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Evaluation of Nutritional Status of Children with Autism Spectrum Disorder Receiving Daytime Rehabilitation

Gündüzlü Rehabilitasyon Gören Otizm Spektrum Bozukluğu Olan Çocukların Beslenme Durumlarının Değerlendirilmesi

Ayşe Hümeyra İSLAMOĞLU[1], Güleren SABUNCULAR[1], Zehra Margot ÇELİK[1], Şule AKTAÇ[1], Fatma Esra GÜNEŞ[2]

[1] Marmara Üniversitesi, Sağlık Bilimleri Fakültesi, Beslenme ve Diyetetik Bölümü, İstanbul, Türkiye
[2] İstanbul Medeniyet Üniversitesi, Sağlık Bilimleri Fakültesi, Beslenme ve Diyetetik Bölümü, İstanbul, Türkiye

Sorumlu Yazar: Ayşe Hümeyra İSLAMOĞLU
E-mail: humeyra.bicer@gmail.com
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ABSTRACT

Objective: The aim of this study was to evaluate the nutritional status, eating habits and behavior of children with autism spectrum disorder.

Methods: This observational study included 109 individuals from Istanbul diagnosed with autism spectrum disorder aged 3-18 years; the patients were receiving daytime rehabilitation. A questionnaire including socio-demographic characteristics, nutritional behavior and eating habits of participants was applied by face-to-face interview method, anthropometric measurements (body weight and height) and food consumption records were taken, using a 24-hour dietary recall taken by the researchers.

Results: Of all, 66.1% (n=72) of the participants were male. It was determined that 16.2% (n=6) of the female participants were overweight and 27.0% (n=10) were obese, while 33.3% (n=24) of the male participants were overweight and 29.2% (n=21) were obese. The rate of food selectivity was found to be 59.6%; 28.4% of the participants received additional support during mealtimes, 13.8% followed various special diets, including gluten-free and casein-free diets. Most of the participants' energy intake (60.6%), vitamin D (100.0%) and calcium (71.6%) were below reference values. The majority of the participants' vitamin A (92.7%) and sodium (92.7%) intakes were above the recommended values.

Conclusion: The findings of the study reveal that children and adolescents with autism spectrum disorder have high rates of obesity and food selectivity. The need for additional support at mealtimes, and the inadequate or excessive intake of nutrients are among other nutrition-related problems faced by this population.

Keywords: Nutrition, children, autism spectrum disorder

ÖZ

Amaç: Bu çalışmada, otizm spektrum bozukluğu olan çocukların beslenme durumlarının, yeme alışkanlıklarının ve davranışlarının değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntem: Bu gözlemsel çalışmaya İstanbul'da gündüzlü rehabilitasyon gören, 3-18 yaş arası, otizm spektrum bozukluğu olan 109 birey dahil edilmiştir. Katılımcılara yüz yüze görüşme metoduyla sosyo-demografik özellikleri, beslenme davranışları ve yemek yeme alışkanlıklarını içeren bir anket uygulanmış, antropometrik ölçümleri (vücut ağırlığı ve boy uzunluğu) ve 24 saatlik hatırlatma yöntemi ile besin tüketim kayıtları araştırmacılar tarafından alınmıştır.

Bulgular: Yüz dokuz katılımcının %66,1 (n=72)'inin erkek olduğu saptanmıştır. Kızların %16,2 (n=6)'sinin hafif şişman, %27,0 (n=10)'sinin obez olduğu, erkek katılımcıların ise %33,3 (n=24)'ünün hafif şişman ve %29,2 (n=21)'sinin obez olduğu belirlenmiştir. Katılımcılarda, besin seçicilik oranı %59,6 olarak bulunmuş ve katılımcıların %28,4'ü öğün zamanlarında ek destek aldığı, %13,8'i glütensiz ve kazeinsiz diyet de dahil olmak üzere çeşitli özel diyetler uyguladığı belirlenmiştir. Katılımcıların çoğunun enerji (%60,6), D vitamini (%100,0) ve kalsiyum (%71,6) alımları referans değerlerin altında; A vitamini (%92,7) ve sodyum (%92,7) alımları önerilen değerlerin üzerinde bulunmuştur. Sonuç: Çalışmanın bulguları, Otizm Spektrum Bozukluğu olan çocuk ve adölesanlarda yüksek oranda obezite ve besin seçiciliği olduğunu ortaya koymaktadır. Öğün zamanlarında ek desteğe ihtiyaç duyulması, yetersiz veya fazla besin ögesi alımı, bu popülasyonun karşılaştığı diğer beslenme ile ilintili sorunlar arasındadır.

