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Dietary Intake and Eating Patterns of Children with Type 1 Diabetes to Achieving Glycemic Targets

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ABSTRACT

Background: Type 1 diabetes (T1D) occurs when there is the autoimmune destruction of pancreatic beta cells leading to insufficient insulin production and resulting in hyperglycemia. The complex balance of glucose is affected by food, insulin doses, body stresses, exercise, and dozens of other factors. Patient and family education is key, as is an acknowledgment of the normal developmental stages and the challenges this brings in the context of daily living with a chronic disease. **Aim of work**: To assess nutritional intake and mealtime routines of young children with T1D. **Methods**: A prospective cohort study was carried out among 100 children with T1D mellitus, aged between 2-18 years old, the child was diagnosed with T1D at least 1 month before recruitment to the study and were taught to count CHO using the 15-g exchange as a method of CHO quantification. Children were recruited from the outpatient clinic of Endocrinology Clint at Tanta University Hospital, Al-Gharbia Governorate. Before participating in the study, the protocol was fully explained to the patients, and their informed consent was obtained. **Results**: There was a significant positive correlation between HB A1C and food frequency of studied T1D patients including Baladi bread (P = 0.050), White honey (P = 0.039), Luncheon (P = 0.030), and cooked vegetable groups (P = 0.017). **Conclusion:** Parents and children with knowledge about the glycemic index of food can achieve glycemic targets and control more than others.

Keywords: Dietary Intake, Eating Patterns, Children with Type 1 Diabetes, Glycemic Targets.

1. Introduction

Type 1 diabetes (T1D) occurs when there is the autoimmune destruction of pancreatic beta cells leading to insufficient insulin production and resulting in hyperglycemia. With insulin replacement, T1D is a chronic disease requiring intensive effort on the part of the person with diabetes and caregivers (Chiang *et al*., 2018). There is an emphasis on reducing hyperglycemia while minimizing the risk of hypoglycemia. The complex balance of glucose is affected by food, insulin doses, body stresses, exercise, and dozens of other factors. Patient and family education is key, as is an acknowledgment of the normal developmental stages and the challenges this brings in the context of daily living with a chronic disease (ADA, 2019).

Diagnostic criteria by the American Diabetes Association (ADA) include the following: A fasting plasma glucose level ≥126 mg/dL (7.0 mmol/L), or A 2-hour plasma glucose level ≥ 200 mg/dL (11.1 mmol/L) during a 75-g oral glucose tolerance test, or A random plasma glucose ≥2 00 mg/dL (11.1 mmol/L) in a patient with classic symptoms of hyperglycemia or hyperglycemic crisis (ADA, 2014).

Glycemic control is assessed by the HbA1C measurement, continuous glucose monitoring (CGM) using either time in range (TIR) and /or glucose management indicator (GMI), and blood glucose monitoring (BGM). A1C is the metric used to date in clinical trials demonstrating the benefits of improved glycemic control (Deshmukh *et al*., 2020). Dietary patterns are defined as the quantities, proportions, variety, or combination of different foods, drinks, and nutrients in diets, and the frequency with which they are habitually consumed (Boushey *et al*., 2020)

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Young children with T1D consume more saturated fat and less fruit and vegetables than recommended. A common challenge in this age group is unpredictable appetite potentially impacting the way parents manage diabetes care at mealtimes (Smart *et al*., 2014). Connection between T1D and eating disorders is of concern as these are associated with poor glycemic control, frequent episodes of ketoacidosis, and more frequent emergency room and hospital visits (Rydall *et al*., 1997).

The study aimed to assess the nutritional intake and mealtime routines of young children with T1D, evaluate the nutritional status of Children with T1D, and find the correlation between dietary intake and eating patterns on achieving glycemic targets for children with T1D and the effect of knowledge about glycemic index of food on achieving glycemic targets in these children.

2. Subjects and methods

2.1. Study design and participants

A prospective cohort study was conducted on 100 patients' children with T1D mellitus. Children were recruited from the outpatient clinic of Endocrinology Clint at Tanta University Hospital, Al-Gharbia Governorate. The sample size was identified according to Thompson, (2012) equation. The inclusion criteria: age between 1-18 years old, children diagnosed with T1D at least 1 month before recruitment to the study, and were taught to count CHO using the 15-g exchange as a method of CHO quantification. Exclusion criteria: Patients≥18 years and those with T1D of < 1 month's duration, an A1C > 12%.

