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Familial Nutrition and Physical Activity Habits in Children and Adolescents with Type 1 Diabetes Mellitus

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ABSTRACT

Objective: The objective of this study was to examine the nutritional habits and exercise patterns in children with type 1 diabetes (T1DM) at the familial level and investigate their relationship with glycemic control.

Materials and Methods: This cross-sectional study included 6-18-year-old patients with T1DM and non-diabetic children from the dietitian outpatient clinic. The Family Nutrition and Physical Activity screening tool (FNPA) was administered to all parents to determine their nutrition and exercise habits. The participants were divided into three subgroups based on their body mass index percentile (underweight, normal weight, overweight/obese), and children with T1DM were further divided into two subgroups based on their Hemoglobin A1c (HbA1c) value as good and poor glycemic control. FNPA scores were compared between the groups/subgroups using t-test/one-way Analysis of Variance (ANOVA). Additionally, a multiple linear regression model was developed to identify the determinants of the FNPA score.

Results: A total of 240 children (129 with T1DM) were included in the study. Children with T1DM had significantly higher FNPA scores than non-diabetic children (p=0.013). When the analysis was restricted to subgroups within the same weight status, this difference was significant only between the overweight/obese subgroups (p=0.032). The mean FNPA score of children with T1DM who had good glycemic control was significantly higher than those with poor glycemic control (p<0.001).

Conclusion: This study is the first to evaluate the FNPA scale in children with T1DM and demonstrates the relationship between family nutrition and physical activity habits with glycemic control. These results highlight the significance of promoting proper nutrition and physical activity at the family level to achieve treatment goals.

Keywords: Children, diabetes mellitus, FNPA, nutrition, physical activity.

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INTRODUCTION

Type 1 diabetes mellitus (T1DM) is a disorder characterized by insufficient secretion of insulin from the beta-islets in the pancreas. It accounts for 90% of all diabetes cases in childhood and adolescence, with approximately 96,000 new diagnoses of T1DM in children under 15 years of age worldwide annually.[1] Lifelong insulin use is the primary treatment for T1DM, either through

insulin pumps or pens. Proper insulin administration is crucial to reduce or prevent microvascular or macrovascular complications associated with diabetes. Additionally, maintaining a regular exercise routine and a balanced diet play vital roles in achieving good glycemic control.[2]

The family's role is paramount in shaping the nutrition and physical exercise habits of school-age children. Children typically consume the food provided by their parents at home, making parental dietary habits the primary influence of children's dietary habits. The family's impact on children's diet habits can be observed in five key areas: meal structure, adult food modeling, accessibility and availability of foods, food-related parenting style, and food socialization practices.[3]

Physical activity habits in children are also closely related to the activity levels of their parents, similar to nutritional habits. In families where parents are physically active, children tend to be active as well.[4] Considering that physical activity and nutritional habits are even more critical for children with T1DM than for healthy children, a better understanding of the role of the family in diabetes management is necessary. The burden of diabetes management falls not only on the child but also on the family members. This age-appropriate shared responsibility is essential for achieving glycemic control.[2]

This study aims to examine the nutritional habits and exercise patterns in children with T1DM at the familial level and investigate their relationship with glycemic control. Our hypothesis is that children with T1DM, who are expected to be more cautious and knowledgeable about physical exercise and nutrition, have better familial nutrition and physical exercise habits compared to non-diabetic children. Furthermore, we anticipate that children with T1DM who have good glycemic control exhibit better habits than those with poor control.

MATERIALS AND METHODS

This cross-sectional study was conducted between June and September 2022. Children aged 6–18 years with a diagnosis of T1DM and non-diabetic children without a chronic disease were recruited from the dietitian outpatient clinic. The inclusion criteria for children with T1DM required a minimum of one year since their initial diagnosis to allow time for familial nutrition and exercise habits to be established and potentially impact diabetes control. Exclusion criteria included being within the first year after diagnosis or being in the honeymoon period. Chronological ages of all participants, duration since the diagnosis of T1DM, and the most recent Hemoglobin A1c (HbA1c) values (within the last 3 months) of patients with T1DM were recorded. A good glycemic control was defined as an HbA1c level below 7%.[5]

Anthropometric Measurements

Anthropometric measurements were performed on all children using a stadiometer (Holtain Limited, UK) and a digital scale (TANITA MC-780MA-N, Tanita Corporation of America, Inc., Illinois, USA). When calculating the body mass index (BMI) standard deviation score (SDS) and percentile, the standards for Turkish children were utilized.[6,7] Consequently, children were categorized into three groups: overweight/obese (OW/O), normal weight (NW), and underweight (UW) (BMI percentile >85th percentile, 5th–85th percentile, and <5th percentile, respectively).

