

Indicators of Diet Quality, Nutrition, and Health for Americans by Program Participation Status, 2011–2016: NSLP Report



Appendix G. NSLP Multivariable Regression Analyses



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Appendix G. NSLP Multivariable Regression Analyses



June 2022

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Appendix G. NSLP Multivariable Regression Analyses

The *Indicators of Diet Quality, Nutrition, and Health for Americans by Program Participation Status: 2011–2016* is the fourth study in a series that uses National Health and Nutrition Examination Survey (NHANES) data to compare indicators of diet quality, nutrition, and health among program participants and nonparticipants of the National School Lunch Program (NSLP). The study employed two types of analyses to make these comparisons:

- ▶ Descriptive analyses provided information on indicators of diet quality, nutrition, and health among participants and both income-eligible and higher income nonparticipants; *t*-tests were used to test for differences between the groups overall and by age and gender groups. Results of the descriptive analyses are presented in the main body of the report.
- ▶ Multivariable regression was used to examine associations between program participation and selected indicators of diet quality, nutrition, and health. Ordinary least squares (OLS) regressions provide a linear interpretation of the association, such that a unit increase in the independent variable of interest is associated with a unit increase in the dependent variable, conditional on covariates. A multivariable regression also facilitates an estimate of the association between the primary independent variables of interest and the dependent variable, after adjusting for covariates. This appendix summarizes and presents findings from the above-described multivariable regression analyses and addresses study objective 6 (see text box).

Study Objective 6

Use advanced regression approaches to examine the multivariable association between program participation and as appropriate the study variables of interest.

Results of the above-described two types of analyses may differ because of differences in the analytic techniques and additional factors for which the regression analyses adjust.¹ Some of the descriptive analysis limitations described in the main report also apply to the multivariable regression analyses presented in this appendix. For example, NSLP participation status was determined as school children who were likely to have received a reimbursable meal based on their lunchtime

meal patterns; participation was not otherwise verified. Because of the cross-sectional nature of the data, causality cannot be inferred. Finally, even in the multivariable context, it is possible some variables that may influence participant outcomes are not being measured, and therefore the relationships between the independent and dependent variables are not fully explained. For these reasons, readers should be cautious when interpreting and extrapolating findings.

Regression Outcomes

Energy Intakes

- Total calories
- Calories from saturated fats and added sugars

Overall diet quality

- Total HEI-2015 scores
- Component HEI-2015 scores

Indicators of nutrition and health

- BMI-for-age
- HDL cholesterol
- LDL cholesterol
- Triglycerides
- Hemoglobin
- Metabolic syndrome

Note: BMI = body mass index;
HDL = high-density lipoprotein
cholesterol; HEI = Healthy Eating Index;
LDL = low-density lipoprotein cholesterol

¹ In section C, differences between the descriptive and multivariable analyses are indicated in footnotes.

A. Methods Summary

This section describes the sample and details the approach used to conduct the multivariable regression analyses. See appendix A of the main report for additional information about the analytic approach, including the use of NHANES sampling weights, calculation of standard errors, and age standardization.

1. Analytic Sample

For all analyses in this appendix, income-eligible NSLP participants were compared with income-eligible nonparticipants. Analyses were based on NHANES 2011–2016 data. NSLP participants were identified as school children aged 5–18 who were likely to have received a reimbursable school lunch on the day of their dietary recall. Children were defined as income-eligible² if their annual household income was less than or equal to 185 percent of the Federal Poverty Guidelines.

Table G.1 presents ages and associated sample sizes for each program participation group. In practice, analytic sample sizes for some regressions are smaller because of missing data.

Table G.1. Analytic Sample Age and Sample Size by Outcome Type

Outcomes	Age of Relevant NHANES Respondents (Years)	Number of NHANES Respondents
Total energy; energy from saturated fats and added sugars; total HEI-2015 score and individual component scores; BMI-for-age; hemoglobin	5–18	2,545
HDL cholesterol	6–18	2,420
LDL cholesterol; TG	12–18	1,070

Note: Sample sizes presented here include all children regardless of income or program participation.

BMI = body mass index; HDL = high-density lipoprotein cholesterol; LDL = low-density lipoprotein cholesterol; NHANES = National Health and Nutrition Examination Survey; TG = triglycerides

Regressions presented in this appendix are based on NHANES data. NHANES does not sample some subsets of the population, such as institutionalized or homeless individuals. Therefore, results labeled “All Individuals” should be interpreted to mean all individuals in the NHANES sample population.

2. Data Analysis

The study team used two types of regressions, depending on the outcome variable. Continuous outcomes (energy intakes, overall diet quality, and hemoglobin concentration) were modeled using OLS regressions. Binary outcomes (overweight or obese body mass index [BMI], low HDL cholesterol, high LDL cholesterol, high triglycerides, and low hemoglobin) were modeled using logistic regressions (see table G.2). In this case, results are presented according to the average marginal effects (for example, see table G.6). Average marginal effects are an alternative to odds ratios the study team selected for ease of interpretation. The average marginal effect for an independent variable is the difference in percentage points between the predicted probability of the modeled outcome associated with a change in that independent variable (either a 1-unit increase for a continuous independent variable or the difference between the reference group and another group for a categorical independent variable). When calculating average marginal effects for program participation, each covariate is held at its mean value.

² All school children may participate in NSLP, but children from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines receive meals at no cost or at a reduced price (not to exceed 40 cents).

For example, when examining weight status, an average marginal effect of 0.02 for NSLP participants compared with income-eligible nonparticipants means that on average, NSLP participants are 2 percentage points more likely to be overweight or obese compared with income-eligible nonparticipants.

The study team structured regressions to produce a coefficient for income-eligible NSLP participants and chose income-eligible nonparticipants as the reference group to facilitate a narrative discussion of differences between these two groups. All regression analyses controlled for the same set of covariates (see text box) except regressions used to examine sample characteristics that did not control for any covariates. Table G.2 presents the outcomes and measures examined through multivariate regression analyses.

