Comparison of Diets of Diabetic and Nondiabetic Women

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OBJECTIVE — To assess the dietary habits of diabetic women.

RESEARCH DESIGN AND METHODS — Participants in the Nurses Health Study, a cohort of 121,700 registered female nurses, were followed since 1976. We compared the usual dietary intakes of women who had been diagnosed with diabetes mellitus by 1980 and age-matched nondiabetic control women; diets of these women were assessed in 1980 and 1984 by a semiquantitative food frequency questionnaire. The study examined 162 IDDM women and 738 NIDDM women. Similar comparisons were made for 429 women who developed NIDDM between 1980 and 1984.

RESULTS — Although differences were small, women with IDDM in 1984 and women with NIDDM in 1980 and 1984 consumed less energy from carbohydrates, especially from sucrose, and more energy from protein and fat than did control women. Similar results were also found in 1984 for the 429 women who developed NIDDM between 1980 and 1984. In 1980, energy from nonsucrose carbohydrate was slightly higher in both IDDM and NIDDM women than in the control women. However, in 1984, using a dietary questionnaire designed to assess more complete dietary intake, less consistent results were obtained. Diabetic women tended to avoid desserts and sweets, sugar-containing beverages, and alcoholic beverages but consumed more meat and meat products. Intakes of foods high in complex carbohydrates (e.g., bread, rice, pasta, and potatoes) were similar between diabetic and control women.

CONCLUSIONS — The results suggest that these diabetic women did not consume the high-carbohydrate, low-fat diets that the American Diabetes Association has been recommending over the past decade.

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CHD, coronary heart disease; CHO, carbohydrate; ADA, American Diabetes Association; IDDM, insulin-dependent diabetes mellitus; NIDDM, non-insulin-dependent diabetes mellitus; FPG, fasting plasma glucose; BMI, body mass index; LDL, low-density lipoprotein; HDL, high-density lipoprotein.

At the beginning of the 20th century, before insulin therapy was available, very-low-CHO diets were recommended for patients with diabetes mellitus (1–3). Because of increasing evidence that higher CHO intake does not impair glycemic control and the growing belief that higher fat intake increases the risk of CHD, the ADA has recommended since 1979 that diabetic patients increase CHO intake, especially complex CHO to 50–60% of calories and decrease fat intake to <30% (4–6). Increased intake of dietary fiber and decreased intakes of saturated fat and cholesterol were also recommended.

Little is known about what diabetic patients actually eat and whether their diets meet ADA's dietary recommendations. To address these issues, we analyzed dietary data from female participants in the Nurses Health Study (7). We compared dietary data collected in 1980 and 1984 from 1329 women who had been diagnosed with diabetes by 1984 with dietary data from 1329 randomly selected, age-matched, control women. Of the 1329 diabetic women, 429 women were diagnosed with diabetes between 1980 and 1984; thus, we could also study changes in the diet after the diagnosis of diabetes.

RESEARCH DESIGN AND METHODS

— The subjects were participants in the Nurses Health Study (7), which included a cohort of 121,700 registered female nurses 30–55 yr of age in 1976. They all completed a baseline questionnaire for height, weight, and history of major illnesses, including cancer, CHD, and diabetes mellitus. Every 2 yr they have received a follow-up questionnaire to update diagnosis of major illnesses; in 1980 and 1984 they completed self-administered, semiquantitative food frequency questionnaires (8–10). By 1984, 4232 women reported having diabetes; in 1985 these women were mailed a supplementary questionnaire to obtain detailed information on

symptoms, laboratory findings, and treatment of diabetes.

Women were identified as having IDDM if they were treated with insulin within 1 yr of diagnosis, were currently receiving insulin, and met at least one of the following criteria: hospitalization for ketoacidosis, presence of ketones in the urine on two or more occasions, body weight at diagnosis no more than 20% above ideal body weight for height, or age at diagnosis <30 yr.