2.2. Data collection tools

2.2.1. Socioeconomic status assessment:

The patient's socioeconomic status was evaluated by the valid and reliable socioeconomic status scale for health research in Egypt (El-Gilany *et al*., 2012). Socioeconomic status (SES) encompasses not just income but also educational attainment, financial security, and subjective perceptions of social status and social class. Socioeconomic status can encompass quality of life attributes as well as the opportunities and privileges afforded to people within society has seven domains with a total score 84, the socioeconomic status was classified according to the quartiles of the score into very low, low, middle, and high levels (8).

2.2.2. Anthropometric measurements and Biochemical assessment:

Height and weight measured for each patient by a trained nutritionist to reduce self-measurement errors as recommended (Kuczmarski *et al*., 2001), using the height and weight scale in hospitals. The body mass index (BMI) was used for defining anthropometric height/weight characteristics and for categorizing patients into groups. BMI was computed using the formula, weight (kg) / height squared (m2) (Nuttall, 2015). According to BMI, participants were classified as normal weight if their BMI was between 18.5-24.9 kg/m2, overweight if their BMI was between 25.0 kg/m2 and 29.9 kg/ m2, obese if their BMI was 30 kg/m2 or higher, and underweight if their BMI was <18.5 kg/m2 (Cope and Allison, 2008). Blood glucose and HBA1C test were measured in the hospital's lab.

2.2.3. Dietary intake assessment:

The food frequency questionnaire (FFQ) generally consists of a list of food items, frequencies of consumption, and portion sizes in either single or multiple categories (Coulston *et al*., 2017). It evaluates the frequency of consumption of food(s), drinks, and food groups during a certain period, which may be daily, monthly, or yearly according to the aim of the study, it usually has a closed and adjustable list because the list should contain local foods or foods related to the target disease.

2.3. Statistical analysis:

The results were analyzed by SPSS statistical package version 15 (Statistical Package for Social Science) and the results were tabulated and used the Harvard graphics package version 4 to represent the results graphically. Qualitative variables were expressed as percentages (Armitage *et al*., 2008). Quantitative variables from normal distribution were expressed as Mean ±SD. A significant P-value was considered when P is less than 0.05. $P<0.05$ was adopted as the level of significance.

3. Results

Table (1) demonstrates the general characteristics of the studied Type 1 Diabetes patients, and shows that there were no significant differences between males and females in their age, socioeconomic level, weight, height, and BMI. Patients were aged between (2- 18) years with approximately the same mean age in both groups (10.012, SD: ± 4.232 &10.675, SD: ± 3.770).

Table 1: The General characteristics of the studied Type 1 Diabetes patients, socioeconomic level, and anthropometric measurements.

		Male (n=43)		Female (n=57)		Sig. Test Mc	P value
		N	%	N	%		
Age	Mean± SD	10.012 ± 4.232		10.675 ± 3.770		χ2 0.604	0.739
	<6years	7	16.3%	6	10.7%		
	7- 12 years	24	55.8%	32	55.4%		
	13-18 years	12	27.9%	19	33.9%		
Socioeconomic level	Middle	8	18.6%	8	14.0%	0.579	0.749
	Low	14	32.6%	22	38.6%		
	Very low	21	48.8%	27	47.4%		
Height	Range	85- 169		92-169		1079.50	0.309
	Mean ±SD	134±25.71		140.69 ± 20.54			
	Median	141		146			
Weight:	Range	11 - 92.30		13-80		1039	0.194
	Mean ±SD	38.66 ± 20.52		41.89 ±15.98			
	Median	33		45			
Body mass index:	Range	8.64 – 38.68		6.30- 74		1145.50	0.578
	Mean ±SD	20.40 ± 6.87		21.35 ± 9.36			
	Median	19.32		20.54			

Data presents as mean ± S , frequency (%), Range or Median, SD= Standard Deviation ,χ2= chi square test, p: probability value *: statistically significant

Table 2: describes the clinical features between studied Type 1 Diabetes patients. There were significant differences between males and females in a family history of diabetes (P=0.025), as (59.5%)of females had a family history of diabetes compared to (63.2%) males do not have a family history of diabetes. Also, there were significant differences between males and females in the mother's history of gestational diabetes or type 1 or type 2 diabetes and diabetes duration (P=0.019&P= 0.001, respectively).

Table 2: Clinical features of the studied Type 1 Diabetes patients (N=100).

