Poor Nutritional Habits: A Modifiable Predecessor of Chronic Illness? A North Carolina Family Medicine Research Network (NC-FM-RN) Study

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Purpose: **To examine associations between personal nutritional patterns and various indicators of health, disease risk, and chronic illness in a diverse, representative sample of adult patients from primary care settings.**

Methods: **As part of a survey of adult patients conducted in the waiting rooms of 4 primary care practices in North Carolina (recruitment rate 74.8%), a 7-item nutrition screen was administered to 1788 study participants. Other questionnaire items addressed disease and functional status, race/ethnicity, health habits, and demographic factors.**

Results: **Respondents included 292 African Americans (17.3%), 1004 non-Hispanic whites (59.4%), 255 Hispanics (15.1%), and 126 American Indians (7.4%); mean age 47.5 years. Thirty percent reported eating 3 or more fast food meals weekly, 29% drank 3 or more high-sugar beverages weekly, 22% ate 3 or more high-fat snacks weekly, 36% ate 3 or more desserts weekly, 11% reported eating "a lot" of margarine, butter, or meat fat; 62% ate 2 or fewer fruits or vegetables daily; and 42% reported consuming protein less than 3 times a week. Scores on a summary measure were worse for prediabetics than for diabetics, for young adults compared with older persons, and for persons reporting good/excellent health versus fair/poor health.**

Conclusions: **People at high risk for developing chronic illnesses later in life reported poorer diets in comparison with people who are already ill. This probably represents increased nutritional awareness and motivation among people with chronic diseases. Because primary care patients have a high prevalence of chronic disease risk factors, the primary care office setting may constitute a particularly appropriate location for nutrition education. (J Am Board Fam Med 2007;20:124–134.)**

Overweight and obesity are major causes of morbidity and mortality in the United States.[1,2] Annual deaths due to overweight and obesity are estimated to be between 112,000 and 414,000.[3–4] The National Health and Nutrition Examination Survey (1999–2000) indicated that nearly two thirds of US adults are overweight (body mass index [BMI] ≥25) and nearly one third are obese (BMI ≥30). The prevalence of overweight and obesity in minorities, especially minority women, is generally higher than that of whites in the United States.[5,6]

Excess weight is an important risk factor for chronic illness, including type 2 diabetes. Nearly 70% to 80% of type 2 diabetic patients are either overweight or obese.[7,8] The prevalence and incidence of both obesity and diabetes have steadily increased in the United States in both genders, all ages, all educational levels, and all smoking levels over the past several years.[9] Diabetes prevalence varies by ethnic group; diabetes prevalence in whites is 8.7%, whereas Hispanics, African Americans, and American Indians have prevalences that are 1.7, 1.8, and 2.2 times greater, respectively.[2] Data from 2005 estimated the prevalence of diabetes in the United States to be 20.8 million people, or 7.0% of the population.[2] An additional 20 mil-

This article was externally peer reviewed.

Submitted 29 August 2006; revised 28 December 2006; accepted 4 January 2007.

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Funding: Supported by Grant R21 HS13521 from the Agency for Healthcare Research and Quality and Grant K07 AG21587 from the National Institute on Aging.

Prior presentation: Portions of this paper were presented at the 2005 Winter Scientific Meeting of the North Carolina Academy of Family Physicians in Asheville, NC. This article is based on a presentation made at the 2006 Agency for Healthcare Research and Quality National Practice-based Research Network Conference, Bethesda, MD, May 15–17, 2006.

Conflict of interest: none declared.

