Nutrición Hospitalaria

Nutr Hosp. 2014;29(3):547-552
ISSN 0212-1611 • CODEN NUHOEQ
S.V.R. 318

Original / ***Síndrome metabólico; diabetes***

Glycemic control and lipid profile of children and adolescents undergoing two different dietetic treatments for type 1 diabetes mellitus

Haline Dalsgaard[1], Cláudia Saunders[2], Patrícia de C. Padilha[3], Jorge Luiz Luescher[4], Renata Szundy Berardo[5] and Elizabeth Accioly[6]

[1]Nutricionist. Master (MSc) in Human Nutrition by the Institute of Nutrition Josué de Castro (INJC). Federal University of Rio de Janeiro (UFRJ). [2]Nutricionist. Doctor (PhD) in Sciences by Osvaldo Cruz Foundation (FIOCRUZ). Professor at the Departament of Nutrition and Dietetics-INJC/UFRJ. Coordinator of the Research Group on Maternal and Child Health (GPSMI) at INJC/UFRJ. [3]Nutricionist. Doctor (PhD) in Nutritional Sciences by INJC/UFRJ. Professor at the Departament of Nutrition and Dietetics-INJC/UFRJ. Researcher of the Research Group on Maternal and Child Health (GPSMI) at INJC/UFRJ. Member of the Diabetes Sector of the Pediatrics and Childcare Institute Martagão Gesteira (IPPMG)/UFRJ. [4]Pediatric Doctor. Specialist in Pediatric Endocrinology. Head member of the Diabetes Sector-IPPMG/UFRJ. [5]Pediatric Doctor. Specialist in Pediatric Endocrinology. Master (MSc) in Medicine focusing Nutrition and Diabetes-UFRJ. Member of the Diabetes Sector-IPPMG/UFRJ. [6]Nutricionist. Doctor (PhD) in Sciences by the Federal University of São Paulo (UNIFESP). Professor at the Department of Nutrition and Dietetics-INJC/UFRJ. Researcher of the Research Group on Maternal and Child Health (GPSMI)-INJC/UFRJ. Brazil.

Abstract

Objective: **To compare the glycemic control and lipid profile of children and adolescents undergoing two different dietetic treatments for type 1 Diabetes Mellitus assisted at the Children and Adolescent's Diabetes Mellitus Health Center-UFRJ.**

Methods: **A retrospective longitudinal study conducted between 2002 and 2006. We evaluated the same subjects in two different periods: after 1 year in TD and subsequently after 1 year in CCHO. The evolution of the nutritional status during the dietary treatments was evaluated using Body Mass Index (BMI) for age. The lipid panel was evaluated according to the 1st Guideline for Prevention of Atherosclerosis in Childhood and Adolescence, used in Brazil, and the glycemic control was evaluated by measuring glycated hemoglobin (HbA1c).**

Results: **We evaluated 93 individuals, 38.7% children and 61.3% adolescents. The mean age at study entry was 11.1 (± 2.66) years and the mean disease duration was 6.1 (± 3.2) years. A significant difference in the percentage of adequacy of HbA1c (p = 0.000) and in the values of total plasma cholesterol (p = 0.043) was found after 1 year of CCHO diet, which did not happen during the observation time of TD. The evolution of anthropometric nutritional status showed no significant difference between the beginning and the end of both dietary treatments.**

Conclusion: **The results of this study suggest that a more flexible food orientation program can contribute to the improvement of blood glucose levels without causing deterioration of the lipid profile when compared to TD.**

(*Nutr Hosp.* 2014;29:547-552)

DOI:10.3305/NH.2014.29.3.7116

Keywords: *Type 1 diabetes. Diet. Carbohydrate counting.*

Correspondence: Elizabeth Accioly.
Rua Epaminondas Jacomé, 27, casa. Irajá.
CEP 21230-250 Rio de Janeiro-RJ. Brazil.
E-mail: elizabethaccioly@ig.com.br

Recibido: 2-V-2013.
1.ª Revisión: 5-XI-2013.
Aceptado: 12-XI-2013.