Covariates Included in Regression Models

- Age (years)
- Race/ethnicity
- Educational attainment for household reference person
- Marital status of household reference person
- Household income-to-poverty ratio
- Household size
- Household food security status

Table G.2. Summary of Outcomes and Measures for Multivariable Regression Analyses

Outcome	Measures	Age of Relevant NHANES Respondents (Years)
Energy Intakes		
Usual energy intakes	■ Total calories (kcal/day)	5–18
Calories from saturated fats and added sugars on a given day	■ Calories contributed from saturated fats and added sugars (kcal/day)	5–18
Overall Diet Quality		
HEI scores on a given day	■ HEI-2015 total score (points) ■ HEI-2015 component scores (points)	5–18
Indicators of Nutrition and Health		
BMI-for-age	■ Greater than or equal to 85th percentile of BMI-for-age (overweight or obese) versus less than 85th percentile of BMI-for-age (not overweight or obese)	5–18
Blood biomarkers	■ HDL cholesterol (indicator of low HDL)	6–18
	■ LDL cholesterol (indicator of high LDL)	12–18
	■ TG (indicator of high TG)	12–18
	■ Hemoglobin (indicator of low hemoglobin; concentration as measured in g/L)	5–18

Note: BMI = body mass index; HDL = high-density lipoprotein cholesterol; HEI = Healthy Eating Index; LDL = low-density lipoprotein cholesterol; NHANES = National Health and Nutrition Examination Survey; TG = triglycerides

As noted previously, this research was not designed to measure the causal impact of NSLP participation on diet quality or health. Therefore, significant differences between income-eligible NSLP participants and nonparticipants cannot be attributed to participation in NSLP. Similarly, the absence of a significant difference cannot be interpreted as evidence that participation in NSLP has no effect. Regression with an indicator of program participation provides an estimate of the expected difference by participation category, after adjusting for covariates, but does not enable a causal interpretation of that difference. The accurate assessment of NSLP impacts requires specially designed studies or, at minimum, complex analytical models that require a variety of measures, some of which are not available in NHANES data.

B. Sample Characteristics

Income-eligible NSLP participants were younger, had a lower household income-to-poverty ratio, and had more people per household than income-eligible nonparticipants (see table G.3). A lower percentage of NSLP participants reported receiving anemia treatment in the past 3 months compared with income-eligible nonparticipants. Income-eligible NSLP participants had a higher mean Healthy Eating Index (HEI)-2015 score on a given day (51 versus 47 points) and scored higher in 9 of the 13 HEI-2015 components than income-eligible nonparticipants. Income-eligible NSLP participants had a lower average hemoglobin concentration than income-eligible nonparticipants (13.27 versus 13.32 grams per liter).

C. Findings

This section discusses significant differences, after adjusting for covariates, in overall diet quality, energy intakes, weight status, and blood biomarkers for income-eligible NSLP participants compared with income-eligible nonparticipants. Supporting tables presented in section D include additional participant and comparison groups (i.e., higher income participants and nonparticipants) not discussed in this section.

1. Overall Diet Quality

HEI is a measure of diet quality that assesses adherence to the 2015–2020 Dietary Guidelines for Americans (DGA) recommendations (U.S. Department of Agriculture [USDA] & U.S. Department of Health and Human Services [HHS], 2010). A higher HEI score—for each component and in total—indicates a diet that aligns more closely with the DGA. See table 2.1 in chapter 2 of the report for more details on HEI-2015 scoring. There were some differences in total and component HEI-2015 scores after adjusting for covariates:

- ▶ Income-eligible NSLP participants scored 4.41 points higher for total HEI-2015 on a given day compared with income-eligible nonparticipants.
- ▶ Income-eligible NSLP participants scored higher (i.e., better) for total fruit (0.58 points), whole fruit (0.83 points), total vegetables (0.30), greens and beans (0.65 points), dairy (0.99 points), total protein foods (0.30), and seafood and plant proteins (0.40 points) components on a given day compared with income-eligible nonparticipants.

Table G.3. Regression-Adjusted Association of NSLP Participation With HEI-2015 Scores

Outcome	Maximum Points	Income-Eligible Nonparticipants	Income-Eligible NSLP Participants
Total fruits	5	Ref	0.58 ***
Whole fruits	5	Ref	0.83 ***
Total vegetables ^a	5	Ref	0.30 *
Greens and beans	5	Ref	0.65 ***
Whole grains	10	Ref	0.08
Dairy	10	Ref	0.99 ***
Total protein foods ^a	5	Ref	0.30 **
Seafood and plant protein ^a	5	Ref	0.40 **

Outcome	Maximum Points	Income-Eligible Nonparticipants	Income-Eligible NSLP Participants
Fatty acids	10	Ref	-0.30
Refined grains	10	Ref	0.37
Sodium	10	Ref	-0.16
Added sugars	10	Ref	0.50
Saturated fats	10	Ref	-0.14
HEI-2015 Total Score	100	Ref	4.41 ***
Observations (n)	NA	949	608

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with a complete day 1 dietary recall. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 130 percent of the relevant Federal Poverty Guidelines. Estimates were calculated using ordinary least squares regressions and were calculated using pooled NHANES dietary day 1 sample weights. Estimates were adjusted for age, race/ethnicity, gender, educational attainment of the household reference person, marital status of the household reference person, income-to-poverty ratio, number of individuals in the household, household food security status, and NHANES cycle. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

HEI = Healthy Eating Index; NSLP = National School Lunch Program; Ref = reference group

^a In the descriptive analysis, differences between income-eligible NSLP participants and nonparticipants were not significant.

Sources: NHANES 2011–2016 dietary recalls and demographic data

2. Energy Intakes

The total energy an individual needs each day to maintain energy balance varies by age, sex, height, weight, and level of physical activity. See table 5.4 in chapter 5 of the report for more details on estimated energy needs. Although total energy intake on a given day was similar across participant groups, there was a difference in total calories from saturated fats and added sugars after adjusting for covariates:

- Income-eligible NSLP participants consumed an average of 52 more calories on a given day from saturated fats and added sugars than income-eligible nonparticipants.

Table G.4. Regression-Adjusted Association of NSLP Participation With Energy Intakes

Outcome	Income-Eligible Nonparticipants	Income-Eligible NSLP Participants
Calories, usual intake ^a	Ref	17.83
Calories from saturated fats and added sugars	Ref	51.79 *
Observations (n)	949	608

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 and older with a complete day 1 dietary recall. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 130 percent of the relevant Federal Poverty Guidelines. Estimates were calculated using ordinary least squares regressions and were calculated using pooled NHANES dietary day 1 sample weights. Estimates were adjusted for age, race/ethnicity, gender, educational attainment of the household reference person, marital status of the household reference person, income-to-poverty ratio, number of individuals in the household, household food security status, and NHANES cycle. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

Ref = reference group; NSLP = National School Lunch Program

^a In the descriptive analysis, differences between income-eligible NSLP participants and nonparticipants were significant.

