



Long-Term Outcomes after Behavior-Analytic Intervention for Pediatric Feeding Disorders

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Abstract

Many children with autism spectrum disorder experience feeding difficulties that can lead to increased health risks (e.g., severe nutrition deficiencies, obesity-related illnesses) if left untreated. Intensive feeding programs that use behavior-analytic interventions have reported positive outcomes for treating challenging behavior associated with pediatric feeding disorders at discharge and up to 1 year post discharge. Whether these children achieve and maintain long-term goals is unknown. The purpose of the current study was to evaluate outcomes of behavior-analytic intervention for pediatric feeding disorders among children with and without autism spectrum disorder in an intensive feeding program post discharge. Caregivers of former patients reported on the positive and negative impact of the program and their child's growth and diet variety at follow-up. 85% of caregivers reported the program had a positive impact. Increases in height-for-age *z* scores were significant from admission to discharge from the intensive program, and progress in growth and diet variety remained the same or improved for most children at follow-up. Results suggest that behavior-analytic intervention in an intensive feeding program produced positive short- and long-term outcomes for children and their families.

Keywords Outcomes · Pediatric Feeding Disorders · behavior-analytic Intervention · Autism Spectrum Disorder · food Selectivity

Pediatric feeding disorders describe the behavior of children who have persistent challenges meeting nutritional needs, energy needs, hydration needs, or a combination, by mouth (Goday et al., 2019). Often pediatric feeding disorders have multiple etiologies, even for children who appear to be “selective eaters” (Manikam & Perman, 2000). Conditions that disrupt oral feeding such as prematurity, or cause eating to be painful (e.g., gastroesophageal reflux disease) or difficult (e.g., oral-motor-skill deficits), may contrib-

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ute to disordered feeding (Blackman & Nelson, 1985; Bazyk, 1990; Dellert et al., 1993; Derrickson et al., 1993; Mukkada et al., 2010; Nucci et al., 2002; Piazza et al., 2003; Vantini et al., 2004). Children with neurological or genetic disorders, such as autism spectrum disorder (ASD), are more likely to be diagnosed with a feeding disorder (Anil et al., 2019). In fact, up to 89% of children with ASD or related diagnoses have feeding difficulties (Bandini et al., 2017). Children with ASD often display change-resistant behavior during meals, meaning they insist on eating the same few foods and following specific and rigid routines (Crowley et al., 2020). They may respond with emotional outbursts or even severe challenging behavior if presented with novel foods or when caregivers attempt to deviate from usual meal routines (e.g., presentation of higher-textured foods, restricting access to a bottle). These behaviors may discourage caregivers from attempting to change the child's diet or meal routines.

Feeding difficulties for children with and without ASD will likely remain the same or worsen over time without direct intervention (Peterson et al., 2019). Often, these difficulties can have a negative and profound impact on child health and the emotional well-being of the family (Auslander et al., 2003; Franklin & Rodger, 2003; Graves & Ware, 1990; Greer et al., 2008; Milnes et al., 2013). If left untreated, children with feeding disorders can experience growth failure, severe nutrition deficiencies, and dehydration. Many children require supplemental nutrition in the form of tube feedings, which involves invasive surgical procedures, long-term maintenance to avoid infection, additional hospital visits, and increased financial burden (Sharp et al., 2010).

The health risks associated with change-resistant feeding behavior among some children with ASD may not be immediately apparent. For example, many children with ASD and food selectivity will consume sufficient calories for growth but their diets are lacking in nutrition to a degree that places them at risk for developing obesity-related illnesses, chronic gastrointestinal dysfunction, and metabolic syndrome (Broder-Fingert et al., 2014). Results of several studies have shown that the prevalence of obesity and diabetes among individuals with ASD and the prevalence of hypertension in males with ASD is higher than that of typically developing peers (Flygare et al., 2018; Levy et al., 2019), which is alarming given the significant negative health consequences of obesity, diabetes, and hypertension. Inadequate consumption of fruits, proteins, and vegetables can cause micronutrient deficiencies, which can have serious and irreversible effects on the brain (Sullivan et al., 2002). Schreck et al. (2004) determined that the children with ASD from their study ate about half the dairy items, fruits, proteins, and vegetables compared to the amount that children without ASD ate. The diets of children with ASD often consist primarily of processed foods that are low in nutritional content and high in fat, salt, and sugar (Bandini et al., 2017). Restrictive diets with poor nutritional content can cause further impairments in cognitive and behavioral functioning (Freedman et al., 1999; Ludwig et al., 1999; Volkert & Piazza, 2012).