Assessment of Family Nutrition and Physical Activity

All eligible patients who visited the dietitian outpatient clinic during the study period were provided with the Family Nutrition and Physical Activity screening tool (FNPA). This tool was used to assess nutrition and exercise habits at the family level through face-to-face interviews. The FNPA scale was initially developed by Ihmels et al.[8] in 2009, and the validity and reliability of its Turkish version were established in 2021 for 1st and 4th-grade school children,[9] and later for a wider age range (6–18 years) in 2022.[10] The scale consists of 10 subdimensions and 20 questions, including family eating habits, screen time behavior and monitoring, beverage choices, family activity involvement, restriction/reward, food choices, family meal patterns, family routine, child activity involvement, and healthy environment. Each item is rated on a four-point Likert-type scale. The total score obtained from the scale ranges between 20 and 80, with higher scores indicating less risky child behaviors and family practices, while lower scores indicate higher risk without a specific cut-off point.

A telephone interview was conducted with parents of diabetic children who completed the FNPA scale to gather sociodemographic information. The questionnaire included questions about the number of people living in the household (≤3 or ≥4), monthly income (categorized as <twice the minimum wage or ≥ twice the minimum wage), marital status (married or divorced), and the educational level of each parent (primary education or below, high school, or university and above).

Statistical Analyses

Statistical Package for Social Sciences v.22 (Chicago, Illinois) was used for the statistical analyses. The distribution of the data was determined using histograms and the Shapiro-Wilk test. Student's t-test was used when comparing two independent groups. The Pearson chi-square test was used to determine the association between categorical variables. Pearson's correlation test was used to determine the relationship between age and FNPA scores. One-way Analysis of Variance (ANOVA) was conducted to compare the FNPA scores among the three

Table 1. Characteristics of diabetic and non-diabetic children

	The diabetic children (n=129)	The non-diabetic children (n=111)	p
Age (years)	12.6±3.3	12.8±3.2	0.540*
Gender distribution (M:F)	61:68	44:67	0.234**
BMI status (n)	UW: 8	UW: 20	<0.001**
	NW: 94	NW: 21	
	OW/O: 27	OW/O: 70	
Total FNPA score	55.5±6.2	53.3±6.8	0.013*
FNPA score in UW children	55.9±7.4	54.5±5.7	0.604*
FNPA score in NW children	55.2±5.9	54.6±5.8	0.681*
FNPA score in OW/O children	56.1±6.9	52.6±7.2	0.032*
p	0.778***	0.246***	

*: Student's t-test; **: Pearson chi-square test; ***: One-way ANOVA; BMI: Body mass index, UW: Underweight; N: Normal weight; OW: Overweight; O: Obese; FNPA: Family nutrition and physical activity.

subgroups created based on BMI percentile. A multiple linear regression model was constructed using the 'enter' method to identify the independent determinants of the FNPA score. A significance level of p<0.05 was considered statistically significant.

A post-hoc power analysis was conducted using G*Power3.1 after the completion of the study to determine the proportion. The analysis indicated that the study had a power of 83% at an alpha level of 5%.

Ethical Considerations

This study was approved by the local ethics committee with the number 409858. Written informed consent was obtained from all parents.

RESULTS

The study included a group of 240 children, consisting of 105 boys and 135 girls. Among them, 129 had been diagnosed with T1DM for at least one year. There were no significant differences in age and gender distribution between the diabetic and non-diabetic groups (p=0.540 and p=0.234, respectively). However, when dividing the subjects into three subgroups based on BMI percentile, there was a significant difference in the distribution of BMI between the two groups (p<0.001). The diabetic group had a higher proportion of children with normal weight (NW), while the non-diabetic group had a higher proportion of children who were underweight (UW) or overweight/obese (OW/O) (Table 1).

The response rate for the FNPA scale was 100%. A weak negative correlation was found between age and FNPA scores (p<0.001, r=-0.330), and this relationship was observed in both the diabetic group (p=0.004, r=-0.250) and the non-diabetic group (p<0.001, r=-0.436).

