Original Article

Behavioral feeding challenges, nutritional deficiencies, and obesity in children with autism spectrum disorder: A cross-sectional study

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ABSTRACT

Objective: This study aimed to investigate behavioral feeding disorders among children with Autism Spectrum Disorder (ASD) and to examine their associations with dietary intake and selected anthropometric measurements.

Material and Methods: The sample included 70 children aged 6–15 years (49 males, 21 females) diagnosed with ASD. The parents or caregivers of children with ASD provided sociodemographic details, answered nutrition-related questions, and completed the Behavioral Pediatric Feeding Assessment Scale (BPFAS) to evaluate behavioral feeding difficulties in their children. Height and weight were measured to calculate BMI percentiles, while body composition was assessed via bioelectrical impedance analysis.

Results: Based on age- and gender-specific cutoffs, 45.7% of the children were classified as obese. Additionally, 37.1% of the children exhibited feeding behavior challenges. Children with feeding behavior problems were found to have significantly lower intake levels of fiber, thiamine, riboflavin, niacin, pantothenic acid, zinc, and iron and significantly higher body fat percentages compared to their peers without such issues (p=0.013, p=0.012, p=0.019, p=0.027, p=0.019, p=0.008, p=0.018, p=0.049 respectively).

Conclusion: This study highlights the high prevalence of obesity and feeding behavior problems among children with ASD, emphasizing the association between behavioral feeding issues, inadequate nutrient intake, and increased body fat percentage. These findings underscore the need for nutritional interventions and behavioral strategies to address feeding challenges and promote healthier dietary patterns in this population.

Keywords: Autism spectrum disorder, feeding behavior, nutritional deficiencies, obesity

INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by persistent difficulties in social communication, along with restricted and repetitive patterns of behavior, interest or activities (1). According to a recent report by the Centers for Disease Control and Prevention (CDC), ASD affects approximately 1 in 31 children aged 8 years (2). Children with ASD often face challenges related to communication, behavior, and feeding (3). Feeding difficulties are particularly prevalent, with rates ranging between 76.0% and 82.4% in this population (4-5).

The most frequently reported issue is food selectivity, followed by problematic mealtime behaviors (6). Food selectivity, influenced by factors such as type, texture, and presentation, frequently manifests as a strong preference for carbohydrates, snacks, and processed foods, while fruits and vegetables are often avoided (7). Problematic mealtime behaviour problems include food neophobia, an aversion to trying new foods, as well as rigid routines, tantrums and adverse reactions such as spitting out or vomiting food (6). These challenges are closely linked to dietary and nutritional concerns, affecting both the quantity and quality of food intake. Limited consumption of nutrient-dense foods such as vegetables, fruits, and dairy products can result in insufficient intake of essential nutrients, including iron, calcium, zinc, omega-3 and omega-6 polyunsaturated fatty acids (PUFAs), and fiber key elements for optimal growth and cognitive development (8). If left unaddresses, feeding difficulties may lead to developmental delays, stunted growth, and nutritional imbalances, increasing the risk for both malnutrition and obesity (3).

Numerous studies have indicated that children with ASD exhibit higher rates of obesity and are more prone to nutritional deficiencies compared to their typically developing peers (9-11).

While existing research has primarily focused on selective eating and undernutrition in children with ASD, limited attention has been given to how specific feeding behaviors affect nutrient intake and growth parameters and anthropometric indicators. Therefore, this study aimed to investigate the relationship between feeding behaviors, dietary intake, and anthropometric development in children with ASD, thereby addressing a notable gap in the current literature.

MATERIALS and METHODS

Participants and data collection

This cross-sectional study involved, between January-May 2017, children aged 6–15 years with a confirmed diagnosis of ASD involved children aged 6–15 years with a confirmed diagnosis of ASD, enrolled in Special Education and Rehabilitation Centers (SERCs) under the Ministry of National Education in Ankara. Written informed consent was obtained from all participating parents or caregivers.

The study's inclusion criteria required participants to be between 6 and 15 years old with a confirmed ASD diagnosis. Individuals with dental or swallowing difficulties, or with medical conditions that might interfere with normal dietary behaviors, known food allergies, or adherence to dietary restrictions such as a gluten-free or casein-free diet were excluded from the study.

