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Assessment of dietary intake in an inner-city African American population and development of a quantitative food frequency questionnaire to highlight foods and nutrients for a nutritional invention

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Abstract

Primary objective To characterize the diets of low-income inner-city African Americans to develop a population-specific quantitative food frequency questionnaire (QFFQ) that will be used to highlight foods and nutrients for a nutritional intervention program aimed at reducing the risk of chronic disease and to evaluate the program.

Methods and procedures A cross-sectional survey conducted in inner-city Baltimore, Maryland, USA. Twenty-four-hour dietary recalls were collected in 91 low-income African Americans aged between 18 and 74 years.

Main outcomes and results The average daily energy intake was approximately 2,165 kcal for women and 2,509 kcal for men. The percentages of energy from fat were approximately 34% and 33% for women and men, respectively. Sodas were the main contributor to energy and sugar intake. A 113-item QFFQ was developed.

Conclusions The results highlighted specific foods and nutrients that would be targeted in the nutritional intervention. The QFFQ developed is culturally appropriate and specific for low-income African Americans in inner-city Baltimore.

Keywords: *Dietary assessment, quantitative food frequency questionnaire, low-income African Americans, nutritional intervention*

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Introduction

Urban minority populations in the United States have disproportionately high levels of obesity and other diet-related chronic diseases (Kumanyika 1993; Dorn et al. 1997; American Heart Association 1998; Flegal et al. 1998; Sowers 1998; Must et al. 1999; Office of epidemcology and planning Baltimore City Health Department 2008; Field et al. 2001; Jacobson et al. 2002; Mirza et al. 2004). African Americans (AfAms), particularly females, have much higher rates of obesity compared with Caucasians (aged 20 years and over) (Melanson et al. 2001). Age-adjusted death rates for diet-related chronic diseases such as cancer, heart disease, stroke and diabetes mellitus are higher among AfAm men and women than for Caucasians, Hispanics and Asian/Pacific Islanders (National Center for Health Statistics, Centers for Diseases Control and Prevention 2007). Substantial evidence suggests that improving diet and nutrition could reduce the risk of diabetes, cancer and cardiovascular diseases that would result in decreasing the incidence, mortality and the economic cost of these chronic diseases (World Cancer Research Fund & American Institute for Cancer Research 1997; Van't Veer et al. 2000; Gundgaard et al. 2003; Rissanen et al. 2003; Ahmed 2004; Eyre et al. 2004; Key et al. 2004; Venn and Mann 2004; US Department of Health and Human Services and U.S. Department of Agriculture 2005; Williams and Hord 2005).

When compared with other populations in the United States, AfAms tend to have diets of poorer quality such as being lower in fruits, vegetables, milk and whole grain products (Basiotis et al. 1998; Gary et al. 2004; Sharma et al. 2004). The diet of low-income AfAms in particular tends to be high in fat and sugar and low in fiber (Kristal et al. 1999; Robinson and Hunter 2001; Tucker et al. 2005). These dietary patterns contribute to the significant health disparity between AfAms and other major ethnicities in the United States and are attributable to multiple factors, including income, culture, education and environment (Liu et al. 1996; Kristal et al. 1999; Tucker et al. 2005).

To address the significantly worsening problem of diet-related chronic diseases among the underserved inner-city low-income AfAms, culturally appropriate nutritional intervention programs are needed. Baltimore Healthy Stores (BHS) is a food store program in Baltimore City targeting a low-income AfAm population with high rates of obesity and food assistance use. The intervention program seeks to improve diet and reduce risk factors for obesity and chronic disease by increasing the availability of healthy food options and promoting these foods at the point of purchase, similar to other studies (Curran et al. 2005; Vastine et al. 2005). However, limited data exist on food intake and the foods contributing to overall dietary intake for many inner-city low-income AfAm populations on which to design appropriate intervention programs. Nutritional interventions must consider and emphasize foods that significantly contribute to the overall diet and should make recommendations for changing dietary behaviors based on the relative contributions of these foods. Therefore, an assessment of usual dietary intake is essential in order to develop culturally appropriate nutritional interventions that focus on appropriate foods, nutrients of concern, and target high-risk relevant segments of the population.

In addition, culturally sensitive evaluation instruments are important components of a successful intervention program. To our knowledge, there are no recently developed instruments for assessing usual long-term total dietary intake (foods, nutrients, food groups, food consumption frequency, and individual portion sizes

consumed) in an inner-city low-income adult AfAm population. Such an instrument would also enable the monitoring of the nutrition situation and highlight areas that may need improvement in the future.