Sources: NHANES 2011–2016 dietary recalls and demographic data

3. Weight Status

Weight status was determined using the Centers for Disease Control and Prevention (CDC) BMI-for-age percentile growth charts, which account for a child's age and gender. BMI-for-age can be used as a tool to screen for overweight and obesity (CDC, 2018). After adjusting for covariates, the likelihood of being overweight or obese was similar for income-eligible participants and nonparticipants.

Table G.5. Regression-Adjusted Association of NSLP Participation With Overweight or Obesity

Outcome	Income-Eligible Nonparticipants	Income-Eligible NSLP Participants
Overweight or obesity ^a	Ref	0.02
Observations (n)	944	606

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with a complete day 1 dietary recall. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 130 percent of the relevant Federal Poverty Guidelines. Estimates were calculated using logistic regressions with average marginal effects and were calculated using pooled NHANES dietary day 1 sample weights. Estimates were adjusted for age, race/ethnicity, gender, educational attainment of household reference person, marital status of household reference person, income-to-poverty ratio, number of individuals in the household, household food security status, and NHANES cycle. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

NSLP = National School Lunch Program; Ref = reference group

^a In the descriptive analysis, the prevalence of obesity was higher among income-eligible NSLP participants compared with nonparticipants.

Sources: NHANES 2011–2016 dietary recalls and demographic data

4. Blood Biomarkers

Blood biomarkers included high-density lipoprotein (HDL) cholesterol and low-density lipoprotein cholesterol (LDL) cholesterol, triglycerides (TG), and hemoglobin (see table J.2). Low HDL cholesterol and elevated LDL cholesterol and TG are linked to heart disease; high blood glucose levels can result in type 2 diabetes; and low hemoglobin may indicate iron deficiency, iron deficiency anemia, or anemia. After adjusting for covariates, HDL and LDL levels and TG and hemoglobin concentrations were similar among income-eligible NSLP participants and nonparticipants.

Table G.6. Regression-Adjusted Association of NSLP Participation With Blood Biomarkers

Outcome	Income-Eligible Nonparticipants	Income-Eligible NSLP Participants
HDL, low	Ref	0.05
Observations (n)	495	787
LDL, high ^a	Ref	0.13
Observations (n)	202	83
TG, high	Ref	0.08
Observations (n)	202	83
Hemoglobin, low	Ref	-0.01
Observations (n)	840	542
Hemoglobin, continuous (g/L)	Ref	0.06
Observations (n)	840	542

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents with a complete day 1 dietary recall aged 6–18 for HDL; aged 12–18 for LDL and TG; and aged 5–18 for the hemoglobin outcomes. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 130 percent of the relevant Federal Poverty Guidelines. See appendix A, table A.1 for definition of reference values and recommendations for blood biomarkers. Estimates were calculated using logistic regressions with average marginal effects and were calculated using pooled NHANES dietary day 1 sample weights. Estimates were adjusted for age, race/ethnicity, gender, educational attainment, marital status, income-to-poverty ratio, number of individuals in the household, household food security status, health insurance coverage, and NHANES cycle. The hemoglobin estimates were adjusted for anemia treatment. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

HDL = high-density lipoprotein cholesterol; LDL = low-density lipoprotein cholesterol; NSLP = National School Lunch Program; Ref = reference group; TG = triglycerides

^a In the descriptive analysis, a higher percentage of income-eligible NSLP participants had borderline high LDL levels compared with income-eligible nonparticipants.

Sources: NHANES 2011–2016 dietary recalls and demographic data

D. Supporting Tables for NSLP

1. Sample Characteristics

Table G.3. Characteristics of NSLP Participants and Nonparticipants Aged 5–18, 2011–2016

Characteristic	Income-Eligible NSLP Participants		Income-Eligible Nonparticipants		Higher Income NSLP Participants		Higher Income Nonparticipants	
	Mean	(SE)	Mean	(SE)	Mean	(SE)	Mean	(SE)
Individual and Household Characteristics, Continuous Variables								
Age (years)	10.34	(0.14)	11.50 ***	(0.12)	11.20 ***	(0.26)	11.64 ***	(0.14)
Household income-to-poverty ratio	1.07	(0.03)	1.22 ***	(0.03)	3.33 ***	(0.08)	3.78 ***	(0.04)
Household size (people in household)	5.04	(0.05)	4.85 ***	(0.04)	4.28 ***	(0.08)	4.31 ***	(0.04)
Individual and Household Characteristics, Categorical Variables								
Race/ethnicity (percentage)								
Asian, non-Hispanic	3.52	(0.72)	2.94	(0.54)	3.85	(1.27)	5.36	(0.87)
Black, non-Hispanic	21.00	(1.60)	22.10	(1.32)	6.85 **	(1.67)	7.48 ***	(1.01)
White, non-Hispanic	37.21	(1.90)	34.87	(1.51)	68.02 *	(3.08)	71.12 ***	(1.75)
Hispanic	32.72	(1.84)	33.84	(1.50)	18.12	(2.54)	11.64 ***	(1.24)
Other race, multiracial	5.56	(0.90)	6.25	(0.77)	3.16	(1.15)	4.41	(0.79)
Female (percentage)	49.65	(1.97)	52.15	(1.59)	44.66	(3.28)	49.50	(1.93)
SNAP recipient	51.45	(1.97)	46.22	(1.59)	4.65 ***	(1.39)	4.09 ***	(0.76)
Household food security status (percentage)								
Household full food security	38.92	(1.92)	44.81	(1.58)	84.99 ***	(2.36)	85.49 ***	(1.36)
Household marginal food security	17.97	(1.51)	16.39	(1.18)	5.08 **	(1.45)	8.54 **	(1.08)
Household low food security	22.66	(1.65)	23.87	(1.35)	8.40 *	(1.83)	4.76 ***	(0.82)
Household very low food security	20.45	(1.59)	14.92	(1.13)	1.53 ***	(0.81)	1.21 ***	(0.42)
Covered by health insurance (percentage)								
No	9.67	(1.16)	8.93	(0.91)	6.33	(1.61)	3.27 ***	(0.69)
Yes	90.33	(1.16)	91.07	(0.91)	93.67	(1.61)	96.73 ***	(0.69)

