



United States
Department
of Agriculture
Food and Nutrition Service

School Nutrition and Meal Cost Study

Volume 4

Student Participation, Satisfaction, Plate Waste, and Dietary Intakes



Mathematica Policy Research

In partnership with:
Abt Associates Inc.

April 2019

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**School Nutrition and Meal Cost Study
Final Report Volume 4:
Student Participation, Satisfaction,
Plate Waste, and Dietary Intakes**

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This study was conducted under Contract AG-3198-C-13-0001 with the Food and Nutrition Service.

This report is available on the Food and Nutrition Service website: <http://www.fns.usda.gov/research-and-analysis>

Suggested Citation:

U.S. Department of Agriculture, Food and Nutrition Service, Office of Policy Support, *School Nutrition and Meal Cost Study, Final Report Volume 4: Student Participation, Satisfaction, Plate Waste, and Dietary Intakes* by Mary Kay Fox, Elizabeth Gearan, Charlotte Cabili, Dallas Dotter, Katherine Niland, Liana Washburn, Nora Paxton, Lauren Olsho, Lindsay LeClair, and Vinh Tran. Project Officer: John Endahl. Alexandria, VA: April 2019.

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ACKNOWLEDGEMENTS

The completion of this volume of the School Nutrition and Meal Cost Study (SNMCS) final report would not have been possible without the contributions of many individuals and organizations. First and foremost, we thank the school foodservice professionals, principals, and other staff in the school districts and schools across the United States who participated in the study. We also appreciate the time taken by students and parents to participate in study activities. We thank Mathematica project directors Mary Kay Fox and Michael Ponza for their leadership. Our collaborative team included Abt Associates led by Michele Mendelson. We gratefully acknowledge the guidance and oversight provided by John Endahl, the Project Officer in the Office of Policy Support (OPS), Food and Nutrition Service (FNS), U.S. Department of Agriculture (USDA). Many others contributed their time and expertise to the efforts described in this report and we acknowledge them here under their respective organizations.

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LIST OF ACRONYMS AND ABBREVIATIONS

AI	Adequate Intake
AMDR	Acceptable Macronutrient Distribution Range
AMPM	Automated Multiple-Pass Method
AT	alpha-tocopherol
CN	child nutrition
cups	cup equivalents
DFE	dietary folate equivalents
DG	Dietary Guidelines for Americans
DHHS	United States Department of Health and Human Services
DRI	Dietary Reference Intake
EAR	Estimated Average Requirement
EER	Estimated Energy Requirement
FPED	Food Patterns Equivalents Database
FPID	Food Patterns Ingredients Database
FNDDS	Food and Nutrient Database for Dietary Studies
FNS	Food and Nutrition Service
FPL	Federal poverty level
FSMC	foodservice management company
g	grams
HHFKA	Healthy, Hunger-Free Kids Act of 2010
HEI	Healthy Eating Index
HMD	Health and Medicine Division of the National Academies of Science
IOM	Institute of Medicine
IPW	inverse probability weighting
kcal	calories
LNED	low-nutrient, energy-dense
mcg	micrograms
mg	milligrams
NCI	National Cancer Institute
NSLP	National School Lunch Program
OVS	offer-versus-serve

oz	ounce equivalent
RAE	retinol activity equivalent
NR	not reported
SBP	School Breakfast Program
SE	standard error
SFA	school food authority
SNDA	School Nutrition Dietary Assessment Study
SNM	school nutrition manager
SNMCS	School Nutrition and Meal Cost Study
SY	school year
tsp	teaspoon
UL	Tolerable Upper Intake Level
USDA	United States Department of Agriculture

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EXECUTIVE SUMMARY

The National School Lunch Program (NSLP) and School Breakfast Program (SBP) form the cornerstone of the nation's nutrition safety net for low-income children. These programs, which are administered by the U.S. Department of Agriculture (USDA), Food and Nutrition Service (FNS), provide 30 million Federally subsidized lunches and 15 million Federally subsidized breakfasts to children each school day.¹

In school year (SY) 2012–2013, the school meal programs began to undergo widespread changes, mainly stemming from the Healthy, Hunger-Free Kids Act of 2010 (HHFKA; Public Law 111-296). Key reforms included more fruits, vegetables, and whole grains in the school menu; updated nutrition standards to improve the nutritional quality of meals and students' diets in order to reduce children's risk of developing chronic diseases; a new requirement that students select at least 1/2 cup of fruits or vegetables for their meal to be eligible for Federal reimbursement; equitable price-setting for full-price (also called "paid") meals; and the introduction of nutrition standards for all foods and beverages sold in competition with reimbursable meals in schools during the school day (competitive foods).

There is a critical need for information about how school food authorities (SFAs) and schools are implementing these changes, and about whether and how the changes are affecting school foodservice operations; the nutritional quality, cost, and acceptability of meals; student participation and satisfaction; plate waste; and the quality of students' diets. FNS sponsored the School Nutrition and Meal Cost Study (SNMCS) to ensure that this information would be available to policymakers and other stakeholders. The SNMCS continues FNS's long-standing commitment to periodically assess the school meal programs, and is the first nationally representative, comprehensive assessment of the programs since major reforms began in SY 2012–2013.

A. Overview of the School Nutrition and Meal Cost Study

The SNMCS addressed a broad array of research questions of interest to stakeholders at the national, State, and local levels. The research questions are grouped under four broad domains:

- School meal program operations and school nutrition environments
- Food and nutrient content of school meals and afterschool snacks and overall nutritional quality of meals
- School meal costs and school foodservice revenues
- Student participation, student and parent satisfaction, plate waste, and students' dietary intakes.

To address these research questions, the SNMCS collected data from nationally representative samples of public SFAs and public, non-charter schools participating in the NSLP, students enrolled in these schools, and their parents. Data collection primarily occurred in spring

¹ Statistics reported for the NSLP and SBP were obtained from national-level annual summary tables generated by FNS. These tables are available at <http://www.fns.usda.gov/pd/child-nutrition-tables>. Accessed April 19, 2018.

of SY 2014–2015. Study findings are presented in four report volumes plus a summary report that highlights key findings from across the volumes. Report Volume 4 (this volume) provides information on student participation; parent and student satisfaction; plate waste; and students' dietary intakes.² Findings are based on analyses of data from multiple sources:

- Students completed a 24-hour dietary recall and the Child/Youth Interview.
- Parents/guardians completed the Parent Interview.
- School foodservice staff provided information about whether the student received a reimbursable breakfast or lunch on the day referenced in the 24-hour dietary recall.
- Trained field interviewers conducted plate waste observations on random samples of breakfast and lunch trays. These observations documented the foods and beverages taken by students and the amounts that students wasted (did not consume).

B. Participation in and Satisfaction with the School Meal Programs

For the school meal programs to accomplish their policy goals, students must participate in the programs. Therefore, it is important to understand the rates at which students participate and the factors that may influence participation decisions.

1. Target-Day Participation in the NSLP and SBP

To estimate rates of student participation in the NSLP and SBP on a typical school day, the study team collected administrative data that documented whether schools recorded sampled students as having received a reimbursable breakfast or lunch on the day referenced in the 24-hour dietary recall (the target day).³

Overall, 56 percent of students participated in the NSLP on the target day. Participation rates were higher among elementary school students (71 percent) than middle or high school students (52 and 39 percent, respectively). NSLP participation rates were also higher among boys, Hispanic and non-Hispanic black students, students from lower income households, and students who were certified to receive free or reduced-price meals. Students who attended schools that operated under Provision 2 or 3 for lunch or under the Community Eligibility Provision were considered to be certified to receive free lunch regardless of household poverty level.

² Volume 1 (Forrestal et al. 2019) provides updated information on SFA and school characteristics, foodservice operations, and school nutrition environments. Volume 2 (Gearan et al. 2019) focuses on the food and nutrient content of reimbursable meals and afterschool snacks and the overall nutritional quality of meals. Volume 3 (Logan et al. 2019) provides a detailed examination of the costs to produce reimbursable school meals and school foodservice revenues. A separate summary report (Fox and Gearan 2019) summarizes key findings across the report volumes, and a separate methodology report (Zeidman et al. 2019) provides technical details about study design, sampling, and data collection procedures.

³ When administrative data were not available for a given student, the study team constructed measures of target-day participation based primarily on the lunch and breakfast foods that the student reported obtaining at school on the target day.

Student participation rates were considerably lower in the SBP. On a typical day, less than one-quarter (21 percent) of all students participated in the SBP.⁴ Like the NSLP, participation was highest among elementary school students (28 percent) and lower among middle (19 percent) and high school students (14 percent). Differences in participation by gender, household poverty level, certification status, and race/ethnicity were similar to those observed for the NSLP but, with the exception of gender, were more pronounced.

2. Reasons for Participation and Nonparticipation

Information on factors that influence participation decisions can help policymakers understand customer choice and identify areas for program improvement. Students who ate school meals were asked to report reasons for participation in the NSLP and SBP, and both students and parents reported reasons for nonparticipation.

Hunger was the reason most commonly reported for participating in the NSLP (35 percent of students overall), followed by liking the food in general (25 percent), and ease and convenience (14 percent). Reasons for not participating in the NSLP were similar for both students and parents. The most frequently cited reasons for nonparticipation were that the student preferred to eat a lunch from home (52 percent of students and 81 percent of parents) and that the child didn't like the school lunch or taste of the food in general (40 percent of students and 69 percent of parents). In addition, parents commonly reported that they preferred that the child eat a lunch from home (58 percent).

Ease/convenience was the reason most commonly reported by students for participating in the SBP (29 percent), followed closely by hunger (27 percent), and the food being good (26 percent). Student- and parent-reported reasons for not participating in the SBP were similar. The most commonly cited reasons for nonparticipation were that the student ate breakfast at home (47 percent of students) or, among parents, that the parent preferred the child eat breakfast at home (66 percent of parents) or thought the student preferred to do so (74 percent). Other commonly reported reasons included disliking the food (20 percent of students and 43 percent of parents), inconvenience (15 percent of students), and insufficient time to eat breakfast at school (35 percent of parents).

3. Opinions of School Lunches and Breakfasts

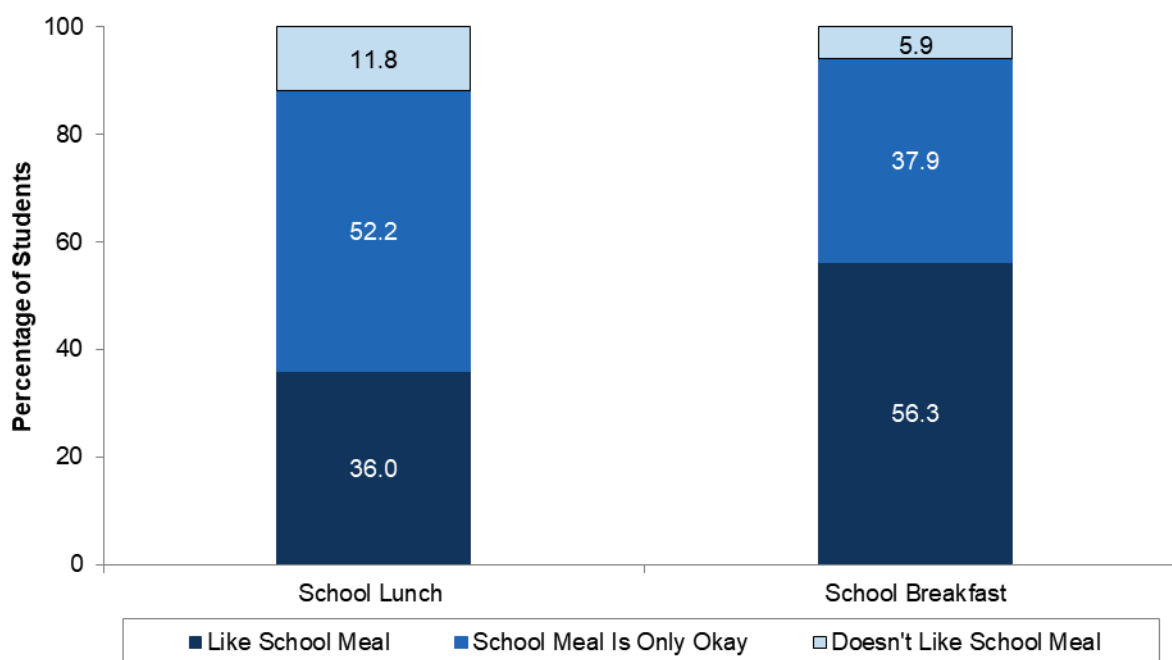
The extent to which students and parents—the “customers” of the school meal programs—are satisfied with the programs may influence participation decisions. Thus, it is important to understand how students and parents feel about the programs and, in particular, to identify factors that contribute to dissatisfaction. Students were asked about their perceptions of the lunchtime environment and their general views on school lunches and breakfasts. Parents were asked about their general views on school lunches and breakfasts and reasons for any dissatisfaction.

⁴ To provide a picture of typical SBP participation rates among all public school students, estimates of target-day SBP participation include students in schools that did not offer the SBP.

Students' Opinions of School Lunches

- Most students (84 percent) thought that the timing of their scheduled lunch period was about right, and about half (48 percent) of students reported that the line to get lunch was long most of the time. Despite long lunch lines, most students (79 percent) reported that they had enough time to eat after they got their lunch and were seated.
- Roughly 4 in 10 students who reported having eaten a school lunch responded “always” or “often” to questions about whether the lunch menu included foods they liked (40 percent) and whether they liked the look (42 percent), smell (43 percent), and taste (40 percent) of the food.
- More than one-third (36 percent) of students who had ever eaten a school lunch reported that they liked the school lunch, more than half (52 percent) reported that the school lunch was only okay, and 12 percent said they did not like the school lunch (Figure ES.1).

Figure ES.1. General Satisfaction with School Meals among Students Who Have Ever Eaten School Meals



Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15. Results for each meal include only students who reported ever eating the meal.

Students' Opinions of School Breakfasts

- Most students reported that they had enough time to eat school breakfast before classes started (84 percent) and that school breakfast was served at an okay time (86 percent).
- Students' opinions about school breakfast were more positive than their opinions about school lunch. Overall, more than half (56 percent) of students who had ever eaten school breakfast reported that they liked the school breakfast. More than one-third (38 percent)

reported that the school breakfast was only okay, and 6 percent said they did not like the school breakfast (Figure ES.1).

Parents' Opinions of School Lunches and Breakfasts

- Twenty percent of parents rated school lunches as very healthy, and more than half of parents (63 percent) rated school lunches as somewhat healthy.
- More than half (55 percent) of all parents reported that school lunches were a pretty good value, and 18 percent said they were a good value. However, one in five parents reported that school lunches were not a good value.
- Most parents (80 percent) whose child had ever eaten a school lunch were very satisfied or somewhat satisfied with the lunches. However, the remaining 20 percent of these parents reported that they were somewhat or very dissatisfied with the lunches.
- Parents who expressed dissatisfaction with school lunches were asked to report reasons for their dissatisfaction. The most commonly reported reason was poor quality or taste of the lunches (60 percent). Other reasons for parental dissatisfaction with school lunches included concerns that the lunches were not healthy (36 percent), that students were not offered enough choices (30 percent) or enough food (portion sizes were too small; 29 percent), and that their child won't eat the lunch (24 percent).
- Parents' opinions about school breakfasts were somewhat more positive than their opinions about school lunches. Most parents (87 percent) whose child had ever eaten a school breakfast were very satisfied or somewhat satisfied with the breakfasts.
- Twenty-nine percent of parents rated school breakfasts as very healthy, and 59 percent rated school breakfasts as somewhat healthy.

C. Factors Related to Participation in the NSLP

To address multiple study research questions about potential determinants of student participation in the NSLP, the study team used multivariate analyses to explore relationships between student participation in the NSLP and key characteristics of: (1) NSLP lunches, including overall nutritional quality and compliance with updated NSLP nutrition standards; (2) school foodservice operations; (3) the school food environment; and (4) students, schools, and SFAs.⁵ Because of the large number of characteristics of interest across the four domains, separate regression models were run for each domain. This approach allowed the study team to maintain sufficient degrees of freedom to estimate standard errors and test the statistical significance of associations. In addition to the key variables of interest in each domain, multivariate models included additional variables to control for differences between individual students' demographic characteristics (including race and ethnicity, gender, and certified for free or reduced-price meals) and the institutional characteristics of their corresponding schools and SFAs (including school size, school type, urbanicity, FNS region, and share of students approved

⁵ The study team also examined factors associated with (1) student satisfaction with the NSLP, (2) student participation in and satisfaction with the SBP, and (3) parent satisfaction with the NSLP and SBP. These findings are presented in Chapter 4.

for free or reduced-price meals), which are not determined by the school or SFA but may be associated with participation in the school meal programs.

Findings from these analyses estimate how participation in the NSLP was associated with a key variable of interest after controlling for differences in participation related to the demographic characteristics of students and the schools they attended. Because the probability of finding significant associations by chance increases with the number of associations tested, findings from these analyses should be considered exploratory and interpreted with caution. In addition, it is important to understand that significant associations do not imply causality.

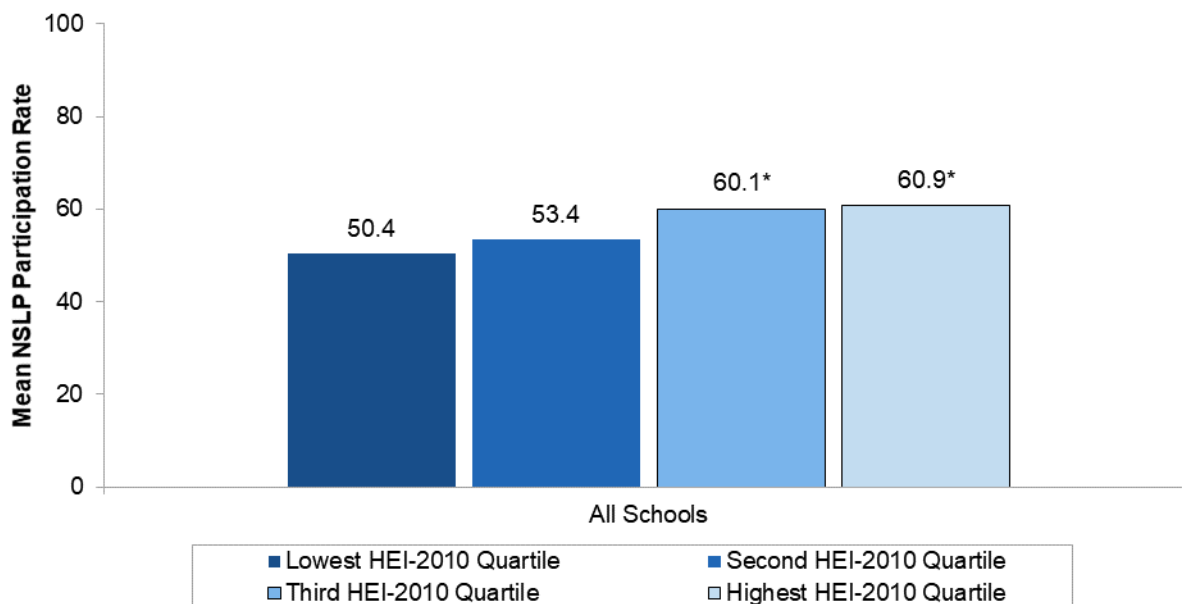
1. Key Characteristics of NSLP Lunches

The study team examined the relationship between student participation in the NSLP and (1) the overall nutritional quality of NSLP lunches, (2) compliance with selected NSLP nutrition standards, and (3) the types of food offered in daily NSLP menus. The study team used total scores on the Healthy Eating Index (HEI)-2010 to measure the nutritional quality of NSLP lunches. The HEI-2010 is a diet quality index that measures conformance to key recommendations of the 2010 *Dietary Guidelines for Americans*.⁶ The total score has a maximum of 100. Higher scores indicate better conformance with recommendations of the *Dietary Guidelines for Americans* and, thus, higher nutritional quality.

