Nutritional Status and Feeding Behavior Problems of Turkish Children with Special Learning Disabilities

Cansu Memiç İnan (dyt.cansumemic@gmail.com)
Ankara University
Ayşe Özfer Özçelik
Ankara University

Research Article

Keywords: Child, feeding behavior problems, specific learning disability, nutrition

Posted Date: June 16th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1739439/v1

Abstract

Background: The most common feeding behavior problems in childhood are refusal to eat, eating too little, choosing food, and inappropriate behavior at mealtimes, and they are more common in children with neurodevelopmental disorders than in children with normal development. Specific Learning Disability (SLD), one of the neurodevelopmental disorders, is defined as educational skills being below what is expected according to chronological age and intelligence level. In this cross-sectional study aims to determine the nutritional behavior problems and nutritional status of children with specific learning difficulties.

Method: Sociodemographic informations, anthropometric measurements and food consumption records of 76 children (38 boys and 38 girls) diagnosed with SLD were obtained by face-to-face interviews and applying a questionnaire. The Behavioral Pediatrics Feeding Assessment Scale was used to determine the feeding behavior problems of children.

Results: The mean age of the children was 9.67±0.19 years. According to the BMI-Z score classification, 2.6% of the children were underweight, 17.1% were overweight and 14.5% were obese. Feeding behavior problems were found in 39.5% of the children. The dietary protein intake of children with feeding behavior problems was found to be significantly lower than those without ($p<0.05$). A negative and significant correlation was found between feeding behavior problems and body weight ($r=-0.406$), BMI ($r=-0.423$), TMI ($r=-0.404$), MUAC ($r=-0.540$), TSFT ($r=-0.395$) and waist circumference ($r=-0.337$) ($p<0.05$).

Conclusions: In conclusion, it was determined that feeding behavior problems are common in children diagnosed with SLD. Childhood eating behavior problems are likely to persist into young adulthood and may have adverse effects on overall health. Therefore, the nutritional status of children with SLD should be evaluated with appropriate screening tests.

Plain English Summary

Eating behavior problems are more common in neurodevelopmental disorders than in healthy children. This study aimed to determine the eating behavior problems and nutritional status of children with specific learning difficulties. Data from the children were obtained with a questionnaire. As a result, eating behavior problems were detected in 39.5% of the children. Eating behavior problems were also found to affect dietary intake and anthropometric measurements.

Introduction

Specific learning disability (SLD) is a neurodevelopmental disorder that can be seen with the interaction of genetic and environmental factors, defined as educational skills being significantly below the expected level according to chronological age and intelligence level. SLD are examined under three groups as dyslexia (reading difficulty), dyscalculia (math learning disability) and dysgraphia (written expression difficulty) [1]. SLD shows comorbidity with many diseases such as attention deficit and hyperactivity

disorder, depression, epilepsy, bipolar disorder and psychosis, negatively affects academic achievement and can severely impair daily living skills [2]. It has been reported that approximately 50.5% of children receiving special education have SLD. The prevalence of learning disabilities in reading, writing and mathematics is reported to be 5%-15% among school-age children in different languages and cultures, 4% in adults, and it is seen two-three times more in boys than in girls [3].

The development of eating behavior is under the influence of many variables such as the reward system, homeostatic mechanisms, and the child's emotional, sensory and motor skill capacity. Additionally, the attitudes and skills of the child's parents or primary caregivers, the social environment and cultural elements of the child are closely related to the development of eating behavior [4]. The most common eating behavior problems in childhood are refusal to eat, eating too little, choosing food, and inappropriate behavior at mealtimes, and the prevalence is 25%-40% in healthy children, while it can increase up to 80% in children with neurodevelopmental disorders [5]. Weak motor skills, lack of coordination, emotional, social and behavioral problems seen in children with SLD may lead to the development of nutritional behavior that may cause malnutrition [6, 7]. However, the appetite-reducing effects of stimulant drugs used for Attention deficit hyperactivity disorder (ADHD) [6, 8], the most common comorbidity in children with SLD, may lead to malnutrition in children.

When the literature is examined, no study has been found that evaluates the nutritional status and investigates feeding behavior in children diagnosed with SLD. It is important to understand children's eating habits and behavior, given the continuation of dietary habits acquired in childhood into adulthood and its role in adult health. This study was planned and conducted in order to determine the feeding behavior problems that may lead to obesity or malnutrition in children diagnosed with SLD, and to determine the nutritional status of children.

Materials And Methods

Participants

This study was conducted with 76 children (38 girls, 38 boys) between the ages of 7 and 12 who were diagnosed with SLD and were educated at the Private Albatros Special Education Center in Ankara. Research data were collected through face-to-face interviews by applying a questionnaire to the participants. Before the questionnaire form was applied, the voluntary consent form at the beginning of the form was approved by the families of the children and the child consent form was completed for the children (over 8 years old). Those who were not diagnosed with SLD, children and families who did not give their consent, those with diabetes, celiac and phenylketonuria, those with diseases that directly affect nutrition, and those with severe central nervous system dysfunction were excluded from the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data collection

Dietary intake

To evaluate the food consumption status, one-day food consumption of the children was taken with the method of remembering 24 h retrospectively. The "Food and Food Photo Catalogue"[9] was used to evaluate the amount of food consumed accurately, and the book "Standard Food Tariffs in Institutions Providing Mass Nutrition" was used to determine the content of ready-made meals or meals consumed outside the home [10]. The food consumption record data were analyzed using the Nutrition Information System (BEBIS) 8 program and the energy and nutrient intakes from the consumed foods were calculated [11].

