UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
FACULDADE DE MEDICINA
PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIAS MÉDICAS:
ENDOCRINOLOGIA
ÁREA DE CONCENTRAÇÃO: NUTRIÇÃO E METABOLISMO
MESTRADO E DOUTORADO

Índice de Alimentação Saudável e desfechos de saúde em pacientes com Diabetes Melito tipo 2

Juliana Peçanha Antonio

Orientadora:
Profª Drª Jussara Carnevale de Almeida

Porto Alegre, dezembro de 2017.

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Tese apresentada ao Programa de Pós-Graduação em Ciências Médicas: Endocrinologia como requisito parcial para obtenção do título de doutora

Porto Alegre, dezembro de 2017.

CIP - Catalogação na Publicação

Antonio, Juliana Peçanha
Índice de Alimentação Saudável e desfechos de saúde em pacientes com Diabetes Melito tipo 2 / Juliana Peçanha Antonio. -- 2017.
82 f.
Orientadora: Jussara Carnevale de Almeida.

Tese (Doutorado) -- Universidade Federal do Rio Grande do Sul, Faculdade de Medicina, Programa de Pós-Graduação em Ciências Médicas: Endocrinologia, Porto Alegre, BR-RS, 2017.

1. Diabetes Melito tipo 2. 2. Índices dietéticos. 3. Qualidade da dieta. I. de Almeida, Jussara Carnevale, orient. II. Título.

Elaborada pelo Sistema de Geração Automática de Ficha Catalográfica da UFRGS com os dados fornecidos pelo(a) autor(a).

“Grandes realizações são possíveis quando se dá importância aos pequenos começos.”

Lao-Tsé

Dedicatória

Dedico este trabalho à minha mãe,

meu grande amor.

AGRADECIMENTOS

À minha mãe, Marli, por ser meu exemplo de pessoa generosa, íntegra e obstinada. Agradeço a ti por ter me inspirado a escolher a profissão de Nutricionista e ter oferecido todo o suporte para que eu me tornasse a pessoa que sou hoje.

Às minhas irmãs, Ana Carolina e Viviane, pela amizade, amor e apoio em todos os momentos da minha vida.

À minha orientadora, Jussara Carnevale de Almeida, pelo acolhimento, apoio e confiança depositados em mim. Acompanhando-me desde a graduação, agradeço pelo estímulo em busca do conhecimento e por ser meu exemplo de professora e pesquisadora.

À querida colega e amiga, Roberta Aguiar Sarmento, pelo apoio na coleta de dados, companheirismo e pelos momentos de diversão compartilhados.

Às Nutricionistas Ingrid Miranda e Cíntia Rodrigues pela dedicação e colaboração na coleta de dados.

Aos pacientes que aceitaram a participar deste estudo e dedicaram seu tempo na realização do protocolo.

Ao Serviço de Endocrinologia do Hospital de Clínicas de Porto Alegre, minha eterna gratidão, pelo acolhimento desde minha entrada como aluna de iniciação científica e pela confiança e oportunidades a mim concedidas durante estes últimos dez anos da minha trajetória acadêmica.

FORMATO DA TESE

Esta tese de Doutorado segue o formato proposto pelo Programa de Pós - Graduação em Ciências Médicas: Endocrinologia da Universidade Federal do Rio Grande do Sul, sendo apresentada por um breve referencial teórico a cerca do tema proposto e dois manuscritos referentes ao tema estudado:

CAPÍTULO I: Referencial teórico

CAPÍTULO II: Artigo original aceito para publicação no periódico *Nutrition Journal* (Qualis A2, Medicina I).

CAPÍTULO III: Artigo original a ser submetido para publicação no periódico *Diabetes Care* (Qualis A1, Medicina I), redigido conforme as normas do periódico.

CAPÍTULO IV: Considerações finais

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LISTA DE ABREVIATURAS E SIGLAS

ADA: *American Diabetes Association*

BMI: *body mass index*

CI: *confidence interval*

DASH: *Dietary Approaches to Stop Hypertension*

DHEI: *Diabetes Healthy Eating Index*

DM: *Diabetes Mellitus*

DQI: *Diet Quality Index*

FFQ: *food frequency questionnaire*

GFR: *glomerular filtration rate*

HbA1c/A1c: hemoglobina glicada

HDI: *Healthy Diet Indicator*

HDL-cholesterol: *high density lipoprotein cholesterol*

HEI: *Healthy Eating Index*

IAS: Índice de Alimentação Saudável

IASD: Índice de Alimentação Saudável para o diabetes

IMC: índice de massa corporal

LDL-cholesterol: *low density lipoprotein cholesterol*

MUFA: *monounsaturated fatty acid*

OR: *odds ratio*

PUFA: *polyunsaturated fatty acid*

ROC: r*eceiver operating characteristic*

SD: *standard deviation*

SFA: *saturated fatty acid*

TG: *triglycerides*

INTRODUÇÃO

Estratégias para atingir um controle glicêmico adequado e retardar o desenvolvimento e progressão de complicações crônicas em pacientes com diabetes têm sido cada vez mais estudadas. A literatura evidencia que a melhor escolha para atingir este objetivo é a adoção de um estilo de vida saudável, especialmente mudanças na dieta, prática de atividade física regular e uso adequado dos medicamentos, fundamentando o indivíduo em relação aos conhecimentos e as habilidades no autocuidado do diabetes.

Neste ano encerro um ciclo de 10 anos como membro do Grupo de Pesquisa em Nutrição e Metabolismo do Serviço de Endocrinologia do Hospital de Clínicas de Porto Alegre. O início do estudo sobre avaliação da qualidade da dieta em pacientes ambulatoriais com diabetes tipo 2 deu-se na graduação, sendo tema do meu trabalho de conclusão de curso. Como a adoção de dieta saudável é um dos principais pilares do tratamento do diabetes e havia poucas evidências na literatura em relação à avaliação da qualidade da dieta nesse perfil de pacientes, no mestrado, tive o desafio de adaptar um índice dietético para essa população com a finalidade de contemplar as diretrizes nacionais e internacionais de recomendação de consumo alimentar. Além disso, este índice deveria tentar minimizar uma das principais limitações dos índices dietéticos existentes na literatura: realizar um cálculo de proporção de consumo que realmente diferenciasse os pacientes. Porém, após o mestrado ainda ficaram algumas perspectivas de estudo em relação à qualidade da dieta.

Neste sentido, no doutorado, nosso objetivo foi avaliar a associação entre a qualidade da dieta e desfechos de saúde em pacientes com diabetes tipo 2 e, a partir da verificação da existência dessa associação, auxiliar os profissionais de saúde a elaborar estratégias de condutas dietoterápicas mais direcionadas para estes pacientes.

CAPÍTULO I

REFERENCIAL TEÓRICO

DIABETES

O diabetes é uma doença crônica que acomete parte significativa da população mundial, cerca de 415 milhões de pessoas em todo mundo, e estima-se que para o ano de 2040 ocorra um aumento para 642 milhões de pessoas com a doença[1]. O Brasil está entre os 10 países com maior prevalência de diabetes, onde em 2015 esse total atingiu 14,3 milhões de pessoas, correspondendo a 8,1% da população nacional[1]. O diabetes constitui um importante problema de saúde pública, em razão da sua elevada prevalência, gravidade das complicações e custos envolvidos no tratamento, tornando-a uma doença onerosa para o sistema de saúde [1,2].

O diabetes tipo 2 é a forma mais comum e ocorre geralmente na vida adulta, estando associado à obesidade em cerca de 80% dos casos. A hiperglicemia sustentada, resultado da resistência à ação da insulina e da incapacidade pancreática em suplantar essa resistência, associada a fatores genéticos e ambientais é uma das principais responsáveis pelo desenvolvimento das complicações crônicas microvasculares, neuropáticas e macrovasculares[3].

O controle intensivo do diabetes, refletido pela hemoglobina glicada (HbA1c) menor que 7%, reduz o desenvolvimento de complicações crônicas relacionadas à doença[3]. Além do controle glicêmico, o perfil lipídico e a manutenção da pressão arterial em valores normais ou mais próximos da normalidade também são medidas para o tratamento e prevenção das complicações do diabetes[3]. Neste sentido, modificações no estilo de vida (plano alimentar saudável e individualizado com a prática regular de exercícios físicos) combinadas ao tratamento farmacológico e automonitoramento da glicemia são recomendadas para o manejo rigoroso da hiperglicemia[3], embora este controle intensivo possa aumentar em duas vezes os episódios graves de hipoglicemia[4]. Assim, a melhor estratégia farmacológica para reduzir a glicemia de pacientes com

diabetes tipo 2 tem sido constantemente avaliada[5], pois muitos pacientes não conseguem atingir os alvos terapêuticos estabelecidos[6], reforçando a importância da adoção de um estilo de vida saudável, em especial o manejo da dieta, no controle do diabetes.

Terapia nutricional no Diabetes

Para a maioria dos indivíduos com diabetes, o maior desafio do tratamento é determinar um plano alimentar. De acordo com a *American Diabetes Association*[7], não existe um padrão alimentar ideal ou único que possa ser recomendado para indivíduos com diabetes. Nos últimos anos, as evidências tem sugerido que as recomendações nutricionais não devam basear-se em percentuais ideais de energia provenientes de carboidratos, proteínas e lipídeos e, portanto, a avaliação deve ser individual considerando o padrão alimentar atual do indivíduo, preferências e alvos metabólicos a serem atingidos[8]. Neste sentido, o objetivo da terapia nutricional no indivíduo adulto com diabetes é fornecer ferramentas para a adoção de padrões alimentares saudáveis ao invés de manter foco em macronutrientes individuais, micronutrientes ou alimentos específicos [7,8].

Para adoção de um padrão alimentar saudável e efetividade na terapia nutricional no diabetes, recomenda-se que seja priorizada a ingestão de carboidratos provenientes de grãos integrais, vegetais, frutas, legumes e produtos lácteos, com ênfase em alimentos ricos em fibras e com menor carga glicêmica[7]. A ingestão de proteínas deve ser individualizada considerando o padrão alimentar atual do indivíduo. A recomendação de quantidade ideal de gorduras da dieta ainda é controversa, mas evidências atuais tem sugerido que o tipo de gordura é mais importante do que a quantidade, com benefícios importantes na redução de risco para desfechos cardiovasculares e mortalidade [9,10,11]. Além disso, a ingestão de sódio não deve

ultrapassar 2.300 mg ao dia e o consumo de álcool – por aqueles que já possuem o hábito de consumo - deve ser feito com moderação (15g de etanol por dia para as mulheres e, no máximo, 30g de etanol por dia para os homens), principalmente pelo risco aumentado de hipoglicemia[7].

O papel dos nutrientes no controle metabólico, bem como no desenvolvimento das complicações crônicas em pacientes com diabetes ainda não está completamente esclarecido e devemos considerar que medidas de quantidade de consumo podem não revelar adquadamente a complexidade das escolhas alimentares[12], representando um grande desafio para qualquer estudo que contemple sua relação com a doença. Tradicionalmente, a epidemiologia nutricional dedicou-se ao estudo do efeito de nutrientes ou de um alimento específico sobre desfechos de saúde. Contudo, há evidências de que alimentos e nutrientes agem sinergicamente no risco de várias doenças[13]. Neste sentido, é crescente a investigação de padrões alimentares e sua relação com desfechos de saúde na epidemiologia nutricional[13].

A identificação de padrões alimentares pode ser feita *a priori* ou *a posteriori*. A análise de padrões alimentares *a posteriori*, parte-se de dados empíricos de alimentos que são agregados com base em análise estatística, com posterior identificação de um ou mais padrões alimentares [13,14]. Na definição de padrões alimentares *a priori*, que é o foco desta tese, são propostos índices dietéticos que permitem avaliar a qualidade da dieta com base em critérios conceituais de nutrição saudável e de diretrizes e recomendações nutricionais vigentes [13,14].

