Atypical eating behaviors in children and adolescents with autism, ADHD, other disorders, and typical development

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ABSTRACT

Background: Previous research has not yet examined the prevalence of atypical eating behaviors in children and adolescents with autism compared to those with ADHD, other disorders, and typical development.

Method: The sample comprised 2102 children: 1462 with autism, 327 with other disorders (e.g., ADHD, intellectual disability, language disorder, and learning disability), and 313 typical children, 1–18 years of age (mean 7.3). Atypical eating behaviors were assessed with the Checklist for Autism Spectrum Disorder based on a standardized parent interview conducted by licensed psychologists.

Results: Atypical eating behaviors were significantly more common in autism (70.4%) than in children with other disorders (13.1%) and typical children (4.8%). For children with autism who had atypical eating behaviors, the most common behavior was limited food preferences (88%), followed by hypersensitivity to food textures (46%), other peculiar patterns most often eating only one brand of food (27%), pocketing food without swallowing (19%), and pica (12%). Grain products and/or chicken (usually nuggets) were the preferred foods for 92% of children with autism who had limited food preferences. For children with autism who had atypical eating behaviors, 25% had three or more atypical eating behaviors (vs. 0% for children with other disorders or typical development). Only children with autism had pica or pocketed food.

Conclusions: The number and types of atypical eating behaviors found only in children with autism and not in children with other disorders or typical development should alert clinicians to the possibility of autism and the need to evaluate for autism in order to facilitate early identification and access to evidence-based treatment.

1. Introduction

Atypical eating behaviors have been recognized as common in autism since autism was first conceptualized as a diagnosis by Kanner (1943). Limited food preferences (also referred to as selective eating, food selectivity, restricted variety, or reduced food repertoire) is the most frequent feeding problem in children with autism (Beighley, Matson, Rieske, & Adams, 2013; Bicer & Alsaffar, 2013; Postorino et al., 2015). Many children with autism demonstrate atypical eating behaviors during infancy (Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007) and have narrower diets than typical peers by 15 months of age (Emond, Emmett, Steer, & Golding, 2010).

A systematic literature review summarized in Table 1 revealed six studies of children with autism (1–18 years) that included the

Table 1

Percent of children and adolescents with autism exhibiting limited food preferences.

%	N	Study
30%	115	Bicer and Alsaffar (2013)
60%	100	Williams et al. (2000)
60%	50	Valicenti-McDermott et al. (2006)
63%	67	Dominick et al. (2007)
72%	138	Schreck et al. (2004)
84%	19	Lockner et al. (2008)

prevalence of limited food preferences, yielding a median prevalence of 62%. The prevalence estimates for autism are far higher than the 6%–50% range for picky eating in preschool typical children in a review by Cardona Cano, Hoek, and Bryant-Waugh, (2015) and medians of 27% for preschool children and 28% for children and adolescents in a review by Taylor, Wernimont, Northstone, and Emmett, (2015).

In fifteen studies, limited food preferences in children with autism were compared to children in contrast groups, with autism sample sizes ranging from 19 to 269 (median 53). Children and adolescents with autism had significantly more limited food preferences compared to (1) typical children (Bandini et al., 2017; Beighley et al., 2013; Castro et al., 2016; Curtin et al., 2015; Emond et al., 2010; Kuschner et al., 2015; Lockner, Crowe, & Skipper, 2008; Martins, Young, & Robson, 2008; Matson, Fodstad, & Dempsey, 2009; Schreck, Williams, & Smith, 2004; Valicenti-McDermott et al., 2006; Zimmer et al., 2012), (2) their parents and siblings (Aponte & Romanczyk, 2016; Schreck & Williams, 2006), and (3) children with developmental disabilities other than autism (Beighley et al., 2013; Dominick et al., 2007; Matson et al., 2009; Valicenti-McDermott et al., 2006).