Anthropometric measurements

As anthropometric measurements, children's body weight (kg), height (cm), circumference measurements [upper middle arm circumference (MUAC, cm), waist circumference (cm) and neck circumference (cm)] and triceps skinfold thickness (TSFT, mm) was measured. A sensitive scale sensitive to 0.1 kg was used to measure the body weight of the children. In the measurement of height performed while on the frankfort plane care was taken to keep the head, hips and heels parallel to the wall, with the feet side by side, and to remove the shoes. Body mass index (BMI, kg/m^2) and tri-ponderal mass index (TMI, kg/m^3) were calculated using body weight and height measurements [12]. Children's BMI values for age were evaluated using the "WHO Anthro Plus Program" [13] with "WHO-2007, reference values for children aged 5–19 years"[14] and classified according to Z-score (SD) cut-off points [15]. In the classification of waist circumference according to percentile values, waist circumference percentile classifications developed by Öztürk et al. [16] for children and adolescents aged 0-18 were used. With the recommendation of the International Diabetes Federation, the 90th percentile cut-off point was taken and those who were at the 90th percentile and above were classified as "obese" and those below the 90th percentile were classified as "normal"[17].

Behavioral pediatrics feeding assessment scale

The Behavioral Pediatric Feeding Assessment Scale (BPFAS), developed by Crist et al. [18] and the Turkish validity and reliability of which was done by Önal et al. [19] was used to determine the nutritional behavior status of children. Necessary permissions were obtained before the scale was applied, and the answers to all questions in the scale were obtained from the parents of the children. In item 25 of the scale, the use of supplements to maintain adequate nutritional status was questioned; Since the majority of the participants stated that they did not use supplements, the factor load of this item was found to be low and it was removed from the scale by taking expert opinions. Since the 25th item of the scale, which was originally 35 items, was not adapted, 34 items were applied. While the first 24 items of the scale contain expressions of children's eating behavior, the other 10 items describe the parents' feelings about their child's nutrition. Statements on the scale were scored between one and five. A score >84 indicates that children have feeding behavior problems. Problem behaviors in children were determined by asking the parent the question, "Is this problem for you," for each of the 34 items in the scale. The number of problems >9 indicates that there are problematic behaviors in children.

Statistical analysis

The data obtained from the study were evaluated with the Statistical Package for Social Sciences (SPSS) package software. Hypothesis tests (Kolmogorov-Smirnov/Shapiro-Wilk tests) were used to determine the conformity of the variables to the normal distribution. Descriptive analysis are given using mean ($\bar{X}$), standard deviation (SD), minimum and maximum values for all variables. In the comparison of variables in independent groups, Mann–Whitney U test was used in case of non-normal distribution, and t-test was used in case of normally distributed independent groups. The Pearson Correlation test was used to determine whether there was a statistically significant relationship between two normally distributed quantitative variables. Binary logistic regression analysis was performed to determine the relationship of eating behavior problems with anthropometric measurements and gender. In all statistical tests, the confidence interval was accepted as 95.0%, and the $p<0.05$ significance level was evaluated [20].

Results

Seventy-six children diagnosed with SLD were included in the study. Sociodemographic and clinical characteristics of the children according to their gender are given in Table 1. The mean age of the children was 9.67 ± 0.19 years (male 9.53 ± 0.24, female 9.79 ± 1.77). It was determined that the majority (94.7%) of the children participating in the study received breast milk. According to the statements of the parents, it was determined that 44.7% of the children had comorbidities and the most common comorbidity was ADHD (79.5%). 81.9% of the children use stimulant drugs, 56.6% of them do physical activity for ≤ 100 minutes/week. When the BMI Z score classifications of the children participating in the study were examined, 2.6% underweight, 17.1% were overweight and 14.5% were obese. 39.5% of children had feeding behavior problems and 17.1% had problematic behavior.

Table 1
Sociodemographic and clinical characteristics of children

Characteristics	Male		Female		Total	
	n	%	n	%	n	%
Age (years)						
X̄±SS	9.53 ± 0.24		9.79 ± 1.77		9.67 ± 0.19	
Breastfeeding status						
Yes	34	89.5	38	100.0	72	94.7
No	4	10.5	-	-	4	5.3
Average duration of breastfeeding (months)						
X̄±SS	13.11 ± 7.71		17.45 ± 6.62		15.40 ± 0.88	
Comorbidities						
Yes	16	42.1	18	47.4	34	44.7
No	22	57.9	20	52.6	42	55.3
Type	(n = 16)		(n = 18)		(n = 34)	
ADHD	14	87.4	13	72.2	27	79.5
Epilepsy	-	-	1	5.6	1	2.9
Bipolar disorder	1	6.3	1	5.6	2	5.9
Asthma	-	-	1	5.6	1	2.9
Diabetes	-	-	2	11.0	2	5.9
Ulcer	1	6.3	-	-	1	2.9
Medication						
Use	16	42.1	17	44.7	33	43.4
Don’t use	22	57.9	21	55.3	43	56.6
Type						
Stimulants	14	87.4	13	76.5	27	81.9
İnsulin	-	-	1	5.9	1	3.0
Antileptic	-	-	1	5.9	1	3.0
Antihistaminic	-	-	1	5.9	1	3.0

X̄: Arithmetic Average, SS: Standard Deviation, a = median value (100) is set as the cutoff point.