Padrão alimentar definido *a priori*: utilização dos índices dietéticos

Índices dietéticos têm sido propostos para avaliar a qualidade global da dieta de indivíduos ou populações a partir das informações obtidas com os inquéritos

alimentares. Estes índices levam em consideração o atendimento às recomendações nutricionais, construídos com base no conceito prévio de uma dieta saudável[13] e podem refletir a situação da ingestão de diversos componentes da dieta em uma única variável[15]. Diferentes índices dietéticos têm sido elaborados e/ou adaptados de acordo com as recomendações nutricionais de populações específicas e seus guias alimentares [15,16]: Índice de Nutrientes, Escore de Variedade da Dieta, Escore de Diversidade da Dieta, Índice de Qualidade da Dieta, Índice de Qualidade da Dieta Revisado, Índice de Alimentação Saudável (IAS), Índice de Alimentação Saudável Alternativo, Contagem de Alimentos Recomendados, Escore da Dieta Mediterrânea, Escore da dieta *DASH*, bem como suas derivações. Estes índices são ferramentas inovadoras em relação a conceito de qualidade, possibilitando a promoção de saúde por meio de programas de educação nutricional e redução do risco das enfermidades mais prevalentes na atualidade [15,16].

Dentre os principais índices dietéticos existentes, destaca-se o Índice de Alimentação Saudável (IAS), por considerar tanto o consumo de grupos alimentares como o de nutrientes específicos[17]. Este instrumento foi proposto pelo Departamento de Agricultura dos Estados Unidos, com o objetivo de avaliar a qualidade global da dieta da população saudável norte-americana de acordo com as recomendações nutricionais vigentes. O IAS é revisado a cada cinco anos e a sua última versão engloba 12 componentes: nove grupos alimentares e três referentes a componentes de moderação[18]. Neste sentido, o IAS vem sendo utilizado no monitoramento de mudanças nos padrões alimentares, como ferramenta para definição de estratégias e intervenções nutricionais mais eficientes e, também, para subsidiar programas de alimentação e nutrição voltados para a promoção da saúde e prevenção de doenças[15].

Avaliação da qualidade da dieta em populações

A avaliação da qualidade da dieta fornece informações determinantes referentes à ingestão de alimentos e nutrientes que, por sua vez, conduzem à identificação da população em risco, tornando possível realizar propostas de políticas públicas de saúde, melhorando a conduta dietética apropriada para a população em estudo[16].

Devido ao crescente interesse da comunidade científica na abordagem deste tema, alguns índices dietéticos vêm sendo desenvolvidos e/ou adaptados a partir do IAS para avaliar a qualidade da dieta na população brasileira saudável [19,20] ou com diabetes[21]. Recentemente, em nosso grupo de pesquisa, foi elaborado o Índice de Alimentação Saudável para o Diabetes (IASD)[21] conforme as recomendações nutricionais específicas para essa população, com o objetivo de avaliar a qualidade da dieta de pacientes ambulatoriais com diabetes tipo 2. Este índice foi elaborado a partir da primeira versão do IAS[17] e caracteriza-se por 10 componentes: seis grupos alimentares, três referentes a nutrientes e um referente à variedade da dieta[21]. A validade interna do IASD já foi testada em estudo prévio[21], no entanto, associações com desfechos de saúde ainda precisavam ser avaliadas.

Recente metanálise de estudos de coorte[22] examinou associações da qualidade da dieta avaliada pelo IAS, IAS alternativo e escore da dieta *DASH* com risco de desenvolvimento de diabetes tipo 2 e outros desfechos. Escores maiores de qualidade da dieta avaliada pelos três instrumentos resultaram numa redução em 15% de risco para desenvolvimento da doença, evidenciando que educação para manutenção de uma boa qualidade da dieta deve ser realizada para prevenção do diabetes[22]. Em relação a populações com diferentes graus de tolerância a glicose [23-29], a qualidade da dieta, avaliada por diferentes índices dietéticos, já foi investigada em estudos transversais[24-29] e um estudo caso controle[29] que estão apresentados resumidamente no **Quadro 1.**

Apesar de ser amplamente aplicado para a população saudável, estudos que utilizaram o IAS para avaliar a qualidade da dieta de pacientes com glicemia de jejum alterada[23] ou diabetes[24-29] ainda são escassos na literatura. De fato, quatro dos sete estudos encontrados somente descrevem a qualidade da dieta de amostras limitadas de pacientes chineses[24], brasileiros[25], gregos[26], cipriotas[27]. Nestes estudos, foi observado que a maioria dos pacientes necessitava de melhorias na qualidade de suas dietas. Ainda, somente um estudo transversal[26] com 94 pacientes gregos com diabetes tipo 2 teve como objetivo avaliar quais características clínicas estavam relacionadas com qualidade da dieta considerada adequada a partir de análise de componentes principais[26]. O hábito de fumar e consumir álcool, ser do gênero feminino, a presença de doença cardiovacular, úlcera péptica, obesidade e sindrome do pé diabético contribuiram para a presença de um IAS de pelo menos 80%. Das comorbidades associadas ao diabetes, somente a presença de nefropatia diabética contribuiu para valores de IAS <80%[26]. De fato, os pacientes com mais comobidades parecem relatar qualidade da dieta superior quando comparado com os pacientes sem comorbidades[30], possivelmente por já terem recebido orientações específicas para cuidado de sua saúde.

A relação entre qualidade da dieta, avaliada por outros índices dietéticos, com desfechos de saúde em pacientes com diabetes foi observada em apenas dois estudos com tamanho amostral reduzido [28,29]. Correlações inversas, porém fracas, entre qualidade da dieta com valores de IMC[29] e controle glicêmico [28,29] foram encontradas. Assim, cabe ressaltar que até a presente data, a associação entre qualidade da dieta, especialmente avaliada pela versão mais atual do IAS, com desfechos de saúde ainda não foi investigada.

JUSTIFICATIVA

O estudo da dieta com suas diversas combinações de alimentos, mais do que o consumo de itens alimentares individuais ou a ingestão de nutrientes pode ser útil, já que os alimentos não são consumidos isoladamente e refletem a escolha por determinado estilo de vida[15]. Por isso, torna-se conveniente a utilização de índices dietéticos que avaliem a ingestão global de alimentos e nutrientes e que sumarizem vários aspectos da dieta em uma única medida[15].

A complexidade da dieta humana representa um grande desafio para qualquer estudo que contemple sua relação com a doença[12]. No nosso conhecimento, até a presente data, não foram encontrados estudos que avaliaram a qualidade global da dieta e sua possível associação com desfechos de saúde em pacientes com diabetes. A hipótese da presente tese é que uma dieta com baixa qualidade está associada a um pior controle metabólico, em especial controle glicêmico, em pacientes com diabetes tipo 2. O estabelecimento da existência dessa associação, a partir da escolha de um índice dietético, possibilitará um melhor direcionamento do aconselhamento dietoterápico a este grupo de indivíduos.

OBJETIVOS DA TESE

1. Avaliar a concordância entre o Índice de Alimentação Saudável e o Índice de Alimentação Saudável para o Diabetes na avaliação da qualidade da dieta e possível associação com alvos terapêuticos em pacientes com diabetes tipo 2.
2. Avaliar a associação entre qualidade da dieta e desfechos de saúde, em especial o controle glicêmico, em pacientes com diabetes tipo 2, a partir da escolha de um índice dietético.

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Quadro 1. Resumo dos principais estudos que avaliaram a qualidade da dieta em indivíduos com glicemia alterada ou diabetes tipo 2.

Autor, revista e ano	População e país de origem	Delineamento	Inquérito dietético	Índice dietético	Qualidade da dieta	Desfechos avaliados
Taglieta J, Cervato AM. Nutrire (2005)[23]	N=176 Glicemia alterada 56,2 ± 12,8 anos Brasil	Transversal	R 24h	Variedade e diversidade	*	Não avaliado
Lin Y e cols. Wei Sheng Yan Jiu (2004)[24]	N= - DM tipo 2 China	Transversal	R 24h/QFA	IAS (versão não especificada)	66,0%	Não avaliado
Santos CRB e cols. J Brazilian Soc Food Nutr (2009)[25]	N=67; DM tipo 2 56,0 ± 11,0 anos Brasil	Transversal	R 24h	IAS (1999/2000)	67,8%	Não avaliado
Mangou A e cols. Endocrinol Nutr (2012)[26]	N = 94; DM tipo 2 66,4 ± 11,8 anos Grécia	Transversal	QFA	IAS (2005)	80,2%	Características clínicas relacionadas à qualidade da dieta
Direktör S, Özer E. Asia Pac J Clin Nutr (2013)[27]	N = 200; DM tipo 2 52,9 ± 9,8 anos Chipre	Transversal	R 24h	IAS (1995/2000)	58,8%	Não avaliado

*Dado não disponível
R 24h: recordatório alimentar 24h; QFA: questionário de frequência alimentar; IAS: Índice de Alimentação Saudável

Autor, revista e ano	População e país de origem	Delineamento	Inquérito dietético	Índice dietético	Qualidade da dieta	Desfechos avaliados
Kim JY e cols. Clin Nutr Res (2013) [28]	N= 110; DM tipo 2 54,6 ± 8, anos Coreia do Norte	Transversal	R 24h	IQD IDS IAS(A)	68,9% 5,0% 39,4%	Controle glicêmico (glicemia de jejum, pós-prandial e HbA1c%)
Murray A e cols. Nutr J (2013) [29]	N = 65; DM tipo 2 56,0 ± 7,7 anos Irlanda	Caso-controle	RA de 3 dias	EDM EDM(A) IDS IAS(A)	3,4% 3,3% 2,6% 40,2%	IMC e controle glicêmico (glicemia de jejum e HbA1c%)

R 24h: recordatório alimentar 24h; RA: registro alimentar; QFA: questionário de frequência alimentar
IQD: Índice de Qualidade da Dieta; IDS: Indicador de Dieta Saudável; IAS(A): Índice de Alimentação Saudável alternativo; EDM: Escore da Dieta Mediterrânea; EDM(A): Escore da Dieta Mediterrânea alternativo

CAPÍTULO II

Artigo original aceito para publicação no periódico *Nutrition Journal,* redigido conforme as normas do periódico.

Diet Quality and Therapeutic Targets in Patients with Type 2 Diabetes: Evaluation of Concordance between Dietary Indexes

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ABSTRACT

Background: This study aimed to evaluate the concordance between two dietary indexes, the Healthy Eating Index (HEI) and the Diabetes Healthy Eating Index (DHEI), in evaluating diet quality and its possible association with therapeutic targets in patients with type 2 diabetes.

Methods: Cross-sectional study of outpatients with type 2 diabetes mellitus treated at a university hospital. Dietary information was obtained from a quantitative food frequency questionnaire (previously validated for use in patients with type 2 diabetes) and converted into daily intakes. Diet quality was assessed using two dietary indexes: HEI (12 components, nine food groups and three moderation components) and DHEI (10 components, six food groups, three nutrient groups, and one for variety of diet). In both indexes, the sum of the scores for each component yields an overall score converted on a scale from 0-100%; diet quality is subsequently ranked as low (<51%), needing improvement (51-80%), or high (>80%). Patients underwent clinical and laboratory assessment. Those with fasting blood glucose values 70-130 mg/dL, A1c<7%, total cholesterol <200 mg/dL, LDL-cholesterol <100 mg/dL, and triglycerides <150 mg/dL were considered to meet therapeutic targets. All analyses were conducted in PASW Statistics 18.0, and $p<0.05$ deemed significant.

