Food consumption and metabolic control in children and adolescents with type 1 diabetes mellitus

Consumo alimentar e controle metabólico em crianças e adolescentes portadores de diabetes melito tipo 1

Consumo alimentar y control metabólico en niños y adolescentes portadores de diabetes mellitus tipo 1

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ABSTRACT

Objective: To evaluate the relationship between dietary intake and metabolic control in children and adolescents with type 1 diabetes mellitus (DM1).

Methods: Cross-sectional study with 11 children and 39 adolescents with DM1. The following variabes were collected: meals data (habits, three 24-hour recall – R24h), therapeutic (insulin) and biochemical data (index of glycated hemoglobin – inHbA, casual glucose – GLC, post-prandial glucose – GLPP, and lipid profile). Student's t-test and Pearson correlation were applied, being significant $p<0.05$.

Results: Among the studied subjects, consumption of food out of time was identified in 64% and consumption of sugary products in 6%. The parameters included in the lipid profile were adequate in 88% for serum total cholesterol (sCT), in 92% for LDL, in 100% of children and 69% of adolescents for TG and in 82% of children and 84.6% of adolescents for HDL. InHbA was adequate in 64% and GLPP in 18% of the studied population. There was a negative correlation between sCT and carbohydrate intake (r=-0.324; $p=0.022$) and a positive correlation with lipids intake (r=0.315; $p=0.026$).

Conclusions: The increased consumption of lipids and the lower carbohydrate intake are correlated with higher levels of sCT.

Key-words: adolescent; food consumption; child; diabetes mellitus, type 1; dyslipidemias; blood glucose.

RESUMO

Objetivo: Avaliar a relação entre consumo alimentar e controle metabólico em crianças e adolescentes com diabetes melito tipo 1 (DM1).

Métodos: Estudo transversal com 11 crianças e 39 adolescentes com DM1. Coletaram-se dados alimentares (hábitos, três recordatórios de 24 horas – R24h), terapêuticos (insulinoterapia), bioquímicos (índice da hemoglobina glicada – inHbA, glicemias casuais – GLC, pós-prandiais – GLPP e perfil lipídico). Utilizou-se o teste *t* de Student e a correlação de Pearson, sendo significante $p<0,05$.

Resultados: Dentre os indivíduos estudados, identificaram-se alimentação fora de horário em 64% e consumo de produtos açucarados em 6%. Os parâmetros que compõem o perfil lipídico foram adequados em: colesterol total sérico – CTs (88%), LDL (92%), TG (100% das crianças e 69% dos adolescentes) e HDL (82% das crianças e 85% dos adolescentes). Quanto aos parâmetros que medem o controle glicêmico, o inHbA foi adequado em 64% e a GLPP em 18%. Houve correlação negativa entre CTs e consumo de carboidratos (r=-0,324; $p=0,022$) e positiva com o consumo de lipídeos (r=0,315; $p=0,026$).

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Conclusões: O maior consumo de lipídeos e a consequente menor ingestão de carboidratos correlacionaram-se a maiores níveis de CTs.

Palavras-chave: adolescente; consumo de alimentos; criança; diabetes mellitus tipo 1; dislipidemias; glicemia.

RESUMEN

Objetivo: Evaluar la relación entre consumo alimentar y control metabólico en niños y adolescentes con diabetes mellitus tipo 1 (DM1).

Métodos: Estudio transversal con 11 niños y 39 adolescentes con DM1. Se recogieron datos alimentares (hábitos, tres recordatorios de 24 horas-R24h), terapéuticos (insulinoterapia), bioquímicos (índice de hemoglobina glucada-inHbA, glucemias casuales - GLC, post-prandiales - GLPP y perfil lipídico). Se utilizó la Prueba t de *Student* y la correlación de *Pearson*, siendo significante $p<0,05$.

Resultados: Entre los individuos estudiados, se identificaron alimentación fuera de horario en 64% y consumo de productos azucarados en 6%. Los parámetros que componen el perfil lipídico fueron adecuados en: colesterol total sérico - CT_s - 88%, LDL - 92%, TG - 100% de los niños y 69,2% de los adolescentes y HDL - 81,8% de los niños y 84,6% de los adolescentes. Respecto a los parámetros que miden el control glucémico, el inHbA fue adecuado en 64% y la GLPP en 18%. Hubo correlación negativa entre CT_s y consumo de carbohidratos (r=-0,324; p=0,022) y positiva con lípidos (r=0,315; p=0,026).