Women were identified as having NIDDM if they were not classified as having IDDM and met at least one of the following five criteria: *1*) symptoms of diabetes (unusual thirst, polyuria, unintended weight loss, unusual hunger, genital pruritus, ketoacidosis, or coma) in conjunction with FPG measurements ≥140 mg/dl or random plasma glucose level ≥200 mg/dl; *2*) at least two FPG ≥140 mg/dl; *3*) at least two random plasma glucose ≥200 mg/dl; *4*) at least two abnormal oral glucose tolerance test results (FPG level ≥140 mg/dl or ≥200 mg/dl at 2 or 3 h); or *5*) any two elevations of blood glucose defined in criteria 2, 3, and 4.

Among the 4232 women, 3132 women responded to the supplementary diabetes questionnaire. From these 3132 women, we excluded 1423 as follows: 585 reported diagnosis of cancer or CHD, 1051 did not respond completely to either the 1980 or 1984 dietary questionnaire, and 213 were excluded for both reasons. Of the remaining 1709 women, 1352 women met the above criteria for IDDM or NIDDM. Among them, 162 had developed IDDM before the 1980 questionnaire and 23 did so between the 1980 and 1984 questionnaires. The latter 23 women were excluded from the analysis because they were too few to analyze separately, leaving a total of 1329 for our analysis. Among women with NIDDM, 738 women had been diagnosed by 1980, and 429 women were diagnosed between 1980 and 1984. Throughout this study, we will refer to IDDM and NIDDM women diagnosed before 1980 as pre-1980 IDDM and pre-1980 NIDDM women, respectively. The NIDDM women diagnosed between 1980 and 1984 will be referred to as post-1980 NIDDM women. An equal number of age-matched control women was selected at random for each of the diabetic women categories from the nondiabetic women in the Nurses Health Study.

Assessment of dietary intake

Dietary information was obtained by a self-administered semiquantitative food frequency questionnaire, which asked how often the individual consumed a specified amount of various foods, on average, over the preceding year. The 1980 questionnaire included 61 food items; the 1984 questionnaire expanded the list to 126 items, largely by separating foods that had been grouped together previously, but also by adding more food items. For each person, nutrient intakes were computed as follows: for each food item, the frequency of consuming specified amount of food was multiplied by its nutrient value. Nutrient values of foods were based primarily on U.S. Department of Agriculture sources (11). Separate publications were used for computing dietary fiber (12,13) and sucrose (14). The reproducibility and validity of the food frequency questionnaire have been reported previously (8–10).

For the 1980 questionnaire, if ≥10 food items were left blank or if food consumption was extremely low or high (indicating that the instructions were not followed properly), the questionnaire was excluded from the analysis. The 1984 questionnaire was excluded if responses to ≥10 foods were left blank or if energy intake was outside the range 600-3500 kcal. To estimate complex CHO intake, we calculated nonsucrose CHO by subtracting sucrose intake from total CHO intake.

In addition to absolute values of nutrient intakes, the nutrient composition of diets was calculated in two ways: nutrient densities (e.g., percentage of energy intake, g or mg/1000 kcal) and energy-adjusted nutrient values (15). To obtain energy-adjusted nutrient values, residuals from regression analyses using the nutrient value as a dependent variable and energy intake as an independent variable were calculated. Because results were similar between nutrient densities and energy-adjusted nutrient values, we present results for nutrient densities only.

Statistical analysis

Means and SDs for age, age at diagnosis of diabetes, duration of diabetes, and BMI (kg/m^2) were calculated for each of the three groups of diabetic women (pre-1980 IDDM, pre-1980 NIDDM, and post-1980 NIDDM). Means were compared using Duncan's multiple-range test. When analyzed separately for the 1980 questionnaire and the 1984 questionnaire, mean BMI and nutrient intakes of diabetic women were compared with those of nondiabetic women using Student's *t* test. For nutrients that showed a skewed distribution, $\log_e$-transformed values were used for the comparisons. Because the results from these two methods were similar, only the results from the untransformed tests are presented.

RESULTS — In 1984, IDDM women were younger and had been diabetic for a longer time than NIDDM women (Table 1). The BMI was lower in IDDM women than in NIDDM women ($P < 0.05$) but did not differ significantly from the BMI of the control group ($P < 0.05$). On the other hand, the NIDDM women were heavier than the corresponding control group ($P < 0.001$).

