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Article in *Developmental Neurorehabilitation* · January 2021

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**Comorbid feeding and gastrointestinal symptoms, challenging behavior, sensory issues, adaptive functioning and quality of life in children and adolescents with autism spectrum disorder.**

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# **Comorbid feeding and gastrointestinal symptoms, challenging behavior, sensory issues, adaptive functioning and quality of life in children and adolescents with autism spectrum disorder.**

## **Abstract**

**Aim:** Children and adolescents diagnosed with an autism spectrum disorder (ASD) often demonstrate difficulties with feeding. The goal of the current study was to investigate co-occurring issues that often accompany feeding problems in 120 children and adolescents with ASD.

**Method:** This study investigated the relationship between feeding problems and gastrointestinal symptoms, challenging behavior and sensory issues, quality of life, adaptive functioning and use of complementary and alternative medicine (CAM).

**Results:** High rates of feeding problems, gastrointestinal symptoms, challenging behavior and sensory issues were endorsed by caregivers. Considerable differences were observed in the levels of gastrointestinal symptoms, challenging behavior, sensory issues, quality of life and CAM practices.

**Conclusion:** The results of this study extend the present literature by highlighting comorbid conditions related to feeding problems and how feeding problems impact quality of life and adaptive behavior.

## 1. Introduction

### *1.1 Autism Spectrum Disorder and Feeding Problems*

Autism Spectrum Disorder (ASD) is a disorder characterized deficits in social communication and restricted patterns of behavior.<sup>1</sup> The prevalence of children and adults diagnosed with ASD has continued to rise over the past several decades, with the current prevalence being 1 in 54 children having ASD.<sup>2</sup> While the core features of ASD are related to communication and interests, this disorder is often accompanied by a host of other medical and behavioral conditions.<sup>3</sup> Over 70% of children diagnosed with ASD present with at least one comorbid disorder.<sup>4,5</sup> While much of the literature has focused on the core deficits of ASD, relatively less has been done to address comorbid conditions frequently observed in ASD.<sup>6,7</sup> Comorbidities in ASD include anxiety disorders, attention-deficit/hyperactivity disorder, epilepsy, sleep problems, toileting problems, and gastrointestinal symptoms.<sup>8,9,10,11,12</sup> One of the potentially most serious and frequently endorsed comorbid disorder is feeding problems.<sup>4, 13</sup>

Feeding problems refer to difficulties consuming foods that deviate enough to produce negative social and health implications.<sup>4,14</sup> Feeding problems seen in ASD are perceived as multi-factorial and include behavioral, physiological, emotional, cognitive, and medical origins.<sup>15</sup> Children with ASD have significantly more feeding problems and eat a narrower range of foods than children without ASD.<sup>16,17,18</sup> Some have suggested that the atypical feeding behavior could be result of the restrictive and repetitive patterns of behavior characteristic of ASD.<sup>19,20</sup> Estimates on the prevalence of feeding problems in ASD have varied, with earlier research indicating 6-33%,<sup>21</sup> and recent research estimating 13-80%.<sup>17, 22</sup>

The presence of feeding problems can increase risks for other more serious conditions and feeding problems have both short- and long-term implications for health.<sup>23</sup> Short-term consequences can result in weight loss, dehydration, choking, asphyxiation, failure to thrive

and malnutrition.<sup>24,25,26</sup> Long-term implications of feeding problems include gastrointestinal discomfort,<sup>27</sup> and iron deficiency anemia.<sup>28</sup> Chronic feeding problems can increase a child's risk for negative medical and developmental outcomes, such as inadequate growth, invasive medical procedures, developmental and growth delays, psychological and social deficits and poor academic achievement.<sup>29</sup>

### ***1.2 Feeding Problems and Gastrointestinal (GI) Symptoms***

Recent studies have found that nearly 80% of children diagnosed with ASD experienced at least one gastrointestinal (GI) symptom in the previous three months.<sup>30</sup> Recent literature has highlighted high rates of GI symptoms in children diagnosed with ASD.<sup>31,32,33</sup> These studies have found that abdominal pain, diarrhea and constipation were frequently cited concerns, though a range of other symptoms were reported by caregivers. Other disorders such as gastroesophageal reflux (GERD), gastritis, celiac disease and food allergies were often endorsed at high rates in ASD.<sup>34</sup> Research has found that children with GI symptoms generally show higher rates of food intolerance,<sup>35</sup> are at a greater risk for both feeding,<sup>15</sup> and behavior problems.<sup>36</sup>

### ***1.3 Feeding Problems and Challenging Behavior***

Challenging behavior can be defined as “culturally abnormal behavior of such intensity, frequency or duration that the physical safety of the person or others is likely to be placed in serious jeopardy, or behavior which is likely to seriously limit use of, or result in the person being denied access to, ordinary community facilities”.<sup>37(p3)</sup> Existing research has suggested that over eighty percent of children diagnosed with ASD demonstrate some form of challenging behaviour,<sup>38</sup> and challenging behavior is one of the most common co-occurring problems for children with ASD.<sup>39,40</sup> Challenging behavior often accompanies feeding problems,<sup>4</sup> and these types of behavior can include aggressive, stereotypic/repetitive, and self-injurious behavior (SIB).<sup>1</sup> Challenges associated with feeding problems can manifest as

food refusal, aggression and self-injurious behavior,<sup>42</sup> and as ritualized or inflexible eating behaviour.<sup>43,20</sup>