Characteristic	Income-Eligible NSLP Participants		Income-Eligible Nonparticipants		Higher Income NSLP Participants		Higher Income Nonparticipants	
	Mean	(SE)	Mean	(SE)	Mean	(SE)	Mean	(SE)
Received anemia treatment in past 3 months (percentage)								
No	99.90	(0.13)	98.61 ***	(0.37)	99.62	(0.41)	99.23 ***	(0.34)
Yes	0.10	(0.13)	1.39 ***	(0.37)	0.38	(0.41)	0.77 ***	(0.34)
NHANES cycle (percentage)								
2011–2012	43.70	(1.95)	26.18 **	(1.40)	46.60	(3.29)	24.41 **	(1.66)
2013–2014	33.00	(1.85)	34.87	(1.51)	29.11	(3.00)	35.31	(1.84)
2015–2016	23.31	(1.66)	38.95 **	(1.55)	24.29	(2.83)	40.28 **	(1.89)
Individual Outcome Measures								
Energy intake (calories)								
Total calories, usual intake ^a	1925.50	(8.97)	1932.52	(7.75)	1950.28	(15.93)	1946.18	(9.23)
Calories from saturated fats and added sugars ^b	520.21	(10.95)	477.09	(8.29)	537.01	(18.49)	513.64	(10.40)
HEI-2015 total score ^b	51.01	(0.48)	46.58 ***	(0.39)	49.65	(0.69)	49.43 ***	(0.49)
HEI adequacy components ^b								
Total fruits	2.80	(0.08)	2.13 ***	(0.07)	3.01 ***	(0.13)	2.80	(0.08)
Whole fruits	2.63	(0.09)	1.75 ***	(0.07)	2.80 ***	(0.14)	2.86 ***	(0.09)
Total vegetables	2.44	(0.06)	2.16 ***	(0.05)	2.22 ***	(0.10)	2.12 ***	(0.06)
Greens and beans	1.43	(0.08)	0.81 ***	(0.05)	0.77 ***	(0.10)	1.02 ***	(0.07)
Whole grains	2.82	(0.12)	2.92 ***	(0.11)	3.06 ***	(0.19)	3.19 ***	(0.13)
Dairy	8.28	(0.10)	7.02 ***	(0.10)	8.28	(0.17)	6.77 ***	(0.12)
Total protein foods	3.76	(0.05)	3.48 ***	(0.05)	3.65 ***	(0.09)	3.53 ***	(0.06)
Seafood and plant Proteins	1.75	(0.08)	1.42 ***	(0.06)	1.64 ***	(0.14)	1.85 ***	(0.08)
Fatty acids	3.62	(0.13)	4.08 ***	(0.11)	2.95 ***	(0.19)	3.75 ***	(0.13)
HEI moderation components ^b								
Refined grains	4.96	(0.14)	4.54 ***	(0.11)	5.13 *	(0.23)	5.18 ***	(0.14)
Sodium	4.52	(0.12)	4.61 ***	(0.11)	4.23 ***	(0.18)	5.01 ***	(0.13)
Added sugars	6.50	(0.12)	6.00 ***	(0.11)	6.52	(0.18)	5.96 ***	(0.12)
Saturated fats	5.50	(0.13)	5.65 ***	(0.11)	5.39	(0.20)	5.38 ***	(0.13)

Characteristic	Income-Eligible NSLP Participants		Income-Eligible Nonparticipants		Higher Income NSLP Participants		Higher Income Nonparticipants	
	Mean	(SE)	Mean	(SE)	Mean	(SE)	Mean	(SE)
Weight status (percentage)								
Underweight	3.08	(0.68)	2.50	(0.50)	3.19	(1.16)	4.95	(0.84)
Normal weight	56.30	(1.95)	58.52	(1.57)	60.74	(3.22)	62.73	(1.87)
Overweight	14.69	(1.39)	18.55	(1.24)	17.71	(2.52)	17.28	(1.46)
Obese	25.93	(1.73)	20.44	(1.28)	18.35	(2.55)	15.04 *	(1.38)
Blood biomarkers (percentage)								
HDL cholesterol, low	28.96	(1.98)	27.21	(1.55)	33.40	(3.35)	22.92	(1.83)
LDL cholesterol, high	32.26	(5.01)	17.54	(2.59)	6.84	(3.99)	18.76	(3.71)
TG, high	30.13	(4.92)	24.62	(2.93)	17.95	(6.07)	14.42	(3.33)
Diabetic	0.42	(0.67)	0.00	(0.00)	4.95	(3.39)	2.64	(1.50)
Hemoglobin, low	4.96	(0.91)	7.09	(0.87)	2.03	(0.97)	3.45	(0.77)
Hemoglobin, continuous (mean, g/L)	13.27	(0.05)	13.32 ***	(0.04)	13.66 ***	(0.08)	13.55 ***	(0.05)
Observations (n)	648		993		231		673	

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with complete day 1 dietary recalls and who attended a school that served school lunch. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines, and higher income nonparticipants were individuals from households with monthly income greater than 185 percent of the relevant Federal Poverty Guidelines. Underweight individuals are defined as children at or below the 5th percentile of BMI-for-age. Normal weight individuals are defined as children above the 5th percentile and up to the 85th percentile (inclusive) of BMI-for-age. Overweight individuals are defined as children above the 85th percentile and up to the 95th percentile (inclusive) of BMI-for-age. Obese individuals are defined as children above the 95th percentile of BMI-for-age. For children aged 5–11, hemoglobin levels are defined as follows: normal if ≥ 115 g/L, and low if < 115 g/L. For children aged 12–14, hemoglobin levels are defined as follows: normal if ≥ 120 g/L, and low if < 120 g/L. For nonpregnant women aged 15 or older, hemoglobin levels are defined as follows: normal if ≥ 120 g/L, and low if < 120 g/L. For men aged 15 or older, hemoglobin levels are defined as follows: normal if ≥ 130 g/L, and low if < 130 g/L. See appendix A, table A.1 for definition of reference values and recommendations for blood biomarkers. Estimates were calculated using pooled NHANES dietary day 1 sample weights. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

