



Family Food Choices Relate to Nutritional Behavior in Adult Patients with Type 1 Diabetes: Possible Implications on Metabolic Control

Ticiane Gonçalves Bovi¹, Denise Engelbrecht Zantut-Wittmann¹,
Arnaldo Moura Neto², Elizabeth João Pavin¹
and Maria Cândida Ribeiro Parisi^{2,3*}

¹Division of Endocrinology, Department of Clinical Medicine, Faculty of Medical Sciences, University of Campinas (UNICAMP), Campinas, CP:13083-887, SP, Brazil.

²Division of Endocrinology, Department of Internal Medicine, Faculty of Medical Sciences, University of Campinas (UNICAMP), Campinas, CP:13083-887, SP, Brazil.

³Department of Endocrinology, Faculty of Medicine, Hospital das Clínicas, University of São Paulo, CP: 01246-904 SP, Brazil.

Authors' contributions

This work was carried out in collaboration between all authors. Author TGB designed the study, wrote the protocol, wrote the first draft of the manuscript and managed the literature searches. Author AMN performed the statistical analysis. Authors MCRP, DEZW and AMN helped to draft the manuscript. Authors MCRP, DEZW, AMN and EJP contributed to analyzing, reviewed and edited the data. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/BJMMR/2016/26084

Editor(s):

(1) Kate S. Collison, Department of Cell Biology, King Faisal Specialist Hospital & Research Centre, Saudi Arabia.

(2) Chan Shen, Department of Biostatistics, MD Anderson Cancer Center, University of Texas, USA.

Reviewers:

(1) Dilina Marreiro, Universidade Federal do Piauí (UFPI), PI, Brazil.

(2) Elvira Bormusov, Rambam Medical Center, Israel.

(3) Ayşenur Yeğin, Antalya Research and Educational Hospital, Turkey.

(4) Hend M. Soliman, Cairo University, Egypt.

(5) Anonymous, The Hebrew University of Jerusalem, Israel.

Complete Peer review History: <http://sciencedomain.org/review-history/15098>

Original Research Article

Received 31st March 2016

Accepted 15th June 2016

Published 21st June 2016

ABSTRACT

This study compared the levels of calories and macronutrients ingested by patients with type 1 diabetes and their relatives. This is a cross-sectional study that evaluated dietary intake (24-hour Food Record), nutritional status (Body Mass Index), as well as socioeconomic status of patients and

*Corresponding author: E-mail: emaildacandida@uol.com.br;

their families. Glycemic control was assessed by glycated hemoglobin (HbA1c). There were positive correlations between dietary intake of patients and family members/accompanying persons regarding carbohydrates, proteins and lipids consumption. Dietary intake of patients and their family members was similar, but inadequate and discordant in relation to current recommendations. Longer time since diagnosis and in service as well as higher number of capillary blood tests was related to better HbA1c levels. Kinship relationship to HbA1c requires further study focusing on parental influence on the treatment of adult patients with type 1 diabetes.

Keywords: Diabetes; type 1 diabetes; family; food habits; nutritional status.

1. INTRODUCTION

Type 1 diabetes (T1D) is a chronic autoimmune disease caused by pancreatic β -cell destruction, resulting in absolute deficiency of insulin production [1]. Although less common than type 2 diabetes, studies show an annual growth of 3% in cases of type 1 diabetes worldwide [2].

Glycaemic control is essential to prevent acute and chronic complications of DM. The American Diabetes Association [1] defines as appropriate targets a fasting glycemia lower than 130 mg/dl and glycated hemoglobin (A1C) lower than 7%. However, maintaining recommended glycemic targets is a major challenge for patients and healthcare professionals.

Low socioeconomic status and educational level, high treatment-related costs as well as the complex individual factors of patients and relatives involved in the treatment are considered important barriers in adherence to the therapeutic plan [3-6]. In addition, one of the main issues affecting metabolic control is observance to dietary recommendations [1]. This is especially true in patients with type 1 diabetes (T1D), which are often younger, present more variable blood glucose results and are more prone to hypoglycemia [1].

Given the importance of a structured diet plan for glycemic control and for the dynamics of family life, this study aimed to evaluate the relationship between dietary intake of family members of patients with T1D and metabolic control of patients. Additionally, the influences of demographic, socioeconomic, nutritional and therapeutic factors on glycemic control of patients were investigated.

2. METHODOLOGY

This is a cross-sectional study involving 100 individuals: 50 patients with T1D and 50 of their family members, which shared housing. The

study was conducted from June 2012 to December 2013.

We included patients older than 18 years, with at least two years of diagnosis and who were under follow-up in the Endocrinology service of our university hospital for at least one year. In relation to family members/caregivers, the inclusion criteria were subjects older than 18 years who lived in the same house or were directly involved in the care of patients (e.g., caregivers, nurses etc.) and had knowledge about the patient's disease for at least one year.

