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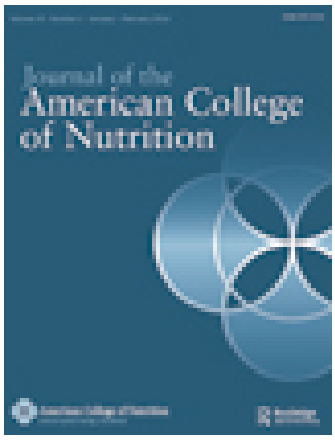

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Food and Nutrient Intake in African American Children and Adolescents Aged 5 to 16 Years in Baltimore City

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Original Research

Food and Nutrient Intake in African American Children and Adolescents Aged 5 to 16 Years in Baltimore City

Fariba Kolahdooz, Jennie L. Butler, Karina Christiansen, Gregory B. Diette, Patrick N. Breysse, Nadia N. Hansel, Meredith C. McCormack, Tony Sheehy, Joel Gittelsohn, and Sangita Sharma

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Key words: dietary assessment, youth food frequency questionnaire, African American, children

Objective: This study aimed to describe food and nutrient intake for low-income, urban African American children and adolescents, to highlight the need for further nutrition intervention programs and appropriate tools to address overweight and obesity.

Methods: This was a cross-sectional study using interviewer-administered single 24-hour dietary recalls. Participants were low-income African American boys and girls aged 5–16 years or their caregivers in Baltimore City. Frequency of food consumption and dietary intakes were analyzed by gender and age groups.

Results: Eighty-one participants were included for analysis. Mean daily energy intakes exceeded Dietary Reference Intakes (DRIs) from 10% to 71% across all gender-age groups: 2304 kcal for children aged 5–8 years; 2429 kcal and 2732 kcal for boys and girls aged 9–13 years, respectively; and 3339 kcal and 2846 kcal for boys and girls aged 14–16 years, respectively. The most frequently reported consumed foods were sweetened drinks, chips, candies, and milk across all age groups. The majority of participants (79–100%) did not meet the DRIs for dietary fiber and vitamin E across all gender-age groups. Milk accounted for 14%, 17%, and 21% of energy, fat, and protein intake, respectively, among children 5–8 years of age, while pizza was the top source of energy, fat, and protein (11%, 13%, and 18%, respectively) among 14-to 16-year-old adolescents. Sweetened drinks and sweetened juices were major sources of sugar, contributing 33% for 5–8 year olds, 29% for 9–13 year olds, and 35% for 14–16 year olds.

Conclusions: Mean daily energy intake exceeded dietary recommendations across all gender-age groups. This study has provided previously unavailable information on diet and highlights foods to be targeted in nutrition intervention programs.

INTRODUCTION

The prevalence of overweight and obesity among children and adolescents in the United States has increased substantially over the past three decades. Currently, childhood obesity affects 17% of children and adolescents aged 2–19 years, the highest rate reported in US history [1,2]. Considerable racial disparities persist among African American and Caucasian children and adolescents, with nearly 39% of African Americans 6–19 years of age overweight and more than 20% obese, compared to 33% and 17%, respectively, of Caucasians in the same age group [1,3]. According to a study by Wang et al. [4] African American adolescents of low socioeconomic status in four Chicago public schools had rates of overweight above 40%. Subsequently, African American and minority children and youth, particularly those in low-income neighborhoods, are at a higher risk than Caucasian children and youth for diet-related chronic diseases, such as metabolic syndrome and type 2 diabetes [5–8]. For the first time in recent history, it was predicted that U.S. life expectancy may decline as a result of the increasing prevalence of childhood overweight [6].

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Concurrent with the increased prevalence of overweight and obesity, American children have inadequate dietary practices, including increased consumption of energy-dense nutrient-poor foods, larger portion sizes [9–12], and more meals and snacks prepared away from home as compared to children in China, Russia, and the Philippines [13]. Soft drink consumption is also increasing among American youth, while intakes of fruits, vegetables, and whole grains are below national recommendations [14–16]. Soda was identified as the top contributor to sugar intake among low-income African American youth in Chicago, and an estimated 55% of the study population was consuming both fried foods and soft drinks ≥2 times/day [17].

Trends seen in poor diet quality are negatively associated with socioeconomic status [18]. In Baltimore City, previous findings have shown that, predominantly African American and lower income neighborhoods have lower accessibility to different types of food stores (e.g., supermarkets, convenience stores, and restaurants) and healthy food in comparison to Caucasian and higher income neighborhoods [19]. An unbalanced diet, meaning a low intake of dairy products, fruits, and vegetables, and a high intake of processed food products, [18] among low-income urban African American households, is reflected by inadequate intake of fiber, vitamins A and C, and calcium, and an excessive amount of saturated and trans fat, added sugar, and sodium [18,20]. Among low-income urban African American youth in Baltimore City, chips, candy, and soda have been reported to be the most commonly purchased foods [21]; these foods are more energy-dense and convenient to access compared to fruits and vegetables, which may be more expensive and take more time to prepare [22]. Results from the 1994–1996 Continuing Survey of Food Intakes by Individuals suggest that low-income American children, in particular, are not consuming a balanced diet [23]. This suggests that African American children and youth, living in lower income neighborhoods, may be especially vulnerable to diets of poor quality and with nutrient inadequacies as a result of these dietary trends and socioeconomic disparities.

Baltimore City, Maryland has a population of approximately 637,000 people, with more than 31% under 18 years of age [26]. Of participants reporting only one racial background, nearly 33% of Baltimore City residents were Caucasian and almost 64% were African American [26]. Median household income in Baltimore City was below the national average by more than 27% in 2007. Approximately 20% of the population lives below the poverty level, compared to the national average of 13%. Among Baltimore City youth, 18.0% have body mass index (BMI) greater than the 95th percentile compared to 12.5% for all Maryland youth according to the 2005 Youth Risk Behavioral Surveillance System [27]. Baltimore African American youth experience a higher rate of obesity (18.0%) than youth of any other ethnic group in the city or state.