#### ***1.4 Feeding Problems and Sensory Defensiveness/Impairments***

Feeding behavior can be negatively affected by a range of sensory aversions in children with ASD.<sup>44</sup> Research has found that many children and adults diagnosed with ASD demonstrate a range of sensory defensiveness and/or impairment.<sup>44,45</sup> Existing measures have suggested that as many as 95% of children with ASD demonstrate one or more forms of these sensory-based challenges, with these individuals often presenting as either hyper- or even non-responsive to certain stimuli.<sup>46</sup> In children and adults with ASD, hyper-responsiveness to certain food textures, tastes, smells and appearance likely contributes to their avoidance, selectivity and/or restriction of foods.<sup>22,47,48,49,50</sup>

#### ***1.5 Feeding Problems and Adaptive Behavior***

Adaptive functioning refers to a range of behavior essential to functioning in everyday life.<sup>51</sup> This range of behavior includes the ability to communicate, socialize, problem-solve, and perform daily living skills.<sup>51</sup> Adaptive behavior is correlated with overall cognitive level, though children and adults with ASD generally demonstrate adaptive skills one-to-two deviations below the norm for their age.<sup>52</sup> This difference is thought to be due to the symptoms of ASD, which correlate negatively with overall levels of adaptive functioning.<sup>53</sup> Consistent with the core symptoms of ASD, children and adults with ASD demonstrate marked difficulties in their ability to communicate and socialize on measures of adaptive functioning.<sup>54</sup>

#### ***1.6 Feeding Problems and Health-related Quality of Life***

Feeding problems increase the risk of a host of social and health-related challenges.<sup>29,35,36</sup> Feeding problems have been found to be a predictive of decreased overall

Health-related Quality of Life (HRQoL).<sup>23</sup> While highly relevant as an outcome of treatment and intervention, HRQoL has been explored considerably less often than other outcome measures.<sup>55,56</sup> Consistent with adaptive behavior, the available research indicated HRQoL scores of children and adults with ASD were substantially lower than their same-aged peers.<sup>55,56,57</sup>

### ***1.7 Feeding Problems and Complementary and Alternative Medicines***

Complementary and Alternative/Integrative Medicines (CAM) are often used as adjuncts or alternatives to other evidence-based therapies. These approaches have taken the form of dietary restrictions and nutritional supplements,<sup>58</sup> as well as chiropractic, massage therapy, energy therapy and acupuncture.<sup>59</sup> Existing research has indicated that caregivers endorsed some improvements with CAM approaches<sup>59</sup> and that nearly 90% of caregivers endorsed using one or more forms of CAM with children diagnosed with ASD.<sup>60</sup> Additionally, related research has suggested that the presence of GI symptoms and challenging behavior have influenced substantially increased the use of CAM services and methods in ASD, as compared to other developmental disorders.<sup>61</sup>

### ***1.8 Study Aims and Objectives***

Feeding behavior is a complex, multi-faceted issue impacting a sizable proportion of individuals diagnosed with ASD. Feeding problems both impact, and are impacted by, a host of factors including GI symptoms, challenging behavior, sensory defensiveness/impairment, and comorbid psychopathology. Leader et al.<sup>62</sup> investigated the relationship between feeding problems and GI symptoms, challenging behavior, sensory issues, and comorbid psychopathology in children and adolescents with ASD. Leader et al.<sup>62</sup> found that higher rates of GI symptoms, challenging behavior, and sensory issues were found in those who presented with rapid eating, food refusal and food stealing than those without these problems, while comorbid psychopathology predicted rapid eating, food selectivity and food refusal.

The current study aims to expand on Leader et al.<sup>62</sup> by investigating the additional variables of adaptive behavior, quality of life and the use of complementary and alternative medicines. Given the range and scope of the factors involved in feeding problems, a better understanding of relevant variables is indicated, and a better understanding of the eating phenotype is needed. The current study aims to expand on the available research conducted by exploring potential predictors of feeding problems in a sample of children and adolescents with ASD.

## **2. Method**

### ***2.1 Participants***

Participants were 120 children and adolescents with a diagnosis of autism spectrum disorder in accordance with DSM-IV-TR criteria.<sup>63</sup> Diagnoses were provided by a licenced psychologist or paediatrician independent of the study. The participants received their diagnosis as a result of the formal diagnostic protocol which employs multiple diagnostic measures. Caregiver information on professional diagnosis, diagnostic setting/organization and professional(s) who made the diagnosis was obtained.

