Dietary patterns in blacks and Hispanics with diagnosed diabetes in New York City's South Bronx[1–3]

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ABSTRACT

Background: An understanding of dietary patterns in diverse populations may guide the development of food-based, rather than nutrient-based, recommendations.

Objective: We identified and determined predictors of dietary patterns in low-income black and Hispanic adults with diagnosed diabetes.

Design: A food-frequency questionnaire was used to assess dietary intake in 235 adults living in the South Bronx, New York City, NY. We used principal factor analysis with promax rotation to identify dietary patterns. Multivariate linear regression models were used to test associations between demographic variables and dietary pattern scores.

Results: The following 5 dietary patterns were identified: pizza and sweets, meats, fried foods, fruit and vegetables, and Caribbean starch. The Caribbean starch and fruit and vegetables patterns were high in fruit and vegetables and low in *trans* fats. In multivariate analyses, sex, language spoken, years living in the United States, and region of birth were significant predictors of dietary patterns. Compared with English speakers, Spanish speakers were less likely to have high scores in pizza and sweets (P = 0.001), meat (P = 0.004), and fried food (P = 0.001) patterns. Participants who lived longer in the United States were less likely to have a meat (P = 0.024) or Caribbean starch pattern ($P < 0.001$). In Hispanics, the consumption of foods in the Caribbean starch pattern declined for each year that they lived in the United States.

Conclusions: In adults with diagnosed diabetes who were living in the South Bronx, a Caribbean starch pattern, which included traditional Hispanic and Caribbean foods, was consistent with a healthier dietary pattern. In developing dietary interventions for this population, one goal may be to maintain healthy aspects of traditional diets. This trial was registered at clinicaltrials.gov as NCT00797888. *Am J Clin Nutr* 2013;97:878–85.

INTRODUCTION

Low-income blacks and Hispanics have high rates of diabetes, have poor control of diabetes, and are at high risk of diabetes-related complications (1–3). An individual's diet is an integral part of diabetes management. To develop effective dietary interventions for any group, it is important to first understand the dietary patterns in that population. A dietary pattern analysis allows for the examination of the relations between types of foods and combinations of foods consumed (4, 5), and the findings of such an analysis can guide the development of food-based recommendations. Dietary pattern analyses have shown health-protective effects of prudent dietary patterns (ie, diets characterized by high intakes of fruit and vegetables and low intake of fat) (6, 7). Higher disease risk has been shown in individuals who consume a Western dietary pattern characterized by higher intakes of saturated fats, processed foods, and refined grains (7–12).

There are limited dietary pattern data for black and Hispanic populations published in the scientific literature. Food consumption varies by culture and is influenced by food access and socioeconomic status, and thus, dietary patterns derived from one population may not be fully applicable to another population (5, 13). Black and Hispanic populations in the United States are diverse, and factors such as acculturation and adherence to traditional eating patterns affect diet. Distinct dietary patterns have been identified in Mexican Americans (14, 15) and Puerto Ricans (16) living in the United States. Dietary patterns have also been shown to differ between blacks and whites enrolled in multicentered studies (17, 18). However, few studies have examined dietary patterns in a culturally diverse black and Hispanic population.

New York City is a heterogeneous population with a variety of cultural and historical origins that may influence dietary intake. The South Bronx, where this study was conducted, is a predominantly low-income, urban population. In the Bronx, 36% of residents are non-Hispanic black, 53% of residents are Hispanic (primarily from Puerto Rico and the Dominican Republic), 68% of residents have completed a high school education, and 28% of residents are below the poverty level (19). Residents of the South Bronx have high rates of obesity (31.8%) and diabetes (13.8%) (20).

The goal of this study was to identify dietary patterns in black and Hispanic adults with diagnosed diabetes residing in the South Bronx and to determine predictors of the identified dietary patterns. An understanding of dietary patterns in this population will allow us to develop food-based interventions and health messages that are

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more applicable to this target population, which is disproportionately impacted by obesity, diabetes, and related complications.