Characteristics	Male		Female		Total	
	n	%	n	%	n	%
Antacid	1	6.3	-	5.9	1	3.0
Antipsychotics	1	6.3	1	5.9	2	6.1
Physical Activity (min/week)[a]						
≤ 100 min	20	52.6	23	60.5	43	56.6
> 100 min	18	47.4	15	39.5	33	43.4
BMI Classification						
Underweight	1	2.6	1	2.6	2	2.6
Normal	21	55.3	29	76.3	50	65.8
Overweight	7	18.4	6	15.8	13	17.1
Obese	9	23.7	2	5.3	11	14.5
Waist Circumference						
Normal	28	73.7	33	86.8	61	80.3
Obese	10	26.3	5	13.2	15	19.7
Feeding Behavior Problem						
Yes	13	34.2	17	44.7	30	39.5
No	25	65.8	21	55.3	46	60.5
Problematic Behavior						
Yes	7	18.4	6	15.8	13	17.1
No	31	81.6	32	84.2	63	82.9

$\bar{X}$: Arithmetic Average, SS: Standard Deviation, a = median value (100) is set as the cutoff point.

The findings regarding the eating habits of the children participating in the study are shown in Table 2. It was determined that 60.5% of the children ate three main meals a day and 94.7% consumed snacks. The most consumed foods in snacks are cake/cake/biscuit (70.8%), chocolate/wafer/candy (65.3%), fruit (65.3%), milk and its products (54.2%). It was stated that 78.8% of the children had nutritional problems. The most common nutritional problem is food selectivity (95.0% total, 90.0% for boys, 100.0% for girls). 43.4% of children receive nutritional support and the most commonly used nutritional supplements are omega 3 (63.6%), vitamin D (15.2%) and multivitamins (9.1%).

Table 2
Eating habits of children

Eating habits	Male		Female		Total	
	n	%	n	%	n	%
Number of main meals						
Two	15	39.5	15	39.5	30	39.5
Three	23	60.5	23	60.5	46	60.5
Consumption of snacks						
Yes	35	92.1	37	97.4	72	94.7
No	3	7.9	1	2.6	4	5.3
Foods consumed in snacks+						
Fruits	20	57.1	27	73	47	65.3
Milk and milk products	15	42.9	24	64.9	39	54.2
Cake, cupcake, biscuit	26	74.3	25	67.6	51	70.8
Chocolate, wafer, candy	23	65.7	24	64.9	47	65.3
Instant juices and soda	16	45.7	15	40.5	31	43.1
Nuts	7	20.0	8	21.6	15	20.8
Chips	12	34.3	8	21.6	20	27.8
Nutritional problems						
Yes	30	78.9	30	78.9	60	78.8
No	8	21.1	8	21.1	16	21.2
Type+						
Anorexia	7	23.3	3	10.0	10	16.7
Overeating	5	16.7	-	-	5	8.3
Food selectivity	27	90.0	30	100.0	57	95.0
Nausea and vomiting	2	6.7	1	3.3	3	5.0
Constipation	3	10.0	3	10.0	6	10.0
Nutritional support						

+: More than one answer given

Eating habits	Male		Female		Total	
	n	%	n	%	n	%
Yes	13	34.2	20	52.6	33	43.4
No	25	65.8	18	47.4	43	56.6
Type						
Omega 3	7	53.8	14	70.0	21	63.6
Vitamin D	2	15.4	3	15.0	5	15.2
Multivitamin	3	23.1	-	-	3	9.1
Coconut oil	-	-	2	10.0	2	6.1
Propolis	1	7.7	-	-	1	3.0
Zinc	-	-	1	5.0	1	3.0
+: More than one answer given						

The mean BPFAS score of the children participating in the study was 82.09 ± 14.86 in the total sample, 80.18 ± 15.46 in boys and 84.00 ± 14.19 in girls. The energy and nutrients that the children take with their daily diet according to the feeding behavior problems classification are given in Table 3. The mean protein intake of children with feeding behavior problems was statistically significantly lower than those without feeding behavior problems ($p < 0.05$). Intakes of energy and other nutrients do not show a statistically significant difference between the groups ($p > 0.05$).