The average age for participants was 8 years ( $SD = 3.79$ ), with a range of 3 to 17 years. Percentages of male and female participants were 77.5% ( $n = 93$ ) and 22.5% ( $n = 27$ ), respectively. Mean age at diagnosis was 6 years ( $SD = 2.87$ ), with a range of 1 to 9 years. A diagnosis of intellectual disability was endorsed for 38.3% of participants ( $n = 46$ ). Rates of mild, moderate, and severe intellectual disability were 11.7% ( $n = 14$ ), 21.7% ( $n = 26$ ) and 5% ( $n = 6$ ), respectively. Co-occurring diagnoses of Attention-Deficit/Hyperactivity Disorder, Epilepsy or Anxiety were endorsed for 33.3% ( $n = 40$ ) of participants. Rates of other co-occurring diagnoses (i.e., dyspraxia, sensory processing disorder, Down syndrome) were endorsed for 29.2% ( $n = 35$ ) of participants.

### ***2.2 Procedure and Informants***



Parents and guardians were made aware of the study through parent support groups and special schools. If parents wished to participate in the study, they were provided with a participant information sheet and a consent form to complete. Once consent was obtained, the informants were provided with the battery of above questionnaires to complete in their own time. Informants were parents of children and adolescents diagnosed with ASD. Rating scales were completed by parents independently according to the instructions printed on top of the questionnaires.

## **2.3 Materials**

### *2.2.1 Demographic measure.*

A self-constructed questionnaire provided information on participant's age, gender, if had a diagnosis of co-occurring disorders, if they had a diagnosis of an intellectual disability and if so, the level of intellectual disability, age at diagnosis of ASD, and whether participants had been referred for nutritional assessment.

### *2.2.2 Screening Tool of Feeding Problems for Children (STEP-CHILD).*

The STEP-CHILD is 15-item survey related to feeding problems in children with good internal consistency (mean Cronbach's alpha = 0.62) that has been successfully validated with established measures of feeding problems.<sup>64</sup> Respondents rated the frequency and severity of the feeding problems and the results of the STEP-CHILD yield six subscales: Chewing Problems, Rapid Eating, Food Refusal, Vomiting and Stealing Food.<sup>64</sup>

### *2.2.3 Pediatric Quality of Life Inventory—Fourth Version (PedsQL).*

The PedsQL,<sup>65</sup> is a measure of health-related quality of life (HRQoL) for children and adolescents aged 2 to 18 years. Respondents rated a child's overall functioning and the results of the PedsQL yielded the following subscales: Physical Functioning, Emotional Functioning, Social Functioning and School Functioning. The PedsQL has good internal consistency, with

coefficient alpha ranging from 0.86 to 0.90, and differentiates HRQoL between healthy children and those with acute or chronic health conditions<sup>66</sup>

#### *2.2.4 Vineland Adaptive Behavior Scales–Second Edition.*

The Vineland Adaptive Behavior Scale – Second Edition (VABS-II) is a standardized, norm-referenced measure of adaptive skills.<sup>51</sup> Caregivers rated a child’s everyday functioning and the results of this measure yielded an index of overall functioning in four domains: Communication, Daily living skills, Socialisation and Motor skills. The VABS-II has excellent internal consistency, test-retest reliability and validity.<sup>51</sup>

#### *2.2.5 Short Sensory Profile (SSP).*

Individual sensory defensiveness and impairment was assessed using the Short Sensory Profile (SSP).<sup>67</sup> The SSP is an abbreviated form of the Sensory Profile (SP).<sup>67</sup> Caregivers rated a child’s reactions to a range of sensory conditions using a thirty-eight-item questionnaire. The results of the SSP yielded seven subscales, including: Tactile Responsiveness, Taste/Smell Responsiveness, Movement Responsiveness, Visual/Auditory responsiveness, Sensory Under-responsive/Seeks Sensation, Auditory Filtering, and Low energy/Weak. The SSP has good internal consistency, with coefficient alpha ranging from 0.70 to 0.90,<sup>67</sup> and has been widely used with children diagnosed with ASD.<sup>46</sup>

#### *2.2.6 Behavior Problems Inventory–Short Form.*

The Behavior Problems Inventory–Short Form (BPI-S)<sup>68</sup> was used to measure challenging behavior. It is a shortened version of the BPI-01<sup>69</sup>, and the internal consistency of the BPI-S has been found to range from fair to good.<sup>70</sup> The BPI-S consists of thirty items and results from the BPI-S yields three subscales: Self-Injurious Behavior, Aggressive/Destructive Behavior and Stereotyped Behavior.

#### *2.2.7 Gastrointestinal Symptom Inventory.*

The Gastrointestinal Symptom Inventory<sup>71</sup> was used to measure gastrointestinal (GI) symptoms. The GI Symptom Inventory is a 35-item questionnaire that assesses GI symptoms. Symptoms assessed include: Abdominal pain, Nausea, Bloating, Diarrhea and Other GI symptoms. A summary variable can be constructed to reflect the total number of chronic GI problems experienced. It has been used in published literature.<sup>22, 72-77</sup>

#### *2.2.8 Autism Treatment Network Registry–Parent Baseline Assessment.*

Information was collected from the Complementary/Alternative Medicine (CAM) Interventions section (Section F) of the Autism Treatment Network Registry–Parent Baseline Assessment.<sup>78</sup> This information was used to examine usage of CAM practices by recording parent responses to two queries: 1) a “Yes” or “No” response to “Is your child receiving any complementary or alternative treatments?” and 2) a section where parents ticked forms of CAM treatments currently being used. The CAM treatments included in this section included: Chiropractic practices, Amino Acids, High Dosing Vitamin B6 and Magnesium, Essential Fatty Acids, Other Vitamin Supplements Gluten-Free Diets, Probiotics, Casein-Free Diets, No Processed Sugars, Probiotics and Other.

