

The association between maternal features and nutritional problems in children with autism spectrum disorder

Associação entre características maternas e problemas nutricionais em crianças com transtorno do espectro do autismo

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ABSTRACT

Objective

In the literature, there is almost no data on the relationship between autistic children's nutritional problems and their mothers' demographic and nutritional characteristics. Therefore, this study aimed to evaluate whether there was a relationship between maternal features and nutritional problems in autistic children.

Methods

This study was conducted with the participation of 58 autistic children (6-19 years) and their mothers. Descriptive data were obtained with a general questionnaire. For the evaluation of children's nutritional status, anthropometric measurements and 24-hour dietary recall were used. Also, the Brief Autism Mealtime Behavior Inventory and ORTO-15 questionnaires were used to evaluate the meal behavior of children and orthorexia tendency of mothers, respectively.

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Results

No significant correlation was found between the Brief Autism Mealtime Behavior Inventory scores in children of mothers with high and low orthorexia tendency. There were also no statistically significant differences between the children of mothers with high and low educational level in terms of Brief Autism Mealtime Behavior Inventory scores. Only the dietary vitamin B6 intake was significantly higher in the children of mothers with high educational level. Maternal age was associated with the dietary energy and protein intake, unlike, maternal orthorexia tendency was not associated with the nutritional status and meal behavior of children. The abdominal pain experience in the last one month was found to be significantly higher in the children of employed mothers than children of unemployed mothers.

Conclusion

It is thought that the maternal characteristics are not effective on meal behavior in children and also maternal age and educational status have a very limited effect on the nutritional status of children.

Keywords: Autism. Maternal educational status. Maternal nutrition. Mealtime.

RESUMO

Objetivo

Na literatura, quase não existem dados sobre a relação entre os problemas nutricionais de crianças autistas e as características demográficas e nutricionais de suas mães. Portanto, este estudo teve como objetivo avaliar se havia relação entre características maternas e problemas nutricionais em crianças autistas.

Métodos

Este estudo foi realizado com a participação de 58 crianças autistas (6-19 anos) e suas mães. Os dados descritivos foram obtidos em questionário geral. Para a avaliação do estado nutricional das crianças, medidas antropométricas e rec24h foram utilizados. Além disso, os questionários Brief Autism Mealtime Behavior Inventory e ORTO-15 foram utilizados para avaliar o comportamento alimentar das crianças e a tendência à ortorexia das mães, respectivamente.

Resultados

Não foi encontrada correlação significativa entre os escores do Brief Autism Mealtime Behavior Inventory nos filhos de mães com alta e baixa tendência à ortorexia. Também não houve diferenças estatisticamente significativas entre os filhos de mães com nível educacional alto e baixo em termos de pontuação no Brief Autism Mealtime Behavior Inventory. Somente a ingestão alimentar de vitamina B6 foi significativamente maior nos filhos de mães com alto nível educacional. A idade materna foi associada à ingestão energética e proteica, diferentemente da tendência à ortorexia materna, não associada ao estado nutricional e ao comportamento das refeições. A experiência de dor abdominal no último mês foi significativamente maior nos filhos de mães que trabalham do que nos filhos de mães que não trabalham.

Conclusão

Acredita-se que as características maternas não influenciam o comportamento alimentar das crianças e também que a idade e o estado educacional da mãe têm um efeito muito limitado no estado nutricional das crianças.

Palavras-chave: Autismo. Nível educacional materno. Nutrição materna. Hora das refeições.

INTRODUCTION

Autism Spectrum Disorder (ASD) is the name of a group of neurodevelopmental disorders with a complex multifactorial etiology. ASD is characterised by persistent abnormal social interactions (e.g., obvious impairment in eye-to-eye gaze, lack of joint attention) and restricted repetitive and stereotyped patterns of behavior, interests, and activities which start in very early life [1]. ASD becomes apparent before the 24th month of age and persists into adulthood, causing lifelong disability [2,3]. There are three distinct groups of ASD identified in the Diagnostic and Statistical Manual of Mental

Disorders (DSM-IV-TR); autistic disorder, Asperger syndrome and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) [4]. This classification is reviewed in the new edition published in 2013 Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [1]. The incidence of ASD is dramatically increasing year by year and about one child to 59 has been identified with ASD according to estimates from Centers for Disease Control and Prevention's (CDC) Autism and Developmental Disabilities Monitoring (ADDM) Network [5]. ASD is reported to occur in all racial, ethnic, and socioeconomic groups and it is almost five times more common among boys than girls [6-8].