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lion have prediabetes, a strong risk factor for developing diabetes later in life.[7] The cost of diabetes in the United States is enormous; direct and indirect costs were estimated at $132 billion in 2002.[2] Extensive risks are associated with long-term type 2 diabetes, especially with prolonged diagnosis. For instance, by the time many patients are diagnosed, vascular damage has already occurred. Therefore, preventing the disease or delaying its onset provide the best approaches to reducing diabetes complications.[10]

Diet can influence the development of type 2 diabetes; recent epidemiologic studies have shown that a low-fiber diet, high trans-fatty acid intake, low unsaturated-to-saturated fat intake ratio, and the absence of or excess alcohol consumption to be associated with an increased risk of type 2 diabetes.[11] Lifestyle interventions have been successful in addressing type 2 diabetes. For example, the Diabetes Prevention Program demonstrated that the 2-year incidence of diabetes in high-risk persons could be decreased 58% by adherence to a lifestyle intervention which included a diet based on the Food Guide Pyramid and regular, moderate physical activity.[12]

Primary care settings have great potential as sites for lifestyle-related chronic disease prevention and management.[13–15] Developing successful assessment methods and management approaches to address nutrition-related disease in these settings is, therefore, a high priority.[16] To develop such interventions, primary care physicians need to understand the factors that influence the dietary habits of their patients and how these factors vary across patient populations. This study used an established diet screening instrument to assess the habits of a diverse sample of 1788 primary care patients and factors associated with them.

Methods

This project was conducted under the auspices of the North Carolina Family Medicine Research Network (NC-FM-RN), a statewide network of 24 family practices.[17] As part of a broader survey of patients from 4 newly recruited network practices, a 7-item nutrition habit screen designed for use in primary care settings by AA and colleagues was used to assess the diet of a representative sample of adult patients from these practices. The instrument's items, adapted from a longer, validated instrument, inquire about fast food, sugar-containing beverages, high-fat snacks, desserts or sweets, fat, fruits and vegetables, and protein; all items are scored on a 3-point scale with 0 representing the most healthy behavior and 2 representing the least healthy behavior.[16,18,19] Using these items, a total nutrition score was generated by summing the scores from the 7 items, yielding a scale with a possible range between 0 (best dietary habits) to 14 (poorest dietary habits). If 1 or 2 of the 7 items are missing, the case-wise average of the nonmissing items is imputed so that the total score maintains the same range; if more than 2 items are missing, the summary score is not computed. The 7-question screen has been validated by comparing it to the Dietary Risk Assessment, a widely used food frequency questionnaire,[19,20] in 68 community-dwelling adults; the Pearson correlation coefficient between the 2 instruments was $r = 0.67$ ($P < .0001$), indicating that the measures were highly correlated.[21]

The study's data collection questionnaire also included information on the respondents' demographic status, BMI, medical history (including diagnoses such as diabetes and hypertension), smoking status, physical activity, and alcohol intake. In addition, persons at high risk for diabetes were identified using the American Diabetes Association (ADA) Diabetes Risk Screen.[22,23] The project was approved by the Institutional Review Board of the School of Medicine of the University of North Carolina at Chapel Hill.

We administered the questionnaire to 1788 consecutive adult patients who presented for a visit to a medical provider (physician, nurse practitioner, or physician assistant) in 4 family practice offices in North Carolina. Three were private practices in small- or medium-sized towns, and the fourth was a rural community health center; the 4 practices were chosen because their joint patient populations represented a diversity of racial and ethnic groups. As described previously,[17] the network surveyed patients in a practice by placing 1 or 2 trained research assistants in the waiting rooms of each practice for 20 days. Research assistants approached eligible people about participation in the survey, obtained written consent, assisted with survey completion, and gathered completed surveys. Eligibility criteria included a minimum age of 18 years, an appointment on the day of recruitment, absence of acute distress, and ability to comprehend the consent form. Both English and Spanish versions of the consent form and questionnaire were available, and bilingual research assistants were placed in practices with high numbers of Hispanic patients. The overall recruitment rate was 74.8% of eligible patients. These analyses report on the 1714 people (95.9% of respondents) for whom responses were provided to the majority of the nutrition items.

BMI was calculated as reported weight in kilograms divided by the square of the reported height in meters. Nutrition scores for each respondent were calculated as noted previously. A high-quality diet was defined as one rich in protein, fruits, and vegetables and low in saturated fats, sweets, and fast foods.[17–19] Respondents were defined as at "high risk" for diabetes if they scored 10 or higher on the ADA Diabetes Risk Screen and did not report a diagnosis of diabetes.

