Teaching Subjects With Type 2 Diabetes How to Incorporate Sugar Choices Into Their Daily Meal Plan Promotes Dietary Compliance and Does Not Deteriorate Metabolic Profile

JULIE NADEAU, MSC, RD
KRISTINE G. KOSKI, PHD, RD
IRENE STRYCHAR, EDD, RD
JEAN-FRANÇOIS YALE, MD

OBJECTIVE — To determine whether teaching free-living subjects with type 2 diabetes how to incorporate added sugars or sweets into their daily meal plan results in a greater consumption of calories (fat or sugar) and deteriorates their glycemic or lipid profiles but improves their perceived quality of life.

RESEARCH DESIGN AND METHODS — In an 8-month randomized controlled trial, 48 free-living subjects with type 2 diabetes were taught either a conventional (C) meal plan (no concentrated sweets) or one permitting as much as 10% of total energy as added sugars or sweets (S). Mean individual nutrient intake was determined using the average of six 24-h telephone recalls per 4 months. Metabolic control and quality of life were evaluated every 2 months. Quality of life was assessed using the Medical Outcome Survey and the Diabetes Quality of Life questionnaire.

RESULTS — The S group did not consume more calories (fat or sugar) and in fact ate significantly less carbohydrate (−15 vs. 10 g) and less starch (−7 vs. 8 g) and had a tendency to eat fewer calories (−77 vs. 81 kcal) than the C group. Weight remained stable, and there was no evidence that consuming more sugar worsened metabolic profile or improved their perceived quality of life.

CONCLUSIONS — Giving individuals with type 2 diabetes the freedom to include sugar in their daily meal plan had no negative impact on dietary habits or metabolic control. Health professionals can be reassured and encouraged to teach the new "sugar guidelines," because doing so may result in a more conscientious carbohydrate consumption.

Diabetes Care 24:222–227, 2001

Historically, the inclusion of sucrose in the diabetic subject's diet has been avoided for fear of hyperglycemia and hyperlipidemia. However, current scientific literature suggests that consuming a moderate amount of dietary sucrose—within a balanced meal—has an effect similar to starch on the glycemic level of patients with type 1 or type 2 diabetes (1). These studies were conducted in controlled environments where as much as 38% of calories were given as sucrose either alone or in mixed meals (2–8). In contrast, Coulston et al. (5,6) found that diets containing 10 and 16% of total energy as sucrose resulted in a rise in fasting plasma glucose (FPG), total cholesterol (TC), triglycerides (TGs), and a reduction in HDL cholesterol. In spite of these metabolic concerns, the most recent recommendations from the Canadian Diabetes Association (CDA) (9) have been revised to "permit," for the first time, a moderate amount (up to 10% of total calories) of added sugars or sweets in the meal plan of diabetic people. This new food group is referred to as the "sugar" choices (Table 1) (11). The guidelines state that these foods should be part of a healthy diet, should be substituted for other carbohydrate (CHO) choices, should be spread out throughout the day as part of slowly digested meals (i.e., meals containing starch, protein, fats, and oils), and serum TG levels should be within normal range (9).

Despite the strong evidence that sucrose does not alter glycemic control, health professionals often fear that teaching free-living patients the new sugar guidelines will result in a deterioration of eating habits and metabolic profile if the guidelines are misinterpreted and/or misapplied. For example, a patient may choose to eat a slice of chocolate cake for dessert but may forget to account for the extra CHO and fat in this food choice, which could potentially affect his or her metabolic control in the long run. In fact, no study to date has evaluated the long-term impact of teaching these new guidelines to free-living patients. The purpose of this study was to determine the consequences on dietary habits, metabolic control, and perceived quality of life of teaching free-living subjects with type 2 diabetes how to use and integrate these new "sugar guidelines." The hypothesis was that subjects who were

From the McGill Nutrition and Food Science Centre (K.G.K., J.-F.Y.) and the School of Dietetics and Human Nutrition (J.N., K.G.K., J.-F.Y.), McGill University; and Centre Hospitalier de l'Université de Montréal (I.S.), Notre-Dame Hospital, University of Montreal, Montreal, Quebec, Canada.

