A Simple Meal Plan Emphasizing Healthy Food Choices Is as Effective as an Exchange-Based Meal Plan for Urban African Americans With Type 2 Diabetes

DAVID C. ZIEMER, MD[1]
KATHY J. BERKOWITZ, RN, FNP, CDE[1]
RITA M. PANAYIOTO, RD, LD, CDE[1]
IMAD M. EL-KEBBI, MD[1]
VICTORIA C. MUSEY, MD[1]
LYNDA A. ANDERSON, PHD[2]
NANCY S. WANKO, MS, RD, LD[3]
MARGARET L. FOWKE, RD, LD, MPA[4]
CAROL W. BRAZIER, RD, LD[3]
VIRGINIA G. DUNBAR, BS[3]
WRENN SLOCUM, RN, MPH[5]
GAEL M. BACHA, RN[1]
DANIEL L. GALLINA, MD[1]
CURTISS B. COOK, MD[1]
LAWRENCE S. PHILLIPS, MD[1]

OBJECTIVE — To compare a simple meal plan emphasizing healthy food choices with a traditional exchange-based meal plan in reducing HbA_{1c} levels in urban African Americans with type 2 diabetes.

RESEARCH DESIGN AND METHODS — A total of 648 patients with type 2 diabetes were randomized to receive instruction in either a healthy food choices meal plan (HFC) or an exchange-based meal plan (EXCH) to compare the impact on glycemic control, weight loss, serum lipids, and blood pressure at 6 months of follow-up. Dietary practices were assessed with food frequency questionnaires.

RESULTS — At presentation, the HFC and EXCH groups were comparable in age (52 years), sex (65% women), weight (94 kg), BMI (33.5), duration of diabetes (4.8 years), fasting plasma glucose (10.5 mmol/l), and HbA_{1c} (9.4%). Improvements in glycemic control over 6 months were significant ($P < 0.0001$) but similar in both groups: HbA_{1c} decreased from 9.7 to 7.8% with the HFC and from 9.6 to 7.7% with the EXCH. Improvements in HDL cholesterol and triglycerides were comparable in both groups, whereas other lipids and blood pressure were not altered. The HFC and EXCH groups exhibited similar improvement in dietary practices with respect to intake of fats and sugar sweetened foods. Among obese patients, average weight change, the percentage of patients losing weight, and the distribution of weight lost were comparable with the two approaches.

CONCLUSIONS — Medical nutrition therapy is effective in urban African Americans with type 2 diabetes. Either a meal plan emphasizing guidelines for healthy food choices or a low literacy exchange method is equally effective as a meal planning approach. Because the HFC meal plan may be easier to teach and easier for patients to understand, it may be preferable for low-literacy patient populations.

Diabetes Care 26:1719–1724, 2003

Minority groups have a high prevalence of type 2 diabetes (1–4). In the National Health and Nutrition Examination Survey III and BRFSS (Behavioral Risk Factor Surveillance System), the age-standardized prevalence of diabetes was 1.6-fold higher in African Americans than in Caucasians (5,6). The disproportionate frequency of diabetes in African Americans is especially impressive in women (4,7), even after correcting for the prevalence of obesity (4,8–10). The problem of diabetes for African Americans is particularly striking above the age of 45 years, when the prevalence of diabetes in African Americans is almost twice that in Caucasians (11); diabetes is present in 29% of African Americans 65–74 years of age (5). It is especially alarming that the frequency of altered metabolism is rising even in younger African Americans; recent studies found the prevalence of impaired glucose tolerance to be 20% in a group with an average age of 34 years (12) and 8.6% in girls between 5 and 10 years old (13).

Medical nutrition therapy is essential in preventing the development of diabetes (14–16), and medical nutrition therapy is well recognized as a cornerstone of management in patients who have diabetes. Medical nutrition therapy takes on even greater urgency in treatment of diabetes in high-risk populations such as African Americans in whom rates of complications are high (17–21) and metabolic control is poor (19,22). African Americans with diagnosed diabetes in National Health and Nutrition Examination Survey III had the lowest prevalence of normal HbA_{1c} and the highest prevalence of HbA_{1c} (>8%) compared with other ethnic groups, and African Americans with undiagnosed diabetes had the highest average HbA_{1c} as well (23).

Recognition of the relationship between dietary constituents and glucose tolerance (24) has contributed to the development of nutritional prescriptions,

From the [1]Division of Endocrinology and Metabolism, Emory University School of Medicine, Atlanta, Georgia; the [2]Division of Adult and Community Health, Centers for Disease Control and Prevention, Atlanta, Georgia; [3]Grady Health System, Atlanta, Georgia; [4]National Oceanic and Atmospheric Administration, Atlanta, Georgia; and the [5]Division of HIV/AIDS Prevention, Centers for Disease Control and Prevention, Atlanta, Georgia.