The majority of children with ASD has been found to present comorbid nutrition problems, especially some mealtime issues [9]. Generally, these problems tended to separate to three categories: (1) food selectivity based on type and texture, (2) food refusal, and (3) disruptive mealtime behaviors. Collectively, these reports indicate that children with ASD have more nutritional problems caused by mealtime behaviors and more narrow in the foods they accept [10]. Besides all these data, it has been reported that 25% of children with ASD have at least one gastrointestinal (GI) symptom (e.g., diarrhea, constipation, abdominal pain, and GI reflux disease). This strongly suggests that the routine treatment should be accompanied by the nutritional therapy in children with ASD [11]. Parents, children's first role model, have an important influence on the dietary behavior of their children [12,13]. Therewithal, the employment of women increases household income, and as a result, this positively affects the nutritional status of households, especially mothers. What's more, studies indicate that there is a strong relationship between the maternal education level and children's nutritional status [14]. So, mothers' empowerment can affect children's nutritional status because of the fact that mother's diet quality is an important predictor for the child's diet quality [15].

In the studies, the effects of the economic power, educational level and health literacy of the parents on the nutritional status of the children without specific diseases were evaluated. In addition, the relationship between nutritional status of children and some maternal features such as employment, order of birth and birth interval has been studied [16-23]. The difference of our study from these studies is that it was conducted on children with ASD. In the literature, there is almost no data on the association between maternal characteristics (demographic features and nutritional status of mothers) and autism-related nutritional problems (meal behavior and nutritional status of children). This paper provides an opinion on whether there was a relationship between the maternal features and common eating disorders such as picky eating, food refusal and inadequate dietary intake in autistic children.

METHODS

This descriptive and cross-sectional study was conducted with autistic children and adolescents (6-19 years) who were registered to special education centers in Eskişehir, Turkey, and with their mothers in January-July 2016. PASS 11, a sample size software, was used for the determination of sample size. In determining the sample size, the mean dietary energy intake reported in a study (1938.7±426.3kcal) evaluating the nutritional status of autistic children was based [24]. For 95% and 80% statistical power, the sample size required 71 and 44 subjects, respectively.

An invitation was sent to the families for "The informative meeting about the study" through the managers of special education centers. Clear explanations about the study design and rights of the participants were provided for the families attended the meetings. A total of 58 mothers agreed to participate in the study with a written informed consent in accordance with Declaration of Helsinki (World Medical Association).

Descriptive and maternal characteristics (gender, age, age at diagnosis, maternal age at birth, maternal education and employment status) and GI symptoms (diarrhea and abdominal pain) of the children were obtained with a general questionnaire. Also, in some evaluations, the children were divided into two groups as school-age children (6-12 years of age) and adolescents (over 12 years), as stated by the World Health Organization (WHO) [25]. For the evaluation of nutritional status and meal behavior, the anthropometric measurements (height and body weight) and 24-hour dietary recall (24HR) were taken, and the Brief Autism Mealtime Behavior Inventory (BAMBI) was applied [26]. Also, for the evaluation of orthorexia nervosa tendency of the mothers, the ORTO-15 questionnaire was applied with face-to-face interview [27]. For the study, ethical approval was obtained from Gazi University Ethics Committee (dated January 15, 2016. Project n. 77082166-604.01.02).

Autistic children and adolescents who were diagnosed with a chronic disease or who have a special diet (i.e. gluten-free diet, casein-free diet, gluten- and casein-free diet, and ketogenic diet) were excluded from the study. The anthropometric measurements were taken by well-trained researchers according to the measurement protocols. The height of the participants was measured in frankfort plane by a stadiometer having 0.1cm sensitivity. The body weight was measured with a calibrated electronic scale having 0.1kg sensitivity [28]. Attention was paid to being with a thin dress and without shoes for the body weight measurement. The Body Mass Index (BMI) was calculated as weight (kg) divided by height squared (m²) (BMI=weight/height²) and was classified according to the BMI cut-off points accepted by WHO [29]. In addition, WHO AnthroPlus software was used to evaluate age- and gender-specific BMI.

Daily energy intake and food consumption was assessed using 24HR. So, the mothers were asked what their children consumed in the last 24 hours. To determine the amounts and portion size of the meals/foods “The Food and Meal Photo Catalog”, a photographic atlas including Turkish foods and meals, was used [30]. Also, BEBIS, a food analysis software, was used to determine the dietary energy and nutrient intakes of the participants [31].

