

# Associations of Food Stamp Participation With Dietary Quality and Obesity in Children

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## KEY WORDS

Supplemental Nutrition Assistance Program, Food Stamps, nutrition, diet quality, children

## ABBREVIATIONS

AHEI—Alternate Healthy Eating Index  
CI—confidence interval  
FPL—federal poverty level  
HEI—Healthy Eating Index  
HR—household reference person  
OR—odds ratio  
RD—relative difference  
SNAP—Supplemental Nutrition Assistance Program  
SSBs—sugar-sweetened beverages  
USDA—US Department of Agriculture

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**WHAT'S KNOWN ON THIS SUBJECT:** The Supplemental Nutrition Assistance Program (SNAP) is the largest federal nutrition assistance program. Studies among adults suggest that SNAP participation may be associated with suboptimal diets. Few studies have extensively examined these associations among children.



**WHAT THIS STUDY ADDS:** SNAP participation was not associated with childhood obesity. SNAP children consumed diets poorer in some aspects than nonparticipants, but intake of some micronutrients was higher. The diets of both groups of low-income children were far from meeting dietary guidelines.

## abstract



**OBJECTIVE:** To determine if obesity and dietary quality in low-income children differed by participation in the Supplemental Nutrition Assistance Program (SNAP), formerly the Food Stamp Program.

**METHODS:** The study population included 5193 children aged 4 to 19 with household incomes  $\leq 130\%$  of the federal poverty level from the 1999–2008 NHANES. Diet was measured by using 24-hour recalls.

**RESULTS:** Among low-income US children, 28% resided in households currently receiving SNAP benefits. After adjusting for sociodemographic differences, SNAP participation was not associated with a higher rate of childhood obesity (odds ratio = 1.11, 95% confidence interval [CI]: 0.71–1.74). Both SNAP participants and low-income nonparticipants were below national recommendations for whole grains, fruits, vegetables, fish, and potassium, while exceeding recommended limits for processed meat, sugar-sweetened beverages, saturated fat, and sodium. Zero percent of low-income children met at least 7 of 10 dietary recommendations. After multivariate adjustment, compared with nonparticipants, SNAP participants consumed 43% more sugar-sweetened beverages (95% CI: 8%–89%), 47% more high-fat dairy (95% CI: 7%, 101%), and 44% more processed meats (95% CI: 9%–91%), but 19% fewer nuts, seeds, and legumes (95% CI: –35% to 0%). In part due to these differences, intakes of calcium, iron, and folate were significantly higher among SNAP participants. Significant differences by SNAP participation were not evident in total energy, macronutrients, Healthy Eating Index 2005 scores, or Alternate Healthy Eating Index scores.

**CONCLUSIONS:** The diets of low-income children are far from meeting national dietary recommendations. Policy changes should be considered to restructure SNAP to improve children's health. *Pediatrics* 2013;131:463–472

The Food Stamp Program, renamed the Supplemental Nutrition Assistance Program (SNAP) in 2008, is the largest of 15 federal nutrition assistance programs. The Food Stamp Program was implemented in 1964 to provide food assistance and distribute agricultural commodities to low-income individuals.<sup>1</sup> Participation is at its highest since the program's inception; in 2011, 45 million Americans received food stamps, at a cost of \$72 billion.<sup>2,3</sup> Program eligibility is generally determined by having a household income  $\leq$ 130% of the federal poverty level (FPL), equivalent to a gross monthly income of \$2389 for a 4-person household in 2011.<sup>4,5</sup> SNAP benefits can be used to purchase most foods and beverages except for alcohol, supplements, and prepared foods.

Although initially established as a program to reduce food insecurity, current obesity trends have increased the emphasis on encouraging participants to choose healthful, nutrient-rich foods.<sup>6,7</sup> Unlike other food assistance programs, SNAP does not use a defined food list or have menu standards; its effects on dietary quality are not well established.<sup>8</sup> Because few foods are ineligible for purchase with SNAP benefits, some public health advocates have questioned whether SNAP benefits are excessively used to buy nutrient-poor foods that may promote obesity and poor health over time.<sup>9</sup> A 2000 US Department of Agriculture (USDA) analysis of the 1994–1996 Continuing Survey of Food Intake by Individuals suggested that Food Stamp participants consumed more meat, added sugars, and total fat after receiving benefits; differences were not observed for fruits, vegetables, total grains, and dairy products.<sup>10</sup> A 2008 USDA report using 1999–2004 NHANES data found that adult Food Stamp recipients consumed a greater proportion of calories from solid fats, added sugars, and alcoholic beverages

compared with income-eligible non-participants.<sup>11</sup>

SNAP has been shown to reduce poverty among the poorest Americans by providing resources to purchase food.<sup>12</sup> We would hope that dietary quality would be better among program participants because of these additional benefits. Unfortunately, previous studies suggest that SNAP participation may be associated with suboptimal dietary patterns among low-income adults. These associations have not been extensively examined in children, who represent 47% of SNAP beneficiaries.<sup>13–16</sup> Early-life dietary patterns are especially important for low-income children who are at higher risk for obesity and obesity-related metabolic consequences.<sup>17–20</sup> The high rates of obesity and food insecurity in low-income populations underscore the importance of employing SNAP as a program to promote healthier food choices. In a national sample of low-income children, we investigated overall dietary quality and whether differences were present by SNAP participation in (1) overweight and obesity status, (2) consumption of foods and nutrients, and (3) overall dietary quality.