Studies analyzing other atypical eating behaviors reported that children with autism rejected foods based on texture more so than controls (Dominick et al., 2007; Field, Garland, & Williams, 2003; Kuschner et al., 2015; Lockner et al., 2008; Matson et al., 2009; Schreck et al., 2004; Valicenti-McDermott et al., 2006). Other atypical eating behaviors documented in autism include pica (Matson et al., 2009) pocketing food without swallowing (Levin, Volkert, & Piazza, 2014; Mayes, 2012), eating only specific brands of a food (Mayes, 2012), not mixing foods and smelling foods before eating (Valicenti-McDermott et al., 2006), and mealtime rituals, such as using only a certain plate or cup or eating food only if presented a certain way (Mayes, 2012; Williams, Dalrymple, & Neal, 2000; Williams, Gibbons, & Schreck, 2005).

Postorino et al. (2015) reported that parents of children with autism who had limited food preferences experienced greater stress than parents of children with autism who did not have restricted diets. Limited food preferences in autism were associated with child behavior problems in some small studies (Curtin et al., 2015; Dominick et al., 2007; Postorino et al., 2015; Williams et al., 2000), but a large study of children with autism found that oppositional behavior, conduct problems, ADHD, irritability, emotional over-reactivity, anxiety, depression, and social problems were not significant correlates (Zickgraf & Mayes, 2018). Deficient nutrition and growth are not reported in most studies of children with autism, despite food selectivity (Cardona Cano et al., 2015; Kral, Eriksen, Souders, & Pinto-Martin, 2013; Mari-Bauset, Zazpe, Mari-Sanchis, Llopis-Gonzalez, & Suarez-Varela, 2015; Postorino et al., 2015; Zickgraf & Mayes, 2018). Findings on the relationship between limited food preferences and gastrointestinal problems in autism are inconsistent (Gorrindo et al., 2012; Postorino et al., 2015; Suarez & Nelson, 2012; Valicenti-McDermott et al., 2006; Zickgraf & Mayes, 2018). A study investigating atypical eating behaviors in 1112 children with autism (who were participants in the present study) showed that young age, increasing autism severity, poor appetite, and constipation were significant correlates of atypical eating behaviors, whereas IQ, sex, race, psychotropic medication use, maternal behavior rating scale scores, weight, and health problems other than constipation were not (Zickgraf & Mayes, 2018).

1.1. Purpose

The study purpose was to compare the prevalence of limited food preferences and other atypical eating behaviors in children and adolescents with autism versus other disorders (including ADHD, which has not yet been studied) and typical development in a sample of children with autism far larger than previous studies covering a broad age range (1–18 years).

2. Material and methods

The study was approved by the Institutional Review Board, which waived informed consent because analyses were conducted retrospectively on existing clinical data.

2.1. Measures

2.1.1. Checklist for Autism Spectrum Disorder (CASD)

The CASD is a 30-item autism diagnostic instrument normed and standardized on 2469 children (1–18 years) with autism, other clinical disorders, and typical development (Mayes, 2012). The CASD is a semi-structured diagnostic interview completed by the clinician based on a parent interview and information from other sources (e.g., teacher report and clinical observations). The CASD comprises 30 items describing core symptoms of autism or behaviors commonly associated with autism, which are scored as present

or absent by the clinician. Children with autism (both with normal and below normal intelligence) earn CASD total scores at or above the autism cutoff of 15 (Mayes & Calhoun, 1999, 2004, 2011). The CASD has established validity in diagnosing autism in infants and toddlers, as well as in older children and adolescents (Mayes, 2019). The CASD has been shown to differentiate children with and without autism with 99.5% accuracy, and inter-rater agreement on autism diagnoses using the CASD and other measures (Childhood Autism Rating Scale, Gilliam Asperger's Disorder Scale, and Autism Diagnostic Interview-Revised) ranges from 93% to 98% (Mayes et al., 2009; Murray, Mayes, & Smith, 2011).