Address correspondence and reprint requests to Jean-François Yale, MD, McGill Nutrition and Food Science Centre, Royal Victoria Hospital, 687 Pine Ave. West, Montreal, PQ, Canada H3A 1A1. E-mail: yale@rvhmed.lan.mcgill.ca.

Received for publication 16 February 2000 and accepted in revised form 20 October 2000.

Abbreviations: BMR_{calc}, calculated basal metabolic rate; C, conventional; CDA, Canadian Diabetes Association; CHO, carbohydrate; DQOL, Diabetes Quality of Life; EI, energy intake; FPG, fasting plasma glucose; MOS, Medical Outcome Survey; S, sugar; TC, total cholesterol; TG, triglyceride.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

Table 1—*Comparison between the CDA's food choice system and the American Diabetes Association's exchange system*

ADA's exchange system (10)		CDA's food choice system (9)	
Food exchanges	Grams of CHO	Food choices	Grams of CHO
Bread/starch	15	Starch foods	15
Fruits	15	Fruits and vegetables	10
Vegetables	5	—	—
Milk	12	Milk	6
Other CHO	15	Sugar	10
Meat and meat substitutes	0	Protein foods	0
Fat	0	Fats and oils	0
Extras	—	Extras	2.5

ADA, American Diabetes Association.

taught how to incorporate the CDA sugar choices would forget to take into account the extra CHO and fat found in these foods and consequently gain weight and/or deteriorate their metabolic control while improving their perceived quality of life.

RESEARCH DESIGN AND METHODS

Design

This 8-month randomized controlled trial consisted of a nutrition education program. During the first 4 months, all subjects were taught, by a dietitian, a conventional meal plan to meet the goals of medical nutrition therapy and advised to avoid concentrated sweets. At the 4-month visit, with use of sealed envelopes to determine treatment group, subjects were randomized to either the conventional (C) group, where they continued the same conventional meal plan, or the sugar (S) group, where they were taught how to use and incorporate the sugar choices from the CDA's *Good Health Eating Guide Resource* (11). A CDA sugar choice contains 10 g CHO (40 kcal) and must be substituted for other CHO choices. For example, a subject could choose to have one-half cup of regular soft drink or two hard candies or two teaspoons of honey instead of a serving of fruit. Subjects were advised that they could consume up to 10% of their total daily calories as sugar choices, and they were advised to distribute them throughout the day. Subjects were also taught how to substitute food choices if they chose to eat their favorite sweets (e.g., cakes and cookies) with emphasis on hidden fats.

Subjects

Type 2 diabetic men and women, 35–75 years of age, attending the Metabolic Day Centre at the Royal Victoria Hospital were recruited if they had no specific dietary restrictions, other than for diabetes, and if they had not previously received formal training on how to incorporate the new sugar guidelines into their diets. Candidates were excluded if they had two values above the following thresholds: FPG >13.2 mmol/l, HbA_{1c} >9.2%, TC >6.8 mmol/l, TG >2.8 mmol/l, HDL cholesterol <0.8 mmol/l, and LDL cholesterol >4.5 mmol/l. The Royal Victoria Hospital's Ethics Committee approved the study, and all study participants signed the consent form. Follow-up visits with the endocrinologist and the dietitian were scheduled every 2 months.

Dietary outcomes

An average of six random 24-h recalls were collected per individual during the 4-month baseline period and another six after randomization; holidays were excluded (12–15). A dietitian, blinded to the study groups, conducted these 24-h recalls by telephone (16–18) using a previously validated two-dimensional food portion visual aid (19,20).

Nutrient analyses were performed using Genesis R&D software (version 5.06; ESHA Research, Salem, OR) containing more than 12,000 items and tracking 127 nutrients compiled from the latest U.S. Department of Agriculture data and more than 1,000 additional scientific sources. Since only limited data are available for the content of the individual monosaccharides (galactose, fructose, and glucose) and disaccharides (lactose, sucrose, and maltose), the true intake of sucrose could not be precisely determined in this study.

Accuracy of self-reported dietary intake was validated by comparing the ratio of the mean energy intake (EI) to the calculated basal metabolic rate (BMR_{calc}), using the World Health Organization equation (21,22), against a predetermined cutoff limit of 1.1 (23).