The 1980 nutrient intakes of women who developed diabetes before 1984 and control women were compared (pre-1980 IDDM and pre-1980 NIDDM in Table 2). Absolute intakes of sucrose and nonsucrose showed large differences between diabetic and nondiabetic women: on average diabetic women consumed 8.2–13.6 g less su-

Table 1—*Characteristics of diabetic and control women*

	Pre-1980 IDDM		Pre-1980 NIDDM		Post-1980 NIDDM	
	Diabetic women	Control women	Diabetic women	Control women	Diabetic women	Control women
n	162	162	738	738	429	429
Age in 1984 (yr)	50.8 ± 7.6[a]	50.8 ± 7.6	53.7 ± 6.4[b]	53.7 ± 6.4	53.5 ± 6.5[b]	53.5 ± 6.5
BMI in 1984 (kg/m^2)	24.3 ± 5.1[a]	25.2 ± 4.7	30.0 ± 6.1[b]	24.8 ± 4.3*	30.7 ± 6.0[b]	24.9 ± 4.8*
Age at diagnosis (yr)	31.5 ± 12.4[a]	—	42.2 ± 8.9[b]	—	51.9 ± 6.5[c]	—
Duration of diabetes (yr)	21.3 ± 10.4[a]	—	13.4 ± 6.2[b]	—	3.6 ± 1.2[c]	—

Data are means ± SD; see METHODS for explanation of groups. Values with superscripts a–c differ significantly at $P < 0.05$ among the three diabetic groups using Duncan's multiple-range test.

*$P < 0.001$ diabetic vs. control women using Student's *t* test.

crose and 6–27 g more nonsucrose CHO than nondiabetic women. Sucrose and nonsucrose CHO compositions of the diets (percentage of energy from sucrose and nonsucrose) showed similar results.

No significant differences were found in macronutrient compositions of the diets between pre-1980 IDDM women and their control women, but significant differences were found between the larger sample size of pre-1980 NIDDM women and their control women. Although differences were small, pre-1980 NIDDM women consumed diets lower in CHO and higher in protein

Table 2—*Comparison of 1980 nutrient intake between diabetic women and control women*

	Pre-1980 IDDM		Pre-1980 NIDDM		Post-1980 NIDDM	
	Diabetic women	Control women	Diabetic women	Control women	Diabetic women	Control women
n	162	162	738	738	429	429
Absolute values						
Energy (kcal)	1664 ± 473	1505 ± 463*	1615 ± 539	1576 ± 521	1624 ± 605	1566 ± 472
CHO (g)	153 ± 53	140 ± 53†	151 ± 60	152 ± 60	160 ± 73	151 ± 60
Sucrose (g)	30.1 ± 23.1	43.7 ± 31.9‡	36.4 ± 30.5	44.6 ± 28.6‡	50.3 ± 43.3	45.8 ± 34.8
Nonsucrose (g)	123 ± 41	96 ± 34‡	114 ± 42	108 ± 42*	110 ± 46	105 ± 38
Dietary fiber (g)	19.3 ± 8.8	14.9 ± 6.1‡	17.7 ± 8.0	17.1 ± 7.8	16.8 ± 8.3	16.7 ± 7.5
Protein (g)	83.2 ± 25.7	74.4 ± 28.3*	83.2 ± 29.6	74.4 ± 26.2‡	77.8 ± 30.1	74.5 ± 24.3
Total fat (g)	75.9 ± 28.4	67.2 ± 26.2*	73.2 ± 32.6	68.7 ± 30.6*	71.3 ± 34.0	68.6 ± 27.6
Saturated (g)	29.8 ± 11.7	27.6 ± 11.7	29.3 ± 13.6	27.3 ± 12.3*	28.9 ± 14.3	27.7 ± 11.4
Polyunsaturated (g)	10.7 ± 5.4	8.3 ± 3.4‡	9.5 ± 4.6	9.2 ± 4.6	9.4 ± 4.9	9.2 ± 4.7
Cholesterol (mg)	384 ± 161	329 ± 157*	381 ± 184	325 ± 148‡	343 ± 146	325 ± 140
Nutrient densities						
CHO (% kcal)	36.8 ± 8.3	37.3 ± 9.1	37.7 ± 9.5	38.8 ± 8.9†	39.4 ± 9.4	38.6 ± 9.4
Sucrose (% kcal)	7.2 ± 4.8	11.4 ± 6.9‡	8.8 ± 5.7	11.2 ± 5.6‡	11.8 ± 7.5	11.3 ± 6.5
Nonsucrose (% kcal)	29.6 ± 6.6	25.9 ± 6.3‡	28.9 ± 7.5	27.6 ± 6.9‡	27.6 ± 7.1	27.3 ± 7.1
Dietary fiber (g/1000 kcal)	11.7 ± 4.4	10.1 ± 3.4*	11.3 ± 4.6	11.1 ± 4.0	10.7 ± 4.2	11.0 ± 4.6
Protein (% kcal)	20.2 ± 3.9	19.8 ± 3.8	20.9 ± 4.2	19.1 ± 3.9‡	19.5 ± 3.8	19.2 ± 4.0
Total fat (% kcal)	40.7 ± 7.6	39.8 ± 7.2	40.1 ± 8.4	38.6 ± 8.0‡	39.1 ± 8.2	39.0 ± 8.0
Saturated (% kcal)	16.0 ± 3.6	16.2 ± 3.5	16.1 ± 3.8	15.4 ± 3.7‡	15.8 ± 3.8	15.7 ± 3.5
Polyunsaturated (% kcal)	5.7 ± 2.0	5.0 ± 1.5‡	5.3 ± 1.6	5.2 ± 1.6	5.2 ± 1.6	5.2 ± 1.7
Cholesterol (mg/1000 kcal)	234 ± 81	219 ± 78	242 ± 101	210 ± 75‡	218 ± 71	211 ± 72