HEI = Healthy Eating Index; HDL = high-density lipoprotein cholesterol; LDL = low-density lipoprotein cholesterol; NSLP = National School Lunch Program; Ref = reference group; SE = standard error; TG = triglycerides

^a Based on usual intake over 2 days of dietary recall

^b Based on 1 day of dietary recall

Sources: NHANES 2011–2016 dietary recalls and demographic data

2. Diet Quality

Table G.4. Regression-Adjusted Association of NSLP Participation With Selected Measures of Diet Quality Among School Children Aged 5–18, 2011–2016

Characteristic	Calories, Usual Intake ^a		Calories From Saturated Fats and Added Sugars ^b		HEI-2015 Score ^b	
	β	(SE)	β	(SE)	β	(SE)
Program participation						
Income-eligible NSLP participant	17.83	(9.38)	51.79 *	(20.38)	4.41 ***	(0.90)
Income-eligible nonparticipant	Ref		Ref		Ref	
Higher income NSLP participants	8.12	(20.47)	47.65	(44.81)	3.45 *	(1.55)
Higher income nonparticipant	9.36	(12.99)	36.40	(31.07)	3.23 *	(1.55)
Age (years)	28.79 ***	(1.08)	7.44 ***	(1.80)	-0.16	(0.10)
Race/ethnicity						
Asian, non-Hispanic	12.58	(11.87)	-107.67 ***	(26.95)	3.69 *	(1.77)
Black, non-Hispanic	17.87 *	(7.62)	-37.78 *	(18.40)	1.52	(1.03)
White, non-Hispanic	Ref		Ref		Ref	
Hispanic	6.97	(6.64)	-32.73	(19.76)	2.81 **	(1.00)
Other race, multiracial	14.63	(11.42)	9.04	(35.37)	1.71	(1.31)
Female	-368.30 ***	(6.94)	-89.72 ***	(15.26)	0.43	(0.70)
Educational attainment for household reference person						
Less than high school	Ref		Ref		Ref	
High school diploma or GED	5.47	(11.44)	23.66	(21.24)	-1.18	(1.08)
Some college or Associate's degree	6.62	(10.40)	61.93 *	(24.14)	-0.16	(0.95)
College graduate or above	12.16	(14.63)	24.62	(25.47)	1.03	(1.41)
Marital status of household reference person						
Never married	Ref		Ref		Ref	
Widowed, divorced, or separated	1.72	(11.91)	11.87	(28.72)	-0.39	(1.44)
Cohabiting	-1.70	(13.67)	15.75	(25.15)	0.84	(1.82)
Married	10.19	(12.72)	-14.19	(21.79)	3.03	(1.57)

Characteristic	Calories, Usual Intake ^a		Calories From Saturated Fats and Added Sugars ^b		HEI-2015 Score ^b	
	β	(SE)	β	(SE)	β	(SE)
Household income-to-poverty ratio	-5.27	(3.94)	-11.01	(9.38)	-0.39	(0.46)
Household size	3.81	(3.79)	-19.65 ***	(4.62)	-0.54	(0.31)
Household food security status						
Household full food security	Ref		Ref		Ref	
Household marginal food security	-17.34	(11.38)	-12.90	(18.88)	0.98	(0.87)
Household low food security	-1.10	(9.96)	-3.00	(22.62)	0.10	(1.14)
Household very low food security	-20.21	(11.15)	-39.70	(23.73)	0.83	(1.12)
Observations (n)	2,430		2,430		2,430	

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with complete day 1 dietary recalls and who attended a school that served school lunch. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines, and higher income nonparticipants were individuals from households with monthly income greater than 185 percent of the relevant Federal Poverty Guidelines. See appendix A, table A.1 for definition of reference values and recommendations for blood biomarkers. Estimates were calculated using ordinary least squares regressions and were adjusted for NHANES cycle and calculated using pooled NHANES dietary day 1 sample weights. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

β = beta; GED = general education diploma; HEI = Healthy Eating Index; NSLP = National School Lunch Program; Ref = reference group; SE = standard error

^a Based on usual intake over 2 days of dietary recall

^b Based on 1 day of dietary recall

Sources: NHANES 2011–2016 dietary recalls and demographic data

Table G.5a. Regression-Adjusted Association of NSLP Participation With Selected HEI Component Scores Among School Children Aged 5–18, 2011–2016

Characteristic	Total Vegetables		Greens and Beans		Total Fruit		Whole Fruit	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Program participation								
Income-eligible NSLP participant	0.30 *	(0.12)	0.65 ***	(0.11)	0.58 ***	(0.15)	0.83 ***	(0.17)
Income-eligible nonparticipant	Ref		Ref		Ref		Ref	
Higher income NSLP participant	0.13	(0.27)	-0.07	(0.22)	0.64 *	(0.31)	0.73	(0.40)
Higher income nonparticipant	0.07	(0.25)	0.21	(0.22)	0.51 *	(0.21)	0.76 **	(0.23)
Age (years)	0.03 *	(0.01)	0.01	(0.02)	-0.06 **	(0.02)	-0.06 **	(0.02)
Race/ethnicity								
Asian, non-Hispanic	0.31	(0.21)	0.31	(0.24)	0.43	(0.25)	0.56 *	(0.24)
Black, non-Hispanic	-0.04	(0.16)	-0.06	(0.15)	0.29	(0.15)	0.01	(0.17)
White, non-Hispanic	Ref		Ref		Ref		Ref	
Hispanic	0.25	(0.15)	0.18	(0.15)	0.60 ***	(0.16)	0.31	(0.17)
Other race, multiracial	0.49	(0.26)	0.03	(0.27)	-0.01	(0.21)	-0.06	(0.24)
Female	0.05	(0.08)	-0.03	(0.11)	0.16	(0.15)	0.30 *	(0.13)
Educational attainment for household reference person								
Less than high school	Ref		Ref		Ref		Ref	
High school diploma or GED	0.21	(0.17)	-0.14	(0.17)	-0.01	(0.18)	-0.27	(0.21)
Some college or Associate's degree	0.12	(0.15)	-0.06	(0.15)	-0.02	(0.16)	-0.04	(0.18)
College graduate or above	0.12	(0.22)	-0.01	(0.22)	0.09	(0.23)	0.18	(0.26)
Marital status of household reference person								
Never married	Ref		Ref		Ref		Ref	
Widowed, divorced, or separated	-0.11	(0.20)	-0.19	(0.23)	0.22	(0.24)	-0.23	(0.28)
Cohabiting	-0.03	(0.23)	-0.26	(0.28)	0.08	(0.29)	-0.21	(0.32)
Married	-0.03	(0.16)	-0.08	(0.28)	0.50	(0.26)	0.22	(0.27)