Metabolic outcomes

Fasting blood samples were collected at entry and every 2 months and measured by routine automated methods in the biochemistry laboratory of the Royal Victoria Hospital using DAX analyzer (Bayer, Etobicoke, Ontario, Canada) for FPG, TC, TG, and HDL cholesterol and the Cobas Miras (Roche, Laval, Quebec, Canada) for HbA_{1c}. LDL cholesterol was calculated as follows: TC – (HDL cholesterol + TG/2.2). Body weights were recorded at every visit and reported as the BMI (kg/m^2). Patients were provided with a memory-equipped glucose meter (Precision QID; MediSense) and sufficient test strips to measure their home blood glucose levels according to a predetermined schedule: 1 day per week—before meals and at bedtime; and 1 day per month—fasting and 1-h postprandial meals and bedtime.

Psychosocial outcomes

To determine the subjects' perceived quality of life, the Medical Outcome Survey (MOS) (24) and the Diabetes Quality of Life (DQOL) measure (25) were completed at entry, at randomization, and at the end of the study. The MOS is a general health measure that consists of 20 questions to evaluate six health concepts: health perceptions, pain, physical functioning, role functioning, social functioning, and mental health. The DQOL is a diabetes-specific measure that consists of 46 questions grouped into four subscales: satisfaction with diabetes and its treatment, impact of having diabetes, social/vocational worries, and diabetes-related worries. Six scores in the MOS (questions 1, 12b, and 12c of the health perceptions scale, question 2 of the pain scale, and questions 8 and 10 of the mental health scale) and all scores in the DQOL were reversed to have high scores represent the highest quality of life. An average score for each subscale was obtained by summing the responses for each item and dividing by the sum of the highest possible score for each item answered. For all measures, the scores were transformed linearly to a scale ranging from 0 to 100, with 100 representing the highest quality of life (26). Three subjects failed to return one of three questionnaires; therefore, they were excluded from these analyses.

Table 2—*Clinical characteristics of patients at entry*

	Conventional	Sugar
Patients (*n*)	23	25
Males (*n*)	16	16
Age (years)	56 ± 10	58 ± 7
Education (years)	14 ± 3	14 ± 3
Duration of diabetes (years)	8 ± 8	9 ± 5
Diabetes treatment		
Diet only (*n*)	3	3
Oral hypoglycemic agents (*n*)	10	12
Insulin (*n*)	10	7
Oral agents + insulin (*n*)	0	3
Body weight (kg)	81.6 ± 11.9	84.2 ± 18.8
BMI (kg/m^2)	30 ± 5	31 ± 7
Fasting plasma glucose (mmol/l)	10.6 ± 4.8	8.8 ± 2.7
HbA_{1c} (%)	8.5 ± 1.9	7.9 ± 2.0
TC (mmol/l)	5.38 ± 1.19	4.99 ± 1.03
LDL cholesterol (mmol/l)	3.41 ± 1.07	2.95 ± 0.79
HDL cholesterol (mmol/l)	1.07 ± 0.25	1.17 ± 0.30
TGs (mmol/l)	2.32 ± 2.02	1.81 ± 0.95
Complications		
Microvascular (*n*)	7	8
Coronary artery disease (*n*)	4	9
Hypertension (*n*)	10	12

Data are means ± SD, unless otherwise stated. With use of an unpaired *t* test, the results were not significantly different between the conventional group and the sugar group.

Statistical analyses

Data are presented as means ± SD. The unpaired *t* test was used to compare the C and S groups at baseline and at the end of study and to compare changes between the groups. Cronbach's α was calculated to determine the internal consistency reliability of the MOS and the DQOL with this sample. Statistical analyses were performed using SPSS version 6.1, with $P < 0.05$ considered statistically significant.

RESULTS — Of 150 patients screened, 69 met inclusion criteria, 59 were recruited on site, and 48 (32 men and 16 women) completed the 8-month study. The greatest dropout was seen during the first 3–4 weeks after entry into the study, and there were no dropouts after randomization. Ten subjects withdrew because of other commitments or personal stress (not related to the study), and one subject was excluded during the first month because of surgical complications and extended hospitalization. Our subjects were obese (mean BMI 30 ± 6 kg/m^2), had suboptimal glycemic control (mean HbA_{1c} 8.2 ± 2.0%), and had an optimal lipid profile (Table 2). There were no significant differences between the two groups at entry, except for a nonsignificant trend for more patients with coronary artery disease in the S group. Pharmacotherapy did not change throughout the study.