- There was a statistically significant association between the quality of NSLP lunches and student participation in the NSLP. Overall, NSLP lunches with HEI-2010 scores in the third and highest quartiles of the distribution were associated with significantly higher student participation rates, relative to NSLP lunches with HEI-2010 scores in the lowest quartile of the distribution. Specifically, the average NSLP participation rate for schools with lunches in the highest quartile of the HEI-2010 distribution (scores between 85.8 and 92.8 out of a possible 100) was 61 percent, compared with 50 percent for schools with lunches in the lowest quartile of the distribution (scores between 64.9 and 79.5) (Figure ES.2). Similarly, the average NSLP participation rate for schools with lunches in the third quartile of the HEI-2010 distribution (scores between 83.1 and 85.7) was 60 percent, versus 50 percent for schools with lunches in the lowest quartile of the distribution.
- Overall, there were significant associations between NSLP participation and compliance with two of the NSLP nutrition standards examined in the analysis. Specifically, compliance with the daily quantity requirement for meats/meat alternates was associated with a significantly higher NSLP participation rate (59 percent versus 49 percent). In contrast, compliance with the Target 1 sodium limit was associated with a significantly lower NSLP participation rate (54 percent versus 64 percent).
- Overall, offering red or orange vegetables on more than half of daily lunch menus was associated with a significantly higher NSLP participation rate (60 percent versus 53 percent).

⁶ The study team used HEI-2010, because the 2010 *Dietary Guidelines for Americans* were in effect when data for this study were collected.

Figure ES.2. Regression-Adjusted Mean Student NSLP Participation Rates by Quartile of Total HEI-2010 Scores for NSLP Lunches Prepared



Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recalls: Day 1, and Menu Survey, school year 2014-2015. Estimates are weighted to be nationally representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: Estimates are regression-adjusted mean NSLP participation rates (as percentages) that control for demographic characteristics of each student, institutional characteristics of schools and SFAs, and the price charged by each school for a paid lunch.

The maximum possible score for the HEI-2010 is 100. The distribution of HEI-2010 scores for NSLP lunches was 64.9 to 79.5 for the lowest quartile, 79.6 to 83.0 for the second quartile, 83.1 to 85.7 for the third quartile, and 85.8 to 92.8 for the highest quartile.

*Difference in participation rates between schools in this category and schools in the lowest quartile of the HEI-2010 distribution is statistically different from zero at the 0.05 level.

HEI = Healthy Eating Index; NSLP = National School Lunch Program.

2. Key Characteristics of School Foodservice Operations

- Overall, use of HealthierUS School Challenge Smarter Lunchroom Techniques was associated with significantly higher NSLP participation rates.⁷ Mean NSLP participation was significantly higher among schools that used 4 to 7 Smarter Lunchroom Techniques compared to schools that did not use any of these techniques (59 percent versus 48 percent).
- Overall, offering brand-name or chain restaurant foods in reimbursable meals was associated with a significantly lower NSLP participation rate (41 percent versus 57 percent).

3. Key Characteristics of the School Food Environment

- Overall, the presence of nutrition standards for school meals that exceeded Federal standards was associated with significantly higher rates of NSLP participation (60 percent versus 53

⁷ Smarter Lunchroom Techniques are intended to promote healthy food choices, and include strategies such as soliciting students' input on vegetable offerings and displaying dark green, red, and orange vegetables prominently among side dish offerings.

percent), whereas the presence of standards for competitive foods that exceeded Smart Snacks in School standards was associated with significantly lower rates of NSLP participation (50 percent versus 58 percent).

4. Key Characteristics of Students, Schools, and SFAs

Student Characteristics

- Not surprisingly, students certified for free or reduced-price meals were significantly more likely to participate in the NSLP than students not certified to receive meal benefits (74 percent versus 40 percent).
- Female students were significantly less likely to participate in the NSLP than male students (53 percent versus 59 percent).
- Hispanic students were significantly more likely than non-Hispanic, white students to participate in the NSLP (60 percent versus 54 percent).
- Students who were reported (by parents) to be somewhat picky eaters were significantly more likely than students who were reported to be very picky eaters to participate in the NSLP (59 percent versus 52 percent).
- Students with larger appetites, relative to their peers, were significantly more likely to participate in the NSLP than students with typical or smaller appetites (61 percent versus 55 and 50 percent, respectively).⁸

Institutional Characteristics of Schools and SFAs

- Controlling for whether individual students were approved for free or reduced-price meals, schools with 40 percent or more of students approved to receive meal benefits had a significantly higher NSLP participation rate than schools with less than 40 percent of students approved for meal benefits (60 percent versus 51 percent).
- Schools in suburban and rural locations had significantly higher NSLP participation rates than schools in urban locations (59 percent for both suburban and rural schools versus 47 percent).

D. Plate Waste in the School Meal Programs

Plate waste is a measure of the amount of available food that is discarded (or not consumed). Some level of plate waste is inevitable in feeding programs like the school meal programs. Because required minimum portion sizes reflect average calorie and nutrient needs of specific grade groups, they may overestimate the needs of some students. However, the level of plate waste can be an important gauge of student satisfaction with meal offerings. It may also reflect menu planning that does not take students' food selection patterns or preferences into account.

⁸ Students' relative appetites were assessed based on parent reports. Parents were asked to assess the amount of food their child usually eats relative to other children of the same age and gender, and to report whether their child ate a larger amount, the same amount, or a smaller amount.

Plate waste varies because of individual student characteristics and preferences, but policy and environmental factors at the school and SFA levels may also influence it.

Since implementation of the updated nutrition standards starting in SY 2012–2013, some SFA directors and other stakeholders have been concerned about the potential for increased levels of plate waste in school meals (USDA, FNS 2016). The SNMCS is the first national study in more than two decades to examine plate waste in school meals, and is the first to examine the extent of plate waste since the updated nutrition standards went into effect.

For operational reasons, schools recruited for the plate waste observations had to serve a minimum number of lunches per day.⁹ In addition, meals had to be served in cafeterias, and students had to consume the meals in the cafeteria. For these reasons, findings related to plate waste are representative of public, non-charter schools that offer the NSLP, serve a minimum number of lunches per day¹⁰, and serve meals in cafeteria-based settings. The plate waste analysis sample included 165 schools and 6,253 trays for lunch and 154 schools and 3,601 trays for breakfast (some sampled schools did not offer the SBP).

1. Plate Waste in the NSLP

Extent of Plate Waste in the NSLP for Specific Types of Food

- Overall, plate waste in NSLP lunches was highest for vegetables—an average of 31 percent of the vegetables on observed trays was wasted—followed by milk (29 percent), fruits and 100% fruit juice (26 percent), and separate or side grains/breads (23 percent) (Figure ES.3). Mean levels of waste were lower for desserts and other menu items (20 percent), and lowest for combination entrées and meats/meat alternates (16 percent and 14 percent, respectively). These findings are generally comparable to findings from studies that examined plate waste prior to implementation of the updated nutrition standards.¹¹ Moreover, small, local studies that examined plate waste before and after implementation of the updated nutrition standards found that levels of plate waste were reduced or unchanged.¹²
- For each type of food, the mean proportion wasted was higher in elementary schools than in middle or high schools and was higher in middle schools than in high schools (though not all differences between middle and high schools were statistically significant).
- This pattern of findings may be partially explained by differences in the use of the offer-versus-serve (OVS) option, which allows students to decline some components of a reimbursable meal as a way of providing choice and reducing waste. OVS is mandatory for high schools but optional for elementary and middle schools (81 percent of all elementary and middle schools used OVS at lunch; Forrestal et al. 2019). Multivariate analyses found

⁹ The minimum number of lunches served per day in the final sample of schools included in the plate waste analysis were 157 lunches for elementary schools, 220 for middle schools, and 87 for high schools.

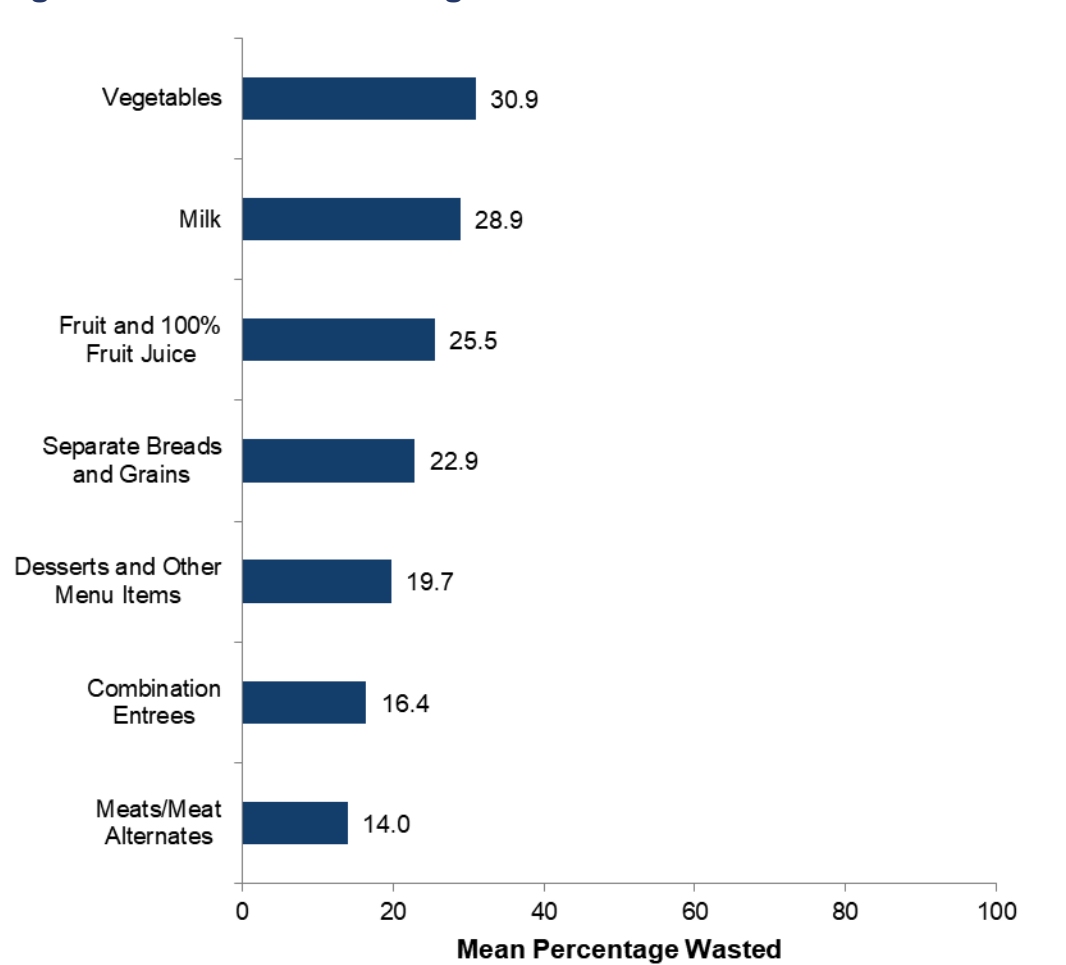
¹⁰ Data for the full sample of schools that completed the SNMCS Menu Survey indicate that, in SY 2014-2015, more than three-quarters of all NSLP schools served the minimum number of lunches per day reflected in the plate waste sample (78 percent of elementary schools, 77 percent of middle schools, and 90 percent of high schools).

¹¹ St. Pierre et al. 1992 and General Accounting Office 1996.

¹² See Cullen, Chen, and Dave 2015, and Schwartz et al. 2015.

that, among elementary schools, use of OVS was associated with significantly lower levels of waste for calories and fruits and vegetables.

Figure ES.3. Mean Percentage of Observed Foods Wasted in NSLP Lunches



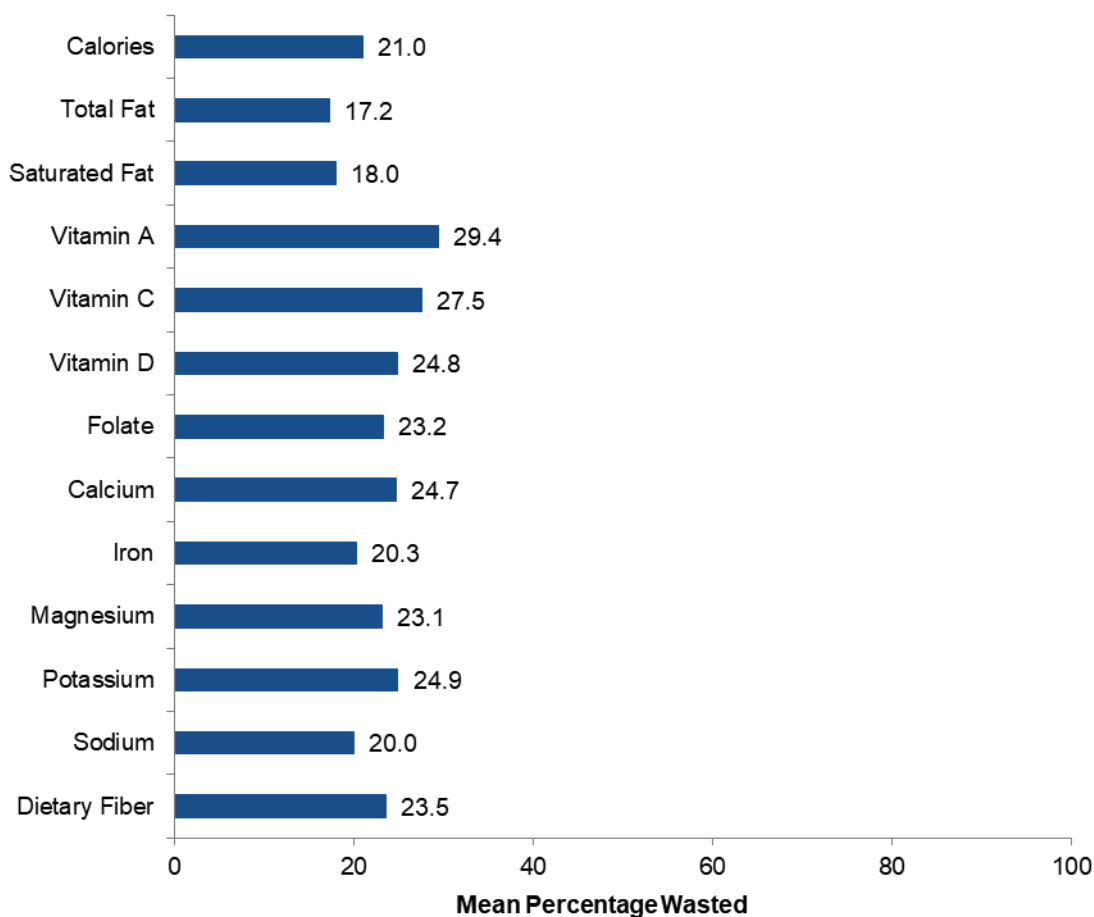
Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of all large public, non-charter schools offering the National School Lunch Program (serving at least 157 lunches per day in elementary schools, 220 lunches per day in middle schools, and 87 lunches per day in high schools).

Calories and Nutrients Wasted in NSLP Lunches

- On average, about one-fifth (21 percent) of the calories available in NSLP lunches overall were wasted, as well as roughly one-quarter or more of the available vitamin A, vitamin C, vitamin D, calcium, and potassium (Figure ES.4). Among the key nutrients examined, the average percentage wasted was lowest for total fat (17 percent), saturated fat (18 percent), iron (20 percent) and sodium (20 percent).
- In keeping with the variation observed across school types in levels of plate waste for specific types of food, the average proportion of calories and most nutrients wasted was significantly higher in elementary schools than in either middle or high schools, and was significantly higher in middle schools than in high schools. The only exceptions were total

fat and saturated fat, where differences between middle and high schools were not statistically significant.

Figure ES.4. Mean Percentage of Calories and Key Nutrients Wasted in NSLP Lunches



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of all large public, non-charter schools offering the National School Lunch Program (serving at least 157 lunches per day in elementary schools, 220 lunches per day in middle schools, and 87 lunches per day in high schools).

2. Plate Waste in the SBP

Extent of Plate Waste in the SBP for Specific Types of Food

- Overall, plate waste at breakfast was highest for milk (41 percent), followed by fruits and 100% fruit juice (27 percent). Mean levels of waste were substantially lower for meats/meat alternates (19 percent), separate grains/breads (16 percent), and combination entrées (11 percent).
- Similar to the pattern observed for the NSLP, the mean proportions wasted were higher in elementary schools than in middle or high schools and were higher in middle schools than in high schools. The vast majority of these differences were statistically significant.

Calories and Nutrients Wasted in SBP Breakfasts

- On average, about one-quarter (23 percent) of the calories available in SBP breakfasts were wasted, as well as one-quarter or more of the available vitamin A, vitamin D, calcium, magnesium, and potassium. Among the key nutrients examined, the average percentage wasted was lowest for iron (17 percent), total fat (18 percent), and folate (18 percent).
- Similar to the pattern observed for the NSLP, the average proportion of calories and nutrients wasted was significantly higher in elementary schools than in either middle or high schools, and was significantly higher in middle schools relative to high schools.

E. Dietary Intakes of School Meal Participants and Nonparticipants

Students provided detailed information about foods and beverages consumed during a midnight-to-midnight recall period covering a school day. Data on the calorie and nutrient content of foods students obtained from reimbursable school lunches and breakfasts were taken from a detailed analysis of each school's reimbursable menus.¹³ This ensured that the dietary intake data represented, as accurately as possible, the nutrient content of foods obtained in reimbursable meals.

Students who were identified in administrative records as having received a reimbursable breakfast or lunch on the day referenced in the 24-hour dietary recall (the target day) were considered SBP participants and NSLP participants, respectively.¹⁴ Students not identified as having received a reimbursable meal on the target day were considered nonparticipants. In comparing the food and nutrient intakes of school meal participants and nonparticipants, the study team used inverse probability weighting to construct matched comparison groups of nonparticipants (for example, NSLP nonparticipants in elementary schools). These matched comparison groups were weighted to more closely resemble participants on observable characteristics that are believed to influence participation, for example, age, gender, household income, and whether a student is a picky eater. Even with these controls, differences between

¹³ Collection and analysis of the detailed data collected in the Menu Survey is described in Volume 2 of the SNMCS final report (Gearan et al. 2019).