## METHODS

### Study Population

NHANES is an ongoing, multistage cross-sectional survey administered by the National Center for Health Statistics. This analysis combined data from the 1999–2008 surveys to maximize a sufficient representation of SNAP participants. The analytical sample was restricted to children aged 4 to 19 years with household incomes  $\leq$ 130% FPL who had complete dietary data. For the interview component, proxy respondents (a parent/guardian) reported for children aged 4 to 5 years and assisted with survey completion for children aged 6 to 11 years. Children aged 12 to 19 years reported for themselves. The analytical sample comprised 5193 children.

### SNAP Participation

Current SNAP participants were classified as program participation at the time of the NHANES interview. Non-participants were classified as not receiving Food Stamp benefits within the past 12 months. Former participants (individuals who were not receiving benefits at the time of the survey but had received benefits within the past 12 months) were excluded to provide a more appropriate comparison between current SNAP participants and income-eligible non-participants.

### Overweight and Obesity Status

NHANES reports BMI as  $\text{kg}/\text{m}^2$  from measured height and weight.<sup>21</sup> For children aged 4 to 17 years, BMI was transformed into z scores by using the 2000 Centers for Disease Control and Prevention Growth Charts and categorized into normal weight, overweight, or obese by using established age- and gender-specific cutpoints.<sup>22,23</sup> For children aged 18 to 19 years, BMI was classified into standard weight categories.<sup>24</sup>

### Dietary Intake

From 1999 through 2002, NHANES administered one 24-hour dietary recall in-person to study participants. From 2003 through 2008, a second recall was administered over the phone 3 to 10 days after the first examination.<sup>25</sup>

### Foods, Food Groups, and Nutrients

We selected foods, food groups and nutrients based on their importance to children's growth and future adult health (Supplemental Table 6).<sup>26–28</sup> We then estimated servings by calculating the grams of intake of each food and applying common serving sizes. Nutrient intakes were derived from the NHANES nutrient files; contributions from dietary supplements were excluded. Consumption levels were compared with national dietary recommendations for chronic disease prevention (Supplemental Table 7).<sup>27,29,30</sup>

**TABLE 1** Sociodemographic Characteristics of Children  $\leq$ 130% FPL

	SNAP Nonparticipants (n = 3831)		SNAP Participants (n = 1362)	
	n	%	n	%
Age, mean $\pm$ SE.	12.0 $\pm$ 0.2		10.4 $\pm$ 0.2	
% girl	1949	49.1	715	53.3
Race				
Non-Hispanic white	723	48.8	223	37.9
African American	1161	17.7	652	31.2
Hispanic/Latino	1801	26.0	430	24.9
Other or multiple ethnicities	146	7.5	57	6.0
% HR born in the United States	2152	73.3	1022	78.8
HR education level				
<12 y	1680	33.1	764	49.6
High school graduate	917	28.6	332	30.5
Some college	776	26.2	211	16.4
College graduate or higher	243	12.2	21	3.5
HR marital status				
Single	700	18.5	416	26.8
Married or living with partner	1975	60.6	448	38.7
Widowed/ divorced/ separated	794	20.9	391	34.4
Household size, mean $\pm$ SE	4.6 $\pm$ 0.1		4.8 $\pm$ 0.1	
Health insurance status				
Not insured	1066	23.9	106	9.4
Insured with public insurance	1510	36.7	1145	81.1
Insured with private insurance	1199	39.4	106	9.5
Poverty income ratio				
0% to 25% FPL	988	25.1	268	18.2
25% to 50% FPL	428	8.7	328	21.6
50% to 75% FPL	632	15.0	396	29.1
75% to 100% FPL	762	19.3	214	15.8
100% to 130% FPL	1021	31.8	156	15.3
Household food security				
Full food security	2439	68.7	572	40.0
Marginal food security	422	8.5	199	13.5
Low food security	652	15.1	376	29.1
Very low food security	313	7.7	215	17.5
Current school breakfast participation				
Consumed school breakfast 0-2 times in past week	1298	31.9	395	26.7
Consumed school breakfast 3-5 times in past week	1176	27.1	673	48.3
Current school lunch Participation				
Consumed school lunch 0-2 times in past week	574	13.4	157	12.4
Consumed school lunch 3-5 times in past week	2253	55.8	975	67.5
Current household WIC participation	84	2.2	53	4.7

All differences in sociodemographic characteristics between SNAP participants and nonparticipants were statistically significant ( $P < .05$ ), except for gender and HR birthplace. WIC, Special Supplemental Nutrition Program for Women, Infants and Children.