A total of 100 children diagnosed with Autism Spectrum Disorder (ASD) were identified at the SERCs. Based on the predefined inclusion and exclusion criteria, 85 children were included in the study. However, 15 parents were excluded due to missed treatment appointments (n=6), loss of interest (n=4), or refusal to allow weight and height measurements (n=5). Consequently, the study was completed with 70 children (49 males, 21 females) whose parents provided consent to participate.

Data for the study were collected through a questionnaire administered via face-to-face interviews with parents. The questionnaire gathered socio-demographic details about both the parents and children with ASD and included the Behavioral Pediatric Feeding Assessment Scale (BPFAS). Additionally, anthropometric measurements such as weight and body fat percentage of the children with ASD were assessed using bioelectrical impedance analysis and height was measured using a tape measure.

Behavioral pediatric feeding assessment scale

The BPFAS is a standardized questionnaire comprising 35 items, designed to assess children's mealtime behaviors

through caregiver reports using a Likert scale ranging from "never" to "always" (12). The Turkish adaptation of the scale was conducted by Önal et al. (13). This assessment requires parents to evaluate how often specific mealtime behaviors occur using a Likert scale and then determine whether each behavior is problematic by selecting either "yes" or "no". A score greater than 84 suggests that a child exhibits feeding behavior challenges. To assess problem behaviors, parents were asked whether each item on the scale concerned them. If the number of reported problems exceeded 9 items, the child was considered to have problematic behaviors.

Anthropometric measurements

Body weight and body fat percentage were measured using a Tanita SC-330 Body Composition Analyzer (Tanita Corp., Tokyo, Japan), with a standard clothing weight of 1 kg assumed for all children. The body type setting was standardized across all participants. Each participant's height was measured once using a tape measure. All anthropometric measurements were recorded for each individual following CDC's recommendations given in anthropometry procedures manual 2021 by National Health and Nutrition Examination Survey (NHANES) (14). BMI values were calculated and interpreted using age-specific percentiles to account for children's growth and developmental stages. BMI was calculated and interpreted using CDC age- and sex-specific percentiles. Participants were categorized as underweight (<5th percentile), normal weight (5th–84th percentile), overweight (85th–94th percentile), or obese (≥95th percentile), based on CDC growth charts (15).

Statistical analysis

Statistical analysis was performed using IBM Statistical Package for the Social Sciences, version 22.0 (SPSS Inc., Armonk, NY, IBM Corp., USA), with statistical significance set at $p < 0.050$. The choice of statistical tests was guided by the distribution of the data, assessed through both visual methods (histograms) and analytical methods (Kolmogorov–Smirnov test). Baseline demographic characteristics and eating habits were reported as proportions of the total sample. Participants were categorized based on the presence or absence of feeding behavior challenges. Comparisons between groups were conducted using independent samples t-tests to examine differences in macro- and micronutrient intake, as well as selected anthropometric measurements.

RESULTS

Table I presents the general characteristics of the 70 participating children with ASD and their parents. Males comprised 70% of the children (n = 49). At the time of participation, 45.7% of the children were classified as obese. Similarly, 45.7% were reported to be using medication, with antipsychotics being the most commonly prescribed (53.1%). A large proportion of children (71.4%) did not engage in regular physical activity.

Table I: General characteristics, lifestyle habits for the children with ASD and parents	
Child Age (year)*	12 (9.5-14.0)
Gender†	
Male	49 (70.0)
Female	21 (30.0)
BMI percentile for age†	
Underweight	5 (7.1)
Normal	26 (37.2)
Overweight	7 (10.0)
Obese	32 (45.7)
Medication†	
Use	32 (45.7)
Don't use	38 (54.3)
Medication type (n=32)†	
Antipsychotics	17 (53.1)
Stimulants	7 (21.9)
Antiepileptic	8 (25.0)
Regular physical activity†	
Yes	20 (28.6)
No	50 (71.4)
Mother's Education†	
High School	52 (74.3)
University/Master	18 (25.7)
Father's Education†	
High School	41 (58.6)
University/Master	29 (41.4)
Number of children in the family†	
One	28 (40.0)
Two or above	42 (60.0)
Feeding behavior challanges†	
Yes	26 (37.1)
No	44 (62.9)
Problematic feeding†	
Yes	10 (14.3)
No	60 (85.7)

*: median (Q_1-Q_3), †: n(%), **ASD:** Autism Spectrum Disorders, **BMI:** Body Mass Index

Most parents had completed high school education. Feeding behavior challenges were identified in 37.1% of the children with ASD.