This study, as part of the process of developing the BHS intervention program, characterizes the diets in low-income inner-city Baltimore AfAms, and demonstrates how this information was incorporated into the development of a quantitative food frequency questionnaire (QFFQ) used to highlight foods and nutrients for the intervention program and to assess the impact of the intervention on overall diet.

Methods

Setting

The study took place in East and West Baltimore. East Baltimore comprises 23 of the 200 census tracts of the city, and is 96% AfAm, with 57% of the households headed by females. Twenty-two to 36% of households with children have incomes below the poverty line (Baltimore Neighbourhood Indicators Alliance 2006). The area has many small food sources, which predominately consist of carryout restaurants, corner and liquor stores. Other food sources include the North East Market (an indoor market) and a few supermarkets, mostly from the Stop Shop and Save chain.

West Baltimore comprises 24 census tracts, with a population that is 92% AfAm with 28% of the households headed by females. Twenty-one percent of households with children have incomes below the poverty line (Baltimore Neighbourhood Indicators Alliance 2006). Like East Baltimore, the West side has many small food stores. Other food stores include several supermarkets, full-service and fast-food restaurants, corner and convenience stores.

Sampling and subjects

The aim was to capture a diverse population to represent residents aged $\geq$18 years of East and West Baltimore to document the large range of foods consumed. AfAm race was determined by self-reporting. To capture lower-income residents, we targeted the Community Action Centers that cater to low-income residents and provide services such as assistance and/or referrals for energy and crisis intervention, health services, education, literacy, jobs, housing, substance abuse and programs for youths and seniors. The respondents are described as low income as they were sampled from low-income areas and in Community Action Centers that are provided specifically for low-income people. As our program would be targeting stores and supermarkets, we also recruited subjects from a supermarket. The aim of this phase was primarily to obtain the amounts and types of foods consumed to enable the development of a comprehensive QFFQ.

Participants were those who attended the Centers or who were shopping in local food stores and responded to announcements requesting recruitment for a survey on food consumption and purchasing habits.

The study was approved by the Johns Hopkins Bloomberg School of Public Health Committee on Human Research and signed informed consent was obtained from all participants.

Twenty-four-hour dietary recall collection

The 24-h dietary recall collection was performed by five graduate students from the School of Public Health, Johns Hopkins University, who were trained for one week by the first author (S.S.). A lecture, demonstration, role-play and observation were used to assure standardization of collection procedures and a high level of data quality. A manual of procedures (30 pages) was developed and closely followed.

Upon meeting the respondent, a brief introduction of the project and the reasons for conducting the recalls were given. The 24-h dietary recall interviews systematically elicited information about foods and drinks consumed during the preceding 24-h period. Portion size was assessed using familiar local utensils such as a Styrofoam containers of fried rice, standard units such as a slice of bread, or three-dimensional food models (NASCO MODESTO 2005) that had been carefully chosen to best estimate the amount consumed after undertaking focus group discussions with some local participants and our AfAm data collectors who were familiar with the setting.

Each interviewer was given a set of food models as well as Styrofoam containers, cups, glasses, and spoons purchased from local stores. For every food item, the following information was recorded on the dietary assessment form: place where the food was obtained, amount consumed (assessed using food models, local utensils and/or standard units), additions such as salt, sugar, butter, margarine, gravy, skin on the chicken, and method of cooking. Additional questions were asked to capture basic socio-demographic information including ethnicity, status of food assistance participation, types of food stores used (major supermarkets and/or corner stores), and frequency of use of each type of food store. Following completion of the recalls, a series of standardized check questions were asked, such as types of oil and fat, and types of milk consumed. These data provided additional information to better assess the most appropriate food composition data to analyze our recall and later QFFQ data. Questions also included prompts for easily forgotten foods such as sweets, alcohol and snacks. We also included questions on smoking, supplement/multivitamin consumption, and any special dietary practices the respondent followed such as a weight-loss diet, or a low-fat diet. All data were examined by the project coordinator; if any data were incomplete, the interviewer was asked to re-contact the respondent for the additional information. Respondents who provided a single recall were compensated with a supermarket gift certificate of $5. The recalls covered both weekdays and weekend days.

