

## Evaluation of the Nutritional Status and Eating Behaviors of Young Children with Type 1 Diabetes and Healthy Peers: A Controlled Cross Sectional Study

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### ABSTRACT

**Aim:** Eating behaviors affect young children with type 1 diabetes mellitus (T1DM). The aim is to identify eating behaviors, and nutritional status in young children with T1DM and healthy peers and evaluate the effect of eating behaviors on glycemic control in children with T1DM.

**Material and Methods:** The study was a single-center controlled cross-sectional study of young children with T1DM (n=33) (age<7 years) and healthy peers (n=31). The eating behaviors of the young children were examined through the Behavioral Pediatric Feeding Assessment Scale and the food consumption status was evaluated using a 3-day food record. Glycosylated hemoglobin (Hemoglobin A1c) values of the young children with T1DM were obtained from hospital records, and analyzed.

**Results:** Young children with T1DM have higher energy, fiber, and cholesterol intake than their healthy peers. (p<0.05). The young children with T1DM eat more healthily and have fewer behavioral eating disorders than their healthy peers. Parents of children with T1DM reported feeling worse about the child's nutrition. No relationship was found between eating behaviors and glycemic control.

**Conclusion:** Because parents of preschool children with type 1 diabetes feel more anxiety about their child's disease, behavioral observation techniques should be used to examine their eating behavior, glycemic control, and other factors that may affect nutritional management.

**Keywords:** Nutrition, Behavioral pediatric feeding assessment scale, Young children, Type-1 diabetes, Eating behaviors

## Tip 1 Diyabetli Küçük Çocukların ve Sağlıklı Akranlarının Beslenme Durumları ve Yeme Davranışlarının Değerlendirilmesi: Kontrollü Kesitsel Araştırma

### ÖZ

**Amaç:** Yeme davranışları Tip 1 Diabetes Mellituslu (T1DM) çocukları etkilemektedir. Amaç T1DM'li küçük çocuklarda ve sağlıklı akranlarında yeme davranışlarını ve beslenme durumunu belirlemek ve T1DM'li çocuklarda yeme davranışlarının glikemik kontrol üzerindeki etkisini değerlendirmektir.

**Gereç ve Yöntemler:** Bu araştırma, T1DM'li küçük çocuklar (n=33) (yaş <7 yıl) ve sağlıklı akranları (n=31) üzerinde yapılan tek merkezli, kontrollü, kesitsel bir çalışmaydı. Küçük çocukların yeme davranışları Davranışsal Pediatrik Beslenme Değerlendirme Ölçeği ile incelendi ve 3-günlük besin tüketim kaydı kullanılarak besin tüketim durumları değerlendirildi. T1DM'li küçük çocukların glikozillenmiş hemoglobinin (Hemoglobinin A1c) değerleri hastane kayıtlarından elde edildi ve analiz edildi.

**Bulgular:** T1DM'li küçük çocukların sağlıklı akranlarına göre enerji, posa ve kolesterol alımları daha yüksektir (p<0,05). T1DM'li küçük çocuklar, sağlıklı akranlarına göre daha sağlıklı beslenmiş ve daha az davranışsal yeme bozukluğu yaşamışlardır. T1DM'li çocukların

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ebeveynleri, çocuklarının beslenmesi konusunda kendilerini daha kötü hissettiklerini bildirdi. Yeme davranışı ile glisemik kontrol arasında bir ilişki bulunamadı.

**Sonuç:** T1DM'li okul öncesi çocukların ebeveynleri, çocuklarının hastalığıyla ilgili daha fazla kaygı duyduklarından, yeme davranışlarını, glisemik kontrollerini ve beslenme yönetimini etkileyebilecek diğer faktörleri incelemek için davranışsal gözlem teknikleri kullanılmalıdır.