SUBJECTS AND METHODS

We selected a random sample of participants enrolled in the Bronx A1c study (21) to complete a modified Block food-frequency questionnaire (FFQ). The Bronx A1c study was a 1-y randomized behavioral intervention trial that compared incremental effects of a telephonic diabetes self-management intervention plus print materials compared with print materials alone on hemoglobin A_{1c}. All participants in the Bronx A1c study were recruited from the New York City Department of Health and Mental Hygiene A1c Registry, and participants or their providers may have received some A1c Registry support (eg, a letter) to improve their diabetes control (22). The Bronx A1c study enrolled 941 participants, who were recruited by telephone, with suboptimally controlled diabetes (defined as hemoglobin A_{1c} >7%) who lived in the South Bronx. The study was approved by the Committee on Clinical Investigations at Albert Einstein College of Medicine and the Institutional Review Board at the New York City Department of Health and Mental Hygiene.

The collection of dietary data began ∼1 y after recruitment and was initiated in the parent study (ie, the Bronx A1c). The behavioral intervention in the Bronx A1c study included dietary counseling, and thus, only newly enrolled participants (n = 713) were eligible to complete the FFQ (**Figure 1**). Because of the length of the FFQ and the time needed for administration, we randomly assigned newly enrolled participants to complete the FFQ or not. All FFQs were administered via telephone and were completed before delivery of the behavioral intervention.

Assessment of dietary intake

Dietary intake was assessed by using a modified version of the Block 2005 Spanish FFQ that includes food lists derived from the NHANES. The Block 2005 Spanish FFQ includes the 103-item core food list plus 9 additional foods appropriate for several Hispanic subgroups (23). Four of these additional foods (ie, evaporated and condensed milk; pudding and flan; viandas, plantain, and cassava; and sauces such as mole and sofrito) were considered more important in the diets of Cuban and Puerto Rican Americans than in the diets of Mexican Americans. Five of these foods were more important in the diets of Mexican Americans (ie, corn tortillas, flour tortillas, cooked green peppers and chile rellenos, avocado and guacamole, and chile peppers and hot chili sauce). The Block 2005 Spanish FFQ was shown to be a valid measure of dietary intake compared with 4-d food records (r = 0.57) (23).

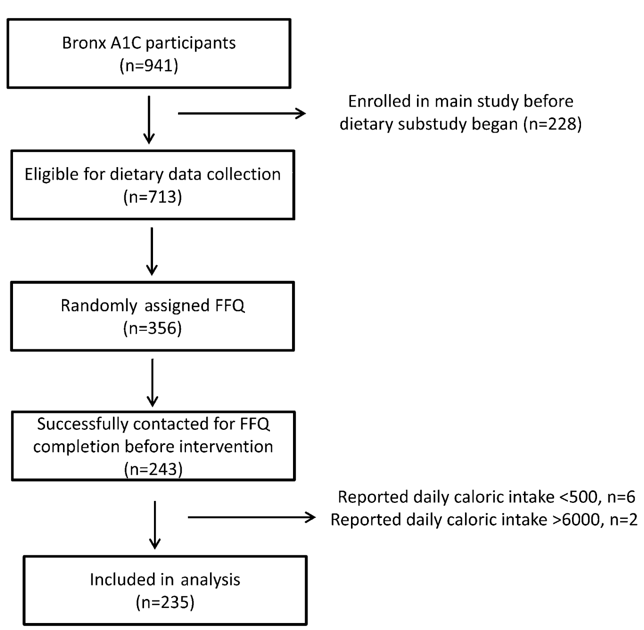

FIGURE 1. Participant selection for the FFQ. FFQ, food-frequency questionnaire.

We further tailored the Block 2005 Spanish FFQ to assess dietary intakes of Bronx A1c participants from the Caribbean, who are predominantly Hispanic. To tailor the FFQ, 4 health educators from Hispanic and Caribbean backgrounds, who were experienced in counseling diabetes patients in this community, reviewed food items on the Block 2005 Spanish FFQ. Food items that were considered to be uncommon in this population (eg cottage cheese) were eliminated, whereas foods thought to be more common (eg, fried cheese) were added. The questionnaire was further abbreviated by asking about multiple related foods within one question. The first 20 participants who completed the modified FFQ were asked whether there were food items that they ate frequently that were not included in the questionnaire and whether there were any additional food items that they thought should be included. These initial participants did not identify any additional foods for inclusion.