Feeding difficulties for a child with ASD may greatly impact their ability to access many different types of community-based settings. Clinically, we observe many children with feeding disorders and ASD insist on eating only at home or with certain caregivers and refuse to eat at school, daycare, or other settings. Many are unable to eat with peers during school lunch and must be pulled away to private locations

to have specialized providers facilitate the unique meal routine. Many require specific mealtime routines that cannot be accommodated or replicated in all settings (Schreck et al., 2004). For example, one patient from our intensive feeding program refused to eat any foods other than French fries from a specific McDonald's, making travel or attending events with food impossible for the family. Unfortunately, these types of restrictions can lead to exclusion from the community or social stigmatization (Bandini et al., 2010). Because children must eat regularly throughout the day, the child's change-resistant feeding behavior can cause more stress on families than other characteristics of ASD because the consequences of change-resistant feeding behavior are often more immediate and salient and can disrupt the entire family's mealtime or daily routines (Curtin et al., 2015). Caregivers of children with change-resistant feeding behavior have reported feelings of anger, anxiety, depression, lack of self-confidence, rejection, and stress (Auslander et al., 2003; Greer et al., 2008). Caregiver stress interacts with child behavior problems such that higher stress is predictive of more behavior problems and vice versa (Baker et al., 2003; Blacher & McIntyre, 2006; McIntyre et al., 2002).

To address these negative nutritional and social impacts of feeding disorders, clinicians and researchers have evaluated various interventions to determine efficacy. Systematic reviews of the literature show that interventions for pediatric feeding disorders (for children with and without ASD) based on the principles of applied behavior analysis have the most empirical support (Kerwin, 1999; Sharp et al., 2010; Volkert & Piazza, 2012). Sharp et al. (2017) reported on the effectiveness of this approach in a meta-analysis of published intensive-program outcomes. Eight of the 11 studies Sharp et al. analyzed used behavioral interventions as at least one program component for children with a variety of diagnoses and histories (Brown et al., 2014; Byars et al., 2003; Clawson et al., 2007; Cornwell et al., 2010; Greer et al., 2008; Sharp et al., 2016; Silverman et al., 2013; Williams et al., 2007). Results of these studies showed that feeding behavior and related targets, such as decreases in tube dependence and increases in oral intake, were improved at discharge (Brown et al., 2014; Byars et al., 2003; Clawson et al., 2007; Cornwell et al., 2010; Greer et al., 2008; Sharp et al., 2016; Silverman et al., 2013; Williams et al., 2007).

Intensive feeding programs are often critical for children suffering from feeding difficulties to jump start their feeding goals and create a new foundation for eating, so they are eventually able to integrate into community settings for meals with peers and family members (e.g., restaurants, school cafeteria, social events). However, less is known about the long-term effects of these programs (i.e., beyond 2 years). Four studies reported follow-up data up to 1 year after discharge (Brown et al., 2014; Byars et al., 2003; Sharp et al., 2016; Silverman et al., 2013). One study reported follow-up data beyond 1 year (Williams et al., 2007). Further, little is known about the long-term outcomes of outpatient step-down programs which often aim to maintain and continue to progress feeding skills, with the current literature demonstrating outcomes after completion of only the intensive programs (Patel et al., 2022; Vincent et al., 2024).

Presumably, the goal of intervention for a child with a feeding disorder is to ensure the child (a) meets appropriate energy and nutritional needs, (b) gains weight and grows, (c) is less or not dependent on enteral or supplemental feeding and nutrition or restricted meal routines, and (d) participates in the social aspects of eating similar to peers (e.g., consuming meals in regular settings and with flexible routines). Another

critical goal should be to improve the child and family's quality of life and emotional well-being. Whether children with feeding disorders treated in intensive programs achieve and maintain these long-term goals is unknown.

