Research Paper

Prevalence of Eating Behaviors and Their Influence on Metabolic Control of Children With Type 1 Diabetes Mellitus

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ABSTRACT

Background: Since a comprehensive study of eating disorders in children with type 1 diabetes in the Iranian population is necessary, this study aimed to investigate the prevalence of eating behaviors and metabolic control status of children and adolescents with diabetes mellitus.

Objectives: The present cross-sectional study aim to explore the prevalence of eating behaviors and their influence on metabolic control of children with type 1 diabetes mellitus.

Methods: In this cross-sectional study, all children and adolescents 6 to 12 years old with diabetes were included. First, the prevalence of eating-related behaviors in participants was assessed and recorded. Then the recorded data were statistically analyzed.

Results: The Mean±SD age of the study participants was 8.92±1.925 years. One hundred children with food approach scores above 12.29 had food-approach behaviors, and 78 children with food avoidance scores above 11.85 were classified as having food avoidance behaviors. The relationships between food-approach behaviors and hemoglobin A1C (HbA1c) and insulin dose, body mass index (BMI), and lipid profile were significant (P<0.05). Nevertheless, the relationship between these variables and food avoidance behaviors was not significant (P>0.05).

Conclusions: High BMI, high insulin dose, increased lipid levels, and high HbA1c are associated with an increased eating tendency in children. Therefore, these children should be evaluated for disordered eating behaviors.

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Introduction

Type 1 diabetes is the most common endocrine and metabolic disorder in childhood and adolescence [1, 2]. This type of diabetes, due to its significant prevalence in children and adolescents, can disrupt the natural physical and emotional developmental process of the child [3, 4].

One of the essential issues related to children and adolescents with diabetes is investigating their eating behaviors and lifestyles. Because eating habits and the desire to eat are among the patterns acquired in early childhood and will remain until adulthood, the study and intervention of these habits in children are of serious and long-term importance. Attention to eating behaviors in diseases such as diabetes, one of the diet-related diseases and one of the most common metabolic disorders in children, is significant in promoting general health and has long-term effectiveness [5].

Eating behavior is a broad term that includes food choices and motivations, eating habits, diet, and food-related problems such as obesity and eating disorders [6]. Research shows that diabetes is associated with an increased risk of eating disorders. This correlation varies depending on the type of diabetic patient [7].

Eating disorders are defined as the presence of persistent and irregular eating behaviors. These disorders, by definition, lead to changes in food intake and absorption and impair a person's physical and mental function. On the other hand, eating disorders are challenging to diagnose in people with type 1 diabetes because of their unique eating behaviors, such as fasting, dieting, overeating, intentional vomiting, and abuse of laxatives or diet pills, diuretics, or other medications. Moreover, doing too much exercise to control weight is often well hidden from patients, and patients deny these behaviors [8, 9].

Considering the importance of eating behaviors of diabetic children in the prevention of short- and long-term complications, and the lack of adequate studies in the field of eating disorders in diabetes, this study was conducted to investigate the frequency of eating behaviors and metabolic control status in children and adolescents aged 6 to 12 years with diabetes referred to the Diabetes Clinic of Bu Ali Sina Hospital in Sari City, Iran, in 2020-21.

Methods

After informed consent, children and adolescents aged 6-12 years old recently diagnosed with diabetes, were included. Exclusion criteria were unwillingness to participate, type 2 diabetes, any other medical condition or psychiatric disorders, and taking drugs that affect eating behaviors (such as cannabis and its derivatives that cause overeating or amphetamine compounds that reduce the urge to eat). The demographic checklist and the Persian version of the child eating behavior questionnaire (CEBQ) [10] were filled out by the children's parents. This questionnaire consists of 35 items and 2 major scales (food approach and avoidance) with 8 subscales. Each subscale has between 3 and 5 items. Questions are scored on a 5-point Likert scale from "never," "rarely," "sometimes," "often," and "always," with a score of 1 to 5 for each phrase. Several questions are scored in reverse. Then, the recorded data were statistically analyzed using statistical methods.

Comparison between qualitative variables was performed applying the Chi-square test or Fisher exact test, and comparison of mean age and other quantitative variables was conducted by independent t-test. Also, the correlation between quantitative variables was evaluated by applying the Pearson correlation coefficient test. Statistical analyses were performed by using SPSS software, version 25 and $P<0.05$ was considered statistically significant.