One of the 30 CASD items is "feeding problems," which has five sub-items: (1) "very picky eater, limited food preferences, insists on eating only a few foods," (2) "hypersensitivity to textures (e.g., lumps in food)," (3) "retains food in mouth without swallowing," (4) "eats inedible substances," and (5) "other peculiar eating patterns (e.g., eats only one brand, color, or shape of food)". In some cases of positive responses to sub-items, additional information was recorded by the clinician (e.g., parents identified their child's preferred foods, inedible substances consumed, and textures the child could not tolerate).

2.1.2. Pediatric Behavior Scale (PBS)

The PBS is a parent and teacher rating scale assessing multiple areas of psychopathology, including ADHD, oppositional defiant and conduct disorders, anxiety, and depression (Lindgren & Koeppl, 1987). The PBS has been used in several studies to diagnose and measure psychological problems and differentiate diagnostic groups (e.g., Conrad, Richman, Lindgren, & Nopoulos, 2010; Mattison & Mayes, 2012; Mayes, Calhoun, Mayes, & Molitoris, 2012; Nichols et al., 2000; Wolraich et al., 1994). The PBS corresponds well with established measures of ADHD, anxiety, and depression (Bixler et al., 2009; Mayes, Gordon, Calhoun, & Bixler, 2014).

2.2. Samples

Study children were from two samples: a psychiatry child diagnostic clinic and the CASD national standardization sample (Mayes, 2012). The total sample comprised 2102 children: 1462 with autism, 327 with other disorders (e.g., ADHD, intellectual disability, language disorder, and learning disability), and 313 typical children.

2.2.1. Child diagnostic clinic sample

The sample comprised 1648 children, 1443 with autism and 205 with ADHD. The children ranged in age from 1 to 17 years (M = 6.5 years, SD = 3.5, 1–6 years n = 955, 7–12 years n = 567, 13–17 years n = 126). All 1-year-olds had a diagnosis of autism. IQs ranged from < 55–146 (M = 90.8, SD = 26.6). For children whose IQ was below that listed in test manual table (e.g., < 55), a ratio IQ was calculated. In all, 70.4% had an IQ $\geq$ 80, 78.9% were male, 88.8% were white, and 35.7% had a parent with a professional or managerial occupation. All children were consecutive referrals to a department of psychiatry child diagnostic clinic and underwent a comprehensive diagnostic evaluation by a licensed PhD psychologist. The evaluation included a diagnostic interview with the parents using the CASD, questionnaires and rating scales completed by parents and teachers or childcare providers (PBS), review of educational and early intervention and medical records, administration of psychological tests (IQ, achievement, attention, and neuropsychological), and clinical observations during psychological testing.

All children and adolescents in the autism group had a clinical diagnosis of autism using DSM-IV or DSM-V criteria (whichever was current at the time the child was evaluated) and a score in the autism range on the CASD. Consistent with research findings (Mayes et al., 2012), almost all children with autism had ADHD symptoms. These children were included only in the autism group and not in the ADHD group. All children in the ADHD group had a clinical diagnosis of ADHD and a score below the autism range on the CASD and fulfilled the following criteria: (1) symptoms of ADHD observed during psychological testing, (2) low scores on individually administered psychometric measures of attention and impulsivity (if age applicable), and (3) ratings of short attention span or distractible as *often* or *very often* a problem on the PBS by at least two raters (mother, father, teacher). Children with comorbid diagnoses (e.g., oppositional defiant disorder, conduct disorder, anxiety disorder, depression, and learning disability) were not excluded, so that the sample is representative of referred children with ADHD. Based on the Child Diagnostic Clinic evaluation, none of the children had an eating disorder diagnosis, with the possible exception of avoidant/restrictive food intake disorder (ARFID), which involves "concern about aversive consequences of eating" or "lack of interest in eating food" (neither of which characterized our sample) or "avoidance based on the sensory characteristics of food," which might have applied to some of our children with autism. However, ARFID was not given as an additional diagnosis because limited food preferences is a symptom of autism and most of the children with autism in our sample who had restricted diets did not have food aversion and sensory sensitivity to foods. For the children who had both limited food preferences and sensory aversion to foods, it could not be determined if the restricted diet was due to sensory sensitivity or to autism, which would be necessary for an ARFID diagnosis. Further, the majority of children with limited food preferences in our study were not underweight (according to parent report), which would also be required for ARFID.