Portion weights

In order to put a weight to the portion sizes that were reported, multiple measurements of each food were obtained from various sources using electronic Salter kitchen scales (Aquatronic Baker's Dream Scale; Salter Houseware Ltd., Fairfield, NJ, USA). For example, 10 take-out containers of pan-fried potatoes were weighed from each source such as the supermarkets, corner stores and restaurants, and the average weight was calculated. The non-ethnic specific portions such as bags of chips were obtained using national standard units, or published data (Pennington and Douglass 2005). For mixed and composite dishes, weight of the whole food item as well as the weight of each ingredient was measured. The portion weights were obtained for approximately 100 different food items reported in the 24-h dietary recalls.

Dietary intake analyses

The 24-h dietary recalls were coded by giving a gram weight to every portion reported. All of the dietary data were entered and analyzed using Nutribase Clinical Nutrition Manager version 5.18 (CyberSoft Inc., Phoenix, AZ, USA), which calculated nutrient intakes and food group servings for all foods reported in the recalls.

Nutribase Clinical has a research quality nutrient database analyzing 121 nutrients and calories for a variety of food items using the USDA National Nutrient Database for Standard Release as the foundation. In Nutribase Clinical, the nutrient composition of each food item was analyzed along with the number of the food group servings per 100 g. To evaluate the overall quality of the diet, we compared our food group servings with those recommended (U.S. Department of Agriculture [USDA] 1996). All other data analyses were undertaken using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA).

To highlight the foods for the BHS intervention program we determined the major foods contributing to the intake of energy, fat and sugar and analyzed food contribution to these nutrients (presented later).

Development of the QFFQ

To develop a QFFQ, three main components are needed: a complete food list, locally appropriate portion models/utensils and consumption frequency categories. We composed our food list by tabulating all foods reported in the 24-h dietary recalls. In addition, foods were added that had not been reported but that would be promoted as part of the intervention in order to track changes in consumption post-intervention such as baked potato chips, low-fat milk, and high-fiber, low-sugar cereals. Foods were grouped into categories and sequenced to make the most sense to local respondents. For example, because of the high amounts of carryout foods consumed in this population, take-out sandwiches and fast foods were listed first on the QFFQ. Based on the information on portion size recorded in the 24-h dietary recalls, locally appropriate three-dimensional food models, household utensils or standard units were assigned to each food item on the QFFQ.

To highlight any possible omissions on the QFFQ, such as the completeness of the food list due to seasonality and the accuracy of the portion size descriptors, a pilot-test was conducted. Data collection took place in the Community Action Centers by the trained students. To ensure that we captured all the foods consumed by our study population, blank lines were added under each food category for respondents to report any additional foods that had not been included such as seasonal foods. No additional foods were reported. Revisions involved adding more food models to make it easier for respondents to state their usual portion sizes. The order of the foods listed on the draft QFFQ was further revised to make the QFFQ more acceptable to the respondents.

Results

Ninety-one low-income respondents completed the dietary recalls. The majority of the sample (96%) described themselves as AfAm. Subjects themselves had volunteered on hearing the announcement to recruit subjects (in the Community Action Centers or stores) to find out more about eating habits for $5. None of these individuals declined to participate. The analyses presented here are from 84 recalls;

60 women and 24 men. Excluded from the analysis were four incomplete recalls and three outliers with caloric intake in excess of 5,000 kcal as all these subjects reported they had eaten more than usual on the day recalled. The age range of the respondents was 18–74 years (mean age: men 45 years, women 38 years; median age: men 47 years, women 38 years). Fifty-one respondents (61%) lived in East Baltimore and 33 (39%) lived in West Baltimore. Food assistance was used by 46% of respondents; 31% received Food Stamps, 2% women, infants and children (WIC) and 13% both Food Stamps and WIC.

Table I presents the mean and median daily energy and nutrient intakes of AfAm males and females derived from the 24-h dietary recalls, and provides comparison data of AfAms from the National Health and Nutrition Examination Survey III (NHANESIII) (Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics 2002). The median daily energy intake was approximately 2,407 kcal for men and 1,989 kcal for women, both of which were higher compared with the median energy intake of the AfAms in NHANESIII. The median percentages of energy from carbohydrate in our sampled men and women were higher than that in NHANES III (52% vs. 49% in women and 51% vs. 46% in men). AfAm men had much higher mean intake of vitamin A compared with women due to the high consumption of sweet potatoes that was reportedly consumed by two low-income AfAm men in this study. However, in general, dietary fiber intake and intake of vitamin A, niacin, riboflavin, thiamin, vitamins B-6, C, D, E and K, folate, calcium and zinc were all lower in our sample compared with the median intake of national AfAm men and women.