Childhood overweight and obesity can be prevented through improved diet quality, thus warranting intervention programs aimed at increasing access to healthy foods and improving food choices [28, 29]. The aims of the present study were to (1) describe food and nutrient intake; (2) compare nutrient intake with Dietary Reference Intakes (DRIs); and (3) identify frequently consumed food items to be included for a nutritional intervention program among urban African American boys and girls aged 5–16 years in Baltimore City, Maryland.

MATERIALS AND METHODS

Settings and Subjects

The study was conducted in low-income neighborhoods of Baltimore City, Maryland. Participants were recruited from various locales within Baltimore City, including recreation centers, human services centers, supermarkets, clinics, local food markets, churches, and organizations, in order to acquire a convenience sample that represented diverse community members with respect to gender and age. Children and adolescents aged 5–16 years were invited to participate in an interviewer-administered 24-hour dietary recall. Participants had to have lived in East or West Baltimore communities within one and a half miles of a Baltimore City recreation center. Only one child per household was eligible to enroll.

Sources of Data

Twenty-Four Hour Dietary Recalls

Dietary recall data were collected from 84 study participants ranging from 5–16 years of age (1 recall per participant) following a standard manual of procedures. Primary caregivers were considered as participants for young children (<8 years). Data collectors were trained for 3 days in the collection of 24-hour dietary recalls by the last author. The data collectors administered face-to-face 24-hour recalls and systematically sought and recorded information about foods and drinks consumed during the preceding 24-hour period. Portion sizes were estimated using standard units (e.g., slice of bread), familiar household utensils (e.g., glass, tablespoon), commercial packages of store-bought foods, such as snack chips and chocolate bars, and three-dimensional food models (NASCO, Fort Atkinson, WI) selected to represent commonly consumed food items. An additional list of questions was generated to prompt for easily forgotten foods such as sweets and snacks. Questions on special dietary practices (e.g., weight loss diet), food allergies, medical conditions, and supplement use were also included. All data were examined for completeness, and if any data were incomplete, the interviewer was asked to re-contact the respondent to acquire additional information.

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Portion Weight Estimation

All foods reported in the 24-hour dietary recalls were weighed to determine weights, in grams, for food portions estimated using household utensils, commercial food packages, food models, or standard units. All food weights were obtained by trained data collectors using an electronic kitchen scale (Aquatronic Baker's Dream Scale 2005, Salter Houseware, Ltd., Tonbridge, Kent, UK). Average gram weights, for all the foods reported, were calculated from up to 10 measurements for each food item.

Identification of Frequently Consumed Food Items and Development of a Draft Youth Food Frequency Questionnaire

The frequency of foods reported in the 24-hour dietary recalls was tabulated. Any food or drink item that was consumed by two or more respondents was included in a draft youth food frequency questionnaire (YFFQ), with the exception of foods very low in energy and nutrients such as condiments and spices. With assistance from local community members and youth leaders, the ordering of the food list and the selection of food models to assess portion sizes were carefully considered for each food item. Focus group discussions revealed that ready-prepared foods are commonly consumed for most meals and snacks; therefore, food packages such as Styrofoam food containers from local corner stores and carry-out restaurants were obtained to aid participants in estimating portion sizes consumed. To ensure no foods had been omitted, blank lines were added to the draft YFFQ for interviewers to record any additional foods reported.

The draft YFFQ was pilot-tested in a convenience sample of Baltimore children and adolescents representing both genders and a distribution of ages between 5 and 16 years. Interviewers were trained for 5 days on how to administer the instrument, and a manual of procedures was developed and used. To ensure standardization of the data collection, each interviewer practiced using multiple draft YFFQs under the supervision of the last author.

Analysis of Dietary Intake

Dietary recall data were entered into and analyzed using NutriBase Clinical Nutrition Manager v. 7.17 software (CyberSoft Inc., Phoenix, AZ). USDA food composition tables were used for dietary analyses. All other analyses were performed using SAS statistical software v. 9.1 (SAS Institute Inc., Cary, NC).

Mean daily energy and nutrient intakes were calculated for each individual based on the single 24-hour dietary recall. Mean nutrient intakes for each participant were compared to the DRIs according to the gender-age groups. The percentage of participants reporting intakes below the DRIs was calculated for specific nutrients and was stratified by gender and age. Nutrient intakes were also evaluated against the Acceptable Macronutrient Distribution Ranges (AMDR) [30]. In addition, the most frequently reported foods were tabulated, and the top 10 foods contributing to energy and macronutrient intakes were determined.

RESULTS

A total of 84 participants were recruited for the study. Three participants were excluded from analysis due to extreme energy intake (above or below mean intake $\pm$ 2 SDs), creating a final sample size of 81 African American participants (40 boys and 41 girls). Of the total sample population, 30% were 5–8 years of age; 35% were 9–13 years of age; and 36% were 14–16 years of age. About 76.5% of participants reported dietary intake during the weekdays (Monday and Thursday each by 17.3%, Tuesday by 12.3%, Wednesday by 16.0%, and Friday by 13.6%) and 23.4% during the weekend (Saturday by 11.1% and Sunday by 12.3%).

Frequency of Consumption

The frequency of consumption of each food item reported in the 24-hour dietary recalls was tabulated for participants in each age group (Table 1). More than 60% of 14- to 16-year-old participants reported consuming chips, sweetened juices, and sodas (66%, 62%, and 62%, respectively). Sweetened drinks, chips, and milk were reported with the highest frequency for both the younger age groups. Sweetened drinks were reported by 71% of children in the 5–8 and 9–13 years age groups. Among children in the 5–8 years age group, milk was reported by 92% of respondents, compared to the older age groups, for whom milk was reported by 64% of 9- to 13-year-olds and 48% of 14- to 16-year-old respondents. Candy was also among the top foods most frequently reported across all age groups, ranging from 50% to 64% of respondents in each age group.