The final Bronx A1c FFQ asked about 156 food items and 11 beverages. Three summary questions asked about servings of fruit and servings of vegetables consumed daily. For each food item, participants were asked the frequency of consumption and the portion consumed. Frequency responses included 9 choices that ranged from never to every day. To evaluate portions consumed, participants used 2-dimensional picture cards that included portion sizes that ranged from one-quarter cup to 2 cups of food (23). For foods that were consumed >1 time/d, interviewers were trained to record the total of the portion size reported. For example, if participants reported eating 1 cup (240 mL) of rice 2 times/d, interviewers would record the frequency as every day and the portion size as 2 cups. Four health educators (3 of whom were bilingual) were trained to administer the FFQ by telephone in English or Spanish on the basis of participant preference. Participants were mailed frequency response cards and portion-size cards 1 wk before the interview and had the cards available during the interview. Responses to the FFQ were entered into the electronic FFQ available online through NutritionQuest.

Statistical analysis

Portion-size and frequency responses for each item on the FFQ were recoded into frequency-per-day indexes. Food items from the FFQ were further categorized into food groups on the basis of nutritional properties (categorizations are shown in **Table 1**). Foods that were consumed often, such as rice, or foods with nutritional properties that differed significantly from existing food categories, such as pizza, were entered as individual food items. These categorizations resulted in 15 food classes that were entered into the factor analysis. Principal factor analysis with promax rotation was used to identify dietary patterns.

TABLE 1
Food groupings entered into factor analysis

	Examples of food items included in group
Eggs	Eggs
Cultural meats	Tacos, burritos, liver, pig feet, goat meat, oxtails
Processed meats	Lunch meats, hot dogs, sausage
Fresh fruit	Bananas, apples, pears, oranges, tangerines, mango, pineapple
Vegetables	Broccoli, carrots, spinach, lettuce
Pasta	Macaroni and cheese, spaghetti, other noodles
Rice	Rice
Starchy vegetables[1]	Yucca, cassava, starchy green banana, plantain, yautia
French fries	French fries, fried potatoes, hash browns
Fish	Tuna, salmon, sardines, mackerel, canned fish, codfish, shrimp, fried fish
Beans	Pinto beans, black beans, kidney beans, pigeon peas, baked beans
Pizza	Pizza
Fried chicken	Fried chicken, chicken nuggets, chicken wings, chicken sandwiches
Breads	Biscuits, bread, hamburger buns, rolls, cornbread, muffins, tortillas
Sweets	Doughnuts, cake, cookies, pastry, pie, any candy, ice cream, syrup, jelly, jam

[1] Starchy vegetables were not included in the calculation of vegetable servings per day.

Rotated factors were retained on the basis of eigenvalues >1, and factor loadings >0.3 for at least one item. Factor scores were calculated for each participant. The median split of factor scores categorized scores as high compared with low. Thus, participants with high scores consumed more of the foods loaded on that dietary pattern. Mann-Whitney *U* tests compared nutrient intake (total calories, percentage of calories from fat, saturated fat, *trans* fats, carbohydrate, protein, and fiber) and daily servings of fruit, vegetables (nonstarchy vegetables), and whole grain in high compared with low scorers in each pattern. Mann-Whitney *U* or chi-square tests compared demographic characteristics [ie, age, sex, race, ethnicity, preferred language (English or Spanish), region of birth, years in the United States, income, and education] in subjects who had high compared with low factor scores in each dietary pattern. Multivariate linear regression models tested associations between demographic variables and scores of each dietary pattern. A regression analysis was done with the Huber-White robust variance estimator to account for nonnormally distributed residuals and unequal variances. Demographic variables included in each model were years in the United States, sex, race, ethnicity, preferred language (English or Spanish), region of birth, income, and education. The initial univariate analyses suggested potential differences in associations on the basis of marital status in men, length of time in the United States in Hispanics, and place of birth. Thus, the regression model tested for the following interactions: sex × marriage, ethnicity × years in the United States, and region of birth × ethnicity. Analyses were done with SPSS software (version 19.0; IBM Corporation) and Stata software (version 12.1 MP; StataCorp LP).