¹⁴ When administrative data were not available for a given student, the study team constructed measures of target-day participation based primarily on the lunch and breakfast foods that the student reported obtaining at school on the target day.

participants and matched nonparticipants may exist for unmeasured characteristics. For this reason, findings from these comparisons should not be interpreted as causal effects of school meal participation.

The 24-hour dietary recalls were used to assess (1) students' meal-specific intakes, including the types of foods students consumed at lunch and breakfast, the calories and nutrients provided by these foods, and the nutritional quality of students' lunches and breakfasts; (2) the prevalence of acceptable, inadequate, and excessive nutrient intakes, considering students' 24-hour diets, including foods and beverages consumed at school, home, and all other settings; and (3) the overall nutritional quality of students' 24-hour diets.

The study team used the HEI-2010 to examine the nutritional quality of lunches, breakfasts, and 24-hour diets consumed by participants and matched nonparticipants. The HEI-2010 is a diet quality index that measures conformance to key recommendations of the 2010 *Dietary Guidelines for Americans*.¹⁵ The HEI-2010 includes 12 component scores that measure specific aspects of diet quality (9 adequacy components and 3 moderation components), and a total score that measures overall diet quality. Maximum scores for the various components range from 5 to 20, and the total score, which is computed by summing scores for each of the 12 components, has a maximum of 100. For all components, higher scores indicate better conformance with recommendations of the *Dietary Guidelines for Americans* and, thus, higher diet quality.

1. Meal-Specific Intakes

For both participants and matched comparison groups of nonparticipants, the analyses of meal-specific intakes (that is, intakes at lunch and at breakfast) included all foods and beverages consumed as part of each meal. For participants, this may include, in addition to foods and beverages obtained as part of a reimbursable meal, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

Foods Consumed at Lunch

- NSLP participants were more likely than matched nonparticipants to consume milk at lunch (66 percent versus 23 percent).
- NSLP participants were also more likely than matched nonparticipants to consume fruit or 100% fruit juice (58 percent versus 47 percent) and vegetables (43 percent versus 21 percent) at lunch. The difference in vegetables was largely driven by higher percentages of NSLP participants consuming starchy vegetables (French fries, other potatoes, and corn) and side salads, relative to matched nonparticipants.
- Overall, NSLP participants were less likely than matched nonparticipants to consume grain or bread products at lunch that were not part of combination entrées like sandwiches or pizza (29 percent versus 40 percent). This difference was largely driven by higher percentages of matched nonparticipants consuming crackers, croutons, and pretzels and granola/breakfast bars.

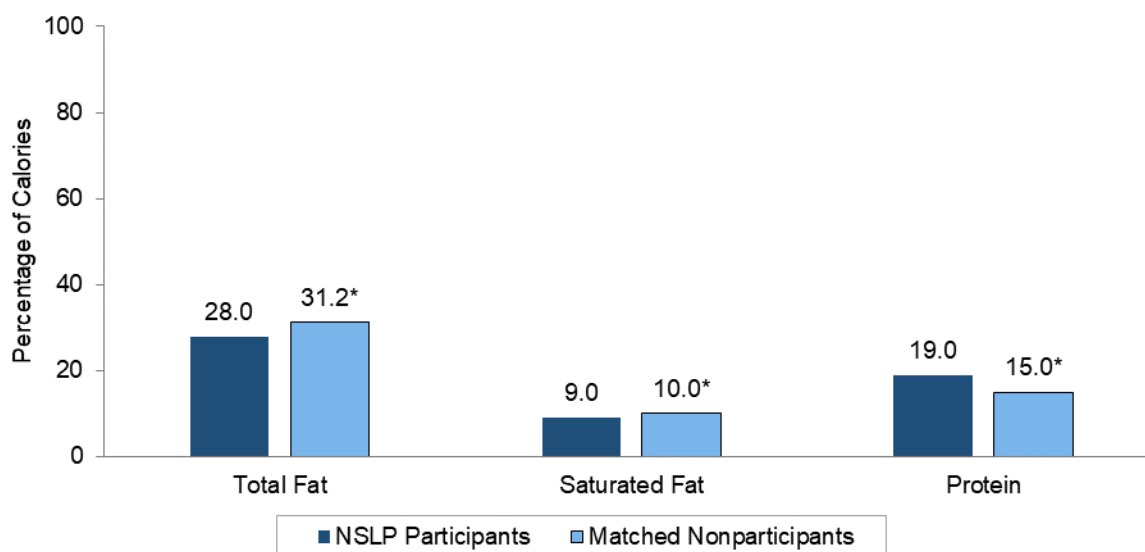
¹⁵ The study team used HEI-2010, because the 2010 *Dietary Guidelines for Americans* were in effect when data for this study were collected.

- NSLP participants were less likely than matched nonparticipants to consume desserts, snacks, and beverages other than milk or 100% juice at lunch (48 percent versus 75 percent).

Mean Calorie and Nutrient Intakes at Lunch

- NSLP participants consumed lunches that provided significantly fewer calories than lunches consumed by matched nonparticipants (515 calories versus 643 calories).
- Relative to lunches consumed by matched nonparticipants, lunches consumed by NSLP participants provided a smaller percentage of calories from total fat (28 percent versus 31 percent), a smaller percentage of calories from saturated fat (9 percent versus 10 percent), and a larger percentage of calories from protein (19 percent versus 15 percent) (Figure ES.5).

Figure ES.5. Mean Percentage of Calories from Total Fat, Saturated Fat, and Protein in Lunches Consumed by NSLP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

- Overall, lunches consumed by NSLP participants provided significantly more vitamins D and B₁₂, on average, than lunches consumed by matched nonparticipants. This finding is consistent with the fact that NSLP participants were more likely than matched nonparticipants to consume milk at lunch.

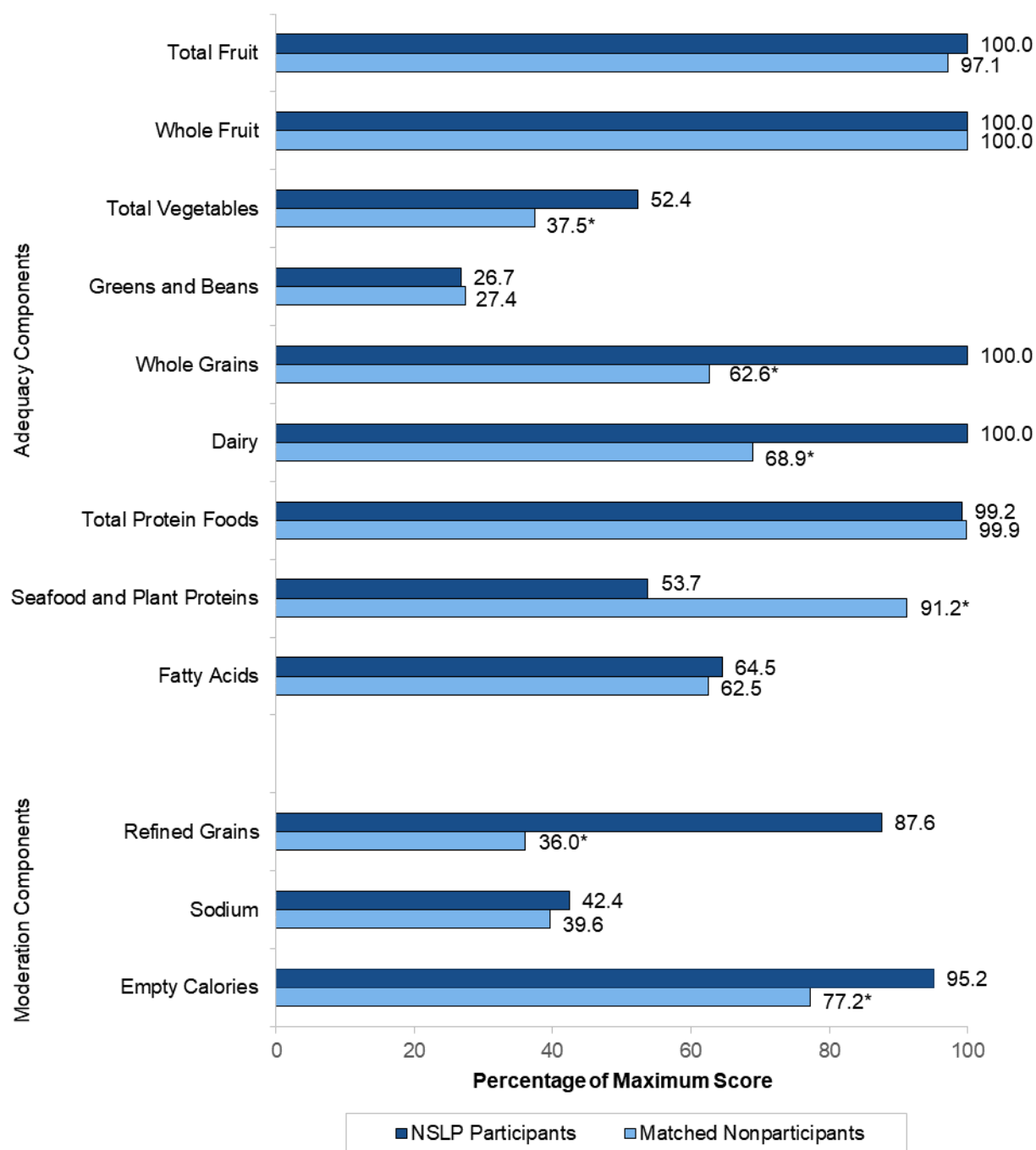
- Lunches consumed by NSLP participants provided significantly less vitamin E, folate, niacin, thiamin, and iron than lunches consumed by matched nonparticipants. These findings are consistent with the fact that NSLP participants were less likely than matched nonparticipants to consume separate bread/grain items at lunch.
- There were no significant differences between NSLP participants and matched nonparticipants in total fiber intake at lunch. However, lunches consumed by NSLP participants had a significantly higher nutrient density for fiber (that is, g/1,000 calories) than lunches consumed by matched nonparticipants. This finding is consistent with the fact that NSLP participants were more likely than matched nonparticipants to consume fruits and vegetables at lunch.
- Lunches consumed by NSLP participants provided significantly less sodium than lunches consumed by matched nonparticipants.

Nutritional Quality of Lunches Consumed

- Overall, the lunches consumed by NSLP participants achieved a higher mean total score on the HEI-2010 than lunches consumed by matched nonparticipants (80.1 out of a possible 100 versus 65.1). As a point of reference, the average total HEI-2010 score for the overall diets consumed by the U.S. population as a whole in 2011–2012 was 59.0 and the average score for children was 55.1.¹⁶
- The lunches consumed by NSLP participants received significantly higher scores than the lunches consumed by matched nonparticipants for total vegetables (52 percent of the maximum score versus 38 percent), whole grains (100 percent versus 63 percent), and dairy (100 percent versus 69 percent) (Figure ES.6). Conversely, the lunches consumed by NSLP participants received a significantly lower score than matched nonparticipants for seafood and plant proteins (54 percent versus 91 percent).
- Overall, the lunches consumed by NSLP participants had significantly lower concentrations of refined grains and empty calories than the lunches consumed by matched nonparticipants (88 percent of the maximum score for refined grains versus 36 percent; and 95 percent versus 77 percent for empty calories) (Figure ES.6).

¹⁶ See https://www.cnpp.usda.gov/sites/default/files/healthy_eating_index/HEI-2010TotalAndComponentScoresTable.pdf.

Figure ES.6. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for Lunches Consumed by NSLP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Lunch intakes for both NSLP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

Healthy Eating Index-2010 scores are based on lunch intakes. Higher scores for adequacy components reflect higher intakes; whereas higher scores for moderation components reflect lower intakes.

Legumes were first counted as protein foods until the standard was met, and then remaining legumes were counted as vegetables.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

Foods Consumed at Breakfast

- There was no significant difference in the proportion of SBP participants and matched nonparticipants who consumed milk at breakfast. However, SBP participants were more likely than matched nonparticipants to consume fat-free or low-fat (1%) milk and less likely to consume 2% or whole milk.
- SBP participants were more likely than matched nonparticipants to consume fruit or 100% fruit juice at breakfast (60 percent versus 32 percent). SBP participants were also more likely to consume a combination entrée at breakfast (22 percent versus 12 percent).
- SBP participants were less likely than matched nonparticipants to consume cold cereal at breakfast (31 percent versus 40 percent).

Mean Calorie and Nutrient Intakes at Breakfast

- Overall, breakfasts consumed by SBP participants provided approximately the same number of calories, on average, as breakfasts consumed by matched nonparticipants (about 400 calories).
- Breakfasts consumed by SBP participants provided significantly fewer calories from total fat (22 percent versus 26 percent) and saturated fat (8 percent versus 10 percent) than breakfasts consumed by matched nonparticipants.
- Breakfasts consumed by SBP participants provided significantly more potassium, on average, than breakfasts consumed by matched nonparticipants, and significantly less vitamin E, folate, and niacin. These differences are consistent with the fact that SBP participants were more likely than matched nonparticipants to consume fruit or 100% fruit juice at breakfast, and less likely to consume cold cereal.
- There were no significant differences between SBP participants and matched nonparticipants in dietary fiber intake at breakfast.

Nutritional Quality of Breakfasts Consumed

- The breakfasts consumed by SBP participants achieved a higher mean total score on the HEI-2010 than breakfasts consumed by matched nonparticipants (66.1 out of a possible 100 versus 58.9). For both groups of students, total HEI-2010 scores were lower for breakfasts than for lunches. This is not surprising, given that several of the food groups assessed in the HEI-2010's adequacy components—for example, vegetables, greens and beans, and seafood and plant proteins—are typically not consumed at breakfast.
- Mean scores for HEI-2010 components showed that breakfasts consumed by SBP participants had higher concentrations of whole grains than breakfasts consumed by matched nonparticipants (98 percent of the maximum score versus 68 percent) and lower concentrations of refined grains (78 percent versus 61 percent) and empty calories (71 percent versus 62 percent).

2. Prevalence of Acceptable, Inadequate, and Excessive Nutrient Intakes on School Days

The study team used the 24-hour recalls collected from all students, as well as a second dietary recall collected from a representative subset (about 27 percent) of students, to estimate usual daily intake distributions of calories and nutrients on school days for school meal participants and matched nonparticipants. To estimate the percentages of students in each group with acceptable, inadequate, or excessive usual nutrient intakes, students' usual intake distributions were compared with standards defined in the Dietary Reference Intakes (DRIs) and 2010 *Dietary Guidelines for Americans*.¹⁷ The DRIs are the most up-to-date scientific standards for determining whether diets meet nutrient requirements without being excessive. They provide standards for the amounts of nutrients healthy individuals should consume, based on age, gender, and life stage (Institute of Medicine 2006).

Key findings for NSLP participants and matched nonparticipants are summarized below. The general pattern of findings was comparable for SBP participants and matched nonparticipants because most SBP participants were also NSLP participants. Detailed findings for SBP participants and matched nonparticipants are presented in Chapter 11.

Macronutrients

- Most NSLP participants and matched nonparticipants had acceptable usual intakes of macronutrients on school days (defined as intakes that fell within the Acceptable Macronutrient Distribution Ranges), and there were few significant differences between the two groups.
- Overall, about 60 percent of students had usual daily intakes of saturated fat that exceeded the 2010 *Dietary Guidelines for Americans* recommended limit. Findings were comparable for NSLP participants and matched nonparticipants.

¹⁷ The 2010 *Dietary Guidelines for Americans* were in effect when data for this study were collected.

Vitamins and Minerals

- Nutrient requirements vary for students of different ages. Consequently, there were notable differences across school types in the prevalence of inadequate nutrient intakes (defined as intakes that were less than the age-and-gender-specific Estimated Average Requirements).
- Among elementary school students, inadequate usual intakes of vitamins and minerals were relatively uncommon, except for vitamins A, D, and E¹⁸, and calcium—which had rates of inadequacy above 10 percent for both NSLP participants and nonparticipants—and magnesium and phosphorus, with rates of inadequacy above 10 percent for matched nonparticipants only.
 - NSLP participants in elementary schools were significantly less likely than matched nonparticipants to have inadequate usual intakes of vitamin D (68 percent versus about 96 percent), calcium (28 percent versus 46 percent), and phosphorus (less than 3 percent versus 14 percent).
- Among middle school students, the prevalence of inadequate usual intakes exceeded 10 percent for both NSLP participants and matched nonparticipants for vitamins A, C, D, and E, and for calcium, magnesium, and phosphorus. In addition, among matched nonparticipants, the prevalence of inadequate usual intakes exceeded 10 percent for vitamin B₆, folate, and zinc.
 - NSLP participants in middle schools were significantly less likely than matched nonparticipants to have inadequate usual intakes of vitamin B₆ (less than 3 percent versus 10 percent) and zinc (about 4 percent versus 28 percent).
- High school students—who have the highest nutrient requirements relative to the other age groups considered in this study—had the greatest prevalence of inadequate usual intakes of vitamins and minerals. The prevalence of inadequacy exceeded 10 percent for both NSLP participants and matched nonparticipants for vitamins A, C, D, and E, and for calcium, magnesium, and phosphorus. In addition, for matched nonparticipants, the prevalence of inadequate usual intakes exceeded 10 percent for vitamins B₆ and B₁₂, folate, riboflavin, thiamin, and zinc.
 - NSLP participants in high schools were significantly less likely than matched nonparticipants to have inadequate usual intakes of several vitamins and minerals. For vitamin B₆, vitamin B₁₂, niacin, riboflavin, and thiamin, the prevalence of inadequacy was rare (less than 3 percent) among NSLP participants, but ranged from 7 to 19 percent among matched nonparticipants. In addition, NSLP participants were significantly less likely than matched nonparticipants to have inadequate usual intakes of folate (8 percent versus 30 percent), calcium (40 percent versus 57 percent), phosphorus (17 percent versus 31 percent), and zinc (9 percent versus 33 percent).

¹⁸ Devaney et al. (2007) pointed out that the diets of most of the U.S. population do not meet the EAR for vitamin E, yet vitamin E deficiency is rare. They noted limitations of both the data used to establish the EAR and the data used to assess vitamin E intakes.