All descriptive and hypothesis-testing analyses were completed using SAS software.[24] Simple descriptive statistics were used to describe the sample and the distribution of each item in the nutritional habit score. To evaluate the internal consistency of the nutritional habit score, interitems correlations, item-total correlations, and Cronbach α were computed. We also evaluated the distribution of the nutritional habit score for normality by visual inspection of the frequency distribution and Q-Q plots. These assessments indicated that the assumption of a normal distribution was valid, justifying the use of parametric statistical methods. To compare the mean nutritional habit scores across selected patient characteristics, we used analysis of variance, first adjusting only for clinic location. To identify characteristics independently associated with the nutritional habit score, we then estimated a multiple linear regression model, including all characteristics from the bivariate analyses with the exception of BMI. BMI was dropped because it had no association with the nutritional habit score in the bivariate (or multivariable) analyses, and it had a substantial amount of missing data (11.4%). To examine the association between race/ethnicity and each nutritional habit item, binary logistic regression models were estimated for selected items (dichotomized as 3 or more servings vs 0–2 within the specified interval), adjusting for practice location, age, gender, smoking status, alcohol consumption, physical activity, BMI, and self-reported health status. We similarly tested the difference between diabetics and nondiabetics at high risk for the disease with respect to the nutritional habit items, using logistic regression, and adjusting for practice location, age, gender, race/ethnicity, smoking status, alcohol consumption, and physical activity.

Results

Table 1 displays the distribution of selected demographic and health status variables in the study sample. Respondents were racially and ethnically diverse, including 275 African Americans (16.8%), 982 non-Hispanic whites (60.1%), 242 Hispanics (14.8%), and 124 American Indians (7.6%); the mean age was 47.4 years. The mean BMI was 29.6, indicating that the average respondent was overweight and nearly obese. Nearly one half (41.6%) reported having high blood pressure; one third (32.4%) reported depression; and 17.5% reported having diabetes. Application of the ADA Diabetes Risk Screen indicated that an additional 40% were at high risk for developing diabetes.

Scores on the nutrition screening questionnaire are displayed in Table 2. Nearly one third of respondents reported eating fast food meals at least 3 times a week. Sweet drinks were consumed 3 or more times daily, and desserts were consumed 3 or more times a week by 29% and 38% of respondents, respectively. Fewer than one-third of respondents reported eating 3 or more servings of fruits and vegetables daily, and nearly one half reported fewer than 3 high-protein meals per week. The average overall nutritional habit score was 6.01 (SD = 2.73).

When nutrition scores were examined by race/ethnicity, Hispanics had significantly better overall scores because of lower intake of fast foods, sugared drinks, desserts, and high-fat snacks than other groups. African Americans reported the highest consumption of high-fat snacks; American Indians the highest consumption of sugared drinks and desserts and the lowest consumption of protein; and non-Hispanic whites the highest consumption of fast-food meals and desserts. Tables 3 and 4 and Figure 1 display these results.

When nutrition score was examined by health status in bivariate comparisons (Table 3), males, younger respondents, smokers, and alcoholic beverage drinkers had significantly higher mean nutrition scores, and therefore poorer quality diets, compared with their female, older, nonsmoking,

