DOI: 10.1590/1413-812320182312.01412017

Consumption of dietary intake markers by patients with diabetes assessed using a mobile application

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Abstract *The aim of this study was to assess the consumption of dietary intake markers in patients with diabetes using a mobile application. A cross-sectional study was conducted with 100 younger and older adult type 2 diabetes patients in treatment in a hospital in the State of Rio Grande do Sul, Brazil. Data was collected using the Diabetes Food Control app. The chi-squared test was used to measure the association between adequate consumption of healthy and unhealthy markers and the variables investigated by the study adopting a 5% significance level. The findings revealed that a high percentage of the respondents were overweight and/or obese and showed inadequate glycemic control. The prevalence of adequate consumption of both healthy and unhealthy diet markers was greatest for the following food groups: fried foods (82%), milk or yogurt (71%), fresh fruit (70%), beans and sugary drinks (68% each item), cookies and sweets (57%), and raw salad (56%). Adequate consumption of unhealthy diet markers was greatest in patients with a family income of less than four minimum salaries, followed by those who did not have high blood pressure. The frequency of consumption of markers was considered adequate for the majority of patients; however, nutritional monitoring is required to correct high blood glucose and HbA1c levels.*

Key words *Diabetes Mellitus, Dietary intake, Diet*

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Introduction

Healthy eating is one of the main pillars of the treatment and management of diabetes mellitus (DM). Dividing meals into appropriate portion sizes, eating natural foods, like fruit and vegetables, wholegrain cereals, and pulses, and reducing fat, sodium, and sugar intake help to control diabetes, maintain adequate nutritional status, and prevent complications caused by the disease[1].

Nutrition is a prominent global health issue. A number of studies in Brazil have confirmed that changes in people's eating habits over the years, marked by a fall in the consumption of traditional staples such as rice and beans and rise in the consumption of processed and ultra-processed foods such as sugary drinks, instant noodles, and cookies, have hugely contributed to the impoverishment of our diet and the increased prevalence of chronic diseases, notably Type 2 DM[2-4].

Within this context, various methods have been used to assess dietary intake in order to provide valid and reliable data, with a view to determining the association between dietary exposure and health status. Food frequency questionnaires, which indicate habitual food intake, are widely used to measure the association between the qualitative characteristics of diet and the incidence of chronic diseases[5,6].

However, in recent years researchers have tended to simplify dietary assessment tools. Short assessment instruments are being developed to reduce administration time, facilitate understanding, and enable the identification of groups at risk of inadequate food intake[7,8].

In this respect, the Brazilian Ministry of Health has developed paper-based and electronic care protocols that are used by primary care health professionals to assess the dietary habits and nutritional status of patients. One of these protocols is a simplified food frequency questionnaire designed to identify inadequacies in dietary intake and, in particular, provide the basis for guidance on developing healthy eating habits[9].

As an alternative to traditional methods, the automation of dietary assessment questionnaires to an electronic format has shown itself to be a promising tool for optimizing the assessment process[10]. Factors such as streamlined access, 24-hour availability, swift processing, low cost, and easy return make electronic questionnaires a practical tool that can be used hospitals, clinics, and outpatient departments, especially when accessed via mobile devices[11]. Thus, given that dietary habits are an essential element of successful DM control and prevention, the aim of the present study was to assess dietary intake markers in diabetes patients using a mobile application.

Methods

A cross-sectional study was conducted with a sample made up of younger and older adult type 2 DM patients in treatment in a hospital in a city in the State of Rio Grande do Sul, Brazil during the period August to November, 2015.

Sample size was calculated based on a margin of error of 5% and 95% confidence interval, the number of patients treated in the hospital in the last year (31,680), and the diabetes prevalence rate for 2012 published in the DATASUS (11.7%)[12], resulting in 158 patients. However, it was only possible to reach a sample of 100 patients during the study period.

The inclusion criteria were as follows: aged 18 years or over; diagnosed with type 2 DM; glycated hemoglobin (HbA1c) levels reported in the patient's medical records; being conscious and able to communicate verbally. The following individuals were excluded: women who were pregnant or breast feeding; patients admitted for more than 72 hours; patients undergoing exclusive enteral or parenteral nutritional therapy; patients admitted to the intensive care unit, recovery or emergency units; amputees or patients with a limb in a plaster cast; patients with edema or ascites; illiterate patients; and patients in palliative care.

Diabetes Food Control App

Data was collected using the Diabetes Food Control app[13] run on a tablet. The app consists of a seven-step electronic questionnaire comprising the following domains: personal details; biochemical assessment; anthropometric measurements; sociodemographic and economic data; medical and nutritional history; lifestyle; and diet.

Procedure

The questionnaire was administered via an interview conducted by the researcher, who entered the information into the app following the steps of the questionnaire. Personal information, including patient admission history, reason for

Ciência & Saúde Coletiva, 23(12):4199-4208, 2018

admission, sex, age, and fasting blood glucose and HbA1c levels, was obtained from the patient's medical records.

Glycemic control was assessed based on the normal blood glucose threshold set by the American Diabetes Association[14].