Data are means ± SD; see METHODS for explanation of groups.

*$P < 0.01$ diabetic vs. control women using Student's *t* test.

†$P < 0.05$ diabetic vs. control women using Student's *t* test.

‡$P < 0.001$ diabetic vs. control women using Student's *t* test.

Table 3—*Comparison of 1984 nutrient intake between diabetic women and control women*

	Pre-1980 IDDM		Pre-1980 NIDDM		Post-1980 NIDDM	
	Diabetic women	Control women	Diabetic women	Control women	Diabetic women	Control women
n	162	162	738	738	429	429
Absolute values						
Energy (kcal)	1733 ± 524	1736 ± 505	1723 ± 531	1747 ± 542	1712 ± 525	1705 ± 518
CHO (g)	189 ± 64	204 ± 75	197 ± 71	204 ± 77	195 ± 71	200 ± 69
Sucrose (g)	29.1 ± 16.9	44.3 ± 27.1*	33.6 ± 19.8	44.0 ± 25.8*	31.2 ± 19.3	40.8 ± 21.1*
Nonsucrose (g)	160 ± 53	160 ± 55	163 ± 59	160 ± 59	164 ± 58	159 ± 54
Dietary fiber (g)	20.7 ± 8.6	18.8 ± 6.8†	20.0 ± 8.3	19.4 ± 8.2	20.4 ± 8.3	19.5 ± 8.8
Protein (g)	82.5 ± 28.9	77.4 ± 21.8	83.2 ± 27.9	76.8 ± 24.6*	84.0 ± 27.7	75.8 ± 24.9*
Total fat (g)	70.9 ± 27.0	65.4 ± 22.1†	68.2 ± 24.7	66.6 ± 23.5	67.9 ± 24.1	65.8 ± 24.3
Saturated (g)	25.4 ± 10.6	23.7 ± 8.6	24.5 ± 9.4	24.0 ± 8.9	24.5 ± 9.3	23.7 ± 9.1
Polyunsaturated (g)	13.3 ± 5.9	12.4 ± 4.6	12.6 ± 5.5	12.8 ± 5.3	12.6 ± 5.4	12.6 ± 5.5
Cholesterol (mg)	337 ± 136	305 ± 107†	340 ± 153	304 ± 123*	335 ± 132	298 ± 117*
Nutrient densities						
CHO (% kcal)	43.9 ± 8.4	46.8 ± 8.2‡	45.5 ± 8.0	46.4 ± 7.9†	45.3 ± 7.7	46.8 ± 7.9‡
Sucrose (% kcal)	6.7 ± 3.3	10.0 ± 4.7*	7.7 ± 3.4	9.9 ± 4.0*	7.1 ± 3.2	9.5 ± 3.7*
Nonsucrose (% kcal)	37.2 ± 6.7	36.8 ± 6.1	37.8 ± 6.8	36.5 ± 6.4*	38.1 ± 6.4	37.3 ± 6.5
Dietary fiber (g/1000 kcal)	12.3 ± 4.8	11.2 ± 4.1†	11.8 ± 3.7	11.2 ± 3.5‡	12.1 ± 3.5	11.7 ± 4.3
Protein (% kcal)	19.2 ± 3.9	18.3 ± 4.1†	19.5 ± 3.8	17.9 ± 3.4*	19.8 ± 3.4	18.0 ± 3.4*
Total fat (% kcal)	36.3 ± 6.2	33.8 ± 5.9*	35.6 ± 6.4	34.4 ± 5.7*	35.7 ± 5.9	34.5 ± 6.0‡
Saturated (% kcal)	13.0 ± 2.7	12.3 ± 2.6†	12.8 ± 2.8	12.4 ± 2.6‡	12.8 ± 2.6	12.4 ± 2.7†
Polyunsaturated (% kcal)	6.8 ± 2.0	6.4 ± 1.5†	6.6 ± 1.9	6.6 ± 1.7	6.6 ± 1.9	6.6 ± 1.8
Cholesterol (mg/1000 kcal)	198 ± 68	179 ± 56‡	201 ± 76	177 ± 58*	200 ± 65	178 ± 59*