Many social events, celebrations, and activities in life revolve around food (e.g., weddings, holidays, birthday parties). It is important that children receive care to address feeding concerns so they can lead healthy lifestyles, and also so they can integrate with others to access important and meaningful opportunities for social interaction. The purpose of the current study was to describe the long-term outcomes of children who were initially treated in an intensive and then transitioned to an outpatient step-down feeding program with behavior-analytic interventions to target their feeding difficulties. One goal was to evaluate the psychosocial impact of intervention on the child and family. A second goal was to assess the program's long-term effects on diet variety and growth, given these are crucial goals for children with and without ASD who have pervasive feeding difficulties. Each time we mention *program*, we are referring to the entire admission for the child, which began with an intensive bout of treatment followed by less-intensive step-down outpatient services.

Method

Participants & Setting

Authors obtained institutional review-board approval to conduct this study. The authors searched the medical records of children admitted to an intensive pediatric feeding disorders program at a university-affiliated medical center from 2006 to 2019 to identify participants. Children were included in the study if they completed an admission in the intensive day-treatment program and were excluded if they chose to stop the program against medical advice. Authors identified 189 children that met the inclusion criteria.

Feeding Program Overview

Admission criteria for the intensive day-treatment program included that the child met the criteria for a pediatric feeding disorder and either had at least 3 months of previous less-intensive therapy with little to no progress or had an urgent feeding disorder, such as recurrent hospitalizations for dehydration. Of the children admitted to the intensive day-treatment program, approximately 60% were dependent on enteral feeding (e.g., gastrostomy, jejunostomy) and consumed less than 15% of their energy needs orally, approximately 30% consumed a limited diet variety in which they ate few or no foods that were nutritionally appropriate, and 10% were admitted due to other concerns (e.g., lack of independence with eating).

Mean age of children at admission was 4 years (range, 8 months to 19 years) with a ratio of six males to four females; 42% of children were diagnosed with a developmental disorder, such as ASD (23%). The most common medical diagnoses were gastroesophageal reflux disease (65%) and prematurity (49%). Mean length of admission was 44 days, during which, children attended the program five days per

week for three to five meals per day that were spaced apart by breaks and other activities (e.g., play time). Children attended the program for approximately 5–8 h per day. Meals typically ranged from 30 to 45 min in duration, and the breaks between meals were of equal length. Therapists typically focused on one major skill area per meal (e.g., solids during meals one, three, and five; liquids during meals two and four) and each meal was comprised of multiple, time- or trial-based sessions.

The goal of the intensive day-treatment program was to make a substantial change in the child's feeding behavior. Common goals across children included increasing consumption of at least 16 foods, four from the groups of fruit, grain, protein, and vegetable, and a nutritionally and developmentally appropriate beverage. Increasing calories consumed by mouth was a goal for children who were not consuming 100% of their energy needs by mouth.

A dietitian monitored the child's growth, helped select nutritionally appropriate foods and liquids, analyzed the child's intake, and made recommendations for adjustments. A pediatric gastroenterologist provided input on patient care and monitored medical problems (e.g., vomiting) that arose during the admission. A speech and language pathologist was available for consultation if concerns arose about the child's oral-motor skills or safety for oral feeding. All children were previously cleared as safe oral feeders by the child's previous providers with expertise in pediatric swallow safety (e.g., speech language pathologist) and the team followed safety recommendations regarding texture and bolus. If the child did not have a previous provider who had expertise in swallow safety, our program's speech language pathologist conducted an evaluation before the admission to confirm whether the child was appropriate and safe to participate in the intensive day-treatment program. Our program's speech language pathologist periodically observed sessions and monitored child progress throughout the intensive day-treatment program for children who displayed oral-motor skill deficits. A licensed psychologist or board certified behavior analyst-doctoral® level with specialized expertise in pediatric feeding disorders developed the assessment and intervention protocols and supervised a team of behavior technicians who implemented the protocols with the child (e.g., nonremoval of the spoon, differential reinforcement; Sharp et al., 2010).