We studied data on socioeconomic status (family income and education), household composition and demographic characteristics, using the Graciano, Lehfeld and Neves Filho [7] questionnaire.

For anthropometric measurements of patients and family members, weight and height were assessed, both measured by the same investigator. Body weight was obtained through an electronic anthropometric platform scale (Filizola®), with a maximum capacity of 150 kg. The results were recorded at the 0.1kg precision level. Height was measured in millimeters with a stadiometer attached to the scale [8].

Body Mass Index (BMI) was calculated dividing the weight in kg by the square of height in meters. Nutritional status was classified according to BMI cutoff points, as recommended by the World Health Organization [9].

For dietary intake evaluation of patients and family members we used the 24 h-Food Record (FR24h), which was obtained always on Fridays. Total Energy Value (TEV) and daily consumption of carbohydrates, lipids, proteins and fibers were estimated. For greater reliability, photographic materials with examples of food portions were used. For FR24h calculation was used the Nutritional Evaluation Software and Dietary Prescription – Dietpro 5i [10]. The following

tables of nutritional composition were used to assess the adequacy of macronutrient intake: the Brazilian Table of Food Composition/NEPA – UNICAMP [11], Table for Dietary intake Evaluation in Homemade measures [12] and Table of Food Composition: Support for nutritional decision [13]. Nutritional composition of processed foods provided by manufacturers were used when necessary.

Data related to glycemic control (the last HbA1c), insulin therapy, associated diseases, diabetes duration and the number of consultations with the Nutrition Service in the previous year were obtained through interview and confirmed when consulting patient records.

The study was approved by the Research Ethics Committee of the School of Medical Sciences, University of Campinas, N 1160/2011.

2.1 Statistical Analysis

Descriptive data are presented as median (interquartile range) and frequency (percentage), unless stated otherwise.

We compared continuous variables between two groups using the Mann-Whitney test. Categorical data were compared with the Chi-square test and Fisher's exact test, as appropriate.

Correlation between variables was evaluated with Spearman nonparametric correlation coefficient. The analysis of the factors influencing glycemic control was assessed with univariate and multivariate linear regression analyses with HbA1c as the dependent variable.

All tests were two-tailed and the statistical significance was set at $p < 0.05$. All tests were done with the software SPSS v20.0.

3. RESULTS

3.1 Characteristics of Patients with Type 1 Diabetes and Their Accompanying Persons

Among the 50 patients with T1D, 66% were female, median age of 32 years (IQ 25.0, 42.0). As for accompanying persons, 64% were female, median age of 48.0 years (IQ 37.75; 55.25). Distributions of socioeconomic and demographic factors as well as health status of patients and their accompanying persons are described in Tables 1 and 2, respectively.

Regarding insulin therapy, 44% used a fixed dose insulin regiment, with no pre-prandial correction (FDWC), 38% used a fixed dose insulin regiment with pre-prandial correction (FDC) and 18% counted carbohydrates (CC). As for diabetes complications, 54% of patients had nephropathy, 46% peripheral neuropathy and 66% had signs of diabetic retinopathy.

There were no significant correlations between nutritional status of accompanying persons and nutritional status of the patient ($p = 0.632$).

3.2 Comparative Analysis for Dietary Intake of Patients with Type 1 Diabetic and Accompanying Persons

Table 3 shows data on dietary intake of patients and the accompanying persons as well as their adequacy according to guidelines. Correlations between macronutrient intakes of both groups are summarized in Table 4.

3.3 Linear Regression Analysis for Variables Influencing Glycemic Control in Patients with Type 1 Diabetes

In univariate evaluation of factors that could influence glycemic control of patients, it was observed statistically significant results in relation to gender, age, number of people in the residence, diabetes duration, follow-up time in service, insulin dose (IU/kg/day) number of blood glucose tests per day, and body mass index (BMI) (Table 5).

Multivariate analysis showed that factors with independent influence on glycemic control were diabetes duration, insulin dose in IU/kg/day and relationship to accompanying persons (Table 5).

The group of patients accompanied by their mother had worse glycaemic control when compared to other groups, with a median HbA1c 9.7% in contrast to 8.6% for the spouse group and 8.5% for those accompanied by other relatives or caregivers.

4. DISCUSSION

Many factors can influence the choices of food in patients with type 1 diabetes. However, it is known that food plan composition, even with some important differences, resembles that recommended for the general population. [1,14,15].

Family eating habits can influence food choices and directly affect the nutritional status of its members. Studies in populations of children without diabetes showed a strong association between dietary intake of parents and their children and the influence exerted by each member of the family separately on the child food intake [18]. In a review by Rasmussen et al. [19], eight of nine studies showed a positive association between parents and son in daily intake of fruits and vegetables.