Results: We analyzed 148 patients with type 2 diabetes (73% white, mean age 63.2±9.4 years, median diabetes duration 10 [IQR 5-19] years, mean A1c% 8.4 ± 2.0%, and mean BMI 30.5 ± 4.2 kg/m²). Mean energy intake was 2114 ± 649 kcal/day. DHEI scores were 17.0 (95%CI -6.8 to 41.0) points lower than HEI scores (55.9 ± 14.2% *vs.* 72.9 ± 10.7%, respectively; $P<0.001$), suggesting there is no agreement (Bland-Altman method), and the Pearson correlation coefficient was 0.55 ($P<0.001$). More patients were classified as having a low-quality diet by the DHEI than by the HEI (38.5% *vs.* 1.4%; $P<0.001$). A higher proportion of patients (35.7%) with out-of-target total cholesterol levels had a low-quality diet evaluated by the DHEI ($P=0.03$). We did not find associations between overall score of HEI and therapeutic targets.

Conclusions: In its intended population of patients with type 2 diabetes, the DHEI seems to be a more rigorous tool to evaluate association between diet quality and changes in metabolic parameters.

Keywords: Dietary indexes, Diet quality, Diabetes mellitus type 2.

BACKGROUND

Diabetes mellitus (DM) is a complex, chronic illness characterized by a heterogeneous set of metabolic disorders, including hyperglycemia and impaired carbohydrate, protein, and lipid metabolism, caused by abnormalities in insulin action and/or secretion [1]. It is consolidated as a serious public health problem at the national and international level, due to its high prevalence, marked morbidity and mortality, and the costs involved in its treatment, parallel to the increasing prevalence of obesity and sedentary lifestyle [1]. The adoption of healthy behaviors, especially changes in diet and physical activity, is an appropriate foundation for a DM self-management program of, and can serve as a basis for people with DM to achieve a healthy lifestyle [2].

Among nutritional recommendations for DM, the following dietary composition is recommended: 45 to 60% of daily calories from total carbohydrates (intake of not less than 130 g/day), 15 to 20% of daily calories from protein (or 0.8 to 1 g/kg/weight), and 25 to 35% of daily total calories from lipids. The latter are stratified as follows: <7% of daily calories from saturated fatty acids (SFA), up to 10% of daily calories from polyunsaturated fatty acids (PUFAs), 5 to 15% of daily calories from monounsaturated fatty acids (MUFAs), and daily cholesterol intake less than 300 mg [3]. The minimum dietary fiber recommendation is 14 g per 1000 kcal, with priority given to whole grains, vegetables, and fruits [3]. Under Brazilian guidelines, the recommended intake of vitamins and minerals is for individuals without diabetes [4], while sodium consumption should not exceed 2,000 mg per day, which is equivalent to 5 g of cooking salt (i.e., one teaspoon of salt at most) [3].

Dietary indexes have been recommended to monitor adherence to nutritional recommendations among individuals and populations [5]. Several instruments are available to evaluate diet quality, among which the Healthy Eating Index (HEI) [6]

stands out because it considers consumption both of food groups and of specific nutrients [6]. Recently, the Diabetes Healthy Eating Index (DHEI) [7] was developed, taking into account nutritional recommendations for this population, with the objective of evaluating diet quality and testing for possible associations with health outcomes in diabetics. Some studies have assessed the dietary quality of patients with DM, but none has used a dietary index that contemplates specific recommendations for this population [8,9]. In this context, the objective of the present study was to compare the agreement of two dietary indexes (HEI and DHEI) to evaluate diet quality and possible association with therapeutic targets in patients with type 2 diabetes.

METHODS

Study population

This was a cross-sectional study of outpatients with type 2 DM treated at Hospital de Clínicas de Porto Alegre (HCPA), a tertiary referral center in Southern Brazil, who were consecutively selected for the study "Quality of usual diet and health outcomes in patients with type 2 diabetes mellitus". The diagnosis of type 2 DM was established as follows: disease onset after 30 years of age, no previous episodes of ketoacidosis or documented ketonuria, and treatment with insulin only ≥5 years after diagnosis [10]. Patients were included according to the following criteria: not having received dietary counseling from a nutritionist for at least 6 months prior to the study, age <80 years, body mass index (BMI) <40 kg/m^2, serum creatinine <2 mg/dL, normal thyroid function tests, and no kidney diseases (other than diabetic nephropathy), severe liver disease, decompensated heart failure, or any acute and/or consumptive illness. The study was conducted in accordance with the Declaration of Helsinki, and all procedures involving patients were approved by the Hospital de Clínicas de Porto Alegre Research Ethics Committee. Written informed consent was obtained from all patients.

Clinical and anthropometric evaluation

Ethnicity information was obtained by self-report. Economic status was evaluated by a questionnaire designed according to the Brazilian reality [11]. The diagnosis of hypertension was established from readings obtained with an Omron model HEM-705CP blood pressure monitor [12]. The patient was considered hypertensive when mean systolic pressure was ≥140 mmHg or diastolic pressure ≥90 mmHg on at least two separate occasions, measured 1 minute apart, or was receiving pharmacological treatment for hypertension, independently of blood pressure levels [13]. Diabetic nephropathy was assessed from spot urinary albumin excretion measurement; patients with values ≥14mg/L were considered to have renal disease [14].

The anthropometric measurements used to assess nutritional status were weight (measured with patients wearing light clothing and barefoot), height, and waist circumference (measured at the midpoint between the lowest rib and the iliac crest) [15]. These measurements were obtained with an anthropometric scale and an inelastic fiberglass tape measure. BMI was calculated with the formula weight (kg)/height $(m)^2$ [16] and its target value was set at <25 kg/m^2 [1].

Dietary assessment

Food intake information was obtained from a quantitative food frequency questionnaire (FFQ), previously validated in patients with type 2 DM [17], which contains 80 items with 10 food groups. A photo album was used to help patients select serving sizes. Reported intake was converted into daily consumption, and diet quality was evaluated using two dietary indexes: the HEI [6] and the DHEI [7]. Intake of individual portions was adjusted to a daily caloric intake of 1000 kcal. The Brazilian food composition table was used to evaluate the nutritional composition of the FFQ items [18].

The latest version of the HEI, used in this study, consists of 12 components [19]: nine food groups ("total fruit", including 100% natural fruit juices; "whole fruit", excluding juices and extracts; "total vegetables"; "greens and beans"; "whole grains"; "dairy"; "total protein foods"; "seafood and plant proteins"; "fatty acids", distinguishing unsaturated and saturated) and three items referring to components to be consumed in moderation ("refined grains", "sodium", and "empty calories", i.e., calories from solid fats, alcoholic beverages, and added sugar). The HEI is described in detail in Table 1. Individual scores range from 0 to 20 points, and the sum of the scores of each component yields a percent global score.

The DHEI [7] consists of 10 components: six food groups ("fruit", including fruit juices; "vegetables"; "carbohydrates and sources of fiber"; "meat and eggs"; "dairy and saturated fat"; "oils and fats"), three components referring to "percent daily calorie intake from lipids", "dietary cholesterol", and "*trans* fatty acids"; and a "diet variety" component. For the last component, each food was counted only when consumption was >50% the recommended intake in the corresponding food group. A score had been established for each component, the value of which is classified according to adherence to current national nutritional recommendations for DM, namely: "poor" (zero points), "fair" (one-half point), and "good" (one point) [7]. The sum of the scores of each component yields an overall score of diet quality, which it converted on a scale of zero to 100. The DHEI is described in detail in Table 2. In both indexes, the overall diet quality is classified as low (<51%), needing improvement (51-80%), or adequate (> 80 points) [19].

Laboratory measurements

Blood samples were obtained after a 12-hour fast. Plasma glucose was determined using the glucose oxidase method (biodiagnostica Kit) [20]; glycated

hemoglobin (HbA1c, reference range 4.7-6.0%), by high-precision chromatography in a Merck-Hitachi 9100 system [21]; and total cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides (TG) by enzymatic colorimetric methods [22]. Low-density lipoprotein (LDL) cholesterol was calculated using the Friedewald equation (LDL = total cholesterol – HDL – TG/5) [23]. Serum creatinine was measured by the Jaffé method [24]. All tests were performed at the Clinical Pathology Laboratory, Hospital de Clínicas de Porto Alegre.

Statistical analysis

The distribution of variables was assessed using the Shapiro-Wilk test. Data were expressed as mean ± standard deviation or absolute and relative frequency (%), as indicated. Comparison of overall diet quality between the dietary indexes was done using the paired *t*-test. Analysis of concordance between the HEI and DHEI was performed using the Bland-Altman plot method, which evaluates the mean difference between two methods and considers the variability in these differences among individuals [25]. Poisson regression models were used to test for possible associations between individual component and overall diet quality of each of the dietary indexes with therapeutic targets (dependent variable). Analyses were adjusted to possible confounding variables selected according to clinical relevance. A chi-square test was used to evaluate the relationship between diet quality categories within each index and the achievement of therapeutic targets (outcomes). All data analyses were performed in PASW Statistics 18.0 (SPSS Inc., Chicago, IL), and the type I error rate was set at 5% (two-tailed).

Estimation of sample size was based on a pilot study previously performed in a subsample of 201 patients with type 2 DM, in which diet quality evaluated by the original HEI [6] was found to differ from DHEI scores (80.2 ± 11.7% vs. 61.7 ± 11.5%,

respectively, P <0.001). Thus, expecting a difference in diet quality of at least 10% among dietary indexes and considering a type I error of 5% and a type II error of 10%, 58 patients would be necessary.

Results

A total of 148 patients with type 2 DM were consecutively included after the pilot study and were analyzed. Mean age was 63.2 ± 9.4 years; 73% were white, and 62.8% female. Mean A1c was 8.4 ± 2.0%, and mean BMI, 30.5 ± 4.2 kg/m². Regarding dietary characteristics, the mean reported total calorie intake was 2114 ± 649 kcal/day. Table 3 describes demographic, clinical, lifestyle, and laboratory characteristics of the sample.

Figure 1 shows the Bland–Altman plots between the two dietary indexes. The mean difference (agreement range) observed between diet quality score evaluated by the HEI as compared to DHEI was 17.0 points (95%CI -6.8 to 41.0; P < 0.001).

Pearson correlation between the overall diet quality assessed by the two indexes was calculated as r=0.55 (P <0.001), and is shown in Figure 2. More patients were classified as having a low-quality diet by the DHEI than by the HEI (38.5% *vs.* 1.4%; P < 0.001).

Poisson regression models were also used to test for possible associations between overall diet quality of each of the dietary indexes and their individual components with therapeutic targets (dependent variable). Regarding the HEI, some individual components as total fruit, total protein foods, whole grains, sodium, empty calories and fatty acids were associated with therapeutic targets. Regarding the DHEI, other individual components as vegetables, meat and eggs, dietary cholesterol, and overall diet quality were associated with therapeutic targets (see Additional File 1).

A higher proportion of patients (35.7%) with out-of-target total cholesterol levels had a low-quality diet evaluated by the DHEI (*P*=0.03). No association was found between overall HEI score and any of the therapeutic targets evaluated.

DISCUSSION

The overall diet quality score from the two dietary indices in this sample of 148 patients with type 2 DM was 72.9 ± 10.7% in the HEI and 55.9 ± 14.2% in the DHEI (*P* <0.001). The mean score yielded by both instruments classified diet as "needing improvement", similar to what was found in a recent systematic review of studies that evaluated diet quality in the Brazilian population [26]. Among the main results of the present study, we observed a moderate correlation between the two dietary indexes and a significant difference in the overall diet quality of approximately 17 points, as shown by the Bland-Altman plot method, suggesting that there is no agreement between the two instruments.