Table II presents the 10 major food sources of energy, fat and sugar. Sodas were the largest contributor to energy (approximately 10%). Chicken (mainly fried) was the second largest food source of energy (approximately 8%) but the largest food source of fat intake (12%). Sodas, chicken and eight other foods contributed to approximately 50% of total energy intake. Fruits and vegetables did not contribute substantially to the diet or to vitamin intake in the sampled inner-city low-income AfAms (data not shown). Frankfurters and sausages made the second highest contribution to total fat intake (8%). Sodas were the single largest source of sugar intake, contributing one-third of all sugar in the diet. Drinks including fruit punch, fruit cocktail drink, iced tea and sweetened tea were the second highest contribution to sugar (15%). Approximately 84% of sugar intake was provided by the top 10 food/drink items.

Table III presents food group consumption compared with USDA recommendations and data for adult AfAm from Continuing Survey of Food Intakes by Individuals, 1994–96 (CSFII 1994–96) (USDA 1996; Food Surveys Research Group 2000). AfAm men and women in our sample consumed less than the recommended number of servings of dairy products and vegetables, but consumed meat and meat alternatives far above the numbers recommended. The intake of dairy products and vegetables was lower compared with AfAm men and women in CSFII 1994–96. AfAm women in our sample consumed less fruit and grain than the USDA recommendations. Mean fruit intake was slightly higher than for women in CSFII 1994–96 while grain intake was lower.

Table I. Daily energy and nutrient intake in inner-city low-income African American adults in Baltimore in comparison with NHANESIII.

	Women			Men		
	BHS ($n=60$)		NHANESIII[a] ($n=637$)	BHS ($n=24$)		NHANESIII[b] ($n=356$)
	Mean ± standard deviation	Median	Median	Mean ± standard deviation	Median	Median
Energy (kcal)	2,165 ± 894	1,989	1,764	2,509 ± 1,071	2,407	2,379
Energy (kJ)	9,071 ± 3,746	8,334	7,391	10,513 ± 4,487	10,085	9,968
Fat (g)	85 ± 45	74	67	94 ± 53	86	89
Saturated fat (g)	28 ± 18	25	21	28 ± 17	24	28
Monounsaturated fat (g)	21 ± 17	19	25	26 ± 18	27	34
Polyunsaturated fat (g)	9 ± 10	7	14	11 ± 11	9	17
Protein (g)	81 ± 52	67	63	79 ± 40	74	88
Carbohydrate (g)	276 ± 118	261	212	332 ± 166	298	264
Sugar (g)	157 ± 76	142	–	169 ± 96	158	–
Dietary fiber (g)	9 ± 6	8	11	14 ± 8	11	13
Cholesterol (mg)	364 ± 306	230	200	331 ± 286	245	322
Vitamin A (μg-RE[c])	611 ± 1,707	306	362	1,191 ± 4,040	298	495
Vitamin B-6 (mg)	1.0 ± 0.9	0.8	1.3	1.4 ± 1.1	1.2	1.8
Vitamin B-12 (μg)	48 ± 66	22	2.8	45 ± 74	15	4.0
Niacin (mg)	15 ± 12	12	16	18 ± 10	16	25
Riboflavin (mg)	1.2 ± 1.1	1.1	1.3	1.1 ± 0.8	0.9	1.8
Thiamin (mg)	1.0 ± 0.8	0.8	1.2	1.2 ± 0.8	1.0	1.7
Total folate (μg)	132 ± 149	90	164	195 ± 209	130	235
Vitamin C (mg)	125 ± 363	43	62	131 ± 155	48	82
Vitamin D (μg)	0.8 ± 2.2	0	2.1	0.3 ± 0.9	0	2.8
Vitamin E (mg)	2.6 ± 2.9	2.1	6.5	4.6 ± 6.1	3.4	7.4
Vitamin K (μg)	0.6 ± 3.1	0	64	1.2 ± 4.4	0	68
Calcium (mg)	570 ± 406	459	463	644 ± 560	551	627
Iron (mg)	12 ± 10	8	10	13 ± 9	11	14
Zinc (mg)	9 ± 10	6	8	6 ± 4	5	11
% energy from fat	34 ± 9	34	35	33 ± 11	32	34
% energy from carbohydrate	51 ± 12	52	49	51 ± 13	51	46
% energy from protein	15 ± 6	14	14	13 ± 5	13	15