Conclusiones: El mayor consumo de lípidos y la consecuente menor ingestión de carbohidratos se correlacionan a mayores niveles de CT_s.

Palabras clave: adolescente; consumo de alimentos; niño; diabetes mellitus tipo 1; dislipidemias; glucemia.

Introduction

The number of diabetes mellitus (DM) cases worldwide was estimated at 171 million in 2000, and may reach 366 million by 2030[1]. A multicenter study conducted in Brazil in the 1980s found an overall (type 1 and 2) DM prevalence rate of 7.6% among the urban population aged 30 to 69[2]. No population-wide studies have been conducted in Brazil for the specific purpose of characterizing the epidemiology of type 1 diabetes mellitus (T1DM). The prevalence and incidence of this condition among under-14s in the country is estimated at 4 cases per 10.000 and 8 cases per 100.000 respectively[3].

Dietary habits play an essential role in glycemic control (GC) in people living with T1DM. The results of the Diabetes Control and Complications Trial (DCCT) show that, among patients undergoing intensive glycemic control, consumption of low-carbohydrate, high-fat (particularly high-saturated fat) diets is associated with poorer GC, regardless of exercise and serum triglyceride levels[4].

Dyslipidemia is a common finding in T1DM[5], possibly due to increased cholesterol absorption[6]. In patients who follow dietary recommendations, the relevance of metabolic control in the management of dyslipidemia goes beyond mere reductions in lipid intake. Targets for dietary management should ensure adequate intake of fiber and carbohydrates, which have an impact on glycated hemoglobin (A1c) levels and, consequently, on metabolic control[5].

In light of the growing importance of T1DM in the current epidemiological scenario and of the influence of diet on the progression of diabetes, the present study sought to assess the relationship between dietary consumption and metabolic control in children and adolescents with T1DM.

Method

This was a cross-sectional study of children and adolescents with T1DM treated at the Hospital das Clínicas da Universidade Federal de Goiás (HC/UFG) outpatient Endocrinology Clinic. At the time of the study, 240 people with T1DM were registered as patients of the aforementioned clinic: 31 children (12%), 79 adolescents (32.2%) and 135 adults (55.8%). The sample comprised 54 children and adolescents who agreed to take part in the study (49% of all registered children and adolescents). Of these 54, four were excluded due to incomplete dietary intake data, leaving a final sample size of 50.

For the purposes of this study, "child" was defined as any participant between the ages of 4 and 9, and "adolescent," as any participant between the ages of 10 and 18[7]. The criteria for inclusion were an established diagnosis of T1DM of at least five months' duration and current insulin therapy. The criteria for exclusion were a history of limb amputation and/or a prior diagnosis of dyslipidemia, celiac disease, nephropathy, thyroid disease, or cardiovascular disease.

Chart reviews were used to determine which participants met the inclusion and exclusion criteria. Data were collected

between January and August 2009, using a structured instrument designed to collect information on a) dietary habits: eating outside regular meal times and eating outside the home (including frequency and type of foods consumed); b) dietary intake assessment: three 24-hour dietary recalls (24hR), one conducted on the day of the interview and the remaining two by telephone, each 30 days apart; c) laboratory tests: lipid profile (triglycerides, total serum cholesterol, high-dentisy lipoprotein [HDL], low-density lipoprotein [LDL], and very low-density lipoprotein [VLDL]), glycated hemoglobin (A1c), and random (RBS) and postprandial (PPBS) blood sugar measurements.

All three dietary recalls were entered into an especially designed spreadsheet containing nutrition facts compiled from several food composition tables[8-14], enabling inclusion of regional foods and specialty (sugar-free and low-fat) products. Macronutrient intake was compared against Brazilian Diabetes Society[15] guidelines for carbohydrates (50-60% of total energy intake), fats (<30% of total energy intake) and protein (0.8-1.0g protein/kg/day). American Diabetes Association recommendations[16] were used for assessment of fiber and cholesterol intake (14g/1000kcal and <200mg/day respectively).