### Dietary Patterns

Overall dietary quality was assessed by using the Healthy Eating Index 2005 (HEI-2005) and the Alternate Healthy Eating Index (AHEI). The USDA MyPyramid Equivalents Databases were used to estimate MyPyramid equivalents for the HEI-2005.<sup>31</sup> The AHEI was developed by the Harvard School of Public Health as a dietary pattern related to chronic

disease risk in adults, although this has not been examined in children.<sup>32,33</sup> For this analysis, we modified the original 9 AHEI components by excluding trans fat, which was unavailable in NHANES, and alcohol, which was considered inappropriate for children's dietary quality. Multivitamin use was defined as any use in the past 30 days.<sup>34</sup> The maximum AHEI score was rescaled

to the original 87.5 points for comparability with other studies.

### Study Covariates

Covariates of interest included the child's age, gender, race/ethnicity, household reference person's (HR) place of birth, HR education level, HR marital status, household size, health insurance status, poverty income ratio, household food security, and participation in other food assistance programs. The HR was  $\geq$ 18 years and owned or rented the residence of the study participant. Missing indicators were used to account for missing HR place of birth, HR education level, HR marital status, or other food assistance program participation. Household food security was assessed by using the USDA 18-item US Food Security Survey Module.<sup>55</sup>

### Statistical Analysis

To make nationally representative estimates, we used complex Mobile Examination Center and dietary survey weights that account for different sampling probabilities and participation rates for NHANES across the 10-year period.

Means and distributions of foods and nutrients were estimated for all low-income children, and by age, gender and food security groups using the National Cancer Institute statistical method for usual dietary intake, which accounts for the within-person variation of dietary intake while preserving the complex NHANES weighting scheme.<sup>56</sup> The National Cancer Institute method involves 2 SAS macros using "integerized" dietary survey weights.<sup>37,58</sup> Standard errors were estimated by using the balanced repeated replication method. Sociodemographic characteristics between SNAP participants and nonparticipants were compared by using  $\chi^2$  tests. Associations between SNAP participation and children's weight status were examined by fitting multinomial logistic regression models for

childhood weight status, using normal weight as the reference. The first model adjusted for age and gender. The multivariate model included all study covariates. Models were estimated separately by subgroups of age, gender, and food security status.

To estimate the relative difference in dietary intake by SNAP participation, linear regression models were fit for log-transformed outcomes (due to the skewness of dietary outcomes). Dietary outcome values of 0 were recoded to half of the minimum amount consumed. Models were adjusted for all study covariates and total energy. Relative differences for the HEI-2005 and AHEI were estimated using the same models for foods and nutrients.

All statistical tests were 2-sided. Significance was considered at  $P < .05$ . Statistical analyses were performed by using SAS 9.3 (SAS Institute Inc, Cary, NC).

## RESULTS

Of the 5193 low-income children in the study population, 27.9% participated in SNAP at the time of the survey. Children participating in SNAP were significantly more likely to be from a single-parent household, enrolled in public health insurance (eg, SCHIP, Medicaid), participate in other nutrition assistance programs, live below the FPL, and report lower household food security than nonparticipants (Table 1).

Among SNAP participants, 18.7% were overweight, and 17.5% were obese (Table 2). After multivariate adjustment, there was no association with

SNAP participation and childhood overweight (odds ratio [OR] = 0.95, 95% confidence interval: CI 0.69–1.30) or obesity (OR = 1.11, 95% CI: 0.71–1.74), compared with low-income nonparticipants. Within age, gender, and food security subgroups, SNAP participants and nonparticipants had similar high rates of childhood overweight and obesity; no significant associations were observed after multivariate adjustment (Supplemental Table 8).

Both groups of children were far from meeting national dietary recommendations for fruits, vegetables, whole grains, fish and shellfish, and nuts, seeds, and legumes (Table 3). Mean consumption of fruits, vegetables, and whole grains, was  $\leq 1$  serving/day. Mean fish and shellfish consumption was  $\leq 0.5$  servings/week. Mean consumption of nuts, seeds and legumes ranged from 1.5 to 2.4 servings/week. In comparison, both groups of children exceeded recommended limits for refined grains, processed meat, high-fat dairy products (eg, milk, cheese, yogurt, ice cream), and sugar-sweetened beverages (SSBs). Mean consumption of refined grains was between 5.6 and 5.7 servings/day. Mean consumption of processed meat ranged from 2.6 to 2.8 servings per week. Mean consumption of high-fat dairy products was between 1.3 and 1.4 servings per day. For SSBs, mean consumption ranged from 2.3 to 2.5 servings per day.

Figure 1 shows the percentage of low-income children meeting 10 selected food and nutrient recommendations

with their daily dietary intake: whole grains, fruits, vegetables, fish/shellfish, nuts/seeds/legumes, processed meats, SSBs, saturated fat, sodium, and potassium. Approximately 22% of SNAP participants and 20% of nonparticipants met none of the dietary recommendations. Zero percent of low-income children, regardless of SNAP participation, met at least 7 national dietary recommendations.