CONTROL GLUCÉMICO Y PERFIL LIPÍDICO DE NIÑOS Y ADOLESCENTES SOMETIDOS A DOS TRATAMIENTOS DIETÉTICOS DISTINTOS PARA LA DIABETES MELLITUS TIPO 1

Resumen

Objetivo: **Comparar el control glucémico y el perfil lipídico de niños y adolescentes sometidos a dos tratamientos dietéticos distintos para la diabetes mellitus tipo 1 atendidos en el Centro de Salud para Niños y Adolescentes con Diabetes Mellitus-UFRJ.**

Métodos: **Estudio longitudinal retrospectivo realizado entre 2002 y 2006. Evaluamos a los mismos individuos en dos momentos distintos: tras un año en tratamiento para diabetes (TD) y posteriormente tras un año con conteo de hidratos de carbono (CHC). La evolución del estado nutricional durante los tratamientos dietéticos se evaluó empleando el índice de masa corporal (IMC) para la edad. El panel de lípidos se evaluó de acuerdo con la 1ª Guía para la prevención de la aterosclerosis en la infancia y adolescencia, empleada en Brasil, y el control glucémico se evaluó midiendo la hemoglobina glucosilada (HbA1c).**

Resultados: **Evaluamos a 93 individuos, 38,7 % niños y 61,3 % adolescentes. La edad promedio en el momento de entrada en el estudio fue de 11,1 (± 2,66) años y la el promedio de duración de la enfermedad fue de 6,1 (± 3,2) años. Se encontró una diferencia significativa en el porcentaje de adecuación de la HbA1c (p = 0,000) y en los valores del colesterol plasmático total (p = 0,043) tras un año de dieta con CHC, lo cual no ocurrió durante el periodo de observación de TD. La evolución del estado nutricional antropométrico no mostró diferencias significativas entre el inicio y el final de ninguno de los tratamientos dietéticos.**

Conclusión: **Los resultados de este estudio sugieren que un programa de orientación alimentaria más flexible puede contribuir a la mejora de la glucemia sin producir un deterioro del perfil lipídico en comparación con el TD.**

(*Nutr Hosp.* 2014;29:547-552)

DOI:10.3305/NH.2014.29.3.7116

Palabras clave: *Diabetes tipo 1. Dieta. Conteo de hidratos de carbono.*

Introduction

Significant advances occurred in the recent decades[1,2] to improve the treatment of Diabetes Mellitus (DM). The American Diabetes Association (ADA) recommends as its main objective for the Medical Nutrition Therapy (MNT) prevention of the development of chronic complications through an adequate nutrient intake and lifestyle modification.[1] The maintenance of a proper anthropometric nutritional status by the patient is necessary, as well as, knowledge about nutrition and healthy eating practices at any stage of the lifecycle.[3,4]

The possibility of having food items limited in the daily diet is a great concern of the diabetic patient and their families. For this reason, the possibility of removing these prohibitions should be strongly considered even if some adjustments become necessary, such as an increased frequency of glucose monitoring and/or further intensification of insulin scheme.[5,6]

During the 20th century, the recommended diet for DM patients underwent several changes, especially regarding the use of CHO. The first dietary recommendations advocated an increased consumption of CHO in order to replace the loss of sugar in the urine. Later, this practice changed and CHO started being avoided.[7] In 1912, Frederick M. Allen, developed the "Therapeutic hunger Allen", in which he offered 1,000 kcal/ day and 10 g CHO/day, with the goal of keeping individuals alive until, supposedly, insulin began to be produced again. Thus, until the emergence of exogenous insulin in 1921, patients with DM were treated with diets very low in CHO and in a semistarvation state.[8]

In this sense, the carbohydrate count (CCHO), used since the mid-1920s, was one of the dietary planning strategies recommended by the *Diabetes Control and Complications Trial* (DCCT).[9] Since ADA's report in 1994, CCHO started being recommended, aiming to optimize glycemic control avoiding even the smallest variations in postprandial glycemia.[9,10]

Even after the advent of insulin therapy, scholars continued recommending a diet low in CHO and rich in lipids. However, over the decades, ADA's nutritional recommendations suffered some modifications due to new discovery in the scientific literature.[11] In the past, it was believed that the restriction of several food items would be the best form of treatment, as it would prevent glycemic elevation. Such procedure, however, caused severe malnutrition, leading individuals to early death. Recent published guidelines reflect a more flexible approach in relation to nutritional interventions and the carbohydrate content of the diet, allowing the patients to adjust their own insulin based on the content of nutrient intake. This is the basic principle of carbohydrate counting.[12]

Mehta et al.[13] found that CCHO accuracy and appropriate glucose monitoring were associated with lower levels of HbA1c in studies with children and adolescents between 4 and 12 years old.