RESULTS

In 713 newly enrolled participants in the Bronx A1c study, 356 subjects were randomly assigned to complete the FFQ; 243 participants were reached by telephone and completed the FFQ. We excluded results that reported a daily caloric intake <500 cal (*n* = 6) or > 6000 cal (*n* = 2), which left 235 FFQs included in the analyses. Demographic characteristics of participants who completed the FFQ compared with participants who did not are shown in **Table 2**. Participants who completed the FFQ were more likely to report having received diabetes education compared with those who did not complete the FFQ (21% compared with 10%; $P < 0.001$). Participants who reported having received diabetes education were demographically similar to those who did not receive diabetes education. In addition, as seen in Table 2, participants who completed the FFQ were more likely to be women ($P = 0.02$) and have some college education ($P = 0.046$).

A factor analysis identified the following 5 dietary patterns named according to the foods that loaded highly for each pattern: pizza and sweets, meats, fried foods, fruit and vegetables, and Caribbean starch (**Table 3**). The pizza and sweets dietary pattern was characterized by high loadings of pizza, sweets (eg, cakes, donuts, and candy), breads, pasta, and fried chicken. The meats pattern was characterized by high loadings of eggs, processed meats, and cultural meats (eg, goat and oxtail). The fried foods pattern was characterized by high loadings of French fries and fried chicken. The fruit and vegetables pattern was characterized by high loadings of fresh fruit, nonstarchy vegetables, and fish. The Caribbean starch pattern was characterized by high loadings of starchy vegetables (eg, yucca, yautia, and plantains), rice, and beans.

The identified dietary patterns differed in nutrient intakes. Nutrient intakes in high and low scores of each pattern are shown in **Table 4**. Within each pattern, high scores were associated with a higher caloric intake and higher fiber intake. High scores in the pizza and sweets, meats, and fried foods patterns were associated with higher saturated fat and *trans* fat intakes. High scores on the Caribbean starch pattern were significantly associated with lower intakes of saturated fat and *trans* fat. High scores on the meats, fruit and vegetables, and Caribbean starch patterns were also associated with higher daily servings of nonstarchy vegetables.

Demographic characteristics of participants with high compared with low scores for each pattern are shown in **Table 5**. Participants with high scores on the pizza and sweets pattern were younger, less likely to be Hispanic, more likely to have been born in the United States, and reported living more years in the United States. Participants with high scores on the meats

TABLE 2
Demographic characteristics of participants who completed the FFQ compared with all participants in the Bronx A1c study[1]

Demographic characteristics	Completed FFQ (n = 235)	Did not complete FFQ (n = 478)
Age (y)	56.51 ± 11.9[2]	56.33 ± 12.0
Sex [n (%)][3]		
M	69 (29.4)	183 (38.3)
F	166 (70.6)	295 (61.7)
Married [n (%)]	72 (30.6)	273 (38.9)
Years in the United States	28.2 ± 15.4	29.6 ± 15.2
Ethnicity [n (%)]		
Hispanic	164 (69.8)	322 (67.4)
Black	64 (27.2)	133 (27.8)
White	2 (0.85)	7 (1.5)
Other	5 (2.1)	16 (3.4)
Language [n (%)]		
English speaking	105 (44.7)	204 (42.7)
Spanish speaking	130 (55.3)	274 (57.3)
Place of birth [n (%)]		
Born in North America	82 (34.9)	163 (34.1)
Born in Caribbean	132 (56.2)	252 (52.7)
Born in Central America	11 (4.7)	33 (6.9)
Elsewhere	10 (4)	30 (6.3)
Annual family income [n (%)]		
<$20,000	153 (77)	318 (77)
$20,000–$29,000	20 (10)	48 (12)
$30,000–$39,000	10 (5)	20 (5)
$40,000–$49,000	10 (5)	12 (3)
≥$50,000	5 (3)	15 (4)
Education [n (%)][3]		
<12th grade	105 (45)	251 (53)
Grade 12 or GED	61 (26)	125 (26)
More than high school	69 (29.3)	102 (21.3)

[1] Categorical variables are presented as the number and percentage of subjects among FFQ completers or noncompleters. FFQ, food-frequency questionnaire; GED, General Educational Development.

[2] Mean ± SD (all such values).