Table 3
Dietary intake and anthropometric measurements according to feeding behavior problem

Variables	No feeding behavior problems		Yes feeding behavior problems		p
	($\bar{X}$±SS)	Range	($\bar{X}$±SS)	Range	
Dietary intake					
Energy (kcal)	1159.23 ± 393.82	620.26–2194.22	1087.94 ± 348.32	616.48–1891.63	t = 0.807 p = 0.423
Carbohydrate (g)	115.74 ± 53.43	32.38–252.40	109.84 ± 44.16	33.82–218.26	u = 672.000 p = 0.848
Carbohydrate (%)	41.52 ± 9.51	20.00–61.00	41.73 ± 8.27	28.00–58.00	t=-0.100 p = 0.921
Protein (g)	47.50 ± 21.04	22.60–94.70	38.69 ± 12.79	21.16–94.46	t = 2.24 p = 0.028*
Protein (%)	17.06 ± 5.82	7.00–37.00	16.00 ± 4.57	10.00–27.00	u = 589.000 p = 0.281
Fat (g)	56.05 ± 21.08	22.88–99.28	52.48 ± 17.53	25.42–92.08	u = 650.000 p = 0.671
Fat (%)	41.37 ± 7.03	25.00–54.00	42.27 ± 6.62	31.00–58.00	t=-0.556 p = 0.580
Fiber (g)	10.22 ± 4.91	2.07–23.87	10.31 ± 5.85	3.57–22.05	u = 640.500 p = 0.599
Vitamin A (mcg)	512.57 ± 296.99	159.10–2125.17	566.48 ± 351.58	176.00–1738.47	u = 662.000 p = 0.766
Vitamin E (mg)	5.42 ± 3.58	1.59–15.98	6.08 ± 3.86	1.40–14.22	u = 629.50 p = 0.520
Vitamin C (mg)	51.52 ± 27.77	3.14–123.67	53.81 ± 31.70	5.39–134.37	t=-0.332 p = 0.741
Thiamin (mg)	0.54 ± 0.19	0.23–0.99	0.53 ± 0.22	0.27–1.09	u = 630.000 p = 0.524

[u] Mann–Whitney U Test, [t] Student t-test, * p < 0,05

Variables	No feeding behavior problems		Yes feeding behavior problems		p
	($\bar{X}$±SS)	Range	($\bar{X}$±SS)	Range	
Riboflavin (mg)	1.04 ± 0.33	0.46–1.90	1.03 ± 0.34	0.46–1.67	t = 0.132 p = 0.896
Niacin (mg)	8.32 ± 5.73	2.04–22.74	6.36 ± 4.45	1.65–19.08	u = 552.000 p = 0.143

[u] Mann–Whitney U Test, [t] Student t-test, * p < 0,05

Table 3
(Con.) Dietary intake and anthropometric measurements according to feeding behavior problem

	No feeding behavior problems		Yes feeding behavior problems		p
	(X̄±SS)	Range	(X̄±SS)	Range	
Dietary intake					
Vitamin B_{12} (mcg)	3.38 ± 2.93	0.81–19.23	3.04 ± 1.39	1.13–6.95	u = 657.00 p = 0.726
Calcium (mg)	528.64 ± 18.65	284.68–1210.95	547.61 ± 196.37	236.95–1156.84	t=-0.431 p = 0.668
Iron (mg)	5.97 ± 2.52	2.52–12.80	6.32 ± 3.55	1.49–16.43	u=-0.064 p = 0.949
Zinc (mg)	6.53 ± 3.24	2.97–15.06	6.31 ± 2.97	2.54–12.41	u = 655.000 p = 0.710
Anthropometric measurements					
Height (cm)	139.28 ± 13.95	112.00–174.00	141.17 ± 10.69	119.00–162.00	t=-0.629 p = 0.531
Body weight (kg)	38.49 ± 13.09	21.10–82.00	34.54 ± 9.06	20.40–62.30	u = 580.000 p = 0.242
BMI (kg/m^2)	19.10 ± 3.66	10.35–28.50	16.26 ± 1.68	12.89–19.78	t = 4.48 p < 0.001*
TMI (kg/m^3)	13.94 ± 2.62	6.59–19.79	12.20 ± 2.64	9.41–23.71	u = 303.000 p < 0.001*
MUAC (cm)	21.29 ± 3.86	15.00–28.00	18.72 ± 2.09	15.00–22.00	u = 452.500 p = 0.011*
TSFT (mm)	15.56 ± 6.78	4.00–29.00	12.17 ± 3.25	6.50–18.00	t = 2.923 p = 0.005*
Waist circumference (cm)	65.47 ± 13.28	38.00–92.00	61.25 ± 6.95	48.50–78.00	t = 1.808 p = 0.075

[u] Mann–Whitney U Test, [t] Student t-test, * p < 0,05

	No feeding behavior problems		Yes feeding behavior problems		p
	(X̄±SS)	Range	(X̄±SS)	Range	
Neck circumference (cm)	27.46 ± 4.48	16.50–35.00	27.15 ± 3.12	18.00–31.00	u = 640.500 p = 0.598
[u] Mann–Whitney U Test, [t] Student t-test, * p < 0,05					

Information on the anthropometric measurement values of children according to the feeding behavior problems classification is given in Table 3. While the differences between the measurements of the average height, body weight, waist and neck circumference of the children according to the feeding behavior problem were not statistically significant (p > 0.05); mean BMI, TMI, MUAC and TSFT measurements were found to be statistically significantly lower in children with feeding behavior problems (p < 0.05).