Nutrient Intake

Nutrient intakes were examined and compared to the gender-age appropriate DRIs (Tables 2 and 3). Compared with the Estimated Energy Requirements (EER), mean daily energy intakes across all gender-age groups exceeded the recommended energy intake by 10% to 71%. The mean daily energy intake was 2304 kcal for children aged 5–8 years, which exceeded the EER range of 1400–1600 kcal per day. Similarly, for children aged 9–13 years, the EER of 1800–2200 kcal per day for boys was exceeded with a mean daily intake of 2429 kcal and the EER of 1600–2000 kcal per day for girls was exceeded with a mean daily intake of 2,732 kcal. Finally, for adolescents aged 14–

Table 1. Most Frequently Reported Foods among Children and Adolescents in Baltimore City

5–8 years[a] $n = 24$		9–13 years[a] $n = 28$		14–16 years[a] $n = 29$	
Food	# of times reported (% of respondents)	Food	# of times reported (% of respondents)	Food	# of times reported (% of respondents)
Milk	32 (92)	**Sweetened drinks**	28 (71)	**Chips**	29 (66)
Chips	23 (75)	**Milk**	28 (64)	**Sweetened juices**	25 (62)
Sweetened drinks	23 (71)	**Candies**	27 (64)	**Sodas**	23 (62)
Sweetened juices	22 (63)	**Chips**	30 (57)	**Candies**	26 (59)
Cereal	16 (58)	**Sodas**	23 (54)	**Pizza**	17 (55)
Chicken dishes	18 (54)	**Sweetened juices**	21 (54)	**Sweetened drinks**	25 (52)
Vegetables	18 (54)	**Rice & pasta dishes**	18 (54)	**Bread**	17 (48)
Bread	15 (54)	**Sandwiches & burgers**	15 (46)	**Milk**	16 (48)
Candies	17 (50)	**Chicken dishes**	14 (46)	**Fried potatoes**	13 (41)
Sandwiches & burgers	14 (50)	**Fried potatoes**	12 (43)	**Sandwiches & burgers**	17 (38)

[a]The most frequently reported foods are presented in this table by Dietary Reference Intake (DRI) life stage age groups: 4–8 y, 9–13 y, and 14–18 y.

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16 years, the EERs of 2400–2800 kcal per day for boys and 2000 kcal per day for girls were exceeded with a mean daily intake of 3339 kcal and 2846 kcal, respectively. Mean daily sugar intake was 160 grams for 5- to 8-year-old children; 160 grams and 219 grams for boys age 9–13 and 14–16 years, respectively; and 136 grams and 202 grams for girls age 9–13 and 14–16 years, respectively (Tables 3 and 4). Mean daily sugar consumption was above the recommended amount for all gender and age groups except for girls aged 9–13 years. For boys and girls of all age groups combined, sugar accounted for 45% and 47%, respectively, of mean carbohydrate intake (data not shown). Percentage contribution to energy from protein, carbohydrates, and fat were within the AMDR for both boys and girls, with the exception of girls in the 9–13 years age group, whose energy from fat was above the AMDR by 3%. Across all the age groups, girls consumed more energy from fat than boys, whereas boys consumed more energy from carbohydrates. The proportions of energy from protein and carbohydrates showed a reciprocal relationship; as boys aged, the percentages of calories from protein decreased and the percentage from carbohydrates increased. Girls in the 9–13 years age group had the highest proportion of energy from protein and the lowest from carbohydrates, while the opposite trend was observed among girls in the 14–16 years age group. Both sexes in the 9–13 years age group had the highest percentage of energy from fat.

The majority of participants did not meet the DRIs for dietary fiber and vitamin E across all gender-age groups. Nutrient intakes for all boys in the 9–13 years age group were below the recommendations for dietary fiber, vitamin E, and magnesium, while intakes for all girls in the 14–16 years age group were below recommendations for vitamin E. In addition, most boys and girls 9–16 years of age consumed vitamins A and D, calcium, and magnesium below the recommended levels. By comparison, 77% and 62% of children aged 5–8 years met the DRIs for calcium and vitamin D, respectively. The average intakes of iron, thiamin, riboflavin, niacin, and vitamins B-6, B-12, and C met the DRIs. Girls across all age groups and boys in the 5–8 years age group met the recommendations for a mean intake of zinc. Overall, children in the 5–8 years age group met the recommended intakes of many nutrients, such as vitamins A, C, D, B-6 and B-12, folate, thiamin, riboflavin, niacin, calcium, magnesium, iron, and zinc compared to older children and adolescents.

Food Sources of Energy and Selected Nutrients

Table 4 shows the top 10 dietary sources of energy and selected nutrients by age group. Among children 5–8 years of age, milk was the primary contributor to energy, fat, and sugar, accounting for 14%, 17%, and 20% of the intakes, respectively. By contrast, the top contributer of energy and fat was chips among 9- to 13-year-olds, and pizza among 14- to 16-year-olds. Pizza and chips were among the top three sources of energy and fat across all age groups. Sweetened drinks, sweetened juices, and sodas were the top three sources of sugar among the older age groups, contributing a combined 41% for 9- to 13-year-olds and 45% for 14- to 16-year-olds. Sweetened drinks alone accounted for 22% of total carbohydrate consumption among children aged 5–8 years (data not shown).

Development of the YFFQ

All foods that were reported in the 24-hour dietary recalls, by two or more respondents, were included on the YFFQ. Foods that would be promoted as part of the nutritional intervention were also added so that any changes in pre- and postintervention consumption could be assessed. For example, baked chips were included on the YFFQ as a lower fat alternative to fried chips.