Body weight was measured in accordance with Food and Nutrition Surveillance System (SISVAN) recommendations[15]. For bedridden patients and those unable to stand upright, measurements were estimated with the app based on equations proposed by Lee and Nieman[16] and Chumlea et al.[17]. Knee height (KH) and Arm Circumference (AC) were measured (CB) using methods described by Lee and Nieman[16]. These measurements were used to calculate Body Mass Index (BMI) and nutritional status according to the classification proposed by the World Health Organization (WHO)[18].

Waist circumference (WC) was measured using a tape measure following the method proposed by SISVAN[15]. After recording the measurement in the app, the risk of metabolic complications associated with obesity was estimated according to the classification proposed by the WHO[18].

During the next step, sociodemographic and economic data was collected, including years of schooling, marital status, place of residence, and family income.

The following items were assessed in relation to medical and nutritional history: length of time since diagnosis, whether the patient suffers from high blood pressure (HBP)/dyslipidemia, nutritional monitoring and guidance, as well as information about lifestyle related to smoking, alcohol consumption, and physical activity.

Dietary intake was assessed using the simplified food markers frequency questionnaire, a 10-item instrument proposed by SISVAN[9] that explores the frequency of consumption of healthy and unhealthy foods over the seven days prior to the interview. The recommendations of the Dietary Guidelines for the Brazilian Population (*Dietary Guidelines para População Brasileira*)[19] were used assess the consumption adequacy of the foods listed in the instrument. Adequate consumption was regarded as: the daily consumption of foods that are healthy diet markers (such as raw salad, pulses and cooked vegetables, fresh fruit and fruit salad, milk or yogurt) and the consumption of beans at least five times a week; the consumption of unhealthy diet markers (such as fried food, hamburgers and processed meat products, savory biscuits or packaged snacks, cookies or sweets and sugary drinks) no more than once a week.

After completing the dietary intake questionnaire, the app provided feedback to the patient regarding his performance in meeting each of the recommendations set out by the Dietary Guidelines.

Statistical analysis

The data was sent by email in a CSV file and then saved in an Excel spreadsheet. Data analysis was performed using the statistical software SSPS version 18.0. The chi-squared test was used to measure the association between adequate consumption of healthy and unhealthy diet markers and variables investigated by the study adopting a 5% significance level.

Ethical aspects

The study was conducted in accordance with Resolution 466/2012 and was approved by the hospital's Research and Postgraduate Committee and by the Ethics Committee. All participants received information about the study objectives and research procedures and signed an informed consent form.

Results

A total of 100 patients diagnosed with type 2 DM were assessed, 57% of whom had been admitted to hospital for heart treatment (data not shown). Table 1 shows the main characteristics of the patients. The majority of the sample were male (51%) and 83% were elderly. Average age was 67.14 ± 8.78 years. Almost half the sample had up to four years of schooling (47%) and 60% were married. The majority of the participants lived in urban areas (83%) and 71% had a family income of less than four minimum salaries (MS).

The average length of time since diagnosis was 9.5 years, ranging between 0.6 and 40 years (data not shown). The prevalence of HBP and dyslipidemia among the sample was 75% and 36%, respectively. With respect to diet, 72% reported that they had received nutritional guidance. Of this group, 42% cited that the source of this guidance was a doctor. Eighty-two percent of the participants were not undergoing nutritional monitoring.

With regard to lifestyle, 57% were ex-smokers, 73% did not drink, and 77% did not practice any type of physical activity.

Table 1. Main characteristics of the study sample. Passo Fundo, Brazil 2015 (n = 100).

Characteristic	n	%	Mean ± SD
Sex			
Male	51	51.0	
Female	49	49.0	
Age (years)			67.14 ± 8.78
< 60	17	17.0	
≥ 60	83	83.0	
Years of schooling			6.07 ± 4.88
≤ 4	47	47.0	
5-8	32	32.0	
≥ 9	21	21.0	
Marital status			
Single	6	6.0	
Married	60	60.0	
Divorced	5	5.0	
Widow	29	29.0	
Place of residence			
Urban area	83	83.0	
Rural area	17	17.0	
Family income (MS)			
< 2	33	33.0	
2-3	38	38.0	
4-9	26	26.0	
≥ 10	3	3.0	
Self-reported HBP			
Yes	75	75.0	
No	25	25.0	
Self-reported dyslipidemia			
Yes	36	36.0	
No	64	64.0	
Nutritional guidance for DM			
Yes	72	72.0	
No	28	28.0	
Professional who provided guidance			
Doctor	42	58.3	
Nutritionist	29	40.3	
Other	1	1.4	
Nutritional monitoring			
Yes	18	18.0	
No	82	82.0	
Smoker			
Never smoked	43	43.0	
Ex-smoker	57	57.0	
Alcohol consumption			
Never	73	73.0	
< 1 unit a ,month	12	12.0	
1-3 units per week	12	12.0	
4-7 units per week	3	3.0	
Physical activity			
Yes	23	23.0	
No	77	77.0	

DM: Diabetes Mellitus. HPB: High Blood Pressure. MS: Minimum Salary.