Anahtar Kelimeler: Beslenme, çocuk, otizm spektrum bozukluğu

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1. INTRODUCTION

Autism spectrum disorder (ASD) is a lifelong neurodevelopmental disorder that can generally be diagnosed before the age of three. According to the Diagnostic and Statistical Manual of Mental Disorders 5 (DSM-5), some criteria have been determined for a person to be diagnosed with ASD. Examples of these criteria include deficits in social communication and interaction, persistent behavior in monotonous tasks, stereotyped and repetitive motor movements, excessive perception of sensory stimuli, overly rigid constancy in one's interests, and social and sensory contrasts (APA, 2013). In March 2023, the Centers for Disease Control and Prevention (CDC) proclaimed that according to the Autism and Developmental Disabilities Monitoring Network, the prevalence of ASD was at a rate of 1/36 (CDC, 2023).

There are medical, nutritional and behavioral contextual factors that affect the nutritional status of individuals with ASD. There are three main subcategories of behavioral contextual factors; problem eating behaviors, sensory processing difficulties, and family factors. The most frequent problematical eating behaviors include food selectivity, food refusal and sometimes overeating, chewing difficulty and eating inedible substances (Özeren, 2013). In the literature, there are significant differences in the incidence of these eating problems and food selectivity in this population (Gilger & Redel, 2009).

When the metabolic and nutritional status of individuals with ASD were compared with neurotypical individuals, many differences were found between the two groups (Adams et al., 2011). It is stated that children with ASD are more prone to being overweight and obese between the ages of 2-5 and being underweight between the ages of 5-11. It is also emphasized that among individuals with ASD obesity increases after childhood (Li et al., 2020).

The incidence of gastrointestinal system (GIS) symptoms in individuals with ASD has been reported as between 9-70%, and common GIS problems include chronic diarrhea, chronic abdominal pain, gastroesophageal reflux disease (GERD), and constipation (Buie et al., 2010). Some types of medications used in individuals with ASD, including antiepileptic agents, stimulants, and atypical antipsychotic medications may have side effects that can affect nutrition (i.e., increasing appetite or malabsorption of some specific nutrients) (West et al., 2009). Furthermore, it has been emphasized that there is insufficient (suboptimal) nutritional intake in children with ASD, and attention should be paid especially to bone health, focusing on calcium and vitamin D (Hyman et al., 2012; Geraghty et al., 2010). Nutritional deficiencies in ASD are thought to be related to inadequate digestion and absorption of nutrients caused by GIS problems, anomalies in metabolic utilization of nutrients, elimination diets and eating problems. Nutrient deficiencies can be associated with food selectivity if one of the food groups is completely skipped or food variety decreases (Kirby & Danner, 2009).

In this study, it was aimed to evaluate the nutritional status of children with ASD who received daytime rehabilitation, as well as to investigate eating problems in these individuals and to determine the effects of these problems on their nutritional status.

2. MATERIALS AND METHODS

2.1. Study Design and Participants

This observational cross-sectional study was conducted with volunteer parents/caregivers of children with autism spectrum disorder (ASD) who received daytime rehabilitation in Istanbul.