In this study, dietary food intake presented inadequacies in relation to what is recommended for patients with diabetes and also compared to recommendations for the healthy population [16,17,20]. This was so for patients as well as accompanying persons. This is of particular

importance, given that patients are from a reference, multidisciplinary clinic specialized in the care of people with T1D and had a median follow-up time of eight years. Thus, it is expected that all received relevant advice regarding treatment of their diabetes several times. This is similar to the findings of Gajda et al. [15] which identified inadequate eating habits when evaluating a group of patients with type 2 diabetes (n=43) and healthy subjects (n=43).

Evaluation of the 24-hour food record of patients in the present study showed that more than 50% had carbohydrate consumption according to the recommendations of BSD [16], ADA [2] and EASD [20,21]. The Spanish Diabetes Association [22], in a study involving patients with T1D and T2D, found that more than

Table 1. Demographic, socioeconomic and health status of patients with type 1 diabetes (n=50)

Education	
Completed high school (≥ 11 years of study)	30 (60%)
Incompleted high school (≤ 11 years of study)	20 (40%)
Number of people in the residence	4 (3.0;5.0)
Income familiar <i>per capita</i> (dollar)	268.90 (217.81; 373.32)
Duration of diabetes (years)	18.5 (12.75; 24.0)
Period of follow-up in service (years)	8.0 (2.75; 15.25)
Insulin dosage (IU/Kg/day)	1.00 (1.0; 1.0)
Number of capillary blood evaluation	4.0 (2.0; 6.0)
Number of consultations with the nutritionist last year.	0 (0; 2.0)
HbA1c	9.0% (8.0%; 11.0%)
BMI - Kg/m ²	25.5 (22.0; 29.0)
TEV (Kcal)	1583.0 (1103.00; 1863.75)
Carbohydrate (% TEV)	49.0 (41.0;54.0)
Lipid (% TEV)	31.0 (24.75; 37.0)
Protein (% TEV)	20.0 (16.75; 23.25)
Fibers (g)	15.50 (8.75; 20.25)

Numbers are median (interquartile range) or frequency (%); BMI - Body Mass Index; TEV – Total Energy Value of the diet

Table 2. Characteristics of accompanying persons (n=50)

Education	
Completed high school (≥ 11 years of schooling)	17 (34%)
Incompleted high school (≤ 11 years of schooling)	33 (66%)
Accompanying persons	
Mother	22 (44%)
Spouse	19(38%)
Others*	9 (18%)
BMI - Kg/m ²	28.1(25.7;31.2)
TEV (Kcal)	1497.50 (1041.50; 2018.75)
Carbohydrate (% TEV)	53.0 (43.75;57.25)
Lipid (% TEV)	28.50 (24.0; 36.25)
Protein (% TEV)	17.50 (15.0;21.25)
Fibers (g)	16.0 (11.0;22.0)

*Numbers are median (interquartile range) or frequency (%); *Others: siblings, grandparents, uncles/aunts, children and caregivers; BMI - Kg/m² - Body Mass Index; TEV – Total Energy Value of the diet*

80% were in accordance with the ADA recommendations for carbohydrate intake, similarly to other works [15,23].

In addition, our study found no correlation between the percentage of carbohydrates consumed and metabolic control, in opposition to the findings of Feinman, et al. [24]. The study of Woo, et al. [25] involving adults with T2D, also

found no correlation between carbohydrate intake and HbA1c. Haimoto, et al. [26], using different levels of carbohydrates restriction for patients with T2D, showed that the drastic reduction of this nutrient is not necessarily associated with better glycemic control, concluding that carbohydrate reduction should be individualized in order to avoid unnecessary restrictions.

Table 3. Average distribution, percentage and dietary intake of patients and their accompanying persons according to the recommendations for macronutrients and fibers for patients with diabetes and for the general population (BSD (2013) [16] and AMDR (2005) [17], respectively)*

Variable	Patients (n=50)	Accompanying persons (n=50)	p
BSD recommendation			
Carbohydrate (% TEV)			
Inadequate	23 (46%)	20 (40%)	0.90
Adequate	27 (54%)	30 (60%)	7
Lipid (% TEV)			
Inadequate	28 (56%)	24 (48%)	0.37
Adequate	22 (44%)	26 (52%)	3
Protein (% TEV)			
Inadequate	36 (72%)	30 (60%)	0.79
Adequate	14 (28%)	20 (40%)	7
Fiber (g)			
Inadequate	37 (74%)	35 (70%)	0.72
Adequate	13 (26%)	15 (30%)	8
AMDR recommendation			
Carbohydrate (% TEV)			
Inadequate	21 (42%)	14 (28%)	0.93
Adequate	29 (58%)	36 (72%)	9
Lipid (% TEV)			
Inadequate	23 (46%)	17 (34%)	0.47
Adequate	27 (54%)	33 (66%)	97
Protein (% TEV)			
Inadequate	3 (6%)	1 (2%)	---**
Adequate	47 (94%)	49 (98%)	
Fiber (g)			
Inadequate	46(92%)	45 (90%)	1.00
Adequate	4 (8%)	5 (10%)	0