Data are means ± SD; see METHODS for explanation of groups.
*$P < 0.001$ diabetic vs. control women using Student's *t* test.
†$P < 0.05$ diabetic vs. control women using Student's *t* test.
‡$P < 0.01$ diabetic vs. control women using Student's *t* test.

and total fat than their control women. Dietary compositions of saturated fat and cholesterol were also higher among pre-1980 NIDDM women than among their control women.

For the 1984 diets, similar dietary differences were found by comparing all diabetic women with their control women (Table 3). Nonsucrose CHO, however, showed inconsistent relationships. No significant difference was found in absolute intake of nonsucrose CHO between all diabetic women and their control women. In addition, the nonsucrose CHO composition of the diet was not different between pre-1980 IDDM women, post-1980 NIDDM women, and their control women.

A group of particular interest was the post-1980 NIDDM women: in 1980, these prediabetic women and their control women consumed similar diets, but in 1984 after being diagnosed with diabetes, these women began consuming diets with a low-sucrose and high-fat content relative to control women. This finding suggests that the differences in dietary intake between diabetic and nondiabetic women are a consequence of being diagnosed with diabetes and represent a behavioral change as a reaction to the diagnosis.

To study how consistently these diabetic women consumed low-sucrose, high-fat diets over 4 yr, we calculated Spearman correlation coefficients between the 1980 diets and the 1984 diets among women who had developed diabetes before 1980. For comparison, we repeated the same calculation for control women. The correlation coefficients ranged between 0.27 and 0.58 among diabetic women. Similar correlation coefficients were found among control women.

To identify food items that contributed to differences in nutrient intake patterns between diabetic and control women, we compared daily servings of selected food items between these two groups. Because results were similar between the 1980 and 1984 diets, we show the results from the latter diets only (Table 4). Diabetic women consumed more foods high in protein and fat (e.g., eggs, bacon, hot dogs, processed meat, and hamburger), fruits (e.g., bananas and apples), and low-calorie cola, but consumed less sugar-containing foods (e.g., cakes, sweet rolls, cookies, doughnuts,

Table 4—*Comparison of daily servings of food items between diabetic and control women*