### **3. Results**

#### *3.1 Feeding Problems*

The overall frequency of feeding problems endorsed on the STEP-CHILD was 90% ( $n = 108$ ). Frequency of specific caregiver-reported feeding problems were as follows: Chewing: 53.3% ( $n = 64$ ), Rapid eating: 70% ( $n = 84$ ), Food refusal: 78.3% ( $n = 94$ ), Food selectivity: 81.7% ( $n = 98$ ), Vomiting: 22.5% ( $n = 27$ ) and Stealing food: 50.8% ( $n = 61$ ). It was reported that 32.5% ( $n = 39$ ) of participants had been referred for nutritional assessment. A summary table of means and standard deviations is provided in Table 1.

---Insert Table 1 about here---

### ***3.2 Health Related Quality of Life***

The PedsQL yielded scores ranging for 0 to 100, with 100 representing areas never being a problem and 0 representing areas that are almost always a problem. Results of the PedsQL indicated that overall health-related quality of life (HRQoL) was sometimes a concern (Total Score;  $M = 47.91$ ,  $SD = 17.04$ ). Similarly, Physical Health ( $M = 55.19$ ,  $SD = 23.55$ ) and Psychosocial Health ( $M = 44.20$ ,  $SD = 16.53$ ) were also, on average, sometimes a concern.

### ***3.3 Gastrointestinal Symptoms***

Most caregivers endorsed observing one or more GI symptoms within the previous 3 months. At least one symptom was endorsed by 84.2% ( $n = 101$ ) of caregivers and 49.2% ( $n = 59$ ) endorsed at least three GI symptoms. Caregivers endorsed 2.57 ( $SD = 1.74$ ) GI symptoms on average, ranging from 0 to 6 reported symptoms. Specific GI symptoms endorsed ranged considerably. The most frequently endorsed concerns were as follows: 1) abdominal pain (60.8%,  $n = 73$ ), 2) constipation (50%,  $n = 60$ ), 3) nausea (48.3%,  $n = 58$ ), 4) diarrhoea (44.2 %,  $n = 53$ ), 5) bloating (27.5 %,  $n = 33$ ) and 6) other GI symptoms (25.8%,  $n = 31$ ).

### ***3.4 Challenging Behavior***

The BPI-S was used to assess levels of self-injurious, aggressive/destructive and stereotyped behavior. Results of the BPI-S indicated that most caregivers endorsed concerns with self-injurious (77.5%,  $n = 93$ ), aggressive/destructive (88.3%,  $n = 106$ ) and stereotyped behavior (99.2%,  $n = 119$ ). The mean scores and standard deviations for both frequency and severity are displayed in Table 1.

### ***3.5 Sensory Profiles***

The results from of the SSP indicated that most caregivers endorsed difficulties in response to a range of sensory stimuli. Most caregivers noted a *definite* difference (95.8%,  $n$

= 115), with a small group endorsing a *probable* difference (2.5%,  $n = 3$ ) or *no* difference (1.7%,  $n = 2$ ). The mean total score for all caregivers was 100.57 ( $SD = 24.34$ ), with scores between 38 and 141 demonstrating a *definite* difference from typical performers, scores between 142 and 154 demonstrating a *probable* difference, and scores between 155 and 190 demonstrating typical performance. A summary of the means and standard deviations for the SSP is provided in Table 2.

---Insert Table 2 about here---

### ***3.6 Adaptive behavior***

Findings from the Vineland Adaptive Behavior Scales indicated that, on average, caregivers endorsed lower levels of overall adaptive functioning. Scores below 70 suggest low levels adaptive functioning, scores between 71 to 85 suggest moderately-low levels of adaptive functioning and scores above 86 are considered typical functioning. The overall average composite score was 69.21 ( $SD = 15.50$ ), suggesting low levels of adaptive behavior overall. A summary of individual subscale means and standard deviations are shown in Table 1.

### ***3.7 Complementary and Alternative Medicine***

Many caregivers endorsed accessing CAM treatments for their children and adolescents. Caregiver reports on the Autism Treatment Network Registry indicated that 32.5% ( $n = 39$ ) of children accessed at least one or more forms of CAM. The specific approaches endorsed in this sample included: 1) Other Vitamin Supplements (17.5%,  $n = 21$ ), Probiotics (10%,  $n = 12$ ), Gluten-Free Diet (6.7%,  $n = 8$ ), Essential fatty acids (5.8%,  $n = 7$ ), No Processed Sugars (5%,  $n = 6$ ), Casein-free diet (4.2%,  $n = 5$ ), Other CAM at (4.2%,  $n = 5$ ), High Dose Vitamin B6 and Magnesium (2.5%,  $n = 3$ ), Chiropractic practices (2.5%,  $n = 3$ ) and Amino acids (1.7%,  $n = 2$ ). No caregivers endorsed using either Digestive enzymes or Glutathione.