The YFFQ instrument contained 112 food and beverage items: 4 cereals, 5 dairy products, 17 sandwich and bread

Table 2. Mean (SD) and Median Daily Intake or Energy and Selected Nutrients and Percentage of Participants Not Meeting (%NM) the DRIs[a] in African American Children Aged 5–8 Years

	Boys ($n = 13$)		Girls ($n = 11$)		
	Mean (SD)[b]	Median[b]	Mean (SD)[b]	Median[b]	%NM[c]
Age (years)	7 (1.2)	7	7 (1.1)	7	—
Energy (kcal)[d]	**2350 (640)**	**2097**	**2251 (584)**	**2097**	—
% calories from protein	13.8 (3.7)	10.9	11.6 (3.3)	10.9	—
% calories from carbohydrates	55.5 (8.8)	55.7	54.3 (7.4)	55.8	—
% calories from fat	30.7 (6.8)	33.0	34.2 (5.6)	33.0	—
Protein (g)	**82.9 (32.6)**	**66.0**	**64.5 (17.6)**	**66.0**	—
Carbohydrates (g)	**329.6 (100.6)**	**297.4**	**311.4 (98.9)**	**297.4**	—
Sugars (g)	**157.2 (68.3)**	**150.7**	**162.6 (53.0)**	**150.8**	—
Dietary fiber (g)	14.7 (6.2)*	13.1*	13.3 (6.0)*	13.2*	96
Fat (g)	82.1 (28.1)	90.2	86.7 (25.5)	90.3	—
Saturated fat (g)	30.4 (9.0)	29.6	29.4 (8.7)	29.7	—
Monounsaturated fatty acids (g)	20.3 (8.8)	15.1	16.3 (6.3)	15.2	—
Polyunsaturated fatty acids (g)	10.2 (5.8)	8.5	9.3 (3.4)	8.5	—
n-3 fatty acids (g)	0.7 (0.4)*	0.5*	0.5 (0.3)*	0.5*	—
n-6 fatty acids (g)	8.8 (5.5)*	7.4*	7.2 (3.5)*	7.4*	—
Vitamin A (mcg_RAE)	**595.7 (442.3)**	318.2*	331.6 (184.8)*	318.2*	42
Thiamin (mg)	**1.9 (1.0)**	**1.1**	**1.3 (0.8)**	**1.1**	4
Riboflavin (mg)	**2.3 (1.0)**	**1.8**	**1.7 (0.9)**	**1.8**	8
Niacin (mg)	**24.6 (8.4)**	**16.7**	**17.3 (9.2)**	**16.7**	4
Vitamin B-6 (mg)	**2.2 (0.9)**	**1.2**	**1.4 (0.9)**	**1.2**	33
Total Folate (μg)	**537.3 (329.9)**	**250.8**	**328.6 (212.2)**	**250.8**	12
Vitamin B-12 (μg)	**5.3 (2.2)**	**4.0**	**3.9 (2.8)**	**4.0**	12
Iron (mg)	**20.0 (8.0)**	**14.0**	**14.8 (8.0)**	**14.0**	8
Vitamin C (mg)	**132.7 (91.8)**	**259.7**	**309.4 (281.7)**	**259.7**	4
Vitamin D (mg)[e]	7.0 (2.7)*	5.0*	**5.4 (3.5)**	**5.0**	38
Vitamin E (mg)[f]	2.8 (1.6)*	2.8*	3.4 (1.8)*	2.8*	92
Calcium (mg)	**1221 (424)**	**1128**	**1070 (412)**	**1128**	23
Magnesium (mg)	**167.1 (64.9)**	**144.9**	**154.4 (44.3)**	**144.9**	23
Potassium (mg)	1831 (828)*	1974*	1858 (479)*	1974.3*	—
Sodium (mg)	**3219 (1384)**	**3144**	**3134 (1145)**	**3144**	—
Zinc (mg)	**11.9 (5.4)**	**6.5**	**6.5**	**5**	67

RAE = Retinol Activity Equivalent.

[a]Dietary Reference Intakes (DRI) of Adequate Intake (AI) and Recommended Dietary Allowance (RDA), and Acceptable Macronutrient Distribution Ranges (AMDR) for children aged 4–8 years.

[b]Mean and median intakes are compared to the DRI; **intakes above the DRI are in bold**, and intakes below the DRI are indicated with an asterisk (*).

[c]%NM represents percentage of both male and female participants whose dietary intakes did not meet the DRIs.

[d]The reference energy intake is the midpoint of Estimated Energy Requirements (EER) for moderately active.

[e]As cholecalciferol. In the absence of adequate exposure to sunlight.

[f]As alpha-tocopherol.

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items, 8 other foods including added sugars and fats, 20 main course dishes, 31 vegetables and fruits, 14 desserts and sweets, 4 salty snacks, and 9 drinks; a list of 10 additional foods was generated (Appendix 1). With assistance from community consultants and in accordance with the 24-hour recall data, standard units, household utensils, and three-dimensional food models were assigned to individual line items to assess portion size. Forty food items had portion size assessed using standard units such as a slice of bread; 21 food items were assessed using familiar household units such as a glass of milk; and 61 food items were assessed using food models appropriate for each item listed. Frequency of consumption was assessed using six categories ranked from "never" to "two or more times per day."

DISCUSSION

This study examined dietary patterns among urban African American children and adolescents aged 5–16 years in Baltimore City, Maryland, and compared nutrient intakes with the DRIs. We also designed the YFFQ for this specific population by identifying most commonly consumed and culturally appropriate foods. There is an increasing need for appropriate intervention aimed at preventing or treating diet-related conditions as well as recognition of the impact of culture on lifestyle. Therefore, developing a culturally appropriate YFFQ is necessary.