**Anahtar Sözcükler:** Beslenme, Davranışsal pediatrik besleme değerlendirme ölçeği, Küçük çocuklar, Tip-1 diyabet, Yeme davranışları

## INTRODUCTION

Type 1 diabetes mellitus (T1DM) is a disorder arising due to autoimmune destruction of insulin-producing pancreatic beta-cells that usually leads to absolute insulin deficiency (1,2). Its cause is not completely known, in light of current information, it is not classified as a preventable disease (3). It is estimated that about 5.0% of people with diabetes have T1DM (4). According to the International Diabetes Federation (IDF) Diabetes Atlas data, there are 1.2 million children and adolescents with T1DM between the ages of 0 and 19 in the world (2).

Insulin therapy carried out in conjunction with an appropriate diet plan plays a pivotal role in normal growth and development, adequate pubertal development, and normal physical activity, including regular and extracurricular activities in school, for patients with T1DM (5). However, it has been reported that the parents of young children (age<7 years) with T1DM experience problems with their child's nutrition, and that these problems are related to the eating habits and mealtime behaviors of the children(6). It is also known that problematic mealtime interactions and mealtime problems such as maladaptive behaviors are common in young children. These problems affect young children with T1DM(7). In various studies, it has been observed that children with T1DM exhibit more problematic behaviors at mealtimes than their healthy peers (6,8,9).

Difficulties in mealtime management can directly affect glycemic control in children with T1DM. Problematic mealtime behaviors of children and parents may affect food intake and may be associated with suboptimal glycemic control (7). While studies have shown that there is a relationship between glycemic control and eating behavior in young children with T1DM (9,10), in one study the mealtime behaviors of parents were not related to glycemic control (6).

The fact that mealtime behaviors play a significant role in the overall management of T1DM (11) expedited studies to be carried out in order to determine the issues that parents have difficulty with when managing their children's mealtimes.

Studies on issues experienced by the parents of young children with T1DM during mealtimes are limited in number. The aim of the present study was to compare the nutritional status and mealtime eating behaviors of young children (age <7 years) with T1DM and healthy peers and to evaluate the effect of eating behaviors on glycemic control in young children with T1DM.

## MATERIALS and METHODS

### Design and Recruitment

This cross-sectional study was conducted in Ankara, between February 2021 and January 2022, with 33 young children diagnosed with T1DM and 31 healthy peers without a history of chronic illnesses in Cebeci Children's Hospital, Faculty of Medicine, Ankara University and their parents/caregivers. The study was approved by the Ethics Committee of the Rectorate of Ankara University with decision number 56786525-050.04.04/7012.

Inclusion/exclusion criteria for the study were as follows: confirmed diagnosis of type 1 diabetes of  $\geq 12$  months duration; no other disease/comorbidities (such as celiac disease or cystic fibrosis etc.) or medication known to affect growth; child aged <7 years; family speaks Turkish as the a primary language; and child had attended a clinic visit within the last 12 months. Healthy peers were selected for inclusion in the study based on the following matching criteria: sex, age, and socioeconomic status.

In order to determine the sample size of the study, a priori G\*Power analysis was performed. In this context, calculations regarding two similar studies (8,9) were made and the effect sizes of those studies were found to be 0.449-0.871. It was planned to include at least 31 individuals from each group in the study in order to conduct the study with 80% power ( $\alpha:0.05$ ).

### Data Collection

Informed consent was obtained from parents of all children included in this study. Interviewers collected study data via a questionnaire (face-to-face interviews) with all parents. The questionnaire was composed of questions on general information (age, gender, main and snacks meals, physical activity, screen time, disease-specific questions for children

with type 1 diabetes) about the children, and the Behavioral Pediatrics Feeding Assessment Scale (BPFAS), assessing the children's eating behavior. A Hemoglobin A1c (HbA1c) that was done 3 months ago was used in the study in order to determine glycemic control in children with T1DM.

### Behavioral Pediatrics Feeding Assessment Scale

The original version of BPFAS was developed by Crist and Napier-Phillips to be used for determining eating behaviors in children (12). The scale was adapted to Turkish by Önal et al. (13). The scale consists of 35 items. While 25 of these items assess the eating behaviors of children, 10 items assess the feelings and behaviors of parents regarding the child's nutrition. The items in the scale are scored 1 to 5 (1:never, 2:rarely, 3:sometimes, 4:often, 5:always). The scale consists of four subscales: child score, parent score, child problem score, and parent problem score. Increases in scores obtained from each subscale indicate an increase in the level of problematic eating behavior and eating habits (14). Permission was obtained from the researchers to use the scale.