Accuracy of dietary reporting

Based on the EI-to-BMR_{calc} ratio <1.1, only 22% of C group subjects or 24% of S group subjects underreported food intake. This incidence was lower than that reported by others (35–71%) who evaluated free-living obese subjects using similar cutoff values (27,28). There were no significant differences in dietary reporting between the C and S groups at baseline or after randomization.

Baseline

The mean nutrient intake at baseline was similar between the C and S groups (Table 3). Although subjects in both treatment groups were advised to avoid concentrated sweets during this period, they consumed an average of three sugar choices per day. The mean intake for total sugars (monosaccharides and disaccharides) was 84 and 80 g/day, respectively (Table 3). At 4 months (before randomization), the C and S groups had similar metabolic profiles except for

Table 3—*Mean nutrient intake and magnitude of change from baseline to end of study*

	Baseline (0–4 months*)		End (4–8 months*)		Changes (from baseline to end of study)		
	Conventional	Sugar	Conventional	Sugar	Conventional	Sugar	*P*
Calories (kcal)	1,878 ± 604	1,971 ± 722	1,960 ± 708	1,894 ± 565	81 ± 282	−77 ± 304	0.067
CHO (g)	243 ± 72	246 ± 80	253 ± 91	231 ± 68	10 ± 45	−15 ± 29	0.027
CHO (%)	51 ± 6	50 ± 6	51 ± 7	48 ± 6	−0.3 ± 5	−2 ± 5	NS
Starch (g)	115 ± 45	123 ± 38	123 ± 53	116 ± 34	8 ± 27	−7 ± 21	0.037
Total fiber (g)	22 ± 8	22 ± 8	22 ± 10	22 ± 8	−0.3 ± 7	−1 ± 5	NS
Total sugars (g)	84 ± 41	80 ± 41	86 ± 48	74 ± 33	2 ± 18	−6 ± 21	NS
Fat (g)	69 ± 34	72 ± 33	72 ± 37	72 ± 25	2 ± 15	0.1 ± 19	NS
Fat (%)	31 ± 7	31 ± 6	31 ± 8	33 ± 5	−0.3 ± 5	2 ± 4	NS
Saturated fat (g)	21 ± 10	23 ± 13	23 ± 12	23 ± 10	2 ± 6	−1 ± 8	NS
Protein (g)	80 ± 21	87 ± 31	84 ± 24	85 ± 22	4 ± 16	−2 ± 18	NS
Protein (%)	17 ± 3	18 ± 3	18 ± 3	18 ± 2	0.2 ± 2	0.1 ± 3	NS

Data are means ± SD unless otherwise stated. The *P* value was calculated using an unpaired Student's *t* test to compare changes from baseline to end of study for subjects in the conventional group ($n = 23$) with subjects in the sugar group ($n = 25$). *Dietary intake of each subject was based on the mean of six food recalls collected during the 4-month baseline period and another six collected from 4 to 8 months.

Table 4—*Mean metabolic profile and magnitude of change from baseline to end of study*