Sodium and Fiber

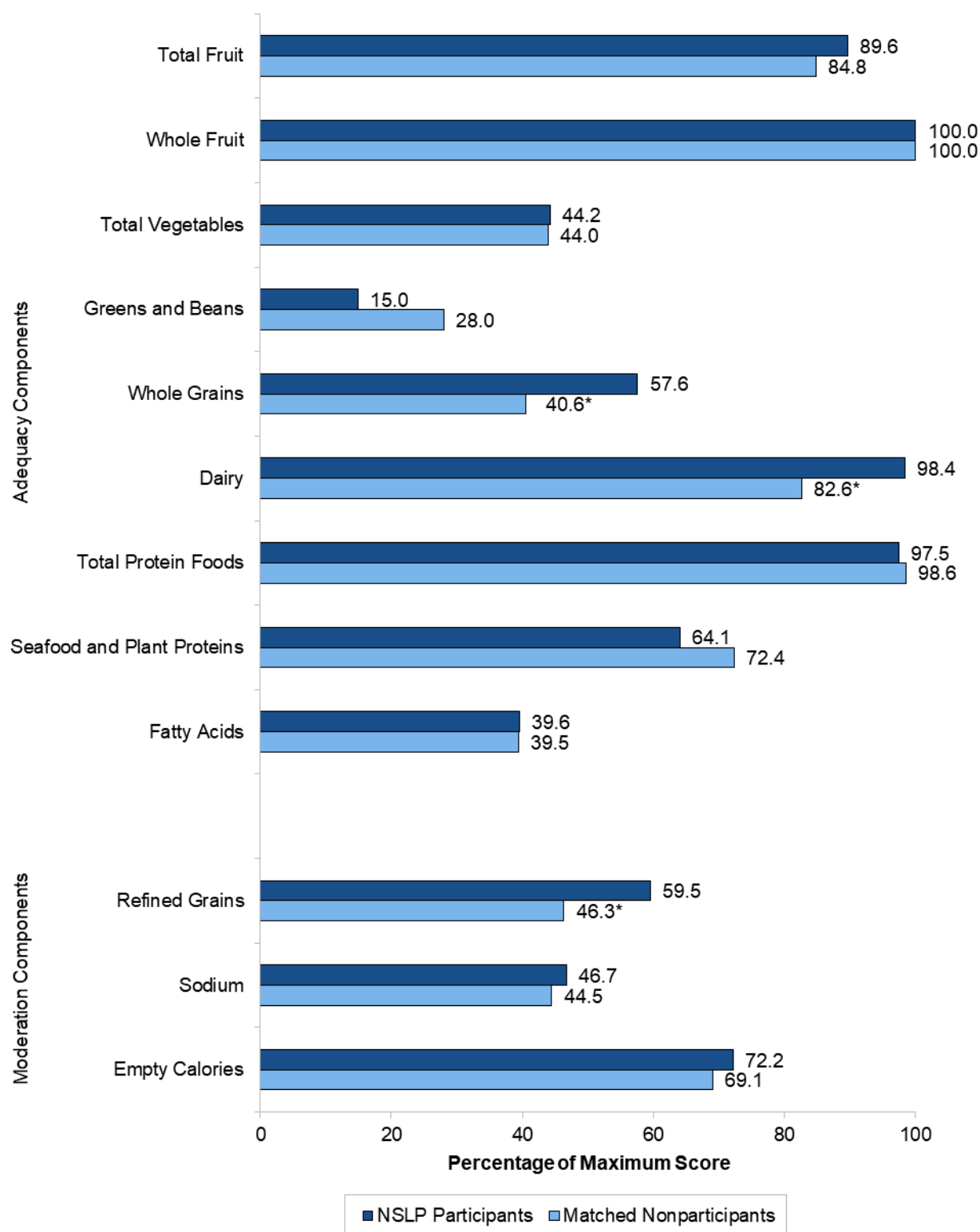
- Overall, more than 81 percent of NSLP participants and matched nonparticipants had excessive usual intakes of sodium, and there were no significant differences between the two groups. Despite significantly lower sodium intakes among NSLP participants at lunch, there were no significant differences between NSLP participants and matched nonparticipants in the prevalence of excessive usual intakes of sodium.
- Mean usual dietary fiber intakes of both NSLP participants and matched nonparticipants were low, relative to the 14 grams of fiber per 1,000 calories benchmark on which the DRIs are based. Overall, there were no statistically significant differences between NSLP participants and matched nonparticipants in usual intakes of dietary fiber.

3. Overall Nutritional Quality of Students' Daily Diets on School Days

The goal of the school meal programs is to provide students with nutritious meals. The updated nutrition standards for school meals that took effect starting in SY 2012–2013 were designed to better reflect the *Dietary Guidelines for Americans* and to enhance the diet and health of school children (USDA, FNS 2012). The study team used the HEI-2010 to assess the overall quality of diets consumed by school meal participants and matched nonparticipants on school days. Key findings for NSLP participants and matched nonparticipants are summarized below. Detailed findings for SBP participants and matched nonparticipants are presented in Chapter 12.

- The positive and significant difference in mean total HEI-2010 scores observed among NSLP participants and matched nonparticipants at lunch persisted over 24 hours, although the magnitude of the difference was smaller than at lunch (65.2 out of a possible 100 versus 60.6 for 24-hour intakes, compared to 80.1 versus 65.1 for lunch intakes).
- A similar pattern was observed for the positive and significant differences between NSLP participants and matched nonparticipants in HEI-2010 component scores for whole grains, dairy, and refined grains at lunch. The significant differences persisted over 24 hours (Figure ES.7), but the magnitude of the differences between NSLP participants and matched nonparticipants was smaller relative to lunches (Figure ES.6).
- The positive and significant difference observed at lunch for total vegetables (Figure ES.6) did not persist over 24-hours (Figure ES.7). A comparison of mean scores for lunches and 24-hour intakes suggest that, relative to lunches, the concentrations of vegetables in other meals and snacks were lower for NSLP participants and higher for matched nonparticipants, resulting in comparable concentrations of vegetables in 24-hour intakes.
- The positive and significant difference between NSLP participants and matched nonparticipants observed at lunch for empty calories (Figure ES.6) also did not persist over 24-hours (Figure ES.7). A comparison of mean scores for lunches and 24-hour intakes suggests that, relative to lunches, the concentrations of empty calories in other meals and snacks were higher for both groups of students, particularly for NSLP participants.

Figure ES.7. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for 24-Hour Intakes for NSLP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Healthy Eating Index-2010 scores are based on daily intakes. Higher scores for adequacy components reflect higher intakes; whereas higher scores for moderation components reflect lower intakes.

Legumes were first counted as protein foods until the standard was met, and then remaining legumes were counted as vegetables.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

F. Changes in the Prevalence of Acceptable, Inadequate, and Excessive Nutrient Intakes since the Third School Nutrition Dietary Assessment Study (SY 2004–2005)

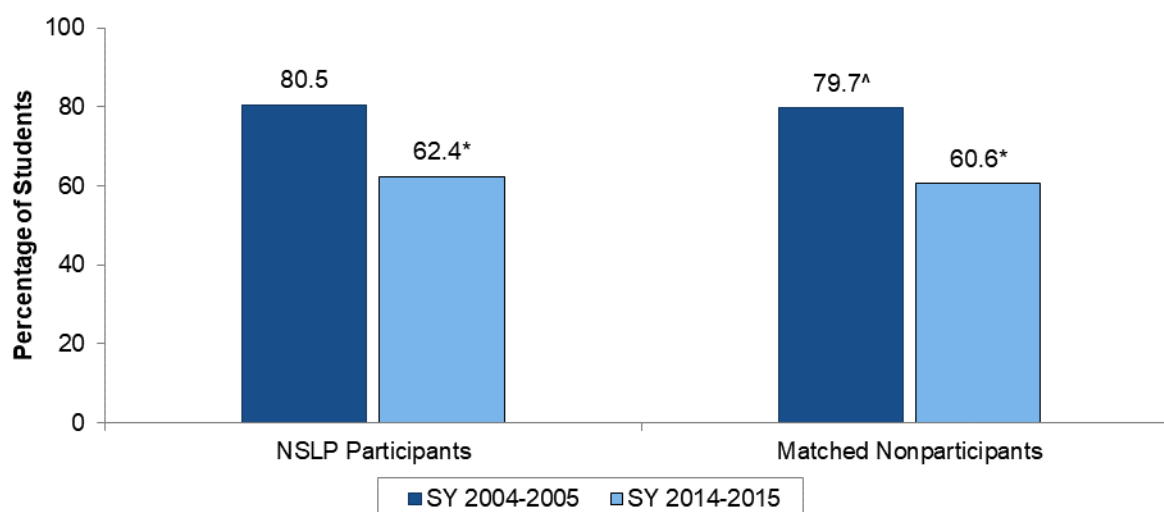
The SNMCS is the first nationally representative, comprehensive assessment of students' dietary intakes since major reforms in the school meal programs began in SY 2012–2013, including updated nutrition standards. To offer perspective on how the updated nutrition standards for school meals may have influenced students' dietary intakes on school days, the study team compared the usual dietary intakes of NSLP participants and matched nonparticipants in SY 2014–2015 and SY 2004–2005 using data from the SNMCS and the third School Nutrition Dietary Assessment Study (SNDA-III), respectively. SNDA-III is the most recent prior national assessment of students' diets (Gordon et al. 2007).

In collecting and processing data for the SNMCS, a conscious effort was made to use methods that were comparable to SNDA-III. However, observed differences in estimated dietary intakes at the two points in time may be due to multiple factors, including improvements in food composition databases, differences in the techniques used to control for measured differences in characteristics of school meal participants and nonparticipants, and secular changes in the general population over time. For this reason, the findings should be interpreted with caution and not viewed as definitive indications of impacts of the updated nutrition standards.

1. Macronutrients

- Overall, the prevalence of excessive usual daily intakes of saturated fat decreased significantly between SY 2004–2005 and SY 2014–2015 for both NSLP participants and matched nonparticipants (from 81 to 62 percent and from 80 to 61 percent, respectively) (Figure ES.8).
- Differences between SY 2004–2005 and SY 2014–2015 in the percentages of NSLP participants and matched nonparticipants with acceptable usual daily intakes of total fat, carbohydrate, and protein were not statistically significant.

Figure ES.8. Comparison of the Percentage of NSLP Participants and Matched Comparison Group of Nonparticipants with Excessive Usual Daily Intakes of Saturated Fat in SY 2004–2005 and 2014–2015



Source: Data for school year 2004-2005 were estimated using 24-Hour Dietary Recall (Day 1 and Day 2) data from the third School Nutrition Dietary Assessment Study (SNDA-III) (Gordon et al. 2007), and are representative of all students in public schools offering the National School Lunch Program in SY 2004-2005. Data for school year 2014-2015 are from the School Nutrition and Meal Cost Study (24-Hour Dietary Recalls: Day 1 and Day 2), and are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Samples includes all students, including those who did not consume a lunch.

Note: SNDA-III and SNMCS both used propensity score approaches to construct samples of matched nonparticipants. See Appendix G for more details.

*Difference between SY 2004-2005 and SY 2014-2015 is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program; SY = school year.

[^] Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

2. Vitamins and Minerals

- With the exception of vitamins C and E, there were few significant differences between SY 2004–2005 and SY 2014–2015 in the prevalence of inadequate usual daily intakes of vitamins and minerals for either NSLP participants or matched nonparticipants.
- Among matched nonparticipants, the prevalence of inadequate usual intakes of vitamin C increased significantly (from 13 to 25 percent) between SY 2004–2005 and SY 2014–2015. There was no comparable change among NSLP participants.
- For both NSLP participants and matched nonparticipants, the prevalence of inadequate usual intakes of vitamin E decreased significantly between SY 2004–2005 and SY 2014–2015 (from 88 to 74 percent and from 86 to 68 percent, respectively).

3. Sodium

- The large percentages of NSLP participants and matched nonparticipants with excessive usual sodium intakes remained about the same between SY 2004–2005 and SY 2014–2015 (95 and 96 percent and 88 and 86 percent, respectively).

G. Consumption of Competitive Foods

Foods and beverages that are sold to students during the school day that are not part of a reimbursable meal considered competitive foods. Competitive foods may be available for a la carte purchase in school cafeterias (in separate serving lines or in lines that also serve reimbursable meals) or sold in vending machines, school stores, snack bars, or fundraisers. Prior research has shown that competitive foods can play a major role in the diets of school children and often include low-nutrient, energy-dense (LNED) foods such as chips, candy, desserts, and sports drinks (Larson and Story 2010; Fox et al. 2009a). In response to concerns about the potential negative impact of competitive foods on the quality of students' diets USDA was required to establish, for the first time, nutrition standards for all foods sold in schools. The proposed Smart Snacks in School rule was published in the Federal Register in 2013 (USDA, FNS 2013), and the final rule took effect in SY 2014–2015 (the year data for this study were collected). The goal of the Smart Snacks in School standards is to ensure that foods sold in competition with school meals are also consistent with the *Dietary Guidelines for Americans*.

1. Consumption of Competitive Foods among NSLP Participants and Nonparticipants¹⁹

- Overall, NSLP participants were significantly more likely than matched nonparticipants to consume one or more competitive foods (29 percent versus 21 percent).
- For both NSLP participants and matched nonparticipants, the leading source of competitive foods was cafeteria lines that sold both reimbursable meals and a la carte foods and beverages. One in five NSLP participants (20 percent and 14 percent for matched nonparticipants) obtained one or more competitive foods from mixed cafeteria lines; the difference between NSLP participants and matched nonparticipants was statistically significant.
- Overall, only 2 to 3 percent of students reported obtaining competitive foods from a vending machine and only 1 to 3 percent reported obtaining a competitive food from a school store, snack bar, food cart, or some other venue that did not also offer reimbursable school meals.
- Among students who consumed competitive foods, the vast majority (81 percent of NSLP participants and 87 percent of matched nonparticipants) consumed competitive foods at lunch. Other competitive food consumers consumed foods obtained at lunch at a later time or obtained competitive foods at different times of the school day.

¹⁹ The analysis also examined consumption of competitive foods among SBP participants and nonparticipants. See Chapter 13.

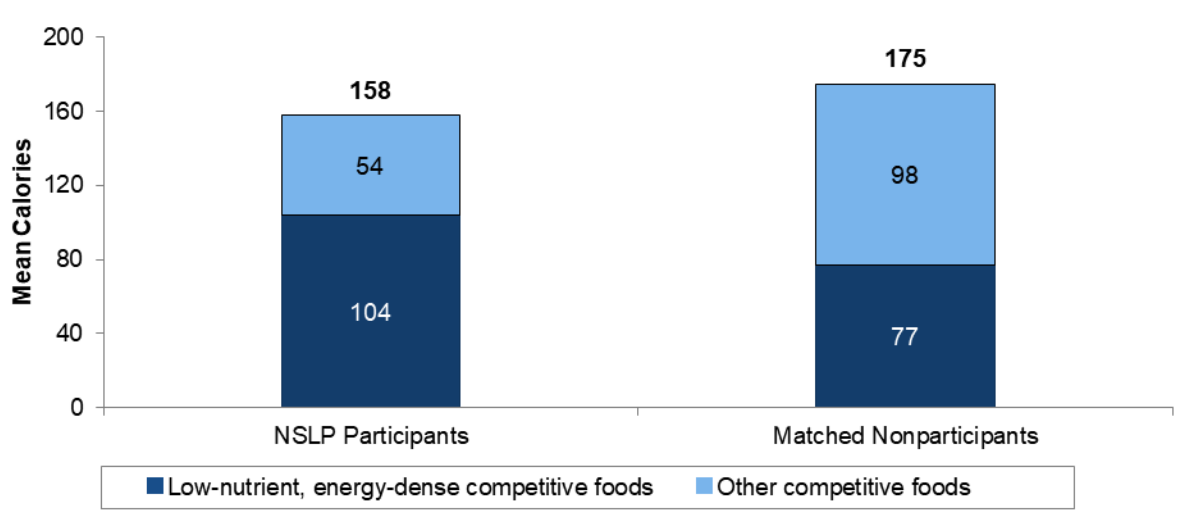
2. Types of Competitive Foods Consumed

- The vast majority of NSLP participants who consumed competitive foods (86 percent), consumed foods that were categorized as desserts, snacks, and other beverages. Such foods were also the most commonly consumed competitive foods among matched nonparticipants, but the overall prevalence of these foods was significantly higher for NSLP participants than matched nonparticipants (86 percent versus 58 percent).
- Within desserts, snacks, and other beverages, the most common competitive foods were beverages other than milk and 100% fruit juice. About one-third of competitive food consumers reported an item in this category. Among NSLP participants who consumed competitive foods, the most commonly reported item in this group was bottled water (23 percent). Among matched nonparticipants who consumed competitive foods, 16 percent consumed bottled water, and approximately 5 to 7 percent consumed sports/energy drinks or juice drinks (not 100% juice).
- Among competitive food consumers, NSLP participants were more likely than matched nonparticipants to consume snack chips and popcorn (19 percent versus 7 percent); dairy-based desserts (11 percent versus 4 percent); and other types of dessert (9 percent versus less than 3 percent).

3. Calorie and Nutrient Content of Competitive Foods

- On average, both NSLP participants and matched nonparticipants who consumed competitive foods obtained more than 150 calories daily from these foods (Figure ES.9). NSLP participants consumed slightly fewer calories from competitive foods than matched nonparticipants, but the difference was not statistically significant (158 calories versus 175 calories). The modest difference in calories from competitive foods may reflect the fact that, relative to NSLP participants, more matched nonparticipants obtained main components of reimbursable meals as competitive foods (a la carte purchases), for example, milk, fruit or 100% juice, combination entrees, and meats/meat alternates, and fewer obtained bottled water. (The difference between NSLP participants and matched nonparticipants was statistically significant for milk and fruit and 100% juice).

Figure ES.9. Mean Calories Obtained from Competitive Foods: NSLP Participants and Matched Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes students who consumed at least one competitive food, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Low-nutrient/energy-dense foods include all candy, cakes/cookies/brownies and other baked desserts, pies, muffins, donuts, sweet rolls, toaster pastries, frozen desserts, snack chips (unless low-fat), French fries, and caloric beverages other than milk or 100% fruit juice. None of the differences between participants and the matched comparison group of nonparticipants are significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

- In keeping with the preceding findings on the types of competitive foods consumed by NSLP participants and matched nonparticipants, a greater share of the competitive food calories consumed by NSLP participants came from low-nutrient, energy-dense (LNED) foods—66 percent (104 of 158 calories) versus 44 percent (77 of 175 calories).
- Similarly, the competitive foods consumed by NSLP participants were lower in vitamin D, calcium, and potassium, on average, than the competitive foods consumed by matched nonparticipants.
- It is difficult to compare these findings to previous studies because of differences in how NSLP participants, matched nonparticipants, and competitive foods were defined. However, the most comparable prior analysis found that, in SY 2004–2005, students overall consumed an average of 177 calories from LNED competitive foods (Fox et al. 2009a). The substantially lower calorie intake from LNED competitive foods observed in the SNMCS (77 calories for matched nonparticipants and 104 calories for NSLP participants) may suggest that the Smart Snacks in School standards are having the desired effect of lowering students' intakes of empty calories at school. (The statistical significance of differences between SY 2004–2005 was not tested).

1. INTRODUCTION

The National School Lunch Program (NSLP) and School Breakfast Program (SBP) form the cornerstone of the nation's nutrition safety net for low-income children. These programs, which are administered by the U.S. Department of Agriculture (USDA), Food and Nutrition Service (FNS), provide 30 million Federally subsidized lunches and 15 million Federally subsidized breakfasts to children each school day (USDA, FNS 2018a, 2018b). Children whose families are living below 130 percent of the Federal poverty level (FPL) are eligible for free meals, although schools in high-poverty areas may provide free meals on a universal basis regardless of households' income. For children whose families earn between 130 and 185 percent of the FPL, meals can be purchased at a reduced price. Children who do not apply or qualify for free or reduced-price meals pay full price for the meals.