		Male (n=43)		Female (n=57)		Sig. test	P value
		n	%	n	%		
Does anyone in your family have diabetes?	Yes	25	59.5%	21	36.8%	χ2 5.001	0.025*
	No	17	40.5%	36	63.2%		
Did the mother have gestational diabetes or type 1 or type 2 diabetes?	Yes	39	90.7%	57	100.0%	Mc 5.523	0.019*
	No	4	9.3%	0	0.0%		
How long have you had diabetes or what year was it diagnosed?	< 1 year	14	32.6%	8	14.0%	17.682	0.001*
	2 years	21	48.8%	17	29.8%		
	3-4 years	3	7.0%	11	19.3%		
	5- 6 years	5	11.6%	10	17.5%		
	>6 years	0	0.0%	11	19.3%		
HB A1c:	Range	1 – 6		1-6		U 1174	0.716
	Mean ±SD	3.35 ±1.75		3.21 ± 1.63			
	Median	3		3			
The dose of insulin	2\3\2\3	8	18.6%	7	12.3%	7.199	0.303
	4\4\4\6	9	20.9%	7	12.3%		
	5\4\3\7	8	18.6%	7	12.3%		
	7\8\4\8	6	14.0%	15	26.3%		
	6\8\6\8	8	18.6%	8	14.0%		
	15\20\10\30	2	4.7%	6	10.5%		
	20\4\20\20	2	4.7%	7	12.3%		

Data presents as mean ± S , frequency (%), Range or Median, SD= Standard Deviation ,χ2= chi square test, p: probability value *: statistically significant

Tables (3-6): indicate that there were significant differences between males and females in the consumption rate of white bread, pasta, pastries and biscuits, milk, fried meat, boiled meat, luncheon, fried fish, liver, brain yogurt, cooked cheese, fresh vegetable groups, banana, apples, grapes, artificial ghee and local ghee (P<0.05), while there were no significant differences in Baldy bread, sugary food including white honey and black honey, drinks group including tea and coffee, and orange, lemon, grapefruit, mandarin, legumes group including beans and falafel, Egyptian lentils, koshary, dry beans, cowpeas, grilled meat, fried chicken, grilled fish, qarish cheese, cooked cheese, cooked vegetable groups and oil.

Table 3: Basic consumption rate of cereal and surgery food among studied Type 1 Diabetes patients (N=100)

Cereal Group		**Male (n=43)**		**Female (n=57)**		**Sig. test MC**	**P value**
		n	%	n	%		
Baldy bread	Once a day	14	32.6%	9	15.8%	7.092	0.105
	2-3 times a day	18	41.9%	26	45.6%		
	Once a week	0	0.0%	1	1.8%		
	2-3 times a week	6	14.0%	17	29.8%		
	Don't eat	5	11.6%	4	7.0%		
White bread	Once a day	8	18.6%	5	8.8%	11.884	0.026*
	Once a week	4	9.3%	0	0.0%		
	2-3 times a week	2	4.7%	7	12.3%		
	1-3 times a month	24	55.8%	31	54.4%		
	Every 3 months	0	0.0%	3	5.3%		
	Don't eat	5	11.6%	11	19.3%		
Pasta	Once a week	10	23.3%	8	14.0%	$\chi2$ 11.740	0.008*
	2-3 times a week	7	16.3%	7	12.3%		
	1-3 times a month	15	34.9%	38	66.7%		
	Don't eat	11	25.6%	4	7.0%		
Pastries and biscuits	Once a day	12	27.9%	11	19.3%	10.374	0.050*
	2-3 times a day	4	9.3%	3	5.3%		
	2-3 times a week	20	46.5%	31	54.4%		
	1-3 times a month	4	9.3%	0	0.0%		
	Every 3 months	1	2.3%	6	10.5%		
	Don't eat	2	4.7%	6	10.5%		
Sugary food							
White honey	Once a week	1	2.3%	1	1.8%	4.444	0.337
	2-3 times a week	1	2.3%	0	0.0%		
	1-3 times a month	4	9.3%	7	12.3%		
	Every 3 months	8	18.6%	19	33.3%		
	Don't eat	29	67.4%	30	52.6%		
Black honey	1-3 times a month	4	9.3%	7	12.3%	$\chi2$ 0.846	0.655
	Every 3 months	7	16.3%	6	10.5%		
	Don't eat	32	74.4%	44	77.2%		

Data presents as frequency (%), SD= Standard Deviation, p: probability value. *: statistically significant

Table 4: Basic consumption rate of animal protein and Dairy products among studied Type 1 Diabetes patients (N=100)