2.2.2. CASD standardization sample

The 454 children and adolescents in the CASD standardization sample were from the CASD standardization study, an independent nationally representative validity study conducted by the Stoelting Company (Mayes, 2012). The CASD was completed by clinical and school psychologists recruited and trained to administer the CASD following standardized administration procedures at several sites throughout the United States. Diagnostic subgroups included 313 children with typical development (CASD score below the autism range and no identified clinical disorder), 19 with autism (CASD score in the autism range and educational exceptionality of autism), and 122 children with other diagnoses, as stated in each child's educational records and who scored below the autism range on the CASD. Other diagnoses included ADHD, learning disability, developmental delay/intellectual disability, deaf, and language disorder.

Table 2

Percent of children and adolescents with atypical eating behaviors.

Child Diagnostic Clinic		CASD Standardization sample					
Autism	ADHD	Autism	ADHD/no ID	LD	LD	Language Disorder	Typical
(n=1443)	(n=205)	(n=19)	(n=35)	(n=47)	(n=19)	(n=21)	(n=313)
70.4%	16.6%	68.4%	8.6%	12.8%	15.8%	0%	4.8%

Children ranged in age from 1 to 18 years ($M = 10.4$, $SD = 4.4$), and 50.7% were male, 51.3% were white, and 60.0% of mothers and 59.7% of fathers had educations beyond high school.

2.3. Data analyses

Chi-square was used to investigate differences in the frequency of atypical eating behaviors between diagnostic groups and between age groups. Data on the presence or absence of atypical eating behaviors were available for all 2102 children. For 287 of the 1050 children with atypical eating behaviors, sub-item scores were also available, indicating what types of atypical eating behaviors the children exhibited. For children with autism, descriptive statistics were used to indicate preferred food percentages in the 113 children with extremely restricted food preferences for whom preferences were recorded. The most common examples of texture sensitivities, pica, and other peculiar eating behaviors were summarized.

3. Results

3.1. Prevalence of atypical eating behaviors

In the Child Diagnostic Clinic sample (Table 2), atypical eating behaviors were 4.2 times more common in autism (70.4%) than in ADHD (16.6%), $\chi^2 = 224.9$, $p < .0001$. Atypical eating behavior percentages did not differ significantly between children and adolescents with and without intellectual disability (ID) in the autism group ($\chi^2 = 0.8$, $p = .37$) and in the ADHD group ($\chi^2 = 3.5$, $p = .08$).

In the CASD Standardization sample (Table 2), atypical eating behaviors were 7.0 times more common in autism (68.4%) than in children and adolescents with other disorders (9.8%), $\chi^2 = 38.7$, $p < .0001$) and were 14.2 times more common in autism than in typical children (4.8%), $\chi^2 = 93.9$, $p < .0001$. Children and adolescents with other clinical disorders were 2.0 times as likely as typical children to have atypical eating behaviors ($\chi^2 = 3.8$, $p = .050$). Atypical eating behaviors were rare for children and adolescents with other clinical disorders (language disorder, deaf, cerebral palsy/traumatic brain injury, ADHD/no ID, ADHD/ID, ID/no ADHD, and learning disability), with a nonsignificant difference between these groups ($\chi^2 = 4.0$, $p = .68$).

3.2. Types of atypical eating behaviors

For children and adolescents who had atypical eating behaviors in both the Child Diagnostic Clinic and CASD Standardization samples, limited food preferences was the most common type of unusual behavior in each of the diagnostic groups (Table 3). Approximately 31% of children and adolescents with autism in both samples had limited preferences only, in contrast to the majority of children and adolescents in the groups without autism. Most children and adolescents with autism had two or more types of atypical eating behaviors and some had three or more, whereas none of the children without autism had three or more.

Table 3

Percent of atypical eating behaviors in children and adolescents who have atypical eating behaviors.