Several relative differences became greater after adjustment for age, gender, and other covariates. SNAP participants consumed 19% fewer servings of nuts, seeds, and legumes than nonparticipants (relative difference [RD] = 0.81, 95% CI: 0.65–1.00). SNAP participants also consumed 44% more servings of processed meats (RD = 1.44, 95% CI: 1.09–1.91), 47% more servings of high-fat dairy products (RD = 1.47, 95% CI: 1.07–2.01), 43% more servings of SSBs (RD = 1.43, 95% CI: 1.08–1.89), and nearly 4 times as much water (RD = 3.94, 95% CI: 2.27–6.84) than nonparticipants after multivariate adjustment. No significant differences in whole grains, fruits, vegetables, or fish and shellfish were observed between groups.

There were no differences in total energy or macronutrient intake between SNAP participants and nonparticipants. Although mean sodium intake was high (ranging from 3131 to 3268 mg/day) and mean potassium intake was low (ranging from 2187 to 2346 mg/day), there were no differences in sodium and potassium intake by SNAP participation. Mean calcium intake ranged from 946 to 955 mg/day. Most low-income children met the Estimated Average Requirement for folate and iron. After multivariate adjustment, SNAP participants had 8% higher folate intake (RD = 1.08, 95% CI 1.00–1.17), 8% higher calcium intake (RD = 1.08, 95% CI 1.02–1.14), and 7% higher iron intake (RD = 1.07, 95% CI 1.01–1.13) than nonparticipants.

In subgroup analyses by gender, age group, and food security status, similar

**TABLE 2** Participation in SNAP and Associations With Weight Status for Children  $\leq 130\%$  FPL

	SNAP Nonparticipants	SNAP Participants	Age- and Gender-Adjusted		Multivariate-Adjusted <sup>a</sup>	
	n (%)	n (%)	OR	95% CI	OR	95% CI
Normal wt	2318 (63.4)	818 (63.8)	Ref		Ref	
Overweight	813 (21.6)	270 (18.7)	0.94	0.70–1.28	0.95	0.69–1.30
Obese	649 (14.9)	254 (17.5)	1.31	0.91–1.89	1.11	0.71–1.74

<sup>a</sup> Model adjusted for age, gender, race/ethnicity, HR place of birth, HR education level, HR marital status, household size, health insurance, poverty income ratio, household food security, and participation in other food assistance programs.

**TABLE 3** Consumption of Selected Foods, Food Groups, and Nutrients Among Children  $\leq 130\%$  FPL by SNAP Participation Status