After determining the energy contribution of carbohydrates, fats, and protein, nutrients were then adjusted for total energy intake. This calculation was obtained from the residuals of linear regression models constructed with macronutrient calories as a dependent variable and total calorie intake as the independent variable. To avoid null or negative values, residuals were added so as to make the lowest sum >0. Adjustment for total energy intake by means of regression modeling is common practice in dietary epidemiology studies. One of the advantages of this method is that, in assessing the influence of consuming a certain food or nutrient on the occurrence of a disease, it negates the potential influence of the disease on total energy intake – which is usually associated with food or nutrient intake[17].

The most recent lipid profile and A1c measurements were obtained from patient charts. If a participant's most recent lipid profile was over 3 months old, a new test was ordered as part of routine outpatient follow-up. New A1c results were brought by participants at each appointment, and, therefore, were never more than 2 weeks old. RBS measurements were obtained at enrollment with an Accu-Chek® Advantage portable glucose meter.

Lipid profile assessment was based on American Academy of Pediatrics-recommended levels[18]. Due to the variety of methods used for measurement of A1c levels, we chose to use the index of measured A1c to the upper limit of normal for the method used (glycated hemoglobin : upper limit of normal), which was then classified as adequate or inadequate, as recommended by Chase *et al*[19] and later used by Cunha *et al*[20], Gomes *et al*[21] and Castro *et al*[22]. For the purposes of the present study, an A1c <1.33 times the upper limit of normal was considered "adequate glycemic control," whereas A1c values ≥1.33 times the upper limit of normal were regarded as evidence of inadequate glycemic control.

This study was approved by the HC/UFG Animal and Human Subject Research Ethics Committee. All participants and their legal guardians provided voluntary, written informed consent for inclusion in the study after all methods and procedures had been thoroughly explained.

Study data were compiled into a Microsoft® Excel 2003 spreadsheet and exported to the Statistical Package for the Social Sciences (SPSS) 17.0 software environment. Biochemical and dietary profile data were analyzed by means of simple descriptive statistics, with categorical variables expressed as absolute and relative frequencies and continuous variables as mean±standard deviation. The distribution of continuous variables was assessed by means of the Kolmogorov–Smirnov (K–S) test; variables with $p \geq 0.05$ were classified as having a normal distribution. The Student *t* test was used for comparison of the adequate GC and inadequate GC groups. Pearson's correlation coefficient was used to assess potential correlations between dietary and biochemical variables. The significance level was set at $p < 0.05$ for all tests.

Results

A total of 50 participants were assessed: 11 children (22%) and 39 adolescents (78%). Mean age was 7.1±1.7 years for children and 14.1±2.5 years among adolescence. Mean time elapsed since initial diagnosis of T1DM was 5.4±4.3 years (children, 2.4±1.6 years; adolescents, 6.2±4.5 years). The mean daily insulin dose was 0.77±0.27 U/kg, with no significant difference between children and adolescents (0.78±0.32 U/kg *vs* 0.77±0.26 U/kg respectively). The mean number of daily insulin shots was 1.7 in children and two in adolescents.

The meals skipped most often were the mid-morning snack (28%) and the evening snack or supper (36%). Adolescents skipped meals more often than children. Most participants (64%) ate outside planned meal hours; the foods most often

consumed during these unplanned snacks were fruit, breads, and similar goods (56%). Products containing sugar were consumed by 6% of participants. Seventy percent of participants ate outside the home only rarely; when they did eat outside the home, participants usually ate large meals (18%) (Table 1).

An analysis of the biochemical parameters measured in the sample is shown in Table 2. A1c (expressed as ratio of measured A1c to the upper limit of normal) was adequate in 64% of cases, and PPBS, in 18%. Total cholesterol, LDL, triglycerides, and HDL were within normal limits in 88%, 92%, 76%, and 84% of participants respectively.