Mean daily energy intake exceeded the EER across all gender-age groups. Our findings, by comparison, are similar to the

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Table 3. Mean (SD) and Median Daily Intake or Energy and Selected Nutrients and Percentage of Participants Not Meeting (%NM) the Dietary Reference Intakes[a] in African American Youth Aged 9–13 and 14–16 Years

	9–13 Years						14–16 Years					
	Boys			Girls			Boys			Girls		
	Mean (SD)[b]	Median[b]	%NM	Mean (SD)[b]	Median[b]	%NM	Mean (SD)[b]	Median[b]	%NM	Mean (SD)[b]	Median[b]	% NM
Age (years)	11 (1.5)	11	—	11 (1.5)	11	—	15 (0.9)	15	—	16 (0.9)	16	—
Energy (kcal)[c]	**2429 (627)**	**2284**	—	**2732 (1081)**	**2481**	—	**3339 (1001)**	**3240**	—	**2846 (984)**	**2645**	—
% calories from protein	12.5 (2.4)	12.7	—	13.7 (3.0)	13.7	—	10.8 (3.6)	11.6	—	10.8 (2.9)	10.9	—
% calories from carbohydrates	56.1 (8.0)	57.5	—	48.3 (7.7)	49.1	—	59.9 (10.6)	58.6	—	58.5 (9.0)	57.6	—
% calories from fat	31.4 (7.6)	29.8	—	**38.0 (6.4)**	**39.3**	—	29.3 (8.8)	29.8	—	30.7 (7.3)	31.4	—
Protein (g)	**74.5 (13.5)**	**74.6**	—	**96.4 (45.5)**	**88.3**	—	**93.3 (44.1)**	**84.9**	—	**78.3 (33.5)**	**69.0**	—
Carbohydrates (g)	**348.5 (110.9)**	**328.1**	—	**332.5 (129.1)**	**306.7**	—	**511.5 (174.1)**	**474.6**	—	**427.1 (153.0)**	**434.9**	—
Sugars (g)	**160.0 (57.4)**	**166.4**	—	136.4 (59.6) *	150.4*	—	**219.4 (86.9)**	**209.9**	—	**202.2 (95.7)**	**192.3**	—
Dietary fiber (g)	14.8 (5.5)*	15.0*	100	13.7 (7.0)*	13.3*	93	20.3 (13.1)*	15.8*	86	14.1 (7.5)*	11.3*	93
Fat (g)	85.1 (27.1)	78.5	—	117.3 (52.4)	108.7	—	114.5 (51.0)	109	—	100.5 (49.9)	89.0	—
Saturated fat (g)	29.1 (10.1)	27.9	—	37.0 (16.9)	34.5	—	39.9 (23.5)	36.1	—	33.0 (17.3)	27.8	—
Monounsaturated fatty acids (g)	17.5 (10.4)	15.0	—	31.6 (20.6)	30.8	—	21.4 (17.1)	17.9	—	21.7 (15.6)	19.3	—
Polyunsaturated fatty acids (g)	7.9 (4.7)	6.5	—	14.5 (8.6)	14.0	—	10.2 (8.3)	9.2	—	9.4 (7.4)	7.8	—
n-3 fatty acids (g)	0.6 (0.4)*	0.5*	—	0.7 (0.3)*	0.7*	—	0.4 (0.3)*	0.4*	—	0.6 (0.5)*	0.6*	—
n-6 fatty acids (g)	5.1 (3.5)*	3.7*	—	**11.5 (7.8)**	**10.5**	—	7.8 (7.7)*	6.4*	—	7.3 (4.5)*	6.7*	—
Vitamin A (mcg_RAE)	341.5 (228.6)*	367.6*	75	476.3 (469.3)*	280.8*	64	400.4 (330.0)*	323.4*	79	471.7 (560.3)*	207.9*	67
Thiamin (mg)	**1.3 (0.7)**	**1.5**	17	**1.2 (0.5)**	**1.3**	29	**1.4 (0.8)**	**1.5**	43	**2.5 (3.5)**	**1.4**	20
Riboflavin (mg)	**1.7 (0.7)**	**2.0**	17	**2.0 (1.0)**	**1.8**	14	**2.3 (1.8)**	**1.8**	36	**2.0 (1.4)**	**1.6**	20
Niacin (mg)	**17.2 (8.1)**	**15.7**	8	**19.5 (9.5)**	**17.1**	7	**18.0 (12.2)**	**15.8**	29	**21.0 (14.0)**	**16.3**	13
Vitamin B-6 (mg)	**1.4 (0.7)**	**1.4**	33	**1.5 (0.8)**	**1.7**	21	**1.7 (1.3)**	**1.4**	36	**1.8 (1.7)**	1.3	47
Total Folate (μg)	**364.0 (228.6)**	**357.5**	33	**304.3 (175.5)**	292.0*	36	356.9 (238.1)*	381.6*	43	**441.6 (435.6)**	297.1*	53
Vitamin B-12 (μg)	**3.9 (2.9)**	**2.4**	25	**4.3 (2.1)**	**4.7**	7	**4.5 (4.6)**	**3.4**	43	**5.1 (4.3)**	**3.5**	20
Iron (mg)	**15.8 (5.0)**	**16.7**	8	**15.0 (6.5)**	**13.3**	0	**17.7 (7.6)**	**17.4**	7	**17.7 (10.3)**	14.1*	7
Vitamin C (mg)	**212.3 (164.3)**	**194.6**	17	**112.1 (96.4)**	**114.0**	36	**198.6 (163.6)**	**152.9**	21	171.2 (173.7)	**128.8**	27
Vitamin D (mg)[d]	4.1 (2.4)*	3.7*	75	3.3 (2.7)*	2.9*	64	3.3 (3.7)*	2.3*	71	4.8 (4.6)*	4.0*	60
Vitamin E (mg)[e]	2.4 (1.3)*	2.6*	100	4.7 (4.9)*	2.7*	79	4.1 (7.1)*	2.0*	93	3.2 (2.1)*	2.8*	100
Calcium (mg)	994 (305)*	1101*	92	786 (443)*	708*	86	1051 (597)*	973.2*	71	1148 (712)*	1015*	67
Magnesium (mg)	127.4 (44.2)*	136.6*	100	164.9 (88.7)*	182.3*	71	173.9 (96.6)*	160.8*	93	162.8 (111.4)*	138.8*	93
Potassium (mg)	1466 (560)*	1444*	—	1867 (937)*	2007.9*	—	2021 (1005)*	1974*	—	1804 (1008)*	1478.8*	—
Sodium (mg)	**4278 (1126)**	**4148**	—	**4435 (1336)**	**4235.2**	—	**6858 (5171)**	**5169**	—	**3920.1 (1291.4)**	**4125.4**	—
Zinc (mg)	7.4 (4.3)*	6.9*	67	**10.2 (6.0)**	**8.56**	36	7.5 (5.7)*	6.3*	64	**10.5 (9.1)**	8.0*	47

RAE = Retinol Activity Equivalent.