Table II presents the findings related to the eating habits of the children with ASD included in the study. A total of 65.7% of parents reported that their child consistently wanted to eat a specific food. More than half of the children with ASD (54.3%) showed a strong preference for consuming snacks foods such as chips, chocolate, cake, biscuits, and coke. Additionally, parents reported that most children refused to eat one or more food items. Among the most rejected foods were vegetables, particularly vegetable dishes, with a rejection rate of 45.5%.

Table III presents the energy intake, macro- and micronutrient consumption, and selected anthropometric measurements of children with ASD, grouped according to the presence or absence of feeding behavior challenges. The mean intake of fiber, thiamin, riboflavin, niacin, pantothenic acid, zinc, and iron was significantly lower in children with feeding behavior challenges

Table II: Some eating habits of children with ASD	
	n %
Food that the child always wants to eat	
Yes	46 (65.7)
No	24 (34.3)
Foods (n=46)	
Snacks (chips, chocolate, cake, biscuit, coke)	25 (54.3)
Bread	7 (15.2)
Pasta	5 (10.9)
French fries	9 (19.6)
Food rejected by the child	
Yes	44 (62.9)
No	26 (37.1)
Rejected foods*	
Legumes	4 (9.0)
Meat or chicken or fish	9 (20.4)
Egg	5 (11.4)
Fruits	4 (9.0)
Vegetables (generally vegetable dishes)	20 (45.5)
Olive	6 (13.6)
Dairy	6 (13.6)

: More than one answer was given

compared to those without such challenges (p=0.013, p=0.012, p=0.019, p=0.027, p=0.019,p=0.008, p=0.018 respectively). No statistically significant differences were observed between the groups in terms of total energy intake or other macro- and micronutrients (p=0.013, p=0.012, p=0.019), p=0.027, p=0.019, p=0.008, p=0.018 respectively). Table III presents data on BMI percentiles and fat mass values of children with ASD, categorized based on the presence of feeding behavior challenges. Although the difference in BMI percentiles between the groups was not statistically significant (p>0.101), the mean fat mass was significantly higher in children with feeding behavior challenges (p<0.049).

DISCUSSION

This study examined whether energy intake, macro- and micronutrient consumption, as well as selected anthropometric measurements, differed based on the presence of feeding behavior challenges in children with ASD. To the best of our knowledge, this is the first study to evaluate both nutritional status and anthropometric indicators in relation to feeding difficulties within this population. The study also aimed to address a gap in the literature, responding to Kittana et al.'s (16) call for integrating nutritional assessment with mealtime behaviors and food preferences, given the substantial variability observed in ASD. The findings suggest that children with ASD who experience feeding behavior challenges tend to have lower nutrient intake and higher body fat compared to their peers without such difficulties.

Children and adolescents with ASD appear to be at an increased risk for excessive weight gain and obesity (17-18). In the present study, the obesity rate was comparable to that reported by Zeybek and Yurttagül (19) (47.5%), yet notably

Table III: Energy, macro- and micronutrient intake and some anthropometric measurements according to feeding behavior challenges