At the State level, the NSLP and SBP are administered by State child nutrition (CN) agencies and at the local level by school food authorities (SFAs). State CN agencies are responsible for ensuring SFAs comply with Federal regulations, but SFAs and schools have operational discretion in how they administer the programs within Federal and State guidelines. For example, SFAs and schools have options in how they set meal prices, plan their menus, select methods of food production, and use nutrition promotion techniques.

In school year (SY) 2012–2013, the school meal programs began to undergo widespread changes, mainly stemming from the Healthy, Hunger-Free Kids Act of 2010 (HHFKA, Public Law 111-296). Key reforms included more fruits, vegetables, and whole grains in the school menu; updated nutrition standards to improve the nutritional quality of school meals and students' diets in order to reduce children's risk of developing chronic diseases; a new requirement that students select at least 1/2 cup of fruits or vegetables in order for their meal to be eligible for Federal reimbursement; equitable price-setting for full-price (also called "paid") meals; and the introduction of nutrition standards for all foods and beverages sold in competition with reimbursable meals in schools during the school day (competitive foods).

All of these reforms have important implications for the school meal programs. The updated nutrition standards are intended to improve the nutritional quality of school meals. However, complying with the updated standards may affect the costs schools face in producing school meals. In addition, meals that comply with the updated standards and new menu options developed by schools may not be as acceptable to students as some of the former options that were served. This could lead to changes in student participation if student acceptability is not taken into account. Students' decisions to eat school meals may also be affected by the requirement to take at least 1/2 cup of fruits or vegetables or the prices charged for paid meals. The updated nutrition standards for competitive foods may affect students' consumption of these foods as well as the likelihood of purchasing reimbursable meals. Ultimately, changes in school meal participation and consumption of competitive foods may affect the quality of students' diets.

There is a critical need for information about how SFAs and schools are doing in implementing the changes made in response to the HHFKA and about whether and how these changes are affecting school foodservice operations; the nutritional quality, cost, and

acceptability of meals; student participation and satisfaction; plate waste; and the quality of students' diets. To ensure this information would be available to policymakers and other stakeholders, FNS sponsored the School Nutrition and Meal Cost Study (SNMCS). The SNMCS continues FNS's long-standing commitment to periodically assess the school meal programs and is the first nationally representative, comprehensive assessment of these programs since major reforms began in SY 2012–2013.

Relative to prior studies of the school meal programs, the SNMCS is unique in three important ways. No previous national study of the school meal programs has (1) simultaneously examined the cost of producing school meals and the nutritional quality of those meals; (2) examined students' acceptance of school meals in a quantitative way, using data on the amount of food students waste (plate waste); or (3) examined associations between major outcomes of interest, for example, the association between the nutritional quality of school meals and student participation and the association between the cost and nutritional quality of school meals.

The goal of the SNMCS was to describe the following after implementation of the updated nutrition standards:

- *School meal program operations and school nutrition environments*
- *Food and nutrient content of school meals and afterschool snacks and overall nutritional quality of school meals*
- *School meal costs and school foodservice revenues*
- *Student participation, student and parent satisfaction, plate waste, and students' dietary intakes.*

A. Overview of the School Nutrition and Meal Cost Study

The SNMCS addressed a broad array of research questions of interest to stakeholders at the national, State, and local levels. The research questions are grouped under four broad domains:

- School meal program operations and school nutrition environments
- Food and nutrient content of school meals and afterschool snacks and overall nutritional quality of meals
- School meal costs and school foodservice revenues
- Student participation, student and parent satisfaction, plate waste, and students' dietary intakes.

To address these research questions, the SNMCS collected data from nationally representative samples of public SFAs and public, non-charter schools participating in the NSLP, students enrolled in these schools, and their parents. The sections that follow describe the SNMCS data collection instruments and activities, followed by the response rates and sample sizes for the components of the study covered in this report volume. Readers who are interested in technical details about the study design, sampling, and data collection procedures should refer to the SNMCS methodology report (Zeidman et al. 2019).

1. Data Collection Instruments and Activities

The SNMCS data collection instruments are summarized in Table 1.1 and the data collection activities are described below, organized by the four domains. With the exception of follow-up cost interviews, data collection activities were completed in the spring of SY 2014–2015.

Table 1.1. Data Collection Instruments

Instrument	Respondent	Mode
School Meal Program Operations and School Nutrition Environments		
SFA Director Survey	SFA directors	Web
School Nutrition Manager Survey	School nutrition managers	Web
A la Carte Checklist	School nutrition managers	Web
Principal Survey	Principals	Web
Competitive Foods Checklists	School liaisons	Hard copy
Vending Machine Checklist		
Other Sources of Foods and Beverages Checklist		
Cafeteria Observation Guide	Field staff, with school nutrition manager input	On-site observation
Nutritional Quality of School Meals		
Menu Survey	School nutrition managers	Web
School Meal Costs and School Foodservice Revenues		
State Education Agency Finance Officer Indirect Cost Survey	State Child Nutrition directors and State education agency finance officers	Telephone
Expanded Menu Survey	School nutrition managers	Web
SFA Director and Business Manager Cost Interview	SFA directors and business managers	In-person (plus telephone for follow-up interviews)
Principal Cost Interview	Principals	In-person
School Nutrition Manager Cost Interview	School nutrition managers	In-person
Student Participation, Student and Parent Satisfaction, Plate Waste, and Students' Dietary Intakes		
24-hour Dietary Recall	Students	In-person (plus telephone for second recalls in a subsample)
Child/Youth Interview	Students	In-person
Height and Weight Measurements	Students	In-person
Parent Interview	Parents	In-person or telephone
Reimbursable Meal Sales Administrative Data	Field staff	Hard copy
Plate Waste Observations	Field staff, with school nutrition manager input	On-site observation

Source: School Nutrition and Meal Cost Study, school year 2014–2015.

SFA = school food authority.

To describe **SFA and school characteristics, foodservice operations, and school nutrition environments**:

- SFA directors (staff who are responsible for the oversight of school meal operations across one or more schools within an SFA) completed the web-based SFA Director Survey, which asked about SFA-level foodservice operations and policies, implementation of the updated nutrition standards, nutrition promotion and outreach, and SFA directors' backgrounds. Although some SFAs were selected to complete only the SFA Director Survey, the majority of SFAs selected to participate in the SNMCS had schools that were also selected to participate in school-level data collection.
- School nutrition managers (SNMs; staff who are responsible for school-level foodservice operations, including the provision of meals to students) completed the web-based SNM Survey.²⁰ Topics included school-level foodservice operations, implementation of the updated nutrition standards, meal pricing, provision of afterschool snacks and suppers, and nutrition promotion and outreach. SNMs also completed the A la Carte Checklist to describe items available for a la carte purchase at breakfast or lunch.
- Principals completed the web-based Principal Survey, which asked about school characteristics, school meal policies, competitive foods sources and policies, and nutrition education and promotion.
- School liaisons (non-foodservice staff who were identified during school recruitment) completed two forms known collectively as the Competitive Foods Checklists. These forms captured information about the nonreimbursable items available for sale to students in locations such as vending machines or school stores.
- Trained field interviewers completed observations of the cafeteria environment (for example, serving line configurations and the availability of potable water) during breakfast and lunch. SNMs provided input to answer some of the questions on the form, called the Cafeteria Observation Guide.

To describe **the food and nutrient content of school meals and afterschool snacks and the overall nutritional quality of meals**, SNMs completed the web-based Menu Survey.²¹ The Menu Survey collected detailed information about the foods offered and served in reimbursable meals and afterschool snacks during one school week, referred to as the “target week.” Most SNMs completed an expanded version of the Menu Survey that collected additional information needed for cost analyses, including information on nonreimbursable foods and the total quantity of food used at each meal.

To describe **the costs of producing school meals and school foodservice revenues**, trained field interviewers completed cost interviews with SFA directors and business managers, SNMs, and school principals to capture the labor costs associated with producing school meals. SFA directors and business managers also answered questions related to SFA staffing and operations

²⁰ The term *school nutrition manager* is updated from prior SNDA studies, which used *foodservice manager* to refer to these staff.

²¹ In some schools, other respondents, such as SFA directors or other SFA staff, completed the Menu Survey.

and indirect costs as part of their interview. During follow-up interviews, researchers reviewed each SFA's SY 2014–2015 annual financial statement with SFA and school district officials to verify reported costs, identify unreported costs, obtain information to impute the value of unreported costs, and determine the SFA's annual revenues. These cost interview data were combined with the data collected in the Menu Survey, as noted above, to determine the composition of school foodservice costs and revenues.

Finally, to describe **student participation, parent and student satisfaction, plate waste, and students' dietary intakes**, respondents participated in a variety of activities:

- Sampled students in participating schools completed a 24-hour dietary recall and the Child/Youth Interview, and had their height and weight measured by trained field interviewers.
- The parents/guardians of students participating in the study completed the Parent Interview in person (for parents of elementary school students) or by telephone (for parents of middle and high school students).
- School foodservice staff provided administrative data, typically generated by point-of-sale systems, on whether the school recorded sampled students as having received a reimbursable breakfast or lunch on the day referenced in the 24-hour dietary recall.
- Trained field interviewers conducted plate waste observations on a sample of breakfasts and lunches in participating schools. These observations documented the foods and beverages taken by students and the amounts of these foods that students wasted (did not consume).

Findings from the extensive analyses of data collected in the SNMCS are presented in four report volumes plus a summary report (Fox and Gearan 2019) that highlights key findings across the volumes. Volume 1 (Forrestal et al. 2019) provides updated information about school meal program operations and school nutrition environments. Volume 2 (Gearan et al. 2019) focuses on the food and nutrient content of reimbursable meals and afterschool snacks and the overall nutritional quality of meals. Volume 3 (Logan et al. 2019) describes school meal costs and school foodservice revenues. Volume 4 (this volume) addresses students' participation in school meals, parents' and students' satisfaction with the meals, amounts of plate waste, and the influence of school meals on students' dietary intakes. A separate methodology report (Zeidman et al. 2019) provides technical details about the study design, sampling, and data collection procedures.

2. Response Rates and Sample Sizes

Table 1.2 shows initial and completed sample sizes and response rates for recruitment of SFAs, schools, and students into the study and for each of the data collection instruments used for this report volume.²² With the exception of plate waste observations, all response rates are weighted using raw sampling weights, which correct for unequal probability of selection.

²² The methodology report (Zeidman et al. 2019) provides response rates for all data collection instruments.

Table 1.2. Completed Sample Sizes and Response Rates

Instrument	Initial Sample	Completed Sample	Weighted Response Rate (%)
Recruitment			
SFAs	633	548	86.6
Schools	1,284	1,282	99.8
Students	5,033	4,141	82.8
Data Collection			
Child/Youth Interview, including Height and Weight	3,591 ^a	2,165 ^b	63.6
Parent Interview	2,165	1,850	88.5
24-Hour Dietary Recall			
First recall	3,591 ^a	2,165	63.6
Second recall	889	583	68.7
Reimbursable Meal Sales			
Administrative Data	2,165	1,961	89.5
Plate Waste Observation ^c			
Lunch	7,559	6,253	82.7 ^d
Breakfast	4,051	3,601	88.9 ^d

Source: School Nutrition and Meal Cost Study, school year 2014-2015.

Notes: With the exception of the plate waste observations, the response rates are weighted using raw sampling weights—that is, weights that correct for unequal probability of selection before any nonresponse adjustments.

The data collection response rates for individual instruments reflect the percentage of eligible students or parents that completed each instrument. Students and parents were eligible if the student was present at school on the target day and the case was pursued (that is, it was not part of unattempted backup student sample).

^aInitial sample includes recruited students who were released for data collection.

^bOf the 2,165 respondents, 122 are missing a body mass index because of missing or implausible values for height, weight, and/or age.

^cPlate waste observations were conducted in a sample of 170 schools for lunch and 157 schools for breakfast.

^dResponse rates for plate waste observations are unweighted.

SFA = school food authority.

The recruitment effort began by gaining approval for the SFA and its sampled schools (one to six schools per SFA) to participate. Students were then randomly selected using lists of all students enrolled at the sampled school. Passive consent was used whenever possible, providing parents or students the opportunity to decline to participate or opt out, although active consent was required by some schools. Once consent was obtained to participate in the study, a student was considered successfully recruited. A total of 5,033 students (and their parents) were invited to participate in the SNMCS and a total of 4,141 agreed (83 percent weighted response rate). Of the 3,591 students that were released for data collection, 2,165 completed the Child/Youth Interview and first 24-hour dietary recall (64 percent weighted response rate). A subsample of 889 students was selected for a second dietary recall, and 583 students completed this recall (69 percent weighted response rate). The weighted response rate for the Parent Interview was 89 percent. Reimbursable Meal Sales data was collected for 1,961 of the 2,165 students that completed the Child/Youth Interview and first dietary recall.

Plate waste observations were conducted in 170 schools in 57 SFAs (3 schools per SFA in 56 SFAs and 2 schools per SFA in one SFA). A total of 7,559 trays were observed for lunch and

4,051 trays were observed for breakfast. Some observed trays could not be included in the analysis because the student did not return the tray after their meal period, the school did not complete the Menu Survey (which was needed to estimate calories and nutrients wasted), or because one or more items on the tray could not be matched to the Menu Survey. The final analysis sample included 165 schools and 6,253 trays for lunch and 154 schools and 3,601 trays for breakfast (some sampled schools did not offer the SBP).

3. Subgroup Analyses

All student-level data are presented separately for NSLP and SBP participants and nonparticipants and by subgroups of students defined by school type: elementary, middle, and high school students. Tables that present data for additional subgroups of students based on household poverty level are presented in appendices and not discussed in the report. Plate waste data are presented for all schools combined and separately by school type. The statistical significance of differences between subgroups of students defined by participation status and, for plate waste, between subgroups of schools defined by school type were tested using two-tailed t-tests.²³ All differences between subgroups that are discussed in the report are statistically significant, unless otherwise noted.

A major focus of the analyses presented in this report was to compare the dietary intakes of NSLP and SBP participants with those of nonparticipants. Because students who participated in school meal programs likely differ from nonparticipants in both observable and unobservable ways, the dietary intakes of these two groups may have differed even if participants had obtained meals from sources other than school meal programs. To adjust for these underlying differences, the study team used inverse probability weighting (Cook et al. 2009; DuGoff, Schuler, and Stuart 2014) to construct matched comparison groups of nonparticipants that closely resemble participants along a number of observable characteristics.

Although the statistical significance of differences between school meal participants and nonparticipants provides an important gauge of underlying population differences, these results should not be interpreted as causal effects of NSLP or SBP participation. Important differences between participants and matched nonparticipants may remain in characteristics that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest differences between participants and matched nonparticipants even if they are not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

4. Statistical Reporting Standards

To help readers assess the reliability of estimates, reporting standards based on those of the joint USDA/National Center for Health Statistics Working Group (Federation of American Societies for Experimental Biology 1995) were applied. Specifically for all student-level analyses, based on a broadly estimated average design effect of 2.5, data are not reported for any

²³ The t-statistics were derived from means and standard errors calculated via the PROC SURVEYMEANS statement in SAS (with a weight variable, PSU variable, and stratum variable) to properly account for the study's complex sample design.

subgroup with fewer than 75 students (30 * average design effect of 2.5). In addition, for analyses that examined dietary intakes of school meal participants and matched nonparticipants, estimated means are flagged (with ^) when the coefficient of variation is greater than 30 percent. Estimated percentages in the tails of the distribution (less than 25 percent or greater than 75 percent) are similarly flagged (with ^) when the number of observations represented by the percentage is less than 20 (8 * average design effect of 2.5). When these rules are applied, percentages close to 0 or 100 are often flagged. In this report, flagged percentages between 0 and 3 percent and between 97 and 100 percent are displayed as <3 and >97, respectively. For the school-level analyses of plate waste, estimated means are flagged (with ^) when the coefficient of variation is greater than 30 percent.

In discussing findings from the study's many analyses, authors generally did not cite flagged point estimates in the text. However, in some cases this was unavoidable. Because flagged point estimates are less precise, readers should interpret them with caution. If a figure or table shows that a difference in means or percentages between two groups is statistically significant, the finding is valid even if one or both of the point estimates is considered to be imprecise.

B. Overview of the Volume 4 Report

The remainder of this report volume describes findings related to student participation, parent and student satisfaction, plate waste, and students' dietary intakes.

- Chapters 2 and 3 describe student participation and student and parent satisfaction with the school meal programs, respectively.
- Chapter 4 describes factors related to participation and satisfaction.
- Chapter 5 presents data on plate waste in school lunches and breakfasts and describes factors related to plate waste.
- Chapter 6 provides an overview of the methods used to assess the dietary intakes of NSLP and SBP participants and nonparticipants.
- Chapters 7 and 10 describe food group intakes of participants and nonparticipants in the NSLP and SBP, respectively.
- Similarly, Chapters 8 and 11 describe nutrient intakes of participants and nonparticipants in the NSLP and SBP, respectively.
- Chapters 9 and 12 explore Healthy Eating Index-2010 scores of participants and nonparticipants in the NSLP and SBP, respectively.
- Chapter 13 describes students' consumption of competitive foods.
- Chapter 14 describes relationships between the nutritional quality of school meal participants' diets and key characteristics of the meals, school foodservice operations, and the school food environment.
- Finally, Chapter 15 presents data on changes in students' dietary intakes since SY 2004–2005, when the third School Nutrition Dietary Assessment Study (SNDA-III) was conducted.

2. PARTICIPATION IN THE SCHOOL MEAL PROGRAMS

For the school meal programs to accomplish their policy goals, students must participate in the programs. Therefore, it is important to understand the rates at which students participate and the factors that may influence participation decisions. This chapter presents information on NSLP and SBP participation rates for all students in public, non-charter schools that participated in the NSLP in SY 2014–2015. The data presented were collected through the Child/Youth Interview, Parent Interview, and Reimbursable Meal Sale Form.

The chapter begins by describing two key measures of student participation used in the analysis—target-day participation and usual participation—and then presents estimates of average NSLP and SBP participation rates for each of these measures. The last section of the chapter summarizes data on reasons for school meal participation (or nonparticipation), as reported by students and parents²⁴. Chapter tables and figures present key findings. Supplementary tables appear in Appendix A and B, as noted throughout the chapter.

All of the tabulations presented in this chapter (and in appendices A and B) are strictly descriptive. With the exception of Section E, which describes key characteristics of school meal program participants and nonparticipants, statistical tests were not performed to assess differences in participation across school types or by student characteristics. Chapter 4 presents findings from multivariate analyses that explored factors associated with participation.

A. Measures of Participation

The study team developed two measures of NSLP and SBP participation that assessed participation for two time frames:

1. “Target-day” participation measured students’ participation on the single school day covered in the student’s 24-hour dietary recall. This measure provides a reasonable estimate of student participation on a typical school day.
2. “Usual” participation measured students’ self-reported participation in a typical school week. This measure provides an estimate of the percentage of students who usually eat the school meal.