Thus, a greater propensity for rigidity of the DHEI is noted, possibly because it follows specific recommendations for the evaluated population. More patients were classified as having poor diet quality by the DHEI than by the HEI (38.5% vs. 1.4%, *P* <0.001), and a higher proportion of patients (35.7%) with out-of-target total cholesterol levels had a low-quality diet evaluated by the DHEI (*P*=0.03).

Associations between individual HEI consumption scores of components total fruit, total protein foods, whole grains, sodium, empty calories and fatty acids with therapeutic targets were observed (*P* <0.05). Regarding the DHEI, some individual components as vegetables, meat and eggs, dietary cholesterol, and overall diet quality were associated with therapeutic targets (*P* <0.05) after adjustment for confounders. However, a larger sample is needed to confirm these findings.

Recent studies evaluated the diet quality of patients with DM, but did not use a specific dietary index designed to take nutritional recommendations for this population into account [8,9]. Regarding the association with health outcomes, only one cross-sectional study, conducted in a Korean population with type 2 DM [8], evaluated the association between glycemic control and diet quality as assessed by three dietary indexes: Diet Quality Index (DQI), alternative HEI, and Healthy Diet Indicator (HDI). The authors found an inverse correlation between DQI and HDI diet quality scores and A1c% (r = -0.21, P <0.05, r = -0.28, P <0.05, respectively), blood glucose (r = -0.21, P <0.05, r = -0.23, P <0.05, respectively), and postprandial glycaemia (r = -0.30, P <0.05; r = -0.26, P <0.05, respectively). Diet quality assessment with the alternative HEI was not associated with any of the outcomes evaluated.

Studies of diet quality in patients with DM are still scarce in the literature, especially when it comes to the use of instruments designed specifically for this population. In the present study, we used a new dietary index based on current nutritional recommendations for DM, with internal validity tested in a previous study [7]. Our objective was to evaluate its agreement with a widely used index [19] and to verify associations with therapeutic targets in type 2 DM.

The limitations of this study include the difficulty of comparing our results with those of other studies conducted in different populations of individuals with type 2 DM. In addition, use of these instruments is still beset by unanswered questions, such as which inferences can actually be drawn from their results and whether they are in fact able to evaluate the quality of eating habits as a whole without considering the impact of each food group has on overall diet quality. These methodological questions need to be evaluated carefully through repeated application in different populations if classification of diet quality is to become more reliable.

CONCLUSION

The two instruments tested in this study (HEI and DHEI) had a moderate correlation, but no agreement. The DHEI seems to be a more rigorous instrument for evaluating the association between diet quality and achievement of metabolic targets in patients with type 2 DM.

List of abbreviations

DM: Diabetes mellitus; SFA: Saturated fatty acids; PUFAs: Polyunsaturated fatty acids; MUFAs: Monounsaturated fatty acids; HEI: Healthy eating index; DHEI: Diabetes healthy eating index; BMI: Body mass index; FFQ: Food frequency questionnaire; HDL: High-density lipoprotein; LDL: Low-density lipoprotein; TG: triglycerides; DQI: Diet quality index; HDI: Healthy diet indicator

Declarations

Ethics approval and consent to participate

The present study is part of a larger project titled "Quality of Usual Diet and Health Outcomes in Patients with Type 2 DM", which was approved by the Hospital de Clinicas de Porto Alegre Research Ethics Committee (number 13-0489). All patients included in this study signed informed consent forms, and data collection followed Declaration of Helsinki guidelines and Brazilian National Health Council Resolution 466/2012.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare no conflict of interest.

Funding

Not applicable.

Authors' contributions

JPA and VCR contributed to data collection and manuscript writing. JPA, RAS, and JCA contributed to the statistical analysis and interpretation of data. JPA and JCA reviewed the manuscript critically for important intellectual content and discussed the results. All authors read and approved the final version of the manuscript.

Acknowledgements

This study was supported by Fundo de Incentivo à Pesquisa e Eventos, Hospital de Clínicas de Porto Alegre.

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Table 1. Healthy Eating Index (HEI) components and criteria used for maximum score and zero score[19]

Components	Maximum Score	Maximum score criteria	Criteria for zero score
1. Total fruit (includes fruit juice)	5	≥ 0.8 cup per 1000 kcal	No fruit or juice
2. Whole fruit (includes all forms except juice)	5	≥ 0.4 cup per1000 kcal	No whole fruit
3. Total vegetables	5	≥ 1.1 cup per 1000 kcal	No vegetables
4. Greens and beans	5	≥ 0.2 cup per 1000 kcal	No dark green vegetables or legumes
5. Whole grains	10	≥ 40 g per 1000 kcal	No whole grains
6. Dairy	10	≥ 1.3 cup per1000 kcal	No dairy
7. Total protein foods	5	≥ 70 g per 1000 kcal	No protein foods
8. Seafood and plant proteins	5	≥ 20 g per 1000 kcal	No seafood or plant protein
9. Fatty acids	10	(PUFAs + MUFAs) / SFAs ≥ 2.5	(PUFAs + MUFAs) / SFAs ≤ 1.2
10. Refined grains	10	≤ 50 g per 1000 kcal	≥ 120 gram per 1000 kcal
11. Sodium	10	≤ 1.1 g per 1000 kcal	≥ 2 gram per 1000 kcal
12. Empty calories	20	≤ 19% of energy	≥ 50% of energy

PUFAs = polyunsaturated fatty acids; MUFAs = monounsaturated fatty acids; SFAs = saturated fatty acids.

Table 2. Diabetes Healthy Eating Index (DHEI)[7] components and criteria for adherence

Components (daily intake)	Portion[27] (kcal)	Criteria for adherence with diabetes recommendations*		
		Poor	Fair	Good
1. Diet variety: number of items	-	<6	6–16	≥16
2. Fresh fruit (portions per 1000 kcal)	70	<1.0	1.0–1.5	≥1 ½
3. Vegetables (portions per 1000 kcal)	15	<1.0	1.0–1.5	≥1 ½
4. Carbohydrates and fiber sources (portions per 1000 kcal)	150	<3	<3 BUT at least 50% from fiber sources	≥3 AND at least 50% from fiber sources
5. Meat and eggs (portions per 1000 kcal)	190	>1.0	0.5–1.0	≤0.5
6. Dairy products (portions per 1000 kcal) AND saturated fatty acids (% of energy)	120	<0.75 portion/day of dairy OR saturated fatty acids intake >10.5% of energy	>0.5 portion of dairy AND Saturated Fatty Acids <7.0% of energy OR >0.75 portion of dairy AND saturated fatty acids between 7.0 and 10.5% of energy	1.0–2.0 portions/day of dairy AND saturated fatty acids <7% of energy
7. Oils, fats, and nuts (portions per 1000 kcal)	73	>1.0	0.5–1.0	≤0.5
8. Total lipids (% of energy)	-	≥45%	30–45%	≤30%
9. Dietary cholesterol (mg/day)	-	≥450	300–450	≤300
10. *Trans*-unsaturated fatty acids (% of energy)	-	≥1.5%	1.0–1.5%	≤1.0%

Criteria for adherence were based on the Brazilian Society for Diabetes [3], Brazilian Dietary Guidelines [27], and original HEI [6] for classification of the diet variety component.

Table 3. Demographic, clinical, lifestyle and laboratory characteristics of patients with type 2 diabetes

Characteristic	
N	148
Age (years)	63.2 ± 9.4
Female	62.8%
White skin color	73.0%
Lower middle class	46.0%
Years of study	7.1 ± 3.7
Duration of diabetes (years)	10 [5-19]
Hypertension	
Systolic blood pressure (mmHg)	140.8 ± 21.9
Diastolic blood pressure (mmHg)	76.5 ± 11.5
Current smoking	6.8%
Micro- or macroalbuminuria	24.2%
BMI (kg/m²)	30.5 ± 4.2
BMI >30 kg/m²	56.1%
Waist circumference (cm)	
Males	105.5 ± 10.9
Females	101.9 ± 9.9
Diabetes treatment	
Diet alone	2.7%
Oral agents	43.2%
Insulin	6.1%
Insulin plus oral agents	48.0%
Hypolipidemic agents	68.2%
Fasting plasma glucose (mg/dL)	161.3 ± 71.9
A1c (%)	8.4 ± 2.0
A1c <7%	27.0%
Total cholesterol (mg/dL)	174.7 ± 40.2
Total cholesterol <200 mg/dL	53.4%
HDL cholesterol (mg/dL)	41.9 ± 10.0
Males	40.5 ± 8.9
Females	42.8 ± 10.6
LDL cholesterol (mg/dL)	100.6 ± 34.4
LDL cholesterol < 100 mg/dL	50.7%
Triglycerides (mg/dL)	163.2 ± 88.2
Triglycerides < 150 mg/dL	44.6%
Serum creatinine (mg/dL)	0.8 ± 0.2
Glomerular filtration rate (mL/min/1.73 m²)	83.7 ± 22.3
Glomerular filtration rate >90 mL/min/1.73 m²	20.9%

Data presented as mean ± standard deviation, median [interquartile range] or n (%).

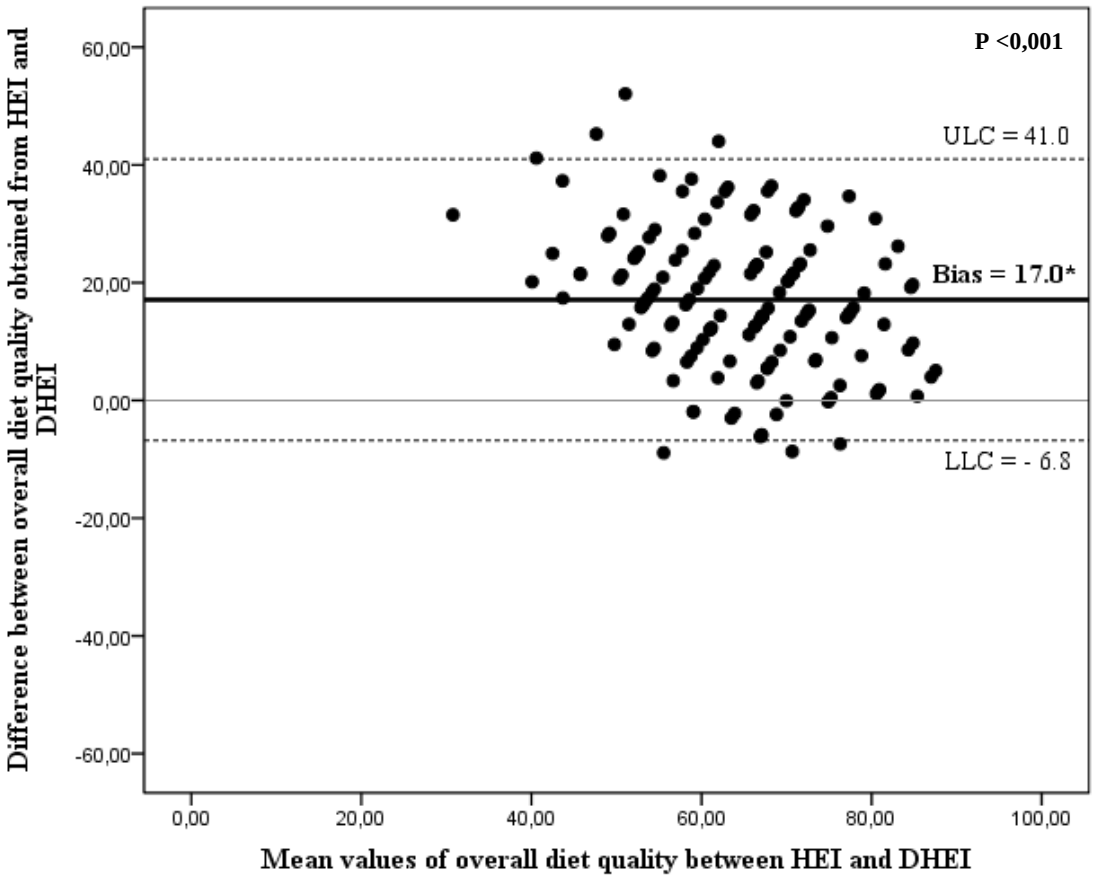

Figure 1. Bland-Altman plot between HEI and DHEI for determining overall diet quality of patients with type 2 diabetes (n = 148). The solid line represents the mean difference between the two instruments, and the dotted lines represent the minimum and maximum differences between HEI and DHEI, where LLC is the lower limit of concordance and ULC is the upper limit of concordance.