### Determination of Energy Intake and Nutritional Status

In order to determine the nutritional status of the young children, parents were asked to record their young children's daily consumption for 3 days within the same week, whether consecutive or nonconsecutive, in the 3-day food record (3-DFR). Before parents were asked to record the 3-DFR, all parents attended a brief session with the same dietician to demonstrate how to estimate food intake using household utensils and record the 3-DFR appropriately. The energy and nutrient values of the foods were analyzed using the student version of the computer-aided nutrition program (Nutrition Information System) (BEBIS).

### Anthropometric Measurements and Evaluations

The body weights and heights of the children were measured in accordance with the method accepted by the World Health Organization (WHO) (15).

Body mass index (BMI) of the children was calculated using body weight and height, and BMI percentile values were evaluated based on the age of the children. Children with a BMI percentile of 3.-15. were regarded as underweight, those with a BMI percentile of 15.-85. were regarded as normal, and those with a BMI percentile of 85.-97. were regarded as overweight. The program WHO Anthro Plus was used to calculate percentile values (16).

### Data Analysis

The data obtained from the study were analyzed with SPSS (version 22.0). In the selection of the analyses, the conformity

of the data to the normal distribution was evaluated by visual (histogram) and analytical (Kolmogorov-Smirnov test) methods. The mean values of two groups with normal distribution were compared using Student's t-test, while the mean values of two groups with nonnormal distribution were compared using the Mann-Whitney U test. Values were expressed as the mean (X), median,  $Q_1$ - $Q_3$ , standard deviation (SD), and min-max. The strength and direction of the relationship between two continuous variables, of which at least one was not normally distributed, was determined by Spearman's correlation test. A confidence interval of 95.0% was accepted for all statistical tests.

## RESULTS

Forty-six mothers and 18 fathers participated in the study. While 57.6% of the fathers of the children with T1DM and 54.9% of the fathers of the healthy children were university graduates, 33.4% of the mothers of the children with T1DM and 38.7% of the mothers of the healthy children were university graduates. A total of 64 young children including 33 children with T1DM and 31 healthy peers, participated in the study.

When age-based BMI values were examined, it was seen that most of the young children had normal body weights. All the children with T1DM and 80.6% of the healthy peers were consuming 3 main meals. In addition, more than half of the young children were consuming 3 snack meals. General information about the young children is presented in Table 1.

The average energy and nutrient intake values of the children participating in the study are presented in Table 2. The energy ( $1383.13 \pm 352.62$  kcal), carbohydrate ( $149.07 \pm 43.20$  g), protein ( $57.09 \pm 13.37$  g), fiber ( $14.96 \pm 6.26$  g), and cholesterol ( $278.76 \pm 82.98$  mg) intake of the children with T1DM was higher than that of the healthy children ( $p < 0.05$ ), while the median value of saturated fat they consumed [ $14.94$ g ( $14.28$ - $17.34$ g)] was lower ( $p > 0.05$ ). The average daily amount of water consumed by the children with diabetes participating in the study was  $766.66 \pm 301.98$  ml, while the average amount consumed by the healthy children was  $1083.87 \pm 331.75$  ml ( $p < 0.05$ ).

The average BPFAS scores of the young children and parents are presented in Table 3. All scores of the parents of the young children with T1DM were lower than those of the parents in the other group, while the numbers of problems they had (regarding children's behavioral disorders as problems, regarding parental feelings and behaviors as problems) were higher. But obtained scores and numbers of problems did not show a significant difference between the healthy peers and the young children with T1DM ( $p > 0.05$ ).