Table 1. Demographic and Health Status of Study Participants (N = 1714)*

	Number	Percentage	Mean	SD	Range
Age (years)			47.4	16.9	18.0, 94.9
Gender					
Male	604	35.3			
Female	1107	64.7			
Education					
8th grade or less	200	11.8			
High school, no diploma	205	12.1			
High school graduate or GED	506	30.0			
Some college, no degree	387	22.9			
Associate's degree	144	8.5			
Bachelor's degree	151	8.9			
Postgraduate school or degree	95	5.6			
Married/living with partner	1052	62.8			
Race/ethnicity					
African American	275	16.8			
White, non-Hispanic	982	60.1			
American Indian	124	7.6			
Hispanic/Latino	242	14.8			
Other	12	0.7			
Practice location					
A	441	25.7			
B	390	22.8			
C	621	36.2			
D	262	15.3			
Current health problems					
Heart disease	210	12.7			
High blood pressure	700	41.6			
Lung disease	97	5.9			
Stroke or mini-stroke	72	4.4			
Depression	538	32.4			
Chronic back pain	478	28.8			
Cancer	76	4.6			
Diabetes	291	17.5			
Osteoarthritis	237	14.4			
Rheumatoid arthritis	150	9.1			
Fibromyalgia	105	6.4			
Self-reported health					
Excellent	142	8.3			
Very good	392	23.0			
Good	575	33.7			
Fair	458	26.8			
Poor	140	8.2			
Drinks alcohol	536	31.7			
Engaged in physical activity in past week	981	59.5			
Physically active 5 days/week, >30 minutes/day	642	39.0			
Current smoker	401	23.6			
Body mass index (BMI)			29.6	7.1	15.0, 64.6
Normal or underweight (BMI <25)	414†	27.3			
Overweight (BMI 25–30)	484	31.9			
Obese (BMI >30)	621	40.9			

* The sample N includes all those who answered the nutritional habit questions. The sample size for individual characteristics varies from 1519 to 1711 because of missing data.
† Includes 30 people classified as underweight (BMI <18.5).

Table 2. Self-Reported Nutritional Habits of Study Participants (N = 1714)*

Item and Response Choices from Nutritional Habits Survey	Number	Percentage
Number of times fast food eaten per week	239	14.6
0		
1 to 2	877	53.4
3 or more	526	32.0
Number of glasses of soda or sweet tea consumed per day	549	32.7
0		
1 to 2	639	38.0
3 or more	492	29.3
Number of times high-fat snacks consumed per week	836	50.4
0 to 1		
2	438	26.4
3 or more	386	23.3
Number of times desserts or sweets consumed per week	610	36.4
0 to 1		
2	433	25.9
3 or more	631	37.7
Amount of margarine, butter, meat fat consumed	729	42.7
None or very little		
Some	787	46.1
A lot	192	11.2
Number of servings of fruits or vegetables eaten per day	568	34.4
3 or more		
2	562	34.1
1 or less	519	31.5
Number of times lean protein eaten per week	947	56.5
3 or more		
1 to 2	674	40.2
0	55	3.3
Overall Nutritional Habit Score (0–14), Mean (SD)†	6.01	(2.73)

* The sample N includes all those who answered at least 5 of the 7 nutritional habit questions. The sample size for individual items varies from 1642 to 1708 because of missing data.

† Scored as the sum of the 7 items, each 0 to 2, with higher scores reflecting poorer nutritional habits. If 2 or fewer items were missing, values for missing items were imputed as the mean of the nonmissing items. Cronbach's α for the score is 0.558, and item total correlation range from 0.069 (lean protein consumption) to 0.407 (high-fat snack consumption). The median value is 6, and the most common (modal) value is 7.0, indicating very little skew. Visual inspection of the distribution and Q-Q plot indicate that the assumption of a normal distribution (and the application of parametric statistical tests) is valid.

nondrinking counterparts. Reported levels of physical activity, self-reported health, and BMI were not significantly associated with nutrition score. Multiple linear regression confirmed these results (Table 4), except that in these analyses the relationship between alcohol intake and nutrition score was reduced to borderline statistical significance (P = .106), and physical activity had a stronger although still not statistically significant (P = .097) association with better nutritional habits.

Both high- and low-risk nondiabetics had poorer nutritional scores than diabetics (Table 3). When nondiabetics at high risk of developing diabetes were compared with diagnosed diabetics, their poorer nutrition scores were seen to be largely due to higher rates of intake of sugared drinks and desserts and lower rates of consumption of fruits and vegetables (Figure 2).