[a]Black, non-Hispanics, aged between 30 and 39 yrs (Department of Health and Human Services, Centers of Disease Control and Prevention, National Center for Health Statistics 2002). [b]Black, non-Hispanics, aged between 40 and 49 years (Department of Health and Human Services, Centers of Disease Control and Prevention, National Center for Health Statistics 2002). [c]Retinol equivalent.

Development of the QFFQ

The final QFFQ developed includes all foods and drinks reported. It has 113 food items in 17 categories: sandwiches = 16, meats and sausages = 8, Chinese foods = 2, egg dishes = 1, chicken or turkey dishes = 7, fish and other sea foods = 5, pasta, rice and pizza = 5, potatoes = 7, other vegetables = 12, fruits = 10, snacks = 4, cakes and

Table II. Ten major sources and their percentage contribution to energy, fat and sugar intakes from 24-h dietary recalls among inner-city low-income African American adults in Baltimore.

Food item	% contribution to energy	Food item	% contribution to fat	Food item	% contribution to sugar
Sodas	9.5	Chicken dishes	12.1	Sodas	34.1
Chicken dishes	8.2	Frankfurters and sausages	8.1	Sweetened drinks	15.2
Breads	6.0	Chips	6.3	Sweetened Juices	9.0
Cake and pastries	4.2	Meat dishes	5.2	Sugar and syrup	8.3
Sandwiches and burgers	4.0	Margarine and butter	5.2	Cake and pastries	4.2
Sweetened Drinks	3.8	Cake and pastries	5.1	Candies	4.1
Chips	3.7	Mayonnaise, salad dressings	4.9	Ice cream, any kind	3.2
Pasta dishes	3.3	Sandwiches and burgers	4.5	Cookies	2.5
Meat dishes	3.1	Cheese, any kind	4.3	Fruits	2.1
Candies	2.9	Eggs dishes	4.0	Cereals	1.6
Total	48.7	Total	59.7	Total	84.3

desserts = 13, soups = 2, cereals = 4, milk = 8, drinks = 6 and alcohol = 3. The food and drink items listed on the QFFQ are shown in Appendix 1.

Appendix 2 displays a sample page of the final QFFQ and the frequency categories, which range from 'never or less than 1 time per month' to '2 or more times per day'. The QFFQ assesses usual food and drink items consumed over the previous 30 days and is interviewer-administered, using three-dimensional food models, standard units and familiar local utensils to estimate usual amounts consumed.

Discussion

Our study population had a high consumption of sweetened beverages and high-fat foods. In contrast, fruit and vegetable intake was extremely low, with two-thirds of the respondents reporting no fruit consumption and three-quarters of the respondents reporting no vegetable consumed during the previous day (data not presented).

Our findings are consistent with other studies on AfAm diet, including Yanek et al. (2000) who also used 24-h dietary recalls in 185 inner-city AfAm women and reported the mean percentage of energy provided by fat to be 32%, comparable with our finding of 34%. In the Black Women's Health Study, in which the investigators used three 24-h dietary recalls collected during different seasons of the year, the percentage of energy from fat was 32.5% (Kumanyika et al. 2003). Compared with the Women's Health Study, intakes for energy (2,165 kcal vs. 1,510 kcal), total fat (85 g vs. 56.7 g) and protein (81 g vs. 56.5 g) were much higher in our study population.

In addition to nutrients, examining intake by food groups permits recommendations that can be more easily translated into public health messages for the BHS program. We used the number of daily servings for adults recommended by the USDA

Table III. Mean daily frequency of servings of food groups in inner-city low-income African American adults in Baltimore compared with non-Hispanic Black CSFII men and women and the USDA dietary guidelines.