In the context of CCHO, modern therapies, including insulin pump and flexible insulin regimens, resulted in less restrictive diets.[14] However, young patients with DM 1 should be advised about the importance of being totally conscious about the method being adopted and that the consumption of a healthy diet should also be an integral part of nutrition education in diabetes.[14,15]

This study aims to compare the glycemic control and lipid profile of children and adolescents undergoing two different dietetic treatments for type 1 Diabetes Mellitus assisted at the Children and Adolescent's Diabetes Mellitus Health Center-Pediatrics Institute Martagão Gesteira (IPPMG), Federal University of Rio de Janeiro (UFRJ).

Materials and methods

This is a retrospective longitudinal study, based on database produced by a Reference Center in the treatment of juvenile diabetes, in its medical charts of patients attended from 2002 to 2006.

This Hospital is a reference in the treatment of type 1 diabetes in children and adolescents in Rio de Janeiro, and is characterized by the presence of a multidisciplinary team, which consists of doctors, nutritionists, psychologists and nurses.

This study evaluated the same subjects in two different periods: 1 year follow-up of traditional diet for diabetes (TD) and, subsequently, 1 year follow-up of CCHO diet.

We included in the study all the patients with DM1 who started dietary guidance for CCHO between the years 2003 and 2005 (n = 147), excluding those with less than 2 or more than 15 years of disease duration, and those with any other endocrine disease with possible effects on nutritional status and metabolic control. Thus, 54 patients were eliminated for not meeting the criteria for inclusion in the study. The final sample comprised 93 patients.

It was named in this study as TD the dietary counseling based on caloric distribution of food. TD was calculated based on the total energy value of the diet (VET) according to FAO/OMS[16] recommendations, which was distributed into 5 to 6 daily meals. Patients received an individualized dietary plan and a list of food substitution which was based on food groups, with similar energy values. The exchanges allowed were only those among the same food group. Patients were also instructed to restrict the use of sweet food items.

This method of exchanging food items, divides food into groups in which each portion of food contains approximately 15 g of CHO, enabling the exchange between them. In the counting method used, the lists of substitutions were based on portions of the food pyramid and its main groups were defined as: cereal, pasta and vegetables; breads and crackers; fruit; salad vegetables; dairy products; meat and sweets. Groups could

Table I
Sample characterisics af baseline observation (TD0). Brazil, Rio de Janeiro

Variables	*Children*		*Adolescents*		*Total*	
	n	*%*	*n*	*%*	*n*	*%*
Gender						
Male	22	61.1	24	42.1	46	49.4
Female	14	38.9	33	57.9	47	50.6
Total	36	100.0	57	100.0	93	100.0
Variables	Mean	SD	Mean	SD	Mean	SD
Age (years)	7,4	2,47	14,8	2,86	11,1	2,66
Time of disease (years)	4,5	1,94	7,3	3,4	6,1	3,2

SD: Standard deviation.

be measured considering 15 grams of carbohydrate if they contained CHO, and the possibility of measuring this amount in kitchen utensils.[17] It was defined as the beginning of this dietary method the observation period of 12 months prior to the beginning of CCHO (TD0) diet. From this baseline, patients were evaluated after 6 months (TD1) and after 12 months (TD2) following TD, when it was introduced CCHO (CCHO0) dietary counseling. Therefore, the period TD2 corresponds to the period CCHO0 (TD2 = CCHO0).