There was no significant correlation between FNPA scores and BMI Standard Deviation Score (SDS) in all participants (p=0.087, r=-0.111), as well as when analyzed separately in the diabetic and non-diabetic groups (p=0.227, r=0.107 and p=0.065, r=-0.176, respectively). Similarly, no significant difference was found in the mean FNPA scores among the UW, NW, and OW/O subgroups, both in all participants (p=0.236) and each of the two groups (p=0.778 for the T1DM group and p=0.346 for the non-diabetic group) (Table 1).

The mean FNPA score was significantly higher in children with T1DM than in the non-diabetic group (p=0.013). When comparing the subdimensions of the tool, significant differences were found in the "Meals in the family," "Beverage selections," and "Limitation/Rewarding" subdimensions (p<0.05 for all three). In the subgroups created based on BMI percentile, the mean FNPA scores of children with T1DM were found to be higher than the non-diabetic group in all three subgroups, but this difference was statistically significant only in the OW/O subgroups (Table 1).

According to the HbA1c value, 27 children with T1DM had good glycemic control, while 102 had poor glycemic control. The mean FNPA score of children with T1DM who had good glycemic control was significantly higher than that of those with poor glycemic control (p<0.001). When comparing each subdimension, it was found that children with good glycemic control had significantly higher scores in the "Meals in family," "Beverage selections," "Limitation/Rewarding," and "Children's activity" subdimensions of the scale (p<0.05 for all four) than those with poor glycemic control. The median duration of diabetes was 4.6 years (1–14.2), and when comparing FNPA scores between subgroups divided based on the median value (<4.6 years and ≥4.6 years), no significant difference was observed (p=0.700).

Table 2. Socio-demographic data of the diabetic group

	Children with well-controlled diabetes (n=25)		Children with poorly controlled diabetes (n=102)		p*
	n	%	n	%	
Monthly income					0.022
< Twice the minimum wage	15	60.0	83	81.3	
≥ Twice the minimum wage	10	40.0	19	16.7	
Number of the people living in the household					0.310
≤3	17	68.0	58	56.8	
≥4	8	32.0	44	43.2	
Marital status					0.734
Married	23	92.0	89	87.2	
Divorced	2	8.0	13	12.8	
Mother's educational level					0.586
Primary education or below	13	52.0	64	62.7	
High school	8	32.0	27	26.5	
University and above	4	16.0	11	10.8	
Father's educational level					0.259
Primary education or below	10	40.0	51	50.0	
High school	10	40.0	42	41.2	
University and above	5	20.0	9	8.8	

*: Pearson chi-square test.

Table 3. Multiple Linear Regression (Model: Enter) analysis to determine the predictors of FNPA score

	Unstandardized coefficients	Sig.	95% Confidence interval for B	
	B	p	Lower bound	Upper bound
Age	-0.677	<0.001	-0.926	-0.428
Gender	-0.678	0.405	-2.277	0.922
Diagnosis of T1DM	2.348	0.006	0.692	4.004
BMI SDS	0.096	0.684	-0.368	0.560

T1DM: Type 1 diabetes mellitus; BMI SDS: Body mass index standard deviation score; FNPA: Family nutrition and physical activity.

Sociodemographic data were obtained through telephone interviews with the parents of 127 children with T1DM (excluding 2). It was found that only monthly income was significantly associated with glycemic control. A higher proportion of families with a monthly income more than twice the minimum wage was observed in the subgroup with good glycemic control (p=0.022), while the rates of other sociodemographic factors did not differ significantly between the subgroups with good and poor glycemic control (Table 2). When comparing FNPA scores among the subgroups divided based on monthly income, parents' education status, the number of people living in the household, or marital status, no significant differences were found within any of the subgroups.

A multiple linear regression model (enter method) was established with the independent factors: age, gender, having a diagnosis of T1DM, and BMI SDS to reveal the factors affecting FNPA scores. The presence of T1DM diagnosis and age were found to be the determinants of FNPA score (F=9.716, adjusted R2=0.127, p<0.001) (Table 3).