Dietary recalls (Table 3) showed no significant differences between the dietary habits of children and adolescents, although the former had a significantly higher protein intake per kg of body weight (p=0.008). Likewise, there were no significant between-group differences when participants

Table 1 - Dietary habits of children (n=11) and adolescents (n=39) with T1DM

	Category	Children		Adolescents		Total	
		n	%	n	%	n	%
Meal	breakfast	11	100.0	37	94.9	48	96
	mid-morning snack	10	90.9	26	66.7	36	72
	lunch	11	100.0	39	100.0	50	100
	afternoon snack	11	100.0	35	89.7	46	92
	dinner	11	100.0	38	97.4	49	98
	evening snack	9	81.8	23	59.0	32	64
Eating outside regular hours		6	54.5	26	66.7	32	64
Type of food consumed	sugar-containing products	-	-	3	7.7	3	6
	fruit, breads and similar goods	6	54.5	22	56.4	28	56
Person in charge of fixing meals	parent/guardian	7	63.6	26	66.7	33	66
	patient	-	-	4	10.3	4	8
	both	-	-	5	12.8	5	10
	other	4	36.4	4	10.3	8	16
Frequency of meals eaten outside the home	daily	-	-	3	7.7	3	6
	once or twice a week	2	18.2	4	10.3	6	12
	once or twice a month	-	-	6	15.4	6	12
	rarely	9	81.8	26	66.6	35	70
Size of meals eaten outside the home	small	1	9.1	5	12.8	6	12
	large	2	18.2	7	17.9	9	18
	both	-	-	2	5.1	2	4
Per capita cooking oil consumption (ml)[a]		25.3±9.5		27.6±15.1		-	-

[a]Mean±SD

Table 2 - Biochemical profile of children and adolescents with T1DM

Variable	Reference range	Adequate		Inadequate		Mean±SD
		n	%	n	%	
A1c ratio[a]	<1.33	32	64.0	18	36.0	1.29±0.4
RBS (mg/dL)[b]	<200	19	38.0	31	62.0	268.3±133.9
PPBS (mg/dL)[c]	<140	9	18.0	41	82.0	253.2±120.1
TG (mg/dL)[d]	≤100 (age <10y)	11	100.0	-	-	68.8±17.5
	≤130 (age 10-19y)	27	69.2	12	30.8	98.1±46.1
Total serum cholesterol (mg/dL)	<200	44	88.0	6	12.0	159.0±28.7
HDL (mg/dL)[e]	≥40 (age <10y)	9	81.8	2	18.2	47.1±9.7
	≥35 (age 10-19y)	33	84.6	6	15.4	48.9±11.5
LDL (mg/dL)[f]	<130	46	92.0	4	8.0	92.6±24.9

[a]Defined as the ratio of measured A1c to the upper limit of normal according to the method used for measurement. [b]RBS: random blood sugar; [c]PPBS: postprandial blood sugar; [d]TG: triglycerides; [e]HDL: high-density lipoprotein; [f]LDL: low-density lipoprotein.

Table 3 - Dietary variables, according to age range and glycemic control (GC), in children and adolescents with T1DM. All values expressed as mean±SD

Dietary variable	Children (n=11)	Adolescents (n=39)	*p**	Adequate GC (n=32)	Inadequate GC (n=18)	*p**
TEI (kcal)[a]	1455.9±364.6	1790.8±579.7	0.077	1656.3±658.2	1655.8±434.0	0.998
% CHO[b]	46.3±4.8	45.1±7.1	0.605	44.7±8.0	44.8±5.0	0.957
% FAT[c]	37.6±5.4	38.6±7.7	0.697	39.0±8.5	40.0±7.0	0.651
% PTN[d]	16.1±2.4	16.3±3.2	0.839	16.4±2.9	15.2±3.4	0.206
gPtn/kg/day[e]	2.5±0.9	1.6±0.7	0.008	1.8±0.8	1.4±0.9	0.085
SAT (mg)[f]	14.1±5.7	16.2±8.0	0.419	15.2±8.3	15.7±6.8	0.833
UNSAT (mg)[g]	17.5±8.2	24.8±16.1	0.156	22.5±15.9	23.2±14.3	0.874
TC (mg)[h]	149.5±85.5	201.0±101.9	0.133	192.2±117.3	161.0±60.4	0.202
TF (g)[i]	23.6±7.8	27.9±14.0	0.326	27.0±14.0	22.7±12.8	0.272

[a]TEI: total energy intake (24-hour dietary recall); [b]%CHO: percentage of TEI provided by carbohydrates; [c]%LIP: percentage of TEI provided by fats; [d]%PTN: percentage of TEI provided by protein; [e]gPtn/kg/day: daily protein intake per kg of body weight; [f]SAT: saturated fats; [g]UNSAT: unsaturated fats; [h]TC: total cholesterol intake; [i]TF: total fiber intake; [j]Student *t* test. *$p<0.05$.