CCHO dietary treatment was calculated using VET and adding the daily requirement of carbohydrate (CHO). The patients received an individualized dietary plan which had its meals distributed as in TD and the amount of CHO was predetermined for each meal. The patient received a list of substitution, based on food groups, in which the exchange was allowed even between different groups, provided that the total amount of CHO was respected at every meal. There was no restriction of any food item. Once introduced to the CCHO dietary orientation, patients were evaluated after 6 months (CCHO1), and after 12 months (CCHO2).

Patients were classified as prepubertal (children) or pubescent (adolescent) according to the degree of sexual maturation, despite the chronological age. We considered prepubertal, girls and boys in stage 1 for breasts (M1) and genitals (G1), respectively, and pubertal those in stage 2 or more.[18,19]

The classification of the anthropometric nutritional status was based on BMI/age, and classified according to the recommendation of the Health Ministry.[20] The collected data were cholesterol, LDL-C, HDL-C and triglyceride levels in TD0, TD2 and CCHO2. The lipid profile was evaluated according to the First Guideline for Prevention of Atherosclerosis in Childhood and Adolescence[21], which considers as suitable values: total cholesterol < 150 mg/dl, LDL-C < 100 mg/dl, HDL-C ≥ 45 mg/dL, and triglycerides < 100 mg/dl.

Glycemic control was assessed by measuring glycated hemoglobin (HbA1c), which was classified as percentage of adequacy of laboratory reference values, according to age, alternative analysis endorsed by ADA.[22] It was considered as suitable any value up to 30% of the maximum reference for the age group of 2-5 years old, up to 25% for those between 5 and 13 years old, and < 20% for patients over 13 years old. The level of HbA1c was measured using high performance liquid chromatography (HPLC).

Statistical analysis was performed using the program *Statistical Package for the Social Sciences* (SPSS) version 17.0 for Windows.

The dependent variables average value was calculated at each time interval of observation. Once verified the normality of the data, analysis of variance (ANOVA) for repeated measures was applied to the mean values of the proportion of appropriate HbA1c and anthropometric indices in 3 different times (start, 6 and 12 months) for each dietary method, and changes in lipid profile in 2 different times (start and 12 months. The Bonferroni test was used for statistical comparison between the mean values obtained.

For the analysis of categorical variables we used the chi-square and Fisher's exact test. It was considered statistically significant values of $p < 0.05$.

This project was approved by the Research Ethics Committee-IPPMG/UFRJ, under the registration number 21/06.

Results

The final sample consisted of 93 children and adolescents, 50.5% male (n = 47) and 49.5% female (n = 46). Time of diabetes diagnosis was of 6.18 ± 3.22 years, and most of them were attending elementary school (100%, n = 89) (table I). According to the anthropometric nutritional status classification, 76.7% (n = 56) were categorized as normal weight, 6.8% (n = 5) as underweight and 16.4% (n = 12) as overweight before CCHO. There was an increase in the percentage of children with overweight in the first period of observation during CCHO, which was reduced during the second period of observation. Such a change was not significant (table II).

Table II
Nutritional status at different timepoints. Brazil, Rio de Janeiro

Timepoints	*Children*						*Adolescents*					
	Normal weight		*Low weight risk*		*Overweight risk*		*Normal weight*		*Low weight risk*		*Overweight risk*	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
TD_0	27	69.2	4	10.3	8	20.5	44	9.8	0	0.0	5	10.2
TD_1	28	71.8	3	7.7	8	20.5	44	9.8	1	2.0	4	8.2
TD_2 = $CCHO_0$	31	79.5	4	10.3	4	10.3	43	6.0	1	2.0	6	12.0
$CCHO_1$	13	3.3[a]	3	7.7	23	59.0[b]	46	8.5	1	1.9	5	9.6
$CCHO_2$	30	76.9[c]	2	5.1	7	17.9[d]	45	8.2	1	2.0	5	9.8

TD_0: Traditional diet inicial observation; TD_1: 6 months observation of traditional diet; TD_2: 1 year observation of traditional diet; $CCHO_0$: Carbohidrates counting diet (CCHO) initial observation; $CCHO_1$: 6 months observation of CCHO diet; $CCHO_2$: 1 year observation of CCHO diet.
[a]Percentage lower than $CCHO_0$ ($p < 0.05$); [b]Percentage higher than $CCHO_0$ ($p < 0.05$); [c]Percentage higher than $CCHO_1$ ($p < 0.05$); [d]Percentage lower than $CCHO_1$ ($p < 0.05$).