	Child Diagnostic Clinic		CASD Standardization sample			Total
	Autism (n=240)[a]	ADHD (n=26)[a]	Autism (n=13)[a]	Other clinical (n=5)[a]	Typical (n=3)[a]	Autism (n=253)[a]
Limited food preferences	88.3%	92.3%	92.3%	100%	100%	88.5%
Sensitivity to textures	46.9%	19.2%	30.8%	0%	33.3%	46.0%
Pockets food	19.8%	0%	7.7%	0%	0%	19.2%
Pica	11.8%	0%	7.7%	0%	0%	11.6%
Other (e.g., brand specific)	26.5%	4.0%	30.8%	0%	0%	26.7%
Limited preferences only	30.8%	73.1%	30.8%	100%	66.7%	30.8%
Total atypical eating sub-items						
Only 1	41.6%	84.0%	38.5%	100%	66.7%	41.0%
2 or more	58.9%	16.0%	61.5%	0%	33.3%	59.0%
3 or more	26.3%	0%	7.7%	0%	0%	25.3%

[a] Number of children for whom the sub-type of atypical eating behavior was recorded.

Table 4

Most common preferred foods in children and adolescents with autism who have limited food preferences.

92.0% grain products and/or chicken (with or without other foods)
71.7% grain products (most common pasta, breakfast foods, pizza, bread/sandwiches, and rice)
59.3% chicken (most often nuggets)
19.5% French fries (most often McDonalds)
15.0% fruit (almost always bananas or apples)
12.4% hot dogs (rarely other meats)
8.8% yogurt (almost always blended)

3.3. Features of atypical eating behaviors in autism

3.3.1. Age

In the Child Diagnostic Clinic sample, atypical eating behaviors were most common in children 0–2 years of age (78.5%), followed by 3–5 years (72.6%) and 6 years and older (67.1%), $\chi^2 = 9.3$, $p = .01$. Age group sample sizes were too small to permit comparisons in the Standardization sample.

3.3.2. Preferred foods

For children and adolescents with autism who had atypical eating behaviors, almost all parents reported the children resisted trying new foods (sometimes referred to as food neophobia) and the vast majority of children (88.5%) had severely limited food preferences. Preferred foods for the 113 children for whom preferences were specified are summarized in Table 4. Children with autism who had restricted preferences overwhelmingly preferred uniform texture, bland, and neutral color foods, most notably grain products and/or chicken (92.0%). For children who preferred chicken (59.3% of those with severely restricted preferences), the preference was almost always for chicken nuggets. For children who preferred grain products (71.7% of those with limited preferences), the most common types in order of preference were pasta (most often macaroni and cheese), breakfast food (pancakes, waffles, and cereal), pizza, bread or crackers, sandwiches (almost exclusively peanut butter and jelly and grilled cheese), and rice. Children with autism who had restricted food preferences rarely limited their diets to vegetables, potatoes (other than French fries), meats (other than hot dogs), eggs, fish, or cheese. Although most children preferred somewhat bland foods, exceptions were reported (e.g., a child who ate raw lemons and another who consumed pepper by the spoonful).

3.3.3. Hypersensitivity to textures

In order of prevalence, children and adolescents with autism could not tolerate smooth creamy textures (e.g., mashed potatoes and pudding), foods that require chewing (e.g., unprocessed meat and raw vegetables), and foods containing lumps (e.g., oatmeal and apple sauce). Interestingly, some of these foods (e.g., apple sauce or yogurt) were the preferred foods for other children with autism.

3.3.4. Pica

The most common nonfood substance ingested by children with autism was crayons, followed with equal occurrence by soap, paper, feces, dirt, and Play-Doh.

3.3.5. Other atypical eating behaviors

The most frequent other atypical eating behavior was eating only a specific brand of a food (e.g., Kraft macaroni and cheese and McDonald's French fries). Brand specificity was followed in occurrence by swallowing food without chewing, unusual food temperature sensitivities (e.g., inability to tolerate hot or cold food), and food preferences based on color or shape (e.g., eating elbow macaroni but not eating other pasta).