Results

In this study, 97 girls and 81 boys participated (54.5% and 45.5%, respectively). The Mean±SD age of the study participants was 8.92±1.925 years. Most participants were from Sari (44.5%), Ghaemshahr (14.7%), and Amol (10.8%) cities. The mean body mass index (BMI) of the participants was 23.14 kg/m^2. The sum of the scores of the first four criteria (food responsiveness [FR], enjoyment of food [EF], emotional over-eating [EOE], and the desire to drink [DD]) as criteria for food approach and scores related to the second four criteria (satiety responsiveness [SR], slowness in eating [SE], food fussiness [FF], emotional under-eating [EUE]) are categorized as food avoidance criteria.

Based on Table 1, 100 children with food approach scores above 12.29 had food-approach behaviors, and 78 children with food avoidance scores above 11.85 were classified as food avoidance behaviors.

Table 1. Scores of eating and avoiding behaviors

Behavior	No.	Mean±SD
Tendency to eat	100	12.29±2.71
Avoid food	78	11.85±1.80

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Table 2 shows the correlation between food approach/avoidant behaviors and metabolic indices.

Discussion

studies have generally focused on adult patients and limited studies have been published on children with type 1 diabetes. To the best of our knowledge, this is the first study to evaluate the prevalence of eating behaviors and their influence on metabolic indices of children with type 1 diabetes mellitus living in Mazandaran Province, Iran.

About 56.17% of children had food-approach behaviors, and 43.82% had food avoidance behaviors.

The present study showed a significant positive correlation between HbA1c, triglyceride, cholesterol levels, BMI, and insulin dose with food approach behaviors. There was not any significant association between food avoidance behaviors and metabolic indices.

Food approach behaviors were found to be significantly associated with HbA1c. However, avoidance behaviors were not associated with HbA1c. This finding was inconsistent with the results of Markowitz's study, which found no association between HbA1c and food-approach behaviors [3]. The reason for this difference can be related to different study populations.

In the current study, increased food cravings were linked to higher BMI and children with higher BMI were more inclined to eat. However, food avoidance behaviors were not associated with BMI. This was in line with previous results [11, 12, 13].

Table 2. Results of the pearson correlation test of eating behaviors with the studied variables

Variables	Behavior	Correlation Coefficient	P
Hemoglobin A1c (mmol/mol)	Tendency to eat	0.205	0.006
	Avoid food	0.076	0.314
Body mass index (kg/m^2)	Tendency to eat	0.285	<0.001
	Avoid food	-0.074	0.089
Dosage of insulin consumed (µIU/mL)	Tendency to eat	0.170	0.023
	Avoid food	0.006	0.983
Triglyceride (mg/dL)	Tendency to eat	0.149	0.47
	Avoid food	-0.012	0.876
Cholesterol (mg/dL)	Tendency to eat	0.085	0.291
	Avoid food	0.310	0.680
Low-density lipoprotein (mg/dL)	Tendency to eat	-0.038	0.612
	Avoid food	0.024	0.752
High-density lipoprotein (mg/dL)	Tendency to eat	-0.11	0.889
	Avoid food	0.015	0.482

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According to the present study, there was a significant difference between the mean triglyceride and insulin dose of children with and without food approach behaviors. The mean triglyceride and insulin doses of children with food-approach behaviors were higher than those of children without food-approach behaviors. These findings confirm the previous findings because with increasing BMI, the mean triglyceride and insulin dose in children also increases.

Racicka et al. reported refusing to take proper insulin dosage as one of the most abnormal behavioral patterns in children with type 1 diabetes. Age, female gender, higher BMI, body image dissatisfaction, history of dieting, and depression were also associated with an increased risk of disordered eating [7]. In contrast, the present study showed no significant difference between gender, BMI, and insulin dose of children with and without abnormal eating behaviors which could be explained by differences in the populations studied.

Traditionally, lifestyle and diet have been linked to type 2 diabetes more than type 1 diabetes. Hanlan et al. reported that patients with type 1 diabetes that begins in adolescence are at greater risk for eating disorders than those with type 1 diabetes sooner or later [14]. For this reason, the present study was performed on type 1 diabetic patients.

According to Winston et al., disordered eating behaviors are common in type 1 and type 2 diabetes. The term "Diabulimia" is defined as the combination of type 1 diabetes and taking inadequate amounts of insulin for weight control. This combination leads to elevated levels of HbA1c and an increased risk of complications. Association between affective states, eating behaviors, blood glucose, and insulin administration should be considered in a comprehensive treatment plan [15].