	SNAP Participation	Mean	Median	(10th, 90th)	% Meeting Guideline	Relative Difference <sup>a</sup>	
						Coef	95% CI
<b>Foods and food groups</b>							
Whole grains, servings/d	Nonparticipants	0.6	0.4	(0.1, 1.5)	1	Ref	
	Participants	0.5	0.3	(0, 1.2)	1	0.89	0.59–1.33
Refined grains, servings/d	Nonparticipants	5.7	5.5	(3.7, 7.7)	97	Ref	
	Participants	5.6	5.4	(3.6, 7.7)	96	1.05	0.95–1.16
Fruits, servings/d	Nonparticipants	1	0.8	(0.2, 2.1)	10	Ref	
	Participants	0.8	0.6	(0.1, 1.9)	7	0.98	0.64–1.49
100% fruit juice, servings/d	Nonparticipants	1.2	0.9	(0.2, 2.7)	—	Ref	
	Participants	1.1	0.8	(0.2, 2.5)	—	1.04	0.68–1.59
Vegetables, servings/d	Nonparticipants	0.7	0.6	(0.2, 1.3)	0	Ref	
	Participants	0.7	0.6	(0.2, 1.3)	0	1.40	0.78–2.52
Potatoes, servings/wk	Nonparticipants	3.6	3.4	(1.7, 5.7)	—	Ref	
	Participants	3.4	3.2	(1.5, 5.5)	—	0.98	0.69–1.38
Fish/shellfish, servings/wk	Nonparticipants	0.5	0.5	(0.2, 0.8)	0	Ref	
	Participants	0.4	0.3	(0.2, 0.6)	0	1.00	0.81–1.22
Nuts, seeds, legumes, servings/wk	Nonparticipants	2.1	1.2	(0.2, 5.0)	13	Ref	
	Participants	1.4	0.8	(0.1, 3.4)	7	0.81*	0.65–1.00
Processed meat, servings/wk	Nonparticipants	2.4	2.3	(0.9, 4.9)	44	Ref	
	Participants	2.8	2.5	(0.9, 5.1)	40	1.44*	1.09–1.91
High-fat dairy products, servings/d	Nonparticipants	1.3	1.1	(0.3, 2.4)	—	Ref	
	Participants	1.4	1.2	(0.4, 2.5)	—	1.47*	1.07–2.01
Flavored milk, servings/d	Nonparticipants	0.4	0.2	(0, 1.0)	—	Ref	
	Participants	0.4	0.3	(0, 1.1)	—	1.08	0.82–1.41
Sweets and bakery desserts, servings/d	Nonparticipants	1.4	1.3	(0.6, 2.3)	3	Ref	
	Participants	1.4	1.3	(0.6, 2.4)	3	1.03	0.78–1.35
Salty snacks, servings/d	Nonparticipants	0.5	0.4	(0.1, 0.9)	—	Ref	
	Participants	0.5	0.5	(0.2, 1.0)	—	1.30	0.94–1.82
Sugar-sweetened beverages, servings/d	Nonparticipants	2.5	2.1	(0.7, 4.6)	8	Ref	
	Participants	2.3	2.0	(0.7, 4.3)	7	1.43*	1.08–1.89
Water, servings/d	Nonparticipants	1	0.1	(0, 3.2)	—	Ref	
	Participants	1.5	0.3	(0, 4.4)	—	3.94*	2.27–6.84
<b>Nutrients</b>							
Total energy, kcal/d	Nonparticipants	1571	1350	(541, 2866)	—	Ref	
	Participants	1714	1487	(610, 3098)	—	0.99	0.93–1.04
EPA+DHA, g/d	Nonparticipants	0.04	0.04	(0.02, 0.07)	0	Ref	
	Participants	0.03	0.03	(0.01, 0.05)	0	1.24	0.94–1.63
ALA, g/d	Nonparticipants	1.3	1.3	(0.8, 1.9)	48	Ref	
	Participants	1.2	1.2	(0.7, 1.8)	49	1.01	0.94–1.07
MUFA, % energy	Nonparticipants	12.1	12.1	(9.9, 14.3)	—	Ref	
	Participants	12.2	12.2	(10.1, 14.4)	—	1.00	0.95–1.05
PUFA, % energy	Nonparticipants	6.1	6	(4.8, 7.4)	—	Ref	
	Participants	6.1	6	(4.8, 7.4)	—	1.01	0.96–1.06
Saturated fat, % energy	Nonparticipants	11.4	11.4	(9.5, 13.3)	0	Ref	
	Participants	11.9	11.9	(10.0, 13.9)	0	1.02	0.97–1.08
Dietary cholesterol, mg/d	Nonparticipants	233	222	(140, 340)	81	Ref	
	Participants	219	208	(130, 320)	86	1.01	0.94–1.09
Total fat, % energy	Nonparticipants	32.3	32.3	(27.4, 37.2)	73	Ref	
	Participants	32.9	32.9	(28.0, 37.8)	69	1.01	0.97–1.06
Carbohydrates, % energy	Nonparticipants	55.6	55.6	(49.7, 61.5)	97	Ref	
	Participants	55.5	55.5	(49.6, 61.4)	97	1.00	0.98–1.03
Protein, % energy	Nonparticipants	13.1	13	(10.7, 15.7)	95	Ref	
	Participants	12.7	12.6	(10.3, 15.3)	93	1.00	0.96–1.03
Folate, mg/d	Nonparticipants	382	364	(233, 552)	80	Ref	
	Participants	381	364	(232, 551)	82	1.08*	1.00–1.17
Dietary fiber, g/d	Nonparticipants	13.4	12.9	(8.5, 18.9)	0	Ref	
	Participants	12.7	12.2	(8.0, 18.0)	0	1.04	0.97–1.11
Sodium, mg/d	Nonparticipants	3268	3150	(2094, 4582)	15	Ref	
	Participants	3131	3021	(1996, 4402)	18	1.00	0.95–1.05
Potassium, mg/d	Nonparticipants	2346	2268	(1492, 3294)	2	Ref	

**TABLE 3** Continued

	SNAP Participation	Mean	Median	(10th, 90th)	% Meeting Guideline	Relative Difference <sup>a</sup>	
						Coef	95% CI
Calcium, mg/d	Participants	2187	2115	(1375, 3089)	1	0.99	0.95–1.04
	Nonparticipants	946	905	(552, 1388)	42	Ref	
Iron, mg/d	Participants	955	916	(559, 1399)	45	1.08*	1.02–1.14
	Nonparticipants	15	14.4	(9.6, 21.1)	86	Ref	
	Participants	14.8	14.2	(9.5, 20.9)	99	1.07*	1.01–1.13

ALA, alpha-linolenic acid; Coef, coefficient; DHA, docosahexaenoic acid; EPA, eicosapentaenoic acid; MUFA, monounsaturated fatty acid; PUFA, monounsaturated fatty acid; Ref, reference; —, no available guideline for this food or nutrient.

<sup>a</sup> Models adjusted for age, gender, race/ethnicity, HR place of birth, HR education level, HR marital status, household size, health insurance, poverty income ratio, household food security, participation in other food assistance programs, and total energy.