The comparison of the differences between BMI was not significant in any observation period, and there were also no differences between gender.

It was observed an adequacy of HbA1c in 63.3% of patients on TD0, 59.4% on TD1, 62.5% on TD2, 72.6% on CCHO1 and 75.9% on CCHO2. Mean values of HbA1c adequacy underwent significant reduction during the first semester of CCHO observation (p = 0,007) and during the whole year of the study (p = 0,000), not observing any significant change during TD. There was significant reduction in these averages for both pubertal stages at the end of the first year of CCHO observation (p = 0.004 for children and p = 0.015 for adolescents).

Inadequate levels of total cholesterol and LDL-C were found respectively in 64.9% and 41.9% of patients on TD0, 62.8% and 41% on TD2 and 58% 36.4% on CCHO2. When analyzing the influence of the dietary method on the adequacy of lipoproteins, there were no significant differences at the end of 1 year of nutritional counseling, as well as no differences according to the different sexual maturation stages.

Table III shows the comparison between the mean values of the variables related to glycemic control and lipid profile. Regarding insulin dose, there was no significant change in the mean values of insulin/kg in both study periods (TD and CCHO).

Discussion

Due to the fact that nutritional therapy is a key component in maintaining adequate metabolic control, it has been discussed over and over, aiming a better adhesion to this therapy and consequent reduction in the onset and severity of acute and chronic disease complications.[23] Studies show that compliance with the prescribed nutrition plan improves the level of HbA1c in adults[24] and has been correlated with better blood glucose control in children.[25,26] The adequacy of the dietary guidance to the lifestyle of each patient should be considered at the time of prescribing each individualized eating plan and it should also be able to follow the changes that occur throughout life.

High glycated hemoglobin is associated with the development of microvascular and macrovascular complications of the disease. Thus, maintaining satisfactory levels of HbA1c throughout the patient's life should be one of the treatments goals. The improvement of the HbA1c adequacy means of

Table III
Biochemical variables mean values at all observation periods of patient treated at the Diabetes Mellitus Center - IPPMG-UFRJ. Brazil, Rio de Janeiro

Variable	*TD_0*	*TD_1*	*TD_2 (= $CCHO_0$)*	*$CCHO_1$*	*$CCHO_2$*
HbA1c (Adequacy %)	122.09 ± 26.24	123.20 ± 28.74	123.02 ± 30.99	113.83 ± 23.51[a]	108.55 ± 22.05[ab]
Colesterol (mg/dl)	172.59 ± 40.42	–	170.05 ± 44.64	–	163.72 ± 40.48[a]
Tryglicerides (mg/dl)	66.72 ± 28.25	–	74.31 ± 38.01[d]	–	66.10 ± 32.24
HDLc (mg/dl)	53.46 ± 14.41	–	55.55 ± 15.92	–	54.57 ± 11.68
LDLc (mg/dl)	103.60 ± 37.32	–	96.40 ± 34.82	–	95.01 ± 37.52

TD_0: Traditional diet inicial observation; TD_1: 6 months observation of traditional diet; TD_2: 1 year observation of traditional diet; $CCHO_0$: Carbohidrates counting diet (CCHO) initial observation; $CCHO_1$: 6 months observation of CCHO diet; $CCHO_2$: 1 year observation of CCHO diet.
HbA1c: Glycated hemoglobin; HDLc: High density lipoprotein; LDLc: Low density lipoprotein.
[a]Mean value lower than $CCHO_0$ ($p < 0.05$); [b]Mean value lower than $CCHO_1$ ($p < 0.05$); [c]Mean value higher than $CCHO_0$ ($p < 0.05$); [d]Mean value higher than TD_0 ($p < 0.05$).