Food group	Recommended servings for adult men and women[a]	Total BHS men and women (mean ± standard deviation)	BHS men (mean ± standard deviation)	CSFII men[c] (mean)	BHS women (mean ± standard deviation)	CSFII women[c] (mean)
Dairy	2–3[b]	0.9 ± 1.5	0.6 ± 1.1	1.5	1.0 ± 1.6	1.2
Meat and meat alternatives	2–3	7.8 ± 7.4	7.1 ± 5.6	8.0	8.0 ± 8.0	4.7
Vegetable	3–5	0.7 ± 1.0	0.6 ± 0.9	3.9	0.7 ± 1.0	2.8
Fruit	2–4	1.9 ± 2.8	3.3 ± 4.0	1.4	1.4 ± 2.0	1.3
Grain	6–11	4.9 ± 2.7	7.3 ± 5.8	7.4	4.0 ± 2.9	4.9

[a]USDA Food Guide Pyramid recommendations (USDA 1996; US Department of Health and Human Services 2005) for daily energy intake: 1,601–2,200 calories: six servings grain, three servings vegetables, two servings fruit, two to three servings dairy, 5 oz meat or meat alternatives; 2,201–2,800 calories: nine servings grain, four servings vegetables, three servings fruit, two to three servings dairy, 6 oz meat or meat alternatives; more than 2,800 calories: 11 servings grain, five servings vegetables, four servings fruit, two to three servings dairy, 7 oz meat or meat alternatives. [b]Adults over the age of 50 years need three servings daily (USDA 1996; US Department of Health and Human Services 2005). [c]USDA Continuing Survey of Food Intakes by Individuals, 1994–96; non-Hispanic black, aged 20 years and over (Food Surveys Research Group 2000).

that was current at the time of our study. These were, depending on age and energy intake: for fruits, 2–4; vegetables, 3–5; dairy, 2–3; meats, 2–3 and grains, 6–11 (US Department of Health and Human Services 2005). In our study, the inner-city low-income AfAm women tended to consume fewer than recommended servings of fruits and vegetables. Other studies on AfAm adults have reported similar findings (Barnhart et al. 1998; Gary et al. 2004). A pilot intervention study targeting inner-city AfAm women found that pre-intervention ($n = 33$), fruit and vegetable intake was approximately 1.2 servings per day (Barnhart et al. 1998). The low intake of fruits and vegetables is a major concern in this population. As fruit and vegetable consumption has an established association with the decreased risk of many chronic diseases (World Cancer Research Fund and American Institute for Cancer Research 1997; Van't Veer et al. 2000; Gundgaard et al. 2003; Rissanen et al. 2003; Eyre et al. 2004), it is imperative to increase intake of these foods.

The dietary data were used to develop a QFFQ to evaluate the BHS intervention program's impact. The food names, the portion size and the frequency of consumption differ greatly among different populations. Instruments developed to evaluate an intervention program must be culturally sensitive and include the appropriate foods in an appropriate order for that population. The QFFQ needs to be culture specific and sensitive enough to detect sometimes subtle change between pre and post intervention (Cade et al. 2002; Sharma et al. 2008a).

To develop a QFFQ for a specific population, one must first obtain an appropriate food list (Willett 1998; Shahar et al. 2003). The foods selected must be frequently eaten and contain a significant amount of the nutrients of interest (Willett 1998; Cade

et al. 2002; Stark 2002). We developed a QFFQ specifically for our population based on current eating habits as we have done in our other studies (Sharma et al. 2007a, 2007b, 2008). We composed our food list by aggregating the foods reported in the 24-h dietary recalls collected from the study population. The sequence and grouping of foods on the QFFQ are based on what is locally appropriate for this population and the manner of reporting foods in the dietary recall. As is recommended (Stark 2002) in the development of food frequency questionnaires, food grouping should fit in within respondents' 'conceptual framework'. The food list cannot be endless and, for practical reasons, some food grouping is necessary. Our instrument was driven by the study population, thus it followed the logical order that was clear to them. For example, sandwiches were almost always bought ready-made by the study participants so meats from sandwiches were not separated and placed under the 'meats' category on the QFFQ; Participants did not consider sandwich meat as meat; rather, they considered sandwiches as a separate category. Grouping the foods rather than listing their ingredients better facilitates probing by the interviewers and it eases the respondent to recall the consumption of the food items. To prevent double-counting of ingredients, the interviewers were trained to clearly probe for those meats that were consumed alone and not as part of sandwiches.

We undertook focus group discussion with local participants on determining the appropriate portion sizes for our study population. Many of our sampled low-income inner-city AfAms lived in one-bedroom apartments without cooking facilities and obtained ready-prepared foods for most of their meals. Therefore, most of their portion sizes were provided by the local take-out restaurants or corner stores that cater to their needs. For example, Styrofoam cups were used from the take-out stores as food models on the QFFQ to assess the culturally specific take-out portions. We also used local utensils and three-dimensional food models on the QFFQ to assess usual portion sizes for other foods as has been recommended (Cade et al. 2002).