With respect to nutritional status, 37% of the respondents were overweight and 44% were obese. With regard to CC, 77% of the participants were at a high risk of developing metabolic complications associated with obesity. Average HbA1c and fasting blood glucose levels were 8.38 ± 2.17% and 154.28 ± 67.93mg/dL, respectively, indicating unsatisfactory glycemic control based on these markers in 50% and 68% of the patients, respectively (Table 2).

With regard to healthy diet markers, over half of patients reported that they consumed milk or yogurt, fresh fruit, and raw salad on a daily basis (71%, 70%, and 56%, respectively), while 68% ate beans at least five times a week. The least consumed healthy diet markers were pulses and cooked vegetables (22.0%). The frequency of consumption of unhealthy diet markers (savory biscuits, hamburgers and processed meat products, cookies and sweets, sugary drinks and fried food) was above the ideal in 67%, 53%, 43%, 32%, and 18% of respondents, respectively (Table 3).

The analysis of the association between adequate consumption of healthy diet markers and unhealthy diet markers and sociodemographic and economic variables showed that adequate consumption of fruit was greatest in females and that adequate consumption of cookies and sweets was greatest among patients whose family income was less than four MSs. No significant association was found between the other variables, as shown in Table 4.

The analysis of the association between adequate consumption of healthy and unhealthy diet markers and the variables in the domains medical and nutritional history, lifestyle, and biochemical assessment showed that adequate consumption of sugary drinks was greatest in patients who did not have HBP, while adequate consumption of milk or yogurt was greatest in individuals who were not overweight. No significant association was found between the other variables, as shown in Table 5.

Discussion

The lifestyle profile of the participants of the present study was similar to that found in studies conducted with diabetes patients in the south of the country[20,21]. The findings in relation to smoking cessation among the study participants are particularly interesting, because they show that this facet of self-care is being incorporated into

Table 2. Nutritional status, metabolic risk and glycemic control. Passo Fundo, Brazil, 2015 (n = 100).

Indicator	n	%	Mean ± SD	Minimum	Maximum
BMI (kg/m2)*			29.29 ± 5.74	13.90	50.87
Low weight	4	4.0			
Healthy weight	15	15.0			
Overweight	37	37.0			
Obese	44	44.0			
WC (cm)**			107.76 ± 14.64	66.0	149.0
Low risk	7	7.0			
High risk	16	16.0			
Very high risk	77	77.0			
Blood glucose (mg/dL)***			154.28 ± 67.93	70.0	361.0
Normal	32	32.0			
Abnormal	68	68.0			
HbA1c (%)***			8.38 ± 2.17	4.7	15.1
Normal	50	50.0			
Abnormal	50	50.0			

*Estado nutricional segundo IMC. **Risco de complicações metabólicas segundo a CC.
***Controle glicêmico segundo a Glicemia capilar e HbA1c.

Table 3. Frequency of consumption of dietary intake makers in the week before the interview. Passo Fundo, Brazil, 2015 (n = 100).

Marker	None	1x	2x	3x	4x	5x	6x	7x
	%	%	%	%	%	%	%	%
Raw salad	6.0	5.0	2.0	12.0	5.0	5.0	9.0	56.0
Pulses and cooked vegetables	7.0	19.0	15.0	17.0	10.0	6.0	4.0	22.0
Fresh fruit	2.0	4.0	2.0	7.0	7.0	5.0	3.0	70.0
Beans	5.0	6.0	9.0	6.0	6.0	17.0	11.0	40.0
Milk or yogurt	17.0	2.0	1.0	2.0	2.0	2.0	3.0	71.0
Fried foods	57.0	25.0	12.0	2.0	-	1.0	-	3.0
Hamburgers and processed meat products	36.0	11.0	8.0	6.0	2.0	3.0	4.0	30.0
Savory biscuits	20.0	13.0	11.0	15.0	7.0	6.0	1.0	27.0
Cookies or sweets	32.0	25.0	19.0	8.0	4.0	3.0	2.0	7.0
Sugary drinks	50.0	18.0	11.0	2.0	3.0	3.0	-	13.0

the treatment of diabetes. However, physical activity should be encouraged in this group given its many benefits, including improved nutritional status, insulin sensitivity, and glucose tolerance, which favors glycemic control[14].

Despite the fact that overweight and obesity are important predictors of morbidity and mortality among both the general population and people who have diabetes, the data regarding BMI reveals that the prevalence of these conditions is particularly high among the study participants (81%). It is important to note, however, that these findings differ from those reported by Lisbôa et al.[22]. Furthermore, based on the WC data, the majority of the group (93%) were at high or very high risk of metabolic complications associated with obesity, corroborating the findings of Supp[23].

The participants did not meet the glycemic control targets set by the Brazilian Diabetes Society. Blood glucose and HbA1c levels were above the recommended levels, which is in line with the findings of Sampaio et al.[24] (154.28 ± 67.93mg/dl and 8.38 ± 2.17% versus 160.5 ± 62.8mg/dl and 8.5 ± 1.90%, respectively). These findings indicate that it is necessary to improve glycemic control among this group, given that chronic hyperglycemia triggers a series of long-term complications[25].