Researchers have generally focused on adult patients in studies, so limited studies have been published on children about the above subject [15, 16]. In the present study, considering the importance of metabolic control in children with type 1 diabetes, we investigated the prevalence of eating behaviors in children and their relationship with the metabolic management of patients in the Iranian population.

Wändell et al. examined 14721 patients with type 1 diabetes in Sweden. In this study, in the age range of 0 to 14 years, there was no significant difference between the prevalence and incidence of type 1 diabetes in boys and girls. However, the incidence of diabetes increased with age and was higher after the age of 14 in boys which is in line with current findings [17].

The mean age of diabetics in our study was 8.92 years. According to studies, children with type 1 diabetes have reported two age peaks, one between 4 and 7 years old and the other between 10 and 14 years old [8, 18]. In the present study, most people were in the second age peak.

The mean BMI of our participants was 23.14 kg/m^2 and both sexes were overweight. According to De Keukelaere et al. survey, the weight changes of children with type 1 diabetes [19] were different from the present study. The reason for this difference can also be related to the study populations. In their study, patients lost weight, and their BMI decreased with the disease onset. The study found that children with type 1 diabetes were at risk of being overweight. In this study, age and the length of time since diagnosis were identified as two independent predictors of overweight in diabetic children. According to this study, girls' risk of being overweight is slightly higher than boys' [19]. Because the prevalence of disordered eating is also higher in people with diabetes than in the general pediatric population, there may be a link between dietary habits and weight gain in these patients.

Numerous studies have shown a severe association between diabetes and metabolic disorders in patients' metabolic profiles. Metabolic syndrome is one of the most serious medical problems in the modern world, which has a high annual cost to the health system, both in developed and developing countries [20]. According to McGill et al. study, 15% of patients with type 1 diabetes also had metabolic syndrome simultaneously. Also, the possibility of insulin resistance and long-term complications associated with diabetes and metabolic syndrome was higher in this group of patients [21]. Guy et al. examined the lipid profile of 599 patients with type 1 diabetes and compared it with the general population in adolescents aged 10 to 22 years [22]. They found that higher HbA1c levels were associated with higher total cholesterol and triglyceride levels [22]. The present study also concluded that the lipid profile increases in children with eating tendencies.

In another study published by Zahra Dasht-e Bozorgi, there was no significant difference between boys and girls in mean scores of food approach or avoidance behaviors. Future studies need to examine the effect of gender on eating behaviors [23].

Minges et al. conducted a systematic review on obesity and overweight in children with type 1 diabetes [24]. According to their study, the prevalence of obesity and overweight in various studies published between 1990 and 2013 in children and adolescents has been reported to be between 12.5% and 33.3% [24]. Kuźbickav and Rachoń also reported poor eating habits, such as overeating, as the leading cause of childhood obesity [25]. Based on the aforementioned studies and current findings, children with type 1 diabetes tend to eat more, but no significant association was observed between type 1 diabetes and food avoidance behaviors.

The present study also investigated the metabolic indices and the possible relationship with the food tendency scores. Food cravings were found to be significantly associated with impaired HbA1c and higher triglyceride levels. Patients with food-approach behaviors also used significantly more insulin to control diabetes. There was no significant relationship between food avoidance behaviors and the indicators studied.

In summary, according to the present study, food approach behaviors were associated with higher BMI, higher insulin dose, higher HbA1c, and higher blood triglyceride levels. These findings are also in line with Troncone et al. results in Italian adolescents with type 1 diabetes, symptoms of disordered eating, emotional problems, and body image dissatisfaction [26]. This study showed that adolescents with type 1 diabetes and disordered eating had lower socioeconomic status, worse metabolic control, higher BMI, and more body image problems. There are also more physical, emotional, and behavioral problems that are in line with the present study's findings.

Conclusion

This study substantiates evidence linking high BMI, high insulin dose, increased lipid levels, and high HbA1c levels to an increased risk for food approach behavior and overeating in children. Therefore, children with high BMI, dangerous lipid profiles, and high HbA1c levels who consume high insulin doses should be evaluated for eating behavior patterns.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Research Ethics Committee of Mazandaran University of Medical Sciences (Code: IR.MAZUMS.REC.1399.614).

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Authors contributions

Conceptualization and Supervision: Arian Jahandideh and Daniel Zamanfar; Methodology: Samaneh Farnia; Investigation and writing- original draft: Arian Jahandideh and Samaneh Farnia; Data Collection: Arian Jahandideh; Data analysisi: Arian Jahandideh, Mamood Moosazadeh and Akbar Hedayatizadeh-Omran.

Conflicts of interest

The authors declared no conflict of interest.

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