Discussion

Nutrition has a major and well-documented impact on health and chronic illnesses. Healthy eating habits such as consumption of fruits and vegetables,[25–28] lean protein sources, adequate fiber,[29] and foods with a low glycemic index and saturated fat content have been implicated in weight loss, in improved prevention and survivorship after chronic illness, and in promoting healthy blood cholesterol, blood pressure,[30] blood lipids,[31,32] and glycemic control.[12,33] Likewise, unhealthy dietary behaviors have been associated with numerous negative

Table 3. Relationship between Nutritional Habit Score and Selected Demographic and Health Status Variables (N = 1714)

Variable	Nutritional Habit Score Mean	SD	*P* Value*
Race/ethnicity			
African American	6.27	2.79	.297
American Indian	6.57	2.56	.759
Hispanic/Latino	5.10	2.45	<.001
Other	5.62	2.13	.285
White, non-Hispanic	6.12	2.79	—
Diabetes/pre-diabetes			
Not diabetic and low risk	6.12	2.74	<.001
Not diabetic and high risk	6.43	2.68	<.001
Diabetic	5.06	2.64	—†
Sex			
Male	6.36	2.65	<.001
Female	5.82	2.75	—
Age			
18 to 44 years old	6.42	2.76	<.001
45+ years old	5.67	2.67	
Smoking status			
Nonsmoker	5.73	2.68	<.001
Smoker	6.91	2.70	—
Alcohol consumption			
Do not drink alcohol	5.87	2.68	.002
Drink alcohol	6.32	2.81	—
Physically active 5 days/week, >30 minutes/day			
No	6.09	2.65	.350
Yes	5.94	2.85	—
Self-reported health status			
Fair/poor	5.91	2.57	.493
Good/very good/excellent	6.07	2.81	—
BMI			
Normal or underweight	5.99	2.90	.632
Overweight	6.25	2.69	.431
Obese	6.11	2.68	—‡

* Based on ANOVA with nutritional habit score as the dependent variable and the specified demographic or health status characteristic as the independent variable and adjusting for practice location.
† *P* value for comparison of low risk versus high risk among nondiabetics is .097.
‡ *P* value for comparison of normal/underweight versus overweight is 0.243.

health outcomes and chronic diseases, including hypertension, insulin resistance and type 2 diabetes, obesity, cardiovascular disease, osteoporosis, and several cancers.

Persons with chronic illness and risk factors for chronic disease tend to be concentrated in the everyday office practices of family physicians and other primary care specialists.[17] The study respondents described in this paper, a random sample of adults from 4 family practice settings in North Carolina that serve a wide range of ethnic and racial groups, had high levels of disease risk and chronic disease. Forty percent engaged in no regular physical activity; 24% were current smokers; 18% had diabetes; 42% had hypertension; and 13% had a history of heart disease. Of particular note is the high prevalence of obesity in these people (41%) and the fact that more than a third (40%) scored "high risk" on the ADA Diabetes Risk Screen.[20,21] Obesity has been

Table 4. Multiple Linear Regression for Nutritional Habit Score (N = 1424)

Variable	Estimate	SE	*P* Value
Intercept	7.682	0.329	<.001
Race/ethnicity			<.001*
African American	0.363	0.198	.067
American Indian	−0.109	0.342	.750
Hispanic/Latino	−1.284	0.273	<.001
Other	−0.726	0.892	.416
White, non-Hispanic	reference		
Diabetes/prediabetes			<.001†
Not diabetic, low risk	0.538	0.215	.013
Not diabetic, high risk	1.164	0.199	<.001
Diabetic	reference		
Male gender	0.571	0.148	.001
Age (per year)	−0.041	0.005	<.001
Practice location			.003‡
A	0.300	0.205	.143
B	−0.257	0.215	.232
C	0.628	0.283	.027
D	reference		
Smoker	0.834	0.168	<.001
Drinks alcohol	−0.262	0.162	.106
Physically active 5 days/week, >30 minutes/day	−0.245	0.147	.097
Self-reported health status as very good or excellent	−0.102	0.159	.521

* Overall type 3 *P* value for race/ethnicity (4 df); additional pairwise comparisons in which $P < .05$ include African American versus Hispanic/Latino ($P < .001$) and American Indian versus Hispanic/Latino ($P = .005$).
† Overall type 3 *P* value for diabetes status (2 df); *P* value for pairwise comparison of high and low risk nondiabetics is <0.001.
‡ Overall type 3 *P* value for clinic location (3 df). Pairwise comparisons that are significant at $P < .05$ include A versus B ($P = .004$) and B versus C ($P < .002$).

strongly linked with the likelihood of developing diabetes and other chronic illnesses,[7,8] and these 2 patient groups might particularly benefit from interventions aimed at preventing the development and complications of lifestyle-related chronic illness.