	Diabetic women	Control women
n	1329	1329
Food items		
Eggs (1)	0.44 ± 0.39	0.34 ± 0.28*
Chicken without skin (4–6 oz.)	0.21 ± 0.23	0.19 ± 0.20
Bacon (2 slices)	0.12 ± 0.21	0.10 ± 0.15†
Hot dogs (1)	0.11 ± 0.15	0.06 ± 0.09*
Processed meats (1 slice)	0.19 ± 0.32	0.13 ± 0.25*
Hamburger (1 patty)	0.21 ± 0.18	0.16 ± 0.14*
Bananas (1)	0.32 ± 0.35	0.24 ± 0.30*
Apples (1)	0.39 ± 0.48	0.32 ± 0.38*
Low-calorie cola (1 glass)	0.48 ± 0.96	0.19 ± 0.51*
Regular cola (1 glass)	0.03 ± 0.16	0.10 ± 0.33*
Beer (1 glass)	0.04 ± 0.22	0.09 ± 0.39*
White wine (4 oz. glass)	0.07 ± 0.25	0.20 ± 0.43*
Cake, ready-made (1)	0.02 ± 0.07	0.03 ± 0.08*
Sweet roll, ready-made (1)	0.04 ± 0.12	0.07 ± 0.13*
Cookies, ready-made (1)	0.17 ± 0.46	0.26 ± 0.57*
Doughnuts (1)	0.04 ± 0.09	0.06 ± 0.12*
Cooked oatmeal (1 cup)	0.08 ± 0.21	0.06 ± 0.18‡
White bread (1 slice)	0.82 ± 1.03	0.56 ± 0.80*
Dark bread (1 slice)	0.79 ± 0.98	0.68 ± 0.84
White rice (1 cup)	0.11 ± 0.15	0.10 ± 0.15
Pasta (1 cup)	0.14 ± 0.13	0.13 ± 0.12
Potatoes: cooked (1) or mashed (1 cup)	0.35 ± 0.31	0.32 ± 0.27
Broccoli (1/2 cup)	0.20 ± 0.17	0.20 ± 0.21
Carrots (1)	0.23 ± 0.34	0.23 ± 0.27
Celery (4-inch stick)	0.30 ± 0.37	0.26 ± 0.32

Data are means ± SD.
*$P < 0.001$ diabetic vs. control women using Wilcoxon's two-sample test.
†$P < 0.05$ diabetic vs. control women using Wilcoxon's two-sample test.
‡$P < 0.01$ diabetic vs. control women using Wilcoxon's two-sample test.

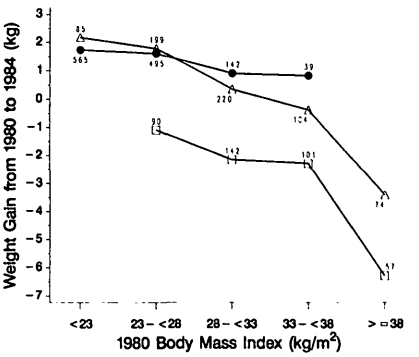

Figure 1—*Mean weight change of diabetic and nondiabetic women between 1980 and 1984. (●), All control women; (△), pre-1980 NIDDM; (□), post-1980 NIDDM. Means are printed if sample size is >30. The numbers denote sample size.*

and regular cola) and alcoholic beverages than nondiabetic control women. The consumption of most cereals, starchy foods, and vegetables did not differ significantly between the two groups.

In addition to recommending specific dietary composition, ADA (4) also recommends that overweight diabetic individuals lose weight by decreasing energy intake and increasing physical activity. To investigate whether overweight diabetic women in our study had followed that recommendation, we compared their weight change between 1980 and 1984 with those of control women. Because in 1980 the BMI was different between diabetic and control women, we separately calculated mean weight gain from 1980 to 1984 for each of the five 1980 BMI levels. An inverse association was found between 1980 BMI and subsequent weight gain, especially in NIDDM women (Fig. 1). Pearson correlation coefficients between 1980 BMI and weight gain from 1980 to 1984 were −0.06, −0.23, and −0.20 for control, pre-1980 NIDDM, and post-1980 NIDDM women, respectively. In each BMI category, no significant differences were found in weight gain from 1980 to 1984 between pre-1980 NIDDM and control women ($P \geq 0.05$). However, significant differences were found in each BMI category between post-1980 NIDDM and control women.

CONCLUSIONS— Compared with control women, diabetic women, regardless of diabetic type, consumed diets higher in protein and fat and lower in sucrose. These differences were small yet statistically significant. Although diabetic women consumed more of some fiber-rich foods (i.e., oatmeal, bananas, and apples), accounting for the small increase in nonsucrose CHO intake, no significant differences in their intakes of cereals, starchy foods, and vegetables were observed. Thus, the diabetic nurses did not consume the high-complex CHO, low-fat diet (50–60% of energy intake from CHO and <30% from fat) recommended in 1979 by ADA. We have no information on whether the diabetic women received dietary instructions (including the ADA recommendations). It is possible that some diabetic women tried, but did not maintain a high-CHO, low-fat diet.