DISCUSSION

The main findings of the study indicate that family nutrition and physical exercise habits are better in children with T1DM compared to non-diabetic children, and these habits are associated with good glycemic control. Although the FNPA tool has not been previously examined in children with T1DM, the relationship between regular exercise, maintaining a balanced diet, and good glycemic control is already known.[11,12]

Children diagnosed with T1DM and their parents receive education from the diabetes team at the time of diagnosis, which includes essential nutritional recommendations such as the importance of healthy eating, meal-time routines, carbohydrate counting (if possible), and basic exercise recommendations, as recommended by the International Society for Pediatric and Adolescent Diabetes (ISPAD).[13] It is reasonable to assume that children with T1DM and their parents are more knowledgeable about physical exercise and nutrition, resulting in better habits, as supported by the findings of this study. When examining the subdimensions of the scale, it is observed that children with T1DM score higher than non-diabetic children in the areas of "Meals in the family," "Beverage selections," and "Limitation/Rewarding". These subdimensions include items that question the frequency of consuming fast food, cookies, candy, chips, and sweetened beverages. Limiting the consumption of these foods applies not only to children with T1DM but also to all healthy children.[14,15] The observation that families of children with T1DM in our study exhibited better habits may reflect the education they received. Additionally, the relationship between controlled consumption of these foods and good glycemic control[16] explains the higher scores in these subdimensions among families with well-controlled children in our study.

When investigating the triple relationship among socioeconomic status, familial nutrition and physical activity habits, and glycemic control, it was found that only higher monthly income and better familial nutrition and physical activity habits were associated with good glycemic control. However, no significant relationship was found between any of the sociodemographic parameters and familial nutrition and physical activity habits. The correlation between good glycemic control and family income is already known and is attributed to factors such as dietary quality, food availability, and the affordability of insulin and other self-management supplies.[17] Unlike our study, a study on childhood obesity in school children, which did not focus on children with diabetes, found that children in schools with higher socioeconomic status had higher FNPA total scores.[9] However, in our study, which examined socioeconomic and sociodemographic data in more detail, such a direct relationship was not observed.

In this study, a negative relationship was shown between family nutrition and activity habits and the age of children. In a study conducted in first and tenth-grade children, FNPA scores were found to be higher in the first-grade children,[18] which was not considered an unexpected finding by the authors, and was attributed to the possibility that adolescents may be less influenced by the attitudes of their parents due to individualization during this period.

The findings of this study indicate no relationship between familial nutrition and activity habits and the child's BMI, which may be an unexpected finding. Similarly, two studies conducted in Türkiye and Oregon also failed to demonstrate a relationship between BMI SDS and total FNPA scores in school-aged children.[4,19] In another study involving first and tenth-grade children, BMI percentiles did not correlate with FNPA scores in either group.[18] However, after dividing the first-grade students into three groups based on FNPA scores, it was observed that the prevalence of obesity was considerably greater among children in the lowest tertile than among those in the highest tertile. Nevertheless, this finding could not be demonstrated in the tenth-grade students. Ihmels et al., the creators of the tool, found that lower total FNPA scores were associated with an increased risk of childhood obesity and that FNPA predicted change in BMI over a one-year period.[8,20] The differences in sample characteristics, such as age groups and socio-demographic features, may have caused the discrepancies in these findings.

Limitations

Our study addressed the exercise and nutritional habits of families with children with T1DM in line with its objectives. However, we acknowledge several limitations in our study. Firstly, we did not consider the BMI of the parents. Secondly, the data on sociodemographic characteristics were obtained over the phone, and only for the diabetic group, while the FNPA scale was administered face-to-face. As a result, we were unable to assess the impact of sociodemographic characteristics on FNPA scores for the non-diabetic population. Furthermore, since our study was conducted in a dietitian outpatient clinic with a cross-sectional design, there was a higher incidence of obese children in the non-diabetic group. To address this potential influence, we compared BMI-matched subgroups. Nevertheless, it is important to note that using a control group composed solely of patients from a tertiary hospital may limit its representativeness.

CONCLUSION

In this study, the FNPA scale was evaluated for the first time in children with T1DM, and the relationship between family nutrition and physical activity habits with glycemic control in T1DM has been clearly demonstrated. The results of our study emphasize the significance of promoting awareness about proper nutrition and physical activity within the family to achieve treatment goals in T1DM.

Peer-review: Externally peer-reviewed.

Ethics Committee Approval: The İstanbul University-Cerrahpaşa University Clinical Research Ethics Committee granted approval for this study (date: 07.06.2022, number: 409858).

Informed Consent: Written, informed consent was obtained from the patients' families for the publication of this case report.

Author Contributions: Concept – GT, DGK; Design – GT, DGK; Supervision – OE; Resource – DGK; Materials – DGK; Data Collection and/or Processing – HK, DGK; Analysis and/or Interpretation – GT; Literature Search – OE, HK; Writing – GT, HK, OE; Critical Reviews – OE.

Conflict of Interest: The authors have no conflict of interest to declare.

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