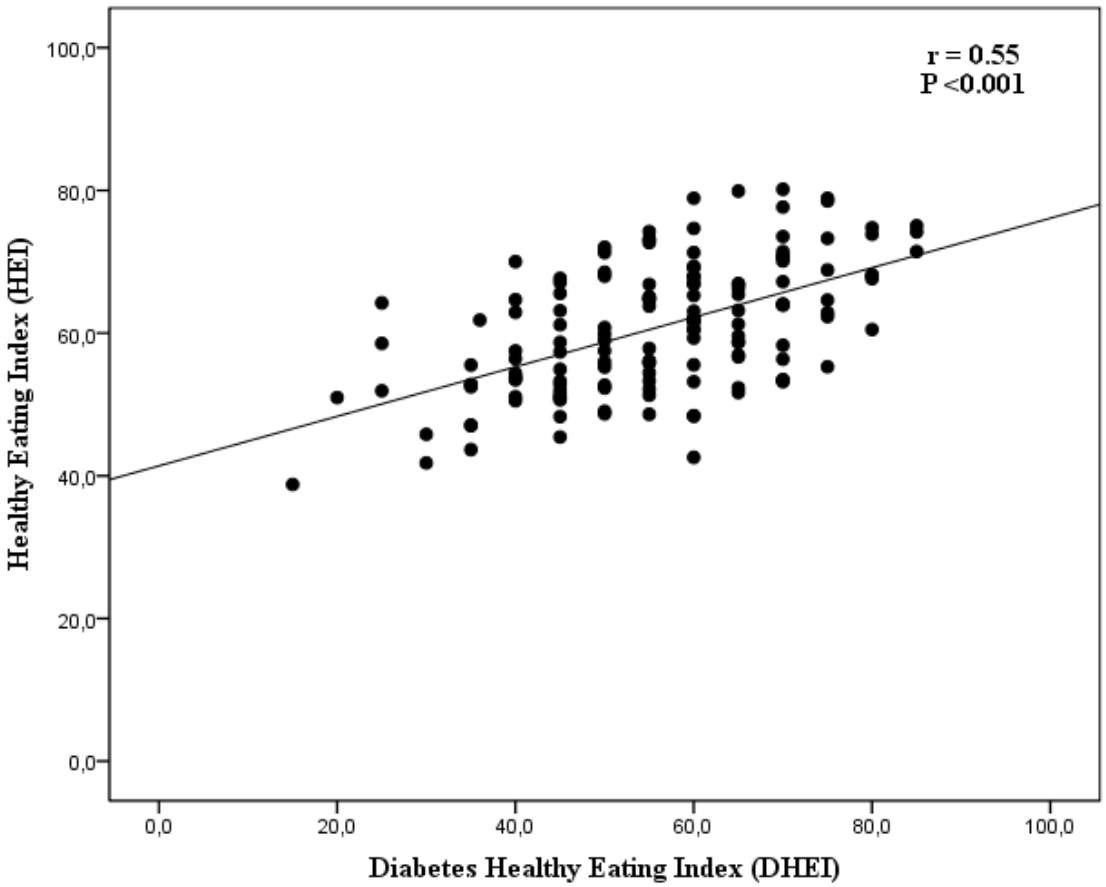

Figure 2. Pearson correlation coefficients (*r*) between HEI and DHEI scores in patients with type 2 diabetes (n = 148).

Additional File 1: Poisson regression models between overall diet quality and individual components of dietary indexes with therapeutic targets (dependent variable) in patients with type 2 DM (n=148)

Overall diet quality and individual components of dietary indexes	Therapeutic targets	Prevalence ratio (CI 95%)
DIABETES HEALTHY EATING INDEX (DHEI)[1]		
Low diet quality (< 51%)	Total cholesterol >200mg/dL	9.07 (2.50-32.70)**
Vegetables (1.0 to 1.5 portions per 1000 kcal)	Glycated hemoglobin >7%	0.54 (0.30-0.98)*
Meat and eggs (0.5 to 1.0 portions per 1000 kcal)	LDL-cholesterol >100mg/dL	3.02 (1.14-7.99)**
Dietary cholesterol (300 to 450 mg/day)	Body mass index >30kg/m²	1.50 (1.01-2.24)*
	LDL-cholesterol >100mg/dL	2.21 (1.31-2.74)**
HEALTHY EATING INDEX (HEI)[2]		
Total fruit (cup per 1000kcal)	Glycated hemoglobin >7%	0.86 (0.75-0.99)*
Total protein foods (g per 1000 kcal)	Body mass index >30kg/m²	1.18 (1.02-1.36)*
Whole grains (g per 1000 kcal)	Fasting glucose >130mg/dL	0.93 (0.87-0.99)*
	Glycated hemoglobin >7%	0.96 (0.92-0.99)*
Sodium (g per 1000 kcal)	Glycated hemoglobin >7%	0.82 (0.70-0.95)**
Empty calories (% of energy)	Fasting glucose >130mg/dL	0.81 (0.73-0.91)**
	Glycated hemoglobin >7%	0.90 (0.85-096)**
	Total cholesterol >200mg/dL	0.65 (0.49-0.88)**
Fatty acids (PUFAs+MUFAs)/SFAs	High waist circumference (cm)	0.98 (0.96-0.99)*

*P <0.05; **P <0.001

DHEI is expressed by categorical variables and HEI is expressed by continuous variables. Other dietary components were not associated with therapeutic targets.

All these analyses were adjusted to possible confounding variables selected according to clinical relevance: gender, age, treatment and diabetes duration, body mass index, and physical activity.

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CAPÍTULO III

Artigo original a ser submetido para publicação no periódico *Diabetes Care*, redigido conforme as normas do periódico.

Diet Quality and Glycemic Control in Patients with Type 2 Diabetes

Short running title: Diet quality and glycemic control in diabetes

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Word count: 2.335

Number of tables: 3

Number of figures: 0

ABSTRACT

This cross-sectional study sought to evaluate the relationship between diet quality and glycemic control in outpatients with type 2 diabetes treated at a university hospital. Dietary information was obtained by a quantitative food frequency questionnaire validated for patients with diabetes. Overall diet quality was evaluated by the Healthy Eating Index (HEI)-2010. Glycemic control was assessed by fasting plasma glucose and glycated hemoglobin (HbA1c). A receiver operating characteristic (ROC) curve was constructed to find the optimal HEI cutoff point to discriminate diet quality, considering good glycemic control as HbA1c <7%. Patients were then classified as having lower vs. higher diet quality, and the two groups compared statistically. Logistic regression models were constructed with HbA1c ≥7% as the dependent variable, adjusted for age, current smoking, diabetes duration and treatment, physical activity, BMI, HDL cholesterol and energy intake. A total of 229 patients with type 2 diabetes (median age=63.0 [58.0-68.5] years; diabetes duration=10.0 [5-19] years; BMI=30.8±4.3kg/m²; HbA1c= 8.1 [6.9-9.7%]) were evaluated. An HEI score >65% yielded the best properties (area under the ROC curve=0.60; sensitivity=71.2%; specificity=52.1%; *P*=0.018). Patients with lower-quality diets were younger and more likely to be current smokers than patients with higher-quality diets. After adjusting for confounders, patients with lower-quality diets had 2.92 times the chance of poorer glycemic control (95%CI=1.27-6.71; *P*=0.012) than those in the higher-quality diet group. In conclusion, lower overall diet quality evaluated by HEI <65% was associated with poor glycemic control in this sample of outpatients with type 2 diabetes.

Key words: Type 2 diabetes mellitus; glycemic control; food intake; dietary assessment; healthy eating

Diabetes mellitus is a chronic condition that features a heterogeneous set of metabolic disorders, including hyperglycemia and impaired carbohydrate, protein, and lipid metabolism, ultimately caused by abnormalities in insulin action and/or secretion (1). Type 2 diabetes is the most common form (2). This illness is considered a major public health problem, due to its high prevalence, morbidity and mortality rates, and the high costs associated with its chronic complications (1).

Strategies to improve glycemic control have been recommended to slow the development and progression of chronic complications in patients with diabetes (1). It has been suggested that treatment decisions should be based on a glycated hemoglobin (HbA1c) target of <7%, as recommended by the *American Diabetes Association* (1). The best strategy to achieve this goal is adoption of healthy behaviors, especially dietary changes, regular physical activity, and proper use of medications, as an appropriate foundation of a diabetes self-management program to facilitate knowledge and skills for diabetes self-care (3).

Nutrition therapy has an integral role in diabetes management. Current dietary recommendations have focused on providing practical tools to promote healthful eating patterns containing nutrient-dense, high-quality foods, with less focus on specific nutrients than before (3,4). The identification of eating patterns can be done *a priori,* in which dietary indexes have been developed to evaluate the overall diet quality of populations (5). These scores can reflect the intake of various dietary components (food groups, nutrients, and diversity or variety) in a single variable (6).

The Healthy Eating Index (HEI) is the most commonly used, internationally recognized tool for evaluation of diet quality in healthy adults, and its latest revised version was published in 2010 (7). Very few studies have evaluated the diet quality of type 2 diabetes patients, and just two studies found weak associations with glycemic

control (8-10). Therefore, this relationship needs to be better explored. Within this context, the aim of the present study was to evaluate potential associations between overall diet quality and glycemic control in patients with type 2 diabetes.

RESEARCH DESIGN AND METHODS

Study design and patient selection criteria

This was a cross-sectional study of outpatients with type 2 diabetes treated at Hospital de Clínicas de Porto Alegre, a university hospital and tertiary referral center in Southern Brazil. All had been diagnosed with type 2 diabetes by standard criteria (disease onset after 30 years of age, no previous episodes of ketoacidosis or documented ketonuria, and treatment with insulin required no sooner than 5 years after diagnosis) (11). Patients were included according to the following criteria: not having received dietary counseling from a nutritionist for at least 6 months prior to the study, age <80 years, BMI <40 kg/m^2, serum creatinine <2 mg/dL, normal thyroid function tests, absence of urinary tract infection or other renal disease, and absence of severe liver disease, decompensated heart failure, or any acute and/or consumptive illness. The study was conducted in accordance with Declaration of Helsinki guidelines, and all procedures involving patients were approved by the Hospital de Clínicas de Porto Alegre Research Ethics Committee. Written informed consent for participation was obtained from all patients.

Clinical and anthropometric evaluation

Information on ethnicity was obtained by self-report and classified dichotomously as white or non-white. Economic status was evaluated by a standardized Brazilian questionnaire (12). Patients were classified as current smokers or not currently smokers (i.e., former smokers and never-smokers). The International Physical Activity Questionnaire, short version (13) was used to assess activities carried out during a

typical week (in MET minutes). Patients whose reported activities corresponded to less than 600 MET minutes per week were considered sedentary (14).