Table 4 - Correlation (r) between biochemical parameters and dietary habits in children and adolescents with T1DM

	A1c ratio[l]		PPBS[m]		Total cholesterol		LDL[n]		TG[o]	
	r[a]	*p*	r[a]	*p*	r[a]	*p*	r[a]	*p*	r[a]	*p*
CHO (g)[b]	0.000	0.999	0.100	0.490	-0.198	0.169	-0.139	0.640	-0.068	0.640
FAT (g)[c]	0.040	0.782	0.275	0.053	0.078	0.592	0.092	0.666	0.063	0.666
PTN (g)[d]	-0.008	0.956	0.168	0.243	-0.105	0.468	-0.057	0.418	-0.117	0.418
CHO_{adj}[e]	-0.039	0.790	-0.217	0.130	-0.324	0.022*	-0.274	0.429	-0.114	0.429
FAT_{adj}[f]	0.055	0.707	0.200	0.163	0.315	0.026*	0.263	0.197	0.186	0.197
PTN_{adj}[g]	-0.051	0.728	-0.030	0.835	-0.092	0.526	-0.069	0.147	-0.208	0.147
SAT (mg)[h]	-0.024	0.867	0.223	0.119	0.016	0.911	0.086	0.474	-0.104	0.474
UNSAT (mg)[i]	-0.021	0.883	0.260	0.069	0.003	0.983	0.071	0.666	-0.063	0.666
TC (mg)[j]	-0.084	0.562	0.119	0.409	-0.111	0.443	-0.052	0.367	-0.130	0.367
TF (g)[k]	-0.043	0.769	0.154	0.286	-0.161	0.264	-0.075	0.417	-0.117	0.417

[a]r: Pearson's correlation coefficient; [b]CHO (g): mean carbohydrate intake; [c]FAT (g): mean fat intake; [d]PTN (g): mean protein intake; [e]CHO_{adj}: carbohydrate intake adjusted for total energy intake; [f]FAT_{adj}: fat intake adjusted for total energy intake; [g]PTN_{adj}: protein intake adjusted for total energy intake; [h]SAT (mg): saturated fat intake; [i]UNSAT (mg): unsaturated fat intake; [j]TC (mg): total cholesterol intake; [k]TF (g): total fiber intake; [l]A1c: ratio of measured A1c to the upper limit of normal according to the method used for measurement; [m]PPBS: postprandial blood sugar; [n]LDL: low-density lipoprotein; [p]TG: triglycerides; *$p<0.05$.

were stratified by adequacy of GC. Carbohydrate intake was uniformly below recommended levels (50–60% of total energy intake from carbohydrates), regardless of GC. Dietary fat consumption also exceeded recommended levels (<30% of total energy intake), as did protein intake, particularly in children, whose mean daily protein intake (2.5g/kg/day) was more than twice as high as the RDI (0.8-1.0g/kg/day).

Analysis of potential correlations between dietary and biochemical variables (Table 4) showed no significant association between A1c level and nutrient intake. PPBS levels also were not correlated with nutrient intake, although a borderline-significant association was found between PPBS and absolute fat intake (r=0.275; $p=0.053$). After adjusting for total energy intake, a negative correlation was found between serum cholesterol levels and carbohydrate intake (r= -0.324; $p=0.022$), and a positive correlation between cholesterol levels and dietary fat consumption (r=0.315; $p=0.026$).

Discussion

The participants of this study were found to consume a low-carbohydrate, high-fat, high-protein diet. Carbohydrate and fat intake was similar to that reported in the DCCT, in which these nutrients accounted for 45.5% and 36.8% of total energy intake respectively[4]. Despite the risk of high-fat diets in the setting of T1DM, several studies[23-25] have found that the dietary habits of people with type 1 diabetes

are often characterized by excess fat intake. On the other hand, total dietary fiber and cholesterol intake was within ADA-recommended levels (14g/1000 kcal and <200mg respectively)[16], which should afford some protection against cardiovascular disease.

There was no significant association between fat intake and A1c levels, perhaps due to small sample size. The negative correlation between A1c levels and carbohydrate intake provides evidence of the protective effect of the latter when consumed in lieu of dietary fats[5]. A significant association between triglyceride levels and percent energy intake provided by carbohydrates has been reported elsewhere in the literature[5], but no such association was found in our sample.