### 3.8 Statistical Analyses

The IBM SPSS Statistical Program, Version 22, was used to perform comparisons between the subscales of the STEP-CHILD and the GI Symptom Inventory, PedsQL, BPI-S, and SSP. Individual *t*-tests were performed between each of the six subscales of the STEP-CHILD individual subscales of each measure. Bonferroni corrections were applied. A series of Chi-square test were run on the six subscales for associations with nominal variables.

#### 3.8.1 Feeding Problems and Gastrointestinal Symptoms.

Independent *t*-tests were used to compare individuals who did and did not demonstrate feeding problems on the GI Symptom Inventory. Levene's test for equality of variances was not significant, indicating homogeneity of variance. There was a significant difference in Total GI symptoms in relation to the scores for individuals with ( $M = 3.14$ ,  $SD = 1.67$ ) and without ( $M = 1.91$ ,  $SD = 1.58$ ) chewing problems;  $t(118) = -4.12$ ,  $p < .05$ ). Chi-square tests were conducted to examine which GI symptoms were affected. Results indicated a significant association between those who exhibit chewing problems and those that do not exhibit chewing problems for Abdominal pain ( $\chi^2 = 14.64$ ,  $p < .05$ ), Nausea ( $\chi^2 = 8.15$ ,  $p < .05$ ), Bloating ( $\chi^2 = 14.38$ ,  $p < .05$ ), Diarrhea ( $\chi^2 = 6.28$ ,  $p < .05$ ) and Other GI issues ( $\chi^2 = 18.14$ ,  $p < .05$ ).

Significant differences were observed in Total GI symptoms with respect to individuals with ( $M = 2.88$ ,  $SD = .19$ ) and without rapid eating ( $M = 1.50$ ,  $SD = .25$ ) problems;  $t(118) = -3.14$ ,  $p < .05$ . Chi-square tests indicated a significant association between those who exhibited rapid eating and those that did not exhibit rapid eating for Abdominal pain ( $\chi^2 = 10.39$ ,  $p < .05$ ), Bloating ( $\chi^2 = 6.53$ ,  $p < .05$ ) and Other GI symptoms ( $\chi^2 = 12.65$ ,  $p < .05$ ). Differences in those who did ( $M = 3.70$ ,  $SD = 1.51$ ) and did not ( $M = 2.24$ ,  $SD = 1.66$ ) exhibit Vomiting were significant, in relation to Total GI symptoms;  $t(118) = -4.11$ ,  $p < .05$ ). Chi-square tests found a significant association between those who did and

did not exhibit vomiting for Abdominal pain ( $\chi^2 = 11.62, p < .05$ ), Nausea ( $\chi^2 = 10.53, p < .05$ ), Bloating ( $\chi^2 = 16.22, p < .05$ ) and Other GI symptoms ( $\chi^2 = 17.28, p < .05$ ). Significant differences were not found in relation to Total GI symptoms between those with and without food selectivity or food stealing.

### 3.8.2 Feeding Problems and Sensory Issues.

Independent *t*-tests were performed to compare individuals who did and did not endorse feeding problems on the SSP. Levene's test for equality of variances was not significant, indicating homogeneity of variance. Significant differences were found between individuals with ( $M = 104.45, SD = 22.27$ ) and without ( $M = 93.69, SD = 24.15$ ) chewing problems, with respect to Total SSP;  $t(118) = 3.46, p < .05$ . A significant difference was also observed between those with ( $M = 14.98, SD = 4.71$ ) and without ( $M = 20.93, SD = 6.23$ ) chewing problems, with respect to the Under Responsive/Seeks sensation measure;  $t(118) = 5.94, p < .05$ .

Significant differences were observed between individuals with ( $M = 112.67, SD = 20.45$ ) and without ( $M = 95.39, SD = 24.14$ ) rapid eating, with respect to Total SSP;  $t(118) = 3.75, p < .05$ . A significant difference was also observed between individual with ( $M = 11.67, SD = 4.67$ ) and without ( $M = 15.11, SD = 5.04$ ) rapid eating, with respect to Auditory filtering;  $t(118) = 3.63, p < .05$ . Significant differences were observed between those with ( $M = 96.75, SD = 23.53$ ) and without ( $M = 114.42, SD = 23.53$ ) food refusal, with respect to Total SSP;  $t(118) = 3.42, p < .05$ . A significant difference was found between those with ( $M = 97.70, SD = 24.52$ ) and without ( $M = 113.36, SD = 19.27$ ) food selectivity, with respect to Total SSP;  $t(118) = 2.8, p < .05$ .