Characteristic	Total Vegetables		Greens and Beans		Total Fruit		Whole Fruit	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Household income-to-poverty ratio	-0.03	(0.07)	-0.02	(0.07)	0.09	(0.08)	0.12	(0.09)
Household size	0.10 *	(0.04)	0.02	(0.06)	-0.12 *	(0.05)	-0.11 *	(0.05)
Household food security status								
Household full food security	Ref		Ref		Ref		Ref	
Household marginal food security	-0.00	(0.16)	-0.30	(0.16)	0.38	(0.21)	0.27	(0.29)
Household low food security	-0.10	(0.16)	-0.22	(0.11)	0.06	(0.14)	0.31	(0.19)
Household very low food security	0.03	(0.18)	0.09	(0.19)	0.31	(0.20)	0.31	(0.21)
Observations (n)	2,430		2,430		2,430		2,430	

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with complete day 1 dietary recalls and who attended a school that served school lunch. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines, and higher income nonparticipants were individuals from households with monthly income greater than 185 percent of the relevant Federal Poverty Guidelines. Estimates were calculated using ordinary least squares regressions and were adjusted for NHANES cycle and calculated using pooled NHANES dietary day 1 sample weights. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

β = beta; GED = general education diploma; HEI = Healthy Eating Index; NSLP = National School Lunch Program; Ref = reference group; SE = standard error

Sources: NHANES 2011–2016 dietary recalls and demographic data

Table G.5b. Regression-Adjusted Association of NSLP Participation With Selected HEI Component Scores Among School Children Aged 5–18, 2011–2016

Characteristic	Whole Grains		Dairy		Total Protein Foods		Seafood and Plant Protein		Fatty Acids	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Program participation										
Income-eligible NSLP participant	0.08	(0.25)	0.99 ***	(0.16)	0.30 **	(0.10)	0.40 **	(0.14)	-0.30	(0.26)
Income-eligible nonparticipant	Ref		Ref		Ref		Ref		Ref	
Higher income NSLP participant	-0.14	(0.34)	0.98 *	(0.39)	0.24	(0.15)	0.22	(0.26)	-0.65	(0.33)
Higher income nonparticipant	-0.29	(0.35)	-0.30	(0.33)	0.10	(0.21)	0.38	(0.23)	0.06	(0.34)
Age (years)	-0.02	(0.03)	-0.12 ***	(0.03)	0.03 *	(0.01)	0.01	(0.02)	0.08	(0.04)
Race/ethnicity										
Asian, non-Hispanic	-0.66	(0.35)	-0.50	(0.38)	0.34	(0.21)	0.23	(0.20)	1.15 *	(0.48)
Black, non-Hispanic	-0.13	(0.26)	-1.41 ***	(0.24)	0.49 ***	(0.13)	-0.08	(0.22)	1.81 ***	(0.32)
White, non-Hispanic	Ref		Ref		Ref		Ref		Ref	
Hispanic	0.13	(0.26)	-0.49 *	(0.20)	0.37 **	(0.13)	0.18	(0.15)	0.77 **	(0.26)
Other race, multiracial	0.24	(0.43)	-0.12	(0.26)	-0.17	(0.17)	0.35	(0.27)	0.51	(0.51)
Female	-0.11	(0.21)	-0.21	(0.16)	-0.14	(0.08)	0.05	(0.11)	0.17	(0.19)
Educational attainment for household reference person										
Less than high school	Ref		Ref		Ref		Ref		Ref	
High school diploma or GED	-0.11	(0.23)	-0.07	(0.28)	-0.10	(0.20)	-0.16	(0.19)	0.11	(0.25)
Some college or Associate's degree	0.28	(0.30)	0.02	(0.29)	0.09	(0.19)	-0.13	(0.18)	-0.06	(0.30)
College graduate or above	0.64	(0.35)	0.09	(0.33)	-0.18	(0.23)	-0.10	(0.23)	-0.10	(0.37)
Marital status of household reference person										
Never married	Ref		Ref		Ref		Ref		Ref	
Widowed, divorced, or separated	0.25	(0.35)	0.85 *	(0.40)	-0.50 *	(0.20)	-0.59 *	(0.23)	-0.48	(0.27)
Cohabiting	-0.10	(0.40)	0.69	(0.42)	-0.18	(0.17)	-0.59 *	(0.26)	0.35	(0.43)
Married	0.35	(0.35)	0.68	(0.41)	-0.01	(0.16)	-0.40	(0.27)	0.43	(0.26)

Characteristic	Whole Grains		Dairy		Total Protein Foods		Seafood and Plant Protein		Fatty Acids	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Household income-to-poverty ratio	0.07	(0.12)	-0.09	(0.12)	0.02	(0.05)	-0.03	(0.07)	-0.04	(0.11)
Household size	0.01	(0.06)	0.01	(0.06)	0.00	(0.05)	-0.04	(0.06)	-0.06	(0.07)
Household food security status										
Household full food security	Ref		Ref		Ref		Ref		Ref	
Household marginal food security	0.27	(0.26)	0.45	(0.27)	-0.45	(0.22)	-0.53 **	(0.18)	-0.53	(0.34)
Household low food security	-0.32	(0.27)	0.14	(0.25)	0.02	(0.13)	-0.33	(0.17)	0.31	(0.29)
Household very low food security	-0.21	(0.33)	0.06	(0.26)	0.19	(0.14)	-0.25	(0.20)	0.09	(0.33)
Observations (n)	2,430		2,430		2,430		2,430		2,430	

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with complete day 1 dietary recalls and who attended a school that served school lunch. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines, and higher income nonparticipants were individuals from households with monthly income greater than 185 percent of the relevant Federal Poverty Guidelines. Estimates were calculated using ordinary least squares regressions and were adjusted for NHANES cycle and calculated using pooled NHANES dietary day 1 sample weights. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