Table 4. Adequate consumption of healthy and unhealthy diet markers across sociodemographic and economic variables. Passo Fundo, Brazil, 2015 (n = 100).

	Raw salada n (%)	Pulses and cooked vegetables[a] n (%)	Fresh fruita n (%)	Beans[b] n (%)	Milk or yogurt[a] n (%)	Fried foods[c] n (%)	Hamburgers and processed meat products[c] n (%)	Savory biscuits[c] n (%)	Cookies and sweets[c] n (%)	Sugary drinks[c] n (%)
Sex	p = 0.687	p = 0.633	p = 0.004	p = 0.393	p = 0.189	p = 0.796	p = 0.316	p = 0.400	p = 0.691	p = 0.136
Male	30 (58.8)	10 (19.6)	29 (56.9)	37 (72.5)	33 (64.7)	41 (80.4)	21 (41.2)	19 (37.3)	28 (54.9)	31 (60.8)
Female	26 (53.1)	12 (24.5)	41 (83.7)	31 (63.3)	38 (77.6)	41 (83.7)	26 (53.1)	14 (28.6)	29 (59.2)	37 (75.5)
Age (years)	p = 0.795	p = 0.348	p = 0.576	p = 0.401	p = 0.564	p = 0. 296	p = 0.301	p = 0.167	p = 0.595	p = 1.000
< 60	9 (52.9)	2 (11.8)	11 (64.7)	10 (58.8)	11 (64.7)	16 (94.1)	10 (58.8)	3 (17.6)	11 (64.7)	12 (70.6)
≥ 60	47 (56.6)	20 (24.1)	59 (71.1)	58 (69.9)	60 (72.3)	66 (79.5)	37 (44.6)	30 (36.1)	46 (55.4)	56 (67.5)
Years of schooling	p = 0.261	p = 0.866	p = 0.879	p = 0.346	p = 0.885	p = 0.111	p = 0.222	p = 0.974	p = 0.115	p = 0.078
≤ 4	26 (55.3)	10 (21.3)	34 (72.3)	35 (74.5)	34 (72.3)	36 (76.6)	20 (42.6)	15 (31.9)	23 (48.9)	27 (57.4)
5-8	21 (65.6)	8 (25.0)	22 (68.8)	21 (65.6)	23 (71.9)	30 (93.8)	19 (59.4)	11 (34.4)	23 (71.9)	26 (81.3)
≥ 9	9 (42.9)	4 (19.0)	14 (66.7)	12 (57.1)	14 (66.7)	16 (76.2)	8 (38.1)	7 (33.3)	11 (52.4)	15 (71.4)
Place of residence	p = 0.795	p = 0.757	p = 0.262	p = 1.000	p = 0.771	p = 0.730	p = 0.790	p = 1.000	p = 1.000	p = 0.401
Urban area	47 (56.6)	19 (22.9)	56 (67.5)	56 (67.5)	58 (69.9)	67 (80.7)	40 (48.2)	27 (32.5)	47 (56.6)	58 (69.9)
Rural area	9 (52.9)	3 (17.6)	14 (82.4)	12 (70.6)	13 (76.5)	15 (88.2)	7 (41.2)	6 (35.3)	10 (58.8)	10 (58.8)
Family income (MS)	p = 0.509	p = 0.793	p = 1.000	p = 0.814	p = 0.472	p = 0.775	p = 0.276	p = 0.349	p = 0.049	p = 0.147
< 4	38 (53.5)	15 (21.1)	50 (70.4)	49 (69.0)	52 (73.2)	59 (83.1)	36 (50.7)	21 (29.6)	45 (63.4)	51 (71.8)
≥ 4	18 (62.1)	7 (24.1)	20 (69.0)	19 (65.5)	19 (65.5)	23 (79.3)	11 (37.9)	12 (41.4)	12 (41.4)	17 (58.6)

MS: Minimum Salary. [a]Daily consumption. [b]At least five times a week. [c]No more than once a week. p value: Chi-squared test.

With respect to adequate consumption of healthy diet markers listed in the Dietary Guidelines, the findings show that frequency of consumption was greatest for milk and yogurt, fresh fruit, and beans and raw salad, drawing attention to the low daily consumption of pulses and cooked vegetables, foods which are essential parts of a balanced diet. These results contrast with the findings of a study conducted by Tiew et al.[26] with patients in a hospital in Sepang, Malaysia, but are similar to the findings of a study undertaken by Destri[27].

In Brazil, VIGITEL data for 2014[4] reveal that 44.1% of the population eat fruit and vegetables on a regular basis and that only 29.4% of these people eat at least five portions of these foods per day, as recommended by the Dietary Guidelines. However, the VIGITEL also found that a relatively large proportion of Brazilians consume beans and milk on a regular basis (63% and 48.8%, respectively). These rates are less than those found by the present study for these markers, which can be deemed satisfactory for the patients assessed by this study.