The intensive program was data-based and outcome oriented. The protocols incorporated the principles of applied behavior analysis to increase the occurrence of appropriate feeding behavior, such as accepting and swallowing bites and drinks, and increasing consumption of a wide variety of foods and liquids. Caregiver training and generality of intervention effects were critical program components to ensure that feeding success maintained in community-based settings. Therapists spent the last week of the admission in other environments (e.g., child's home, school, day-care) observing the caregiver(s) (e.g., parents, teachers) implement the intervention. Transitioning the child to the outpatient step-down program after discharge from the intensive day-treatment program for less-intensive follow-up services was also a planned component of the program. The outpatient step-down program focused on teaching more advanced feeding skills (e.g., chewing, self-feeding) and progressing the child to age- or developmentally typical eating routines (e.g., portion-based meal consumption, eating with the family during shared meals, integrating into the school cafeteria for daily lunch). The dietitian, speech language pathologist, or both were

consulted as needed during the outpatient step-down program based on the child's goals. Typically, sessions were conducted weekly via telehealth or in the clinic setting, and caregivers practiced the intervention or skill-acquisition targets between sessions. The length of time children participated in the outpatient step-down program varied based on when the child met their feeding goals or when the caregiver felt they could continue working on the child's goals on their own.

General Study Procedure

We sent a flyer and consent form to each caregiver via surface mail or REDCap, if an email address was available (Patridge & Baryn, 2018). The flyer described the study's purpose and listed the website URL and QR code to access the REDCap questionnaire. The consent form described that the child and caregiver remained anonymous if the caregiver completed only the first section of the questionnaire and completing the second section served as consent for authors to access the child's medical records.

Follow-Up Questionnaire

The first section of the follow-up questionnaire included 11 statements with a Likert scale (1=*strongly disagree* to 5=*strongly agree*; see Table 1). Eight questions focused on the potential positive impact of the program (intensive day-treatment and outpatient step-down) on child and caregiver behavior, six of which were the target of intervention for all children and caregivers (i.e., overall feeding behavior, family meals, calories by mouth, food variety, motivation to eat, caregiver knowledge) and two of which were the target for only some children and caregivers (i.e., weight gain and behavior problems). Two questions focused on the potential negative impact of the child's feeding disorder (i.e., generality of intervention effects and caregiver stress) and one question asked whether the family participated in the outpatient step-down program until the child was an age- or developmentally typical feeder or until the caregiver thought they could progress the child on their own.

The second section of the questionnaire included seven open-ended questions about the child's health and nutrition. The questionnaire asked for the child's name; the child's most recent height and weight; and a list of fruits, grains, proteins, and vegetables the child regularly consumed. Caregiver responses were analyzed to determine the child's status at follow-up. Data from the follow-up questionnaire are available upon request.

Dependent Variables & Data Analysis

The primary dependent measures were the percentage of caregivers who *agreed or strongly agreed* with each question about the positive impact of the program, *disagreed or strongly disagreed* with each question about the negative impact of the child's feeding disorder, and *agreed or strongly agreed* they participated in the outpatient step-down program. We divided the number of caregivers who agreed or strongly agreed for each positive-impact question and the outpatient step-down pro-