Significant differences were observed between those who did ( $M = 88.33, SD = 22.73$ ) and did not ( $M = 104.13, SD = 23.74$ ) exhibit vomiting, with respect to Total SSP;  $t(118) = 3.07, p < .05$ . Similarly, significant differences were observed in the Under

Responsive/Seeks sensation measure for those who did ( $M = 14.26$ ,  $SD = 6.18$ ) and did not ( $M = 14.26$ ,  $SD = 5.00$ ) demonstrate vomiting;  $t(118) = 3.48$ ,  $p < .05$ . No significant difference was observed in relation to SSP total score with those who exhibit food stealing and who do not exhibit food stealing. Levene's test for equality of variances was significant in the Taste/smell sensitivity subscale ( $F = 49.62$ ,  $p < .05$ ) and no comparisons were performed.

### *3.8.3 Feeding Problems and Challenging Behavior.*

Independent  $t$ -tests compared individuals who did and did not display feeding problems in relation to the BPI-S. Levene's test for equality of variances was not significant, indicating homogeneity of variance. Significant differences were found between the levels of stereotyped behavior in those with ( $M = 23.67$ ,  $SD = 10.49$ ) and without ( $M = 16.02$ ,  $SD = 9.9$ ) chewing problems;  $t(118) = -4.08$ ,  $p < .05$ . A significant difference in levels of stereotyped behavior were observed in those who did ( $M = 24.85$ ,  $SD = 9.79$ ) and did not ( $M = 18.71$ ,  $SD = 10.84$ ) demonstrate vomiting;  $t(118) = -2.65$ ,  $p < .05$ . Levene's test for equality of variance was significant in the SIB frequency ( $F = 12.07$ ,  $p < .05$ ) and severity ( $F = 18.76$ ,  $p < .05$ ) subscales. A significant difference in SIB frequency was observed for those with ( $M = 7.26$ ,  $SD = 6.00$ ) and without ( $M = 3.57$ ,  $SD = 3.54$ ) vomiting;  $t(31.44) = -3.04$ ,  $p < .05$ . Similarly, a significant difference in SIB severity was observed in those with ( $M = 5.78$ ,  $SD = 5.46$ ) and without ( $M = 2.52$ ,  $SD = 2.50$ ) vomiting;  $t(29.25) = -3.01$ ,  $p < .05$ . Significant differences were observed in the frequency of aggressive/destructive behavior for those with ( $M = 5.73$ ,  $SD = 4.70$ ) and without ( $M = 9.14$ ,  $SD = 7.65$ ) food refusal;  $t(118) = -2.15$ ,  $p < .05$ . No significant differences in challenging behavior were observed in relation to rapid eating and food stealing.

### *3.8.4 Feeding Problems and Adaptive Functioning.*



Independent *t*-tests were used to compare levels of adaptive function, with respect to feeding problems. Levene's test for equality of variances was not significant, indicating homogeneity of variance. No significant differences were observed in levels of adaptive function between those with and without feeding problems.

### *3.8.5 Feeding Problems and HRQoL.*

Statistical comparisons were performed using independent *t*-tests between those without and without feeding problems, in relation to HRQoL. Levene's test for equality of variances was insignificant, indicating homogeneity of variance. A significant difference in the PedsQL Total Score was observed between those with ( $M = 42.39$ ,  $SD = 17.44$ ) and without ( $M = 54.22$ ,  $SD = 14.28$ ) chewing problems;  $t(118) = 4.03$ ,  $p < .05$ . A significant difference in the PedsQL Psychosocial Health Score was observed for those with ( $M = 38.43$ ,  $SD = 16.82$ ) and without ( $M = 50.79$ ,  $SD = 13.55$ ) chewing problems;  $t(118) = 4.39$ ,  $p < .05$ . No other significant differences in HRQoL were found in the remaining subscales of the PedsQL.

### *3.8.6 Feeding problems and Complementary and Alternative Medicine.*

Chi-square tests were performed to determine associations between the presence of feeding problems and use of CAM approaches. Significant associations were observed between rapid eating problems and the use of removal of processed sugars ( $\chi^2 = 21.94$ ,  $p < 0.05$ ) and the administration of essential fatty acids ( $\chi^2 = 20.15$ ,  $p < .05$ ). Significant associations were also observed between food selectivity problems and use of Chiropractic practices ( $\chi^2 = 4.80$ ,  $p < 0.05$ ) and Other CAM approaches ( $\chi^2 = 6.05$ ,  $p < 0.05$ ). No other significant associations were observed between feeding problems and CAM practices.

### *3.8.7 Multiple Regression Analyses.*

A standard multiple regression was carried out to evaluate the ability of a model including age, gender, age at ASD diagnosis, GI Symptoms Inventory total score, BPI-S SIB-

severity and stereotyped behavior frequency to predict chewing problems. The overall model was significant;  $F(6, 113) = 4.81, p < .05, R^2 = .20, \text{Adj. } R^2 = .16$ . The GI Symptoms Inventory Total Score was significant as an individual predictor ( $\beta = .36, p < .05$ ) of chewing problems. A summary of the multiple regressions for chewing problems is provided in Table 3.