	Baseline (time = 4 months)		End of study (Time = 8 months)		Changes (from baseline to end of study)		
	Conventional	Sugar	Conventional	Sugar	Conventional	Sugar	*P*
Weight (kg)	82.2 ± 11.8	83.7 ± 18.1	81.8 ± 13.2	84.3 ± 18.5	−0.2 ± 2.1	0.6 ± 2.6	NS
BMI (kg/m^2)	30 ± 5	30 ± 6	30 ± 5	31 ± 6	−0.1 ± 0.7	0.2 ± 1.0	NS
FPG (mmol/l)	9.7 ± 2.8[a]	7.8 ± 1.8[b]	8.4 ± 3.4	8.0 ± 2.4	−1.3 ± 2.0	0.4 ± 2.2	0.013
HbA_{1c} (%)	8.1 ± 1.7	7.4 ± 2.2	7.7 ± 1.5	7.2 ± 1.2	−0.4 ± 0.7	−0.2 ± 2.1	NS
TC (mmol/l)	5.30 ± 1.15	5.03 ± 1.05	4.93 ± 1.02	5.10 ± 1.10	−0.31 ± 0.58	0.07 ± 0.30	0.006
TGs (mmol/l)	1.94 ± 0.80	2.00 ± 0.90	1.71 ± 0.92	2.01 ± 0.86	−0.19 ± 0.59	0.01 ± 0.61	NS
HDL cholesterol (mmol/l)	1.11 ± 0.28	1.22 ± 0.36	1.19 ± 0.30	1.32 ± 0.42	0.09 ± 0.14	0.11 ± 0.21	NS
LDL cholesterol (mmol/l)	3.31 ± 1.05	2.90 ± 0.80	2.91 ± 0.90	2.76 ± 0.81*	−0.36 ± 0.45	−0.03 ± 0.36*	0.008
TC/HDL cholesterol ratio	4.95 ± 1.27	4.43 ± 1.42	4.28 ± 1.06	4.23 ± 1.64	−0.65 ± 0.62	−0.20 ± 0.63	0.016

Data are means ± SD, unless otherwise stated. The *P* value was calculated using an unpaired Student's *t* test to compare changes from baseline to end of study for conventional group (n = 23) and sugar group (n = 25). [a,b]Significant at $P < 0.05$ using an unpaired Student's *t* test between C and S at baseline. *Mean LDL cholesterol based on n = 23 subjects, as TG levels prevented the use of the Friedewald equation in these two subjects.

FPG (Table 4), and perceived quality of life was similar between the C and S groups.

End of study

Dietary outcomes. Using Genesis R&D (version 5.06), which can, with use of the choice system, subdivide the total sugars into those CHOs coming from breads, milks, and fruits, we found no difference in any of these food groups from baseline to end of study in both groups. The mean nutrient intake between the groups was not significantly different; however, the dietary changes from baseline to the end of study were significantly different for CHO and starch (Table 3). Subjects who were taught how to incorporate the CDA sugar choices reduced total CHO intake by 15 g and starch intake by 7 g, whereas the C group increased by 10 and 8 g, respectively (Table 3).

Metabolic outcomes. At the end of study, there were no significant differences between the C and S groups in their metabolic profiles (Table 4). To further evaluate whether increasing sugar intake worsened subjects' metabolic control, nutrient intake data were reclassified, independent of their initial classification (C or S), according to whether subjects had increased or decreased sugar intake (Table 5). Whether they increased or decreased their total sugar intake (−59 to 52 g total sugars/day), subjects still managed to improve FPG, HbA_{1c}, TC, TG, HDL cholesterol, LDL cholesterol, and TC/HDL cholesterol ratio.

The metabolic changes from baseline to end of study showed that both groups showed improved LDL cholesterol and TC/HDL cholesterol ratio; however, the C group showed a greater improvement in LDL cholesterol (−0.36 [range −1.57 to 0.38] vs. −0.03 [–0.75 to 0.59] mmol/l, P = 0.008) and TC/HDL cholesterol ratio (−0.65 vs. −0.20 mmol/l, P = 0.016). TC was reduced by 0.31 mmol/l, while it increased by 0.07 mmol/l in the C and S groups, respectively (Table 4). However, these differences could not be attributed to sugar intake (Table 5). Long-term glycemic control, assessed by the HbA_{1c}, did not deteriorate with either group, despite a reduction of −1.3 mmol/l in FPG in the C group and an increase of 0.4 mmol/l in the S group (Table 4). Weight and BMI were not statistically different between the C and S groups.