	No feeding behavior challenges	Having feeding behavior challenges	Statistic	p
Number of patients	44	26	-	-
Energy (kkal)*	1889.13±327.96 (1338.55-2581.66)	1819.83±292.94 (1386.14-2433.50)	0.884‡	0.380
Macronutrients				
Carbohydrate* (%)	47.31±4.78 (38.00-62.00)	47.80±3.44 (40.0-54.0)	-0.453‡	0.652
Protein† (%)	14.19±1.64 (13.00-15.00)	13.96±1.79 (12.75-15.00)	526.50§	0.932
Fat* (%)	38.31±4.40 (26.00-46.00)	38.38±2.92 (34.0-46.0)	-0.075‡	0.940
Fiber† (g)	18.51±5.05 (14.95-21.49)	15.72±5.21 (12.90-18.76)	339.50§	0.013
Micronutrients				
Vitamin A† (μg)	813.25±340.25 (593.15-895.51)	776.75±404.14 (536.38-939.77)	446.00§	0.389
Vitamin E* (mg)	16.37±4.89 (6.43-27.73)	14.33±4.99 (6.65-28.18)	1656.0‡	0.103
Vitamin C† (mg)	82.67±28.44 (75.85-102.26)	73.18±29.81 (44.98-92.28)	438.00§	0.222
Thiamin† (mg)	0.81±0.20 (0.63-0.93)	0.70±0.20 (0.56-0.76)	337.00§	0.012
Riboflavin† (mg)	1.42±0.33 (1.18-1.69)	1.24±0.36 (0.97-1.39)	351.50§	0.019
Niacin† (mg)	10.06±3.33 (7.44-12.12)	8.36±2.87 (6.54-9.22)	361.50§	0.027
Pantothenic acid* (mg)	4.38±1.02 (3.09-6.96)	3.76±1.07 (2.57-7.13)	2396.0‡	0.019
Vitamin B_6† (mg)	1.24±0.27 (1.02-1.45)	1.14±0.35 (0.90-1.29)	408.0§	0.108
Vitamin B_{12}† (μg)	4.30±1.77 (3.09-5.17)	3.71±1.28 (2.67-4.37)	420.0§	0.146
Zinc† (mg)	9.68±2.40 (7.67-11.48)	8.27±2.41 (6.61-9.26)	328.0§	0.008
Calcium* (mg)	769.74±177.08 (461.94-1222.95)	705.00±246.28 (309.08-1387.84)	1251.0‡	0.215
Iron* (mg)	10.34±2.41 (6.48-16.01)	8.88±2.42 (5.46±17.87)	2420.0‡	0.018
Anthropometric measurements†				
BMI percentile for age	70.27±32.93 (46.97-95.77)	74.74±30.40 (55.40-98.37)	437.0§	0.101
FM (%)	21.78±12.11 (13.12-28.42)	25.37±8.23 (17.75-33.40)	380.0§	0.049

*: mean±SD (min-max), †: mean±SD (Q_1-Q_3),‡: Student T test,§: Mann-Whitney U test, **BIA:** Bioelectric impedance analysis, **BMI:** Body Mass Index, **FM:** Fat Mass

higher than the prevalence reported in a systematic review and meta-analysis of 20 studies, which found a maximum obesity rate of 31.8% (18). Given the potential for outlier effects on weight-related data, the relatively small sample size in this study may contribute to a risk of sampling bias.

Youth with ASD exhibit several behavioral risk factors for obesity, including food selectivity, problematic eating habits, sedentary lifestyles, and sleep disturbances (20). Additionally, the use of antipsychotic medications such as risperidone, aripiprazole, and olanzapine has been associated with increased weight gain and obesity risk (21). The high prevalence of obesity observed in this study may be explained by multiple contributing factors, including antipsychotic medication use (45.7%), lack of regular physical activity (71.4%), and the presence of feeding behavior challenges (37.1%).

Children with ASD frequently avoid nutrient-dense foods, such as legumes and dairy products, instead preferring energy-dense but nutrient-poor options, such as sugary beverages and snack foods (22). In this study, nearly half of the children with ASD refused to eat vegetables, around one-fifth avoided meat, chicken, or fish, and 13.6% rejected olives and dairy products. Additionally, more than half of the children exhibited a persistent preference for snacks. Feeding challenges are commonly observed in children with ASD (3). Furthermore, children with ASD are particularly vulnerable to imbalances in their nutrient intake. These feeding difficulties can exacerbate inadequate nutrition, potentially leading to deficiencies in folic acid, calcium, sodium, potassium, zinc, and vitamins A, B5, B6, C, and D, which may have adverse effects on their development (16).

