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Original Research

Effects of Changing the Amount and Source of Dietary Carbohydrates on Symptoms and Dietary Satisfaction Over a 1-Year Period in Subjects with Type 2 Diabetes: Canadian Trial of Carbohydrates in Diabetes (CCD)

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ABSTRACT

Objectives: To determine the long-term effects of changing the amount or source of dietary carbohydrate on quality of life (QOL), symptoms and dietary satisfaction in people with type 2 diabetes.
Methods: Subjects with diabetes treated by diet alone (n=162) were randomly assigned to high-carbohydrate/high-glycemic-index (HGI) diets; high-carbohydrate/low-glycemic-index (LGI) diets; or lower-carbohydrate/high-monounsaturated-fat (LC) diets for 1 year. We measured QOL at baseline and at study's end, and we measured symptoms and dietary satisfaction quarterly.
Results: The HGI, LGI and LC diets contained, respectively, 47±1, 52±1 and 40±1% energy carbohydrate; 30±1, 27±1 and 40±1% fat with GI 64±0.4, 55±0.4 and 59±0.4. Significantly more participants reported increased flatulence on LGI than on LC and HGI diets at 3 months (41%, 19%, 14%; $p<0.05$), but not at 12 months (29%, 17%, 17%; ns). Abdominal distension was more severe (46% vs. 14%, 19%; $p<0.05$), and headache less severe (8% vs. 22%, 23%; $p<0.05$) on LGI than on both other diets. Increased appetite was more severe on LC (33%) than on HGI diets (14%, $p<0.05$). Joint/limb pains were less severe on LGI (16%) than HGI (28%) diets. LC elicited more severe gloomy thoughts (23%) than LGI (4%; $p<0.05$) but greater dietary-satisfaction (70%; $p<0.05$) than LGI (40%) and HGI (48%) diets. For all diets, glycated hemoglobin (A1C) levels increased less in those who gained less weight, had less increased appetite and were more satisfied with the enjoyment obtained from eating.
Conclusions: Each diet elicited increased severity of 1 or more symptoms than the other diets. Although overall dietary satisfaction was greater on the 40% carbohydrate diet than on the 50% carbohydrate diet, the LGI diet was no less satisfying than the HGI diet. Changes in appetite and dietary satisfaction may influence body weight and glycemic control, or vice-versa.

Mots clés :
régime alimentaire
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indice glycémique
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RÉSUMÉ

Objectifs : Déterminer les effets à long terme de la modification de la quantité ou de la source des glucides alimentaires sur la qualité de vie (QdV), les symptômes et la satisfaction alimentaire chez les personnes atteintes du diabète de type 2.
Méthodes : Les sujets diabétiques traités par le régime alimentaire seul (n=162) ont été répartis de manière aléatoire entre les régimes à haute teneur en glucides/à indice glycémique élevé (IGÉ), les régimes à haute teneur en glucides/à indice glycémique faible (IGF) ou les régimes à plus faible teneur en glucides/à forte teneur en gras mono-insaturés (FTG) durant 1 année. Nous avons mesuré la QdV au début et à la fin de l'étude, et mesuré les symptômes et la satisfaction alimentaire tous les 3 mois.

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Résultats : Les régimes alimentaires à IGÉ, à IGF et à FTG contenaient respectivement 47±1%, 52±1% et 40±1% d'énergie en glucides; 30±1%, 27±1% et 40±1% d'énergie en gras et un IG de 64±0,4%, de 55±0,4% et de 59±0,4%. Beaucoup plus de patients rapportaient une augmentation de la flatulence avec les régimes à IGF qu'avec les régimes à FTG et à IGÉ après 3 mois (41%, 19%, 14%; p<0,05), mais non après 12 mois (29%, 17%, 17%; ns). La distension abdominale était plus importante (46% *vs* 14%, 19%; p<0,05) et les céphalées, moins importantes (8% *vs* 22%, 23%; p<0,05) avec les régimes alimentaires à IGF qu'avec les deux autres régimes alimentaires. L'augmentation de l'appétit était plus importante avec les régimes à FTG (33%) qu'avec les régimes alimentaires à IGÉ (14%, p<0,05). Les douleurs aux articulations et aux membres étaient moins importantes avec les régimes alimentaires à IGF (16%) qu'avec les régimes alimentaires à IGÉ (28%). Les régimes alimentaires à FTG suscitaient plus d'idées pessimistes importantes (23%) que les régimes alimentaires à IGF (4%; p<0,05), mais une plus grande satisfaction alimentaire (70%; p<0,05) que les régimes alimentaires à IGF (40%) et à IGÉ (48%). Dans tous les régimes alimentaires, les concentrations d'hémoglobine glyquée (A1c) augmentaient moins chez ceux qui prenaient moins de poids, avaient une augmentation moindre de l'appétit et étaient plus satisfaits du plaisir obtenu par l'alimentation. *Conclusions :* Chaque régime alimentaire provoquait 1 ou plusieurs symptômes de plus grande importance que les autres régimes. Bien que les régimes alimentaires contenant 40% de glucides aient apporté une plus grande satisfaction alimentaire globale que les régimes alimentaires contenant 50% de glucides, le régime alimentaire à IGF n'était pas moins satisfaisant que le régime à IGÉ. Les modifications de l'appétit et de la satisfaction alimentaire peuvent influencer le poids corporel et la régulation de la glycémie, ou vice-versa.