Address correspondence and reprint requests to David C. Ziemer, MD, Emory University School of Medicine, 69 Butler Street, S.E., Atlanta, GA 30303. E-mail: dziemer@emory.edu.

Received for publication 11 June 2002 and accepted in revised form 27 February 2003.

Abbreviations: EXCH, exchange-based meal plan; HFC, healthy food choices meal plan.

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

such as the food exchange system, as strategies to restrict energy intake and provide macronutrient balance (25). However, patients may have trouble understanding meal plans based on the exchange system (26), and discussion groups in the Grady Health System in Atlanta have shown the exchange system to be difficult for this relatively low-literacy (27) patient population (28). Because of such potential barriers, some have recommended that a more simplified approach to dietary instruction, such as "eat less fat," may be just as effective in the management of diabetes (29). Moreover, some studies suggest that the essential elements of successful medical nutrition therapy might lie in the food choices that are made—such as limitation of carbohydrates—rather than limitation of energy intake (29–32).

Given the difficulties obese African-American patients may face in implementing the recommendations of the exchange system, we asked whether a simpler meal plan that emphasizes "healthy food choices" (without emphasis on weight loss per se) would be as effective as a traditional exchange-based meal plan (emphasizing weight loss). To test this hypothesis, we conducted a randomized, controlled trial in the Grady Diabetes Clinic, comparing changes in HbA_{1c} as the primary outcome and changes in weight, serum lipids, and blood pressure as secondary outcomes.

RESEARCH DESIGN AND METHODS

Setting and study paradigm

The Grady Health System Diabetes Clinic serves an adult population (≥17 years of age) that is primarily urban and African American. A high proportion have incomes below the federal poverty line, lack health insurance, and have poor functional health literacy (27,33,34). Care is provided by a team that includes nurses, dietitians, podiatrists, and endocrinologists, and each patient's initial visit includes an extensive evaluation and education focused on self-care. After the initial visit, patients are scheduled for return visits at 1, 2, and 4 weeks after the initial visit and then at 2, 4, and 6 months. All patients are routinely scheduled to see a dietitian at the initial visit and at visits at 1, 2, and 4 weeks with additional visits as needed; at each of these appointments, patients receive individualized, one-on-one instruction in separate sessions. As described previously (33), all patients are managed with a stepped care protocol that emphasizes nonpharmacologic therapy during the first 2 months. During this period, antidiabetic pharmacologic agents are either discontinued or reduced in dose for patients who are not ketosis prone and do not have symptomatic hyperglycemia. If glycemic goals are not reached after 2 months, pharmacotherapy is reinstituted or intensified.

Diabetes clinic patients were solicited for participation in the study if they had type 2 diabetes [classified according to accepted clinical criteria (33)], were able to understand spoken English, had no major complicating medical illnesses, and were judged to be capable of performing basic self-management skills. Patients were recruited at their initial visit and randomized according to the day of their initial visit (for logistical convenience) to receive instruction in either a simplified exchange-based meal plan (EXCH group) or a meal plan emphasizing healthy food choices without discussion about losing weight or limiting food intake (HFC group); details about dietary instruction are provided below. With the exception of instruction in meal planning, patients received all other management per the standard protocol of the diabetes clinic. The primary outcome was change in glycemic control (HbA_{1c}); secondary outcomes included changes in fat and sugar intake, BMI, lipids, and blood pressure. The study was reviewed and approved by the Emory University Institutional Review Board.

Comparison of meal planning approaches

The Diabetes Clinic dietitians were involved in all phases of design and implementation of the study. Instruction for each meal planning approach (EXCH or HFC) and advice regarding general physical activity involved the same dietitian time and the same personnel for each group. Approximately 1 h was spent on nutritional counseling at the initial visit and 30 min at each of three subsequent clinic visits. At each visit, individualized patient instruction was based on 24-h recalls to direct dietary reinforcement. Before enrolling participants in the study, a curriculum outline was developed, and training sessions were held. Training for the dietitians involved practice sessions to ensure consistency in all aspects of patient instruction, which included planning menus, preparing foods, interpreting food labels, and making appropriate food choices.