the CCHO diet demonstrated in this study is consistent with the results of the *Diabetes Control and Complications Trial.*[15] A study conducted in São Paulo, involving adolescents with DM1, in which it was evaluated the effect of CCHO technique in a single meal for 4 months, showed a significant reduction in HbA1c, accompanied by maintenance of total cholesterol and triglycerides.[27] These results point to the possibility of a more flexible dietary therapy that promotes a much better quality of life, since it has been demonstrated that 1% reduction in HbA1c levels, corresponds to a 44% reduction in the risk of chronic complications of the disease.[9]

Although we found among our patients a high prevalence of dyslipidemia in comparison to other studies, we can observe that the average values of LDLc described in our study were much lower than the values found in the scientific literature.[28-30] Such differences can be attributable to the use of different reference values. It should be noted that the cutoff values used in this study were based on new guidelines for children and adolescentes,[17] in which most of the normal values for total cholesterol and LDLc suffered significant reduction compared to previous existing guidelines.[31,32]

Clinical practice experience has shown that, in childhood, treatment of the disease is directly related to the levels of understanding and adherence by the children's parents/guardians. Dietary and behavioral changes in children only become viable if there are changes in the family's eating habits and lifestyle.[33] When the disease appears during adolescence, essential attitudes to control the disease may be overlooked by the young patients. At this life stage, the need of the so called "diabetes education", together with the establishment of more flexible routines, are essential for an adequate adherence to the treatment.

The weight deviation found in children during the first half of the CCHO period may have occurred because of the greater variety of food allowed. The initial adaptation to a more flexible nutritional plan containing a variety of food choices can initially lead to an increased energy consumption. These findings highlight the importance of a close attention and monitoring of the nutritional status of diabetic patients, with the aim of detecting very early any possible nutritional problems to implement a necessary diet plan intervention. Patton et al.[34] emphasizes that dietary planning should not only prioritize CCHO.

The successful implementation of flexible schemes requires the ability to count carbohydrates and calculate the insulin dose correctly. Measures to assess adherence to the diabetes treatment have been developed, but they do not assess knowledge and ability to implement a plan, which are prerequisites for the therapy adhesion.[35,36]

In this context, diabetes education is crucial to allow individuals to effectively control diabetes. Moreover, there is also the need for a continuous assessment of the patient's disease and treatment knowledge.[37]

In this study there was no difference in weight gain at the end of the monitoring period on CCHO diet. This fact can be explained by the presence of an individualized guidance suitable for each stage of development and nutritional continuous monitoring throughout the treatment of the disease.

All the patients received proportional doses of insulin throughout the observation period of the study, regardless of the dietary method adopted. This finding demonstrates that despite the relationship between CHO intake and insulin dose administered on CCHO diet, it is possible to administrate insulin doses according to the recommendations for each age group. It must be noted that apart from the fear that an eating plan with greater freedom of choice may compromise the metabolic control of diabetes, resistance to a more flexible feeding behavior is due to a concern about the risk of excessive weight gain, which would associate in turn, the greater insulin need. The observed results do not justify such concern and suggest that the CCHO diet is a positive alternative nutritional intervention for children and adolescents with diabetes.

This study indicates that CCHO diet contributed to a significant improvement on glycemic control without promoting significant changes on other biochemical parameters. In addition, it highlights the importance of a clinical-nutrition monitoring, strengthening the necessity of a multidisciplinary team approach in treating diabetic children and adolescents.