The results of this study suggest several ways in which nutritional interventions may target subgroups of primary care patients. As is shown in Tables 3 and 4, younger age and better self-reported health are associated with poorer nutrition scores. Although this does not suggest that the lifestyle habits of patients with existing chronic illness can be ignored by primary care providers, it seems that patients at known risk for chronic illness, such as persons with prediabetes, may be particularly appropriate targets for nutrition-related screening and services.

We were not surprised to find that the reported nutritional habits of known diabetics were better than those of prediabetics (Figure 2). Of course, it is possible that people with the disease reported healthier habits because they know the "right answers"; however, a more likely explanation is that diabetics, by virtue of the education that is part of health care for that diagnosis, understand the advantages of healthier eating. They have, therefore, made changes to improve their diet in response to the disease state. On the other hand, patients at high risk of developing diabetes, some of whom no doubt already have the (undiagnosed) disease, may not have the same sense of urgency to improve their diet as do known diabetics. Thus, it would seem that intense clinical and public health efforts, if targeted at people who were at high risk of developing disease and disability, might help forestall the development of these diseases and their complications.

As family medicine moves toward identifying practice models that focus more on chronic disease care and prevention, the role of the family medicine office in promoting nutritional health, physical activity, and other healthy habits may well increase. In this context, identification and management of