The BAMBI, 5-point Likert-type scale, was used to evaluate the meal behavior of the children. The scale, developed by Lukens and Lischeid [26] in order to determine the behavioral and nutritional problems of children with ASD, consists of 18 items and each item includes five different options indicating the frequency of occurrence (1= never/rarely, 2= seldom, 3= occasionally, 4= often, 5= almost every meal). In the Turkish validity and reliability study of the BAMBI, it was specified that the items 3, 9, 10 and 15 should be evaluated by reverse scoring [32]. The BAMBI gives three subscores (limited variety, food refusal and disruptive behavior) and a total score. The total point of the items 10, 11, 13, 14, 15, 16, 17, and 18 refers to “limited variety” score (minimum 8, maximum 40 points). The total point of the items 1, 2, 4, 7, and 8 refers to “food refusal” score (minimum 5, maximum 25 points), and also the total point of the remaining items (3, 5, 6, 9, and 12) refers to “disruptive behavior” score (minimum 5, maximum 25 points). Finally, the total point of all these subscores refers to the total BAMBI score (minimum 18, maximum 90 points). Higher BAMBI subscores and total score indicate more negative autism specific meal behaviors.

The ORTO-15, 4-point Likert-type scale, was used to evaluate the orthorexia tendency of the mothers. The scale, developed by Donini *et al.* [27], consists of 15 items and each item includes four different options indicating the frequency of occurrence (1= always, 2= often, 3= sometimes, 4= never). The items 2, 5, 8, and 9 are evaluated by reverse scoring. Also, the items 1 and 13 are evaluated by scoring as “1= never, 2= always, 3= sometimes, and 4= often”. The minimum and maximum scores are 15 and 60 points respectively, and also a score greater than or equal to 40 points refers to “high orthorexia tendency”.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 22.0 [33]. Kolmogorov-Smirnov test was used to determine whether the data had normal distribution. The descriptive variables were expressed as “number (percentage)” or “mean±standard deviation” in Table 1. Mann Whitney U test was used to evaluate the statistical differences between the groups (maternal education, maternal employment status, and ORTO-15 groups) in terms of quantitative variables (BAMBI scores, anthropometric measurements, and dietary intake). Spearman's rho correlation was used to evaluate the relationship between maternal features (maternal age at birth, breastfeeding duration, and ORTO-15 scores) and children's characteristics (BAMBI scores, anthropometric measurements, and dietary intake). Presence of diarrhea and abdominal pain in the children according to the maternal features were evaluated by Pearson's Chi-Square test. Boxplots were used to express the BAMBI scores of the mothers with high and low orthorexia tendency. Also, the quantitative variables (BAMBI scores, anthropometric measurements, and dietary intake) were expressed as “median (interquartile range)” in the comparison of the groups (maternal education and employment status). A *p*-value below 0.05 was considered statistically significant.

Table 1. General characteristics of children. Eskişehir, Turkey, 2016.

Characteristics	n=58			
	n	%	\bar{x}	SD
Gender				
Male	47	81.0		
Female	11	19.0		
Age (years)			12.0	3.7
Male			11.9	3.7
Female			12.3	4.1
Age at diagnosis (years)			3.1	1.3
Height (cm)			149.0	18.9
Male			150.5	19.1
Female			142.6	17.2
Weight (kg)			50.8	23.2
Male			51.1	24.1
Female			49.6	19.9
BMI (kg/m ²)			21.8	6.1
School age (6-12 years)			20.2	6.3
Adolescence (over 12 years)			23.6	5.5
BMI Z-score			0.86	2.04
BAMBI (total)			41.1	8.6
BAMBI (limited variety)			22.0	5.6
BAMBI (food refusal)			8.5	3.7
BAMBI (disruptive behavior)			10.8	2.7
Maternal characteristics				
Maternal age at birth (years)			28.3	6.4
Education				
<High school graduates	26	44.8		
≥High school graduates	32	55.2		
Employment status				
Employed	11	19.0		
Unemployed	47	81.0		
Breastfeeding duration (months)			12.6	9.5
ORTO-15			37.9	3.4
High orthorexia tendency (≥40)	21	36.2		
Low orthorexia tendency (<40)	37	63.8		

Note: \bar{x} : Mean; BAMBI: Brief Autism Mealtime Behavior Inventory; BMI: Body Mass Index; SD: Standard Deviation.