Animal protein		Male (n=43)		Female (n=57)		Sig. test MC	P value
		n	%	n	%		
Fried meat	Once a week	8	18.6%	3	5.3%	7.922	0.037*
	1-3 times a month	2	4.7%	0	0.0%		
	Every 3 months	23	53.5%	41	71.9%		
	Don't eat	10	23.3%	13	22.8%		
	Once a day	2	4.7%	0	0.0%		
Boiled meat	1-3 times a month	0	0.0%	5	8.8%	7.613	0.035*
	Every 3 months	31	72.1%	34	59.6%		
	Don't eat	10	23.3%	18	31.6%		
Grilled meat	Every 3 months	13	30.2%	14	24.6%	$\chi2$ 0.400	0.527
	Don't eat	30	69.8%	43	75.4%		
Fried chicken	Once a week	6	14.0%	1	1.8%	6.943	0.070
	1-3 times a month	5	11.6%	13	22.8%		
	Every 3 months	18	42.0%	25	43.9%		
	Don't eat	14	32.4%	18	31.6%		
Luncheon	Once a week	5	11.6%	0	0.0%	7.333	0.050*
	1-3 times a month	10	23.3%	12	21.1%		
	Every 3 months	14	32.6%	22	38.6%		
	Don't eat	14	32.6%	23	40.4%		
Fried fish	Once a week	3	7.0%	2	3.5%	13.991	0.002*
	1-3 times a month	12	27.9%	10	17.5%		
	Every 3 months	9	20.9%	33	57.9%		
	Don't eat	19	44.2%	12	21.1%		
Grilled fish	Once a week	0	0.0%	1	1.8%	1.727	0.898
	1-3 times a month	0	0.0%	1	1.8%		
	Every 3 months	20	46.5%	28	49.1%		
	Don't eat	23	53.5%	27	47.4%		
Liver and brain	1-3 times a month	2	4.7%	0	0.0%	5.567	0.039*
	Every 3 months	15	34.9%	12	21.1%		
	Don't eat	26	60.5%	45	78.9%		
Dairy products							
Milk	Once a day	18	41.9%	16	28.1%	12.079	0.014*
	2-3 times a week	15	34.9%	23	40.4%		
	1-3 times a month	4	9.3%	0	0.0%		
	Every 3 months	0	0.0%	6	10.5%		
	Don't eat	6	14.0%	12	21.1%		
Yogurt	Once a day	1	2.3%	0	0.0%	9.879	0.031*
	Once a week	6	14.0%	1	1.8%		
	2-3 times a week	17	39.5%	20	35.1%		
	1-3 times a month	7	16.3%	20	35.1%		
	Don't eat	12	27.9%	16	28.1%		
Qarish cheese	Once a week	9	20.9%	7	12.3%	$\chi2$ 1.743	0.627
	2-3 times a week	17	39.5%	27	47.4%		
	1-3 times a month	9	20.9%	14	24.6%		
	Don't eat	8	18.6%	9	15.8%		
Full fat salted cheese	2-3 times a week	1	2.3%	0	0.0%	9.527	0.014*
	1-3 times a month	9	20.9%	2	3.5%		
	Every 3 months	14	32.6%	27	47.4%		
	Don't eat	19	44.2%	28	49.1%		
Cooked cheese	Once a day	1	2.3%	0	0.0%	3.881	0.275
	1-3 times a month	5	11.6%	9	15.8%		
	Every 3 months	23	53.5%	22	38.6%		
	Don't eat	14	32.6%	26	45.6%		

Data presents as frequency (%), SD= Standard Deviation, p: probability value. *: statistically significant

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Table 5: Basic consumption rate of legumes, fruits vegetables, and fats among studied Type 1 Diabetes patients (N=100)