[3] $P < 0.05$.

pattern were also younger, more likely to be men, and had lower incomes than did participants with low scores. Participants with high scores in the fried foods pattern were younger, more likely to be men, lived more years in the United States, and were less likely to speak Spanish. Age was the only significant demographic difference in participants with high compared with low scorers on the fruit and vegetables pattern, with older participants having a lower score ($P = 0.03$). For the Caribbean starch pattern, participants with high scores reported living fewer years in the United States, were more likely to be Hispanic, and were more likely to be born in the Caribbean.

In the multivariate analysis seen in **Table 6**, sex, language spoken, years living in the United States, and place of birth remained significant predictors of dietary patterns. Men had significantly higher scores for each pattern identified. Participants who spoke Spanish had lower scores on the pizza and sweets ($P < 0.005$), meats ($P < 0.005$), and fried foods ($P < 0.005$) patterns. Participants who had lived longer in the United States were also less likely to have a meats ($P < 0.05$) or Caribbean starch ($P < 0.005$) pattern. Ethnicity did not independently predict any of the dietary patterns; however, a significant interaction between ethnicity and years in the United States was observed for the Caribbean starch pattern ($P < 0.05$). In Hispanics, the consumption of foods in the Caribbean starch pattern declined for each year that they lived in the United States. We did not observe a consistent association between income or education and dietary patterns; participants with a higher education (more than high school) had lower scores on the Caribbean starch pattern ($P < 0.05$), and participants with a higher income had higher scores on the Caribbean starch pattern ($P < 0.05$).

DISCUSSION

We used exploratory factor analysis to examine dietary patterns in a culturally diverse, low-income, primarily black and Hispanic population with diagnosed diabetes. Five distinct dietary patterns emerged, 3 of which were high in saturated fat, *trans* fat, and processed foods and are considered an unhealthy dietary pattern similar to previously identified Western dietary patterns. The fruit and vegetables pattern and the Caribbean starch pattern were high in nonstarchy vegetables and lower in *trans* fat. In addition, the Caribbean starch pattern was lower in saturated fat. These 2 patterns were more consistent with previously identified prudent dietary patterns.

Studies that focused on specific ethnic groups frequently yielded dietary patterns characterized by foods traditionally consumed by that group (14–16, 24). Associations between these traditional patterns and disease risk have been debated, and some studies suggested that the maintenance of traditional dietary patterns is associated with increased chronic disease risk. In Puerto Rican older adults living in Boston, a traditional pattern that consisted of rice, beans, and oils was identified and shown to be associated with increased risk of metabolic syndrome (16). A study in urban Mexicans showed that a traditional Mexican pattern characterized by high intakes of energy from tacos, tortillas, and sweetened beverages was associated with increased risk of metabolic syndrome (24). Neither of these studies identified a traditional healthier dietary pattern. In contrast, the Caribbean starch pattern identified in our analysis was high in fiber and vegetables and lower in saturated and *trans* fat and was more consistent with a healthier dietary pattern. Our future studies will examine the role of these identified dietary patterns with obesity and diabetes control.

Ethnicity was not independently associated with dietary pattern scores; however, in Hispanics, participants who lived longer in the United States had lower scores on the Caribbean starch pattern. This finding, coupled with the finding that participants who spoke Spanish had lower scores on the pizza and sweets, fried foods, and meats patterns, suggested the important role that

TABLE 3
Identified dietary patterns

	Foods
Pizza and sweets	Breads, sweets, pasta, pizza, fried chicken
Meats	Eggs, processed meats, cultural meat
Fried foods	French fries, fried chicken
Fruit and vegetables	Fresh fruit, vegetables, fish
Caribbean starch	Yucca, pinto beans, rice

TABLE 4
Nutrient intakes in high compared with low scores for each dietary pattern[1]