\*  $P < .05$ .

levels of foods, food groups, and nutrients were consumed (Supplemental Tables 9, 10, and 11). However, girl SNAP participants had higher vegetable consumption (RD = 1.98, 95% CI: 1.08–3.62) compared with girl nonparticipants. Children in food-insecure households receiving SNAP reported higher consumption of refined grains (RD = 1.17, 95% CI: 1.02–1.34) than food-insecure nonparticipants. Boys participating in SNAP also had higher intake of saturated fat (RD = 1.06, 95% CI: 1.01–1.12), compared with boy nonparticipants.

For the HEI-2005, SNAP participants and nonparticipants scored 45.6 and 47.2, respectively, out of a maximum 100 points (Table 4). Among both groups,

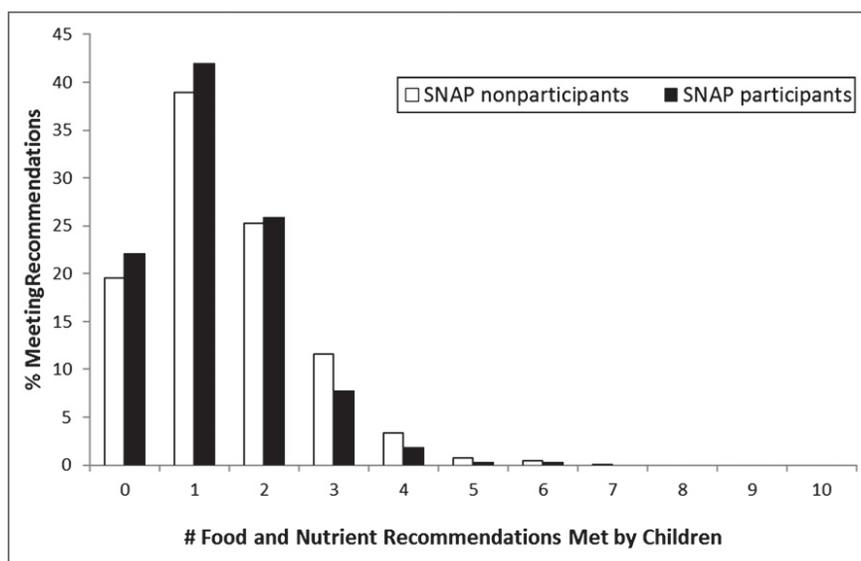
the lowest scores were dark green vegetables, orange vegetables and legumes, and whole grains. The highest scores were meat and beans, milk, saturated fat, and total grains. After adjusting for covariates, SNAP participants had a 97% higher whole grains score than nonparticipants (RD = 1.97, 95% CI: 1.13–3.44) and a 17% higher milk score (RD = 1.17, 95% CI: 1.04–1.31) compared with nonparticipants. There was no difference in the total HEI-2005 score after multivariate adjustment (RD = 1.00, 95% CI: 0.96–1.04).

The total AHEI scores for SNAP participants and nonparticipant were 21.0 and 23.2, respectively, out of a maximum of 87.5 points (Table 5). Both groups had

low scores for vegetables, fruits, and nuts and soy protein. Compared with nonparticipants, SNAP participants had an 18% lower score for nuts and soy protein (RD = 0.82, 95% CI: 0.67–1.00), after adjusting for covariates. There was no significant multivariate-adjusted difference in the overall AHEI score between SNAP participants and nonparticipants (RD = 0.96, 95% CI: 0.91–1.01).

## DISCUSSION

The prevalence of childhood obesity has increased in recent decades.<sup>39</sup> In this national sample of low-income children, more than one-third of low-income children were overweight or obese; however, SNAP participation was not



**FIGURE 1**

Percentage of low-income children meeting 10 food and nutrient guidelines for whole grains, fruits, vegetables, fish/shellfish, nuts/seeds/legumes, processed meats, SSBs, saturated fat, sodium, and potassium.