Other atypical food-related behaviors were reported by parents in addition to those captured by the CASD feeding problems item that were not included in the data analyses because they did not specifically involve types of foods consumed. Instead, these were mealtime rituals captured by a different CASD item ("idiosyncratic and ritualized patterns"). These were smelling food before eating it and demanding that food be presented a certain way (e.g., using a specific plate or cup, insisting that foods not touch other foods on a plate, and eating food only if served a particular way, such as eating a banana only if it is peeled after given to the child and eating a hot dog only if on a bun, even though the child never ate the bun).

4. Discussion

Combining results for the 2102 children from the child diagnostic clinic and CASD standardization samples, atypical eating behaviors were five times more common in autism (70%) than in children with other disorders (13%) and were 15 times more common in autism than in typical children (5%). Percentages were similar for the two independent autism samples (child diagnostic clinic 70% and CASD standardization 68%) with CASDs administered by different clinicians, supporting the reliability of the prevalence estimates and the CASD as an assessment instrument. Our atypical eating behavior prevalence is within the range previously reported for autism based on much smaller samples (Bicer & Alsaffar, 2013; Dominick et al., 2007; Lockner et al., 2008; Schreck et al., 2004; Valicenti-McDermott et al., 2006; Williams et al., 2000).

The 5% prevalence of atypical eating behaviors in typical children in our sample is notably lower than the median prevalence of

28% for picky eating reported in general population studies (Taylor et al., 2015). The CASD is a clinical interview assessing eating behaviors that are clearly atypical. In contrast, the assessment of picky eating in general population studies is usually based on a single or a few questions completed independently by the parent on a questionnaire developed for the study. As noted by Taylor et al. "there is no single widely accepted definition of picky eating, and therefore little consensus on the appropriate measure of assessment" (2015, p. 350). In Taylor and colleagues' large general population cohort (2015), parents answered one question "Does your child have definite likes and dislikes as far as food is concerned?" with three possible responses "No, Yes quite choosy, and Yes very choosy." It is likely that prevalence rates using such items will be higher than the prevalence of markedly abnormal eating behaviors as defined on the CASD.

Because of the high prevalence of atypical eating behaviors in autism, young children referred to feeding clinics and older individuals referred to eating disorders clinics for treatment of their limited food preferences may have undiagnosed autism. A recent study showed that adults with eating disorders (particularly those with restrictive anorexia) had significantly higher scores on a self-report autism symptom scale than did healthy controls (Dell'Osso et al., 2018). As noted by Rastam (2008), the possible link between autism and eating disorders deserves further study. The diagnostic criteria for eating disorders share some overlapping features with atypical eating behaviors in autism. However, unlike children with anorexia nervosa, the children with autism in our study enjoyed eating (but only specific foods) and were not concerned about gaining weight or their body image. The DSM-5 specifies that avoidant/restrictive food intake disorder (ARFID) involves "concern about aversive consequences of eating" or "lack of interest in eating food" (neither of which characterized our sample) or "avoidance based on the sensory characteristics of food," which may apply to some of our children. However, another publication by the authors (Zickgraf & Mayes, 2018) involving 1112 children with autism from the current study investigated the correlates of atypical eating behaviors in autism and found that 48% with limited food preferences also had hypersensitivity to food textures (which may have explained the limited food preferences for some of these children) but that 52% did not have hypersensitivity to food textures. The study also demonstrated that children with autism who had atypical eating behaviors (vs. those who did not) were not significantly more likely to be underweight. This is another feature that may distinguish atypical eating behaviors in autism from eating disorders, such as anorexia nervosa and ARFID, both of which have significant weight loss or failure to achieve expected weight as DSM-5 diagnostic criteria.