The relationship between the anthropometric measurement values of the children participating in the study and the feeding behavior problems (BPFAS score) is given in Table 4. A negative and significant correlation was found between feeding behavior problems and body weight (r=-0.406), BMI (r=-0.423), TMI (r=-0.404), MUAC (r=-0.540), TSFT (r=-0.395) and waist circumference (r=-0.337) (p < 0. 05).

Table 4
Anthropometric measurements and feeding behavior problems

Anthropometric measurements	Feeding behavior problems (BPFAS scale)	
	r	p
Height (cm)	0.058	0.621
Body weight (kg)	-0.406	<0.001*
BMI (kg/m^2)	-0.423	0.001*
TMI (kg/m^3)	-0.404	<0.001*
MUAC (cm)	-0.540	<0.001*
TSFT (mm)	-0.395	0.003*
Waist circumference (cm)	-0.337	0.003*
Neck circumference (cm)	-0.176	0.134
Partial correlation was used to determine the relationship between variables. Control variables age and sex. *p < 0,05		

Table 5 shows the binary logistic regression analysis of children's feeding behavior problems and some variables. While an increase in children's MUAC reduces feeding behavior problems (OR 0.606, CI 0.427–0.862), an increase in waist circumference increases feeding behavior problems (OR 1.172, CI 1.039–1.323).

Table 5
Factors predicting the likelihood of feeding behavior problem (as predicted by the binary logistic regression model)

Variables	B	OR	95% CI for Odds Ratio	p
MUAC (cm)	-0.500	0.606	0.427–0.862	0.005*
BMI (kg/m^2)	-0.064	0.938	0.764–1.151	0.538
TSFT (mm)	-0.146	0.864	0.713–1.049	0.139
Waist circumference (cm)	0.159	1.172	1.039–1.323	0.010*
Binary logistic regression coefficients (B), odds ratios (OR) and confidence intervals (CI). Adjusted for age, gender, energy intake and physical activity				

Discussion

The sample of this cross-sectional study, which was conducted to determine the nutritional status and feeding behavior of children diagnosed with SLD, consisted of 76 children, 38 boys and 38 girls. Although there are serious difficulties in the diagnostic process due to the lack of SLD diagnosis and screening tools in Turkey, all children diagnosed with SLD start special education and 3% of the children receiving special education are those with SLD [19]. Epidemiological studies on the relationship between SLD prevalence and gender reports that SLD is more common in boys than in girls [22–24]. In the special education center where the data of this study were collected, there are 112 children (boys 63, girls 49) between the ages of 7 and 12 who were diagnosed with SLD.

Breast milk, which is the ideal food for newborns and infants, is considered important for optimal brain development and better neurodevelopmental outcomes [25]. According to the Population and Health Survey conducted in Turkey in 2018, the median breastfeeding period of infants was reported as 16.7 months, while 41.0% of children younger than six months were reported to be exclusively breastfed [26]. It was found that 97.0% of the children with SLD who participated in this study were breastfed and the mean duration of breastfeeding was 15.40 ± 0.88 months.

It was determined that 43.4% of the children participating in this study received nutritional support and the most frequently used nutritional supplement was omega 3 (63.6%) fatty acids. It has been stated that some physical symptoms such as excessive thirst, frequent urination, dry hair and skin, soft and brittle nails may be caused by omega-3 fatty acid deficiency in individuals with dyslexia (80%-90%), which is the most common type of SLD [27]. While these results indicate that omega-3 fatty acid supplementation may have positive effects in individuals with SLD, it was determined in a systematic review study that

omega 3 supplementation did not have any positive effect on reading, writing, spelling, or math skills in individuals with SLD [28].

SLD is not usually seen alone, it shows comorbidity with many diseases. The most common comorbidities include ADHD, conduct disorder, psychosis, epilepsy, anxiety, and depression [29]. When studies evaluating comorbidities in SLD were examined, it was reported that 41.9% ADHD [30], 34.0% attention deficit disorder, 22.0% ADHD [31], 45.1% ADHD [32]. In this study, comorbidity was determined in 44.7% of the children according to the statements of the parents. Comorbidities include ADHD, epilepsy, bipolar disorder, asthma, diabetes, and ulcer, and the most common comorbidity is ADHD (79.5%), consistent with the literature.

Sensory processing problems that can be seen in neurodevelopmental disorders can cause inadequate response to foods, limit the variety of foods consumed and social enjoyment of food. Perceived sensory properties of foods affect food selectivity and rejection in children [33]. In a study, the prevalence of nutritional problems in children aged 3–10 years with neurodevelopmental disorders was determined as 61%, and it was determined that food selectivity, food rejection, anger at meal and loss of appetite were among the common nutritional problems [34]. In this study, it was determined that 78.8% of the children had nutritional problems and the most common ones were food selectivity (95.0%) and anorexia (16.7%).