**TABLE 4** Participation in SNAP and Children's Dietary Quality as Measured by the HEI-2005

Component	Standards for Maximum Score	Maximum Score	SNAP Participation	Mean $\pm$ SD	% of Maximum Score	Relative Difference <sup>a</sup>	
						Coef	95% CI
Total fruit	$\geq 0.8$ cup per 1000 kcal	5	Nonparticipants	2.2 $\pm$ 0.1	44	Ref	
			Participants	2.1 $\pm$ 0.1	42	1.50	0.94–2.39
Whole fruit	$\geq 0.4$ cup per 1000 kcal	5	Nonparticipants	1.7 $\pm$ 0.1	34	Ref	
			Participants	1.4 $\pm$ 0.1	28	1.01	0.53–1.92
Total vegetables	$\geq 1.1$ cup per 1000 kcal	5	Nonparticipants	2.2 $\pm$ 0.0	44	Ref	
			Participants	1.9 $\pm$ 0.1	38	0.93	0.76–1.13
Dark green and orange vegetables and legumes	$\geq 0.4$ cup per 1000 kcal	5	Nonparticipants	0.7 $\pm$ 0.0	14	Ref	
			Participants	0.6 $\pm$ 0.1	12	1.05	0.59–1.88
Total grains	$\geq 3.0$ oz per 1000 kcal	5	Nonparticipants	4.6 $\pm$ 0.0	92	Ref	
			Participants	4.5 $\pm$ 0.1	90	0.98	0.95–1.02
Whole grains	$\geq 1.5$ oz per 1000 kcal	5	Nonparticipants	0.7 $\pm$ 0.0	14	Ref	
			Participants	0.7 $\pm$ 0.1	14	1.97*	1.13–3.44
Milk	$\geq 1.3$ cup per 1000 kcal	10	Nonparticipants	6.1 $\pm$ 0.1	61	Ref	
			Participants	6.3 $\pm$ 0.2	63	1.17*	1.04–1.31
Meat and beans	$\geq 2.5$ oz per 1000 kcal	10	Nonparticipants	6.8 $\pm$ 0.1	68	Ref	
			Participants	6.6 $\pm$ 0.1	66	1.01	0.89–1.14
Oils	$\geq 12$ g per 1000 kcal	10	Nonparticipants	4.9 $\pm$ 0.1	49	Ref	
			Participants	4.9 $\pm$ 0.2	49	1.01	0.86–1.19
Saturated fat	$\leq 7\%$ energy	10	Nonparticipants	6.5 $\pm$ 0.1	65	Ref	
			Participants	5.9 $\pm$ 0.2	59	1.07	0.74–1.55
Sodium	$\leq 0.7$ g per 1000 kcal	10	Nonparticipants	4.7 $\pm$ 0.1	47	Ref	
			Participants	4.5 $\pm$ 0.1	45	0.90	0.24–3.34
Calories from SOFAAS	$\leq 20\%$ energy	20	Nonparticipants	9.3 $\pm$ 0.2	47	Ref	
			Participants	9.1 $\pm$ 0.3	46	1.27	0.92–1.77
Total score		100	Nonparticipants	47.2 $\pm$ 0.5	47	Ref	
			Participants	45.6 $\pm$ 0.6	46	1.00	0.96–1.04

Food or nutrient guideline is the recommended maximum. Coef, coefficient; Ref, reference; SOFAAS, solid fats, alcohol, and added sugars.

<sup>a</sup> Models adjusted for age, gender, race/ethnicity, HR place of birth, HR education level, HR marital status, household size, health insurance, poverty income ratio, household food security, and participation in other food assistance programs.

\*  $P < .05$ .

associated with higher rates of overweight or obesity after multivariate adjustment. These findings corroborate the results of a USDA review of SNAP participation and obesity in children,<sup>40</sup> although evidence increasingly suggests an association between SNAP participation and obesity in adult women.<sup>40,41</sup>

All low-income children in the study consumed fewer servings of fruits, vegetables, whole grains, fish and shellfish, nuts, seeds and legumes, dietary fiber, and potassium, and more servings of refined grains, processed meat, high-fat dairy, SSBs, saturated fat, and sodium when compared with national recommendations. As shown in previous studies, the dietary intake of low-income children falls far short of national recommendations, with  $\sim 1$  in 5 low-income children not meeting any of the dietary recommendations.<sup>42–44</sup>

Although there was no difference by SNAP participation, all low-income children had low scores for both dietary quality measures. Mean HEI scores were between the 40th and 50th percentiles of the general population, and mean AHEI scores were within the lowest quintile of dietary quality from the original AHEI report; low AHEI scores have predicted greater risks of chronic disease among adults.<sup>31–33,45</sup> These findings underscore the need to develop policies and educational programs to encourage healthier food choices among low-income children and families.

Although the diets of low-income SNAP participants and nonparticipants were similar in terms of total energy and macronutrients, there were some differences after multivariate adjustment. The nutritional intake of SNAP participants appeared better in some ways:

more water, folate, calcium, and iron. In other ways, their food intake was worse: fewer nuts, seeds, and legumes and more processed meats, high-fat dairy products, and SSBs than nonparticipants. Ironically, the higher intakes of foods not generally regarded as healthy (eg, refined grains, processed meats, high-fat dairy) may have contributed to the higher intakes of folate, iron, and calcium in SNAP participants. The lack of major differences between groups could have resulted from a modest nutritional benefit with the program among SNAP recipients combined with a diet that would have been worse without the program. However, SNAP participation did not raise the nutritional quality of children's diets to anywhere close to national recommendations.