β = beta; GED = general education diploma; HEI = Healthy Eating Index; NSLP = National School Lunch Program; Ref = reference group; SE = standard error

Sources: NHANES 2011–2016 dietary recalls and demographic data

Table G.5c. Regression-Adjusted Association of NSLP Participation With Selected HEI Component Scores Among School Children Aged 5–18, 2011–2016

Characteristic	Sodium		Refined Grains		Saturated Fat		Added Sugar	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Program participation								
Income-eligible NSLP participant	-0.16	(0.24)	0.37	(0.31)	-0.14	(0.23)	0.50	(0.25)
Income-eligible nonparticipant	Ref		Ref		Ref		Ref	
Higher income NSLP participant	-0.19	(0.42)	1.05	(0.55)	0.00	(0.38)	0.52	(0.34)
Higher income nonparticipant	0.80	(0.43)	1.22 **	(0.40)	0.10	(0.33)	-0.40	(0.42)
Age (years)	-0.07 *	(0.03)	0.03	(0.02)	0.01	(0.03)	-0.02	(0.03)
Race/ethnicity								
Asian, non-Hispanic	-0.48	(0.38)	-1.24 **	(0.40)	1.49 ***	(0.39)	1.75 ***	(0.28)
Black, non-Hispanic	-0.31	(0.23)	-0.21	(0.30)	0.97 ***	(0.26)	0.17	(0.29)
White, non-Hispanic	Ref		Ref		Ref		Ref	
Hispanic	-0.26	(0.22)	-0.85 **	(0.26)	0.72 ***	(0.20)	0.90 **	(0.27)
Other race, multiracial	-0.15	(0.50)	0.21	(0.36)	-0.36	(0.46)	0.74	(0.49)
Female	0.12	(0.20)	-0.01	(0.19)	-0.09	(0.16)	0.17	(0.19)
Educational attainment for household reference person								
Less than high school	Ref		Ref		Ref		Ref	
High school diploma or GED	-0.16	(0.28)	-0.17	(0.33)	-0.16	(0.26)	-0.13	(0.30)
Some college or Associate's degree	-0.37	(0.29)	-0.04	(0.33)	-0.04	(0.31)	0.10	(0.35)
College graduate or above	-0.14	(0.35)	0.09	(0.38)	-0.02	(0.35)	0.36	(0.37)
Marital status of household reference person								
Never married	Ref		Ref		Ref		Ref	
Widowed, divorced, or separated	0.50	(0.37)	0.07	(0.45)	0.04	(0.32)	-0.22	(0.41)
Cohabiting	0.27	(0.40)	0.94	(0.63)	0.23	(0.35)	-0.35	(0.44)
Married	0.25	(0.32)	0.68	(0.40)	0.44	(0.33)	-0.01	(0.34)

Characteristic	Sodium		Refined Grains		Saturated Fat		Added Sugar	
	β	(SE)	β	(SE)	β	(SE)	β	(SE)
Household income-to-poverty ratio	-0.20	(0.13)	-0.37 **	(0.12)	-0.10	(0.10)	0.18	(0.09)
Household size	-0.26 **	(0.09)	-0.25 *	(0.11)	-0.10	(0.08)	0.23 **	(0.07)
Household food security status								
Household full food security	Ref		Ref		Ref		Ref	
Household marginal food security	0.56	(0.31)	0.72 *	(0.27)	0.09	(0.28)	0.07	(0.35)
Household low food security	0.07	(0.31)	0.14	(0.30)	0.25	(0.27)	-0.23	(0.30)
Household very low food security	-0.46	(0.33)	0.23	(0.31)	-0.05	(0.36)	0.50	(0.30)
Observations (n)	2,430		2,430		2,430		2,430	

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with complete day 1 dietary recalls and who attended a school that served school lunch. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines, and higher income nonparticipants were individuals from households with monthly income greater than 185 percent of the relevant Federal Poverty Guidelines. Estimates were calculated using ordinary least squares regressions and were adjusted for NHANES cycle and calculated using pooled NHANES dietary day 1 sample weights. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

β = beta; GED = general education diploma; HEI = Healthy Eating Index; NSLP = National School Lunch Program; Ref = reference group; SE = standard error

Sources: NHANES 2011–2016 dietary recalls and demographic data

3. Health Outcomes

Table G.6. Regression-Adjusted Association of NSLP Participation With Selected Health Outcomes Among School Children, 2011–2016

Characteristic	HDL, Low		LDL, High		TG, High	
	Est	(SE)	Est	(SE)	Est	(SE)
Program participation						
Income-eligible NSLP participant	0.05	(0.04)	0.13	(0.08)	0.08	(0.07)
Income-eligible nonparticipant	Ref		Ref		Ref	
Higher income NSLP participants	0.08	(0.08)	-0.13	(0.07)	-0.16	(0.10)
Higher income nonparticipant	-0.04	(0.06)	-0.01	(0.09)	-0.20 *	(0.09)
Age (years)	0.02 **	(0.00)	0.00	(0.02)	0.01	(0.01)
Race/ethnicity						
Asian, non-Hispanic	-0.02	(0.05)	0.01	(0.10)	0.01	(0.10)
Black, non-Hispanic	-0.12 ***	(0.03)	-0.08	(0.06)	-0.16 ***	(0.04)
White, non-Hispanic	Ref		Ref		Ref	
Hispanic	0.04	(0.04)	-0.07	(0.07)	0.11	(0.06)
Other race, multiracial	0.03	(0.07)	-0.02	(0.20)	0.11	(0.12)
Female	-0.09 *	(0.03)	0.02	(0.06)	-0.02	(0.05)
Educational attainment for household reference person						
Less than high school	Ref		Ref		Ref	
High school diploma or GED	-0.04	(0.05)	0.07	(0.10)	0.00	(0.06)
Some college or Associate's degree	-0.02	(0.04)	0.04	(0.10)	-0.02	(0.08)
College graduate or above	0.02	(0.05)	0.02	(0.11)	0.04	(0.07)
Marital status of household reference person						
Never married	Ref		Ref		Ref	
Widowed, divorced, or separated	-0.11	(0.06)	0.05	(0.05)	0.06	(0.10)
Cohabiting	-0.05	(0.07)	0.21 *	(0.09)	0.06	(0.10)
Married	-0.09	(0.07)	0.13 *	(0.05)	0.04	(0.07)