Nutrient intakes	Factor scores	Pizza and sweets	Meats	Fried foods	Fruit and vegetables	Caribbean starch
kcal/d	Low	1036 (570)	998 (499)	1073 (639)	1095 (713)	1102 (971)
	High	1884 (953)	1900 (1012)	1782 (1041)	1695 (1008)	1602 (782)
P		<0.001	<0.001	<0.001	<0.001	<0.001
Total fat (percentage of total kcal)	Low	38.5 (8)	37.6 (9)	37.6 (9)	39.3 (8)	40.8 (8)
	High	40.5 (8)	40.5 (7)	40.9 (7)	39.3 (8)	38.3 (7)
P		0.151	0.012	0.013	0.354	0.014
Saturated fat (percentage of total kcal)	Low	11.1 (4)	11 (4)	10.7 (4)	11.5 (4)	12 (4)
	High	11.9 (3)	12 (3)	12.0 (3)	11.4 (3.2)	11 (3)
P		0.010	0.001	<0.001	0.117	0.012
trans Fat (percentage of total kcal)	Low	0.7 (0.4)	0.8 (0.5)	0.7 (0.4)	1.0 (0.6)	0.9 (0.5)
	High	1.0 (0.5)	0.9 (0.5)	1.0 (0.5)	0.8 (0.4)	0.8 (0.4)
P		<0.001	0.001	<0.001	0.001	0.001
Carbohydrate (percentage of total kcal)	Low	45.6 (11)	46.7 (12)	46.3 (11)	45.2 (11)	43.2 (11)
	High	43.0 (9)	42.6 (8)	42.6 (8)	43.3 (10)	45.6 (10)
P		0.073	<0.001	0.002	0.658	0.170
Protein (percentage of total kcal)	Low	17.2 (4)	16.9 (3)	17.1 (4)	16.4 (3)	17.2 (4)
	High	17.4 (4)	17.4 (4)	17.4 (4)	17.6 (4)	17.4 (4)
P		0.745	0.016	0.642	<0.001	0.763
Fiber (g/kcal)	Low	12.6 (9)	11.0 (8)	14.0 (11)	10.3 (7)	11.5 (10)
	High	17.2 (10)	18.4 (9)	16.2 (10)	18.9 (8)	16.9 (8)
P		<0.001	<0.001	0.006	<0.001	<0.001
Fruit (servings/d)	Low	0.8 (0.8)	0.8 (0.8)	1.0 (0.9)	0.6 (0.8)	0.9 (0.8)
	High	1.0 (1.1)	1.0 (1.1)	0.9 (0.9)	1.0 (1.4)	1.0 (1.0)
P		0.208	0.199	0.228	<0.001	0.267
Nonstarchy vegetables (servings/d)	Low	2.1 (2.2)	1.9 (1.9)	2.2 (2.2)	1.3 (1.6)	1.7 (1.9)
	High	2.2 (2.2)	2.5 (2.3)	2.1 (2.0)	3.0 (2.3)	2.5 (2.4)
P		0.176	0.008	0.730	<0.001	0.002
Whole grains (servings/d)	Low	0.5 (0.9)	0.4 (0.8)	0.5 (0.9)	0.4 (0.9)	0.5 (1.7)
	High	0.6 (1.8)	0.8 (1.8)	0.7 (1.8)	0.8 (1.7)	0.5 (1.6)
P		0.137	0.002	0.063	0.002	0.248

[1] All values are medians; interquartile ranges in parentheses. High scores were defined as those above the median. Low scores were defined as those below the median.

acculturation may play in the abandonment of traditional dietary patterns. In Hispanics, the healthfulness of the diet has been shown to decrease during acculturation (25), and adults with less acculturation had higher intakes of fruit, rice, and beans and lower intakes of sugar and sugar-sweetened beverages. We did not directly measure acculturation at baseline; however, factors such as language preference and years in the United States are frequently used proxies for acculturation (26, 27). Our findings suggested that Hispanics who lived in the United States longer and who spoke English had less healthy dietary patterns. As dietary interventions are developed to target these populations, one aspect of dietary education may be to encourage and provide strategies for the maintenance of healthy aspects of traditional diets.

Our univariate analyses showed that younger participants scored higher on pizza and sweets and fried foods patterns, which may have suggested higher intake of fast foods. We did not specifically ask about fast-food intake, but combinations of foods such as fried chicken and French fries, which constituted our fried foods pattern, are common, inexpensive meal combinations in local fast-food restaurants. Fast-food usage in younger populations, primarily adolescents, is well documented (28, 29); however, the mean age of our participants was 57 y, with few participants who were younger than 40 y old, and we did not expect to see these age-related differences in dietary patterns within this narrow age range.