Instructional materials used approximated the fifth and sixth grade reading level (J. Nurss, personal communication); median literacy for our patients has been estimated at the sixth grade level (K. Dobberstein, personal communication, 1993). In the EXCH group, low literacy educational material consisted of "Eating Healthy Foods" (American Diabetes Association, Inc. and The American Dietetic Association, copyright 1988). Patients were instructed in both food exchanges and portion sizes. Patients classified as obese (>120% of ideal body weight) were assigned meal plans that were 500 kcal below their estimated daily energy requirements, as calculated from the Harris-Benedict equation (35). In the HFC group, we used the same educational material but removed all content related to quantity of food (copyright permission obtained from the American Diabetes Association) and substituted the FDA Food Guide Pyramid, which was modified to group high-starch and high-protein foods as recommended for persons with diabetes. The modified food guide pyramid was glossy and in full color with line drawings of foods. Patients were instructed to limit use of sweets and fats, particularly saturated fat. Although food models were used, portion sizes were not discussed and weight loss was not emphasized.

Patients' food usage was assessed at baseline and after 2 to 4 months of follow-up using questionnaires administered verbally. Use of fat-containing foods was assessed with a modification of the Kristal fat screener (36) and a revised version of Block et al.'s (37) 1989 food frequency scale that was modified for foods appropriate to this population. Use of sugar-sweetened foods was assessed with an instrument modeled after the fat screener. All scales were scored so that a higher score indicates a "healthier" meal plan (i.e., lower intake of the high fat or high sugar food item).

Laboratory analyses

Fasting plasma glucose was determined at each visit, HbA_{1c} at intervals of 2 months, and fasting lipids (secondary outcome) at baseline and between 4 and 6 months.

Table 1—*Presenting characteristics of study population, including all subjects at baseline and those with laboratory studies available from return visits after 6 months of follow-up care*

	EXCH Initial	HFC Initial	*P*	EXCH 6-month return	HFC 6-month return	*P*
Number	359	289		126	94	
Sex (F/M)	243/116	180/109	0.15*	92/34	67/27	0.78*
Race (%)			0.42*			0.42*
African American	90.3	89.6		85.7	89.4	
Caucasian	7.5	9.7		11.1	9.6	
Other	2.2	0.7		3.2	1.1	
Therapy (%)			0.87*			0.68*
Meal plan only	20.3	18		22.2	16.0	
Sulfonylurea	43.5	45.7		41.3	44.7	
Insulin	33.4	33.9		32.5	36.2	
Both	2.8	2.4		4	3.2	
Obese (%)	77	80.3	0.32*	69.8	79.8	0.09*
Age (years)	52 ± 0.7	52 ± 0.8	0.96	57.5 ± 1.0	55.2 ± 1.3	0.14
BMI (kg/m^2)	33.7 ± 0.5	33.2 ± 0.4	0.41	32.1 ± 0.7	32.9 ± 0.8	0.41
Duration (years)	4.8 ± 0.4	4.9 ± 0.4	0.95	6.2 ± 0.7	5.3 ± 0.8	0.39
Fasting glucose (mmol/l)	10.3 ± 0.23	10.7 ± 0.25	0.26	10.8 ± 0.4	10.3 ± 0.4	0.37
HbA_{1c} (%)	9.32 ± 0.1	9.57 ± 0.2	0.23	9.46 ± 0.20	9.69 ± 0.25	0.46
Blood pressure (mmHg)						
Systolic	127.5 ± 1.1	128.8 ± 1.1	0.43	130.3 ± 1.7	128.8 ± 1.8	0.56
Diastolic	77.7 ± 0.6	77.9 ± 0.6	0.79	77.9 ± 0.9	76.5 ± 0.9	0.29
LDL cholesterol (mmol/l)	3.62 ± 0.06	3.7 ± 0.07	0.26	3.85 ± 0.1	3.74 ± 0.12	0.46
HDL cholesterol (mmol/l)	1.11 ± 0.02	1.10 ± 0.02	0.61	1.12 ± 0.03	1.12 ± 0.03	0.9
Triglycerides (mmol/l)	1.75 ± 0.07	2.12 ± 0.15	0.14†	1.91 ± 0.17	1.89 ± 0.16	0.70†
C-peptide (mmol/l)	0.89 ± 0.08	0.90 ± 0.03	0.85	0.87 ± 0.04	0.90 ± 0.05	0.61

Data are means ± SEM or %. Comparisons are by unpaired Student's *t* test, except where indicated by * (χ^2) or † (Mann-Whitney *U* test).

HbA_{1c} was measured using an high-performance liquid chromatography method (Diamat; Biorad, Hercules, CA). Glucose analyses used a glucose oxidase method (APEC, Danvers, MA). Triglycerides were measured with a Hitachi 717 instrument using a lipase/glycerol kinase/glycerol-3-phosphate method. Total cholesterol was determined with the same instrumentation using a cholesterol esterase and cholesterol oxidase reaction from Boehringer Mannheim Diagnostics (Mannheim, Germany). HDL cholesterol was assessed by the same method after precipitation of LDL and VLDL cholesterol. LDL cholesterol was calculated using the Friedewald equation (38).