Feeding behavior problems in children can be seen because of disturbing behavioral problems and changing appetite. This can lead to food selectivity and refusal to try new foods in children, leading to malnutrition [35]. In a study, feeding behavior problems were determined in one-third of children (4–12 years old) with ADHD, and problematic behaviors were determined in 27.8% of them [36]. As in other neurodevelopmental disorders, feeding behavior problems were found in 39.5% of children with SLD in this study. When parents were asked whether the statements about their children's feeding behavior were a problem for them, 17.1% reported that they created a problem. According to the results of this study, it is thought that the high number of feeding behavior problems in children and the appetite-reducing effects of stimulant drugs (81.9%) may pose a risk of malnutrition in children with SLD.

When the energy and nutrient intakes of the children with SLD were examined according to the feeding behavior problems, the average energy, carbohydrate, protein, fat, niacin, B12 and zinc intakes of the children with eating behavior problems were found to be lower than those of the children without feeding behavior problems, but the difference between only protein intake the difference was found to be statistically significant. When these results are evaluated, it is seen that nutritional behavior problems affect children's daily dietary energy and nutrient intakes. These results show that feeding behavior problems affect children's daily dietary energy and nutrient intakes. Considering both the negative effects of stimulant drugs on appetite and feeding behavior problems, appropriate screening tests are recommended to determine the nutritional status of children with SLD.

Although there is no study in the literature that evaluates anthropometric measurements in children with SLD, there are studies on ADHD, which is a comorbidity found in most children. In a study, children between the ages of 6 and 12 diagnosed with ADHD were classified according to their BMI percentile

values, and it was found that 23% of the children were underweight and 25% were overweight. While the rate of the newly diagnosed children was 6.5%, it was found as 41.4% in the group using stimulant drugs [37]. In the study by Kim and Chang [38] with a healthy control group of children diagnosed with ADHD at school age, children with ADHD were 6 cm shorter in height and 1.7 kg lower in body weight, and this difference was found to be statistically significant. Tayşi [39] reported that 50.8% of the children were at normal body weight, 18.5% were overweight and 13.0% were obese, in her study with participants (6–10 years old) diagnosed with ADHD. It was determined that 65.8% of the children included in this study had normal body weight according to the BMI Z score classification. The fact that the majority of children consume three main meals and snacks daily can explain their normal body weight according to BMI classification. Additionally, due to the pandemic, continuing education online and children's meals with their parents may have affected food consumption. However, in this study, it was not questioned how long the children had been using stimulant drugs. If there is a decrease in appetite in children who are new to or have been using stimulant drugs for a short time, this may not have affected anthropometric measurements yet.

In this study, the relationship between children's BMI, TMI, MUAC, TSFT and waist circumference and feeding behavior problems was found to be statistically significant. The lower the body weight, BMI, MUAC, TSFT and waist circumference in children with SLD, the more feeding behavior problems are seen. In a study, a negative correlation was found between body weight, height, BMI, and feeding behavior problems of children aged 4–12 years with ADHD, but this relationship was found to be statistically significant for body weight and BMI ($p < 0.05$) [36].

In the binary logistic regression analysis, it was determined that 1 cm increase in children's MUAC reduced feeding behavior problems by 0.606 times, and 1 cm increase in waist circumference increased eating behavior problems 1.172 times. While the MUAC is a measurement that evaluates the arm muscle and subcutaneous adipose tissue, the waist circumference indicates abdominal fatness [40]. The fact that children with feeding behavior problems consume unhealthier foods (snacks and beverages, etc.), uniform nutrition, and insufficient physical activity may have caused this result. The presence of abdominal obesity in children with SLD indicates that there may be feeding behavior problems. Abdominal obesity in childhood can increase the risk of developing many diseases such as diabetes, dyslipidemia and hypertension in adulthood. For this reason, it is important to evaluate the waist circumference in children with SLD during health checks and to expand nutrition education in schools to prevent or reduce feeding behavior problems.

Conclusions

Feeding behavior, which is a complex concept with its biological and social aspects, can lead to malnutrition by affecting the food intake of children. In this study, feeding behavior problems were found in 39.5% of children diagnosed with SLD. It has been determined that children with feeding behavior problems receive less energy and nutrients with their daily diet. Additionally, it was observed that feeding behavior problems were also reflected in anthropometric measurements. The body mass index,

triponderal mass index, waist circumference, upper middle arm circumference and triceps skinfold thickness of the children with feeding behavior problems were found to be lower than the children without feeding behavior problems.

Childhood feeding behavior problems are likely to continue into young adulthood, and this may have adverse effects on growth, development and mental functions. Therefore, the nutritional status of children diagnosed with SLD should be evaluated with appropriate screening tests. In addition to special education programs and medical treatments, it is important to include nutritional therapy by dietitians specialized in this field, to ensure that children gain life-long healthy eating habits.