This study was conducted between February and June 2018. Four daytime rehabilitation centers located on the Anatolian side of Istanbul were selected randomly. The study population was 152 children receiving outpatient treatment in the four rehabilitation centers. The sample size was calculated using the Epi Info program. In this calculation, the sample size was determined as n=109 when the frequency of the event was taken as 50%, the level of error as 5%, the pattern effect as 1, and the 95% confidence interval. A total of 115 children with ASD between the ages of 3-18 were invited to the study and the study was completed with 109 children. The children whose anthropometric measurements could not be taken (n=4) or who had problems with oral intake (n=2) were excluded from the study. Ethical approval for the study was obtained from the Clinical Research Ethics Committee of Marmara University Faculty of Medicine, decision number 09.2017.045 on 06.01.2017. Prior to the application of the questionnaire and measurements, written consent was obtained from the legal guardians of the participants with a voluntary information form.

2.2. Data Collection

Anthropometric measurements of the participants were measured by researchers in the presence of parents/caregivers and educators working in rehabilitation centers. Body Mass Index (BMI) was calculated with the formula "body weight (kg)/height (m)²".

The 24-hour dietary recalls were taken from the parents/caregivers of participants. The amount of ingredients included in the meals were calculated by using the "Standard Recipes" book, and the measurement amounts were calculated using the "Food Photo Catalog" book.

Socio-demographic information, nutritional behavior and eating habits of the participants were investigated with the face-to-face interview method.

2.3. Data Analyses

World Health Organization – Multicenter Growth Reference Study (WHO-MGRS) Growth Curves were used for children aged 0-5 (WHO, 2007; WHO, 2006). Body weight for age,

height for age and body mass index for age were evaluated according to Z-scores for children aged 5-19 years, using the AnthroPlus Computer program, based on the reference values created by WHO in 2007 (WHO, 2023).

The food consumption records obtained were analyzed using the "Nutrition Information Systems Package Program (BeBiS) Version 7.0" (EBISpro, 2023). The intake of energy, macronutrients and micronutrients of the participants were analyzed and compared to the Estimated Average Requirement (EAR) and Adequate Intake (AI) values for the Turkish population (TÜBER, 2019). The food consumption of each participant was calculated according to the reference values of their age groups. Macro – and micronutrients that are frequently inadequate or over-intake in children with ASD were evaluated (Bicer & Alsaffar, 2016). Percentages of children with inadequate and excess intakes of energy and macro – and micronutrients were calculated in comparison with EAR/AI reference values.

All data were evaluated by using the "SPSS 21.0 Computer Package Program". The distribution of data is expressed as numbers (n) and percentages (%).

3. RESULTS

One hundred and nine children aged between 3 and18 participated in the present study. Of these, 66.1% (n=72) of the participants were male. Table 1 presents the distribution of BMI classifications of participants by gender. Of all the male participants, 33.3% (n=24) were overweight, and 29.2% (n=21) were obese. In female participants, 46.0% (n=17) were in the normal range of BMI, and 27.0% (n=10) were obese.

Table 1. *BMI classification by gender*

BMI Classification	Male (n=72)		Female (n=37)	
	n	%	n	%
Underweight	2	2.8	4	10.8
Normal	25	34.7	17	46.0
Overweight	24	33.3	6	16.2
Obese	21	29.2	10	27.0

BMI: Body Mass Index

The eating and mealtime behaviors of the participants are given in Table 2. It was stated that out of 15 (13.8%) children followed a special diet; 8 followed a gluten-free and casein-free diet, 3 a diabetic diet, one DASH diet, one a low-cholesterol diet, one a lactose-free diet, and one a protein-based diet (not shown in the table).

The frequency of participants' energy and nutrient intakes being below or above the EAR/AI values according to the recommended values for their age is given in Figure 1. It was found that the majority of the participants' energy (60.6%), fiber (51.4%), vitamin D (100.0%) and calcium (71.6%) intakes were below the EAR/AI values. The vitamin A (92.7%) and sodium (92.7%) intakes of most of the participants were above the EAR/AI reference values.