The present study showed that higher fat intake and the consequently lower energy intake provided by carbohydrates are associated with increased serum cholesterol levels. Likewise, the DCCT reported an association between replacement of carbohydrates with fat in the diet and increased A1c levels[4], confirming the adverse impact of fat intake on GC.

Regarding biochemical parameters, lipid profile adequacy was associated with that of current and past markers of glycemic control. Compared to controls, participants with T1DM and adequate GC had similar LDL and total cholesterol levels, lower triglycerides and higher HDL concentrations. Subjects with ineffective GC exhibited an atherogenic lipid profile, with significantly higher LDL and total cholesterol levels and, contrary to expectations, higher HDL levels than in controls. In short, abnormal lipid profiles were uniformly present in our young subjects with T1DM, even in those who were newly diagnosed and those with adequate GC. The extent of these changes is, of course, greater in patients with poor GC[26].

The inadequacy of PPBS levels in 82% of participants is an alarming finding in light of the evidence that postprandial hyperglycemia is directly associated with increased cardiovascular mortality. This impact is due to the oxidative stress and endothelial inflammation that accompany postprandial hyperglycemia with increased free fatty acids levels, triggering atherosclerosis[27].

The postprandial and random blood sugar measurements obtained in our sample are in direct contradiction to its A1c patterns. Although 64% of participants had adequate A1c levels, rates of RBS and PPBS inadequacy were inordinately high (62% and 82% respectively). One potential explanation for this finding is the fact that A1c reflects the weighted average of mean daily blood glucose levels over a 3- to 4-month period, although it is most influenced by recent blood sugar levels[28]. Conversely, RBS and PPBS measurements (obtained at any time of day and 2 hours after meals respectively) reflect isolated events.

Factors that may have influenced RBS and PPBS measurements include: a) measurements were obtained during follow-up visits, and it is well known that patients are usually anxious and concerned during physician appointments[29] particularly when their glycemic control is to be discussed; b) as patients are seen on a first-come-first-serve basis at the clinic where the present study was carried out and the clinic opens at noon, many patients—even those referred from other municipalities for treatment—often arrive before 11 a.m. Therefore, many patients eat an early lunch, skip lunch altogether, or eat unusual foods (particularly fast foods and junk foods sold near the hospital) on the day of their appointment, without changing their insulin administration schedule and dosage accordingly. These factors can have an adverse effect on the accuracy of random blood sugar measurements, making these readings reflect a deviation from patients' usual dietary habits.

Another potential influence on RBS and PPBS measurements is inadequate compliance with insulin administration schedules, particularly with regard to time. Conventional insulin therapy requires strict adherence to the planned timing and size of meals[29]. During their interviews, many participants informally reported frequent noncompliance with planned insulin administration schedules. This suggests that many of our subjects exhibit chronic postprandial hyperglycemia, though mild enough to have no major effect on A1c levels.

GC is an essential goal in the management of T1DM. Elevated A1c levels are associated with increased serum lipid concentrations and, consequently, with increased cardiovascular risk (CVR). Proportionally, a single percentage point increase in A1c have been associated with a 7.8-mg/dL increase in total serum cholesterol and a 5.1-mg/dL increase in LDL concentrations in a study of children and adolescents with T1DM[30].

Sample size was a limitation in this study. Nevertheless, bearing in mind the relatively low prevalence of T1DM and the high frequency of complications, we believe the number of participants was satisfactory. In Brazil, patients with T1DM are usually referred to specialty Unified Health System clinics for management, and the HC/UFG Department of Endocrinology is one of the most active such centers in the state of Goiás, with the highest outpatient flow and acceptance rates in the state. Therefore, the large number of individuals seen at this clinic enabled enrollment of a substantial sample of healthy (complication-free) volunteers living with T1DM.

In short, dietary fat intake was correlated with total serum cholesterol levels in the study sample, highlighting the association between diet and metabolic control. Macronutrient intake was uniformly inadequate, which reflects a need for providing improved dietary guidance to this patient population. Dietary intervention is an effective means of improving blood glucose levels and lipid profile and, consequently, reducing CVR in people with T1DM. Nutritional guidance in this population should stress the importance of a balanced, varied diet designed to meet current dietary recommendations. This is especially relevant in light of the importance of controlled dietary fat intake as a strategy for prevention of dyslipidemia.

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