Statistical analysis

Data were analyzed using Statview II (Abacus Concepts, Berkeley, CA). Student's *t* test and Mann-Whitney *U* test were used to test differences in baseline characteristics. χ^2 analyses were used to compare categorical data. ANOVA with repeated measures was used for follow-up data; only patients with values at every time point were included in these analyses. Spearman rank correlation analysis was used to test changes in triglyceride levels. Chronbach's α and logistic regressions were performed using STATA Statistical Software (Stata, College Station, TX).

RESULTS

Patient characteristics

Between August 1994 and August 1995, 648 patients with initial visits to the Grady Diabetes Clinic qualified and agreed to participate in the study; 359 were assigned to the EXCH group and 289 to the HFC group. A small number of patients later requested to switch from the HFC to the EXCH group for the purpose of weight management, but in all case subjects, data were analyzed on the basis of intention to treat.

The presenting population had a mean age of 52 years, 90% were African American, 65% were women, and 78% were obese (>120% ideal weight, Table 1). The mean duration of diabetes was 4.8 years, the initial fasting plasma glucose 10.5 mmol/l, and HbA_{1c} 9.4%. There were no significant differences between the EXCH and HFC groups in age, ethnicity, gender, BMI, duration of diabetes, fasting glucose, or HbA_{1c}. The EXCH group had a higher follow-up rate at 2 months (59 vs. 51%, $P = 0.03$) but not at 6 months (48 vs. 52%, $P > 0.2$). Such follow-up rates are characteristic of this patient population and reflect barriers to care that are not unusual in patient groups that are confronted with poverty and low literacy (27,33,34). In both groups, the patients who returned for their 6-month visits had comparable demographic characteristics at baseline (see Table 1, "6-month return" groups).

On presentation, 19% of patients were being managed with meal plan alone, 44% were using sulfonylureas, 34% were using insulin only, and 3% were using sulfonylureas and insulin in combination (Table 1). The percentage of patients managed with meal plan alone increased to 38% at 2 months (reflecting a vigorous trial of nonpharmacologic management for obese patients, see RESEARCH DESIGN AND METHODS) and then decreased gradually to 28% at 6 months. There was no difference in the distribution of therapies between the two groups at any time point (all χ^2 tests, $P > 0.15$).

Changes in fat and sugar intake

We used questionnaires to determine whether the EXCH versus HFC approaches to dietary instruction led to differences in eating patterns. Reliability of the modified Kristal fat screener in this population was comparable with that reported by Kristal et al. (39); Chronbach's α's were generally 0.5 to 0.7 for initial evaluations with all of our questionnaires. At baseline, the EXCH and HFC groups had comparable fat intake as measured by the food frequency and Kristal fat screener. During follow-up, both groups decreased their fat intake ($P < 0.01$ for all but the HFC meal plan on the Kristal scale ($P = 0.07$)). Use of sugar-containing foods was comparable in the two groups initially ($P = 0.09$), and decreases were significant but similar in both groups ($P < 0.01$ for both changes). Change in food usage was not a significant predictor of change in HbA_{1c}, whether it was tested in univariate analysis or in a multiple regression model that included age, duration of diabetes, sex, ethnicity, BMI, and metabolic variables (data not shown).

Changes in HbA_{1c}

HbA_{1c} declined comparably for both groups over the 6 months of follow-up, dropping from 9.6 to 7.7% in the EXCH group and 9.7 to 7.8% in the HFC group ($P < 0.0001$ for both) (Fig. 1*A*). At 6 months, 41% of the EXCH group and 32% of the HFC group had achieved a HbA_{1c} of 7.0% or less ($P = 0.12$ between groups). Decreases in glucose levels were also comparable between the groups ($P > 0.5$, data not shown) with fasting glucose declining from 10.8 to 9.2 mmol/l for the EXCH group, and 9.9 to 9.0 mmol/l for the HFC group ($P < 0.0001$ for each change). In both groups, responses were similar for patients who were classified as lean or obese (data not shown).