Psychosocial outcomes. The MOS and DQOL questionnaires administered at entry were used to determine internal consistency reliability as measured by Cronbach's α. For subscales with more than one item, Cronbach's α ranged from 0.77 to 0.87 for the MOS and from 0.67 to 0.95 for the DQOL. Cronbach's α is considered acceptable when it is ≥0.50 (29). The total for the DQOL questionnaire also revealed a high internal consistency reliability with a Cronbach's α of 0.88, which is similar to those reported by others (26,30,31). The instructional sessions, which aimed to liberalize the intake of sugar-containing foods, had no significant impact on subjects' perceived quality of life. Changes in quality of life scores, from baseline to end of study, were <3% and were not statistically different between treatment groups. The mean quality of life scores, for both study groups, ranged from 55.2 to 91.7% for the MOS and from 78.5 to 85.7% for the DQOL. Scores for "health perception" were the lowest (61.6 vs. 55.2% [C vs. S, respec-

Table 5—*Mean change in metabolic profile according to sugar intake*

	Changes from baseline to end (4–8 months)	
	Increase in total sugar (≥1 g)	Decrease in total sugar (≤−1 g)
n	26	22
Mean change in total sugar intake (g)	11 ± 10	−17 ± 18
Weight (kg)	0.1 ± 2.4	0.3 ± 2.3
BMI (kg/m^2)	0.1 ± 0.9	0.1 ± 0.8
FPG (mmol/l)	−0.42 ± 2.3	−0.49 ± 2.2
HbA_{1c} (%)	−0.3 ± 0.1	−0.3 ± 0.2
TC (mmol/l)	−0.06 ± 0.48	−0.17 ± 0.50
TGs (mmol/l)	−0.08 ± 0.51	−0.09 ± 0.71
HDL cholesterol (mmol/l)	0.12 ± 0.19	−0.07 ± 0.15
LDL cholesterol (mmol/l)	−0.17 ± 0.38	−0.21 ± 0.51
TC/HDL cholesterol ratio	−0.44 ± 0.56	−0.38 ± 0.77

Data are means ± SD, unless otherwise stated. Using an unpaired *t* test, the results were not significantly different ($P < 0.05$) between subjects who increased and those who decreased total sugar intake.

tively]), therefore indicating that having diabetes was perceived as having an illness. Scores for "social functioning" were the highest (91.7 vs. 89.3% [C vs. S, respectively]), thus indicating that diabetes had only a limited impact on one's social functioning. In the DQOL, scores for "satisfaction" were the lowest (77.6 vs. 77.2% [C vs. S, respectively]), indicating that subjects were moderately satisfied with their diabetes treatment, and were the highest (85.4 vs. 85.7% [C vs. S, respectively]) for "social/vocational worries."

CONCLUSIONS — This study reports the nutritional, metabolic, and psychosocial consequences of teaching free-living individuals with type 2 diabetes how to incorporate sugar choices into their daily meal plan. Our educational intervention to permit 10% of total calories from added sugars or sweets did not result in an increased consumption of calories (fat or total sugars). In fact, the educational intervention resulted in subjects in the S group consuming less CHO (25 g, or the equivalent of 1.5 slices of bread) in the form of starch in comparison with the C group. Furthermore, despite being advised to avoid concentrated sweets during the baseline period, our subjects were eating only slightly less sugar (86 vs. 74 g as total sugars [C vs. S group, respectively]) than a nondiabetic population, which is estimated at 95 g per day (32). This study showed that all diabetic subjects were eating sugar at baseline and that the educational intervention resulted in greater awareness of the CHO content of foods, because the S group, not the C group, reduced their intake of CDA sugar choices by one serving.

Giving our subjects the freedom to eat added sugars and sweets did not result in any metabolic deterioration. Reclassifying our subjects into two groups—those who increased their total sugar intake compared with those who decreased it—further substantiated this result. Our results are consistent with other studies. Bantle et al. (3) found that the metabolic profile of their 12 subjects did not change significantly after consuming a diet containing 19% of calories as sucrose for 28 days. Abraira and Derler (2) found similar results with 18 hospitalized subjects who were fed a diet containing 38% of calories as sucrose for 4 weeks. The only study to evaluate the effect of dietary sucrose on free-living diabetic subjects demonstrated that a calculated menu (45 g sucrose compared with a diet consisting mainly of complex CHOs) prepared at home resulted in an increase in sucrose intake (from 10 to 18% of calories) without altering energy, protein, or fat intake (33). No deterioration was noted on the metabolic profile of these free-living individuals after a 6-week intervention period (33).