Surprisingly, we did not observe an association between income, education, and any of the identified patterns. Previous studies have shown positive associations between income and fruit and vegetable intake (30). The lack of association may have been due to the narrow income range in this population, with ∼80% of our population who reported an annual household income <$20,000. Participants who had high scores on the fruit and vegetables pattern reported an average of 1.4 fruit servings/d and 3.2 vegetable servings/d. Although these values are still below daily recommendations (31), it will be important to learn how these participants achieved these higher intakes of fruit and vegetables within the potential limitations of income and access to healthy foods.

All participants in this study have a diagnosis of diabetes, which may have contributed to why the healthier dietary patterns observed in this population were not observed in other studies of dietary patterns in diverse populations. Twenty percent of participants who completed the FFQ reported having received some diabetes education in the past, and it is possible that some participants made changes in their diets as a result of having a diagnosis of diabetes. It is also possible that participants who have received previous education may have overreported their fruit and vegetable intake because they have been taught about

TABLE 5
Univariate associations between demographic characteristics and high compared with low scores for each dietary pattern[1]

Demographic characteristics	Factor scores	Pizza and sweets	Meats	Fried foods	Fruit and vegetables	Caribbean starch
Age (y)	Low	59 (14)[2]	60 (17)	59 (15)	59 (20)	59 (15)
	High	54 (15)	55 (14)	54 (15)	56 (14)	55 (15)
P		<0.001	<0.001	<0.001	0.028	0.117
Sex (%)						
M	Low	29	17	22	72	76
	High	40	42	37	69	65
F	Low	75	83	78	28	24
	High	66	58	63	31	35
P		0.106	<0.001	0.013	0.637	0.057
Marital status (%)						
Single	Low	74	77	75	76	81
	High	73	69	72	70	65
Married	Low	26	22	25	23	18
	High	27	31	28	29	35
P		0.852	0.172	0.630	0.284	0.005
Years in the United States	Low	31 (18)	38 (29)	31 (29)	41 (29)	45 (28)
	High	42 (31)	38 (31)	43 (29)	31 (29)	28 (29)
P		0.003	0.998	0.006	0.079	<0.001
Ethnicity (%)						
Hispanic	Low	80	73	77	73	60
	High	61	68	64	68	80
Non-Hispanic	Low	20	27	23	27	40
	High	39	32	36	32	20
P		0.002	0.398	0.023	0.398	0.001
Race (%)						
Black or African American	Low	39	44	44	47	61
	High	60	56	55	53	38
White	Low	33	30	28	29	22
	High	20	22	24	23	30
Asian	Low	1	0	1	0	0
	High	0	1	0	1	1
American Indian/Alaskan	Low	2	2	2	1	0
	High	1	1	1	2	3
More than one race	Low	21	24	23	22	16
	High	16	18	19	21	27
P		0.076	0.375	0.572	0.679	0.015
Language (%)						
English speaking	Low	27	36	32	43	57
	High	63	55	58	47	33
Spanish speaking	Low	73	64	68	57	43
	High	37	45	42	53	67
P		<0.001	0.003	<0.001	0.560	<0.001
Place of birth (%)						
North America	Low	17	22	18	33	42
	High	53	42	46	31	22
Caribbean	Low	72	66	68	54	46
	High	40	46	43	58	66
Central America	Low	6	4	8	5	7
	High	3	5	2	4	3
Elsewhere	Low	5	8	6	8	6
	High	3	7	9	7	9
P		<0.001	0.009	<0.001	0.943	0.003
Income (%)	Low	86	86	80	81	75
<$20,000	High	68	68	74	73	80
$20,000–29,000	Low	7	7	11	9	13
	High	13	13	9	11	7
$30,000–39,000	Low	3	3	5	3	5
	High	7	7	5	7	5
$40,000–49,000	Low	3	1	2	5	6
	High	7	9	8	5	4
≥$50,000	Low	1	2	1	1	1
	High	4	3	4	4	4
P		0.058	0.027	0.233	0.420	0.401

(Continued)

TABLE 5 (*Continued*)