Strengths And Limitations

This study has some limitations. First of all, there is no control group in the study. Retrieval of study data during a period of restrictions due to the COVID-19 pandemic may have affected the nutritional status and physical activity levels of the participants. Additionally, the 24-hour food consumption of the participants was recorded according to the statements of themselves (over 8 years old) and their parents. Therefore, possible participant bias should be taken into account for the interpretation of the results. The children's parents' eating habits and nutritional environment were not evaluated. Finally, the cross-sectional nature of the study limits the establishment of causal relationships between the variables. This study should be repeated by increasing the number of samples in a wider age range and adding the control group.

Abbreviations

SLD: Specific learning disability; ADHD: *Attention deficit hyperactivity disorder; MUAC:* Upper middle arm circumference; TSFT: triceps skinfold thickness; BMI: Body mass index; TMI: tri-ponderal mass index; BPFAS: Behavioral Pediatric Feeding Assessment Scale

Declarations

Acknowledgements

The authors are grateful to the staff of Albatros special education center and the children and their parents who agreed to participate in the study.

Author contributions

CMI planned the study, collected data from patients and performed the statistical analysis, and authored the study. AOO read and revised the article. All the authors read and approved the final manuscript

Funding

No funding support was received for the study.

Availability of data and materials

The data set created and analyzed during this study can be obtained from the corresponding author upon request.

Ethics approval and consent to participate

After obtaining permission from the Private Albatros Special Education Center Directorate to conduct the research, approval was obtained from the Ankara University Ethics Committee on 31.11.2020. Participants were recruited into the study on a voluntary basis.

Consent for publication

All authors agree to publish this manuscript.

Competing interests

The authors declare no conflicts of interest.

References

1. Ghislanzoni L, Tobia V, Gambarini A, Rossi E, Tombini G, Ogliari A. The psychopathological profile of children with specific learning disorders: the point of view of children and their mothers. Eur J Spec Needs Educ. 2022;37:89–103.
2. Willcutt EG, McGrath LM, Pennington BF, Keenan JM, DeFries JC, Olson RK, et al. Understanding comorbidity between specific learning disabilities. New Dir Child Adolesc Dev. 2019;165:91–109.
3. APA (2013) Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM 5). Washington, DC, American Psychiatric Association.
4. Scaglioni S, Arrizza C, Vecchi F, Tedeschi S. Determinants of children's eating behavior. Am J Clin Nutr. 2011;94:2006–2011.
5. Schreck KA, Williams K, Smith AF. A comparison of eating behaviors between children with and without autism. J Autism Dev Disord. 2004;34:433–438.
6. Kirk SA, Gallagher J, Coleman MR. Özel gereksinimli çocukların eğitimi. Nobel Akademik Yayıncılık, 2017.
7. Salman U, Özdemir S, Salman AB, Özdemir F. Özel öğrenme güçlüğü "Disleksi". İstanbul Bilim Üniversitesi Florence Nightingale Tıp Dergisi. 2016;2:170–176.
8. Davis C, Fattore L, Kaplan As, Carter Jc, Levitan Rd, Kennedy Jl. The suppression of appetite and food consumption by methylphenidate: the moderating effects of gender and weight status in healthy adults. IJNP. 2012;15:181–187.
9. Rakicioğlu N, Acar Tek N, Ayaz A, Pekcan G. Yemek ve besin fotoğraf kataloğu. Ankara, Hatiboğlu Yayınevı, 2012.