RESULTS

Descriptive characteristics of participants are given in Table 1. The majority of the samples were male with the percentage of 81.0%. The mean age was 11.9 ± 3.7 years and also ASD diagnosis age was 3.1 ± 1.3 years. The mean body weight, height, BMI, and BMI Z-score values were 50.8 ± 23.3 kg, 149.0 ± 18.9 cm, 21.8 ± 6.1 kg/m², and 0.86 ± 2.04 , respectively. Also, the mean BAMBI scores of the samples were 41.1 ± 8.6 (total), 22.0 ± 5.6 (limited variety), 8.5 ± 3.7 (food refusal), and 10.8 ± 2.7 (disruptive behavior), respectively. The mothers were asked for age of birth, breastfeeding duration, educational level, and employment status. The mean age of birth and breastfeeding duration were determined as 28.3 ± 6.4 years and 12.6 ± 9.5 months, respectively. Besides, 44.8% of mothers had low educational level (<high school graduates) and 81.0% of them were unemployed. The mean ORTO-15 score of the mothers was 37.9 ± 3.4 and it was found that 36.2% of the mothers had high orthorexia tendency.

The mean dietary energy, protein, carbohydrate, fat, dietary fiber, vitamin B6, magnesium and iron intakes were 1685.7 ± 601.9 kcal, 57.8 ± 26.4 g, 209.0 ± 82.1 g, 67.4 ± 26.3 g, 21.0 ± 7.8 g, 1.2 ± 0.5 mg, 233.2 ± 102.0 mg, and 9.9 ± 4.0 mg, respectively. In addition, as expected, dietary intakes of adolescents were found to be higher than school-age children (not shown in the tables).

The BAMBI scores of the children of mothers with low and high orthorexia tendency were given in Figure 1. There were no statistically significant differences between these two groups in terms of BAMBI total and subscores ($p>0.05$).

There were also no statistically significant differences between the children of mothers with low educational level (<high school graduate) and the children of mothers with high educational level (\geq high school graduate) in terms of BAMBI scores, body weight, BMI, and BMI-Z values ($p>0.05$). The BMI values of the children were evaluated separately for school-age children and adolescents according to the mothers' employment status and educational level, and there were no statistically significant differences between the groups. On the other hand, in relation to dietary intake, the children of mothers with high educational level had significantly higher vitamin B6 intake ($p<0.05$). However, the differences between two groups were not statistically significant in terms of dietary intake other than vitamin B6 ($p>0.05$). Also, when two age groups (school age and adolescence) were examined separately in terms of all nutrient intakes, there were no statistically significant differences between the mother groups (not shown in the tables) ($p>0.05$). The BAMBI (limited variety) scores of the employed mothers' children were significantly higher than the scores of unemployed mothers' children ($p<0.05$). In addition, there were no statistically significant differences between employed and unemployed mothers' children in terms of the other BAMBI scores (food refusal, disruptive behavior, and total) ($p>0.05$) (Table 2).

Table 3 shows the correlations between maternal features (maternal age at birth, breastfeeding duration and ORTO-15 scores) and children's features (BAMBI total and subscores, body weight measurements, BMI values, and dietary intakes). Maternal age at birth was negatively correlated with dietary energy and protein intakes ($p<0.05$). Also, there were significantly positive correlations between breastfeeding duration and BAMBI scores (disruptive behavior and total) ($p<0.05$). However, the ORTO-15 scores of mothers were not significantly correlated with children's features ($p>0.05$).

The GI symptoms of children (diarrhea and abdominal pain) are given in Table 4. When the children were grouped according to the maternal features, there were no statistically significant

