
</tr>
<tr>
<td><strong>Child Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female, N (%)</td>
<td>1(33.3%)</td>
<td>2(50%)</td>
</tr>
<tr>
<td>Male, N (%)</td>
<td>2(66.7%)</td>
<td>2(50%)</td>
</tr>
<tr>
<td><strong>Child Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino, N (%)</td>
<td>1(33.3%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Non-Hispanic or Latino, N (%)</td>
<td>2(66.7%)</td>
<td>4(100%)</td>
</tr>
<tr>
<td><strong>Child Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, N (%)</td>
<td>1(33%)</td>
<td>3(75%)</td>
</tr>
<tr>
<td>Black or African American, N (%)</td>
<td>1(33.3%)</td>
<td>1(25%)</td>
</tr>
<tr>
<td>Asian or Asian American, N (%)</td>
<td>0(0%)</td>
<td>0(0%)</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander, N (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Two or more Races, N (%)</td>
<td>1(33.3%)</td>
<td>0%</td>
</tr>
<tr>
<td>Other (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Parent Age, mean±SD</strong></td>
<td>43±5.3</td>
<td>35.5±1</td>
</tr>
<tr>
<td><strong>Parent Sex</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female, N (%)</td>
<td>3(100%)</td>
<td>4(100%)</td>
</tr>
<tr>
<td>Male, N (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Parent Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic or Latino, N (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Non-Hispanic or Latino, N (%)</td>
<td>3(100%)</td>
<td>4(100%)</td>
</tr>
<tr>
<td><strong>Parent Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White, N (%)</td>
<td>2(66.7%)</td>
<td>3(75%)</td>
</tr>
<tr>
<td>Black or African American, N (%)</td>
<td>1(33.3%)</td>
<td>1(25%)</td>
</tr>
<tr>
<td>Asian or Asian American, N (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander, N (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Two or more Races, N (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Other, N (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Parent Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-12 y of high school, N (%)</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>1-4 y or trade school, N (%)</td>
<td>2(66.7%)</td>
<td>0%</td>
</tr>
<tr>
<td>1-4 y of college, N (%)</td>
<td>0%</td>
<td>1(25%)</td>
</tr>
<tr>
<td>More than 4 y of college, N (%)</td>
<td>1(33.3%)</td>
<td>3(75%)</td>
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</table>
Table 2. Anthropometric measures of Children with ASD and TD Children

<table>
<thead>
<tr>
<th></th>
<th>ASD (N=3)</th>
<th>TD (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child BMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Weight, N(%)</td>
<td>3 (100%)</td>
<td>3 (75%)</td>
</tr>
<tr>
<td>Overweight, N (%)</td>
<td>0 (0%)</td>
<td>3 (75%)</td>
</tr>
<tr>
<td>Obese, N (%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td><strong>Child waist circumference (cm), mean±SD</strong></td>
<td>57.3±1.8</td>
<td>55±3.2</td>
</tr>
<tr>
<td><strong>Parent BMI</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Weight, N (%)</td>
<td>1(33.3%)</td>
<td>1(25%)</td>
</tr>
<tr>
<td>Overweight, N (%)</td>
<td>1(33.3%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Obese, N (%)</td>
<td>1(33.3%)</td>
<td>3 (75%)</td>
</tr>
<tr>
<td><strong>Parent waist circumference (cm), mean±SD</strong></td>
<td>93.5±18.4</td>
<td>101.5±20.3</td>
</tr>
</tbody>
</table>

Table 3. Vineland Adaptive Behavior Scale Scores of Children with ASD

<table>
<thead>
<tr>
<th></th>
<th>ASD (N=3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Communication, mean±SD</strong></td>
<td>55.7±15.7</td>
</tr>
<tr>
<td><strong>Daily Living Skills, mean±SD</strong></td>
<td>68±13.9</td>
</tr>
<tr>
<td><strong>Socialization, mean±SD</strong></td>
<td>66.3±4.5</td>
</tr>
<tr>
<td><strong>Adaptive Behavior Composite (ABC), mean±SD</strong></td>
<td>63.7±8.5</td>
</tr>
</tbody>
</table>

Table 4. Parental Stress Scores in Children with ASD and TD Children

<table>
<thead>
<tr>
<th></th>
<th>ASD (N=3)</th>
<th>TD (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parental Distress, mean±SD</strong></td>
<td>34.3±14</td>
<td>25.2±12.2</td>
</tr>
<tr>
<td><strong>Parent-child dysfunctional interaction, mean±SD</strong></td>
<td>31.7±3.2</td>
<td>17±6.2</td>
</tr>
<tr>
<td><strong>Difficult Child, mean±SD</strong></td>
<td>43.3±3.8</td>
<td>22±9.3</td>
</tr>
<tr>
<td><strong>Total Stress, mean±SD</strong></td>
<td>109.3±17.4</td>
<td>65±26.2</td>
</tr>
</tbody>
</table>
### Table 5. Mealtime Behaviors in Children with ASD and TD Children