Sitting blood pressure was measured twice, after a 10-minute rest, using a standard digital sphygmomanometer (Omron HEM-705CP, Kunotsubo, Terado-cho, Muko, Kyoto, 617–0002, Japan) (15), and the mean of the two measurements was used for analysis. Hypertension was defined as systolic blood pressure ≥140 mm Hg and diastolic blood pressure ≥90 mm Hg, measured on two occasions, and/or the use of antihypertensive drugs (16). Patients with an estimated glomerular filtration rate (GFR) <60 mL/min/1.73m² and persistently elevated urinary albumin excretion, translated as albuminuria ≥14mg/dL, were considered to have diabetic kidney disease (17). Information about medication use was collected from patients' medical records of their last visit to the study center before the date of dietary assessment.

The anthropometric measurements used to assess nutritional status were weight (measured with patients barefoot and wearing lightweight clothing), height, and waist circumference (measured once to the nearest 1 cm, at the midpoint between the lowest rib margin and the iliac crest, near the umbilicus, using flexible, non-stretch fiberglass tape) (18). All measurements were performed well-trained team. The waist circumference cut points were defined as ≥80cm for women and ≥94cm for men, according to *International Diabetes Federation* criteria (19). BMI was calculated using the formula weight (kg)/height $(m)^2$ (19), and its target value was ≥25kg/m² for adults and ≥27kg/m² for elderly (20,21).

Dietary assessment

Food intake information was obtained from a quantitative food frequency questionnaire (FFQ), previously constructed (22) and validated in patients with type 2

diabetes (23), which consists of 80 items across 10 food groups. A photo album was used to help patients select serving sizes, and reported intakes were converted into daily intakes.

Diet quality was evaluated by the latest revised version of the HEI-2010 (7), which consists of 12 components: “total fruit” (including 100% natural fruit juices); “whole fruit” (excluding juices and extracts); “total vegetables”; “greens and beans”; “whole grains”; “dairy”; “total protein foods”; “seafood and plant proteins”; “fatty acids” (distinguishing unsaturated and saturated); and three items referring to components to be consumed in moderation: “refined grains”, “sodium”, and “empty calories” (i.e., calories from solid fats, alcoholic beverages, and added sugar). Individual scores range from 0 to 20, and the sum of the scores of each component yields a percent global score. Individual serving intake was adjusted to a daily energy intake of 1000 kcal. The Brazilian food composition table was used to evaluate the nutritional composition of the FFQ items (24). Patients who reported puzzling energy daily intake were excluded from analysis.

Laboratory measurements

Blood samples were obtained after a 12-hour fast. Plasma glucose was quantitated using the glucose oxidase method (Biodiagnostica Kit) (25); glycated hemoglobin (HbA1c, reference range 4.7-6.0%), by high-performance liquid chromatography in a Merck-Hitachi 9100 system (26); and total cholesterol, HDL cholesterol, and triglycerides (TG) by enzymatic colorimetric methods (27). LDL cholesterol was calculated using the Friedewald equation (LDL = total cholesterol – HDL – TG/5) (28), only in patients with TG values <400 mg/dL. Serum creatinine was measured by the Jaffé method (29). GFR was estimated by the CKD-EPI equation

(Chronic Kidney Disease Epidemiology Collaboration Calculator, © 2000–2011), and urinary albumin excretion was measured by immunoturbidimetry (30). All tests were performed at the Clinical Pathology Laboratory, Hospital de Clínicas de Porto Alegre.

Statistical analysis

The Shapiro-Wilk test was used to test variables for normality of distribution. Data were expressed as mean ± standard deviation, median (interquartile range), or n (%) as appropriate.

An ROC curve was constructed to evaluate the performance of HEI values, considering good glycemic control as HbA1c values lower than 7%, and a cutoff HEI score was established from the balance between sensitivity and specificity values (prioritizing sensitivity).

The sample was divided into two groups according cutoff to overall diet quality, and the characteristics of these groups compared using the chi-square or Fisher's exact test (adjusted standardized residuals were adopted) and Student's *t*-test or the Mann–Whitney *U* test as appropriate.

Logistic regression models were constructed, with HbA1c ≥7% as the dependent variable, to test for possible associations between overall diet quality and glycemic control. Analyses were adjusted for possible confounding variables, selected according to clinical relevance or significance ($P<0.10$) on univariate analysis. *P*-values <0.05 (two-tailed) were considered statistically significant. All analyses were carried out in PASW Statistics 18.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

Of 250 eligible patients, 21 were excluded due to under- or over-reporting of food intake information. Therefore, 229 outpatients with type 2 diabetes (median age

63.0 [58.0-68.5] years; diabetes duration, 10.0 [5-19] years; BMI, 30.8 ± 4.3 kg/m²; HbA1c, 8.1 [6.9-9.7%]) were evaluated.

On classification of overall diet quality, only 10% sample of our patients had higher diet quality, which hindered distribution of patients into tertiles of diet quality (low, need improvement or high) as performed in the American population by the HEI (31). Therefore, we constructed an ROC curve to evaluate the performance of HEI values (study factor), considering good glycemic control as HbA1c <7%. The area under the ROC curve found was 0.60, with a sensitivity of 71.2% and specificity of 52.1% (*P*=0.018) for a cutoff HEI score of 65% to discriminate between lower vs. higher overall diet quality.

The main clinical and laboratory characteristics of this sample, stratified by overall diet quality, are described in **Table 1.** Patients with a lower-quality diet were younger and more likely to be current smokers when compared to patients with higher diet quality (*P* <0.05). Overall, patients with lower diet quality had a higher intake of energy, protein, total lipids, dietary cholesterol, sodium, fatty acids, glycemic index, and glycemic load when compared to patients with higher diet quality, as expected (*P* <0.001). These results are shown in **Supplemental Table S1**.

A greater proportion of patients with higher diet quality had good glycemic control than did patients with lower diet quality (*P*<0.003 for analyses), as showed in **Table 2.** Lipid profile, blood pressure values, and anthropometric parameters did not differ between the two diet quality groups. Besides, the overall diet quality was correlated negatively with fasting plasma glucose (*r* = -0.223; *P* = 0.001) and HbA1c (*r* = -0.151; *P* = 0.022), data not showed.

Logistic regression models were used to test for possible associations of overall diet quality with glycemic control (as the dependent variable), as described in **Table 3**.

Patients with lower diet quality had 2.92 times the chance of poorer glycemic control (95% CI 1.27 to 6.71; $P = 0.012$) as compared to patients with higher diet quality, after adjusting for age, current smoking, diabetes duration, diabetes treatment, physical activity, BMI, HDL cholesterol and energy intake.

CONCLUSIONS

In the present study, we evaluated the association between overall diet quality and glycemic control in patients with type 2 diabetes. Patients whose diets were classified as lower-quality had 2.92 times the chance of poor glycemic control as compared to patients with higher-quality diets.

Our study stands out from the existing literature in some aspects: we used a FFQ previously validated for patients with type 2 diabetes and chose to use the HEI as the dietary index, because nutritional recommendations for diabetes are becoming increasingly similar to those for the general population and this index is more internationally recognized than others. Furthermore, we found associations between HEI and glycemic control; this finding suggests that using dietary patterns to model dietary recommendations may be more beneficial than using nutrient-based approaches.

Patients whose diets were classified as lower-quality had poor glycemic control when compared to patients with higher diet quality. There is mounting evidence that higher HbA1c values are implicated in the pathogenesis of the chronic complications of diabetes (1), as in our patients.

Studies of the relationship between diet quality and glycemic control and/or complications in type 2 diabetes are still scarce in literature (8-10). Only two such studies have observed a negative correlation with glycemic control (9, 10). However, the authors did not find or describe associations with health outcomes and did not use the HEI, but rather other adapted dietary indexes.

The cutoff point established in this study (65%) was similar to the mean score found in a recent systematic review of studies that evaluated diet quality in the Brazilian population (32), and is best classified as a diet "needing improvement". It is well established that nutrition therapy in diabetes can result in cost savings and improved outcomes (1). In this sense, our findings suggest that dietary advice for patients with type 2 diabetes should include a strong recommendation of adhering to healthy eating patterns in order to improve HbA1c values.

We are aware of the limitations of a cross-sectional study and the use of dietary indexes is still beset by unanswered questions, such as which inferences can actually be drawn from their results and whether they are in fact able to evaluate the quality of eating habits as a whole without considering the impact of each food group has on overall diet quality. These methodological questions need to be evaluated carefully through repeated application in different populations if classification of diet quality is to become more reliable.

In conclusion, lower diet quality (defined as an HEI <65%) was associated with poor glycemic control in this sample of patients with type 2 diabetes. *A priori* evaluation of overall diet quality can be a useful tool for planning of specific nutritional advice for these patients, with the specific goal of improving glycemic control. However, the effectiveness of this approach needs to be tested in clinical trials.

Acknowledgements

This study was supported by Fundo de Incentivo à Pesquisa e Eventos, Hospital de Clínicas de Porto Alegre.

Authors' contributions

JPA and RAS contributed to data collection. JPA wrote the manuscript. JPA and JCA contributed to the statistical analysis, interpretation of data, and reviewed the manuscript critically. All authors read and approved the final version of the manuscript.

Competing interests

The authors declare no conflict of interest.

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Table 1. Clinical and laboratory characteristics of patients with type 2 diabetes stratified by overall diet quality score (n = 229)

	Diet quality		
Characteristic	**Lower (< 65%)**	**Higher (> 65%)**	***P***
n	103	126	-
Age (years)	61.0 (56.0- 67.5)	64.0 (59.0-70.0)	**0.034**[1]
Female	58 (56.3%)	84 (66.7%)	0.132[2]
Skin color, white	70 (68.0%)	95 (75.4%)	0.238[2]
Socioeconomic status, lower middle class	49 (50.5%)	59 (47.9%)	0.532[2]
Duration of diabetes (years)	10 (4-7)	10 (5-20)	0.102[1]
Hypertension	89 (86.4%)	114 (90.5%)	0.334[2]
Systolic blood pressure (mmHg)	137 (122-149)	139 (127-152)	0.375[1]
Diastolic blood pressure (mmHg)	76 (69-84)	75 (70-84)	0.873[1]
Current smoking (self-reported)	21 (20.4%)	9 (7.1%)	**0.010**[2]
Sedentary lifestyle	69 (69.7%)	78 (62.4%)	0.348[2]
Diabetic kidney disease	46 (48.1%)	43 (36.1%)	0.094[2]
Cardiovascular disease	35 (34.0%)	30 (23.8%)	0.121
BMI (kg/m^2)	30.7 ± 4.6	30.8 ± 4.0	0.825[3]
Waist circumference (cm)			
Females (n = 142)	103 (95-109)	102 (97-109)	0.744[1]
Males (n = 87)	105 (101-114)	106 (97-111)	0.628[1]
Diabetes treatment			
Diet	2 (1.9%)	2 (1.6%)	
Oral agents	47 (46.7%)	60 (47.6%)	0.990[2]
Insulin or insulin plus oral agents	54 (52.5%)	64 (50.8%)	
Hypolipidemic agents	72 (69.9%)	86 (68.3%)	0.886[2]
Fasting plasma glucose (mg/dL)	168 (131-207)	130 (103-177)	**<0.001**[1]
Glycated hemoglobin (%)	8.5 (7.4-10.0)	7.8 (6.7-9.4)	**0.002**[1]
Total cholesterol (mg/dL)	173 (149-201)	165 (140-196)	0.169[1]
HDL cholesterol (mg/dL)			
Females (n = 142)	46 (38-51)	42 (36-50)	0.137[1]
Males (n = 87)	37 (33-42)	39 (35-46)	0.065[1]
LDL cholesterol (mg/dL)	98.3 (80-125)	89.7 (70-118)	0.144[1]
Triglycerides (mg/dL)	148 (110-194)	127 (98-199)	0.236[1]
Serum creatinine (mg/dL)	0.84 (0.7-1.0)	0.82 (0.7-1.0)	0.236[1]
Glomerular filtration rate (mL/min/1.73m^2)	88.0 (73.0-98.0)	86.0 (70.0-98.0)	0.563[1]

[1]Mann–Whitney *U* test; [2]Chi-square test; [3]Student's *t*-test
Data expressed as mean ± SD, median (interquartile range) or n (%).
Sedentary lifestyle defined as physical activity < 600 MET minutes per week.[14]
LDL cholesterol was not calculated in two patients who had triglyceride values > 400 mg/dL.