**Table 1:** General information regarding the children.

General Informations *		T1DM (n=33)	Healthy (n=31)
<b>Gender*</b>			
Female	(n=33)	16 (48.5)	17 (54.8)
Male	(n=31)	17 (51.5)	14 (45.2)
<b>Age (year ±SD)</b>		4.24±1.27	4.52±1.43
<b>Age-based BMI percentile classification*</b>			
Underweight	(n=6)	6 (18.1)	-
Normal	(n=42)	20 (60.7)	22 (71.0)
Slightly Overweight	(n=16)	7 (21.2)	9 (29.0)
<b>Number of main meals*</b>			
2-meals	(n=6)	-	6 (19.4)
3-meals	(n=58)	33 (100.0)	25 (80.6)
<b>Number of snack meals*</b>			
1-snack	(n=5)	-	5 (16.1)
2-snacks	(n=19)	9 (27.3)	10 (32.3)
3-snacks	(n=40)	24 (72.7)	16 (51.6)
<b>Regular Physical Activity*</b>			
Yes	(n=8)	1 (3.0)	7 (22.6)
No	(n=56)	32 (97.0)	24 (77.4)
<b>Time spent on Television/Tablet/Phone (hours, Median, Q<sub>1</sub>-Q<sub>3</sub>)</b>		3.0 (2.0-4.0)	2.0 (1.5-3.0)
<b>Insulin Type Used*</b>			
Rapid-acting/Long-acting		33 (100.0)	-
<b>Carbohydrate counting literacy</b>			
Yes	(n=29)	29 (87.9)	-
No	(n=35)	4 (12.1)	31 (100.0)
<b>HbA1c (% , Median, Q<sub>1</sub>-Q<sub>3</sub>)</b>		8.4 (7.7-9.7)	-
<b>T1DM diagnosis time (month, Median, Q<sub>1</sub>-Q<sub>3</sub>)</b>		12.0 (12.0-18.0)	-

\*Data are presented as n (%)

**Table 2:** Children's energy and macronutrient intake.

Energy and Macronutrient Intakes *	T1DM (n=33)	Healthy (n=31)	p
Energy (kcal) <sup>a</sup>	1383.13±352.62 (537.80-2110.06)	1156.56±345.92 (464.91-1733.13)	<b>0.012**</b>
CHO (%) <sup>b</sup>	45.00 (41.00-47.00)	44.00 (41.00-47.00)	0.787
Protein (%) <sup>b</sup>	17.00 (15.00-18.00)	17.00 (15.00-18.00)	0.582
Fat (%) <sup>b</sup>	38.00 (36.00-41.00)	40.00 (37.00-43.00)	0.332
Fiber (g) <sup>a</sup>	14.96±6.26 (2.08-28.87)	9.89±3.34 (3.30-15.19)	<b>&lt;0.001**</b>
Saturated fat (%) <sup>b</sup>	14.94 (14.28-17.34)	17.17 (15.40-18.36)	0.057
Monounsaturated fatty acid (g) <sup>a</sup>	19.65±6.33 (7.60-39.04)	16.73±5.67 (5.66-25.86)	0.057
Polyunsaturated fatty acid (PUFA) (g) <sup>a</sup>	12.47±4.72 (2.73-21.82)	9.71±4.45 (3.50-20.93)	<b>0.020**</b>

<sup>a</sup>Student's t-test, <sup>b</sup>Mann-Whitney U test, <sup>\*\*</sup>Data are presented as mean±SD (Minimum-Maximum), <sup>\*\*b</sup>Data are presented as Median (Q<sub>1</sub>-Q<sub>3</sub>), <sup>\*\*</sup>p<0.05

**Table 3:** BPFAS scores of the children and the number of eating problems.

Scores*	T1DM	Healthy	p**	t	Cronbach alfa
Child score	57.69±11.67 (37.0-84.0)	60.90±12.06 (39.0-91.0)	0.284	-1.080	0.704
Child problem score	6.54±4.40 (0.0-17.0)	5.93±2.76 (1.0-11.0)	0.508	0.667	0.759
Parent score	24.69±6.87 (16.0-38.0)	27.38±7.58 (16.0-47.0)	0.142	-1.488	0.707
Parent problem score	3.24±2.10 (0.0-8.0)	2.93±2.37 (0.0-7.0)	0.586	0.547	0.676
Total score	82.39±16.52 (53.0-118.0)	88.29±17.69 (57.0-130.0)	0.173	-1.378	0.800
Total problem score	9.78±5.73 (0.0-21.0)	8.87±4.80 (1.0-16.0)	0.492	0.691	0.749