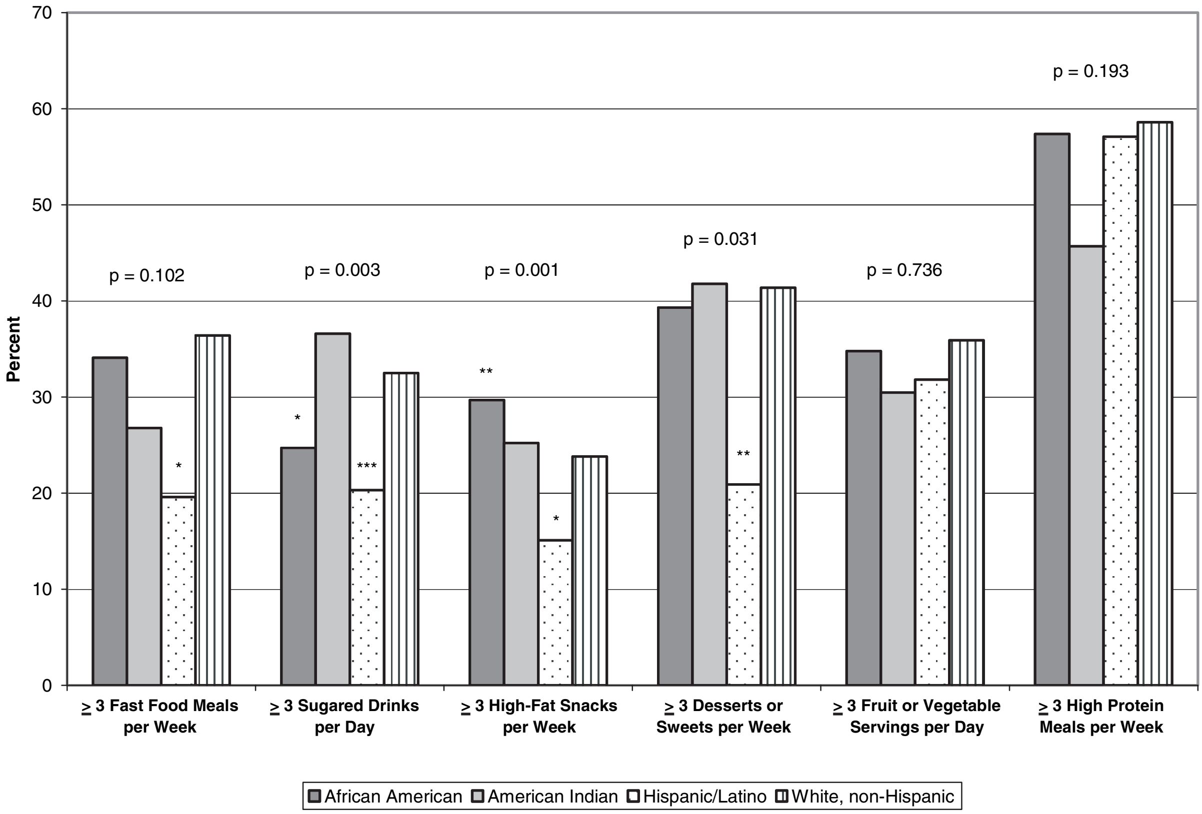

Figure 1. Racial and ethnic differences in the percentage of respondents reporting selected nutritional habits. *P* values are based on logistic regression models with given food habit as the dependent variable and race/ethnicity as the independent variable, adjusted for clinic site, age, sex, smoking status, alcohol consumption, physical activity, self-rated health, and BMI. N ranges from 1323 to 1357, depending on missing data for the food habit. Percentages are not adjusted. *, $P < .05$; **, $P < .01$; and ***, $P < .001$ for comparison with white, non-Hispanic respondents.

high-risk patients may become an increasingly important aspect of primary care. Examples of such target groups might include persons who have prediabetes or people making the transition from adolescence to early adulthood.[34,35]

The benefits of primary prevention, including maintaining an optimum body weight, eating a healthy diet, exercising, and not smoking, in prevention of chronic illness have been known for many years. With the increased time and financial constraints in today's primary care practice, one of the challenges is choosing which populations to target to maximize the impact of efforts aimed at reducing chronic disease risk. These data suggest that the primary care office may be an ideal setting to carry out this case identification and, perhaps, also the subsequent efforts at risk reduction. Thus, screening for chronic disease risk, coupled with a short screen for nutritional habits, initial counseling, and links with existing community resources may be worth testing.

Of particular importance is the translation of intensive interventions like the Diabetes Prevention Program into more practical approaches that can be feasibly implemented in a practice setting.[12] Currently, a series of primary care-based studies are exploring this question, under funding from the Robert Wood Johnson Foundation Prescription for Health initiative.[36] By building on the increased knowledge about behavior change that has developed in the community and public health areas over recent decades, they will hopefully provide new insights into feasible methods by which primary care practices can help prevent nutrition-related chronic illness.

This research study was conducted by the North Carolina Family Medicine Research Network (NC-FM-RN). The NC-