Changes in weight

Results were evaluated for the 275 patients classified as obese (>120% of ideal

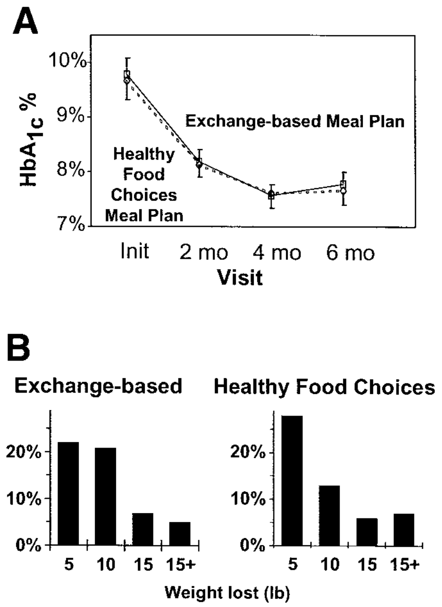

Figure 1—A: *Changes in HbA_{1c} levels in patients on the EXCH and HFC.* B: *Percent of patients losing 0–5, 5–10, 10–15, or ≥15 lb (0–2.3, 2.3–4.5, 4.6–6.8, or ≥6.8 kg) by the 2-month follow-up visit.*

weight) who returned for their 2-month follow-up appointment (158 EXCH and 117 HFC) and the 155 who returned for all three of their bi-monthly appointments (86 EXCH and 69 HFC). The EXCH and the HFC groups did not differ significantly in the percentage of patients who lost weight (53.2 vs. 53.0%, $P > 0.97$) or in the distribution of patients who lost 0–5, 5–10, 10–15, or >15 lb (0–2.3, 2.3–4.5, 4.5–6.8, or >6.8 kg, Fig. 1*B*). Both groups had small but significant average weight change at 6 months ($P = 0.02$ for both). The average weight of the EXCH group increased from 96.4 to 96.8 kg, and that of the HFC group declined from 95 to 94.1 kg; 59.7% of the EXCH and 45.1% of the HFC group gained weight ($P = 0.07$ between groups). Neither weight nor BMI was significantly different between the two groups at 6 months ($P = 0.15$). Changes in weight among the patients classified as obese were not significantly related to changes in fat or sugar usage or to dietary assignment group either by univariate analysis or in the multiple regression model. A small but significant increase in weight also occurred in patients classified as lean with the EXCH group gaining 2.3 kg and the HFC gaining 3.6 kg ($P < 0.0001$).

Lipids and blood pressure

Information on lipids was available for 638 patients at baseline and for 169 patients who had repeat measurements at the 4- or 6-month return visit. There was no systematic strategy to repeat lipid measurements or to institute or alter use of hypolipidemic agents. Neither total nor LDL cholesterol differed significantly between the groups on initial presentation, and values did not change significantly over time (all $P > 0.15$). HDL cholesterol increased slightly but significantly in both groups (from 1.09 to 1.15 mmol/l in EXCH and from 1.11 to 1.17 mmol/l in HFC; $P < 0.005$ for both). Average triglycerides dropped from 2.03 to 1.78 mmol/l in the EXCH group and from 2.92 to 2.38 mmol/l in the HFC group ($P < 0.001$ for both). Blood pressure did not differ significantly between the EXCH and HFC groups at initial presentation or after 6 months of follow-up (data not shown).

CONCLUSIONS— Medical nutrition therapy is essential in the management of type 2 diabetes. Moreover, effective medical nutrition therapy will be particularly important for populations such as that served by the Grady Health System in which diabetes and obesity are common, glycemic control on presentation is often poor (Table 1), and many patients already have diabetes complications (33,40,41). However, there has been relatively little examination of different nutritional approaches for urban populations enriched in minorities, the poor, and the underserved (25). In this setting, we found that instruction in meal planning based only on HFC was comparable with the EXCH system in impact on food selection, glycemic control, weight, lipids, and blood pressure. Although the additional benefits of weight loss should not be discounted (42,43), the data indicate that nutritional management for patients with type 2 diabetes does not need to be focused primarily on weight loss or to involve exchange approaches to have a beneficial impact on glycemic control. Since changes in lipids were small with both approaches, our findings also raise the possibility that neither the EXCH nor the HFC meal plan will constitute an effective first-line method for modifying these important cardiovascular risk factors in municipal populations; if LDL cholesterol abnormalities persist despite improvements in glycemic control (44), patients may need earlier institution of hypolipidemic agents.

The lack of difference in outcomes between the EXCH and HFC approaches may be due to similarities in food usage; both groups had comparable fat and sugar intakes at baseline and reported significant but comparable reductions in fat and sugar intake at follow-up. It should be recognized that even though others have used similar approaches to evaluate dietary intake (36,45), such self-reports might not always be accurate reflections of actual dietary composition and energy intake (45–52). However, to the extent that the HFC approach produces comparable outcomes but is easier to understand and easier to teach than the EXCH approach, the HFC approach may be preferable for use in urban populations with low literacy such as that served by Grady (27).