10. Merdol T. Standart Yemek Tarifeleri. 3. Baskı. Ankara: Hatipoğlu Yayınevi, 2003.
11. Beslenme Bilgi Sistemi (BEBIS) (2017). Bilgisayar Paket Programı. [Program]. Pasifik Company.
12. Gibson RS (2005). Principles of nutritional assessment. Oxford University Press, 2nd Edition. New York. p., 324–328.
13. WHO (2009). AnthroPlus for personal computers Manual: Software for assessing growth of the world's children and adolescents. Erişim Adresi: https://www.who.int/growthref/tools/who_anthroplus_manual.pdf?ua=1. Erişim Tarihi: 28.09.2020.
14. WHO (2007). Growth reference data for 5–19 years. Erişim Adresi: . Erişim Tarihi: 28.09.2020
15. WHO (2008). Training Course on Child Growth Assesment. Erişim Adresi: https://www.who.int/childgrowth/training/module_a_introduction.pdf?ua=1. Erişim Tarihi: 28.09.2020.
16. Öztürk, A., Borlu, A., Çiçek, B., Altunay, C., Ünalan, D., Horoz, D., … enol, V. (2011).0–18 yaş çocuk ve adolesanlarda büyüme eğrileri. Türkiye Aile Hekimliği Dergisi, 15(3), 112–129.
17. Zimmet P, Alberti K George Mm, Kaufman F, Tajima N, Silink M, Arslanian S, Wong G, Bennett P, Shaw J, Caprio S, Idf Consensus Group. The metabolic syndrome in children and adolescents – an IDF consensus report. Pediatr Diabetes. 2007;(8):299–306.
18. Crist W, Napier-Phillips A. Mealtime behaviors of young children: A comparison of normative and clinical data. J Dev Behav Pediatr. 2001;22:279–286.
19. Önal S, Var EÇ, Uçar A. Davranışsal Pediatrik Besleme Değerlendirmesi Ölçeği (DPBDÖ)'ni Türkçe'ye Uyarlama Çalışması. Nevşehir Bilim ve Teknoloji Dergisi. 2017;6: 93–101.
20. Sümbüloğlu K, Sümbüloğlu V (2009). Biyoistatistik. Hatiboğlu yayınevi. Baskı 13. Ankara.
21. Balikci OS, Melekoglu MA. Early signs of specific learning disabilities in early childhood. International Journal of Early Childhood Special Education, 2020;12: 84–95.
22. Bilaç Ö, Tahillioğlu HA, Önder A, Kavurma C (2021). Özgül Öğrenme Güçlüğünde Enflamasyonun Rolünün Değerlendirilmesi. Turk J Child Adolesc Ment Health. 2021;28(1): 60–64.
23. Rutter M, Caspi A, Fergusson D, Horwood Lj, Goodman R, Maughan B, et al. Sex differences in developmental reading disability: new findings from 4 epidemiological studies. Jama. 2004;291: 2007–2012.
24. Sinir GE (2020). Özel öğrenme güçlüğü tanısı almış ve almamış öğrencilerin Problem çözme, Dikkat Becerileri ve yönetici işlevlerinin karşılaştırılması. Doktora Tezi. Marmara Üniversitesi, İstanbul.
25. Nogay NH. Beslenmenin beyin gelişimi üzerindeki etkisi. Ejovoc. 2012;2(2): 42–45.
26. Türkiye Nüfus ve Sağlik Araştirmasi (2019). Hacettepe Üniversitesi Nüfus Etütleri Enstitüsü, Ankara, Türkiye. Erişim Adresi: http://www.hips.hacettepe.edu.tr/tnsa2018/rapor/TNSA2018_ana_Rapor.pdf Erişim Tarihi: 15.02.2021
27. Cyhlarova E, Bell JG, Dick JR, Mackinlay EE, Stein JF, Richardson AJ. Membrane fatty acids, reading and spelling in dyslexic and non-dyslexic adults. Eur Neuropsychopharmacoly. 2007;17: 116–121.

28. Tan ML, Ho JJ, Teh KH. Polyunsaturated fatty acids for children with specific learning disorders. Cochrane Database Syst Rev. 2016;9:1–44.
29. Willcutt EG, Mcgrath LM, Pennington BF, Keenan JM, Defries JC, Olson RK, et al. Understanding comorbidity between specific learning disabilities. New Dir Child Adolesc Dev. 2019;165: 91–109.
30. Bandla S, Mandadi GD, Bhogaraju A. Specific learning disabilities and psychiatric comorbidities in school children in South India. Indian J Psychol Med. 2017;39: 76–82.
31. Sahu A, Patil V, Sagar R, Bhargava R. Psychiatric comorbidities in children with specific learning disorder-mixed type: A cross-sectional study. J Neurosci Rural Pract. 2019;10: 617–622.
32. Dupaul GH, Gormley MJ, Laracy SD. Comorbidity of LD and ADHD: Implications of DSM-5 for assessment and treatment. J Learn Disabil. 2013;46: 43–51.
33. Smith B, Rogers SL, Blisett J, Ludlow AK (2020). The relationship between sensory sensitivity, food fussiness and food preferences in children with neurodevelopmental disorders. Appetite. 2020;150: 104643.
34. Crasta JE, Benjamin TE, Suresh APC, Alwinesh MTJ, Kanniappan G, Padankatti SM, et al. Feeding Problems Among Children with Autism in a Clinical Population in India. Indian J Pediatr. 2014; 81:169–172.
35. Kerzner B, Milano K, Maclean W, Berall G, Stuart S, Chatoor I. Practical approach to classifying and managing feding difficulties. Pediatrics. 2015;135: 344–353.
36. Sha'ari N, Manaf ZA, Ahmad M, Rahman FNA. Nutritional status and feeding problems in pediatric attention deficit–hyperactivity disorder. Pediatr Int. 2017;59: 408–415.
37. Caferoğlu Z, Özel HG, Hamidi F, Ertürk G. Dikkat eksikliği hiperaktivite bozukluğu tanısı olan çocuklarda ilaç tedavisinin beslenme durumu üzerine etkileri. Beslenme ve Diyet Dergisi. 2014;42: 99–107.
38. Kim Y, Chang H (2011). Correlation between attention deficit hyperactivity disorder and sugar consumption, quality of diet, and dietary behavior in school children. Nutr Res Pract. 2011;5: 236–245.
39. Tayşi S (2018).Gaziantep İlinde Dikkat Eksikliği Ve Hiperaktivite Bozukluğu Olan 3–18 Yaş Grubu Çocukların Beslenme Durumlarının ve E-110 (Sunset Yellow) Katkı Maddesi Bulunan Besinlerin Tüketim Miktarlarının Saptanması. Yüksek Lisans Tezi. Hasan Kalyoncu Üniversitesi, Gaziantep.
40. Moore LL, Singer MR, Qureshi MM, Bradlee ML. Dairy intake and anthropometric measures of body fat among children and adolescents in NHANES. J Am Coll Nutr. 2008;27(6):702–710.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- GraphicalAbstract.docx