\*Data are presented as mean±SD (Minimum-Maximum). \*\*Student's t-test

**Table 4:** Correlations of HbA1c and BPFAS.

	HbA1c	Parent score	Parent problem score	Child score	Child problem score
HbA1c	rho	0.101	0.150	-0.011	0.136
	p	(0.576)	(0.404)	(0.952)	(0.451)
Parent score	rho		0.781*	0.547*	0.602*
	p		(<0.001)	(0.001)	(<0.001)
Parent problem score	rho			0.465*	0.536*
	p			(0.006)	(0.001)
Child score	rho				0.792*
	p				(<0.001)
Child problem score					

Spearman's correlation test, \*p<0.01

The correlation between the HbA1c values and BPFAS scores (their relationship with each other) of the young children with T1DM is presented in Table 4. Parents' feelings and behaviors about their children's nutrition (parent score), parent problem score in the BPFAS, child score, and child problem score were positively related ( $p<0.05$ ). The negative feelings and behaviors of the parents about their children's nutrition increased as the children's behavioral disorders at mealtimes and the rate at which parents regard these disorders as problems increased.

A significant correlation was found between parent problem score, child score, and child problem score and between child score and child problem score ( $p<0.05$ ). As the children's behavioral disorders at mealtimes increased, the rate at which parents regarded their own feelings and behaviors and their child's behavioral disorders at mealtimes as problems also increased.

However, the correlation between the glycemic control marker HbA1c and total BPFAS scores of the children with T1DM was not statistically significant ( $p>0.05$ ).

## DISCUSSION

The present study highlighted difficulties (mealtime behaviors, etc.) and impediments related to nutrition in children, which are experienced by parents of both

young children with T1DM and healthy peers. It is a comprehensive study investigating eating behaviors, dietary intake, and glycemic control together, which are important for the management of T1DM throughout life.

During the period in which the patient is recently diagnosed, blood sugar monitoring and acquisition of healthy eating habits in addition to insulin therapy are also protective against the complications of the disease for individuals with T1DM (17). The international guidelines for the nutrition of people with T1DM provide guidance on macronutrient intake, and these guidelines recommend a healthy diet that is suitable for the whole family (18). The International Society for Pediatric and Adolescent Diabetes (ISPAD) recommends a macronutrient composition for young children that entails daily calories being composed of 45-55% carbohydrates (CHO), 15-20% protein, and 30-35% fats (of which less than 10% should be saturated fat) (19,20). In the present study, the CHO and protein intakes (%) of both groups are within the target range ( $p>0.05$ ). In previous studies, it has been reported that children with T1DM consume a higher amount of fat and a lower amount of fiber than recommended (21,22). In the present study, in contrast to the literature, the fiber consumption of children with T1DM is higher than that of their healthy peers. This may be because the patients were newly

diagnosed and adhered to a diet. In addition, it may be that they are younger and that the nutrition of their children at school age is more dependent on the parents. Moreover this may have been due to the parents' level of education and their literacy regarding carbohydrate counting, their having received nutrition education in hospitals at least once, and the methods they apply in order to prevent their children's blood glucose rising and falling rapidly. Similar to the literature (18), both children with T1DM and healthy peers consume higher amounts of total fat and saturated fat than the recommendations. It is thought that this consumption rate may pose a high risk of excessive weight gain, dyslipidemia, atherosclerosis, and cardiovascular diseases for children at a later age. In addition, it is thought that the inclusion of balanced polyunsaturated fatty acid (PUFA) intake as part of a healthy and balanced diet can prevent heart diseases that may occur in the future (23). The significantly high PUFA consumption in the children with T1DM included in our study can also be explained by the awareness of the parents.