One limitation of this study is that we did not assess patient satisfaction with either meal plan. However, patients reported anecdotally that the HFC meal plan was easy to understand, which contrasts with the difficulty patients may have with the EXCH meal plan (28). We also did not evaluate ease of use, but the dietitians reported anecdotally that the HFC meal plan was easier to teach. Although portion sizes were not discussed with patients in the HFC meal plan, it is possible that they were implied from demonstration of the food pyramid and use of food models. While the EXCH and HFC groups had comparable demographic characteristics and return rates, it remains possible that the substantial dropout rate led to some selection bias. However, a comparable dropout was recently reported for a diabetes education program that used a similar randomization scheme but was based in a suburban setting (53). Finally, it was not possible to obtain data on the cost of our interventions or on patient socioeconomic status, education, or literacy. However, demographic characteristics of the patients were otherwise similar between study groups and to what we have previously reported (33) with no obvious change in referral patterns.

Instruction in both meal plans, and the observed improvement in glucose control, occurred in the context of our general treatment program. Nonetheless, the reductions in HbA_{1c} under the HFC meal plan can be seen as further support for the idea that emphasizing food choices, and not just energy intake, can be an important element in improving glycemic control. As a result of this study, providers in the Grady Diabetes Clinic continue to use the EXCH meal plan for those patients who desire a focus on food exchanges and portion sizes as a strategy to lose weight, but instruction in HFC without an emphasis on weight loss has become the standard approach to meal planning for all other patients.

Acknowledgments— This work was supported in part by research awards from the Centers for Disease Control and Prevention (to D.C.Z. and D.L.G.) and the National Institutes of Health and the Agency for Healthcare Research and Quality (DK-48124 and HS-07922 to L.S.P.). This work was presented in part at the annual meeting of the American Diabetes Association, 1995.

We thank Brudy Francis and Mary Lou Mojonnier for assistance in preparation of the manuscript. For statistical help with the food scale analyses we thank Jeph Herrin of the Kerr White Institute, Center for Clinical Health Evaluation Sciences of Emory University.

References

1. Diehl AK, Stern MP: Special health problems of Mexican-Americans: obesity, gallbladder disease, diabetes mellitus, and cardiovascular disease. *Adv Int Med* 34:73–96, 1989
2. Centers for Disease Control and Prevention, Division of Diabetes Translation: Diabetes surveillance, 1980–1987 policy program research: annual report. *DHHS* 9–12, 1990
3. Harris MI: Epidemiological correlates of NIDDM in Hispanics, Whites, and Blacks in the U.S. population. *Diabetes Care* 14: 639–648, 1991
4. Harris MI: Non-insulin dependent diabetes in black and white Americans. *Diabetes Metab Rev* 6:71–90, 1990
5. Harris MI, Flegal KM, Cowie CC, Eberhardt MS, Goldstein DE, Little RR, Wiedmeyer H-M, Byrd-Holt DD: Prevalence of diabetes, impaired fasting glucose, and impaired glucose tolerance in U.S. adults: a third national nutrition examination study, 1988–1994. *Diabetes Care* 21:518–524, 1998
6. Mokdad AH, Bowman BA, Ford ES, Vinicor F, Marks JS, Koplan JP: The continuing epidemics of obesity and diabetes in the United States. *JAMA* 286:1195–1200, 2001
7. Bonham GS, Brock DB: The relationship of diabetes with race, sex, and obesity. *Am J Clin Nutr* 41:776–783, 1985
8. Stern MP: Invited commentary: do risk factors explain ethnic differences in type II diabetes? *Am J Epidemiol* 137:733–734, 1993
9. Cowie CC, Harris MI, Silverman RE, Johnson EW, Rust KF: Effect of multiple risk factors on differences between blacks and whites in the prevalence of non-insulin-dependent diabetes mellitus in the United States. *Am J Epidemiol* 137:719–732, 1993
10. Brunner EJ, Marmot MG, Nanchahal K, Shipley MJ, Stansfeld SA, Juneja M, Alberti KGMM: Social inequality in coronary risk: central obesity and the metabolic syndrome: evidence from the Whitehall II study. *Diabetologia* 40:1341–1349, 1997
11. Tull ES, Roseman JM: Diabetes in African-Americans. In *Diabetes in America*. 2nd ed. Bethesda, MD, The National Institutes of Health, 1995, p. 613–630
12. Falkner B, Sherif K, Sumner AE, Kushner H: Blood pressure increase with impaired glucose tolerance in young adult American blacks. *Hypertension* 34:1086–1090, 1999
13. Young-Hyman D, Schlundt DG, Herman L, De Luca F, Counts D: Evaluation of the insulin resistance syndrome in 5- to 10-year-old overweight/obese African-American children. *Diabetes Care* 24:1359–1364, 2001
14. Hu FB, Manson JE, Stampfer MJ, Colditz G, Liu S, Solomon CG, Willett WC: Diet, lifestyle, and the risk of type 2 diabetes mellitus in women. *N Engl J Med* 345: 790–797, 2001
15. Tuomilehto J, Lindstrom J, Eriksson JG, Valle TT, Hamalainen H, Ilanne-Parikka P, Keinanen-Kiukaanniemi S, Laakso M, Louheranta A, Rastas M, Salminen V, Uusitupa M, Aunola S, Cepaitis Z, Moltchanov V, Hakumaki M, Mannelin M, Martikkala V, Sundvall J: Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance. *N Engl J Med* 344:1343–1350, 2001
16. Diabetes Prevention Program Research Group: Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 346:393–403, 2002
17. Pi-Sunyer XF: Obesity and diabetes in blacks. *Diabetes Care* 3:1144–1149, 1990
18. Rabb MF, Gagliano DA, Sweeney HE: Diabetic retinopathy in blacks. *Diabetes Care* 13:1202–1206, 1990
19. Harris MI, Klein R, Cowie CC: Is the risk of diabetic retinopathy greater in non-Hispanic blacks and Mexican Americans than in non-Hispanic whites with type 2 diabetes: a U.S. population study. *Diabetes Care* 21:1230–1235, 1998