With regard to the consumption of unhealthy diet markers, adequate consumption was greatest for fried foods, sugary drinks, and sweet foods. These findings contrast with those reported by Kobayashi et al.[28] and Lima et al.[29], who showed that the diet of participants was inadequate due to the excessive consumption of these markers. Limiting the consumption of sweets and fried foods is the main recommendation given by health professionals to diabetes patients given that there is a direct relation between the consumption of these foods and high blood glucose and lipid levels.

Bleich and Wang[30] showed that 45% of respondents consumed sugary drinks on a daily basis, while Lima et al.[29] reported that 40% of diabetes patients consumed soft drinks and artificial juice drinks. These results differ from the findings of the present study, which show that only 13% of respondents consumed these items on a daily basis. These differences may be due to the use of different dietary assessment methods. Furthermore, given the number of patients with comorbidities and the high average length time since diagnosis, the group is probably more interested in diet and adopting healthy behaviors.

Despite adequate consumption of unhealthy diet markers, it is worth mentioning that the intake of cookies, sweets, sugary drinks, and fried food is still common among the respondents and that over half of the patients eat savory biscuits

Table 5. Adequate consumption of healthy and unhealthy diet markers across clinical, lifestyle, nutritional, and biochemical variables. Passo Fundo, Brazil, 2015 (n = 100).

	Raw salada n (%)	Pulses and cooked vegetables[a] n (%)	Fresh fruita n (%)	Beans[b] n (%)	Milk or yogurt[a] n (%)	Fried foods[c] n (%)	Hamburgers and processed meat products[c] n (%)	Savory biscuits[c] n (%)	Cookies and sweets[c] n (%)	Sugary drinks[c] n (%)
Self-reported HBP	p = 0.650	p = 0.413	p = 0.615	p = 0.458	p = 0.800	p = 0.378	p = 0.819	p = 0.807	p = 0.818	p = 0.052
Yes	43 (57.3)	15 (20.0)	51 (68.0)	49 (65.3)	54 (72.0)	63 (84.0)	36 (48.0)	24 (32.0)	42 (56.0)	47 (62.7)
No	13 (52.0)	7 (28.0)	19 (76.0)	19 (76.0)	17 (68.0)	19 (76.0)	11 (44.0)	9 (36.0)	15 (60.0)	21 (84.0)
Self-reported dyslipidemia	p = 1.000	p = 1.000	p = 0.822	p = 0.513	p = 0.821	p = 0.101	p = 0.835	p = 0.508	p = 0.536	p = 0.513
Yes	20 (55.6)	8 (22.2)	26 (72.2)	23 (63.9)	25 (69.4)	33 (91.7)	16 (44.4)	10 (27.8)	19 (52.8)	23 (63.9)
No	36 (56.3)	14 (21.9)	44 (68.8)	45 (70.3)	46 (71.9)	49 (76.6)	31 (48.4)	23 (35.9)	38 (59.4)	45 (70.3)
Nutritional guidance for DM	p = 0.266	p = 0.178	p = 1.000	p = 0.812	p = 1.000	p = 0.573	p = 0.505	p = 1.000	p = 0.500	p = 0.812
Yes	43 (59.7)	13 (18.1)	50 (69.4)	48 (66.7)	51 (70.8)	60 (83.3)	32 (44.4)	24 (33.3)	43 (59.7)	48 (66.7)
No	13 (46.4)	9 (32.1)	20 (71.4)	20 (71.4)	20 (71.4)	22 (78.6)	16 (53.6)	9 (32.1)	14 (50.0)	20 (71.4)
Nutritional monitoring	p = 1.000	p = 0.347	p = 0.257	p = 0.266	p = 0.260	p = 1.000	p = 0.447	p = 0.277	p = 0.436	p = 0.579
Yes	10 (55.6)	2 (11.1)	15 (83.3)	10 (55.6)	15 (83.3)	15 (83.3)	10 (55.6)	8 (44.4)	12 (66.7)	11 (61.1)
No	46 (56.1)	20 (24.4)	55 (67.1)	58 (70.7)	56 (68.3)	67 (81.7)	37 (45.1)	25 (30.5)	45 (54.9)	57 (69.5)
Physical activity	p = 0.347	p = 1.000	p = 0.195	p = 0.801	p = 1.000	p = 1.000	p = 1.000	p = 1.000	p = 0.811	p = 0.126
Yes	15 (65.2)	5 (21.7)	19 (82.6)	15 (65.2)	16 (69.6)	19 (82.6)	11 (47.8)	8 (34.8)	14 (60.9)	19 (82.6)
No	41 (53.2)	17 (22.1)	51 (66.2)	53 (68.8)	55 (71.4)	63 (81.8)	36 (46.8)	25 (32.5)	43 (55.8)	49 (63.6)
BMI*	p = 0.801	p = 0.121	p = 0.170	p = 0.412	p = 0.054	p = 0.325	p = 0.445	p = 0.594	p = 1.000	p = 1.000
Not overweight	10 (52.6)	7 (36.8)	16 (84.2)	11 (57.9)	17 (89.5)	14 (73.7)	7 (36.8)	5 (26.3)	11 (57.9)	13 (68.4)
Overweight	46 (56.8)	15 (18.5)	54 (66.7)	57 (70.4)	64 (66.7)	68 (84.0)	40 (49.4)	28 (34.6)	46 (56.8)	55 (67.9)
WC (cm)**	p = 0.215	p = 0.302	p = 0.884	p = 0.411	p = 0.926	p = 0.124	p = 0.593	p = 0.476	p = 0.681	p = 0.333
Low risk	3 (42.9)	-	5 (71.4)	4 (57.1)	5 (71.4)	4 (57.1)	2 (28.6)	3 (42.9)	3 (42.9)	3 (42.9)
High risk	12 (75.0)	3 (18.8)	12 (75.0)	13 (81.3)	12 (75.0)	12 (75.0)	8 (50.0)	7 (43.8)	10 (62.5)	11 (68.8)
Very high risk	41 (53.2)	19 (24.7)	53 (68.8)	51 (66.2)	54 (70.1)	66 (85.7)	37 (48.1)	23 (29.9)	44 (57.1)	54 (70.1)
Blood glucose (mg/dL)***	p = 0.130	p = 0.130	p = 0.060	p = 0.492	p = 0.814	p = 1.000	p = 0. 091	p = 0.649	p = 0.830	p = 0.363
Normal	14 (43.8)	4 (12.5)	18 (56.3)	20 (62.5)	22 (68.8)	26 (81.3)	11 (34.4)	12 (37.5)	19 (59.4)	24 (75.0)
Abnormal	42 (61.8)	18 (26.5)	52 (76.5)	48 (70.6)	49 (72.1)	56 (82.4)	36 (52.9)	21 (30.9)	38 (55.9)	44 (64.7)
HbA1c (%)***	p = 0.840	p = 0.470	p = 0.828	p = 0.830	p = 0.660	p = 0.192	p = 0.689	p = 0.395	p = 0.686	p = 0.133
Normal	29 (58.0)	13 (26.0)	34 (68.0)	35 (70.0)	37 (74.0)	44 (88.0)	25 (50.0)	19 (38.0)	30 (60.0)	38 (76.0)
Abnormal	27 (54.0)	9 (18.0)	36 (72.0)	33 (66.0)	34 (68.0)	38 (76.0)	22 (44.0)	14 (28.0)	27 (54.0)	30 (60.0)