Table 2. Diet quality and therapeutic targets in patients with type 2 diabetes (n=229)

		N	Diet quality		
Therapeutic targets	**Criteria**		**Lower (<65%)**	**Higher (>65%)**	***P****
n			103	126	-
Fasting plasma glucose[1]	70 to 130 mg/dL	226	23 (22.8%)	62 (49.6%)	**<0.001**
Glycated hemoglobin[1]	<7%	228	17 (16.5%)	42 (33.6%)	**0.003**
Total cholesterol[1]	<200 mg/dL	205	66 (75.0%)	93 (79.5%)	0.553
HDL cholesterol[1]	Males ≥ 40 mg/dL Females ≥ 50 mg/dL	205	55 (63.2%)	78 (66.1%)	0.780
LDL cholesterol[1]	<100 mg/dL	202	46 (53.5%)	72 (62.1%)	0.281
Triglycerides[1]	<150 mg/d[1]	205	44 (50.0%)	70 (59.8%)	0.208
Overweight[20,21]	Adults ≥ 25 kg/m² Elderly ≥ 27 kg/m²	229	49 (47.6%)	49 (38.9%)	0.235
Waist circumference (cm)[19]	Males ≥ 94 cm Females ≥ 80 cm	229	9 (8.7%)	9 (7.1%)	0.842
Blood pressure[1]	<140/90 mmHg[1]	226	57 (55.3%)	64 (52.0%)	0.717

*Chi-square test for all analyses.

Table 3. Logistic regression models of diet quality and glycemic control (as dependent variable) in patients with type 2 diabetes (n = 229)

Health outcomes	**Higher diet quality**	**lower diet quality**	***P*-value**
n	**126**	**103**	**-**
HbA1c ≥ 7%	-		
OR (95% CI)	1.0	2.56 (1.35-4.85)	**0.004**
OR adjusted[1] (95% CI)	1.0	2.26 (1.17-4.37)	**0.016**
OR adjusted[2] (95% CI)	1.0	2.92 (1.27-6.71)	**0.012**

Data expressed as odds ratio (OR; 95%CI).

Lower diet quality defined as a Healthy Eating Index <65%.

[1]Model 1: adjusted for age and current smoking.

[2]Model 2: adjusted for age, current smoking, diabetes duration, diabetes treatment, physical activity, BMI, HDL cholesterol and energy intake.

Table S1. Online-Only Supplemental Material

Daily intakes stratified by diet quality in patients with type 2 diabetes (n=229)

	Diet quality		
Composition of diet	**Lower (< 65%)**	**Higher (> 65%)**	***P****
N	103	126	
Energy intake (kcal/day)	2258.4 (1634.6-2571.8)	1667.6 (1404.1-2020.2)	**<0.001**[1]
Carbohydrates (% daily intake)	55.0 ± 9.0%	56.0 ± 7.6%	0.096[2]
Protein (% daily intake)	18.0% (15.0-20.0%)	19.3% (17.0-22.0%)	**<0.001**[1]
Protein (g per body weight)	1.1 (0.9-1.5)	1.0 (0.9-1.3)	**0.020**[1]
Total lipid (% daily intake)	27.3% (23.9-31.5%)	25.8% (21.6-29.7%)	**0.033**[1]
Dietary cholesterol (mg/day)	261.0 (213.3-369.1)	219.0 (166.3-303.8)	**<0.001**[1]
Fiber (g/day)	27.3 (21.0-33.6)	26.0 (22.0-32.0)	0.757[1]
Sodium (mg/day)	1659.7 (1146.3-2269.2)	1313.5 (967.6-1694.9)	**<0.00[1]1**
Saturated fatty acids (% daily intake)	9.7 (8.5-11.3)	8.9 (7.2-10.4)	**<0.001**[1]
Fatty acids (% daily intake)	-	-	-
Monounsaturated (% daily intake)	8.7 (7.3-10.1)	8.0 (7.0-9.4)	**<0.001**[1]
Polyunsaturated (% daily intake)	4.0 (3.2-5.5)	4.7 (3.4-6.1)	0.071[1]
***Trans*-unsaturated (% daily intake)**	0.8 (0.5-1.1)	0.6 (0.4-0.8)	**<0.001**[1]
Glycemic load (g)	140.4 (106.8-182.2)	110 (87.4-129.0)	**<0.001**[1]
Glycemic index (%)	49.7 (45.5-53.4)	46.0 (42.5-49.7)	**<0.001**[1]

[1]Mann–Whitney *U* test; [2]Student's *t*-test.
Data are mean ± standard deviation or median (interquartile range).

CAPÍTULO IV

CONSIDERAÇÕES FINAIS

CONSIDERAÇÕES FINAIS

O manejo dietoterápico no tratamento do diabetes é um dos pilares fundamentais para o controle rigoroso da hiperglicemia e na redução das complicações relacionadas à doença. Assim, a melhor estratégia dietoterápica para manutenção de um adequado controle glicêmico em pacientes com diabetes tem sido constantemente avaliada.

Os índices dietéticos têm sido estudados como uma ferramenta inovadora para avaliar a qualidade da dieta de indivíduos com o objetivo de promover saúde por meio de programas de educação nutricional. No entanto, uma das maiores limitações da comparação e escolha do uso de um determinado índice dietético baseia-se no fato de que esses instrumentos abordam diferentes grupos alimentares e/ou nutrientes e a forma de lidar com as diferenças na ingestão energética diária, pontuando cada componente e combinando-os em uma única medida, são problemas metodológicos que ainda precisam ser resolvidos e mais estudados.

Neste trabalho, escolhemos utilizar o índice de alimentação saudável por ser reconhecido internacionalmente e por apresentar correlação moderada com o instrumento previamente desenvolvido pelo nosso grupo. Concluímos, portanto, que uma pior qualidade da dieta foi associada com pior controle glicêmico em pacientes com diabetes tipo 2. Estes achados sugerem que intervenções na qualidade da alimentação dos pacientes podem ser benéficas na melhora do controle glicêmico e mais custo-efetivas; entretanto, esta hipótese precisa ser testada em ensaio clinico randomizado. Sugerimos ainda, que as associações descritas neste trabalho sejam avaliadas em outras amostras de pacientes com diabetes.

ANEXOS

ANEXO I – CARTA DE APROVAÇÃO DO PROJETO NO COMITÊ DE ÉTICA EM PESQUISA

HCPA - HOSPITAL DE CLÍNICAS DE PORTO ALEGRE
GRUPO DE PESQUISA E PÓS-GRADUAÇÃO

COMISSÃO CIENTÍFICA

A Comissão Científica do Hospital de Clínicas de Porto Alegre analisou o projeto:

Projeto: 130489
Data da Versão do Projeto:

Pesquisadores:
JUSSARA CARNEVALE DE ALMEIDA
MIRELA JOBIM DE AZEVEDO
JULIANA PECANHA ANTONIO
NICOLI BONALUME

Título: Qualidade da dieta usual e desfechos de saúde em pacientes com Diabetes Melito tipo 2

Este projeto foi APROVADO em seus aspectos éticos, metodológicos, logísticos e financeiros para ser realizado no Hospital de Clínicas de Porto Alegre.
Esta aprovação está baseada nos pareceres dos respectivos Comitês de Ética e do Serviço de Gestão em Pesquisa.

- Os pesquisadores vinculados ao projeto não participaram de qualquer etapa do processo de avalição de seus projetos.

- O pesquisador deverá apresentar relatórios semestrais de acompanhamento e relatório final ao Grupo de Pesquisa e Pós-Graduação (GPPG)

Porto Alegre, 26 de dezembro de 2013.

Prof. Eduardo Pandolfi Passos
Coordenador GPPG/HCPA

ANEXO II – QUESTIONÁRIO DE FREQUÊNCIA ALIMENTAR

IDENTIFICAÇÃO		
NOME:		PRONTUÁRIO:
IDADE:	SEXO: (1) M (2) F	DATA:
ENTREVISTADOR:	INÍCIO:	TÉRMINO:
NUTRIÇÃO		
Quantas refeições você costuma fazer por dia? ( )		
Que adoçante você utiliza nas bebidas? (0)açúcar refinado (1)açúcar mascavo (2)mel (3)adoçante artificial. Qual?_____ (4)nenhum		
Que tipo de gordura você costuma utilizar no preparo das refeições? _____ (9)não sabe		
Quanto costuma ser o gasto mensal de óleo na sua casa? _____Quantas pessoas realizam as refeições em sua casa? _____ Quais refeições você participa? _____ (9)não sabe		
Costuma comer a gordura visível das carnes bovina/suína? (0)sempre (1)algumas vezes (2)nunca/raramente (3)não come carne		
Costuma comer a pele do frango/peru? (0)sempre (1)algumas vezes (2)nunca/raramente (3)não come frango		
Costuma acrescentar sal na comida depois de pronta? (0)sempre (1)algumas vezes (2)nunca/raramente		
Costuma temperar as saladas com sal? (0)sempre (1)algumas vezes (2)nunca/raramente		

QUESTIONÁRIO QUANTITATIVO DE FREQÜÊNCIA ALIMENTAR

ALIMENTO	QUANTAS VEZES VOCÊ CONSOME	UNIDADE	PORÇÃO	QTD
CEREAIS, TUBÉRCULOS E MASSAS				
Arroz □branco □parboilizado* □integral*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 COL S CH □ 4 COL S CH □ 5 COL S CH □ 8 COL S CH	50 g 100 g 125 g 200 g
Massa □sem molho □com molho Tipo de molho?	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 3 COL S CH □ 4 COL S CH □ 1 PT R R □ 1 PT R CH	75 g 100 g 200 g 320 g
Aipim □cozido □frito*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 PED □ 3 PED □ 4 PED □ 6 PED	60 g 90 g 120 g 240 g
Batata □cozida □assada □frita*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 COL S CH □ 3 COL S CH □ 4 COL S CH □ 6 COL S CH	60 g 90 g 120 g 180 g
Polenta □cozida* □frita*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL A CH □ 2 COL S CH □ 4 COL S CH □ 1 PT R	60 g 90 g 150 g 325 g

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:			
ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA	

PÃES, BOLOS E BOLACHAS				
Pão francês, cervejinha*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ UND □ 1 UND □ 1 ½ UND □ 2 UND	25 g 50 g 75 g 100 g
Pão de fôrma branco	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT □ 2 FT □ 2 ½ FT □ 3 ½ FT	25 g 50 g 62,5 g 87,5 g
Pão integral	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ FT □ 1 FT □ 2 FT □ 3 FT	15 g 30 g 60 g 90 g
Pão caseiro Receita no final do QFA	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2/3 FT □ 1 FT □ 1 ½ FT □ 2 ½ FT	60 g 68 g 86 g 145 g
Bolo/cuca Recheio?	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT P □ 1 FT M □ 1 FT G □ 2 FT M	50 g 70 g 90 g 140 g
Bolacha água/sal, cream creaker*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 4 UND □ 6 UND □ 9 UND □ 20 UND	20 g 30 g 45 g 100 g
Bolacha doce (Maria, Maisena)	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 5 UND □ 8 UND □ 11 UND □ 32 UND	25 g 40 g 55 g 160 g