Our results highlighted specific foods to be targeted in the BHS program, an intervention aimed at reducing risk of diabetes and other chronic diseases in inner-city low-income AfAm populations. The main objective of the BHS intervention program is to promote increased consumption of low-sugar, low-fat and high-fiber foods, with concurrent reductions in the intake of their less healthy and more commonly consumed unhealthy alternatives. Data from the recalls enabled us to target specific foods based on the population's current eating patterns, such as reducing sugar intake by recommending sugar free drinks, reducing fat intake by substituting lower-fat snack alternatives for chips, and decreasing the addition of fats to foods and fried foods by working to increase the consumption of fruits and vegetables. All these foods were listed as significant contributors to sugar and fat intake from the 24-h dietary recall analysis.

A comprehensive dietary assessment strategy is essential to evaluate a nutritional intervention. QFFQs have been previously used for this purpose to assess overall dietary intake for other study populations (Sharma et al. 2007a, 2007b, 2008a, 2008b). Our QFFQ is interviewer-administered, which has been shown to be more feasible than multiple dietary recalls in community studies with AfAms (Yanek et al. 2001). The QFFQ we developed for the inner-city low-income Baltimore AfAms is currently being used to evaluate the impact of the nutritional intervention program. The same methodology for developing QFFQs has been used to evaluate similar food store-based intervention programs in other minority populations including American

Indians and First Nations in Canada (Sharma et al. 2007b, 2008a). QFFQs have been used in many nutrition-related intervention studies and were sensitive enough to detect the impact of intervention (Yeh et al. 2003; Bhargava and Hays 2004; Xinying et al. 2004). We intend to use this carefully designed instrument in our larger population studies for which the food frequency questionnaire is the ideal method of choice because of its relatively low expense and ability to capture many components of the diet such as frequency, portion and type of food consumed over a long period of time (30 days plus).

The work described in this study has several limitations. Our sample size was small and nutrient intake estimates were derived from a single 24-h dietary recall. However, multiple recalls would have increased subject burden, which may have decreased study participation. The sampling for this study was not random, which limits our ability to generalize to the rest of the AfAm population in the USA. However, the aim of our sampling frame was to ensure that we had a sample of inner-city Baltimore adult men and women who were both low-income and shopped at local food stores, the characteristics essential for the development of our Baltimore Healthy Stores intervention program.

Conclusions

There is an urgent need to implement a nutritional intervention program among inner-city low-income AfAm populations to reduce risk of chronic disease. The QFFQ we developed is complete and up-to-date for assessing usual food and nutrient intake. Our instrument is being used to evaluate a food-store-based nutritional intervention aimed at increasing consumption of low-sugar, low-fat and high-fiber foods in a low-income urban AfAm population. We will also use this QFFQ to monitor changes in diet over time.