Another standard multiple regression was performed to evaluate the ability of age, gender, age at ASD diagnosis, BPI-S aggressive/destructive behavior-frequency and SSP total score to predict food refusal. The overall model was significant;  $F(5, 114) = 7.88, p < .05, R^2 = .26, \text{Adj. } R^2 = .23$ . SSP total score was significant as an individual predictor of food refusal ( $\beta = -.40, p < .05$ ). A summary of the multiple regressions for food refusal is provided in Table 3.

A final standard multiple regression was performed to evaluate the ability of age, gender, age at ASD diagnosis, GI symptom Inventory total score, BPI-S SIB-frequency, BPI-S SIB-severity, BPI-S stereotyped behavior-frequency, SPP total score and SSP Under Responsive/seeking sensation to predict vomiting. The overall model was significant;  $F(9, 110) = 5.18, p < .05, R^2 = .30, \text{Adj. } R^2 = .24$ . GI Symptom Inventory Total Score ( $\beta = .30, p < .05$ ), BPI-S SIB-severity ( $\beta = .45, p < 0.05$ ) and SSP total score ( $\beta = -.19, p < .05$ ) were significant predictors of vomiting. A summary of the multiple regressions for vomiting is presented in Table 3.

---Insert Table 3 about here---

## **4. Discussion**

### ***4.1 Frequency of Feeding Problems***

The present study examined rates of feeding problems as well as other, co-occurring disorders. Results indicated that 90% of respondents endorsed feeding problems, a rate

consistent with earlier estimates.<sup>22</sup> Consistent with earlier findings, food selectivity was endorsed as the most often observed feeding problem.<sup>47,79,80</sup>

#### ***4.2 Gastrointestinal Symptoms and Feeding Problems***

GI symptoms were a commonly occurring co-occurring condition with the majority (84.2%) of participants experiencing at least one GI symptom within the previous 3 months. GI symptoms often contribute to impaired eating behavior.<sup>81</sup> The results of this study indicated that nearly half of participants endorsed at least 3 or more symptoms, consistent with earlier findings in this area.<sup>30</sup> This study added to the present literature by examining the relationships between GI symptoms and specific feeding problems. More specifically, this study found that GI symptoms are predictive of chewing problems, rapid eating, and vomiting. Future research is needed in order to better understand the relationship between feeding problems and GI symptoms.

#### ***4.3 Sensory-related Impairments and Feeding Problems***

Sensory challenges were also frequently endorsed as a concern by parents. Over ninety percent of caregivers endorsed Sensory Defensiveness/Impairments, a prevalence rate consistent with earlier studies.<sup>45</sup> Sensory Defensiveness/Impairments were investigated as a potential factor in reported feeding problems. This study found that the subscales of the STEP-CHILD were predictive of the SSP Total Score. This relationship between sensory challenges and feeding problems has been documented before.<sup>22</sup>

#### ***4.4 Challenging Behavior and Feeding Problems***

All parents endorsed that their children displayed at least some degree of challenging behavior. A high correspondence between feeding problems and levels of challenging behavior has been documented in this area before.<sup>9,39</sup> The current study found that the individuals with food refusal, chewing, and vomiting problems demonstrated significantly higher levels of challenging behavior. Additionally, certain types of challenging behavior

were found to be predictive of feeding difficulties. This study found that self-injurious behavior was predictive of vomiting problems. While likely related, bidirectionally, feeding problems likely influence the amount of challenging behavior observed by caregivers.

#### ***4.5 Health-related Quality of Life and Feeding Problems***

The presence of feeding problems was found to influence caregiver-endorsed quality of life for individuals with ASD. The results of this study indicated that HRQoL was significantly lower on the PedsQL in the presence of chewing problems. Significant differences were found for the Total and Psychosocial Health Scores. Feeding problems have been found to negatively impact quality of life for individuals with disabilities.<sup>55</sup>

#### ***4.6 Adaptive Functioning and Feeding Problems***

While difficulties with eating are a significant detriment to individual functioning, no significant relationships were found between these two areas. The present results suggest that these two issues are independent of one another and that feeding problems did not impact measures of adaptive functioning. Additional research may be warranted to better understand the interplay between these two domains.

#### ***4.7 Complementary and Alternative Medical Practices and Feeding Problems***

Caregivers of children and adults with ASD may use CAM practices as one avenue to address health and behavioral challenges. Roughly one-third (32.5%) of study respondents endorsed using these practices. These rates were considerably lower than previously reported for this area of research.<sup>60</sup> The lower rate of CAM usage observed in this sample may be due to a focus on CAM products specifically, while Owen-Smith et al.<sup>60</sup> examined a broader range of CAM products, providers and practices. Among specific feeding problems, rapid eating was found to be associated with the use of removal of processed sugars and the administration of essential fatty acids. Food selectivity was found to be associated with the use of Chiropractic practices and the use of “Other” forms of CAM.