20. Wetterhall SF, Olson DR, DeStefano F, Stevenson JM, Ford E, German RR, Will JC, Newman JM, Sepe SJ, Vinicor F: Trends in diabetes and diabetic complications, 1980–1987. *Diabetes Care* 15:960–967, 1992
21. National Center for Health Statistics, Hospital Care Statistics Branch: 1987 Summary: National Hospital Discharge Survey. *DHSS* 88–1250:1988b, 1988
22. Hamman RF, Mayer EJ, Moo-Young GA, Hildebrandt W, Marshall JA, Baxter J: Prevalence and risk factors of diabetic retinopathy in non-Hispanic Whites and Hispanics with NIDDM. *Diabetes* 38: 1231–1237, 1989
23. Harris MI, Eastman RC, Cowie CC, Flegal KM, Eberhardt MS: Racial and ethnic differences in glycemic control of adults with type 2 diabetes. *Diabetes Care* 22:403–408, 1999
24. Feskens EJM, Virtanen SM, Rasanen L, Tuomilehto J, Stengard J, Perkanen J, Nissinen A, Kromhout D: Dietary factors determining diabetes and impaired glucose tolerance: a 20-year follow-up of the Finnish and Dutch cohorts of the Seven Countries Study. *Diabetes Care* 18:1104–1112, 1995
25. Wheeler ML, Franz M, Barrier P, Holler H, Cronmiller N, Delahanty LM: Macronutrient and energy database for the 1995 exchange lists for meal planning: a rationale for clinical practice decisions. *J Am Diet Assoc* 96:1167–1171, 1996
26. West KM: Diet therapy of diabetes: an analysis of failure. *Ann Int Med* 79:425–434, 1973
27. Nurss JR, El-Kebbi IM, Gallina DL, Ziemer DC, Musey VC, Lewis S, Liao Q, Phillips LS: Diabetes in urban African-Americans. VIII. Functional health literacy of patients with type II diabetes. *Diabetes Educ* 23:563–568, 1997
28. El-Kebbi IM, Bacha GA, Ziemer DC, Musey VC, Gallina DL, Phillips LS: Diabetes in urban African-Americans. V. Use of discussion groups to identify barriers to dietary therapy. *Diabetes Educ* 22:488–492, 1996
29. Gohdes D: Diet therapy for minority patients with diabetes. *Diabetes Care* 11: 189–191, 1988
30. Gallagher AM, Abraira C, Henderson WG: A four-year prospective trial of unmeasured diet in lean diabetic adults. *Diabetes Care* 7:557–565, 1984
31. Gallagher AM, Henderson WG, Abraira C: Dietary patterns and metabolic control in diabetic diets: a prospective study of 51 outpatient men on unmeasured and exchange diets. *J Am Coll Nutr* 6:525–532, 1987
32. Horwath CC, Worsley A: Dietary habits of elderly persons with diabetes. *J Am Diet Assoc* 91:553–557, 1991
33. Ziemer DC, Goldschmid M, Musey VC, Domin WS, Thule PM, Gallina DL, Phillips LS: Diabetes in urban African-Americans. III. Management of type II diabetes in a municipal hospital setting. *Am J Med* 101:25–33, 1996
34. Williams MV, Parker RM, Baker DW, Parikh NS, Pitkin K, Coates NC, Nurss JR: Inadequate functional health literacy among patients at two public hospitals. *JAMA* 274:1677–1682, 1995
35. Harris JA, Benedict TG: *Biometric Studies of Basal Metabolism in Man*. Washington, DC, Carnegie Institute of Washington, 1919
36. Kristal AR, White E, Shattuck AL, Curry S, Anderson GL, Fowler A, Urban N: Long-term maintenance of a low-fat diet: durability of fat-related dietary habits in the women's health trial. *J Am Diet Assoc* 92:553–559, 1992
37. Block G, Clifford C, Naughton MD, Henderson M, McAdams M: A brief dietary screen for high fat intake. *J Nutr Educ* 21: 199–205, 1989