Numbers are median (interquartile range) or frequency (%)

TEV – Total Energy Value of the diet; *BSD (Brazilian Society of Diabetes (SBD, 2013)); AMDR (Acceptable Macronutrient; Distribution Range (Standing Committee on the Scientific Evaluation of Dietary Reference Intake, 2005)), **inability to perform statistical test due to group distribution

Table 4. Correlation coefficients between dietary intake of accompanying persons/family members, metabolic control and dietary intake of patients

Companions (N=50)	Carbohydrate (% TEV)	Lipid (% TEV)	Protein (% TEV)	Fiber (g)
Patients (N=50)				
HbA1c (%)	0.063	0.092	0.108	0.095
Carbohydrate (% TEV)	0.275*	0.296*	0.006	0.50
Lipid (% TEV)	-0.357*	0.300*	0.163	0.159
Protein (% TEV)	0.091	0.063	- 0.270	0.035
Fiber (g)	0.051	0.068	0.184	0.087

%TEV = Total Energy Value of the diet; *p<0,05

Table 5. Variables influencing glycemic control of patients (HbA1c) – Analysis of univariate and multivariate linear regression analyses

Univariate regression				
Variable	Coef B	Coef β	BI (95%CI)	p
Gender	2.219	.368	(0.572; 3.865)	0.009*
Age	-0.118	-0.460	(-0.184; -0.051)	0.001*
Patient education	-1.593	-0.270	(-3.258; 0.072)	0.060
Number of people in residence	0.500	0.274	(-0.015; 1.014)	0.057*
Family income	0.000	-0.082	(-0.001; 0.000)	0.574
Diabetes duration	-0.166	-0.551	(-0.240; -.092)	<0.001**
Time of follow-up in service	-0.118	-0.338	(-0.214; -0.021)	0.018*
Insulin Dose (IU/Kg/day)	2.393	0.389	(0.732; 4.055)	0.006*
Body Mass Index (BMI)	-0.150	-0.282	(-0.301; 0.000)	0.049*
Blood glucose tests/day	-0.511	-0.335	(-0.933; -0.090)	0.019*
Consultations with Nutrition (n/year)	0.409	0.212	(-0.143; 0.961)	0.143
TEV	8.493	0.019	(-0.001; 0.001)	0.895
Carbohydrate (% TEV)	0.011	0.036	(-0.077; 0.099)	0.806
Lipid (% TEV)	0.056	0.155	(-0.049; 0.161)	0.289
Protein (% TEV)	-0.106	-0.249	(-0.227; 0.015)	0.084
Fiber (g)	-0.018	-0.051	(-0.124; 0.087)	0.730
Multivariate regression				
Diabetes duration	-0.123	-0.425	(-0.186; -0.060)	<0.001**
Insulin Dosage (IU/Kg/day)	2.393	0.303	(0.721; 4.064)	0.006
Kinship	-1.226	-0.334	(-2.024; -0.428)	0.003

* $p < 0.05$; ** $p < 0.001$; TEV = Total Energy Value of the diet

In a study evaluating carbohydrate restriction versus carbohydrate counting in T1D, Krebs, et al. [27], pointed out that in addition to being of difficult adherence, several adverse effects related to low carbohydrate intake, such as irritability, were reported by patients. Moreover, the authors also indicated that in some cases the patients expressed difficulty in finding the correct insulin dosage to be administered for carbohydrate when it was restricted (50-75 grams CHO/day). Bilsborough and Crowe [28] pointed out that carbohydrate-restricted diets could promote increased cholesterol, reinforcing the need for individualization in the distribution of carbohydrates in the diet, especially for patients with diabetes.

Data as these may indicate that carbohydrates consumption would not solely be responsible for uncontrolled diabetes and would help explain our results, since low-carbohydrate diets and concomitant replacement by fat and protein are associated with the worst HbA1c outcomes [23,29,30].

Krebs, et al. [27] reported that in individuals more susceptible to diabetes, high protein coupled with low carbohydrate intake, could increase hepatic glucose output and reduce peripheral utilization of glucose, indicating a state of insulin

resistance. This suggests that high intake of proteins could be one of the factors related to poor glycemic control in patients with diabetes.

In the present study, protein intake was at the maximum limit of the BSD [16] and EASD recommendations [20,21]. However, there was no correlation with HbA1c, contrary to some findings in the literature [31]. Furthermore, we observed an increase in protein intake in people with and without diabetes in our study.