Table 2. *Eating and mealtime behaviors*

Variables		n	%
Food selectivity	Yes	65	59.6
	No	44	40.4
Eating place	Table	83	76.1
	In front of TV	10	9.2
	Couch	6	5.5
	Standing	5	4.6
	Wandering around	5	4.6
Eating with	Alone	19	17.4
	Family	77	70.6
	Friends	3	2.8
	Caregiver	10	9.2
Getting additional support	Yes	31	28.4
	No	78	71.6
Special Diet	Yes	15	13.8
	No	94	86.2

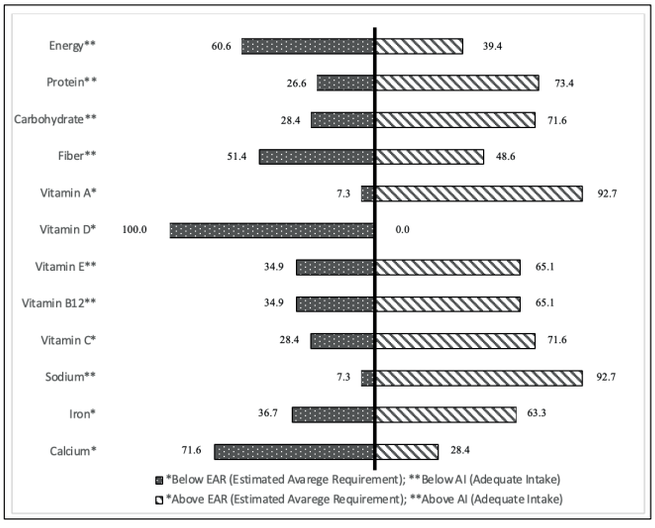

Figure 1. *Energy and nutrient intakes below or above the EAR/AI (%)*

4. DISCUSSION

In this study, which aimed to evaluate the nutritional status of individuals with ASD who were receiving daytime rehabilitation, the rate of overweight and obese participants was found to be high; 59.6% of them had food selectivity, and most of the participants' energy, fiber, vitamin D, and calcium intakes were found to be below the recommended values.

According to a CDC press release in March 2023, ASD is nearly four times higher in boys than girls (CDC, 2023). In the study by Shmaya et al., with 91 individuals, 80.4% of the participants were male (Shmaya et al., 2017). Similarly, the rate of male participants was found to be higher (66.1%) in this study.

Recent studies have reported that psychiatric disorders such as attention-deficit/hyperactivity disorder and ASD in children may be related to obesity and being overweight (Kummer et al., 2016). A meta-analysis compiling 15 studies with a total

of 1,045,538 ASD cases showed that obesity, not overweight, was associated with ASD (Zheng et al., 2017). According to the study by Egan and colleagues, 17.16% of 273 children with ASD were overweight and 21.89% were obese (Egan et al., 2013). In a study conducted with 51 children with ASD, it was found that 44.9% of the children were within the normal BMI range and 16.8% were obese (Molina – López et al., 2021). In the study of Bicer & Alsaffar, 32.3% of individuals with ASD were found to be obese (Bicer & Alsaffar, 2013). Considering the general population in Turkey, 17.9% of children aged 0-5 are overweight and 8.5% are obese; 14.3% of children aged 6-18 years are overweight and 8.2% are obese; and in the 18-30 age group 26.9% are overweight and 10.2% are obese (TBSA, 2014). In this study, it was determined that 16.2% of female participants were overweight, 27% were obese and 33.3% of male participants were overweight, 29.2% of them were found to be obese. These results show that, in parallel with the literature, the rates of being overweight and obesity are higher in individuals with ASD than in the general population.

Studies have reported the prevalence of mealtime eating problems in individuals with ASD as being between 43.6% and 96% (Mayes & Zickgraf, 2019; Gray et al., 2018; Seiverling et al., 2018), and the most frequently seen eating problem was food selectivity. For instance, in the study of Cornish et al., it was stated that 70% of children with ASD have food selectivity (Cornish, 1998); in a more recent study, this rate was found to be 72% (Schreck & Williams, 2006). In the study conducted by Williams et al., 67% of parents stated that they faced the problem of food selectivity. In addition, the factors affecting this selectivity were texture (69%), appearance (58%), taste (45%), smell (36%), and temperature (22%). Moreover, it has been emphasized that individuals with ASD have a small repertoire of foods (60%) (Williams et al., 2000). In the study of Schreck et al., it was also stated that 57% of individuals with ASD exhibited food refusal (Schreck & Williams, 2006). In the current study, similar to these studies, it was found that 59.6% of participants exhibited food selectivity.