[a]Dietary Reference Intakes (DRI) of Adequate Intake (AI) and Recommended Dietary Allowance (RDA), and Acceptable Macronutrient Distribution Ranges (AMDR) for youth aged 9–13 and 14–18 years.

[b]Mean and median intakes are compared to DRI; **intakes above DRI are in bold**, and intakes below DRI are indicated with an asterisk (*).

[c]The reference energy intake is the midpoint of Estimated Energy Requirements (EER) for moderately active.

[d]As cholecalciferol. In the absence of adequate exposure to sunlight.

[e]As alpha-tocopherol.

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Table 4. Major Dietary Sources of Energy and Selected Nutrients by Age Group

Age (years)	Food	% Contri.[a] to Energy	Food	% Contri.[a] to Fat	Food	% Contri.[a] to Fiber	Food	% Contri.[a] to Sugar
5-8	Milk	13.9	Milk	17.2	Cereals	13.4	Sweetened drinks	21.9
	Pizza, any kind	7.9	Chips	11.8	Chips	10.7	Milk	19.9
	Chips	7.7	Pizza, any kind	9.3	Raw fruits	9.7	Sweetened juices	11.5
	Sweetened drinks	7.5	Chicken dishes	7.5	Pizza, any kind	8.8	Cereals	9.3
	Cereals	7.1	Frankfurters, sausage,s & lunchmeats	6.9	Canned fruits	7.5	Sodas	6.8
	Breads	5.5	Sandwiches & burgers	6.6	Breads	7.0	Candies	4.6
	Sandwiches & burgers	5.2	Meat dishes	6.3	Vegetables, any kind	6.9	Canned fruits	3.4
	Chicken dishes	5.1	Nuts, any kind	4.7	Nuts, any kind	4.3	Raw fruits	3.3
	Sweetened juices	3.9	Cakes, donuts, & pastries	3.8	Hash browns & fried potatoes	4.2	Ice cream	2.5
	Meat dishes	3.6	Hash browns & fried potatoes	3.6	Sandwiches & burgers	4.2	Cakes, donuts, & pastries	2.5
Total		**67.3**		**77.6**		**76.7**		**85.7**
9-13	Chips	10.1	Chips	15.1	Chips	13.5	Sweetened drinks	17.4
	Pizza, any kind	9.1	Pizza, any kind	9.8	Pizza, any kind	12.0	Sweetened juices	11.7
	Rice & pasta dishes	7.4	Chicken dishes	9.3	Rice & pasta dishes	11.9	Sodas	11.6
	Chicken dishes	6.0	Meat dishes	9.3	Cereals	10.7	Milk	11.1
	Cereals	5.7	Frankfurters, sausages, & lunchmeat	8.0	Raw fruits	8.6	Canned fruits	8.8
	Milk	5.6	Sandwiches & burgers	6.3	Breads	7.2	Candies	7.2
	Meat dishes	5.3	Eggs	5.6	Vegetables, any kind	5.6	Cereals	6.3
	Sodas	4.8	Milk	5.4	Canned fruits	4.7	Raw fruits	3.6
	Sweetened drinks	4.8	Rice & pasta dishes	4.9	Beans, any kind	4.0	Cakes, donuts, & pastries	2.6
	Sandwiches & burgers	4.7	Hash browns & fried potatoes	4.5	Nuts, any kind	4.0	Cookies	2.5
Total		**63.4**		**78.4**		**82.0**		**82.9**
14-16	Pizza, any kind	10.7	Pizza, any kind	13.0	Pizza, any kind	13.0	Sweetened drinks	21.8
	Chips	8.1	Chips	12.7	Beans, any kind	9.9	Sweetened juices	12.9
	Chicken dishes	6.0	Chicken dishes	10.6	Chips	9.6	Sodas	10.6
	Breads	6.0	Cakes, donuts, & pastries	7.6	Breads	8.8	Milk	8.3
	Sweetened drinks	5.7	Sandwiches & burgers	6.8	Cereals	5.9	Candies	6.2
	Cakes, donuts & pastries	5.5	Cookies	6.2	Vegetables, any kind	4.6	Sugar & syrup	6.1
	Sodas	5.3	Milk	6.0	Sandwiches & burgers	4.0	Cereals	5.5
	Milk	5.2	Meat dishes	3.8	Cakes, donuts, & pastries	3.7	Cookies	4.3
	Sandwiches & burgers	4.6	Ice cream	3.8	Rice & pasta dishes	3.2	Ice cream	3.5
	Cookies	4.6	Breads	3.0	Chicken dishes	3.0	Canned fruits	3.0
Total		**61.8**		**73.6**		**65.7**		**82.2**

[a]Percent contribution.

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National Health and Nutrition Examination Survey (NHANES) III that reported mean daily energy intakes, calculated from up to two 24-hour dietary recalls, in excess of DRI recommendations for a multi-ethnic sample of American children and adolescents in 2005–2006. While the NHANES III findings are comparable to findings from the present study, our results provide more insight into gender differences among African American boys and girls. Among NHANES III participants, boys 6–11 years and 12–19 years consumed 2092 kcal and 2707 kcal, respectively. Girls aged 6–11 years and 12–19 years consumed 1879 kcal, and 1906 kcal, respectively. Another study also used 24-hour dietary recalls in a multi-ethnic sample of American children, including 554 third-, fifth-, and eighth-grade African American youth, and likewise reported energy intakes above the recommended levels [31]. Higher energy intakes among respondents may also be associated with increased intake of energy-dense, nutrient-poor foods (e.g., pizza and sweetened drinks) among African American children and adolescents [9].

Foods high in fat and sugar (e.g., pizza, chips, and sweetened drinks) were among the top contributors to energy, fat, and sugar intake across all gender-age groups. Furthermore, pizza and soda have been targeted as key foods contributing to increased energy intakes among children and adolescents over the past three decades; African American adolescents may be particularly susceptible to this trend [9,10]. Several studies among U.S. children have identified increased energy intakes concurrent with increased consumption of sweetened beverages and high-fat foods, further increasing risk of overweight, obesity and related chronic disease [32,33].