Most of the analyses in this chapter focus on target-day participation, which is the measure used to define school meal participants and nonparticipants in analyses of diet-related outcomes. Later sections of this report present those outcomes.

1. Defining Target-Day Participation

To assess whether a student received a school lunch or breakfast on the target day (that is, the school day covered in the 24-hour recall), the study team relied primarily on administrative data from the Reimbursable Meal Sale Form. These school-level records documented whether the school recorded the student as having received a reimbursable breakfast or lunch on the target day. The records were typically generated by point-of-sale systems, although some data

²⁴ The term ‘parent’ is used throughout this chapter to refer to Parent Interview respondents. Actual respondents may have included grandparents, guardians, or other responsible adults.

were reported by school foodservice staff. Reimbursable Meal Sale Form data were available for lunch for 91 percent of students (1,961 of 2,165 students). In schools that offered the SBP, Reimbursable Meal Sale Form data were available for 87 percent of students (1,772 of 2,047 students).

When Reimbursable Meal Sale Form data was not available for a given student, the study team constructed measures of target-day participation based primarily on the lunch and breakfast foods that the student reported obtaining at school on the target day. This approach is similar to the method used in SNDA-III; however, the rules that define the number and types of foods required for a student to count as a participant were updated to reflect the meal pattern requirements included in the updated nutrition standards that took effect in SY 2012–2013. Appendix A describes the methodology used to construct food-based measures of target-day participation for the 9 percent (NSLP) and 13 percent (SBP) of students missing Reimbursable Meal Sale Form data.

2. Defining Usual Participation

Usual participation provides a picture of students' participation during a typical school week. To assess usual participation, older students were asked how many days per week they usually ate the school meal (separate questions were asked for lunch and breakfast). Younger students were asked a simpler version of the question—whether they usually ate the school meal three or more times per week. Students who reported that they usually consumed a school meal three or more times per week were considered usual participants.

B. Participation in the National School Lunch Program

1. Target-Day Participation

Based on estimates of target-day participation, 56 percent of students participated in the NSLP on a typical school day (Figure 2.1). Participation rates were higher among elementary school students (71 percent) than middle or high school students (52 percent and 39 percent, respectively). This trend was consistent across subgroups of students differentiated by gender, household income, school meal certification status, and race/ethnicity (Table 2.1).

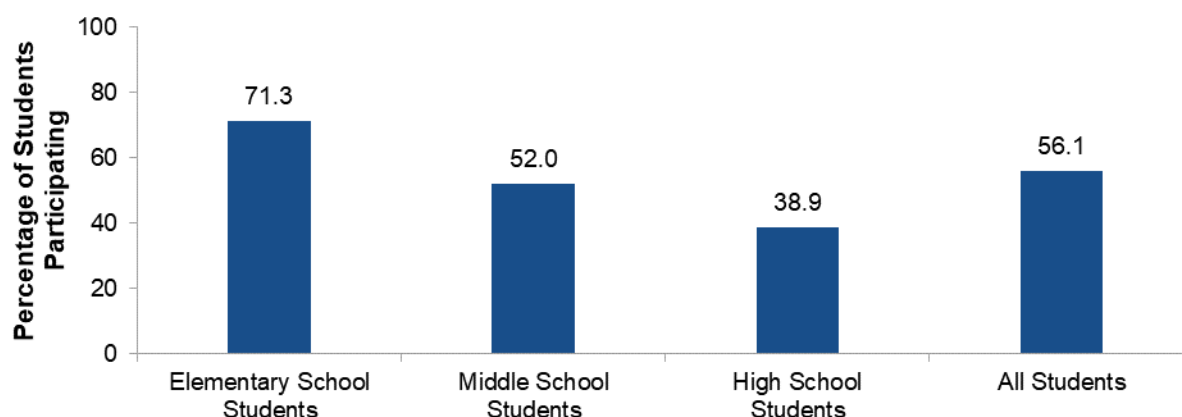
On a typical school day, 56 percent of students participated in the NSLP. Participation was highest among elementary school students (71 percent) and lower among middle (52 percent) and high school students (39 percent).

There were notable differences in target-day participation rates among demographic subgroups of students. Overall, and for each school type, boys participated in the NSLP at a higher rate than girls. Participation rates for students from lower income households and students who were certified to receive free or reduced-price meals were generally twice as high as rates for students from higher income households and students not certified to receive meal benefits.²⁵ Overall, 70 percent of Hispanic and non-Hispanic black students participated in the NSLP on the target day, compared with about half of non-Hispanic

²⁵ All students who attended schools that operated under Provision 2 or 3 for lunch or under the Community Eligibility Provision were considered to be certified to receive free lunch regardless of household poverty level. As a result, participation trends for certified students may be slightly biased because higher-income students in provision schools may be more or less likely to eat a school lunch when they attend schools where all students are eligible to receive a free lunch.

whites and students of other races (48 percent and 50 percent, respectively). As the introduction to the chapter notes, these statistics, as well as those presented below for the SBP, are strictly descriptive and do not control for other differences between subgroups of students that may affect participation. Chapter 4 presents findings from multivariate analyses that assessed determinants of student participation.

Figure 2.1. Average Target-Day Participation Rates in the NSLP



Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recall, and Child/Youth Interview, school year 2014-15. Estimates are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: Target-day participation is based primarily on whether the Reimbursable Meal Sale Form identified the student as having taken a reimbursable meal. See further discussion in the text.

NSLP = National School Lunch Program.

Table 2.1. Average Target-Day Participation Rates in the NSLP

Student Characteristic	Average Target-Day Participation Rates			
	Elementary School Students	Middle School Students	High School Students	All Students
All Students	71.3	52.0	38.9	56.1
Gender				
Male	73.8	56.0	42.5	59.1
Female	68.9	47.8	35.3	53.1
Household Poverty Level ^a				
From lower income households	89.5	72.1	59.1	78.5
From higher income households	50.4	38.8	29.3	39.3
Certification Status ^b				
Certified for free or reduced-price lunches	88.5	71.2	60.1	78.1
Not certified for free or reduced-price lunches	44.9	35.1	27.2	35.2
Race/Ethnicity ^c				
Hispanic	81.8	69.1	42.7	70.3
White, non-Hispanic	62.6	43.4	34.7	48.2
Black, non-Hispanic	82.6	--	56.9	71.1
Other (including multi-racial)	--	--	--	49.6
Missing	70.4	51.9	34.8	42.4
Number of Students	748	714	703	2,165

Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recall, and Child/Youth Interview, school year 2014-15. Some data on student characteristics were obtained from the Parent Interview and student rosters.

Notes: Target-day participation is based primarily on whether the Reimbursable Meal Sale Form identified the student as having taken a reimbursable meal. See further discussion in the text.

Table B.1 provides sample sizes for the all of the cells included in this table.

^aLower income households had incomes less than or equal to 185 percent of the Federal poverty level; higher income households had incomes greater than 185 percent of the Federal poverty level.

^bStudents who attended schools that operated under Provision 2 or 3 for lunch or under the Community Eligibility Provision were considered to be certified to receive free lunches.

^cData on race/ethnicity were missing for 183 students.

-- Sample size is too small to produce reliable estimate.

NSLP = National School Lunch Program.

2. Usual Participation

More than half (58 percent) of all students reported that they usually participated in the NSLP three or more days per week (Table 2.2). Compared with target-day participation rates, usual participation rates were somewhat higher for middle and high school students and somewhat lower for elementary school students. Patterns of participation by gender, household poverty level, certification status, and race/ethnicity were comparable to those observed for target-day participation.

Table 2.2. Average Usual Participation Rates in the NSLP, as Reported by Students

Student Characteristic	Average Usual Participation Rates			
	Elementary School Students	Middle School Students	High School Students	All Students
All Students	67.8	58.0	46.5	58.4
Gender				
Male	70.6	59.0	52.7	61.9
Female	65.1	56.9	40.0	54.8
Household Poverty Level				
Less than or equal to 185 percent	85.6	79.3	72.5	81.1
More than 185 percent	47.6	43.7	34.7	41.5
Certification Status ^a				
Certified for free or reduced-price lunches	83.2	79.9	73.6	80.1
Not certified for free or reduced-price lunches	44.5	38.5	32.0	37.8
Race/Ethnicity ^b				
Hispanic	78.9	78.0	55.4	73.2
White, non-Hispanic	58.6	43.7	41.1	49.0
Black, non-Hispanic	76.5	--	61.6	72.9
Other (including multi-racial)	--	--	--	53.4
Missing	70.4	58	48.2	52.7
Number of Students	742	714	702	2,158

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15. Some data on student characteristics were obtained from the Parent Interview, Reimbursable Meal Sale Form, and student rosters. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: Usual participation was defined as usually consuming a school lunch three or more times per week. Usual participation status was missing for seven students.

^aStudents who attended schools that operated under Provision 2 or 3 for lunch or under the Community Eligibility Provision were considered to be certified to receive free lunches.

^bData on race/ethnicity were missing for 183 students.

-- Sample size is too small to produce reliable estimate.

NSLP = National School Lunch Program.

C. Participation in the School Breakfast Program

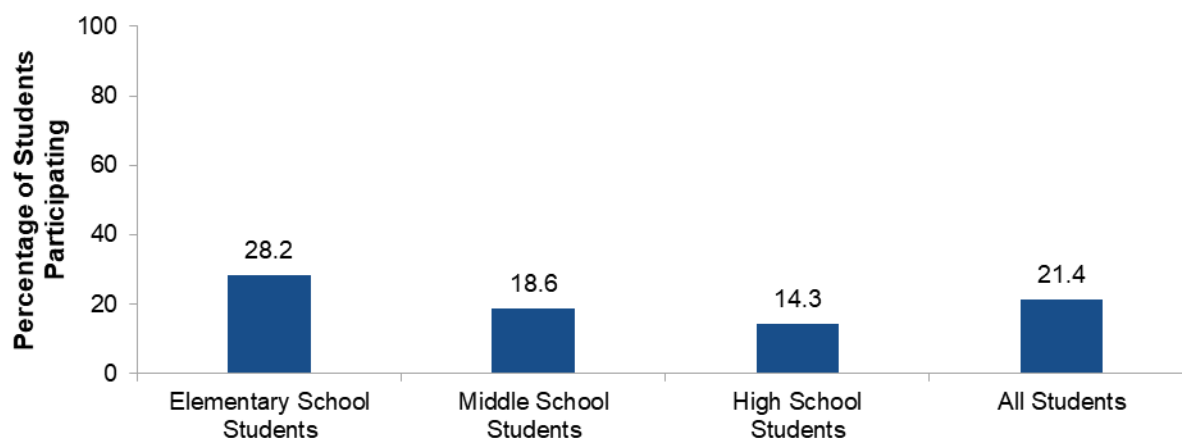
1. Target-Day Participation

Relative to the NSLP, target-day participation in the SBP was considerably lower. Overall, on a typical school day less than one-quarter (21 percent) of students participated in the SBP (Figure 2.2).²⁶ Similar to the pattern observed for the NSLP, participation was highest for elementary school students (28 percent) and lower for middle (19 percent) and high school students (14 percent).

Differences in participation by gender, household poverty level, certification status, and race/ethnicity were similar to those observed for the NSLP but, with the exception of gender, were more pronounced (Table 2.3). Students from lower income households participated at about three times the rate of students from higher income households (36 percent versus 11 percent, overall), and students certified to receive free or reduced-price meals participated at six to seven times the rate of students not certified to receive meal benefits (37 percent versus 5 percent, overall). Hispanic and non-Hispanic black students participated in the SBP at higher rates than non-Hispanic white students and students of other races (32 to 33 percent versus 15 and 21 percent, respectively).

Student participation rates were considerably lower in the SBP. On a typical school day, less than a quarter (21 percent) of students participated in the SBP. Like the NSLP, participation was highest among elementary school students (28 percent) and lower among middle (19 percent) and high school students (14 percent).

²⁶ To provide a picture of typical SBP participation rates among all public school students, estimates of target-day SBP participation include students in schools that did not offer the SBP. Among students who attended schools that offered the SBP, target-day participation rates were somewhat higher—30 percent among elementary school students, 21 percent among middle school students, 15 percent among high school students, and 23 percent overall.

Figure 2.2. Average Target-Day Participation Rates in the SBP

Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recall, and Child/Youth Interview, school year 2014-15. Estimates are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: Target-day participation is based primarily on whether the Reimbursable Meal Sale Form identified the student as having taken a reimbursable meal. See further discussion in the text.

The sample includes students in schools that did not offer the School Breakfast Program.

SBP = School Breakfast Program.

Table 2.3. Average Target-Day Participation Rates in the SBP

Student Characteristic	Average Target-Day Participation Rates			
	Elementary School Students	Middle School Students	High School Students	All Students
All Students	28.2	18.6	14.3	21.4
Gender				
Male	30.4	20.5	15.8	23.2
Female	26.1	16.6	12.8	19.6
Household Poverty Level ^a				
From lower income households	39.4	34.0	28.5	35.7
From higher income households	15.3	9.2	7.9	11.0
Certification Status ^b				
Certified for free or reduced-price breakfasts	40.8	35.0	31.1	37.2
Not certified for free or reduced-price breakfasts	6.5	4.5	4.2	5.0
Race/Ethnicity ^c				
Hispanic	39.0	30.2	13.9	31.5
White, non-Hispanic	19.4	8.5	13.1	14.8
Black, non-Hispanic	35.7	--	24.8	33.1
Other (including multi-racial)	--	--	--	21.1
Missing	0.0	19.0	9.7	12.1
Number of Students	748	714	703	2,165

Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recall, and Child/Youth Interview, and 24-Hour Dietary Recall, school year 2014-15. Some data on student characteristics were obtained from the Parent Interview and student rosters. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: Target-day participation is based primarily on whether the Reimbursable Meal Sale Form identified the student as having taken a reimbursable meal. See further discussion in the text.

The sample includes students in schools that did not offer the School Breakfast Program.

^aLower income households had incomes less than or equal to 185 percent of the Federal poverty level; higher income households had incomes greater than 185 percent of the Federal poverty level.

^bStudents who attended schools that operated under Provision 2 or 3 for breakfast, operated under the Community Eligibility Provision, or offered universal free breakfasts were considered to be certified to receive free breakfasts.

^cData on race/ethnicity were missing for 183 students.

-- Sample size is too small to produce reliable estimate.

SBP = School Breakfast Program.

2. Usual Participation

Overall, only about a quarter (27 percent) of all students reported that they usually participated in the SBP three or more days per week (Table 2.4). Compared with target-day participation rates, usual participation rates were comparable for middle and high school students but were notably higher for elementary school students (39 percent versus 28 percent). Patterns of participation by gender, household poverty level, certification status, and race/ethnicity were comparable to those observed for target-day participation.

Table 2.4. Average Usual Participation Rates in the SBP, as Reported by Students

Student Characteristic	Average Usual Participation Rates			
	Elementary School Students	Middle School Students	High School Students	All Students
All Students	38.5	20.2	14.9	26.5
Gender				
Male	41.9	23.3	16.2	28.9
Female	35.2	16.9	13.6	24.1
Household Poverty Level				
Less than or equal to 185 percent	51.8	32.7	29.7	42.6
More than 185 percent	21.0	11.2	8.0	13.4
Certification Status ^a				
Certified for free or reduced-price breakfasts	51.8	32.8	31.5	42.9
Not certified for free or reduced-price breakfasts	10.7	6.3	4.2	6.8
Race/Ethnicity ^b				
Hispanic	48.5	27.3	15.1	36.7
White, non-Hispanic	26.2	10.6	12.7	17.8
Black, non-Hispanic	58.0	--	31.7	46.4
Other (including multi-racial)	--	--	--	22.3
Missing	48.4	22.5	8.6	15.4
Number of Students	742	714	702	2,158

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15. Some data on student characteristics were obtained from the Parent Interview, Reimbursable Meal Sale Form, and student rosters. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: Usual participation was defined as usually consuming a school breakfast three or more times per week. Usual participation status was missing for seven students.

The sample includes students in schools that did not offer the School Breakfast Program.

^aStudents who attended schools that operated under Provision 2 or 3 for breakfast, operated under the Community Eligibility Provision, or offered universal free breakfasts were considered to be certified to receive free breakfasts.

^bData on race/ethnicity were missing for 180 students.

-- Sample size is too small to produce reliable estimate.

SBP = School Breakfast Program.

D. Reasons for Participation and Nonparticipation

This section examines factors that influence participation decisions. This information can help policymakers understand customer choice and identify areas for program improvement. The findings presented include both descriptive crosstabulations that summarize reasons cited by students and parents for participation or nonparticipation, as well as results of multivariate analyses that examined relationships between student participation and key characteristics of school meals, schools, and students.

1. Reasons Why Students Participated or Did Not Participate in the NSLP

Students who reported that they ate the school lunch on the target day²⁷ were asked to identify the main reason they eat school lunch. Hunger was the reason most commonly reported (by 35 percent of students overall), followed by liking the food in general (25 percent), and ease and convenience (14 percent; Table 2.5). Student-reported reasons for participation differed slightly by school type. Hunger was the reason most frequently reported among middle and high school students (48 percent and 41 percent, respectively), but liking the food was the most frequent response among elementary school students (33 percent). Other student-reported reasons for participation, such as not having time to make lunch and parents wanting the student to get the lunch, were reported by less than 10 percent of students overall.

Students and parents alike most commonly cited hunger, liking the food, and convenience as reasons for eating a school lunch. The primary reasons for not eating the school lunch were that the student brought a lunch from home or disliked the food.

Parents were asked to report the main reason their child ate school lunches. Overall, the most frequently reported reasons included ease for the parent (23 percent) and the fact that the student liked the food (21 percent; Table 2.5). Seventeen percent of parents said the main reason their child ate the school lunch was that the child was hungry and would not otherwise eat lunch. Slightly more than 10 percent of parents said that eating the school lunch was easy/convenient for the child (13 percent) or that the school lunch was inexpensive/free or a good value (11 percent). Parent-reported reasons for eating the school lunch varied by school type. Student hunger was the reason most commonly reported by parents of middle and high school students (20 percent and 28 percent, respectively), and ease for the parent was the reason most commonly reported by parents of elementary school students (34 percent).

²⁷ The student-reported target-day participation discussed in this section is based on responses in the Child/Youth Interview. It is distinct from the target-day participation measure discussed in Sections A, B, and C, which is based primarily on administrative data from the Reimbursable Meal Sale Form.