As for lipids, we observed that consumption exceeded the BSD recommendation [16], remaining close to the maximum limit of the ADA recommendation [2,16] and it was not related to metabolic control. These findings are in agreement with some authors [25], but disagree with others [32].

A Chinese study [33], comparing the food intake of patients with T1D and individuals without DM, showed that the intake of macronutrients differ substantially. According to the authors, patients with diabetes tend to consume a lower percentage of energy from carbohydrates and higher from fat and protein. When stratified by insulin regimen, it was observed that the difference between the consumption of carbohydrate and fat was stronger among

participants on fixed insulin regimens. Since 82% of patients in our study were under a fixed dose insulin regimen, this finding could explain the high consumption of fat we have found in our population. We emphasize this aspect remains controversial, so, more studies are necessary.

In relation to fibers, the consumption was below the recommendations of the main societies and health organizations [16,17,20] and was not correlated with glycaemic control, as opposed to what is reported in the literature [15,23,34].

Therefore, we suggest that lipid consumption beyond the recommendations and inappropriate intake of fibers would be associated with the idea of replacing carbohydrate consumption by other dietary sources, a modification that would not lead to better metabolic control. Studies such as the DCCT (Diabetes Control and Complication Trial) [35] showed that replacing carbohydrate by fat (that is, a low carbohydrate/high fat diet) was associated with higher levels of HbA1c regardless of age, gender, exercise, triglyceride levels and BMI.

Meissner, et al. [36] observed a greater consumption of lipids and lower consumption of carbohydrates and fibers in adolescents with type 1 diabetes. For these authors, such behavior aims minimizing weight gain.

We found similarities in the dietary intake of patients and accompanying persons regarding carbohydrates, proteins and lipids. Higher consumption of these macronutrients by family members was associated to higher consumption among patients. It was also observed that the lower carbohydrate intake of patients was accompanied by higher consumption of lipids among family members, data so far not reported in the literature. This could be a sample characteristic or an indication of replacement of dietary sources of carbohydrate by high fat foods, thus reflecting the current models of dietary intake.

Among accompanying persons and patients, there was inadequate intake of carbohydrates, proteins and fibers according to the WHO recommendations [37]. Lipids and fibers consumptions were in according to the AMDR recommendations [17]. In both cases, the support for food and nutrition transition is evident, indicating that both accompanying persons and patients have not properly understood the guidance provided by healthcare professionals. Alternatively, they might not have

been motivated to implement the modifications proposed or have difficulties introducing the recommendations in everyday life.

Education is one of the main factors considered relevant in understanding the importance of dietary characteristics [38-39]. Studies show that over 50% of patients with diabetes have no knowledge or sufficient ability to manage their disease. [40] We found higher education level in patients when compared to accompanying persons. At the same time, the educational level of the accompanying persons as well as that of patients had no influence on glycaemic control of patients. One hypothesis for this lack of association would be the homogeneity of the sample as compared to other studies.

Family income also had no effect on the metabolic control of patients, in contrast to most authors. It is reported that lower educational level and family income can make it difficult to adhere to treatment plans, especially nutritional therapy, and can promote low indexes of quality of life in patients with diabetes [3,41-42].

At the same time, we found that the higher the number of individuals per residence the worse the HbA1c result. Despite solid information reporting that the family unit has great influence on the treatment of diabetes, so far we found no studies that correlate the number of family members in the same environment with glycaemic control of patients with diabetes [42-44].

We noted that there was no correlation between nutritional status of family members and patients. However, we highlight that only studies in children and adolescents showed the influence of the parents' nutritional status on their children [44,45]. This was especially so for the mother's influence [46,47] and so far we are not aware of studies that evaluated such influence in adult populations. An interesting finding in our study was the relationship between the degree of kinship of accompanying persons and glycaemic control of the patient. We found that patients followed by their mothers had worse glycaemic control. As our population consisted of adult subjects, we believe that issues related to the degree of autonomy of the patients require further investigation before drawing any conclusions. At the same time, we found no studies that consistently evaluate the motherly figure contribution to the treatment and glycaemic control of DM in adults.

We found better glycaemic control in patients with longer duration of diabetes, diverging from previous publications [48-49]. A possible explanation is based on the idea that the longer time of disease results in longer medical follow-up, repeated guidance regarding glycaemic control, factors that could contribute to better HbA1c results.

On the other hand, patients with a higher insulin dose per Kg/day had worse glycaemic control, a finding that is in agreement with previous works, where children and adolescents with T1D had worse glycaemic control even with larger doses of insulin per Kg/day [49-51]. In our population, more than 50% of patients were overweight or obese, which could explain the increase in insulin dose per Kg/day. Similar results were found in studies with children and adolescents with T1D [52].

Finally, in this study, patients who performed a greater number of capillary blood tests/day showed better glycaemic control, agreeing to the literature [16,53].