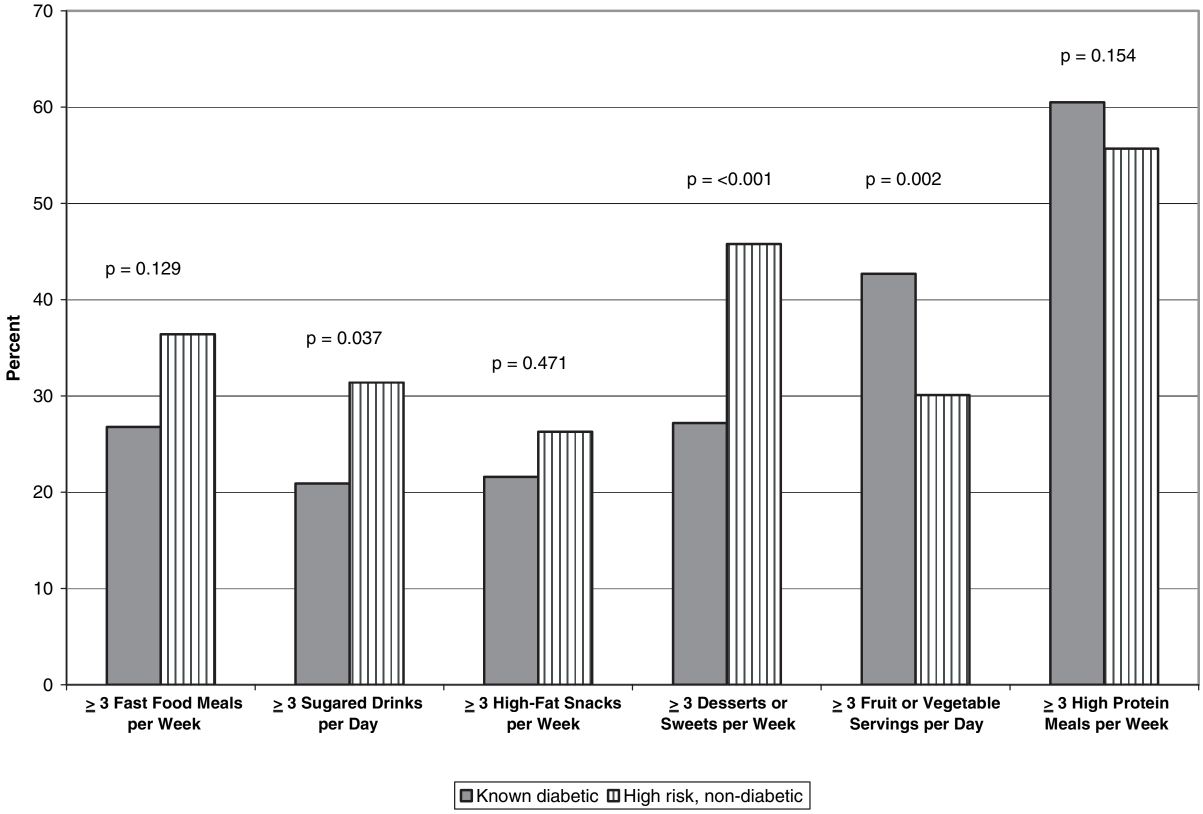

Figure 2. Comparison of selected nutritional habits of diabetics with those of nondiabetics who are at high risk for the disease. *P* values are based on logistic regression models with given food habit as the dependent variable and diabetes group as the independent variable, adjusted for clinic site, age, sex, race, smoking status, alcohol consumption, and physical activity. N ranges from 801 to 822, depending on missing data for the food habit. Percentages are unadjusted.

FM-RN is jointly sponsored by the Department of Family Medicine, the Thurston Arthritis Research Center, and the Cecil G. Sheps Center for Health Services Research at the University of North Carolina at Chapel Hill (UNC-CH), in collaboration with the North Carolina Academy of Family Physicians. The project codirectors are Leigh Callahan, PhD, and Philip Sloane, MD, MPH. Participating family practices have included: Biddle Point Health Center, Charlotte; Bladen Medical Associates, Elizabethtown; Black River Health Services, Atkinson and Burgaw; Blair Family Medicine, Wallace; Chatham Primary Care, Siler City; Community Family Practice, Asheville; Cornerstone Medical Center, Burlington; Crissman Family Practice, Graham; Dayspring Family Medicine, Eden; Goldsboro Family Physicians, Goldsboro; Henderson Family Health Center, Hendersonville; Lumber River Family Practice, Lumberton; Moncure Community Health Center, Moncure; North Park Medical Center, Charlotte; Orange Family Medical Center, Hillsborough (pilot site); Person Family Medical Center, Roxboro; Pittsboro Family Medicine, Pittsboro; Prospect Hill Community Health Center, Prospect Hill; Robbins Family Practice, Robbins; South Cabarrus Family Physicians, Harrisburg, Concord, Mt. Pleasant, and Kannapolis; Summerfield Family Practice, Summerfield; and Village Family Medicine, Chapel Hill. Activities of the NC-FP-RN have been supported by the Centers for Disease Control and Prevention, the Agency for Healthcare Research and Quality, the National Institutes of Health, the Department of Family Medicine at UNC-CH, and the Program on Health Outcomes at UNC-CH. In addition, the study would like to acknowledge the work of Ana Cerna, Nicole Collins, Samantha Earnhardt, Laura Hinson, Karishma Patel, William Bradford, and Julia Thorp, each of whom made significant contributions to the data collection process.

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