The high intake of SSBs by low-income children deserves attention for its

**TABLE 5** Participation in SNAP and Children's Dietary Quality as Measured by a Modified AHEI

Component	Standards for Maximum Score	Maximum Score	SNAP Participation	Mean $\pm$ SE	% of Maximum Score	RD <sup>a</sup>	
						Coef	95% CI
Vegetables (excluding potatoes)	5 servings/d	10	Nonparticipants	1.3 $\pm$ 0.1	13		
			Participants	1.3 $\pm$ 0.1	13	1.40	0.78–2.52
Fruits	4 servings/d	10	Nonparticipants	1.8 $\pm$ 0.1	18		
			Participants	1.5 $\pm$ 0.1	15	0.96	0.64–1.46
Nuts and soy protein	1 serving/d	10	Nonparticipants	1.2 $\pm$ 0.1	12		
			Participants	0.7 $\pm$ 0.1	7	0.82*	0.67–1.00
Ratio of white to red meat	4:01	10	Nonparticipants	2.5 $\pm$ 0.1	25		
			Participants	2.2 $\pm$ 0.1	22	1.11	0.81–1.52
Cereal fiber	15 g/d	10	Nonparticipants	2.4 $\pm$ 0.1	24		
			Participants	2.3 $\pm$ 0.1	23	1.20	0.88–1.63
Ratio of polyunsaturated to saturated fat	1:01	10	Nonparticipants	5.7 $\pm$ 0.1	57		
			Participants	5.4 $\pm$ 0.1	54	0.99	0.95–1.05
Multivitamin use	Any use in past 30 d	7.5	Nonparticipants	3.4 $\pm$ 0.1	45		
			Participants	3.0 $\pm$ 0.1	40	0.93*	0.87–0.99
Total score (rescaled to original)		87.5	Nonparticipants	23.2 $\pm$ 0.4	27		
			Participants	21.0 $\pm$ 0.5	24	0.96	0.91–1.01

<sup>a</sup> Models adjusted for age, gender, race/ethnicity, HR place of birth, HR education level, HR marital status, household size, health insurance, poverty income ratio, household food security, total energy intake, and participation in other food assistance programs.

\*  $P < .05$ .

implications for the Farm Bill reauthorization. It was estimated that as much as \$4 billion of SNAP benefits in 2011 were used to purchase soft drinks by program participants.<sup>46</sup> In an effort to improve the diets of SNAP participants, New York City recently requested a waiver to restrict SSB purchases with SNAP benefits. Although the USDA denied its request, public health advocates have supported similar policies to improve dietary quality for SNAP participants and have urged policymakers to align SNAP with the Dietary Guidelines for Americans.<sup>9,47,48</sup>

This study also found that SNAP participants had high intakes of beverages (eg, SSBs, high-fat dairy, water), compared with nonparticipants. Coupled with lower household food security, increasing water consumption, and possibly beverages in general, might have been used not only to address thirst but as a coping strategy for experiences of food insecurity by SNAP participants.<sup>49</sup>

This study has limitations. One is the cross-sectional nature of the data, which makes it difficult to determine temporality. Variables like household food security may predict SNAP participation or mediate its association with obesity and

dietary quality. The results did not change when household food security was excluded from multivariate models; thus, it was retained as a covariate because bivariate analyses showed significant differences in household food security by SNAP participation. Measurement error is always a problem with dietary intake; however, 24-hour recalls to assess children's diets have been validated for energy intake using doubly labeled water in other studies.<sup>50,51</sup> Information on external influences would also enhance knowledge of how the larger environment affects the use of SNAP benefits and dietary intake.<sup>52</sup>

This study could not control for "self-selection bias" or other unmeasured differences between SNAP participants and nonparticipants. Although some variables related to self-selection were accounted for (eg, household food security, participation in other food assistance programs), there may be other unmeasured characteristics, such as access to healthier foods. We cannot determine the extent that these differences may be explained by SNAP participation. Another limitation is the low SNAP participation rate in NHANES. This may be due to lower NHANES response

rates among SNAP households, misreporting of SNAP participation, which may be related to gender, marital status, or income, or other household eligibility criteria not captured by NHANES.<sup>4,53,54</sup>

## CONCLUSIONS

The name change to the Supplemental Nutrition Assistance Program in 2008 and the SNAP Nutrition Education and Obesity Prevention Grant Program for nutrition education in 2010 indicate a growing emphasis on promoting improved food choices in SNAP.<sup>6,55</sup> This study highlights the poor dietary quality of low-income children compared with national recommendations for foods and nutrients. Importantly, it suggests possible differences in dietary intake between SNAP participants and low-income nonparticipants with respect to specific foods (eg, more SSBs, high-fat dairy products, processed meats, and fewer nuts, seeds, and legumes), which may have, in part, contributed to higher intakes of micronutrients (eg, calcium, iron, folate), despite no differences in overall dietary quality scores.

SNAP has the potential to influence the diets of 45 million participants, 47% of whom are children, by providing

additional resources to purchase food.<sup>13</sup> The low intake of nutritious food among children participating in SNAP represents a significant missed opportunity for the program to promote

health during an important life stage. Policy changes should be considered to restructure SNAP as a program that goes beyond alleviating food insecurity by increasing the availabil-

ity, marketing, and desirability of healthier foods that better support the use of SNAP benefits for nutritious foods to improve children's health.<sup>56</sup>

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