Demographic characteristics	Factor scores	Pizza and sweets	Meats	Fried foods	Fruit and vegetables	Caribbean starch
Education (%)						
<12th grade	Low	57	52	54	47	40
	High	32	37	35	43	50
Grade 12 or GED[3]	Low	22	27	23	25	30
	High	30	25	29	26	22
More than high school	Low	21	20	23	28	31
	High	38	38	36	31	28
P		0.001	0.007	0.011	0.827	0.272

[1] High scores were defined as above the median, low scores below the median.
[2] Median; interquartile range in parentheses (all such values).
[3] GED, General Educational Development.

increasing fruit and vegetables in their diet, and this could have been a socially desirable response. Our study was limited by its cross-sectional nature, and we do not know if participants made any dietary changes. Future analyses from these data will examine whether the identified dietary patterns are associated with clinical variables, including weight and glycemic control.

Our findings should be interpreted in the context of the following limitations. First, there were inherent challenges and biases associated with deciding what foods to include in the dietary pattern analyses. We attempted to initially categorize foods on the basis of their nutrient properties and to include foods consumed frequently. However, it is possible that the initial food groupings may have resulted in some bias in the way patterns emerged. A factor analysis based on the individual food items, although preferable, would have required a much-larger sample. There were also inherent biases with the use of FFQs to collect dietary data. FFQ data are self-reported and ask participants to report usual dietary intakes over the past few months; thus, FFQs are subject to recall bias. Participants in this study are enrolled in a study that focuses on improving diabetes control, and questions about diet may also be subject to a social desirability bias. Overweight participants, in particular, have been shown to underreport dietary intake (32). In addition, although the Spanish Block FFQ has been validated in previous studies, we did not validate this modified version in our population. Additional research that validates our identified dietary patterns in another sample by using confirmatory factor analysis is needed.

In conclusion, we identified 5 dietary patterns in an urban, low-income, primarily Hispanic and black population with diagnosed diabetes. Sex, language, years in the United States, and region of birth were significant predictors of the dietary patterns. The Caribbean starch pattern identified had features that were consistent with a healthier dietary pattern and Hispanics who lived longer in the United States were less likely to have this pattern. As dietary interventions are developed to target these populations, one important aspect of dietary education may be to encourage

TABLE 6
Multivariate linear regression of demographic predictors of dietary patterns[1]

Variables	Pizza and sweets	Meats	Fried foods	Fruit and vegetables	Caribbean starch
M sex	0.32*	0.58***	0.52***	0.37*	0.35***
Married	0.27	0.18	0.20	0.17	0.25
M sex × married	−0.38	−0.36	−0.39	−0.44	−0.33
Years in the United States	−0.00	−0.01*	−0.00	−0.01	−0.02***
Hispanic ethnicity	−0.11	−0.29	−0.21	0.14	−0.39
Hispanic ethnicity × years in the United States	−0.01	0.01	−0.00	0.01	0.02*
Spanish language preference	−0.54***	−0.53***	−0.57**	0.09	−0.08
North America	0.38*	0.66**	0.30	0.50	0.10
Caribbean	0.09	0.35	0.04	0.35	0.39
Central America	0.00	0.43	0.02	0.37	−0.12
Caribbean × Hispanic	−0.33	−0.24	−0.38	0.07	0.26
High school diploma or GED[2]	−0.11	0.09	0.08	0.16	−0.13
More than high school	−0.11	−0.10	0.03	0.08	−0.25*
$20,000–29,000 income	0.06	−0.13	−0.21	0.11	0.11
$30,000–39,000 income	0.35	0.12	−0.31	0.57*	0.31
$40,000–49,000 income	−0.05	−0.19	−0.22	−0.11	−0.01
≥$50,000 income	−0.02	−0.17	−0.29	0.66	0.72*
Constant	0.08***	−0.23*	0.15***	−0.70	−0.26
R^2	0.27	0.26	0.28	0.13	0.33

[1] *,**,****P* values were calculated by *t* test with Huber-White robust standard errors: *$P < 0.05$, **$P < 0.01$, ***$P < 0.005$.
[2] GED, General Educational Development.

and provide strategies for the maintenance of healthy aspects of traditional diets.

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