5. CONCLUSION

We conclude that dietary intake of patients and their family members was similar, inadequate and discordant from what is recommended, highlighting that educational guidance related to food consumption in patients with T1D should also include the family.

Longer period since diagnosis and longer follow-up in the service were independent factors leading to better metabolic control. The influence of accompanying personnel on HbA1c requires further studies focusing on parental influence in the treatment of adult patients with T1D.

6. STUDY LIMITATIONS

One limitation of this study was the use of only one 24-hour food recall in patients and family members. Given the dynamics of the service and the need to obtain data from both groups at the same time, we opted for this practice.

CONSENT

All authors declare that written informed consent was obtained from the patient (or other approved parties) for publication of this paper.

ACKNOWLEDGEMENTS

The authors also thank CAPES (Higher Education Personnel Improvement Coordination) for the post-graduate scholarship received.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Cameron F. Standards of medical care in diabetes - 2016. *Diabetes Care*. 2016;39:386–90.
2. IDF Diabetes Atlas Edition S. *IDF Diabetes Atlas Seventh Edition*. 2015;144.
3. Tan C, Stacy H, Taira Juarez D, Grimm C. A descriptive study of Marshallese and Chuukese patients with diabetes in Hawaii. *Hawaii J Med Public Heal*. 2014;73(6):168–71.
4. Smalls BL, Walker RJ, Hernandez-tejada M, Campbell J, Davis KS, Egede LE. Associations between coping, diabetes knowledge, medication adherence, and self-care behaviors in adults with type 2 diabetes. *Gen Hosp Psychiatry*. 2013;34(4):385–9.
5. Gómez-Rico I, Pérez-Marín M, Montoya-Castilla I. Diabetes mellitus tipo 1: breve revisión de los principales factores psicológicos asociados. *An Pediatr*. 2015;82(1):2013–6. Brazil.
6. Colles SL, Singh S, Kohli C, Mithal A. Dietary beliefs and eating patterns influence metabolic health in type 2 diabetes: A clinic-based study in urban North India. *Indian J Endocrinol Metab*. 2013;17(6):1066–72.
7. Graciano MIG, Leffeld NA de S, Neves Filho A. Critérios de avaliação para classificação sócio-econômica: elementos de atualização. *Soc Serv Real*. 1999;8(1):109–28. Brazil.
8. Gordon C, Chumlea W, AF R. Anthropometric standardization reference manual. Champaign: Human Kinetics Books. 1988;3-8.
9. [WHO] World Health Organization. Obesity: Preventing and managing the global epidemic. Geneva. 2000;894.
10. DietPRO 5.0. Software for nutritional assessment and diet prescription. Available:<https://dietpro.com.br/site/>