<table>
<thead>
<tr>
<th></th>
<th>ASD (N=3)</th>
<th>TD (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BPFAS Total frequency score, mean±SD</strong></td>
<td>77.3±29.7</td>
<td>78.3±29.5</td>
</tr>
<tr>
<td><strong>BPFAS Total problem score, mean±SD</strong></td>
<td>11.3±12</td>
<td>3.25±2.5</td>
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</tbody>
</table>

### Table 6. Parental Feeding Styles in Children with ASD and TD Children

<table>
<thead>
<tr>
<th></th>
<th>ASD (N=3)</th>
<th>TD (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Authoritarian, N (%)</strong></td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td><strong>Authoritative, N (%)</strong></td>
<td>2 (66.7%)</td>
<td>3 (75%)</td>
</tr>
<tr>
<td><strong>Indulgent, N (%)</strong></td>
<td>1 (33.3%)</td>
<td>1 (25%)</td>
</tr>
<tr>
<td><strong>Uninvolved, N (%)</strong></td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

### Table 7. Parental Feeding Practices in Children with ASD and TD Children

<table>
<thead>
<tr>
<th></th>
<th>ASD (N=3)</th>
<th>TD (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control, mean±SD</strong></td>
<td>3.8±0.5</td>
<td>4.1±0.4</td>
</tr>
<tr>
<td><strong>Prompting/Encouragement, mean±SD</strong></td>
<td>4.3±0.3</td>
<td>4.5±0.2</td>
</tr>
<tr>
<td><strong>Instrumental Feeding, mean±SD</strong></td>
<td>2.2±0.6</td>
<td>2.1±0.5</td>
</tr>
<tr>
<td><strong>Emotional Feeding, mean±SD</strong></td>
<td>2.1±0.1</td>
<td>2±0.1</td>
</tr>
</tbody>
</table>
Table 8. Nutrient Intake in Children with ASD and TD Children

<table>
<thead>
<tr>
<th>Macronutrient</th>
<th>ASD (N=3)</th>
<th>TD (N=4)</th>
<th>ASD % below RDA or AI</th>
<th>TD % below RDA or AI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Calories (kcal/d), mean±SD</td>
<td>1287±492</td>
<td>1343±504</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>% calories from protein, mean±SD</td>
<td>13.1%</td>
<td>14.3%</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>% calories from carbohydrate, mean±SD</td>
<td>55%</td>
<td>54.7%</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>% calories from total fat, mean±SD</td>
<td>33%</td>
<td>33%</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Saturated Fat (g/d), mean±SD</td>
<td>16.1±12.7</td>
<td>14.9±13</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Sugar (g/d), mean±SD</td>
<td>63.4±26.8</td>
<td>66.3±25.8</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Fiber (g/d), mean±SD</td>
<td>14.8±7.6*</td>
<td>16.8±6.9*</td>
<td>3(100%)</td>
<td>4(100%)</td>
</tr>
</tbody>
</table>

Table 9. Physical Activity/Total Energy Expenditure

<table>
<thead>
<tr>
<th></th>
<th>ASD (N=1)</th>
<th>TD (N=4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Energy Expenditure*, kcal/d</td>
<td>1155±0</td>
<td>1180±457.8</td>
</tr>
</tbody>
</table>

* Determined via Previous Day-Physical Activity Recall Questionnaire (PD-PAR)
Appendix B

IRB APPROVAL LETTER

DATE: January 14, 2019

TO: Oshay Johnson, B.S
FROM: University of Delaware IRB

STUDY TITLE: [1326546-1] Parent stress, parent feeding styles, and nutrient intake among families of young children with Autism Spectrum Disorder (ASD)

SUBMISSION TYPE: New Project

ACTION: APPROVED

APPROVAL DATE: January 14, 2019

EXPIRATION DATE: January 13, 2020

REVIEW TYPE: Expedited Review

REVIEW CATEGORY: Expedited review category # (4,7)

Thank you for your submission of New Project materials for this research study. The University of Delaware IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a study design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the study and insurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the study via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure.

All SERIOUS and UNEXPECTED adverse events must be reported to this office. Please use the appropriate adverse event forms for this procedure. All sponsor reporting requirements should also be followed.

Please report all NON-COMPLIANCE issues or COMPLAINTS regarding this study to this office.

Please note that all research records must be retained for a minimum of three years.