Among other atypical eating behaviors, it has been shown that individuals with ASD have difficulty sitting at the table until mealtime is over (Gray et al., 2018; Attlee et al., 2015). In the current study, 76.1% of participants sat at the table until the end of mealtime, whereas 4.6% stood and 4.6% wandered around during mealtimes. In a study, mothers who have children with ASD emphasized that it was difficult to eat together as a family at mealtimes and important for their children to eat with at least one family member (Ausderau & Juarez, 2013). It was also emphasized that individuals with ASD needed additional support at mealtimes (Marquenie et al., 2011; Williams & Seiverling, 2010). In the current study, the rate of participants who ate alone was 17.4%, and of all, 28.4% of the participants received help during mealtimes. These results show similarities with previous studies.

Although the gluten-free and casein-free (GFCF) diet does not cause a significant improvement in ASD symptoms or ASD-related nutritional or eating problems, it is the most studied diet in the literature and is the most preferred one by families of individuals with ASD (Cornish, 2002). In the current study, it was found that 7.3% of participants followed the GFCF diet.

Food selectivity that restricts food consumption is common in individuals with ASD, and this may lead to nutrient deficiencies (Esteban-Figuerola et al., 2019). Many studies have reported various nutrient deficiencies in individuals with ASD (Molina – López et al., 2021; Esteban-Figuerola et al., 2019; Stewart et al., 2015; Hyman et al., 2012). In a study with 288 children with ASD between the ages of 2 and 11 it was stated that more than 40% of children were at risk of insufficient intake of vitamins D and E, calcium, choline, potassium, and pantothenic acid (Stewart et al., 2015). In another study with a control group paired with ASD, children with ASD consumed fewer calories, vitamins A and C, and zinc; the majority met the recommended reference values for vitamins K and E. Certain age groups consume excessive amounts of sodium, folate, manganese, zinc, vitamin A, selenium, and copper (Hyman et al., 2012). In another case-control study, a greater percentage of children with ASD were below the RDA for energy and fiber intake (for energy, ASD group: 34.9% and control group: 15.3%; for fiber, ASD group: 37.2% and control group: 8.5%). Although no significant difference was observed between the groups in terms of vitamin and mineral intakes, more children with ASD showed greater deficiencies in vitamins such as vitamin B2 and retinol, and minerals such as calcium, magnesium, iron, selenium, and iodine (Molina – López et al., 2021). A meta-analysis stated that children with ASD consumed less protein, calcium, phosphorus, selenium, vitamin D, thiamine, riboflavin, and vitamin B12 and more polyunsaturated fatty acids and vitamin E than the control group (Esteban-Figuerola et al., 2019). Contrary to the results of those studies that found insufficient calcium intake in children with ASD, Plaza-Diaz et al. found that approximately 79% of children with ASD had adequate calcium intake, which was a higher rate than neurotypical children (Plaza-Diaz et al., 2021). In this study, especially energy, vitamin D, and calcium intake were found to be below the recommended values in most children with ASD. The results of different studies on nutrient intakes are affected by many environmental and cultural factors. Different results in the literature may differ depending on conditions such as special diet applications and food selectivity in the sampled participants.

Limitations of this study include the participants being from one city of Turkey, which makes it difficult to represent the whole population, and not having a control group to compare. Moreover, taking 24-hour dietary recalls may not be representative for their general nutritional intakes, but individuals with ASD have a routine eating pattern so it is thought that 24-hour dietary recalls might actually represent their daily nutrient intakes. In addition to their anthropometric measurements and food records, mealtime behaviors of participants were also assessed; this is a strength of this study.

5. CONCLUSION

In conclusion, most of the participants were overweight or obese, and had a high rate of food selectivity, one of the major eating problems of this population. Some of the participants received additional support during mealtimes and followed a specific diet (i.e., gluten-free and casein-free diet). Fiber, calcium and vitamin D intakes were some of the nutrients which were below the recommended values as well as energy intakes. Further research with a wider sample size is needed to explore additional factors contributing to nutritional challenges and eating problems faced by this population.

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