As indicated in Table III, children with ASD who exhibited feeding behavior challenges had significantly lower intakes of fiber, thiamin, riboflavin, niacin, pantothenic acid, zinc, and iron compared to those without such challenges. These findings are consistent with previous research, which has shown that food selectivity and restrictive eating patterns commonly observed in children with ASD can lead to nutritional deficiencies, particularly in essential vitamins and minerals crucial for growth and development. Furthermore, the results of this study align with earlier studies indicating that children with ASD often have inadequate dietary fiber intake compared to their typically developing peers (23-24). The lower fiber intake is especially concerning, as insufficient fiber consumption has been linked to gastrointestinal issues, which are commonly reported in children with ASD (22). However, the specific impact of feeding behavior challenges on nutrient intake in the ASD population remains insufficiently examined.

Feeding challenges are commonly observed in children with ASD (3). Furthermore, children with ASD are particularly vulnerable to imbalances in their nutrient intake. These feeding difficulties can exacerbate inadequate nutrition, potentially leading to deficiencies in folic acid, calcium, sodium, potassium, zinc, and vitamins A, B5, B6, C, and D, which may have adverse effects on their development (16).

Interestingly, although differences were observed in the intake of specific nutrients, overall energy, macronutrient, and other micronutrient consumption did not differ significantly between children with and without feeding behavior challenges. This suggests that while total energy intake may be similar for children with ASD, the quality and variety of the diet may be insufficient for children with ASD experiencing feeding challenges. These findings emphasize the need for targeted nutritional interventions to improve dietary diversity and address potential nutrient deficiencies in this population.

The results of this study indicate that although there were no statistically significant differences in BMI percentiles between children with ASD based on feeding behavior challenges, children with feeding behavior challenges had a significantly higher mean fat mass (Table III). This finding suggests that BMI percentile alone may not fully reflect differences in body composition within this population. Since BMI primarily measures overall body weight relative to height, it does not distinguish between fat mass and lean mass. Therefore, children with ASD who experience feeding behavior challenges may be at an increased risk of adiposity, despite having similar BMI percentiles to their peers without such challenges.

The clinical implications of these findings underscore the importance of assessing body composition beyond BMI percentile when evaluating nutritional status and obesity risk in children with ASD. Future research should examine the long-term metabolic consequences of increased fat mass in this group and explore targeted nutritional and behavioral interventions to promote healthier body composition outcomes.

This study provides valuable insights into the relationship between feeding behavior challenges, dietary intake, and body composition in children with ASD. The findings suggest that children with ASD who experience feeding difficulties tend to have lower intakes of essential nutrients, such as fiber, B vitamins, zinc, and iron, while also exhibiting higher fat mass despite no significant differences in BMI percentile. These results underscore the importance of assessing not only overall energy and macronutrient intake but also the quality and diversity of the diet in this population.

Study Limitations

This study has several limitations, including its cross-sectional nature and the fact that it was conducted at a single point in time. Moreover, the relatively limited sample size may restrict the applicability of the results to broader populations.

CONCLUSION

The findings highlight the need for targeted nutritional interventions that address both feeding behavior challenges and nutrient deficiencies in children with ASD. Strategies such as sensory-based feeding therapies, gradual exposure to nutrient-dense foods, and personalized dietary guidance may

help improve nutritional intake and overall health outcomes. Future research should further explore the long-term effects of feeding behavior challenges on metabolic health and investigate effective interventions to optimize growth and development in children with ASD.

In addition to direct interventions, it is essential to involve families and caregivers in the process. Educating parents about the importance of varied, nutrient-dense diets and the potential long-term effects of feeding behavior challenges on their child's health could help facilitate more positive mealtime interactions and promote healthier eating habits.

Ethics committee approval
The study was approved by Ankara University Noninvasive Clinic Ethics Committee (date: 22.02.2016, number: 04-132-16).

Contribution of the authors
Study conception and design: SÖ, AU; data collection: SÖ; analysis and interpretation of results: SÖ, AU; draft manuscript preparation: SÖ, AU. All authors reviewed the results and approved the final version of the article.

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The authors declare that there is no conflict of interest.

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