Lack of access to healthy foods may contribute to the health inequities observed among African Americans in the U.S. Franco et al. described racial and economic disparities in access to healthy foods in Baltimore City [19]. A total of 43% of predominantly African American neighborhoods and 46% of lower income neighborhoods were in the lowest tertile of healthy food availability, compared to predominantly higher income neighborhoods where only 13% of individuals were represented in the lower tertile of healthy food accessibility [19]. Residents in disadvantaged neighborhoods have greater exposure to fast food outlets and convenience stores [34] and tend to consume more nutrient-poor foods, resulting in increased risk for potential adverse health outcomes [35,36]. Aggarwal et al. reported an association between high food cost and increasing consumption of dietary fiber, vitamins, and minerals [37]. This previous finding supports our results; the average intakes of dietary fiber, vitamins A, D, and E, calcium, magnesium, and potassium were below recommendations among both boys and girls in the 9–16 years age group. A seemingly better diet quality among younger children (5–8 years age group) may be attributed to parents having more control over their diet compared to older children or adolescents [38,39]. Partnering with local food stores to increase access to healthy foods may serve as a powerful tool in reducing systematic local barriers that are shown to exist by race, ethnicity, and income [40]. Modifying the food environment to promote nutrient-rich foods may be an effective public health initiative to improve food choices and consumption for a community-based intervention program.

Age and healthy diets have a positive association among adults [41], presumably due to increasing health concerns [42]. Contrarily, among younger populations, a negative association was reported previously, as children tend to have higher dietary scores [38] and a greater consumption of vegetables and fruits [43] compared to adolescents. Consumption of soda and sweetened beverages may be associated with low intakes of calcium and vitamins A and D observed among children and adolescents 9–16 years of age. Lytle et al. identified an inverse relationship between consumption of soda and sweetened beverages and consumption of milk among American youth [31]. Similarly, our study showed a step-wise decrease in milk consumption with age coupled with a comparatively high consumption of sweetened beverages. Additionally, this study found greater frequency of consumption of cereal, chicken dishes, and vegetables in the 5–8 years age group compared to older age groups. These dietary data are of significant interest as numerous studies have found that diet quality among U.S. youth declines as they age, and similarly, that rates of childhood overweight and obesity escalate with increasing age [29,31,41]. However, the lack of age and culturally appropriate dietary assessment methods limits the nutritional epidemiology studies undertaken and the subsequent number and quality of nutritional intervention programs [45]. As such, a population-specific dietary assessment instrument is necessary to describe food and nutrient intake among African American children and adolescents in Baltimore City.

Gender differences in dietary patterns were observed in the older age groups (9–16 years age groups), including that the average intakes of added sugar, folate, and zinc among girls met the recommendations, whereas those of boys did not. However, girls in these age groups had lower mean intakes for vitamins C and E, suggesting that low-income girls may have limited fruit consumption as reported by Pitel et al. [39]. Although in general, girls tend to follow a healthier diet than boys regardless of age [38], gender-specific dietary behaviors may be different between low-income boys and girls [39].

The FFQ has been used to assess dietary quality and determine consumption patterns in youth in several well-known surveys and studies [46–48]. Another study also used a FFQ to assess dietary intake in children based on the Willett FFQ [49–51]. The development of a culturally and youth-specific FFQ requires three major components for comprehensive dietary assessment: a complete food list, food grouping that reflects the dietary habits and cultural practices of the target population, and frequency of consumption categories [52,53]. The foods selected must be commonly consumed by a

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substantial segment of the population and contain significant amounts of nutrients of interest [52,54,55]. Single 24-hour dietary recalls were used in this study to generate the initial list. However, some food grouping is necessary to reduce participant burden and should follow a logical order that is clear to the study population [52–55]. For the present study, the dietary recall data as well as the focus group discussions were used to inform the grouping and ordering of the foods and to determine appropriate food models for the population.

The 24-hour recall data characterized current food and nutrient intake and highlighted specific foods to be targeted for future nutrition intervention programs aimed at reducing obesity. Many of the most frequently consumed foods (e.g., sweetened drinks, chips, and candies) can be replaced with lower sugar, lower fat and often more nutrient-dense alternatives. For example, intervention strategies to reduce sugar and fat intake might include promoting baked chips or low-sodium pretzels in place of fried chips, choosing reduced fat or low-fat milk instead of whole milk, and substituting sweetened juices and drinks with unsweetened juices, sugar-free beverages, and water. While these are simple solutions to reduce fat and sugar intake, efforts to increase consumption of nutrient-rich foods such as fruit, vegetables, whole grains, low-fat dairy products, and lean proteins will require further public health research as well as age and culturally appropriate nutrition intervention.

A comprehensive dietary assessment tool is essential for impact evaluation of a nutritional intervention program. FFQs have been used previously to evaluate interventions and to assess dietary intake for other study populations [56–60]. The YFFQ developed in the present study was interviewer-administered, which reduces respondent burden and has been shown to be more feasible than multiple dietary recalls in studies among African American communities [61]. Once validated, this tool may be effectively used to evaluate future nutrition interventions targeted for urban African American youth. The same methodology has been used to evaluate the impact of nutritional intervention strategies in African American and other multi-ethnic populations [57,58,60].

This study is not without limitations. A convenience sample was recruited and the sample size was relatively small. The nutrient intakes were estimated using single recalls. However, the administration of multiple recalls may have significantly increased respondent burden and therefore decreased study participation of low-income African American children and adolescents in Baltimore City.

CONCLUSION

This study demonstrates dietary patterns that may have contributed to the increased prevalence of overweight and obesity among low-income urban African American children and adolescents. Our results also propose a potential evaluation tool, the YFFQ, for implementing community-based nutritional intervention programs to improve dietary quality and reduce risk factors for overweight and obesity.