We had hypothesized that "permitting" added sugars and sweets to people with type 2 diabetes would improve their perceived quality of life by acknowledging the human desire for sweet tastes and minimizing the sense of deprivation and misplaced guilt of "cheating" (9). The results in this study, however, did not indicate any significant impact on our subjects' perceived quality of life. One could argue that the negligible change in quality of life may be attributable to the fact that our subjects were given the freedom to incorporate—or not to incorporate—the new "sugar guidelines," but in fact they chose to maintain a similar intake of sugar comparable to that of a nondiabetic population (32). This may be because of previous antisugar indoctrination and/or guilt. Peterson et al. (33) also found that subjects with long-standing diabetes initially had some difficulty adding sucrose to their diet, despite enjoying the freedom of eating a modest amount of sucrose (45 g/day). The lack of significant differences cannot be explained by the internal consistency reliability of the questionnaires used, since the reliability of the DQOL and the MOS was shown to be acceptable and comparable to other studies (26,30).

We conclude that giving type 2 diabetic individuals the freedom to include added sugars and sweets into their daily meal plan had no negative impact on their dietary habits and metabolic control. Therefore, dietitians and health care providers should be encouraged to teach their patients how to incorporate the new "sugar guidelines," since doing so may increase patient awareness and understanding of the food exchange system and consequently result in a better adherence to a healthy meal plan with more careful CHO intake.

References

1. Franz MJ, Horton ES, Bantle JP, Beebe CA, Brunzell JD, Coulston AM, Henry RR, Hoogwerf BJ, Stacpoole PW: Nutrition principles for the management of diabetes and related complications. *Diabetes Care* 17:490–518, 1994
2. Abraira C, Derler J: Large variations of sucrose in constant carbohydrate diets in type II diabetes. *Am J Med* 84:193–200, 1988
3. Bantle JP, Swanson JE, Thomas J, Laine DC: Metabolic effects of dietary sucrose in type II diabetic subjects. *Diabetes Care* 16:1301–1305, 1993
4. Bantle JP, Laine DC, Thomas J: Metabolic effects of dietary fructose and sucrose in type I and II diabetic subjects. *JAMA* 256: 3241–3246, 1986
5. Coulston AM, Hollenbeck CB, Donner CC, Williams R, Chiou Y-AM, Reaven GM: Metabolic effects of added dietary sucrose in individuals with non-insulin-dependent diabetes mellitus (NIDDM). *Metabolism* 34: 962–966, 1985
6. Coulston AM, Hollenbeck CB, Swislocki ALM, Chen Y-DI, Reaven GM: Deleterious metabolic effects of high carbohydrate, sucrose containing diets in patients with non-insulin-dependent diabetes mellitus. *Am J Med* 82:213–220, 1987
7. Emanuele MA, Abraira C, Jellish WS, De Bartolo M: A crossover trial of high and low sucrose-carbohydrate diets in type II diabetics with hypertriglyceridemia. *J Am Coll Nutr* 5:429–437, 1986
8. Jellish WS, Emanuele MA, Abraira C: Graded sucrose/carbohydrate diets in overtly hypertriglyceridemic diabetic patients. *Am J Med* 77:1015–1022, 1984
9. Canadian Diabetes Association: Guidelines for the nutritional management of diabetes mellitus in the new millennium. *CJDC* 23: 56–59, 1999
10. American Diabetes Association: Nutrition recommendations and principles for people with diabetes mellitus (Position Statement). *Diabetes Care* 23 (Suppl. 1):S43–S46, 2000
11. Canadian Diabetes Association: *Good Health Eating Guide Resource*. Toronto, Ontario, Canada, Canadian Diabetes Association, 1994
12. Nelson M, Black AE, Morris JA, Cole TJ: Between- and within-subject variation in nutrient intake from infancy to old age: estimating the number of days required to rank dietary intakes with desired precision. *Am J Clin Nutr* 50:155–167, 1989
13. Basiotis PP, Welsh SO, Cronin FJ, Kelsay JL, Mertz W: Number of days of food intake records required to estimate individual and group nutrient intakes with defined confidence. *J Nutr* 117:1638–1641, 1987
14. Bingham SA: The dietary assessment of individuals: methods, accuracy, new techniques and recommendations. *Nutr Abstr Rev* 51:705–742, 1987
15. Karkeck JM: Improving the use of dietary survey methodology. *J Am Diet Assoc* 87: 869–871, 1987
16. Posner BM, Borman CL, Morgan JL, Borden WS, Ohls JC: The validity of a telephone-administered 24-hour dietary recall methodology. *Am J Clin Nutrition* 36:546–553, 1982
17. Mullenbach V, Kushi LH, Jacobson C, Gomez-Marin O, Prineas RJ, Roth-Yousey