A similar energy intake between NIDDM women and thinner control women in our study confirms results from previous epidemiological studies (16–18). Analysis of these cross-sectional data showed no correlation or a

weak negative correlation between energy intake and BMI. Possible explanations include a lower physical activity level and a greater tendency to underestimate energy intake among obese individuals than among nonobese individuals.

In this study, diabetic women tended to avoid foods containing simple sugars such as cakes, cookies, and sugar-containing soda drinks. This avoidance accounts for their lower CHO intake compared with control women. Because energy intakes among diabetic and control women were similar, it appears that diabetic women reduced their intakes of sugar-containing foods while increasing intake of foods high in protein and fat. The 1980 dietary data suggest that diabetic women consumed more nonsucrose CHO than control women. However, this result was less consistent with the expanded questionnaire used in 1984, which was designed to assess nutrient intakes more completely, especially CHO.

The ADA dietary recommendations are controversial (19). Short-term experimental studies have shown a beneficial effect of such diets on glycemic control and on the plasma levels of total cholesterol and LDL cholesterol in patients with diabetes (20–23). However, because such diets have increased plasma triglyceride levels and decreased HDL-cholesterol levels in some studies (24–26), a concern exists that a high-CHO diet may increase the risk of CHD among diabetic patients (27). Because of lack of long-term studies on the effect of dietary composition on factors that may contribute to the development of diabetic complications (e.g., glycemic control, blood lipid levels), whether the ADA dietary recommendations will improve the overall health of diabetic patients remains uncertain.

Because of the small sample size among control women in the highest BMI category, we were unable to determine whether the very obese pre-1980 NIDDM women had lost more weight than the very obese nondiabetic women. However, in the second and third highest BMI categories, weight gain from 1980 and 1984 were similar between pre-1980 NIDDM and control women. Because energy intake was similar between pre-1980 NIDDM and control women, it appears that most NIDDM women were not trying to lose weight. The large weight loss between 1980 and 1984 among post-1980 NIDDM women confirms previous reports of weight loss in newly diagnosed diabetic patients. Such weight loss in the women in this study could have been caused by a period of poorly controlled diabetes before diagnosis, but more likely represents the early success of dieting efforts following diagnosis, a success that is not likely to be sustained.

In summary, we assessed current dietary practices of women with diabetes mellitus by comparing their dietary intakes with those of nondiabetic women. Diets of diabetic women were lower in CHO, especially in sucrose, and higher in protein, fat, and cholesterol than diets of nondiabetic women. No consistent differences for complex CHO intake were observed. Thus, the diets of these diabetic women reflect older dietary practices rather than recent dietary recommendations.