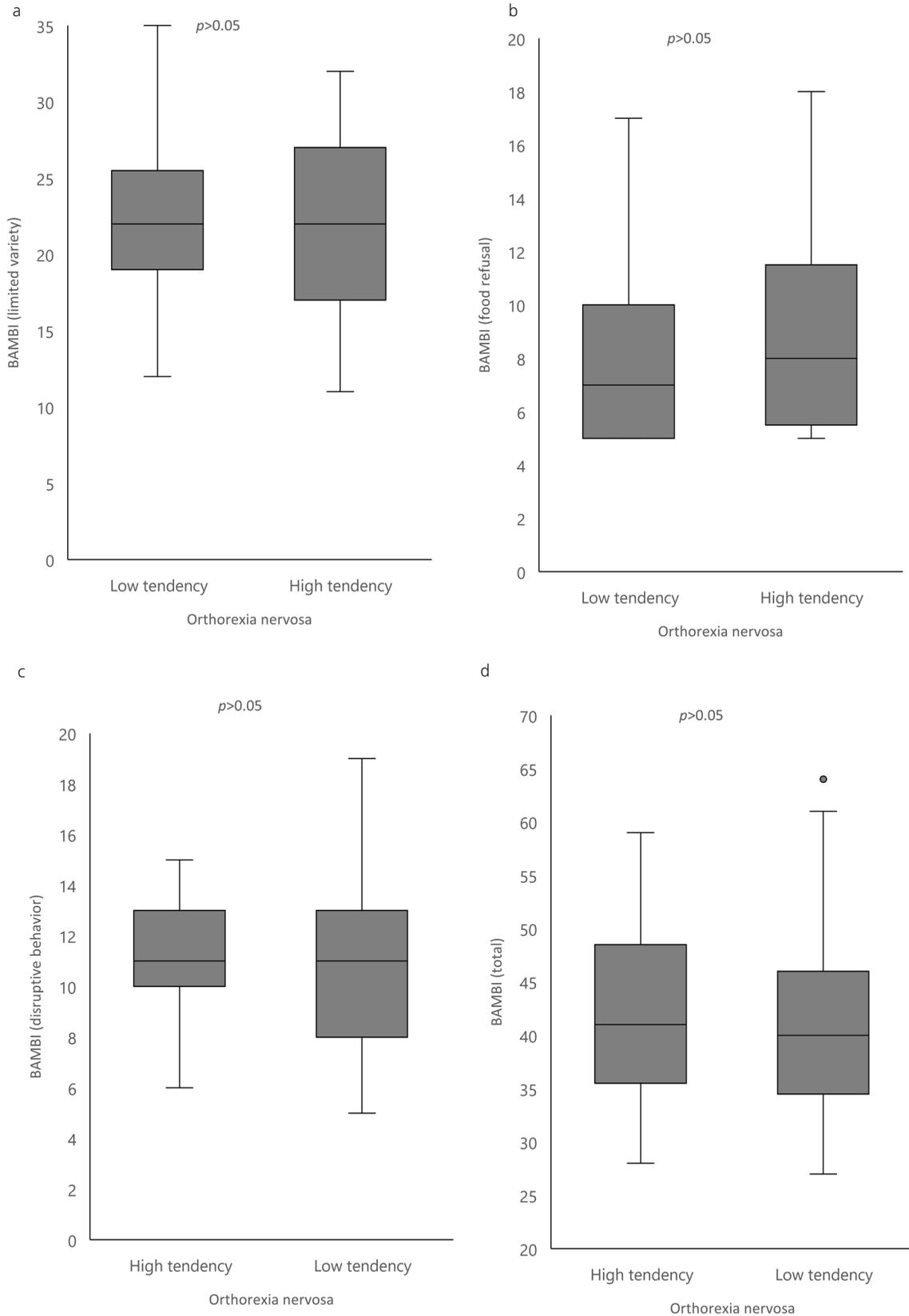


Figure 1. ORTO-15 in its two outcomes, respectively, referring to the Brief Autism Mealtime Behavior Inventory (BAMI).

Note: (a) limited variety, (b) food refusal, (c) disruptive behavior and (d) total.

Table 2. BAMBI scores, anthropometric measurements and dietary intake of children according to maternal education and employment status. Eskişehir, Turkey, 2016.