Table 1 Follow-up questionnaire questions and responses

Question	1 Strongly Disagree	2 Disagree	3 Neutral	4 Agree	5 Strongly Agree
1. Overall feeding behavior					
My child's feeding improved as a result of treatment at the pediatric feeding disorders program.	13%	0%	2%	19%	66%
2. Family meals					
My child always eats what the family is eating.	6%	17%	15%	28%	34%
3. Calories by mouth					
My child meets all their caloric needs orally.	11%	2%	9%	26%	53%
4. Nutrition					
My child eats a healthy variety of foods across food groups (e.g., dairy, fruits, grains, proteins, vegetables).	2%	4%	9%	38%	47%
5. Motivation to eat					
My child requests to eat or gets food on their own.	6%	9%	4%	32%	49%
6. Caregiver knowledge					
If my child began refusing food again, I feel that I have the knowledge necessary to handle it on my own because of the training I received through the feeding program.	11%	4%	13%	34%	38%
7. Weight gain					
My child's weight improved due to the feeding program.	9%	11%	28%	19%	34%
8. Behavior problems					
My child's problem behavior decreased at meals due to the feeding program.	15%	0%	21%	19%	45%
9. Generality of intervention effects					
My child only eats appropriately at home.	17%	45%	9%	19%	11%
10. Caregiver stress					
I am stressed by my child's current eating habits.	21%	53%	9%	13%	4%
11. Outpatient services					
I participated in the outpatient program until my child met the feeding goals my family set or until I felt I could progress my child to age-typical or developmentally appropriate eating on my own.	17%	2%	13%	17%	51%

gram question or disagreed or strongly disagreed for each negative-impact question by the number of caregivers who answered the question and converted the ratios to percentages.

If the caregiver completed the second section of the questionnaire, we obtained the child's height; weight; and list of fruits, grains, proteins, and vegetables the child consumed at admission and discharge from the intensive day-treatment program from medical records. The program dietitian selected various measures by which

to determine the child's growth and nutritional status. More specific, she calculated each child's height-for-age and body-mass index-for-age percentiles and z scores at admission and discharge from the intensive program and at follow-up (CDC, 2000). The authors used GraphPad QuickCalcs Statistical Software to conduct paired t tests to compare each child's z score for height-for-age and body-mass index-for-age from admission to the intensive day-treatment program to discharge from the intensive day-treatment program and discharge to the outpatient step-down program.

The dietitian classified each child's height-for-age and body-mass index-for-age z scores (Becker et al., 2014; O'Conner et al., 2017; de Onis & Onyango, 2008). The child's body-mass index-for-age z score was classified as obese above 1.645, overweight from 1.036 to 1.5, within normal limits from -0.9 to 1.02, mild malnutrition from -1 to -1.9 , moderate malnutrition from -2 to -2.9 , and severe malnutrition from -3 or greater. The child's height-for-age z score was classified as within normal limits above -1.9 , stunted from -2 to -2.9 , and severely stunted from -3 or greater. The dietitian then determined whether the child's growth status (i.e., body-mass index, height) stayed the same, improved, or worsened from discharge from the intensive day-treatment program to the time at which we sent the follow-up questionnaires. The child's growth status had *not changed* if both z scores were within normal limits or met criteria for the same classification level of body-mass index or height, had *improved* if the discharge z score met criterion for obese, overweight, or malnutrition (stunted or severely stunted) and the follow-up z score met criterion for within normal limits or less-severe malnutrition or obesity/overweight (less-stunted), had *worsened* if the discharge z score met criterion for within normal limits, obese, overweight, or malnutrition (stunted or severely stunted) and the follow-up z score met criterion for malnutrition, more-severe malnutrition, or obesity/overweight (more-stunted), and was *not classified* if measures were missing.

The dietitian compared the specific foods the child regularly consumed at discharge from the intensive program to follow-up to determine whether the child's diet variety increased, decreased, or was unchanged. Diet variety increased if the child ate more foods from the four groups at follow-up than they had at discharge from the intensive program, decreased if the child ate fewer foods from the four groups at follow-up than they had at discharge, or did not change if the child ate the same number of foods from the four groups at follow-up as they had at discharge.