11. Núcleo de Estudos e Pesquisas em Alimentação – NEPA UNICAMP. Tabela brasileira de composição de alimentos. II. NEPA-UNICAMP, editor. Campinas; Brazil. 2006;105.
12. Pinheiro A, Lacerda E, Benzecry E, Gomes M, Costa V. Tabela para Avaliação de Consumo Alimentar em Medidas Caseiras. 5a ed. Atheneu, editor. São Paulo; Brazil. 2004;131.
13. Philippi ST. Tabela de Composição de Alimentos: Suporte para decisão nutricional. 2a ed. Coronário, editor. São Paulo; Brazil. 2002;135.
14. Evert AB, Boucher JL, Cypress M, Dunbar S, Franz MJ, Mayer-Davis EJ, et al. Nutrition therapy recommendations for the management of adults with diabetes. *Diabetes Care* [Internet]. 2013;36(11):3821–42. Available:<http://www.ncbi.nlm.nih.gov/pubmed/24107659> [Cited 2014 Mar 21]
15. Gajda K, Sulich A, Hamułka J, Białkowska A. Comparing diabetic with non-diabetic overweight subjects through assessing dietary intakes and key parameters of blood biochemistry and haematology. *Rocz Panstw Zakl Hig.* 2014;65(2):133–8.
16. Sociedade Brasileira de Diabetes (SBD). Diretrizes da Sociedade Brasileira de Diabetes: 2013-2014/Sociedade Brasileira de Diabetes. Oliveira JEP de, Sérgio Vencio, editors. São Paulo; Brazil. 2013;382.
17. Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids (Macronutrients). *Nutrition reviews.* 2005;319-326.
18. Robinson LN, Rollo ME, Watson J, Burrows TL, Collins CE. Relationships between dietary intakes of children and their parents: A cross-sectional, secondary analysis of families participating in the family diet quality study. *J Hum Nutr Diet.* 2014;443–51.
19. Rasmussen M, Krølner R, Klepp K-I, Lytle L, Brug J, Bere E, et al. Determinants of fruit and vegetable consumption among children and adolescents: A review of the literature. Part I: Quantitative Studies. *Int J Behav Nutr Phys Act.* 2006;3(1):22.
20. Grant PJ, Chairperson E, Germany SDA, France ND, Uk CD, Germany HH, et al. ESC Guidelines on diabetes, pre-diabetes, and cardiovascular diseases developed in collaboration with the EASD the European Society of Cardiology (ESC) and developed in collaboration. 2013;3035–87.
21. Connor H, Annan F, Bunn E, Frost G, McGough N, Sarwar T, et al. The implementation of nutritional advice for people with diabetes. *Diabet Med* [Internet]. 2003;20(10):786–807. Available:<http://www.ncbi.nlm.nih.gov/pubmed/14510859>
22. ASSOCIATION GOTSD. Diabetes nutrition and complications trial. Trends in nutritional pattern between 1993 and 2000 and targets of diabetes treatment in a sample of Spanish people with diabetes. *Diabetes Care.* 2004;27(4):984–7.
23. Helgeson VS, Viccaro L, Becker D, Escobar O, Siminerio L. Diet of adolescents with and without diabetes: Trading candy for potato chips? *Diabetes Care.* 2006;29:982–7.
24. Feinman RD, Pogozelski WK, Astrup A, Bernstein RK, Fine EJ, Westman EC, et al. Dietary carbohydrate restriction as the first approach in diabetes management: Critical review and evidence base. *Nutrition* [Internet]. Elsevier Inc. 2014;31(1):1–13. Available:<http://www.sciencedirect.com/science/article/pii/S0899900714003323>
25. Woo M-H, Park S, Woo J-T, Choue R. A comparative study of diet in good and poor glycemic control groups in elderly patients with type 2 diabetes mellitus. *Korean Diabetes J.* 2010;34:303–11.
26. Haimoto H, Sasakabe T, Kawamura T, Umegaki H, Komeda M, Wakai K. Three-graded stratification of carbohydrate restriction by level of baseline hemoglobin A1c for type 2 diabetes patients with a moderate low-carbohydrate diet. *Nutr Metab (Lond)* [Internet]. 2014;11(1):33. Available:<http://www.ncbi.nlm.nih.gov/pubmed/25114711>
27. Krebs JD, Strong AP, Mn PC, Reynolds AN, Hanna A, Haeusler S. A randomised trial of the feasibility of a low carbohydrate diet vs standard carbohydrate counting in adults with type 1 diabetes taking body weight into account. *Asia Pac J Clin Nutr.* 2016;25(1):78–84.
28. Bilsborough SA, Crowe TC. Low-carbohydrate diets: What are the potential short- and long-term health implications? *Asia Pac J Clin Nutr.* 2003;12(4):396–404.