	Maternal education				Z	p-value
	<High school graduates		≥High school graduates			
	Median	Interquartile range	Median	Interquartile range		
BAMBI						
BAMBI (limited variety)	21.00	8.00	22.50	9.00	-0.603	0.547
BAMBI (food refusal)	7.50	6.00	8.00	6.00	-0.111	0.911
BAMBI (disruptive behavior)	11.00	4.00	11.00	4.00	-0.434	0.664
BAMBI (total)	40.00	11.00	40.50	12.00	-0.266	0.790
Anthropometric measurements						
Weight (kg)	49.50	37.80	47.60	32.70	-0.336	0.737
BMI (kg/m ²)	21.30	9.10	21.80	11.70	-0.172	0.863
BMI (school age)	16.00	10.40	21.80	9.80	-1.044	0.296
BMI (adolescence)	21.70	9.10	22.10	9.80	-0.151	0.880
BMI Z-score	0.97	2.70	1.72	3.31	-1.188	0.235
Dietary intake						
Energy (kcal)	1445.60	872.10	1750.40	780.70	-0.750	0.453
Protein (g)	53.40	19.70	58.20	42.10	-0.860	0.390
Protein (%)	13.00	4.00	13.00	4.50	-0.378	0.705
Carbohydrate (g)	189.60	148.80	188.40	132.80	-0.313	0.755
Carbohydrate (%)	49.00	8.30	50.00	13.00	-0.266	0.790
Fat (g)	56.10	40.40	72.10	39.30	-1.157	0.247
Fat (%)	37.00	7.00	36.00	10.00	-0.008	0.994
Dietary fiber (g)	20.40	12.10	21.50	12.00	-0.977	0.328
Vitamin B6 (mg)	1.01	0.56	1.26	0.61	-2.408	0.016*
Magnesium (mg)	196.10	118.60	241.00	129.50	-1.673	0.094
Iron (mg)	8.70	5.30	10.20	4.40	-1.454	0.146
Maternal employment status						
	Employed		Unemployed		Z	p-value
	Median	Interquartile range	Median	Interquartile range		
BAMBI						
BAMBI (limited variety)	25.00	6.00	21.00	8.00	-2.563	0.010*
BAMBI (food refusal)	8.00	4.00	7.00	6.00	-0.767	0.443
BAMBI (disruptive behavior)	11.00	5.00	11.00	4.00	-0.320	0.749
BAMBI (total)	45.00	6.00	39.00	12.00	-1.857	0.063
Anthropometric measurements						
Weight (kg)	42.50	24.40	50.00	37.70	-1.052	0.293
BMI (kg/m ²)	21.20	8.30	21.70	11.10	-0.307	0.759
BMI (school age)	21.20	6.60	20.60	10.70	-0.331	0.741
BMI (adolescence)	24.40	10.20	21.70	9.20	-0.205	0.838
BMI Z-score	1.43	1.97	1.08	3.13	-0.526	0.599
Dietary intake						
Energy (kcal)	1742.30	797.90	1735.20	801.30	-0.248	0.804
Protein (g)	50.80	24.90	56.90	33.70	-0.129	0.897
Protein (%)	13.00	7.00	13.00	4.00	-0.180	0.857
Carbohydrate (g)	190.50	119.50	189.20	140.90	-0.069	0.945
Carbohydrate (%)	50.00	18.00	49.00	10.00	-0.238	0.812
Fat (g)	68.50	52.80	61.40	37.80	-0.248	0.804
Fat (%)	33.00	10.00	37.00	10.00	-0.616	0.538
Dietary fiber (g)	18.10	9.30	21.70	11.70	-0.040	0.968
Vitamin B6 (mg)	1.18	0.25	1.17	0.81	-0.119	0.905
Magnesium (mg)	233.30	119.90	215.50	105.80	-0.407	0.684
Iron (mg)	10.20	3.90	9.80	4.50	-0.179	0.858

Note: Mann Whitney U test: * $p < 0.05$. BAMBI: Brief Autism Mealtime Behavior Inventory; BMI: Body Mass Index.

Table 3. Correlation between maternal characteristics and nutrition-related characteristics of the children. Eskişehir, Turkey, 2016.

	Maternal age at birth		Breastfeeding duration		ORTO-15	
	r	p-value	r	p-value	r	p-value
BAMBI						
BAMBI (limited variety)	0.023	0.865	0.220	0.106	-0.047	0.728
BAMBI (food refusal)	-0.128	0.338	0.266	0.050	0.106	0.428
BAMBI (disruptive behavior)	0.112	0.401	0.297	0.028*	0.052	0.700
BAMBI (total)	-0.028	0.835	0.270	0.046*	0.035	0.793
Anthropometric measurements						
Weight	-0.065	0.627	-0.191	0.161	0.105	0.432
BMI	-0.056	0.678	-0.113	0.410	0.116	0.384
Dietary intake						
Energy	-0.268	0.042*	-0.083	0.548	-0.130	0.332
Protein	-0.368	0.004*	-0.118	0.389	-0.132	0.323
Protein (%)	-0.174	0.191	-0.005	0.973	-0.001	0.993
Carbohydrate	-0.252	0.056	-0.042	0.762	-0.134	0.318
Carbohydrate (%)	-0.039	0.769	0.025	0.855	0.011	0.936
Fat	-0.162	0.223	-0.158	0.249	-0.074	0.583
Fat (%)	0.186	0.162	0.016	0.910	0.053	0.691
Dietary fiber	-0.078	0.559	-0.076	0.582	-0.081	0.548
Vitamin B6	-0.257	0.051	-0.095	0.489	-0.234	0.077
Magnesium	-0.249	0.060	-0.112	0.414	-0.147	0.271
Iron	-0.246	0.063	-0.106	0.442	-0.171	0.200

Note: Spearman's Rho correlation: *p<0.05; BAMBI: Brief Autism Mealtime Behavior Inventory; BMI: Body Mass Index.

Table 4. Presence of gastrointestinal symptoms at least once a month according to maternal characteristics. Eskişehir, Turkey, 2016.