References

1. American Diabetes Association: Standards of medical care in diabetes-2012. *Diabetes Care* 2012; 35 (Suppl. 1): S11-S63.
2. Devendra D, Liu, E, Eisenbarth GS. Type 1 diabetes: recent developments. *BMJ* 2004: 328 (7442): 750-4.
3. Marques RMB, Nélida Schmid Fornés NS, Stringhini MLF. Fatores socioeconômicos,demográficos, nutricionais e de atividade física no controle glicêmico de adolescentes portadores de diabetes melito tipo 1 (Social, economical, demographical, nutritional and physical activity factors in the glicemic control of Diabetes Mellitus 1 adolescents patients). *Arq Bras Endocrinol Metab* 2011; 55 (3): 194-202.
4. Teles SAS, Fornés NS. Consumo alimentar e controle metabólico em crianças e adolescentes portadores de diabetes melito tipo 1 (Food intake and metabolic control in children and adolescents with Diabetes Mellitus 1). *Rev Paul Pediatr* 2011; 29 (3): 378-84.
5. Smart CE, Ross K, Edge JA, King BR, McElduff P, Collins CE. Can children with Type 1 diabetes and their caregivers estimate the carbohydrate content of meals and snacks? *Diabet Med* 2010; 27 (3): 348-53.
6. Scavone G, Manto A, Pitocco LD, Gaglardi SC, Mancini L, Zaccardi F, Ghirlanda G. Effect of carbohydrate counting and medical nutritional therapy on glycaemic control in Type 1 diabetic subjects: a pilot study. *Diabetes Medicine* 2010; 27 (4): 477-9.
7. Costa PAA, Franco LJ. Introdução da sacarose no plano alimentar de portadores de diabetes mellitus tipo 1 – sua influência no controle glicêmico (Sucrose introduction in the dietary plan of Diabetes Mellitus 1 patients – its influence in the glicemic control). *Arq Bras Endocrinol Metab* 2005; 49 (3): 403-9.
8. Geil PB. Complex and simple carbohidrates in diabetes therapy. In: Powers, MA. Handbook of diabetes medical nutrition therapy, 2nd ed. New York:Aspen Publication, 1996; 303-17.