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Supplementary Material

Appendix 1: *Food and drink items listed on the QFFQ*

Category	Food items
Sandwiches (16)*	Ham, turkey, bologna, barbeque loaf sub or sandwich; Sub, cheese steak, steak sandwich; Sandwich with meat patty; Sandwich breakfast without meat; Sandwich, tuna salad; Sandwich, peanut butter with or without jelly; Hot dog or Polish Sausage (on bun); Chili (including on top of the hot dog); Chicken sandwich; Fried fish Sandwich; Bread, white or potato; Bread, whole wheat; Biscuit; Cornbread; Crackers; Butter or margarine;
Meats and sausages (8)*	Meatloaf; Bacon; Breakfast sausages or patties; Scrapple; Steak, all kinds, pan-fried or grilled; Ribs; Fried pork chop; Gravy;
Chinese foods (2)*	Egg Roll; Noodle, stir-fry or fried rice dishes;
Eggs (1)*	Eggs (Any kind)
Chicken/Turkey (7)*	Chicken or turkey baked (BBQ, Rotisserie) drumstick; Chicken baked (BBQ, Rotisserie) thigh or breast; Chicken baked (BBQ, Rotisserie) wingettes or wings; Chicken or turkey fried drumstick; Chicken fried thigh or breast; Chicken or turkey fried wings or wingettes; Chicken nuggets;
Fish and other seafoods (5)*	Fried fish; Grilled fish; Tuna or seafood salad; Crabcake, salmon cakes; Crabs, steamed;
Pasta, rice and pizza (5)*	Pasta in tomato and meat sauce; Pasta in cream sauce, pasta salad, macaroni and cheese; Pizza; Steamed rice and seasoned rice; Oodles of Noodles, Cup of Noodles;
Potato (7)*	Mashed potatoes; Potato salad; French fries, potato wedges; Mayonnaise, regular on sandwiches or fries; Mayonnaise, lite on sandwiches or fries; Hash browns, pan-fried potatoes; Sweet potatoes, yams;
Other vegetables (12)*	Cole slaw; Peas, carrots, mixed vegetables; Green beans, string beans; Collards, spinach, cabbage, other cooked greens; Lima beans; Beans, baked; Corn; Broccoli, cauliflower; Squash, pumpkin; Salad, garden, green;
Fruits (10)*	Fresh fruit salad; Canned fruit or fruit salad in juice; Canned fruit or fruit salad in syrup; Apple, pear; Banana; Orange, tangerine; Grapes; Plums, peaches, nectarines; Cherries, Berries; Melons;
Snacks (4)*	Potato chips, corn chips, regular; Potato chips, baked; Pretzels, low sodium; Nuts;
Cakes and desserts (13)*	Candy bar; Hard candies, small chocolates; Cookies; Cake; Muffin, cupcakes; Donuts, honey buns; Fruit pies; Sweet potato pie; Pancakes, waffles; Ice cream, sundae, frozen yogurt; Ice cream cake, sandwich; Pudding; Yogurt;
Soups (2)*	Soup, not cream; Creamy soups;
Cereals (4)*	Sweet cereals; Less sweet, low fiber cereals; High fiber cereals; Hot cereals;
Milk (8)*	Milk, whole; Milk, 2%; Milk, 1%; Coffee; Tea; Cream; Real sugar; Artificial sweetener;
Drinks (6)*	Soda, regular; Soda, diet; Iced tea, lemonade, half and half, Kool Aid, fruit punch, juice, not 100%; 100% fruit juice; Water; Frozen drink;
Alcohol (3)*	Beer or malt liquor; Wine; Hard liquor;

*Total number of food items in this category.

Appendix 2: *Sample page of the QFFQ*

BALTIMORE HEALTHY STORES FOOD FREQUENCY QUESTIONNAIRE

HOW OFTEN during the last 30 days did you USUALLY eat the following foods and how much do you USUALLY eat at one time? So for example, how often did you eat xxxx during the last 30 days?

Food	Usual Portion Size	Never or less than 1x/30days	1x/30 days	2-3x/30 days	1x/ wk	2-3 x/ wk	4-6 x/ wk	1x/day 7 day/wk	2 or more x/day
SANDWICHES, INCLUDING FAST FOOD/TAKE OUT									
1. Ham, turkey, bologna, barbeque loaf sub or sandwich	#_____6 inch (sub)	(0)*	(1)	(3)	(4)	(10)	(20)	(30)	(60)
2. Sub, cheesesteak, steak sandwich	#_____6 inch (sub)	(0)*	(1)	(3)	(4)	(10)	(20)	(30)	(60)
3. Sandwich with meat patty (hamburger, cheeseburger, sausage)	#_____ sandwiches	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
4. Sandwich breakfast without meat (egg, egg and cheese, biscuit sandwich)	#____sandwiches	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
5. Sandwich, tuna salad	#_____ sandwiches	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
6. Sandwich, peanut butter with or without jelly	#_____ sandwiches	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
7. Hot dog or Polish Sausage (on bun)	#_____ 6 inch	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
8. Chili including on top of the hot dog	#_____small ladles	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
9. Chicken sandwich (like McDonalds, Burger King, etc.)	#_____ sandwiches	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
10. Fried fish Sandwich (incl Lake Trout, McDonalds Filet O Fish), may be home cooked	#_____ sandwiches	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
11. Bread, white or potato, not in sandwich, include rolls and toast 1 roll =2 slices bread	#_____ slices	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)
12. Bread, whole wheat (incl rye bread), not in sandwich, including toast	#_____ slices	(0) *	(1)	(3)	(4)	(10)	(20)	(30)	(60)

*Number in parentheses is the number of times of consumption in one month.