Maternal characteristics	Diarrhea						Abdominal pain					
	Yes		No		χ^2	p-value	Yes		No		χ^2	p-value
	n	%	n	%			n	%	n	%		
Maternal education												
<High school graduates	9	34.6	17	65.4	0.220	0.639	4	15.4	22	84.6	2.698	0.100
≥High school graduates	13	40.6	19	59.4			11	34.4	21	65.6		
Maternal employment status												
Employed	6	54.5	5	45.5	1.592	0.207	6	54.5	5	45.5	5.825	0.016*
Unemployed	16	34.0	31	66.0			9	19.1	38	80.9		
Maternal orthorexia tendency												
High orthorexia tendency	8	38.1	13	61.9	0.000	0.985	7	33.3	14	66.7	0.958	0.328
Low orthorexia tendency	14	37.8	23	62.2			8	21.6	29	78.4		

Note: Pearson's Chi-square test: *p<0.05.

differences between the groups in terms of diarrhea presence ($p>0.05$). In addition, the mothers were asked if the children had abdominal pain often. It was determined that the percentage of abdominal pain in employed mothers' children was 54.5% and this percentage was 19.1% in unemployed mothers' children ($p<0.05$).

DISCUSSION

In many studies, it was reported that there is a close relationship between eating habits, nutritional status and ASD. The studies focused on maternal nutrition as much as the nutritional status

of the children with ASD [34-37]. Mostly, the nutritional status of mothers during pregnancy was emphasized in the studies investigating the effect of maternal nutrition on autism [35-37]. However, there are no studies investigating the effect of maternal eating disorder on the meal behavior of children with ASD in the literature.

In this study, the mean age of children with ASD, 81.0% of whom were male, was 12.0 ± 3.7 years. Also, the mean heights were 150.5 ± 19.1 cm and 142.6 ± 17.2 cm in males and females, respectively. In Turkey Dietary Guideline (TUBER), the specified median height values were 149 cm and 151 cm for 12-year-old males and females, respectively [38]. On the other hand, the mean body weight of males and females (51.1 ± 24.1 kg and 49.6 ± 19.9 kg respectively) was found to be higher than the median body weight values for 12-year-old children specified in TUBER (38.9 kg for males and 41.2 kg for females). In addition, it was determined that the daily dietary protein, carbohydrate and fiber intakes of children were higher than the adequate intake levels of protein (43.8 g for males and 45.8 g for females), carbohydrate (130 g) and fiber (19 g) specified in TUBER. Based on all these results, it is thought that the children with ASD do not have serious physical development retardation.

The BAMBI is a standardized assessment tool developed to evaluate meal behavior problems in children with ASD. In our study, the mean total BAMBI score was 41.1 ± 8.6 . Since there was not a control group in the study, children with ASD were not comparable with typically developing children in terms of BAMBI scores. However, in a study conducted by Zobel-Lachiusa *et al.* [39], the mean total BAMBI score in children with ASD was found to be 44.39 ± 10.83 ; on the other hand, this mean value was 30.08 ± 7.90 in typically developing children ($p < 0.05$). Because of BAMBI do not have cut-off points, the children with ASD could not be grouped in terms of meal behavior. Even so the BAMBI scores show that the children with ASD have more obvious meal behavior problems than typically developing children.

Studies conducted with mentally healthy children and their mothers show that maternal eating disorders and nutritional status may reflect the eating habits and nutritional status of children [40-42]. In this study, the fact that there was no statistically significant difference between the children of mothers with low and high orthorexia tendency in terms of BAMBI scores indicates that the mother's orthorexia tendency was not influential on meal behavior in children with ASD. Therefore, it can be considered maternal eating disorders do not significantly affect meal behaviors of children with ASD.

Many studies reported that mother's empowerment and autonomy based on educational and socioeconomic status have a direct positive effect on healthy eating habits and anthropometric indicators in children [43-48]. In a study, it was reported that the children whose mothers had salary from employment had a better Weight for Age Z score (WAZ) and Weight for Height Z score (WHZ), and it was also reported maternal educational status was correlated with WHZ of children ($r = 0.25$, $p = 0.001$) [12]. In this study, it was found that dietary energy, protein, fat, fiber, vitamin B6, iron and magnesium intakes were higher in autistic children of mothers with high educational level. However, there was a statistically significant difference between the groups only in terms of vitamin B6 intake. Likewise, mother's educational level does not have an effect on meal behavior and anthropometric measurements of children with ASD. It is thought that maternal demographic factors have a limited effect on the nutritional status in children with ASD.