Table 2.5. Top Reason for Eating School Lunch

	Percentage of Students/Parents			
	Elementary School Students	Middle School Students	High School Students	All Students
Students Who Reported They Ate the School Lunch on the Target Day				
Hungry	27.5	40.5	48.4	34.9
Like the Food (General)	32.9	22.0	10.2	25.4
Easy/Convenient to Get	10.6	14.3	21.3	13.8
Parent Wants Me To/No Other Choice	9.7	4.3	7.9	8.2
No Time to Make Lunch	6.8	11.4	5.5	7.4
Like Today's/Yesterday's Meal	3.5	1.4	2.7	2.9
No One at Home to Make Lunch	3.3	1.2	1.5	2.5
It's Free/Prices Are Good	2.0	3.5	2.0	2.3
Other	1.4	1.0	0.5	1.1
Number of Students	540	406	308	1,254
Parents of Students Who Reported They Ate the School Lunch on the Target Day				
Easy for Parent	34.2	11.5	5.0	23.3
Child Likes the Food	23.6	19.8	15.5	21.0
Hunger/Wouldn't Eat Lunch Otherwise	11.3	20.3	28.0	16.7
Easy for the Child	5.8	18.3	26.0	12.7
Inexpensive/Free/Good Value	12.8	8.8	9.8	11.4
Likes to Eat with Friends/Friends Get It	4.8	4.9	1.7	4.1
Good/Healthy Meals	2.7	0.7	2.5	2.3
Other	4.8	15.7	11.6	8.4
Number of Parents	536	314	245	1,095

Source: School Nutrition and Meal Cost Study, Child/Youth Interview and Parent Interview, school year 2014-15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: The samples include students who reported eating a school lunch on the target day. Students and parents were asked to name the "number one reason" (students) or "main reason" (parents) for eating the school lunch. Interviewers selected the most appropriate response from lists of possible answers or entered a verbatim response.

Students who reported that they usually never eat the school lunch were asked why they didn't do so.²⁸ Just over half of these students (52 percent) reported that they brought a lunch from home, although students also commonly reported that they didn't like the school lunch or taste of the food in general (40 percent; Table 2.6). Bringing a lunch from home was more common among elementary and middle school students (64 percent and 59 percent, respectively) than high school students (42 percent). Other reasons were reported by less than 10 percent of students.

²⁸ Students first reported that they did not eat the school lunch on the target day and then, in a subsequent question, reported that they never eat school lunch.

Table 2.6. Reasons for Not Participating in the NSLP

	Percentage of Students/Parents			
	Elementary School Students	Middle School Students	High School Students	All Students
Among Students Who Usually Never Eat a School Lunch^a				
Bring Lunch from Home	63.8	58.7	41.6	51.9
Don't Like School Lunch/Taste in General	37.5	34	43.3	39.6
Not Nutritious	7.9	8.6	9.1	8.6
Monetary Reasons	4.1	7.6	9.4	7.4
Eat Lunch Off Campus	0.0	0.0	6.6	3.2
Portions Not Big Enough/Not Enough Food	0.5	1.5	5.2	3.0
Not Enough Variety, Tired of What's Offered	1.8	1.9	3.8	2.8
No Time, Long Lines	0.8	8.4	1.7	2.8
Not Hungry, Don't Feel Like Eating	0.0	1.5	4.6	2.6
Don't Eat Any Lunch	0.2	0.6	2.6	1.5
Special Diet	1.6	0.8	1.5	1.4
Parent Prohibits/Limits How Often Eat School Lunch	1.9	1.3	1.0	1.3
Leave School Before Lunch Is Served	0.0	0.0	2.7	1.3
Want A La Carte Item	0.0	0.0	0.2	0.1
Busy with School Activities	0.0	0.0	0.1	0.1
Other	1.3	0.0	1.9	1.3
Number of Students	105	130	197	432
Among Parents Who Reported That Their Child Ate the School Lunch Fewer than Three Times per Week^b				
Child Prefers to Eat a Lunch Brought from Home	83.1	86.1	77.1	81.1
Child Does Not Like the Food	64.7	71.4	70.4	68.7
Parent Prefers Child to Eat Foods Sent from Home	70.3	61.7	46.8	57.9
Child Doesn't Like Waiting in Line	22.8	33.6	40.9	33.3
Child Doesn't Have Enough Time to Get and Eat Lunch in School	26.6	33.4	33.0	31.0
Child Eats Lunch at Home or Off Campus	3.0	7.8	27.4	15.0
Too Expensive	9.1	16.3	9.3	10.7
Child Is a Vegetarian or Has a Special Diet	7.3	8.0	12.0	9.6
Child Doesn't Eat School Lunches Because Friends Don't	5.8	6.7	12.0	8.8
Thought Child Couldn't Participate	1.8	5.8	5.6	4.4
Child Thinks Only Needy Kids Eat School Lunches and Doesn't Want To Be Thought of That Way	0.3	1.5	1.0	0.9
Other	15.4	31.0	25.8	23.4
Food is not healthy	6.5	11.0	4.7	6.6
Food is not good	2.8	6.9	2.1	3.3
Picky eater	1.3	3.0	4.3	3.0
Lack of choices	0.0	2.0	3.1	1.8
Number of Parents	218	196	252	666

Source: School Nutrition and Meal Cost Study, Child/Youth Interview and Parent Interview school year 2014-15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

^aThe sample includes students who reported that they did not eat the school lunch on the target day and then reported, in a subsequent question, that they usually never eat the school lunch. Students were asked an open-ended question, and multiple responses were allowed.

^bThe list of possible reasons for not eating the school lunch more frequently was read out loud to respondents, and a response was coded for each reason.

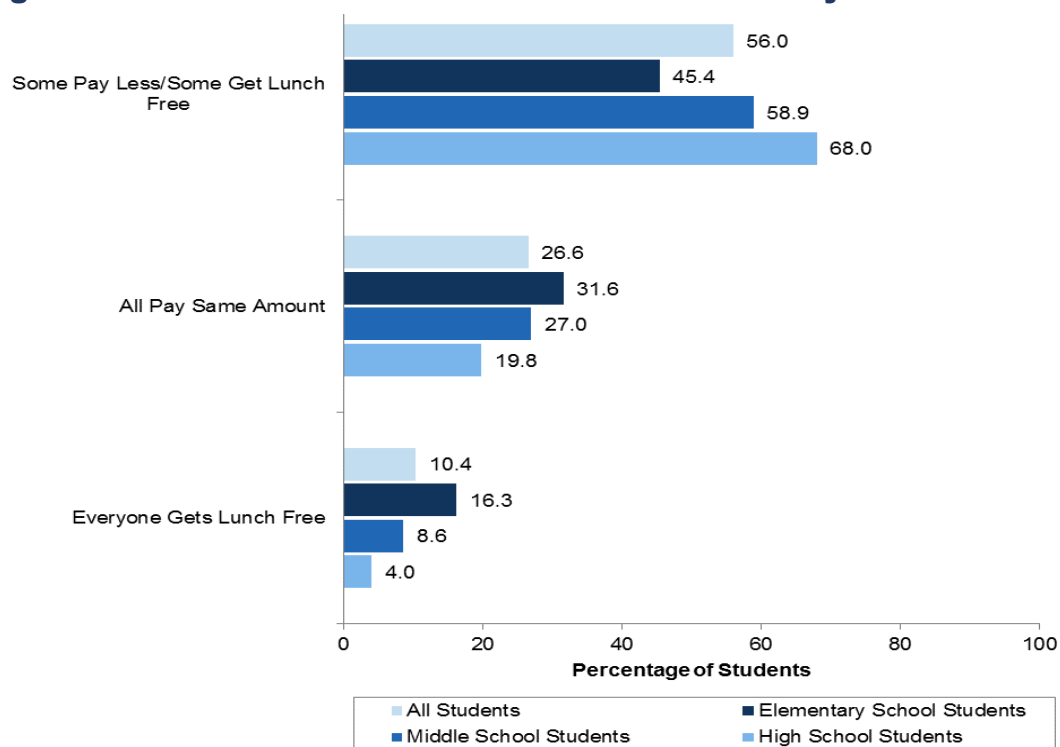
NSLP = National School Lunch Program.

Parents who reported that their child ate school lunches less than three times per week reported reasons why their child did not participate more frequently (or ever). Parent-reported reasons for nonparticipation were consistent with student-reported reasons. The most frequently cited reasons were that the child preferred to eat a lunch from home (81 percent) and that the child didn't like the school lunch food (69 percent; Table 2.6). In addition, parents commonly reported that they preferred that the child eat a lunch from home (58 percent). About one-third of all parents cited the child's dislike of waiting in line (33 percent) and the child not having enough time to get and eat lunch (31 percent) as reasons for nonparticipation. Parents less commonly reported that the child ate lunch at home or off campus (15 percent), the food was too expensive (11 percent), or the child was a vegetarian or had a special diet (10 percent). There were some noteworthy differences across school types in specific reasons for nonparticipation. Relative to parents of elementary and middle school students, parents of high school students much less frequently reported a personal preference that their child eat a lunch from home (47 percent versus 79 and 62 percent, respectively). In contrast, parents of high school students much more frequently reported that their child ate lunch at home or off-campus than parents of elementary and middle school students (27 percent versus 3 and 8 percent, respectively).

2. Student Awareness of Who Received Free and Reduced-Price Lunches

One factor that could influence NSLP participation is students' awareness of school meal benefits. Understanding students' awareness of who received a free or reduced-price lunch may lend insight into the potential influence of perceived stigma on NSLP participation.²⁹ More than half of all students (56 percent) were aware that some students pay less or get lunch free (Figure 2.3). High school students were more aware of this variation than elementary or middle school students (68 percent versus 45 and 59 percent, respectively). Examining general awareness of school meal benefits among students who did and did not participate in the NSLP on the target day may contribute to understanding students' perceived stigma. For example, FRP-eligible students who are aware of lunch pricing differences may perceive stigma and choose not to participate. Alternatively, students who are aware of uniform pricing or universal free lunches may perceive less stigma and, therefore, choose to participate. General awareness of school meal benefits among students who did and did not participate in the NSLP on the target day was similar—more than half of students in both groups (54 percent and 57 percent, respectively) were aware that some students pay less or get lunch for free (Figure 2.4). Furthermore, a smaller share of participants than nonparticipants thought that all students paid the same amount for lunch (23 percent versus 31 percent), and a larger share thought that everyone got lunch for free (15 percent versus 5 percent).

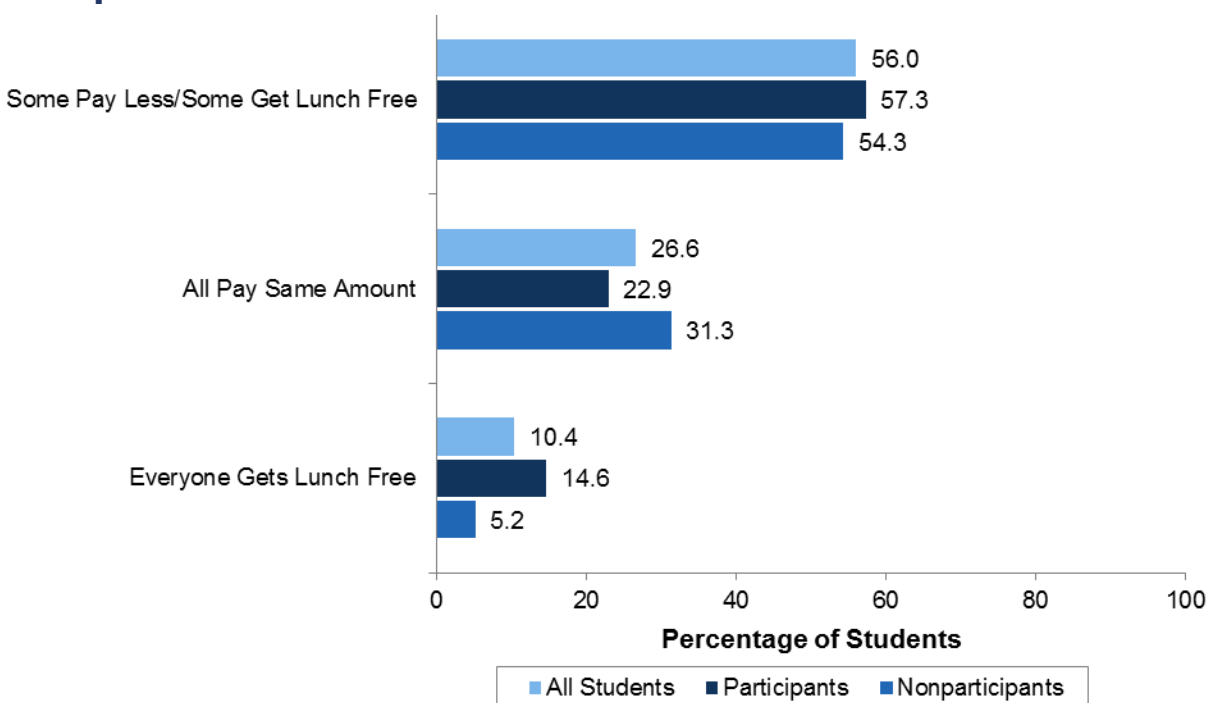
²⁹ SBP participation rates may also be influenced by awareness of meal benefits and who received them; however, these questions were asked only in reference to the NSLP.

Figure 2.3. Students' Views of How Lunch Prices Vary

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15. Estimates are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: Data on views about variation in lunch prices were missing for 7 percent of students overall (5 to 8 percent by school type).

Figure 2.4. Students' Views of How Lunch Prices Vary, by Target-day Participation in the NSLP



Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15. Estimates are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: Target-day participation is based primarily on whether the student was identified as having taken a reimbursable meal on the Reimbursable Meal Sale Form. See further discussion in the text.

Data on views about variation in lunch prices were missing for 7 percent of students overall, 5 percent of participants, and 9 percent of nonparticipants.

NSLP = National School Lunch Program.

Among students who were aware of price variation in school lunches, about one in five (19 percent) thought they could tell who paid less or got a free lunch (Table B.4). These students reported several ways they could tell who received meal benefits. Personal knowledge was the most commonly reported way that students could tell who received meal benefits (37 percent of students; Table B.4). Fewer students reported that they could tell who received meal benefits because of the form of payment (17 percent) or the amount paid to the cashier (16 percent). Other ways that students thought they could identify meal benefit recipients—including stigma-related reasons, such as appearance or behavior, use of a separate line, and the type

More than half of students (56 percent) were aware that some students pay less for lunch or get lunch for free. One in five (19 percent) of these students reported that they could tell who pays less or gets lunch for free. However, only 10 percent or less cite stigma-related reasons such as appearance or behavior, using a separate lunch line, or the type or amount of food taken.

or amount of food taken³⁰—were reported by less than 10 percent of the students. Findings were generally similar when the data were examined by target-day participation status. However, although the overall percentages were still small, larger shares of participants than nonparticipants cited stigma-related reasons as the way they were able to identify students that received meal benefits (Table B.5).

3. Reasons Why Students Participated or Did Not Participate in the SBP

Students who attended schools that offered the SBP and reported that they ate the school breakfast on the target day³¹ were asked to identify the number one reason they eat school breakfast. Overall, ease/convenience was the most commonly reported reason for breakfast participation (29 percent), followed closely by hunger (27 percent) and the food being good (26 percent; Table 2.7). The leading reasons for eating school breakfast differed considerably across school types. Nearly half of high school students (45 percent) reported that ease/convenience was the number one reason they eat school breakfast, compared with 23 percent of elementary school students and 31 percent of middle school students.³² The share of elementary school students that reported that the food was the number one reason for breakfast participation was two to almost three times higher than the share of middle and high school students (33 percent versus 16 and 12 percent, respectively).

Students who reported that they never eat the school breakfast were asked why they didn't do so.³³ Almost half of these students (47 percent) reported that they eat breakfast at home (Table 2.8). This reason was more common among elementary and middle school students than high school students (52 and 53 percent, respectively, versus 42 percent). Other less common reasons for not participating in the SBP, but reported by at least 15 percent of students, were that the foods offered were not appealing or tasty (20 percent) and that eating the school breakfast wasn't convenient (15 percent). Relative to elementary and middle school students, high school students more commonly reported that eating a school breakfast was not convenient (18 percent versus 12 and 11 percent, respectively).

Students were asked to name the “number one reason” for eating the school breakfast, then selected the most appropriate response from a list of possible answers or entered a verbatim response.

³⁰ Examples of responses were the student took a carton of milk and not a bottle, “kids who get it free have to get certain foods,” students get a “different type of lunch,” and “if they try to get something else, [they] have to pay for it.”

³¹ Student-reported target-day participation is based on responses in the Child/Youth Interview. It is distinct from the target-day participation measure used in previous sections that report average target-day participation.

³² Chapter 4 Section C discusses the relationship between SBP participation and non-cafeteria breakfast service methods like “grab-and-go” breakfasts. In high schools, SBP participation was significantly and positively associated with offering “grab-and-go” breakfasts (Table D.11). In addition, “grab-and-go” breakfasts are two to three times more common in high schools than in elementary or middle schools (Forrestal et al. 2019).

³³ Students first reported that they did not eat the school breakfast on the target day and then, in a subsequent question, reported that they never eat school breakfast.

Table 2.7. Top Reason for Eating School Breakfast

	Percentage of Students			
	Elementary School Students	Middle School Students	High School Students	All Students
Easy/Convenient to Get	22.6	31.4	45.3	28.9
I Am Hungry	21.4	33.5	36.1	26.6
Food Is Good	33.3	16.3	12.0	25.8
Parents Make Me	7.8	1.6	1.3	5.3
No Other Choice	4.4	2.0	2.7	3.6
Friends Eat There	3.1	5.9	0.4	3.0
Prices Are Good	1.1	0.0	0.0	0.7
Other	3.8	7.3	2.1	4.1
Missing	2.6	1.9	0.2	2.0
Number of Students	227	142	137	506

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: The sample includes students who attended a school that offered the SBP and reported eating a school breakfast on the target day.

Table 2.8. Reasons for Not Participating in the SBP

	Percentage of Students/Parents			
	Elementary School Students	Middle School Students	High School Students	All Students
Among Students Who Never Eat a School Breakfast^a				
Eat Breakfast at Home	51.5	53.1	41.5	47.3
Foods Offered Are Not Appealing/Not Tasty	18.1	18.7	21.8	19.9
Not Convenient	11.9	11.4	18.1	14.6
I Don't Eat Breakfast	6.5	9.2	9.1	8.3
Long Lines, Not Enough Time	4.9	5.9	7.3	6.2
Monetary Reasons	5.5	3.6	4.4	4.6
Transportation Issues	3.0	5.5	4.4	4.2
Not Nutritious Enough	3.2	3.2	4.4	3.7
Busy with School Activities	1.1	1.3	1.4	1.3
Other	3.1	2.4	3.0	2.9
More Likely to Eat School Breakfast if Served in the Classroom	45.2	39.0	41.3	42.1
Number of Students	273	399	433	1,105
Among Parents Who Reported That their Child Eats the School Breakfast Fewer than Three Times per Week^b				
Child Prefers to Eat at Home	72.4	80.0	73.6	74.3
Parent Prefers Child to Eat at Home	70.0	65.0	61.0	65.9
Child Doesn't Like Food Served at School	39.8	44.4	45.9	42.8
Child Doesn't Have Enough Time to Eat Breakfast at School	28.0	36.9	44.0	35.4
Child Does Not Like to Eat Breakfast	17.1	15.0	23.7	19.0
Thought Child Couldn't Participate	5.2	13.7	13.1	9.6
Child's Friends Don't Eat School Breakfast	6.4	10.6	12.4	9.3

	Percentage of Students/Parents			
	Elementary School Students	Middle School Students	High School Students	All Students
Child Thinks Only Needy Kids Eat School Breakfasts and Doesn't Want To Be Thought of That Way	1.0	3.7	4.8	2.9
Doesn't Want Others to Think Parent Can't Provide Breakfast for Child	0.1	2.1	1.6	1.0
Other	17.5	19.6	22.0	19.5
Cost, value	3.6	1.3	1.6	2.4
Dietary choice, allergies	1.3	1.0	2.2	1.6
Not healthy, parents provide healthier breakfast	1.0	2.7	2.8	2.0
Breakfast is family time	1.1	0.9	0.9	1.0
Number of Parents	412	341	395	1,148

Source: School Nutrition and Meal Cost Study, Child/Youth Interview and Parent Interview, school year 2014-15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: The sample includes only students who attended schools that offered the School Breakfast Program.