Results

Forty-seven of 189 caregivers (25%) completed the first anonymous section of the questionnaire (Table 1). Of the six questions about the positive impact of the intensive day-treatment and outpatient step-down programs on behavior that was the target of intervention for all children and caregivers, the percentage of caregivers who *agreed* or *strongly agreed* was 85% for overall improvement in feeding behavior, 62% for the child eats what the family eats, 79% for the child meeting energy needs by mouth, 85% for the child consuming a healthy variety of foods, 81% for motivation to eat, and 72% for caregiver knowledge to progress the child's feeding behavior. Of the two questions about the positive impact of the program on behavior that was the target of

intervention for some children, the percentage of caregivers who *agreed* or *strongly agreed* was 53% for weight gain and 64% for decrease in mealtime problem behavior. Of the two questions that assessed the negative impact of the child's feeding disorder, the percentage of caregivers who *disagreed* or *strongly disagreed* was 62% for lack of intervention generality and 74% for caregiver stress. More than two-thirds of caregivers (68%) participated in the outpatient step-down program until their child was an age- or developmentally typical feeder or until the caregiver thought they could progress the child without additional services.

Caregivers of 16 males and 17 females completed the second section of the questionnaire. Mean age of children was 4.1 years (range, 0.7–11.7 years) at admission to the intensive program, 4.3 years (range, 0.9–11.9 years) at discharge from the intensive program, and 10.9 years (range, 3.8–20.1 years) at follow-up. Mean number of years between discharge from the intensive program and follow-up was 7 (range, 0.4–13).

Mean height-for-age z score was -1.3 ($SD=1.5$) at admission, -0.9 ($SD=1.3$) at discharge, and -1.0 ($SD=1.2$) at follow-up. The difference from admission to discharge was statistically significant; $t(31)=3.00$, $p=.0053$. The difference from discharge to follow-up was not statistically significant; $t(28)=0.58$; $p=.57$. At follow-up, height-for-age z score improved for 6%, was unchanged for 66%, decreased for 19%, and 9% had no data.

Mean body-mass index z score was -0.4 ($SD=1.4$) at admission, -0.5 ($SD=1.3$) at discharge, and -0.7 ($SD=1.3$) at follow-up. The differences were not statistically significant. At follow-up, body-mass index z score improved for 6%, was unchanged for 50%, decreased for 9%, and 34% had no data.

Mean number of foods consumed from the groups of fruit, grain, protein, and vegetable was 3.3 (range, 0–14) at admission, 16.9 (range, 2–23) at discharge, and 24.8 (range, 1–46) at follow-up. Food variety from discharge to follow-up increased for 75%, was unchanged for 9%, and decreased for 16%.

Discussion

Results of outcome studies suggest that behavior and other targets associated with pediatric feeding disorders have improved at discharge from intensive feeding programs that used behavioral interventions (Brown et al., 2014; Byars et al., 2003; Clawson et al., 2007; Cornwell et al., 2010; Greer et al., 2008; Laud et al., 2009; Seiverling et al., 2020; Sharp et al., 2016; Silverman et al., 2013; Williams et al., 2007). One limitation of these studies is that follow-up data mostly described children who were dependent on gastrostomy tubes (Brown et al., 2014; Byars et al., 2003; Cornwell et al., 2010; Silverman et al., 2013; Williams et al., 2007), and only two studies presented data beyond 1 year (Laud et al., 2009; Williams et al., 2007). The current study extends the literature by reporting long-term outcomes for children with heterogeneous presentations of pediatric feeding disorders, including children with ASD and related disorders, for a mean of 7 years and up to 13 years after discharge. 85% of caregivers reported that treatment in the intensive day-treatment and outpatient step-down programs improved their child's feeding behavior.

Williams et al. (2007) reported that 74% of children who were 100% gastrostomy-tube dependent at admission were not receiving tube feedings 2 years after treatment in an intensive program. The current study assessed a slightly different outcome, whether the child was meeting their energy needs by mouth, for several reasons. First, eliminating tube feedings is not necessarily equivalent to meeting energy, hydration, or nutritional needs orally. Some children may not receive tube feedings but also may not meet all of their needs via oral feeding. For example, the many children with ASD who engage in change-resistant feeding behavior have significantly limited diet variety and nutrition, leading to poor health outcomes. Second, unlike Williams et al., our sample included children with and without a history of tube dependence. Asking about calories by mouth provided information about the oral intake of the entire sample, not just those with a history of tube dependence. One limitation is that we cannot determine whether children who were not consuming 100% of their energy needs by mouth were those who continued to receive tube feedings or were exclusive oral feeders with insufficient oral intake. Nevertheless, the 13% of caregivers who disagreed or strongly disagreed with the question about their child meeting calorie needs by mouth suggests that some children with feeding disorders continue to require caloric supplementation even after treatment in an intensive program.