[a]Daily consumption. [c]At least five times a week. p value: Chi-squared test. *Nutritional status based on BMI. ** Risk of metabolic complications based on WC. *** Glycemic control based on blood glucose and HbA1c. DM: Diabetes Mellitus. HBP: High Blood Pressure.

and hamburgers and processed meat products more than once a week. Industrialized foods, which are high in simple sugars and additives, often contain saturated fat and excess salt and are reduced into complex carbohydrates. This pattern is strongly associated with the development of chronic noncommunicable diseases and obesity and should be discouraged, particularly in people with chronic disease[31].

The analysis of the association between adequate consumption of healthy diet markers and sociodemographic variables showed that adequate consumption of fruit is greater among women than in men, which is similar to the findings of the most recent VIGITEL[4]. Other studies with diabetes patients have also reported gender differences in the adequate consumption of fruit, indicating that women are more concerned with diet and health than men[27,32].

With respect to anthropometric measurements, adequate consumption of milk or yogurt was greater in individuals who where not overweight or obese based on BMI. This finding is particularly pertinent because some studies have shown that adequate consumption of dairy products, especially low-fat food items, is inversely associated with increased blood glucose, insulin, and blood pressure levels and excess body weight[33,34].

With respect to adequate consumption of unhealthy diet markers, the results show that adequate consumption of cookies or sweets was greater among individuals with a family income of less than four MSs, corroborating the findings of a study with diabetes patients conducted by Iop et al.[32] that observed a positive relationship between the consumption of cookies and cakes and income, demonstrating that the greater the income the greater the consumption of these foods. These findings show that a better quality diet is possible even among people with more modest incomes[35].

Adequate consumption of sugary drinks (no more than once a week) was greatest among patients who did not have HBP. A systematic review and meta-analysis based on data from prospective cohort studies showed that a high level of consumption of sugary or artificially sweetened drinks was associated with a significant increase in the risk of developing HPB[36]. Reducing the consumption of sugar and sodium-rich foods is widely recommended among diabetes patients due to their harmful effects[1]. Thus, this finding is positive and may be the result of the effects diabetes has on health and fear of developing other diseases, obliging diabetes patients to make more appropriate and healthier choices.

Conclusions

The findings of this study show that the majority of participants showed adequate consumption of healthy and unhealthy diet markers based on the consumption frequency recommended by the Ministry of Health. However, based on the anthropometric measurements and results of the biochemical assessment, the fact that blood glucose and HbA1c levels were particularly high among this group is worrying.

The app was shown to be an adequate tool for the collection of information on the dietary habits assessed by this study, given that it is quick and easy to use and dispenses with the need for long and complex paper questionnaires. Furthermore, it enabled process automation, with the assessments being directly transmitted to a database, thus minimizing time and chances of protocol entry errors and resulting in greater accuracy. The app offers a further advantage over paper-based assessment in the form of immediate patient feedback on his/her nutritional status and food consumption adequacy.