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:		
ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

VERDURAS E LEGUMES				
Cenoura crua/cozida	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 COL S CH □ 3 COL S CH □ 5 COL S CH □ 10 COL S CH	24 g 36 g 60 g 120 g
Tomate	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 3 FT P □ 5 FT P □ 7 FT P □ 7 FT M	30 g 50 g 70 g 100 g

Chuchu	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL S CH □ 2 COL S CH □ 3 ½ COL S CH □ 5 COL S CH	30 g 60 g 100 g 145 g
Repolho cru/cozido	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 4 COL S CH □ 7 COL S CH □ 10 COL S CH □ 6 ESC M CH	40 g 70 g 100 g 150 g
Alface	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 PEGADOR □ 2 PEGADORES □ 5 FOLHAS M □ 1 PT R CH	20 g 30 g 50 g 80 g
Agrião, rúcula* e radite*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 PT SOB CH □ 2 PEGADORES □ 1 PT R CH □ 2 PT R CH	20 g 30 g 80 g 160 g
Couve refogada, espinafre	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 COL S CH □ 3 COL S CH □ 5 COL S CH □ 9 COL S CH	40 g 60 g 100 g 180 g
Couve-flor, brócolis	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 RAMO P □ 1 RAMO M □ 1 RAMO G □ 2 RAMOS M	30 g 60 g 100 g 130 g
Vagem	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 COL S R □ 2 COL S CH □ 5 COL S CH □ 15 COL S CH	30 g 40 g 100 g 300 g
Moranga	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 PED M □ 2 PED M □ 2 ½ PED M □ 6 PED M	50 g 100 g 125 g 300 g
Beterraba*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 FT M □ 5 FT M □ 8 FT M □ 12 FT M	30 g 60 g 90 g 140 g

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:

ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

FRUTAS

Banana	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 UND P □ 1 UND M □ 1 UND G □ 2 UND M	40 g 70 g 90 g 140 g
Maçã, pêra	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 UND P □ 1 ½ UND P □ 1 UND M □ 1 UND G	90 g 135 g 150 g 230 g

Laranja, bergamota	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 UND P □ 1 ½ UND P □ 1 UND G □ 2 UND M	90 g 135 g 180 g 225 g
Mamão	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ FT P □ 1 FT P □ ¼ UND PAPAYA □ ½ UND PAPAYA	80 g 100 g 135 g 270 g
Manga	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 PED P □ 2 PED P □ 1 PED M □ 6 PED P	60 g 120 g 140 g 360 g
Uva	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 8 UND □ 14 UND □ 1 CACHO P □ 1 CACHO M	64 g 112 g 170 g 350 g
Caqui	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 UND P □ 1 UND G □ 2 UND M □ 3 UND P	85 g 150 g 220 g 255 g
Melão*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ FT P □ 1 FT P □ 1 FT M □ 1 FT G	78 g 125 g 200 g 300 g
Melancia*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT P □ 1 FT M □ 1 FT G □ 2 FT M	143 g 200 g 282,5 g 350 g

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:

ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

CARNES E OVOS

Carne bovina □assada □cozida □frita*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT P □ 4 PED P □ 1 FT G □ 2 FT G	70 g 80 g 135 g 270 g
Carne moída □ 1ª □ 2ª	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 COL S CH □ 3 COL S CH □ 4 COL S CH □ 8 COL S CH	50 g 75 g 100 g 200 g
Bife bovino Corte?	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ UND P □ 1 UND P □ 1 UND M □ 2 UND M	40 g 80 g 100 g 200 g
Bife de fígado	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ UND G □ 1 UND P □ 1 UND M □ 1 UND G	75 g 80 g 100 g 150 g

Coxa/sobrecoxa de frango □assado □cozido □frito*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 PED M □ 1 PED G □ 2 PED M □ 3 PED M	60 g 95 g 110 g 180 g
Peito de frango □assado □cozido □frito*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FILÉ P □ 1 FILÉ M □ 2 FILÉS P □ 1 FILÉ G	60 g 95 g 110 g 180 g
Peixe □assado □cozido □frito*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ FILÉ P □ 1 FILÉ P □ 1 FILÉ G □ 2 FILÉS G	60 g 100 g 155 g 310 g
Carne de porco Corte?	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT P □ 1 FT M □ 1 FT G □ 2 FT M	60 g 90 g 120 g 180 g
Lingüiça/salsichão	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ GOMO □ 1 GOMO □ 1 ½ GOMO □ 2 ½ GOMOS	30 g 60 g 90 g 150 g
Salsicha	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 UND □ 1 ½ UND □ 2 UND □ 3 ½ UND	42 g 63 g 84 g 147 g
Mortadela, presunto*, salame*	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT M □ 1 FT G □ 2 FT M □ 2 FT G	15 g 25 g 30 g 50 g
Ovo* □cozido □frito	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ UND □ 1 UND □ 1 ½ UND □ 3 UND	25 g 50 g 75 g 150 g

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:

ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

ÓLEOS E GORDURAS

Margarina □normal □light Tipo?	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ R □ 1 COL CHÁ CH □ 1 COL SOB R □ 1 COL SOB CH	4 g 8 g 13 g 23 g
Manteiga	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ R □ 1 COL CHÁ CH □ 1 COL SOB R □ 1 COL SOB CH	4 g 8 g 13 g 23 g
Maionese □normal □light	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ CH □ 2 COL CHÁ CH □ 1 COL SOB CH □ 2 COL SOB CH	6 g 12 g 17 g 34 g

Patê	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ CH □ 2 COL CHÁ CH □ 1 COL SOB CH □ 3 COL SOB CH	8 g 16 g 21 g 63 g
Óleo adicionado Tipo?	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ □ 2 COL CHÁ □ 1 COL SOB □ 1 COL S	2 ml 4 ml 5 ml 8 ml

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:

ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

LEGUMINOSAS

Feijão Tipo?	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 CO P CH □ 1 CO M R □ 2 CO P CH □ 2 CO M R	65 g 80 g 130 g 160 g
Lentilha	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 CO M R □ 1 CO M CH □ 2 CO M R □ 2 CO M CH	100 g 160 g 200 g 320 g

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:

ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

LEITES E DERIVADOS

Leite integral	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ XÍCARA □ ¾ XÍCARA □ 1 XÍCARA □ 1 CANECA	100 ml 150 ml 200 ml 300 ml
Leite semi-desnatado ou tipo C	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ XÍCARA □ ¾ XÍCARA □ 1 XÍCARA □ 1 CANECA	100 ml 150 ml 200 ml 300 ml
Leite desnatado	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ¾ XÍCARA □ 1 XÍCARA □ 1 COPO P □ 1 ¼ XÍCARA	150 ml 200 ml 240 ml 250 ml
Leite em pó □integral □desnatado	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL S CH □ 2 COL SOB CH □ 2 COL S CH □ 4 COL SOB CH	16 g 18 g 32 g 36 g
Queijo fatiado □lanche □mussarela	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT □ 1 ½ FT □ 2 FT □ 3 FT	20 g 30 g 40 g 60 g

Queijo branco □ricota □minas □frescal	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT P □ 1 FT M □ 1 FT G □ 2 FT G	15 g 35 g 45 g 90 g
Queijo colonial	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 FT P □ 1 FT M □ 1 FT G □ 2 FT M	25 g 35 g 50 g 70 g
Requeijão □normal □light	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL SOB R □ 1 COL S R □ 1 COL S CH □ 2 COL S CH	10 g 15 g 30 g 60 g
Nata/creme de leite	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ □ 1 COL S R □ 1 COL S CH □ 4 COL S R	10 g 15 g 25 g 60 g
Iogurte natural □integral □desnatado	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ POTE □ 1 POTE □ 1 ½ POTE □ 2 POTES	100 g 200 g 300 g 400 g
Iogurte de fruta*□normal □diet □light	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□1 POTE □ 1 ½ POTE □ 2 POTES □ 3 POTES	100 g 150 g 200 g 300 g

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:

ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

BEBIDAS				
Café passado	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ¼ XÍCARA □ ½ XÍCARA □ ¾ XÍCARA □ 1 XÍCARA	50 ml 100 ml 150 ml 200 ml
Café solúvel	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ □ 2 COL CHÁ □ 4 COL CHÁ □ 6 COL CHÁ	1,5 g 3 g 6 g 9 g
Chá	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ¾ XÍCARA □ 1 XÍCARA □ 1 ¼ XÍCARA □ 1 CANECA	150 ml 200 ml 250 ml 300 ml
Refrigerante □normal □diet/light	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 XÍCARA □ 1 COPO CH □ 1 LATA □ 2 COPOS CH	200 ml 250 ml 350 ml 500 ml
Suco de fruta natural Qual a fruta?	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ¾ XÍCARA □ 1 XÍCARA □ 1 COPO CH □ 2 XÍCARAS	150 ml 200 ml 250 ml 400 ml

Suco artificial □normal □diet/light	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ¾ XÍCARA □ 1 XÍCARA □ 1 COPO CH □ 2 COPOS CH	150 ml 200 ml 250 ml 500 ml
Extrato de soja	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ¾ XÍCARA □ ½ COPO □ 1 XÍCARA □ 1 COPO CH	150 ml 175 ml 200 ml 250 ml
Cerveja	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 TULIPA □ 1 GARRAFA □ 1 ½ GARRAFA □ 6 GARRAFAS	300 ml 600 ml 900 ml 3600 ml
Vinho □branco □tinto	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ ½ TAÇA □ ¾ TAÇA □ 1 TAÇA □ 2 TAÇAS	75 ml 115 ml 150 ml 300 ml

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:

ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

DOCES E SOBREMESAS

Sagu	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 3 COL S CH □ 4 COL S CH □ 5 COL S CH □ 6 COL S CH	90 g 120 g 150 g 180 g
Chocolate, tipo_____ □normal □diet	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 QUADRADOS □ 3 QUADRADOS □ 4 QUADRADOS □ 8 QUADRADOS	15 g 30 g 40 g 80 g
Pudim, flan □normal □diet □light	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL S CH □ 2 COL S CH □ 3 COL S CH □ 5 COL S CH	50 g 90 g 130 g 220 g
Sorvete □normal □diet □light	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL S CH □ 1 BOLA □ 1 XÍCARA □ 2 BOLAS	55 g 75 g 100 g 150 G
Gelatina □normal □diet	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 2 COL S CH □ 3 COL S CH □ 5 COL S CH □ 12 COL S CH	50 g 75 g 125 g 300 g
Doce de leite	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ R □ 1 COL SOB R □ 1 COL S CH □ 2 COL SOB CH	10 g 15 g 40 g 50 g
Geléia, chimia □normal □diet	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL CHÁ CH □ 2 COL CHÁ CH □ 1 COL S CH □ 2 COL S CH	10 g 20 g 34 g 68 g

Mel	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL SOB □ 1 COL S □ 2 COL SOB □ 2 COL S	10 g 15 g 20 g 30 g
Achocolatado □normal □diet □light	N 1 2 3 4 5 6 7 8 9 10 11 12	D S M A	□ 1 COL SOB R □ 1 COL S R □ 1 COL S CH □ 2 COL S CH	7 g 11 g 16 g 32 g

Liste outros alimentos ou preparações deste grupo que você costuma comer ou beber e que não foram mencionados:

ALIMENTO	FREQUÊNCIA	QUANTIDADE CONSUMIDA

LEGENDA:

CH = cheio **COL S = colher de sopa** **PED = pedaço** **P = pequeno**

CO = concha **COL SOB = colher de sobremesa** **PT F = prato fundo** **M = médio**

COL CHÁ = colher de chá **FT = fatia** **PT R = prato raso** **G = grande**

R = raso **UND = unidade** **PT SOB = prato de sobremesa**