Most caregivers in the current study (85%) reported their child was eating a healthy variety of fruits, grains, proteins, and vegetables. Mean total foods consumed at admission was 3.3 (0.7 fruits, 1.3 grains, 1.1 proteins, and 0.2 vegetables). At discharge from the intensive program, mean total foods consumed increased to 16.9 (4.1 fruits, 4.6 grains, 4.4 proteins, and 3.7 vegetables). At follow-up, mean total foods consumed increased to 24.8 (6.3 fruits, 5.1 grains, 6.8 proteins, and 6.6 vegetables). This outcome is noteworthy given the documented nutritional deficiencies in the diets of typically eating children in the United States (Guenther et al., 2006; Krebs-Smith et al., 2010). This also has important implications for children with ASD who have limited diets severely lacking in nutrition.

Poor growth can be a concern for some children with pediatric feeding disorders. Previous outcome studies have reported mixed findings relative to the effect of intervention on growth, including initial weight loss (Byars et al., 2003; Silverman et al., 2013), weight gain (Greer et al., 2008), and no weight change (Brown et al., 2014; Cornwell et al., 2010). Comparison between studies is challenging because researchers used different measures to report growth and assessed growth at different intervals. Thus, outcomes may be difficult to interpret without information on the child's relative growth (Hermanussen, 2015). In this study, the dietitian transformed heights and BMI's to *z* scores. The height and BMI of 72% and 56% of children, respectively, remained the same or improved from discharge to follow-up, but some children still had growth concerns. Future research should evaluate why growth remains a challenge for some children with feeding disorders.

The negative effects of pediatric feeding disorders on the child and family's psychosocial functioning cannot be underestimated. Caregivers of children with feeding problems have reported additional stress, depression, and feelings of rejection (Franklin & Rodger, 2003). Much of this stress and anxiety could be due to a lifestyle that requires frequent contact with medical providers or maintaining unique and complex feeding routines (e.g., traveling to the same McDonalds every day) to ensure their

child meets their nutritional and calorie needs. In the current study, most caregivers reported that after the intensive feeding program, their child ate what the family ate, requested to eat or obtained food on their own, and ate appropriately across settings (i.e., not just in the home); this outcome suggests that the child's feeding behavior was no longer a barrier to the social aspects of mealtime, likely increasing their access to other settings. Recall, for many children with ASD and feeding difficulties, change-resistant feeding behavior serves as a major barrier to them participating fully in activities that occur in other settings during meals or social events (e.g., birthday party, holiday gatherings). Therefore, outcomes such as eating appropriately across settings and eating what the family eats are significant and suggest improvements in these change-resistant behaviors, which leads to fuller participation in the community. Similarly, caregivers in Silverman et al. (2013) reported significantly reduced aversion to mealtime and significantly improved family mealtime environment. In Greer et al. (2008) and the current study, 62% and 74% of caregivers, respectively, did not report stress at follow-up. Future studies should examine the factors that contribute to caregiver pretreatment stress and stress reduction posttreatment.

More than two-thirds of caregivers in this study participated in the outpatient step-down program until their child was an age- or developmentally typical feeder, or until the caregiver felt they could progress the child without additional services. Other studies (a) did not report whether they provided outpatient step-down services (Greer et al., 2008; Laud et al., 2009; Sharp et al., 2016; Williams et al., 2007), (b) did not describe the details of outpatient step-down services (Byars et al., 2003; Cornwell et al., 2010), or (c) referred families to unspecified outpatient providers (Brown et al., 2014). Clawson et al. (2007) reported that families returned for follow-up at 1, 4, 7, and 12 months following discharge. The absence of details and lean schedule of outpatient services is surprising as we find that caregivers need significant support to maintain and progress their child's feeding. In addition, outpatient step-down services could be important to ensure success maintains across community settings, different feeders, expanded food variety, and over time as the child progresses toward adolescence and adulthood.