Given the findings and the fact that nutritional therapy is one of the pillars of diabetes treatment, this study concludes that it is necessary to reinforce nutritional guidance and explain to patients the importance of making positive changes to unhealthy eating habits to help control their diabetes. Encouraging patients to adopt a balanced diet and regular physical activity can help improve nutritional status and metabolic control in these patients, as well as reducing acute and chronic complications associated with the disease.

It is also suggested that future research should conduct qualitative and quantitative assessments of dietary intake in outpatients, with a view to enabling health professionals to develop nutrition interventions tailored to promote more desirable behaviors in nutrition, contributing to improved health and quality of life among this population group.

Collaborations

MC Zanchim was responsible for study conception, data collection, analysis and interpretation, and drafting this article. VR Kirsten co-supervised this work and participated in data analysis and interpretation, and in drafting this article. ACB De Marchi supervised this work, participating in study conception, data analysis and interpretation, and in drafting this article.

Acknowledgements

We are grateful to the Coordination of Improvement of Higher Education Personnel (CAPES, acronym in Portuguese) and National Council for Scientific and Technological Development (CNPq, acronym in Portuguese).

References

1. Sociedade Brasileira de Diabetes. Princípios para orientação nutricional no diabetes mellitus. *Diretrizes da Sociedade Brasileira de Diabetes* 2015; 19:41.
2. Levy-Costa RB, Sichieri R, Pontes NS, Monteiro CA. Disponibilidade domiciliar de alimentos no Brasil: distribuição e evolução (1974-2003). *Rev Saude Publica* 2005; 39(4):530-540.
3. Instituto Brasileiro de Geografia e Estatística (IBGE). *Pesquisa de Orçamentos Familiares 2008-2009. Análise do Consumo Alimentar Pessoal no Brasil*. Rio de Janeiro: IBGE; 2011.
4. Brasil. Ministério da Saúde (MS). *Vigitel Brasil 2014: vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico*. Brasília: MS; 2015.
5. Selem SS, Carvalho AM, Verly-Junior E, Carlos JV, Teixeira JA, Marchioni DM, Fisberg RM. Validity and reproducibility of a food frequency questionnaire for adults of São Paulo, Brazil. *Rev Bras Epidemiol* 2014; 17(4):852-859.
6. Pedraza DF, Menezez TN. Questionários de Frequência de Consumo Alimentar desenvolvidos e validados para população do Brasil: revisão da literatura. *Cien Saude Colet* 2015; 20(9):2697-2720.
7. Eysteinsdottir T, Thorsdottir I, Gunnarsdottir I, Steingrimsdottir L. Asessing validity of a short food frequency questionnaire on present dietary intake of elderly Icelanders. *Nutr J* 2012; 11(12):1-8.
8. Mannato LW, Pereira TSS, Velasquez-Melendez G, Cardoso LO, Benseñor IM, Molina MCB. Comparison of a short version of the Food Frequency Questionnaire with its long version - a cross-sectional analysis in the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *Sao Paulo Med J* 2015; 133(5):414-420.
9. Brasil. Ministério da Saúde (MS). *Protocolos do Sistema de Vigilância Alimentar e Nutricional. SISVAN na assistência à saúde*. Brasília: MS; 2008.
10. Curioni CC, Brito FSB, Boccolini CS. O uso de tecnologias de informação e comunicação na área da nutrição. *Jornal Brasileiro de TeleSSaúde* 2013; 2(3):103-111.
11. Costa TM, Salomão PL, Martha AS, Pisa IT, Sigulem D. The impact of short message service text messages sent as appointment reminders to patients' cell phones at outpatients clinics in São Paulo, Brazil. *Int J Med Inform* 2010; 79(1):65-70.
12. Brasil. Ministério da Saúde (MS). *Banco de dados do Sistema Único de Saúde-DATASUS: Indicadores de Fatores de Risco e de Proteção, Prevalência de diabete melito em 2012*. [acessado 2014 Nov 8]. Disponível em: http://www.datasus.gov.br
13. Baldo C, Zanchim MC, Kirsten VR, de Marchi ACB. Diabetes FoodControl – Um aplicativo móvel para avaliação do consumo alimentar de pacientes diabéticos. *RECIIS* 2015; 9(3):1-12.
14. American Diabetes Association. Standards of Medical Care in Diabetes-2015. *Diabetes Care* 2014; 38(1):1-94.
15. Brasil. Ministério da Saúde (MS). *Orientações para a coleta e análise de dados antropométricos em serviços de saúde: Norma Técnica do Sistema de Vigilância Alimentar e Nutricional - SISVAN*. Brasília: MS; 2011.
16. Lee RD, Nieman DC. Assessment of the hospitalized patient. In: Lee RD, Nieman DC. *Nutritional Assessment*. New York: McGraw Hill; 2007. Cap. 7. p. 222-260.