#### ***4.8 Limitations***

While the results of this study yielded findings consistent with earlier works, limitations exist that may limit the generalizability of these findings. This study was conducted using caregiver self-report. While self-report data is not a replacement for objective measurement, earlier work in this area has found that caregiver self-report was highly concurrent with symptoms revealed from clinical diagnosis.<sup>82</sup> Despite this, future replications of this work would benefit from including additional, objective measures of health and behavior.

#### ***4.9 Conclusions***

The present study brings to light multiple, often overlapping, sources of difficulty when children and adolescents demonstrate feeding problems. The results of this study indicate that feeding problems affect both quality of life as well as the likelihood of other types of behavioral problems. While the specific relationship between feeding problems and other behavior is not fully understood, it is likely that the amelioration of feeding problems may lessen and remove symptoms in other, related comorbid conditions.

The results of this study highlight the relevance of gastrointestinal symptoms, challenging behavior, sensory defensiveness/impairments and quality of life in the assessment and treatment of feeding problems. These findings highlight the multi-factor nature of feeding issues and confirm the high frequency of these problems for children and adolescents with ASD. This work extends the present literature by investigating the relationships between feeding problems and adaptive behavior and quality of life, areas which have not been examined extensively. Future research should examine how these measures may change over the lifespan and in response to evidence-based treatment for feeding problems.

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Table 1.

*Means and Standard Deviations of Study Measures*

Scale	<i>N</i>	<i>M</i>	<i>SD</i>
<b>STEP-CHILD</b>			
Chewing Problem	120	1.39	1.95
Rapid Eating	120	2.36	2.43
Food Refusal	120	3.26	2.77
Food Selectivity	120	3.61	2.76
Vomiting	120	.66	1.44
Stealing Food	120	1.19	1.59
<b>BPI-S</b>			
SIB-Frequency	120	4.40	4.47
SIB-Severity	120	3.25	3.64
Aggressive/destructive Behavior-Frequency	120	8.39	7.23
Aggressive/destructive Behavior-Severity	120	6.67	5.99
Stereotyped Behavior-Frequency	120	20.09	10.89
<b>SSP</b>			
Tactile Sensitivity	120	20.62	5.66
Taste/Smell	120	6.78	4.22
Movement Sensitivity	120	10.45	3.98
Under Responsive/seeking sensation	120	17.76	6.21
Auditory Filtering	120	12.70	5.01
Low energy/weak	120	19.12	8.45
Visual/Auditory sensitivity	120	12.30	4.99
Total SSP	120	100.57	24.34
<b>VABS</b>			
Communication	120	73.39	20.99
Daily living skills	120	70.89	19.62
Socialization	120	68.89	16.32
Motor	120	71.15	23.71
Composite score	120	69.21	15.50

Table 2.

*Participant Classifications for SSP*

Subscale	Typical <i>n (%)</i>	Probable <i>n (%)</i>	Definite <i>n (%)</i>
Tactile sensitivity	7 (5.8)	15 (12.5)	98 (81.7)
Taste/smell	10 (8.3)	7 (5.8)	103 (85.3)
Movement sensitivity	45 (37.5)	18 (15)	57 (47.5)
Under Responsive/seeking sensation	10 (8.3)	12 (10)	98 (81.7)
Auditory filtering	5 (4.2)	9 (7.5)	106 (88.3)
Low energy/weak	36 (30)	11 (9.2)	73 (60.8)
Visual auditory sensitivity	13 (10.8)	13 (10.8)	94 (78.3)
Total SSP	2 (1.7)	3 (2.5)	115 (95.8)

Table 3.

*Multiple Regression Predictors*

Variable	<i>B</i>	<i>p</i>	<i>R</i> <sup>2</sup>	<i>Adj. R</i> <sup>2</sup> <i>change</i>	<i>F change</i>
<b>Rapid Eating</b>					
Step 1			.00	-.02	.15
Age	.07	.48			
Gender	-.02	.85			
Age at diagnosis	-.13	.23			
Step 2			.13	.09	8.24
GI Symptom Inventory total	.22	.02*			
SSP total	-.22	.02*			
<b>Chewing Problems</b>					
Step 1			.02	-.01	.75
Age	-.05	.58			
Gender	-.02	.75			
Age at diagnosis	-.01	.94			
Step 2			.17	.14	20.99
GI Symptom Inventory total	.36	.00**			
Step 3			.20	.16	2.33
SIB – severity	.18	.07			
Stereotyped Behavior	.02	.87			
<b>Food Refusal</b>					
Step 1			.03	-.06	2.34
Age	-.17	.07			
Gender	-.07	.38			
Age at diagnosis	-.09	.36			
Step 2			.22	.20	15.35
Aggressive/destructive Behavior frequency	.11	.21			
SSP total	-.40	.00**			
<b>Vomiting</b>					
Step 1			.07	.07	2.97
Age	-.03	.75			
Gender	-.04	.61			
Age at diagnosis	-.06	.55			
Step 2			.22	.19	21.99
Taste/Smell sensitivity	-.42	.00**			

\*  $p < .05$ \*\*  $p < .01$