4.1. Limitations

A study limitation was that sub-item data on the CASD feeding problems item were missing for the majority of participants, so more detailed information could only be examined in a subset of cases. Most important, for our research and that of others, is the absence of a valid and universally accepted instrument for assessing atypical eating behaviors in children. The Swedish Eating Assessment for Autism Spectrum Disorders is a promising self-report questionnaire assessing eating problems in adolescents and adults with normal intelligence and autism (Karlsson, Rastam, & Wentz, 2013). Until valid instruments are developed for children, researchers must continue to rely on clinical parent interviews focusing on assessing all of the unusual eating patterns associated with autism. Another limitation (although not a focus of our study) was that BMI was not measured. Lastly, the ADI-R and ADOS were not used to assess autism. Instead, our diagnoses were made by PhD psychologists with extensive autism training and experience using a comprehensive, multisource, and validated diagnostic procedure based on a semi-structured diagnostic interview with the parents using the CASD, questionnaires and rating scales completed by parents and teachers or childcare providers (PBS), review of early intervention and educational records, administration of psychological tests, and clinical observations during psychological testing.

Another aspect of the study some may regard as a limitation is the inclusion of 1-year-olds (i.e., children 12–23 months of age) with autism. In support of this, the CASD has established validity in diagnosing autism in infants and toddlers, as well as in older children and adolescents (Mayes, 2019). The American Academy of Pediatrics advises screening for autism at every 12- and 18-month well child visit. Research reviews suggest that reliable and valid autism diagnoses are possible before age 2 (Matson, Wilkins, & Gonzalez, 2008; Rogers, 2000), and home video recordings demonstrate that autistic symptoms are apparent during the first year of life (Rogers, 2000; Zwaigenbaum, Bryson, & Garon, 2013). Parents often express concerns in infancy and almost always by 18 months of age (Rogers, 2000), but there is a 2- to 6-year gap across studies between early detection and an autism diagnosis (Kishore & Basu, 2011), which unnecessarily delays evidence-based treatment. Furthermore, a previous study using many of the same children in the current study (Zickgraf & Mayes, 2018) showed that the percentages of children with autism who had atypical eating behaviors did not differ significantly between children at ages 1 (80.0%), 2 (80.9%), and 3 (78.3%). Research by others (Dominick et al., 2007) shows that atypical eating behaviors are present in 1-year-olds with autism and that the diets of children with autism are narrower than typical peers by 15 months of age (Emond et al., 2010). By including 1-year-olds with autism in our sample, we are not excluding this important age group and we hope to encourage and not discourage research with very young children who have autism.

4.2. Implications for practice

Once identified, atypical eating behaviors in a child with autism should continue to be given clinical attention and not be overshadowed by the presence of other more prototypical autism symptoms. Atypical eating behaviors were present by 1–2 years of age in our children with autism, which has also been reported in other studies (Dominick et al., 2007; Emond et al., 2010). Research suggests that limited food preferences and hypersensitivity to texture persist into adolescence and young adulthood for many individuals with autism (Bandini et al., 2017; Kuschner et al., 2015).

Although picky eating is fairly common in young typical children, eating from a very narrow range of foods (particularly diets

restricted to grains and processed chicken) combined with the other peculiar eating patterns found only in our autism sample and not in children with other disorders or typical development (i.e., the presence of three or more atypical eating behaviors, pica, and pocketing food) should signal the possibility of autism. Primary care physicians and early intervention providers should be aware of this and consider a referral for an autism assessment, especially if the child is also experiencing social, behavioral, sensory, or language difficulties. This is critical because numerous controlled studies demonstrate an improvement in functioning for children with autism receiving intensive early ABA in comparison to traditional community services (e.g., Birnbrauer & Leach, 1993; Dawson, Rogers, Munson, Smith, & Winter, 2010; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Lovaas, 1987; Smith, Groen, & Wynn, 2000) and that ABA is most effective if provided during the preschool years (Fenske, Zalenski, Krantz, & McClannahan, 1985; Harris & Handleman, 2000). Research shows that ABA is also effective in treating feeding problems in children with autism (Ledford & Gast, 2006; Matson & Fodstad, 2009).

Conflicts of interest

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