17. Chumlea WC, Roche AF, Steunbaugh ML. Estimating stature from knee height for persons 60 to 90 years of age. *J Am Geriatr Soc* 1985; 33(2):116-120.
18. World Health Organization (WHO). *Obesity: preventing and managing the global epidemic. Report of a WHO Consultation on Obesity*. Geneva: WHO; 1998.
19. Brasil. Ministério da Saúde (MS). *Guia alimentar para a população brasileira: promovendo a alimentação saudável*. Brasília: MS; 2006.
20. Pinheiro DS, Costa CDD, Rocha-Filho CRR, Mundim CA, Reis AAS, Ghedini PC. Avaliação do nível de controle glicêmico dos pacientes diabéticos tipo 2 atendidos em um Hospital universitário. *Revista da Universidade Vale do Rio Verde* 2012; 10(2):3-11.
21. Winkelmann ER, Fontela PC. Condições de saúde de pacientes com diabetes mellitus tipo 2 cadastrados na Estratégia Saúde da Família, em Ijuí, Rio Grande do Sul, 2010-2013. *Epidemiologia e Serviços de Saúde* 2014; 23(4):665-674.
22. Lisbôa HRK, Souilljee M, Cruz CS, Zoletti L, Gobbato DO. Prevalência de hiperglicemia não diagnosticada nos pacientes internados nos hospitais de Passo Fundo, RS. *Arquivos Brasileiros de Endocrinologia & Metabologia* 2000; 44(3):220-226.
23. Supp EDP. *Avaliação dos fatores relacionados ao surgimento de hipertensão, em um grupo de diabéticos tipo 2 de Timbé do Sul – SC* [monografia]. Criciúma: Universidade do Extremo Sul Catarinense; 2012.
24. Sampaio HAC, Carioca AAF, Sabry MOD, Santos PM, Coelho MM, Passamai MPB. Letramento em saúde de diabéticos tipo 2: fatores associados e controle glicêmico. *Cien Saude Colet* 2015; 20(3):865-874.
25. Ferreira LT, Saviolli IH. Valentini VE, Abreu LC. Diabetes melito: hiperglicemia crônica e suas complicações. *Arquivos Brasileiros de Ciências da Saúde* 2011; 36(3):182-188.
26. Tiew KF, Chan YM, Lye MS, Loke SC. Factors associated with dietary diversity score among individuals with type 2 diabetes mellitus. *J Health Popul Nutr* 2014; 32(4):665-676.
27. Destri K. *Marcadores de Consumo Alimentar de Hipertensos e Diabéticos do Município de Nova Boa Vista-RS* [dissertação]. Pelotas: Universidade Federal de Pelotas; 2014.
28. Kobayashi Y, Hattori M, Wada S, Iwase H, Kadono M, Tatsumi H, Kuwahata M, Fukui M, Hasegawa G, Naoto NN, Kido Y. Assessment of daily food and nutrient intake in Japanese type 2 diabetes mellitus patients using dietary reference intakes. *Nutrients* 2013; 5(7):2276-2288.
29. Lima LA, Nedel FB, Olinto MTA, Baldisserotto J. Food habits of hypertensive and diabetics cared for in a Primary Health Care service in the South of Brazil. *Revista de Nutrição* 2015; 28(2):197-206.
30. Bleich SN, Wang YC. Consumption of sugar-sweetened beverages among adults with type 2 diabetes. *Diabetes Care* 2011; 34(3):551-555.
31. Brasil. Ministério da Saúde (MS). *Estratégias para o cuidado da pessoa com doença crônica*. Brasília; MS; 2014. (Cadernos de Atenção Básica, n. 35) (Série A. Normas e Manuais Técnicos).
32. Iop SCF, Teixeira E, Deliza R. Comportamento alimentar de indivíduos diabéticos. *Brazilian Journal Food Technology* 2009; II SSA:36-43.
33. Martins ML, Kac G, Silva RA, Bettiol H, Barbieri MA, Cardoso VC, Silva AA. Dairy consumption is associated with a lower prevalence of metabolic syndrome among young adults from Ribeirão Preto, Brazil. *Nutrition* 2015; 31(5):716-721.
34. Drehmer M, Pereira MA, Schmidt MI, Del Carmen B Molina M, Alvim S, Lotufo PA, Duncan BB. Associations of dairy intake with glycemia and insulinemia, independent of obesity, in Brazilian adults: the Brazilian Longitudinal Study of Adult Health (ELSA-Brasil). *Am J Clin Nutr* 2015; 101(4):775-782.
35. Zanetti ML, Arrellias CCA, Franco RC, Santos MA, Rodrigues FFL, Faria HTG. Adesão às recomendações nutricionais e variáveis sociodemográficas em pacientes com diabetes mellitus. *Revista Escola de Enfermagem USP* 2015; 49(4):619-625.
36. kim Y, Je Y. Prospective association of sugar-sweetened and artificially sweetened beverage intake with risk of hypertension. *Arch Cardiovasc Dis* 2016; 109(4):242-253.

Article submitted 18/06/2016
Approved 13/05/2017
Final version submitted 15/05/2017