L, Sinaiko AR: Comparison of a 3-day food record and 24-hour recall by telephone for dietary evaluation in adolescents. *J Am Diet Assoc* 92:743–745, 1992
18. Dubois S: Accuracy of telephone dietary recalls in elderly subjects. *J Am Diet Assoc* 90:1680–1687, 1990
19. Posner BM, Smigelski C, Duggal A, Morgan JL, Cobb J, Cupples A: Validation of two-dimensional models for estimation of portion size in nutrition research. *J Am Diet Assoc* 92:738–741, 1992
20. Buzzard MI, Faucett CL, Jeffery RW, McBane L, McGovern P, Baxter JS, Shapiro AC, Blackburn GL, Chlebowski RT, Elashoff RM, Wynder EL: Monitoring dietary change in a low-fat diet intervention study: advantages of using 24-hour dietary recalls vs. food records. *J Am Diet Assoc* 96:574–579, 1996
21. Garrel DR, Jobin N, De Jonge LHM: Should we still use the Harris Benedict equations? *NCP* 11:99–103, 1996
22. FAO/WHO/UNU: *Report of a Joint Expert Consultation: Energy and Protein Requirements*. Geneva, World Health Org., 1985 (Tech. Rep. Ser., no. 724)
23. Goldberg GR, Black AE, Jebb SA, Cole TJ, Murgatroyd PR, Coward WA, Prentice AM: Critical evaluation of energy intake data using fundamental principles of energy physiology. I. Derivation of cut-off limits to identify under-recording. *Eur J Clin Nutr* 45:569–581, 1991
24. Stewart AL, Hays RD, Ware JE: The MOS short-form general health survey: reliability and validity in patient population. *Med Care* 26:724–735, 1988
25. DCCT Research Group: Reliability and validity of a diabetes quality of life measure for the Diabetes Control and Complications Trial (DCCT). *Diabetes Care* 11:725–732, 1988
26. Jacobson AM, De Groot M, Samson JA: The evaluation of two measures of quality of life in patients with type I and type II diabetes. *Diabetes Care* 17:267–274, 1994
27. Lafay I, Basdevant A, Charles M-A, Vray M, Balkau B, Borys J-M, Eschwège E, Romon M: Determinants and nature of dietary underreporting in a free-living population: the Fleurbaix Laventile Ville Santé (FLVS) study. *Int J Obes* 21:567–573, 1997
28. Ballard-Barbash R, Graubard I, Krebs-Smith SM, Schatzkin A, Thompson FE: Contribution of dieting to the inverse association between energy intake and body mass index. *Eur J Clin Nutr* 50:98–106, 1996
29. Stewart AL, Hays RD, Ware JE: The MOS Short-Form General Health Survey: reliability and validity in patient population. *Med Care* 26:724–735, 1988
30. Glasgow RE, Ruggiero L, Eakin EG, Dryfoos J, Chobanian L: Quality of life and associated characteristics in a large national sample of adults with diabetes. *Diabetes Care* 20:562–567, 1997
31. Stewart AL, Greenfield S, Hays RD, Wells K, Rogers WH, Berry SD, McGlynn EA, Ware JE Jr: Functional status and well-being of patients with chronic conditions: results from the medical outcomes study. *JAMA* 262:907–913, 1989
32. Glinssmann WH, Irausquin H, Youngmee KP: Evaluation of health aspects of sugars contained in carbohydrate sweeteners. *J Nutr* 116 (Suppl. 11):S1–S216, 1986
33. Peterson DB, Lambert J, Gerring S, Darling P, Carter RD, Jelfs R, Mann JI: Sucrose in the diet of diabetic patients: just another carbohydrate? *Diabetologia* 29:216–220, 1986