29. Trial C, Delahanty LM, Nathan DM, Lachin JM, Hu FB, Cleary PA, et al. Association of diet with glycated hemoglobin during intensive treatment of type 1 diabetes in the diabetes control and complications trial. *Am J Clin Nutr.* 2009;89:518–24.
30. Toeller M, Buyken AE, Heitkamp G, Cathelineau G, Ferriss B, Michel G. Nutrient intakes as predictors of body weight in European people with type 1 diabetes. *Int J Obes Relat Metab Disord.* 2001;25:1815–22.
31. Tucker LA, Erickson A, Lecheminant JD, Bailey BW. Dairy consumption and insulin resistance: The role of body fat, physical activity, and energy intake. *J Diabetes Res.* 2015;2015:1–11.
32. Wiltshire EJ, Hirte C, Couper JJ. Dietary fats do not contribute to hyperlipidemia in children and adolescents with type 1 diabetes. *Diabetes Care* [Internet]. 2003;26(5):1356–61. Available:<http://www.ncbi.nlm.nih.gov/pubmed/12716788>
33. Jaacks LM, Du S, Mendez MA, Crandell J, Liu W, Ji L, et al. Comparison of the dietary intakes of individuals with and without type 1 diabetes in China. *Asia Pac J Clin Nutr.* 2015;24(4):639–49.
34. Velázquez-lópez L, Muñoz-torres AV, García-peña C, López-alarcón M, Islas-andrade S, Peña JE. Fiber in diet is associated with improvement of glycated hemoglobin and lipid profile in Mexican patients with type 2 diabetes. *J Diabetes Res.* 2016;2016:1–9.
35. Delahanty L, Nathan D, Lachin J, Hu F, Cleary P, Ziegler G. Association of diet with glycated hemoglobin during intensive treatment of type 1 diabetes in the diabetes control and complications trial. *Am J Clin Nutr.* 2009;89(2):518–24.
36. Meissner T, Wolf J, Kersting M, Fröhlich-Reiterer E, Flechtner-Mors M, Salgin B, et al. Carbohydrate intake in relation to BMI, HbA1c and lipid profile in children and adolescents with type 1 diabetes. *Clin Nutr* [Internet]. Elsevier Ltd. 2014;33(1):75–8. Available:<http://dx.doi.org/10.1016/j.clnu.2013.03.017>
37. [WHO] World Health Organization. Diet, nutrition and the prevention of chronic diseases. Joint WHO/FAO Expert Consultation on Diet N and the P of, Chronic Diseases., editors. 2003;160.
38. Ozcariz SGI, de O Bernardo C, Cembranel F, Peres M, González-Chica D. Dietary practices among individuals with diabetes and hypertension are similar to those of healthy people: A population- based study. *BMC Public Health* [Internet]. BMC Public Health. 2015;15(1):1–10. Available:<http://www.biomedcentral.com/1471-2458/15/479>
39. Darmon N, Drewnowski A. Does social class predict diet quality? *Am J Clin Nutr.* 2008;87(5):1107–17.
40. Alireza Didarlo, Davoud Shojaeizadeh M. Impact of educational intervention based on interactive approaches on beliefs, behavior, hemoglobin A1c, and quality of life in diabetic women. *Int J Prev Med.* 2016;7(38).
41. Bortsov A, Liese AD, Bell RA, Dabelea D, Jr RBDA, Hamman RF, et al. Correlates of dietary intake in youth with diabetes results from the search for diabetes in youth study. *J Nutr Educ Behav.* 2011;43(2):123–9.
42. Al-Odayani AN, Alsharqi OZ, Ahmad AMK, Khalaf Ahmad AM, Al-Borie HM, Qattan AMN. Children's glycemic control: mother's knowledge and socioeconomic status. *Glob J Health Sci* [Internet]. 2013;5(6):214–26. Available:<http://www.ncbi.nlm.nih.gov/pubmed/24171891>
43. Gucciardi E, Vahabi M, Norris N, Paul J, Monte D, Farnum C. The intersection between food insecurity and diabetes: A review. *Curr Nutr Rep.* 2014;3:324–32.
44. Endevelt R, Elkayam O, Cohen R, Peled R, Tal-Pony L, Michaelis Grunwald R, et al. An intensive family intervention clinic for reducing childhood obesity. *J Am Board Fam Med* [Internet]. 2014;27:321–8. Available:<http://www.ncbi.nlm.nih.gov/pubmed/24808110>
45. Terres NG, Pinheiro RT, Horta BL, Amaral K, Pinheiro T. Prevalence and factors associated to overweight and obesity in adolescents. *J Public Health (Bangkok).* 2006;40(4):1–6.
46. Faith MS, Heshka S, Keller KL, Sherry B, Matz PE, Pietrobelli A, et al. Maternal-child feeding patterns and child body weight: Findings from a population-based sample. *Arch Pediatr Adolesc Med.* 2003;157:926–32.
47. Dubois L, Girard M. Early determinants of overweight at 4.5 years in a population-

- based longitudinal study. *Int J Obes (Lond)*. 2006;30(4):610–7.
48. Who. Innovative care for chronic conditions: Building blocks for action. Geneva: World Health Organization (WHO/MNC/CCH/02.01). 2002;117. Available:<http://www.who.int/chp/knowledge/publications/icccreport/en/> (Accessed: 2013-08-20) (Archived by WebCite® at <http://www.webcitat> Geneva: World Health Organization)
49. Olsson L, Grill V, Midthjell K, Ahlbom A, Anderssonc T, Carlsson S. Mortality in adult-onset autoimmune diabetes is associated with poor glycemic control: Results from the HUNT study. *Diabetes Care*. 2013;36:3971–8.
50. Setoodeh A, Mostafavi F, Rabhani A, Hedayat T. Female sex as a risk factor for glycemic control and complications in Iranian patients with type one diabetes mellitus. *Iran J Pediatr* [Internet]. 2011;21(3):373–8. Available:<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3446184&tool=pmcentrez&rendertype=abstract>
51. O'Hagan M, Harvey JN. Glycemic control in children with type 1 diabetes in Wales. *Diabetes Care*. 2010;33(8):1724–6.
52. Nansel TR, Lipsky LM, Iannotti RJ. Cross-sectional and longitudinal relationships of body mass index with glycemic control in children and adolescents with type 1 diabetes mellitus. *Diabetes Res Clin Pr*. 2014;29(1):997–1003.
53. Committee PP, Classification A. Standards of medical care in diabetes--2010. *Diabetes Care* [Internet]. 2010; 33(Suppl 1):S11–61. Available:<http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2797382&tool=pmcentrez&rendertype=abstract> [cited 2014 May 26];

© 2016 Bovi et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:
The peer review history for this paper can be accessed here:
<http://sciencedomain.org/review-history/15098>