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References

1. Allen FM, Stillman E, Fitz R: *Total Dietary Regulation in the Treatment of Diabetes*. Monograph 11. New York, The Rockefeller Institute for Medical Research, 1919
2. Joslin EP: *The Treatment of Diabetes Mellitus*. Lea and Febiger, Philadelphia, 1917, p. 470–76
3. Arky RA: Diet and diabetes. In *The Diabetes Annual*. Alberti KGMM, Krall LP, Eds. New York, Elsevier, 1986, p. 49--68
4. American Diabetes Association: Principles of nutrition and dietary recommendations for individuals with diabetes mellitus. *Diabetes Care* 2:520–23, 1979
5. American Diabetes Association: Nutritional recommendations and principles for individuals with diabetes. *Diabetes Care* 10:126–32, 1987
6. American Diabetes Association: Nutritional recommendations and principles for individuals with diabetes mellitus. *Diabetes Care* 14:20–27, 1991
7. Willett WC, Stampfer MJ, Colditz GA, Rosner BA, Hennekens CH, Speizer FE: Dietary fat and the risk of breast cancer. *N Engl J Med* 316:23–28, 1987
8. Willett WC, Sampson L, Stampfer MJ, Rosner B, Bain C, Witchi J, Hennekens CH, Speizer FE: Reproducibility and validity of a semiquantitative food frequency questionnaire. *Am J Epidemiol* 122:51–65, 1985
9. Willett WC, Reynolds RD, Cottrell-Hoehner S, Sampson L, Browne ML: Validation of a semi-quantitative food frequency questionnaire: comparison with a 1-year diet record. *J Am Diet Assoc* 87:43–47, 1987
10. Willett W, Sampson L, Browne M, Stampfer MJ, Rosner B, Hennekens CH, Speizer FE: The use of a self-administered questionnaires to assess diet four years in the past. *Am J Epidemiol* 127: 188–99, 1988
11. Consumer and Food Economics Institutes: Composition of Foods. In *Agriculture Handbook Number 8 Series*. Washington, DC, U.S. Department of Agriculture, 1975–1989.
12. Paul AA, Southgate DA: *McCance and Widdowson's the Composition of Foods*. 4th ed. New York, Elsevier/North-Holland, 1978
13. Paul AA, Southgate DA: McCance and Widdowson's the Composition of Foods: dietary fibre in egg, meat and fish dishes. *J Hum Nutr Diet* 33:335–36, 1979
14. Southgate DA, Paul AA, Dean AC, Christie AA: Free sugars in foods. *J Hum Nutr Diet* 32:335–47, 1978

15. Willett W, Stampfer MJ: Total energy intake: implications for epidemiologic analysis. *Am J Epidemiol* 124:17–27, 1986
16. Kromhout D: Energy and macronutrient intake in lean and obese middle-aged men: the Zutphen Study. *Am J Clin Nutr* 37:295–299, 1983
17. Romieu I, Willett WC, Stampfer MJ, Colditz GA, Sampson L, Rosner B, Hennekens CH, Speizer FE: Energy intake and other determinants of relative weight. *Am J Clin Nutr* 47:406–412, 1988
18. Slattery ML, McDonald A, Bild DE, Caan BJ, Hilner JE, Jacobs DR, Liu K: Associations of body fat and its distribution with dietary intake, physical activity, alcohol, and smoking in blacks and whites. *Am J Clin Nutr* 55:943–49, 1992
19. Grundy SM: Dietary therapy in diabetes mellitus. *Diabetes Care* 14:796–97, 1991
20. Anderson JW, Ward K: High-carbohydrate, high-fiber diets for insulin-treated men with diabetes mellitus. *Am J Clin Nutr* 32:2312–21, 1979
21. Taskinen MR, Nikkila EA, Ollus A: Serum lipids and lipoproteins in insulin-dependent diabetic subjects during high-carbohydrate, high-fiber diet. *Diabetes Care* 6:224–30, 1983
22. Hollenbeck CB, Riddle MC, Connor WE, Leklem JE: The effects of subject-selected high-carbohydrate, low-fat diets on glycemic control in insulin dependent diabetes mellitus. *Am J Clin Nutr* 41:293–98, 1985
23. Howard BV, Abbott WGH, Swinburn BA: Evaluation of metabolic effects of substitution of complex carbohydrates for saturated fat in individuals with obesity and NIDDM. *Diabetes Care* 14:786–95, 1991
24. Coulston AM, Hollenbeck CB, Swislocki ALM, Chen YDI, Reaven GM: Deleterious metabolic effects of high-carbohydrate sucrose-containing diets in patients with non-insulin-dependent diabetes mellitus. *Am J Med* 82:213–20, 1987
25. Coulston AM, Hollenbeck CB, Swislocki ALM, Reaven GM: Persistence of hypertriglyceridemic effect of low-fat high-carbohydrate diets in NIDDM patients. *Diabetes Care* 12:94–101, 1989
26. Garg A, Bonanome A, Grundy SM, Zhang ZJ, Unger RH: Comparison of a high-carbohydrate diet with a high-monounsaturated fat diet in patients with non-insulin-dependent diabetes mellitus. *N Engl J Med* 319:829–34, 1988
27. Hollenbeck CB, Coulston AM: Effect of dietary carbohydrate and fat intake on glucose and lipoprotein metabolism in individuals with diabetes mellitus. *Diabetes Care* 14:774–85, 1991