Legumes		Male (n=43)		Female (n=57)		Sig. test MC	P value
		n	%	n	%		
Beans and falafel	Once a day	27	62.8%	39	68.4%	χ2 0.346	0.556
	2-3 times a day	16	37.2%	18	31.6%		
Egyptian lentils and koshary	Once a day	2	4.7%	2	3.5%	1.943	0.876
	Once a week	12	27.9%	17	29.8%		
	2-3 times a week	15	34.9%	20	35.1%		
	1-3 times a month	7	16.3%	11	19.3%		
	Every 3 months	6	14.0%	4	7.0%		
	Don't eat	1	2.3%	3	5.3%		
Dry beans and cowpeas	Once a day	2	4.7%	5	8.8%	0.691	0.914
	Once a week	18	41.9%	23	40.4%		
	Every 3 months	16	37.2%	21	36.8%		
	Don't eat	7	16.3%	8	14.0%		
Fruits & vegetables							
Fresh vegetable groups	Once a day	1	2.3%	0	0.0%	6.378	0.027*
	2-3 times a day	28	65.1%	25	43.9%		
	Once a week	14	32.6%	32	56.1%		
Cooked vegetable groups	Once a day	11	25.6%	21	36.8%	χ2 5.391	0.249
	2-3 times a week	14	32.6%	14	24.6%		
	1-3 times a month	6	14.0%	7	12.3%		
	Every 3 months	12	27.9%	11	19.3%		
	Don't eat	0	0.0%	4	7.0%		
Banana, apples, grapes	Once a week	27	62.8%	30	52.6%	8.761	0.030*
	2-3 times a week	2	4.7%	14	24.6%		
	1-3 times a month	13	30.2%	10	17.5%		
	Every 3 months	1	2.3%	3	5.3%		

Data presents as frequency (%), SD= Standard Deviation, p: probability value. *: statistically significant

Table 6: Basic consumption rate of legumes, fruits, vegetables, and fats among studied Type 1 Diabetes patients (N=100)

Fats		Male (n=43)		Female (n=57)		Sig. test MC	P value
		n	%	n	%		
Oil	Once a day	21	48.8%	19	33.3%	6.991	0.133
	2-3 times a day	9	20.9%	12	21.1%		
	2-3 times a week	11	25.6%	17	29.8%		
	1-3 times a month	2	4.7%	2	3.5%		
	Every 3 months	0	0.0%	7	12.3%		
Artificial ghee	Once a day	28	65.1%	24	42.1%	6.972	0.050*
	2-3 times a day	0	0.0%	1	1.8%		
	2-3 times a week	6	14.0%	19	33.3%		
	1-3 times a month	9	20.9%	13	22.8%		
Local ghee	1-3 times a month	0	0.0%	3	5.3%	7.862	0.014*
	Every 3 months	8	18.6%	22	38.6%		
	Don't eat	35	81.4%	32	56.1%		

Data presents as frequency (%), SD= Standard Deviation, p: probability value. *: statistically significant

Table (7): indicates that there was a significant positive correlation between HB A1C and food frequency of studied T1D patients in consumption rate of some foods including Baladi bread, White honey, Luncheon, and cooked vegetable groups ($P < 0.05$). There was an insignificant correlation between HB A1C and food frequency of studied T1D patients including white bread, pasta, biscuits, black honey, fried meat, and boiled meat.

Table 7: Correlation between HB A1C and food frequency of studied Type 1 Diabetes patients in some food.

Correlation	HB A1c	
	R	P
Baladi bread	0.190	0.050*
White bread	0.148	0.140
Pasta	0.092	0.361
Biscuits	0.150	0.136
White honey	0.207	0.039*
Black honey	0.084	0.403
Fried meat	-0.010	0.925
Boiled meat	0.162	0.106
Luncheon	0.217	0.030*
Cooked vegetable groups	0.238	0.017*

Data presents as numbers, SD= Standard Deviation, p: probability value *: statistically significant

4. Discussion

T1D is an autoimmune condition that typically manifests in childhood, necessitating lifelong insulin therapy and meticulous management of blood glucose levels. Young children with T1D face unique challenges due to their developing physiology, unpredictable eating habits, and varying activity levels, all of which can complicate glycemic control. Effective management requires a multidisciplinary approach, including medical oversight, nutritional guidance, and psychosocial support (Monaghan *et al*., 2022).

The mean age in both groups was approximately the same (10.012, SD: ±4.232 &10.675, SD: ±3.770) years, with a predominance of females (57%). Also, Souza da Cunha *et al*. (2024) study was comprised of 120 children and adolescents diagnosed with T1DM, who had an average age of (11.7 ±2.8) years and a predominance of females (53.3%, n = 64).

Regarding the socioeconomic level of the studied Type 1 Diabetes patients, the very low social level prevailed over the participating patients with a percentage of (48.8%) in males and (47.4%) in females, with no significant differences.

There were no significant differences between males and females in height, weight, and body mass index. There were no significant differences in HbA1C among male and female T1D patients. In agreement with us, Dominguez-Riscart *et al*. (2022) reported that no differences were found between the groups in any of the anthropometrical variables or the lipid profile variables.