Future studies should examine the frequency and intensity of outpatient services needed to maintain the gains of an intensive program and to progress the child to age- or developmentally typical feeding. After intensive feeding concerns are addressed, it may not be necessary to retain long-term support from feeding specialty providers. Many children with ASD receive ABA treatment for non-feeding related goals (e.g., communication; Roane et al., 2016). It could be that transitioning a child from an intensive behavior-analytic feeding program to a less intensive behavior-analytic general service provider (e.g., in home, school, community) could be one way to maintain progress and continue to develop skills over time with a similar treatment philosophy. More research is needed to identify the best methods for children with feeding difficulties to eventually become age- or developmentally typical feeders.

Although most caregivers in this study reported maintenance or improvement in their child's eating over time, some caregivers reported that their child's feeding behavior relapsed after discharge from the programs (i.e., decrease in growth measure or diet variety). Questionnaire results did not provide information about why relapse occurred. Previous researchers evaluating relapse found interfering behavior often increases when the feeding environment changes (Ibañez et al., 2019). Other researchers have evaluated

strategies for mitigating relapse during similar contextual changes, but results have been mixed (Haney et al., 2021; Kelley et al., 2018). Researchers should determine the conditions in which treatment relapse is likely to occur and assess strategies for preventing relapse. The current survey did not ask caregivers whether they were currently using an intervention developed during the child's feeding admission. However, the goal of the program is to progress children to age-typical eating, meaning that at some point, interventions should no longer be required. That is, the ultimate goal for children participating in this type of treatment is for them to eat typically without additional treatment in place. Future research should assess how long children admitted to an intensive feeding program require intervention to maintain their progress and how long it takes before they begin eating age-typically.

The low response rate (25%) is a limitation of the current study. Meta-analyses have reported a mean response rate of 53% for questionnaires (i.e., return or completion; Cook et al., 2000). Therefore, we cannot be sure of the long-term outcomes of the 75% that did not respond to the questionnaire. However, there are a multitude of factors which can influence response rates (Fan & Yan, 2010). Researchers in other studies collected follow-up data in person or by phone and had better response rates (Byars et al., 2003; Laud et al., 2009). Although in-person and telephone follow-up might increase response rate, it also may increase response bias. By contrast, providing anonymity may increase respondents' willingness to respond to questions without bias (Ong & Weiss, 2000).

Results of the current study suggest that behavior-analytic intervention for children with feeding disorders produced meaningful and lasting change in feeding behavior, growth, nutrition, and psychosocial functioning for up to 13 years post treatment. Important changes included increases in the number and variety of foods the child consumed and stable or improved growth. The psychosocial functioning of the child and family appeared to approximate that of families with typically eating children given the absence of previous challenges (e.g., child ate with family, child indicated hunger), suggesting these children were better able to access other settings and reducing stress for caregivers. The changes are noteworthy because these children had not progressed in traditional outpatient therapy or their feeding disorder was causing significant medical problems before admission to the intensive program. Future research should focus on increasing response rate at follow-up to evaluate whether results are representative of most children receiving behavior-analytic treatment for pediatric feeding disorders in an intensive program.

Declarations

Conflict of Interest All authors agree with the content of the manuscript and the order of authorship listed on the title page; the authors do not have any conflicts of interest (financial or non-financial) to report.

Ethical Approval We received full approval from our University's Institutional Review Board (IRB) to conduct this study and as such, obtained informed consent. The study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Informed Consent The IRB approved the process of sending a flyer and consent form to each caregiver via surface mail or REDCap, if an email address was available (Patridge & Bardyn, 2018). The flyer described the study's purpose and listed the website URL and QR code to access the REDCap questionnaire. The consent form described that the child and caregiver remained anonymous if the caregiver completed only the first section of the questionnaire and completing the second section served as consent for authors to access the child's medical records. We do not disclose any identifiable protected health information in the manuscript. Participants were informed that they could withdraw their participation at any time. There was no funding for this research.

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