9. DCCT Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. *N Engl J Med* 1993; 329 (14): 977-86.
10. Franz MJ. Carbohydrate and diabetes: is the source or the amount of more importance? *Curr Diab Rep* 2001; 1 (2): 177-86.
11. American Diabetes Association. Executive summary: standards of medical care in diabetes- 2010. *Diabetes Care* 2010; 33 (Suppl. 1): S4-S10.
12. Costa ACP, Thalacker M, Besenbruch N, Simony RF, Branco FC. Aspectos metabólicos e nutricionais da contagem de carboidratos no tratamento do diabetes mellitus tipo 1 (Metabolic and nutritional aspects in the carbohidrate counting method treatment of Diabetes Mellitus type 1). *Nutrire: Rev Soc Bras Alim Nutr = J Brazilian Soc Food Nutr* 2011; 36 (1): 151-62.
13. Metha SN, Quinn N, Volkening LK, Laffel LMB. Impact of carbohydrate counting on glycemic control in children with type 1 diabetes. *Diabetes Care* 2009; 32 (6): 1014-6.
14. Rovner AJ, Nansel TR. Are Children With Type 1 Diabetes Consuming a Healthful Diet? *The Diabetes Educator* 2009; 35 (1): 97-107.
15. Gellar L, Rovner AJ, Nansel RT. Whole grain and legume acceptability among youths with type 1 diabetes. *The Diabetes Educator* 2009; 35 (3): 422-7.
16. World Health Organization. Food and Agriculture Organization of the United Nations, United Nations University. Human energy requirements: Report of a Joint FAO/WHO/UNU Expert Consultation, Rome, Italy, 17-24 October 2001. FAO, 2004.
17. Sociedade Brasileira de Diabetes (Brazilian Society of Diabetes). Manual oficial de contagem de carboidratos (Official Guide of carbohidrate counting). Departamento de Nutrição (Nutrition Department). Rio de Janeiro: Dois C: Sociedade Brasileira de Diabetes, 2009.
18. Duarte MFS. Maturação física: uma revisão da literatura com especial atenção à criança brasileira (Physical Maturation: a literature review with focus on Brazilian children). *Cad Saúde Publ* 1993; 9 (Suppl.1): S71.
19. World Health Organization. Physical Status: the use and interpretation of anthropometry. WHO Technical Report Series. Geneva: WHO, 1995.
20. Ministério da Saúde (Health Ministry). Vigilância Alimentar e Nutricional – SISVAN (Food and Nutritional vigilance). Brasília, DF: MS, 2008.
21. Sociedade Brasileira de Cardiologia (Brazilian Society of Cardiology). I Diretriz de Prevenção da Aterosclerose na Infância e na Adolescência (First guideline for atherosclerosis prevention in children and adolescents). *Arq Bras Cardiol* 2005; 85 (Suppl. 6): S3-36.
22. American Diabetes Association (ADA). Diagnosis and Classification of Diabetes Mellitus. *Diabetes Care* 2005; 28 (Suppl. 1): S37-42.
23. American Diabetes Association (ADA) Statement: Nutrition Recommendations and Interventions for Diabetes. *Diabetes Care* 2008; 31 (Suppl. 1): S61.
24. Delahanty LM, Halfort BN. The role of diet behaviors in achieving improved glycemic control in intensively treated patients in the Diabetes Control and Complications Trial. *J Am Diet Assoc* 1993; 16 (11): 1453-8.
25. Burroughs TE, Pontious SL, Santiago JV. The relationship among six psychosocial domains, age, health care adherence, and metabolic control in adolescents with IDDM. *Diabetes Educ* 1993: 19 (5): 396-402.
26. Cherron-Prochownik D, Becker MH, Brown MB, Liang WM, Bennett S. Understanding young children's health beliefs and diabetes regimen adherence. *Diabetes Educ* 1993; 19 (5): 409-18.
27. Costa PAA, Franco LJ. Introdução da sacarose no plano alimentar de portadores de diabetes mellitus tipo 1 – sua influência no controle glicêmico (Introducing sucrose in the dietary plan of Diabetes Mellitus type 1 patients – its influence in the glicemic control). *Arq Bras Endocrinol Metab* 2005; 49 (3): 403-9.
28. Alves C, Veiga T, Toralles M, Ribeiro F. Acompanhamento ambulatorial de crianças e adolescentes com diabetes melito tipo 1 na cidade de Salvador (Children and adolescents with Diabetes mellitus type 1 follow-up in the city of Salvador). *Rev Baiana Saúde Pública* 2007; 31 (1): 52.
29. Castro JC, Goulart EMA, Camargos AF, Chagas AJ. Avaliação antropométrica e bioquímica de crianças e adolescentes com diabetes mellitus tipo 1 comparados a um grupo de não diabéticos de mesmo nível sócio econômico (Antropometric and biochemical evaluation of children and adolescents with type 1 Diabetes Mellitus compared to a non-diabetic group with the same social and economic situation). *Arq Bras Endocrinol Metab* 2000; 44 (6): 502.
30. Arcanjo CL, Piccirillo LJ, Machado IV, Andrade Jr. CRM, Gomes MB. Avaliação de Dislipidemia e de Índices Antropométricos em Pacientes com Diabetes Mellitus Tipo 1 (Lipid and antropometric evaluation of Diabetes Mellitus 1 patients). *Arq Bras Endocrinol Metab* 2005; 49 (6): 951.
31. Santos JE, Castro I. II Consenso Brasileiro sobre Dislipidemias (Dyslipidemia Brazilian Consensus). *Arq Bras Endocrinol Metab* 1999; 43 (4): 287.
32. III Brazilian Guidelines on Dyslipidemias and Guideline of Atherosclerosis Prevention from Atherosclerosis Department of Sociedade Brasileira de Cardiologia. *Arq Bras Cardiol* 2001; 77 (Suppl. 3): S1-48.
33. Liberatore RDR, Chandelier EM, Chaccur MIB, Pellini RO, Sassaki TH, Machado WA, Falsetti LAV. A criança diabética numa equipe multiprofisional enfoque terapêutico: experiência ambulatorial (The diabetic chlid in a multiprofessional group: na outpatient experience). *Pediat (São Paulo)* 1980; 2: 278-85.
34. Patton SR. Adherence to diet in youth with type 1 diabetes. J *Am Diet Assoc* 2011; 111 (4): 550-5.
35. Iannotti RJ, Nansel TR, Schneider S, Haynie DL, Simons-Morton B, Sobel DO, Zeitzoff L, Plotnick LP, Clark L. Assessing regimen adherence of adolescents with type 1 diabetes. *Diabetes Care* 2006; 29 (10): 2263-7.
36. Diabetes Research in Children Network (DirecNet) Study Group. Diabetes self management profile for flexible insulin regimens: cross-sectional and longitudinal analysis of psychometric properties in a pediatric sample. *Diabetes Care* 2005; 28 (8): 2034-5.
37. Audit Commission National Report. Testing Times: a review of diabetes services in England and Wales. 2000.