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Author Contributions

F.K. and J.L.B. wrote and had primary responsibility for the final content of the manuscript; K.C., G.B.D., P.N.B., N.N.H., M.C.M., T.S., and J.G. critically revised the manuscript for improvement intellectual content; S.S. designed the study and provided essential data and finalized the manuscripts; and all authors read and approved the final manuscript.

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Appendix 1: Food and Drink Items Listed on the YFFQ

Category	Food Items
Cereal (4)	Cereals such as Frosted Flakes, Fruity Pebbles, Froot Loops, Apple Jacks, Cinnamon Toast Crunch, Trix, Cap-n Crunch (high sugar); cereals such as Rice Chex, Cheerios, Cornflakes, Rice Krispies, Kix (lower sugar); cereals such as Branflakes, Shredded Wheat, granola (high fiber); oatmeal, cream of wheat, or grits (cooked)
Dairy (5)	Whole milk incl. carton; 2% milk incl. carton; 1% or skim milk incl. carton; chocolate or strawberry milk incl. milkshake, hot chocolate, and carton; yogurt incl. Gogurt
Sandwiches, breads, and buns (17)	Peanut butter and jelly sandwich, cheese sandwich incl. grilled cheese sandwich, breakfast sandwich incl. McGriddle sandwich, breakfast burrito; lunch meat sandwich; tuna or salmon sandwich; burger incl. Burger King, McDonald's, or Checker's burger, cheesesteak; veggie burger; fried chicken sandwich incl. McDonald's or Burger King, breaded chicken patty; grilled chicken sandwich such as McDonald's, incl. patties, turkey burger; hot dog with bun; taco; white bread NOT in sandwich incl. french toast, dinner rolls, bagel; wheat bread alone (split top bread of 100% whole wheat); Cornbread; Waffles; Pancake; Biscuits.
Other foods (8)	Added sugar on cereal or fruits or to drinks; butter or margarine incl. on toast, pancakes, waffles, sausage, baked potato, pasta; syrup; cheese NOT in sandwich or burger incl. American cheese with crackers, Lunchables, string cheese; cheese spread, easy cheese spray, or nacho cheese; sausage; eggs (boiled, poached, fried, scrambled) NOT in sandwich, burger, or salad; Bacon NOT in burger or sandwich
Main dishes (20)	Pizza, Hot Pockets, Lunchable pizza; steak or roast beef; meatloaf; pork and beans, baked beans; pork chops; chicken wings; fried chicken (NOT wings) incl. breast, thigh, or drumstick; baked or grilled chicken, rotisserie chicken, BBQ chicken, roasted turkey; chicken nuggets, chicken strips, fingers, tenders, or popcorn chicken; fried, baked, grilled, or steamed fish NOT in sandwich; fish sticks; crab cake; rice; macaroni and cheese, easy Mac; Spaghetti incl. any type of pasta, Hamburger Helper; Lasagna; Oodles of Noodles, Cup of Noodles, or Ramen noodle packet; Egg rolls; Rice Chinese stir-fry incl. chicken, shrimp, egg, or pork; Noodle Chinese stir-fry incl. chicken, shrimp, egg, or pork
Vegetables and fruits (31)	French fries such as steak fries, curly fries, tater tots, or hash browns; sauces incl. ketchup, BBQ, sweet and sour, or steak; mashed potatoes; gravy; baked potato; sweet potato or yam; greens incl. spinach, collard, mustard, or kale; sweet corn; corn on the cob; string beans, green beans; broccoli or cauliflower; any green salad; cucumber; celery; baby carrots; cooked carrots; squash or pumpkin; regular dressing incl. Italian, ranch, bleu cheese, or caesar; light dressing incl. Italian, ranch; canned fruits such as mixed fruit, fruit cocktail, fruit cup, canned peaches, pineapples, or tangerines; fresh orange or tangerine; fresh fruit salad; apple or pear; applesauce; banana; grapes; fresh pineapple; fresh peaches, plums, or nectarines; Berries incl. strawberries, cherries, blueberries, or raspberries; Melons incl. watermelon, cantaloupe, or honeydew; Dried fruit, trail mix (no candy), nuts, or seeds
Cakes, desserts, and sweet snacks (14)	Snacks such as Tastykakes, brownies, or cupcakes; muffins incl. regular or mini; Little Debbie's oatmeal cream pie, McDonald's, or Burger King; doughnut incl. regular or mini; Pop-tarts, Honey Buns, or Danish; Snowballs or popsicles; pudding incl. chocolate or vanilla; cookies, wafers, or graham crackers; granola bar; sugar candies incl. Starburst, fruit roll-ups, or mints; chocolate candy or candy bars incl. Snickers or M&Ms; gum incl. bubble gum; Ice cream sandwich, bar; Ice cream sundae such as McDonald's or Burger King
Salty snacks (4)	Potato chips, corn chips, Lays, UTZ, Doritos, Fritos, or cheese curls; Cheez-Its or Ritz crackers; baked chips incl. Lays or Utz, sunflower chips, Sun Chips; popcorn incl. microwave or snack bag
Drinks (9)	Soda incl. Pepsi, Coca Cola; Dr. Pepper, or grape soda; diet soda, diet energy drinks incl. Diet Pepsi or Pepsi One; sugary drinks incl. iced tea, lemonade, Kool Aid, punch, Clear Fruit, orange drink, Capri Sun, Sunny D, or Hugs; 100% fruit juices incl. orange juice, apple, grape, pineapple, or Juicy Juice; diet drinks such as Crystal Light or flavored water; sport drinks such as Splash or Gatorade; energy drinks such as Monster, Red Bull, or Rockstar; Water incl. bottled or tap; Vitamin water or Propel water
Additional foods (10)	Jello; mixed vegetables, incl. peas; Lunchable meats; soup, any kind; burrito, any kind; fried fish sandwich incl. Filet-o-Fish, lake trout sandwich; salmon cake; chili, stew; sloppy joe sandwich; fried, grilled, pan-fried shrimp

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