Characteristic	HDL, Low		LDL, High		TG, High	
	Est	(SE)	Est	(SE)	Est	(SE)
Household income-to-poverty ratio	-0.01	(0.02)	0.00	(0.02)	0.02	(0.04)
Household size	-0.01	(0.01)	-0.01	(0.02)	-0.02	(0.02)
Household food security status						
Household full food security	Ref		Ref		Ref	
Household marginal food security	-0.04	(0.05)	0.08	(0.10)	-0.10	(0.07)
Household low food security	-0.03	(0.05)	-0.09	(0.07)	-0.07	(0.05)
Household very low food security	-0.02	(0.05)	-0.01	(0.10)	-0.00	(0.13)
Covered by health insurance	-0.08	(0.06)	0.07	(0.13)	0.08	(0.07)
Observations (n)	1,983		434		434	

^ This covariate was omitted from the regression outcome denoted in the column header for theoretical reasons.

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with complete day 1 dietary recalls and who attended a school that served school lunch for the HDL outcome and includes NHANES respondents aged 12–18 with complete day 1 dietary recalls and who attended a school that served school lunch for the LDL and TG outcomes. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines, and higher income nonparticipants were individuals from households with monthly income greater than 185 percent of the relevant Federal Poverty Guidelines. See appendix A, table A.1 for definition of reference values and recommendations for blood biomarkers. Estimates for were calculated using logistic regressions with average marginal effects and were adjusted for NHANES cycle and calculated using pooled NHANES dietary day 1 sample weights. Time spent on the computer was omitted from the regression with outcome low HDL because of collinearity. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

Est = estimate; GED = general education diploma; NSLP = National School Lunch Program; Ref = reference group; SE = standard error; TG = triglycerides

Sources: NHANES 2011–2016 dietary recalls and demographic data

Table G.7. Regression-Adjusted Association of NSLP Participation With Overweight or Obese and Hemoglobin Among School Children Aged 5–18, 2011–2016

Characteristic	Overweight or Obese		Hemoglobin, Low		Hemoglobin, Continuous	
	Est	(SE)	Est	(SE)	β	(SE)
Program participation						
Income-eligible NSLP participant	0.02	(0.03)	-0.01	(0.02)	0.06	(0.07)
Income-eligible nonparticipant	Ref		Ref		Ref	
Higher income NSLP participants	-0.02	(0.07)	-0.02	(0.02)	0.19	(0.11)
Higher income nonparticipant	-0.03	(0.05)	-0.01	(0.02)	0.09	(0.10)
Age (years)	0.00	(0.00)	0.00	(0.00)	0.13 ***	(0.01)
Race/ethnicity						
Asian, non-Hispanic	-0.07	(0.05)	0.06	(0.03)	-0.14	(0.13)
Black, non-Hispanic	0.05	(0.04)	0.13 ***	(0.02)	-0.81 ***	(0.08)
White, non-Hispanic	Ref		Ref		Ref	
Hispanic	0.13 ***	(0.03)	0.02	(0.01)	-0.20 *	(0.08)
Other race, multiracial	0.13	(0.07)	0.01	(0.02)	-0.11	(0.17)
Female	-0.04	(0.03)	0.05 ***	(0.01)	-0.70 ***	(0.06)
Educational attainment for household reference person						
Less than high school	Ref		Ref		Ref	
High school diploma or GED	0.07	(0.05)	-0.01	(0.02)	-0.05	(0.11)
Some college or Associate's degree	0.01	(0.04)	-0.02	(0.02)	-0.04	(0.13)
College graduate or above	0.02	(0.04)	-0.03	(0.03)	-0.11	(0.15)
Marital status of household reference person						
Never married	Ref		Ref		Ref	
Widowed, divorced, or separated	-0.05	(0.05)	-0.01	(0.01)	0.02	(0.10)
Cohabiting	-0.00	(0.05)	-0.01	(0.02)	-0.02	(0.13)
Married	0.01	(0.06)	-0.00	(0.01)	0.05	(0.10)

Characteristic	Overweight or Obese		Hemoglobin, Low		Hemoglobin, Continuous	
	Est	(SE)	Est	(SE)	β	(SE)
Household income-to-poverty ratio	-0.00	(0.03)	0.00	(0.01)	-0.03	(0.04)
Household size	-0.01	(0.01)	0.01	(0.00)	0.04	(0.03)
Household food security status						
Household full food security	Ref		Ref		Ref	
Household marginal food security	0.03	(0.05)	-0.01	(0.01)	0.13	(0.10)
Household low food security	-0.02	(0.05)	-0.00	(0.01)	-0.04	(0.09)
Household very low food security	-0.06	(0.05)	-0.01	(0.02)	-0.14	(0.13)
Covered by health insurance	0.04	(0.05)	-0.00	(0.02)	0.02	(0.12)
Treated for anemia	^		0.15	(0.08)	-0.79	(0.81)
Observations (n)	2,419		2,130		2,130	

^ This covariate was omitted from the regression outcome denoted by the column header due to a lack of theoretical relationship with the outcome.

Note: Sample includes National Health and Nutrition Examination Survey (NHANES) respondents aged 5–18 with complete day 1 dietary recalls and who attended a school that served school lunch. Income-eligible nonparticipants were defined as individuals from households with monthly family income less than or equal to 185 percent of the relevant Federal Poverty Guidelines, and higher income nonparticipants were individuals from households with monthly income greater than 185 percent of the relevant Federal Poverty Guidelines. See appendix A, table A.1 for definition of reference values and recommendations for blood biomarkers. Estimates for overweight/obese and low hemoglobin were calculated using logistic regressions with average marginal effects. Estimates for continuous hemoglobin were calculated using ordinary least squares regression. All estimates were adjusted for NHANES cycle and calculated using pooled NHANES dietary day 1 sample weights. Significant differences in estimates are noted by * $p < .05$, ** $p < .01$, or *** $p < .001$.

β = beta; Est = estimate; GED = general education diploma; NSLP = National School Lunch Program; Ref = reference group; SE = standard error

Sources: NHANES 2011–2016 dietary recalls and demographic data