In previous studies, advanced maternal age was found to be associated with increased risk of ASD [49]. According to the results of the 6- and 66-month Taiwan Birth Cohort Study, the risk

of being diagnosed with ASD was increased by the maternal age being over 40 years old [50]. Also, Rubenstein *et al.* [51] reported that advanced maternal age is a risk factor for ASD, but it was not independently associated likely, because it is a consequence of maternal education and other sociodemographic features. Unlike, the mean maternal age at birth was not very high (28.3 ± 6.4 years) in our study. This may be because the sample size in this study is relatively small compared to the other studies. Furthermore, maternal age was significantly associated with daily dietary energy and protein intake in children with ASD. In the literature, no data was found on the relationship between maternal age and nutritional status of children with ASD. However, in a study conducted with typically developing children and their mothers, advanced maternal age was reported to be associated with malnutrition in children [52].

There is convincing evidence that breastfeeding has positive effects on ASD [53,54]. In a meta-analysis including the results of seven studies, it was reported that the children with ASD were significantly less likely to have been breastfed than typically developing children (*Odds Ratio* (OR)=0.61, %95 Confidence Interval (CI)=0.45-0.83, $p=0.002$), therefore breastfeeding could provide protection against ASD [53]. In a case-control study evaluating the association between breastfeeding and ASD, the absence of breastfeeding when compared to breastfeeding for more than six months was associated with a significant increase in the risk of ASD (OR=2.48, %95 CI=1.42-4.35) [54]. Besides, in a study by Soke *et al.* [55], the reported mean breastfeeding duration of the children with ASD was 7.3 ± 7.2 months and that of control children was 9.3 ± 7.2 months. In another study, Boucher *et al.* [56] reported that the mean breastfeeding duration in the children with ASD was 6.9 ± 5.1 months. It is well-known that breastfeeding is a traditional behavior in Turkish society. So, it is nearly impossible to report that the higher breastfeeding durations in our study (12.6 ± 9.5 months) is associated with ASD.

Comorbidities often accompany ASD, and GI dysfunction is among the most frequently cited comorbidities [57,58]. The prevalence of GI dysfunction in the children with ASD range from 9 to 70% [59-63]. A meta-analysis reported that the children with ASD experienced GI symptoms such as diarrhea (OR=3.63; 95% CI=1.82-7.23) and abdominal pain (OR=2.45; 95% CI=1.19-5.07) significantly more than control children [64]. In another study, the percentages of children with ASD who experienced diarrhea and abdominal pain in the last three months were 13% and 5.1%, respectively. This rate was 1.6% for both symptoms in typically developing children [65]. In this study, the percentages of the children who experienced diarrhea and abdominal pain at least once a month were 37.9% and 25.9%, respectively. In addition, maternal features were not found to be effective on GI symptoms in the children with ASD. It is thought that, GI symptoms were more frequent in this study, because all of the children had severe autism characterized by highly visible lack of communication skills, very limited social interactions, and extreme difficulty coping with unexpected changes.

Orthorexia tendency of the mothers was not associated with meal behavior, anthropometric measurements and dietary intake of the children with ASD in our study. The ORTO-15, developed by Donini *et al.* [27] based on the Bratman's test, was used to determine the orthorexia tendency of mothers. Varga *et al.* [66] reported that the validity of orthorexia assessment instruments, including ORTO-15, was not convincing. Because the Bratman's test includes items that are not unique to orthorexia [67]. It is also based on clinical experience and its validity has never been checked. The limitations of the Bratman's test are making the face-validity of the ORTO-15 doubtful. So, further studies are needed to clarify the appropriate diagnostic methods for orthorexia.

CONCLUSION

Within the scope of the study, we examined the effects of some maternal features including the maternal age at birth, educational level, employment status, breastfeeding duration, and orthorexia tendency on meal behaviors, dietary intakes, anthropometric measurements and some GI symptoms in children with ASD. We concluded that maternal features are not associated with children's meal behavior in this sample. However, it may be mentioned that the maternal age and educational level have a very limited effect on the dietary intake in children with ASD. More comprehensive longitudinal studies with large sample sizes are needed to investigate if maternal eating disorders and demographic factors were associated with meal behavior and nutritional status in autistic children.

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CONTRIBUTORS

N ATEŞ-ŞAHİNKAYA designed the study, coordinated the data collection, and contributed interpretation of the article. N ACAR-TEK designed and coordinated the study, contributed interpretation and drafting of the article, and also approved the final version of the article. E ADIGÜZEL contributed statistical analysis, interpretation and drafting of the article.

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