38. Friedwald WT, Levy RI, Fredrickson DS: Estimation of the concentration of low density lipoprotein cholesterol in plasma without the use of the preparative ultracentrifuge. *Clin Chem* 18:499–502, 1972
39. Kristal AR, Shattuck AL, Henry HJ: Patterns of dietary behavior associated with selecting diets low in fat: reliability and validity of a behavioral approach to dietary assessment. *J Am Diet Assoc* 90:214–220, 1990
40. Goldschmid MG, Domin WS, Ziemer DC, Gallina DL, Phillips LS: Diabetes in urban African-Americans. II. High prevalence of microalbuminuria and nephropathy in African-Americans with diabetes. *Diabetes Care* 18:955–961, 1995
41. Anderson LA, Janes GR, Ziemer DC, Phillips LS: Diabetes in urban African-Americans: body image, satisfaction with size, and weight change attempts. *Diabetes Educ* 23:301–308, 1997
42. Hansen BC: Dietary considerations for obese patients. *Diabetes Care* 11:183–188, 1988
43. Wing RR, Blair EH, Bononi P, Marcus MD, Watanabe R, Bergman RN: Caloric restriction per se is a significant factor in improvements in glycemic control and insulin sensitivity during weight loss in obese NIDDM patients. *Diabetes Care* 17: 30–36, 1994
44. Erdman DM, Cook CB, Greenlund KJ, Giles WH, El-Kebbi IM, Ryan GJ, Gallina DL, Ziemer DC, Dunbar VG, Phillips LS: The impact of outpatient diabetes management on serum lipids in urban African-Americans with type 2 diabetes. *Diabetes Care* 25:9–15, 2002
45. Willett WC, Sampson L, Stampfer MJ, Rosner B, Bain C, Witschi J, Hennekens CH: Reproducibility and validity of a semiquantitative food frequency questionnaire. *Am J Epidemiol* 122:51–65, 1985
46. Arnold MS, Funnell MM, Herman WH, Brown MB, Merritt JH, Fogler JM, Halter JB: Discrepancies between perceived dietary changes and 4-day food records in older adults with diabetes. *J Am Diet Assoc* 96:705–707, 1996
47. Mayer-Davis EJ, Monaco JH, Hoen HM, Carmichale S, Vitolins MZ, Rewers MJ, Haffner SM, Ayad MF, Bergman RN, Karter AJ: Dietary fat and insulin sensitivity in a triethnic population: the role of obesity: the Insulin Resistance Atherosclerosis Study (IRAS). *Am J Clin Nutr* 65: 79–87, 1997
48. Parker DR, Weiss ST, Troisi R, Cassano PA, Vokonas PS, Landsberg L: Relationship of dietary saturated fatty acids and body habitus to serum insulin concentrations: the normative aging study. *Am J Clin Nutr* 58:129–136, 1993
49. Stevens J, Ahn K, Juhaeri, Houston D, Stefan L, Couper D: Dietary fiber intake and glycemic index and incidence of diabetes in African-American and white adults: the ARIC Study. *Diabetes Care* 25:1715–1721, 2002
50. Palaniappan LP, Carnethon MR, Fortmann SP: Heterogeneity in the relationship between ethnicity, BMI, and fasting insulin. *Diabetes Care* 25:1351–1357, 2002
51. Mertz W, Tsui JC, Judd JT, Reiser S, Hallfrisch J, Morris ER, Steele PD, Lashley E: What are people really eating: the relation between energy intake derived from estimated diet records and intake determined to maintain body weight. *Am J Clin Nutr* 54:291–295, 1991
52. Block G, Woods M, Potosky A, Clifford C: Validation of a self-administered diet history questionnaire using multiple diet records. *J Clin Epidemiol* 43:1327–1335, 1990
53. Rickheim PL, Weaver TW, Flader JL, Kendall DM: Assessment of group versus individual diabetes education: a randomized study. *Diabetes Care* 25:269–274, 2002