For the comparison of medical history between the study patients, the family history of diabetes was higher in the male group compared to the female group (59.5% & 36.8% respectively, P=0.025), while the percentage of mother history of gestational diabetes or type 1 or type 2 diabetes was lower in the male group compared to female group (90.7%& 100.0% respectively, P=0.019), and diabetes duration was significant difference between both groups (P= 0.001).

In agreement with us, Dominguez-Riscart *et al*. (2022) reported that no differences were found between the groups in insulin therapy, however, they compared patients with optimal and suboptimal adherence to diet.

Brandão-Lima *et al*. (2018) showed that an inadequate intake of micronutrients may impair the insulin synthesis, secretion, and signaling pathways. This supports the need for a balanced diet for these children.

It was considered that, among macronutrients, carbohydrates are the main constituents of the diet constituting 45–50% of the daily energy intake and providing 4 Kcal/g, and proteins, which constitute 15–20% of the daily intake and provide 4 Kcal/g of energy. Proteins are included in both animal (eggs, meat, fish) and vegetable foods, such as legumes. They mostly perform a building function by contributing to growth, although in some cases, such as in uncontrolled T1D, they are used as a metabolic source (Quarta *et al*., 2023).

There were significant differences between males and females in the consumption of white bread, pasta, pastries, and biscuits males were higher than females, while there were no significant differences in balady bread. Also, there were no significant differences between both groups in the consumption of sugary food including white honey and black honey.

There were significant differences between males and females in consumption of milk (males consume more milk) whereas there were no significant differences between both groups in the consumption of drinks including tea and coffee, and orange, lemon, grapefruit, and mandarin. There were significant differences between males and females in consumption of fried meat, boiled meat, luncheon, fried fish, and liver and brain ($p<0.05$) whereas there were no significant differences between both groups in the consumption of grilled meat, fried chicken, and grilled fish. There were significant differences between males and females in the consumption of yogurt and cooked cheese (males had high consumption) whereas there were no significant differences between both groups in the consumption of qarish cheese and cooked cheese.

There were significant differences between males and females in the consumption of fresh vegetable groups and bananas, apples, and grapes (p=0.027, 0.030) whereas there were no significant differences between both groups in cooked vegetable groups. There were significant differences between males and females in artificial ghee and local ghee (p=0.050, 0.014) whereas there were no significant differences between both groups in the consumption of oil.

There was a significant positive correlation between HBA1C and food frequency of studied T1D patients including Baladi bread (P = 0.050), White honey (P = 0.039), Luncheon (P = 0.030), and cooked vegetable groups (P = 0.017).

In difference, Seckold *et al*. (2019) HbA1c was not correlated with daily total carbohydrate, protein, or fat intake. HbA1c was significantly higher in children offered food in a grazing pattern compared with those offered regular meals (mean 61 mmol/mol vs 43 mmol/mol.

There was an insignificant correlation between HBA1C and food frequency of studied T1D patients including white bread, pasta, biscuits, black honey, fried meat, and boiled meat.

Our results were confirmed and illustrated by Lejk *et al*. (2021) who stated that patients who consumed more vegetables or grains, more wheat products, fewer fats, and ranked fruit juice as the most common selection in the drinks category achieved glycemic control more often after the introduction of a 30% carbohydrate diet, as opposed to those with different dietary patterns, whose glycaemic control was negatively impacted after switching to this diet .

Similar to our results, Abdelseed (2021) demonstrates that, out of 71 diabetic children 78.9% were of poor glycemic control, but the majority had good knowledge about the diabetic treatment including insulin administration, its storage conditions, and also the effect of exercise on blood glucose .

In difference with our insignificant data, a cross-sectional study by Dominguez-Riscart *et al*. (2022) suggested that adherence to the Mediterranean diet may contribute to better glycemic control in children. This should be taken into account at the time of nutritional education on T1D patients and their families.

The limitations of the study were the relatively small sample size from only one center and the lack of assessing the relation between several parameters and HBA1C.

5. Conclusion

From our study results, parents and children with knowledge about the glycemic index of food can achieve glycemic targets and control more than others. We found no association between HBA1C and food frequency in children with type 1 diabetes including white bread, pasta, biscuits, black honey, fried meat, and boiled meat, while there was a positive association with other food frequencies including Baladi bread, White honey, Luncheon, and cooked vegetable groups.

Therefore, we recommend assessing the nutritional intake and mealtime routines of young children with T1D, utilizing the same study methodology on further studies with larger sample sizes and multiple centers, and assessing the relation between several parameters and HBA1C.

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