Additionally, early detection and treatment of eating disorders in children and adolescents with T1DM are also important due to the potentially serious consequences of the disease (retinopathy, neuropathy, ketoacidosis, etc.). Eating behaviors developed in the first 5 years of life affect future eating behaviors in all children (24). According to the literature, children with T1DM exhibit problematic eating behaviors at higher rates than their healthy peers (8). Due to the complexity of diabetes management combined with eating disorder treatment, it is necessary to identify those at risk as early as possible. Valid and reliable psychometric questionnaires for children with clinical eating problems are limited in number. Among these scales, the BPFAS is known to have the highest psychometric profile (25). In the present study, the eating behaviors of the children are determined through the BPFAS.

Although BPFAS scores were higher for both the children with T1DM and the healthy children in the present study when compared to studies in the literature, the child and parent scores of the two groups did not differ from each other. This lack of difference may have been due to the children included in our study receiving support from their parents in this regard. Additionally, the parents of the children with T1DM regarded their children's behavioral disorders as problems at a higher rate, and scores related to parents' feelings and behaviors were higher for these parents. This indicates that the mealtime behaviors of children with T1DM and the feelings and behaviors of parents at mealtimes cause more problems when compared

to the parents of healthy children. This may be related to the parents of children with T1DM having more anxiety when their children are facing diabetes. The dependence of young children on their parents suggests that in addition to obtaining information about the children in the clinic, it may be useful to question the behavior of the parents at mealtimes. Teaching strategies to parents to manage mealtime behaviors may help reduce parent reporting of mealtime problems and improve children's dietary adherence.

Additionally, it is assumed that eating behaviors could affect the glycemic control of children with T1DM. In a previous study, the HbA1c levels of children and the scale scores reported by their parents were positively correlated (9). However, no significant correlation between HbA1c and total BPFAS scores was found in our study. In order to determine factors affecting glycemic control in children with T1DM, further experimental studies are required.

American Diabetes Association and the ISPAD accept a target HbA1c of <7.0% and <7.5% for optimal glycemic control in children with T1DM(19,26). The median value ( $Q_1$ - $Q_3$ ) of the last measurements of HbA1c in the children with T1DM in our study was 8.4% (7.7-9.7). The suboptimal glycemic control in the children may have been due to as determined in Table 1, lack of physical activity and the time spent in front of the screen is higher than the recommended time. The parents' limited ability concerning disease management, parents' stress level, poor parent-child interactions, and their inability to establish the relationship between nutrition and lifestyle according to their children's insulin treatment may also have contributed to this situation. Systematic behavioral observation and evaluation studies on daily mealtime behaviors of young children with T1DM may be beneficial for understanding how mealtime behavior affects parent-child interactions.

Obtaining detailed information from parents about their young children's eating behavior in mealtime was the difficult part of the study. To obtain more detailed and accurate information from parents, it is recommended that information on the subject be added to diabetes education to raise awareness about eating behavior. Moreover there are some limitations to this study. A major limitation of the study was also the small size which is maybe why some of the results were not statistically significant. Second, the study was mainly conducted in families with university degrees. These data cannot be generalized to families with lower educational status. Third, the data relied exclusively on parent report of young children's nutritional intake, which could introduce a bias related to parent reporting. Lastly,

to determine the direction in the relationships between glycemic control, dietary intake, and mealtime behavior, a longitudinal design is needed.

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### Author Contributions

Conception and design: **Seda Önal, Aslı Uçar**, Methodology: **Seda Önal, Aslı Uçar**, Reviewing the manuscript critically: **Aslı Uçar, Zeynep Şıklar, Merih Berberoğlu**, Supervision: **Aslı Uçar**. All authors read and approved the final manuscript. The authors have accepted responsibility for the entire content of this manuscript and approved its submission

### Conflict of Interest

The authors state no conflict interests.

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### Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the Rectorate of Ankara University with decision number 56786525-050.04.04/7012.

### Data Availability Statement

The raw data can be obtained on request from the corresponding author.

### Peer Review Process

Extremely and externally peer-reviewed.

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