Introduction

There is controversy about the optimum source and amount of dietary carbohydrate for persons with type 2 diabetes. It has traditionally been considered that low-fat/high-carbohydrate diets may help maintain body weight (1) and insulin sensitivity (2) but may increase risk for cardiovascular disease (CVD) by increasing blood glucose, insulin and triglyceride levels and by reducing high-density lipoprotein (HDL)-cholesterol levels (3). However, more recent evidence suggests that diets containing higher amounts of fat (4) may be beneficial in persons with type 2 diabetes, although replacing carbohydrate with protein may not be beneficial (5,6). Thus, the American Diabetes Association currently recommends that the mix of carbohydrate, fat and protein may be adjusted to meet the metabolic goals and personal preferences of people with diabetes. The role of the glycemic index (GI), a classification of the glycemic impact of high-carbohydrate foods, has been (7,8) and continues to be controversial (9,10). Although more and more evidence is accumulating about the effects of altering the source and amount of carbohydrate on anthropometric and metabolic endpoints, recent meta-analyses indicate that no studies report data concerning how diet influences quality of life (QOL) in persons with diabetes (11,12). This is important because the efficacy of a treatment is determined not only by how effective the treatment is in producing the desired effect, but also by how well the individuals being treated comply with the treatment. If a diet causes unacceptable symptoms or is inconvenient or not enjoyable, compliance may be reduced and, hence, the desired outcomes may not be achieved. However, little is known about acceptability of altering the type and amount of dietary carbohydrate in people with type 2 diabetes. Therefore, we determined the long-term effects of changing amounts or sources of carbohydrate on QOL, symptoms and dietary satisfaction in those with type 2 diabetes and examined whether changes in symptoms and dietary satisfaction were related to compliance and to overall glycemic control.

Methods

The data reported here are from a substudy of the Canadian Trial of Carbohydrates in Diabetes (CCD), whose primary aim was to determine the effects of altering the sources or amounts of dietary carbohydrate on glycemic control in persons with type 2 diabetes, as previously reported (13). The procedures followed were in accordance with the ethical standards of each institution involved, and approval was obtained from the relevant ethics review committee on human subjects.

Men and nonpregnant women with type 2 diabetes (fasting plasma glucose ≥7.0 mmol/L or 2-hour plasma glucose after 75 g oral glucose tolerance test ≥11.1 mmol/L), whose diabetes was managed by diet alone, were recruited. Subjects were 35 to 75 years of age, had glycated hemoglobin (A1C) levels ≤130% upper limit of normal and body mass indexes (BMIs) 24 to 40 kg/m^2 and were otherwise healthy. Details of inclusion and exclusion criteria and the rationale for the sample size are reported elsewhere (11).

After determining their eligibility, subjects were instructed by a registered dietitian in how to record a 3-day food record. The dietitian provided advice about how to achieve a diet containing ~55% of energy as carbohydrate,~15% protein and ~30% fat with ≤10% saturated fat (SFA), ≤10% polyunsaturated fat and the remainder as monounsaturated fatty acids (MUFAs). After 2 weeks, subjects were randomly assigned, as previously described, to receive 1 of the following diets for 1 year: 1) high-carbohydrate/high-glycemic index (high-GI); 2) high-carbohydrate/low-GI (low-GI) or 3) low-carbohydrate/high MUFA (low-carbohydrate). Cards indicating treatment assignments were sealed in sequentially numbered opaque envelopes kept by a person not involved with the study and assigned to subjects in order on the day they attended for the baseline visit.

The dietary intervention was provided by instructing subjects to consume an individually prescribed amount of key foods each day, chosen from a list of 16 to 21 key foods per diet and provided free of charge. Use of key foods was recorded in a daily diary. A dietitian advised the subjects how to incorporate the key foods into their diets to avoid weight gain. The high-GI and low-GI diet key foods were starchy foods whose GIs we had determined, and they were prescribed such that their carbohydrates provided 20% to 25% of energy. The low-carbohydrate diet key foods consisted of oils, spreads, nuts and other foods low in SFA and high in MUFAs and have been reported to reduce diabetes and cardiovascular disease risk and/or to reduce blood lipids. They were prescribed to replace the carbohydrate normally consumed so as to increase total fat intake by ~10%. The amounts and types of key foods consumed are given in Supplementary Table A1. Compliance with the dietary intervention was calculated as the average number of servings of key foods consumed per day (as recorded in the daily diary) as expressed as a percentage of the number prescribed.