^aThe sample includes students who reported that they did not eat the school breakfast on the target day and then reported, in a subsequent question, that they never eat the school breakfast. Students were asked an open-ended question and multiple responses were allowed.

^bThe list of possible reasons for not eating the school breakfast more frequently was read out loud to respondents and a response was coded for each reason.

SBP = School Breakfast Program.

Students who never ate school breakfast reported whether they would be more likely to participate in the SBP if breakfast were offered in their classroom. Overall, 42 percent of these students indicated that they would be more likely to participate if breakfast were offered in the classroom. Elementary school students were most likely to report a positive response to breakfast in the classroom (45 percent), followed by high school students (41 percent) and middle school students (39 percent).

Parents who reported that their child ate school breakfasts fewer than three times per week reported reasons their child did not participate more frequently (or ever). Parent-reported reasons for nonparticipation were consistent with student-reported reasons. The most frequently cited reasons were that the child preferred to eat breakfast at home (74 percent; Table 2.8) and that the parent preferred the child to eat breakfast at home (66 percent). More than one-third of parents reported that their child disliked the food (43 percent), or that the child didn't have enough time to eat breakfast at school (35 percent). One in five parents (19 percent) reported that their child did not like to eat breakfast. There was some variation in parent-reported reasons for nonparticipation across school types. Not having enough time to eat breakfast at school was a more common response among parents of high school students (44 percent) than parents of middle or elementary school students (37 percent and 28 percent, respectively). Similarly, the child's disdain for breakfast was reported more often by parents of high school students (24 percent) than parents of middle or elementary school students (15 percent and 17 percent, respectively). Ten percent of parents thought their child could not participate in the SBP, which is more than double the percentage of parents who reported this factor as reason for nonparticipation in the NSLP (Table 2.6).

4. Parents' General Knowledge about the School Meal Programs

The extent to which parents know about the availability and goals of the NSLP and SBP may affect whether their children participate in the programs. Most parents (73 percent) agreed strongly or somewhat that they received enough information about the NSLP (Table 2.9). Parents of elementary school students more commonly indicated having enough information about the NSLP than parents of middle and high school students (83 percent versus 67 and 63 percent). Nearly all parents (94 percent) agreed strongly or somewhat that the NSLP gives all students an opportunity to eat lunch. At the same time, however, 16 percent of parents agreed strongly or somewhat that only students from needy families participate in the NSLP. These findings indicate that, although most parents were aware that the NSLP is available to all students, one in six parents believed that only low-income students participate in the program.

Table 2.9. Parents' Views on the School Meal Programs

	Percentage of Parents of			
	Elementary School Students	Middle School Students	High School Students	All Students
Parent Receives Enough Information About the NSLP				
Strongly agree	55.1	44.6	32.5	45.1
Agree somewhat	27.4	22.1	30.9	27.5
Disagree somewhat	9.1	20.8	17.7	14.5
Strongly disagree	8.2	12.3	17.9	12.4
Missing	0.2	0.2	0.9	0.4
The NSLP Gives All Students an Opportunity to Eat Lunch				
Strongly agree	81.4	81.2	71.4	77.9
Agree somewhat	13.7	13.0	22.4	16.5
Disagree somewhat	3.5	4.3	3.2	3.6
Strongly disagree	0.9	1.5	2.7	1.7
Missing	0.5	0.0	0.3	0.3
Only Students from Needy Families Participate in the NSLP				
Strongly agree	7.3	8.8	7.4	7.6
Agree somewhat	7.1	8.7	10.0	8.4
Disagree somewhat	21.2	16.1	17.0	18.7
Strongly disagree	62.5	63.3	60.3	61.9
Missing	2.0	3.2	5.2	3.3
Parent Awareness of the SBP (n = 1,733) ^a				
Parent said offered, SBP offered	92.7	82.4	85.7	88.4
Parent said not offered, SBP not offered	5.2	11.9	2.6	5.7
Parent said not offered, SBP offered	1.1	3.6	11.5	4.9
Parent said offered, SBP not offered	1.0	2.0	0.2	1.0
Number of Parents	740	562	548	1,850

	Percentage of Parents of			
	Elementary School Students	Middle School Students	High School Students	All Students
Among Parents with a Child That Attends a School That Offers the SBP				
Parent Receives Enough Information About the SBP				
Strongly agree	46.0	40.2	25.5	38.5
Agree somewhat	26.4	25.7	26.5	26.3
Disagree somewhat	14.7	16.2	19.6	16.5
Strongly disagree	12.8	16.8	25.4	17.4
Missing	0.1	1.1	3.0	1.2
The SBP Gives All Students an Opportunity to Eat Breakfast				
Strongly agree	75.7	74.9	69.5	73.7
Agree somewhat	16.2	15.4	17.8	16.5
Disagree somewhat	5.7	5.5	8.1	6.4
Strongly disagree	1.4	2.6	1.9	1.8
Missing	1.1	1.5	2.6	1.6
Only Students from Needy Families Participate in the SBP				
Strongly agree	7.6	8.9	8.8	8.2
Agree somewhat	9.2	13.7	16.7	12.4
Disagree somewhat	23.0	24.9	24.7	23.9
Strongly disagree	55.7	45.2	41.1	49.2
Missing	4.5	7.2	8.6	6.3
Number of Parents	700	508	534	1,742

Source: School Nutrition and Meal Cost Study, Parent Interview, school year 2014-15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

^aData were missing for 117 respondents.

NSLP = National School Lunch Program; SBP = School Breakfast Program.

Almost all parents (94 percent) were aware of whether their child's school offered the SBP and correctly reported that their child's school offered the program (88 percent) or did not offer the program (6 percent).

Parent's general awareness of the SBP was lower than for the NSLP. Among parents whose child attended a school that offered the SBP, about two-thirds (65 percent) of parents agreed strongly or somewhat that they received enough information about SBP. Similar to the NSLP, parents of elementary school students more commonly reported having enough information about the SBP (72 percent) than parents of middle school students (65 percent) and especially parents of high school students (52 percent). Although most parents (90 percent) agreed strongly or somewhat that the SBP gives all students an opportunity to eat breakfast, 21 percent agreed strongly or somewhat that only students from needy families participate in the program.

The vast majority of parents were aware that the NSLP and SBP are available to all students. However, one in six parents believed that only children from needy families participate in the NSLP and one in five parents believed this about the SBP.

E. Characteristics of School Meal Participants and Nonparticipants

School meal participants and nonparticipants differed along a number of dimensions (Table 2.10). Unadjusted, descriptive tabulations showed that NSLP participants were more likely than nonparticipants to be:

- Enrolled in lower grades—45 percent of NSLP participants were in grades 1-4, whereas 48 percent of nonparticipants were in grades 9-12
- Male (53 percent versus 47 percent)
- Hispanic or non-Hispanic black (46 percent versus 25 percent)
- Obese (22 percent versus 13 percent).³⁴

In addition, NSLP participants were more likely than nonparticipants to be from households that were:

- Low-income—60 percent of NSLP participants were from households with incomes at or below 185 percent of the Federal poverty threshold, compared to 20 percent of nonparticipants
- Less-educated—17 percent of NSLP participants' parents had less than a high school education, compared to 5 percent of nonparticipants' parents; 25 percent of NSLP participants' parents had a college education, compared to 53 percent of nonparticipants' parents
- Receiving TANF or other cash welfare benefits (12 percent versus 5 percent)
- Food insecure (26 percent versus 10 percent).

SBP participants and nonparticipants exhibited comparable differences in most student and household characteristics (Table 2.11). However, relative to NSLP participants, SBP participants were poorer and more food insecure. Seventy-one percent of SBP participants were from households with incomes at or below 185 percent of the Federal poverty level, compared to 60 percent of NSLP participants. One-third of SBP participants were from food-insecure households, compared to about one-quarter (26 percent) of NSLP participants. (Differences between NSLP participants and SBP participants were not tested for statistical significance).

These findings underscore the importance of controlling for differences in the characteristics of school meal participants and nonparticipants in analyses that compared the food and nutrient intakes of these two groups (presented in Chapters 7 through 13). The methods used to control for these differences are described in Chapter 6 (Section B.6) and Appendix G.

³⁴ Tables B.2 and B.3 present data on the weight status of subgroups of NSLP and SBP participants, respectively.

Table 2.10. Characteristics of NSLP Participants and Nonparticipants

	Percentage of Students		
	NSLP Participants	Nonparticipants	All Students
Grade Level*			
1	11.1	4.8	8.4
2	11.4	6.2	9.1
3	12.4	5.9	9.5
4	10.1	5.5	8.1
5	8.7	5.9	7.5
6	6.6	8.6	7.5
7	8.6	6.5	7.6
8	6.3	8.6	7.3
9	8.4	11.8	9.9
10	6.0	11.7	8.5
11	6.1	14.1	9.6
12	4.3	10.5	7.0
Gender*			
Male	53.2	47.1	50.5
Female	46.8	52.9	49.5
Race/Ethnicity*			
Hispanic	30.3	16.4	24.2
White, non-Hispanic	42.0	57.8	48.9
Black, non-Hispanic	15.7	8.2	12.4
Other (includes multi-racial)	7.1	9.3	8.1
Missing	4.8	8.4	6.4
Weight Status ^{a*}			
Underweight	1.0	3.8	2.2
Healthy weight	56.0	62.2	58.7
Overweight	14.6	15.8	15.1
Obese	21.8	13.4	18.1
Missing	6.5	4.8	5.8
Number of Students	1,254	911	2,165
Among Students with Completed Parent Interviews (n=1,850)			
Household Poverty Level (Income as a Percentage of Poverty) ^{b*}			
0 to 130	47.3	15.2	33.3
More than 130 to 185	12.5	4.9	9.2
More than 185 to 200	1.6	0.7	1.2
More than 200 to 300	10.9	14.6	12.5
More than 300	24.2	54.6	37.5
Missing	3.5	10.0	6.3
Parents' Highest Education Level*			
Less than high school	16.9	4.5	11.5
High school or GED	22.2	15.4	19.2
Some college or postsecondary	35.4	27.4	31.9
College graduate	25.3	52.6	37.2
Child is SBP Participant*	33.2	6.6	21.5
Family Receives SNAP or FDPIR	39.6	25.9	36.2
Family Receives WIC	17.0	9.4	15.0
Family Receives TANF or Other Welfare Benefits*	12.4	4.5	10.4

	Percentage of Students		
	NSLP Participants	Nonparticipants	All Students
Household Food Security*			
Food secure	73.2	89.3	80.2
Food insecure	26.4	10.2	19.3
Low food security	19.3	8.0	14.4
Very low food security	7.1	2.2	5.0
Missing	0.4	0.5	0.5
Number of Students	1,095	755	1,850

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, Parent Interview, school year 2014-15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: Participants are defined based on target day participation, which is based primarily on whether the student was identified as having taken a reimbursable meal on the Reimbursable Meal Sale Form. See further discussion in the text.

^aWeight status is based on BMI-for-age percentiles, using the following cutoffs: underweight: < 5th; healthy weight: ≥ 5th and < 85th; overweight: ≥ 85th and < 95th; and obese: ≥ 95th. BMI-for-age percentiles are based on age, gender, and measured height and weight per CDC guidelines (available at http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html).

^bHousehold poverty level came from the Parent Interview or, when missing, from the student certification status on the Reimbursable Meal Sale Form or student roster data from schools. Data were missing from both sources for 98 students.

*Difference between participants and nonparticipants is significantly different from zero at the * 0.05 level. Significance tests for binary variables used two-tailed t-tests; significance tests for categorical variables used chi-square tests.

FDPIR= Food Distribution Program on Indian Reservations; GED = general equivalency diploma; NSLP= National School Lunch Program; SBP = School Breakfast Program; SNAP= Supplemental Nutrition Assistance Program; TANF= Temporary Assistance for Needy Families; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

Table 2.11. Characteristics of SBP Participants and Nonparticipants

	Percentage of Students		
	SBP Participants	Nonparticipants	All Students
Grade Level*			
1	12.8	7.2	8.4
2	11.7	8.4	9.1
3	13.9	8.3	9.5
4	12.1	7.0	8.1
5	8.1	7.3	7.5
6	7.0	7.6	7.5
7	4.9	8.4	7.6
8	6.5	7.5	7.3
9	8.1	10.4	9.9
10	5.8	9.2	8.5
11	4.9	10.9	9.6
12	4.0	7.8	7.0
Gender			
Male	54.7	49.4	50.5
Female	45.3	50.6	49.5
Race/Ethnicity*			
Hispanic	35.6	21.1	24.2
White, non-Hispanic	33.7	53.1	48.9
Black, non-Hispanic	19.2	10.5	12.4
Other (includes multi-racial)	7.9	8.1	8.1
Missing	3.6	7.1	6.4
Weight Status ^{a*}			
Underweight	0.4	2.7	2.2
Healthy weight	52.8	60.3	58.7
Overweight	14.2	15.4	15.1
Obese	22.7	16.9	18.1
Missing	9.8	4.7	5.8
Number of Students	511	1,654	2,165
Among Students with Completed Parent Interviews			
Household Poverty Level (Income as a Percentage of Poverty) ^{b*}			
0 to 130	55.2	27.3	33.3
More than 130 to 185	15.8	7.3	9.2
More than 185 to 200	1.6	1.1	1.2
More than 200 to 300	8.9	13.5	12.5
More than 300	16.2	43.3	37.5
Parent's Highest Education Level*			
Less than high school	19.8	9.2	11.5
High school or GED	22.0	18.5	19.2
Some college or postsecondary	40.9	29.4	31.9
College graduate	17.3	42.7	37.2
Child Is NSLP Participant*	86.7	47.9	56.3
Family Receives SNAP or FDIPIR	43.5	32.5	36.2
Family Receives WIC	18.9	13.1	15.0
Family Receives TANF or Other Welfare Benefits	12.4	9.5	10.4

	Percentage of Students		
	SBP Participants	Nonparticipants	All Students
Household Food Security*			
Food secure	66.9	83.9	80.2
Food insecure	32.7	15.7	19.3
Low food security	24.0	11.7	14.4
Very low food security	8.7	4.0	5.0
Missing	0.4	0.5	0.5
Number of Students	444	1,406	1,850

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, Parent Interview, school year 2014-15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: Participants are defined based on target day participation, which is based primarily on whether the student was identified as having taken a reimbursable meal on the Reimbursable Meal Sale Form. See further discussion in the text.

^aWeight status is based on BMI-for-age percentiles, using the following cutoffs: underweight: < 5th; healthy weight: ≥ 5th and < 85th; overweight: ≥ 85th and < 95th; and obese: ≥ 95th. BMI-for-age percentiles are based on age, gender, and measured height and weight per CDC guidelines (available at http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/about_childrens_bmi.html).

^bHousehold poverty level came from the Parent Interview or, when missing, from the student certification status on the Reimbursable Meal Sale Form or student roster data from schools. Data were missing from both sources for 98 students.

*Difference between participants and nonparticipants is significantly different from zero at the *0.05 level. Significance tests for binary variables used two-tailed t-tests; significance tests for categorical variables used chi-square tests.

FDPIR= Food Distribution Program on Indian Reservations; GED = general equivalency diploma; NSLP= National School Lunch Program; SBP = School Breakfast Program; SNAP= Supplemental Nutrition Assistance Program; TANF= Temporary Assistance for Needy Families; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children.

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3. SATISFACTION WITH THE SCHOOL MEAL PROGRAMS

The extent to which students and parents—the “customers” of the school meal programs—are satisfied with the school meal programs may influence participation.³⁵ Substantial reforms have been implemented since SY 2012–2013, including more fruits and vegetables and whole grains in the school menu; updated nutrition standards for reimbursable meals; equitable increases in paid meal prices; and implementation of nutrition standards for all foods sold on school campuses. It is important to understand how students and parents feel about the programs and, in particular, to identify factors that contribute to dissatisfaction. This chapter describes students’ and parents’ opinions about the school meal programs in SY 2014–2015. Data were collected through the Child/Youth Interview and the Parent Interview. Topics included students’ perceptions about the lunchtime environment, foods served for lunch, and general views about school breakfasts, as well as parents’ general views about school lunches and breakfasts, reasons for dissatisfaction, and awareness of and views about competitive foods (foods and beverages sold to students during the school day outside of reimbursable school meals).

A. Students’ Views on the Lunchtime Environment

All students, including those who reported that they usually never eat a school lunch, provided feedback on their views about the general lunchtime environment. Students were asked about the timing of lunch periods, waiting time, seating, sound level, and cleanliness. Most students (84 percent) thought that the timing of their scheduled lunch period was about right (Table 3.1). Eight percent of students thought their lunch period was too early, and 6 percent thought it was too late. About half (48 percent) of students reported that the line to get lunch was long most of the time, and 39 percent said the length of the line depended on what was being served. Most students (79 percent) reported that they had enough time to eat after they got their lunch and were seated. However, 8 percent of students reported that they did not have enough time to eat, and another 13 percent said they sometimes did not have enough time to eat.

Despite long lunch lines experienced by about half of all students, most students (79 percent) reported that they had enough time to eat after they got their lunch and were seated.

Most students said there were usually plenty of seats and tables available (81 percent) and that they were allowed to pick where to sit and with whom to eat (78 percent). Responses to questions about seating varied by school type. The proportion of students who reported adequate seating was lower for high school students than for elementary or middle school students (71 percent versus 89 and 80 percent, respectively), and the proportion of students who were allowed to choose their seat was lower for elementary school students than for middle or high school students (61 percent versus 83 and 98 percent, respectively).

Overall, more than half (55 percent) of all students had no concerns about the sound level in the place where they eat lunch. However, 43 percent of students reported that the area was too noisy. The proportion of students who reported that their lunch area was too noisy was highest

³⁵ The term ‘parent’ is used throughout this chapter to refer to Parent Interview respondents. Actual respondents may have included grandparents, guardians, or other responsible adults.

among elementary school students (66 percent) and lowest among high school students (20 percent). Most students reported that tables (66 percent) and floors (51 percent) were always or usually clean. However, one-third of students reported that tables were never or only sometimes clean, and close to half (48 percent) reported that floors were never or only sometimes clean. In both cases, the percentage of students who reported concerns about cleanliness was higher for elementary school students than for middle or high school students (41 percent versus 26 percent and 27 percent, respectively, for tables, and 61 percent versus 44 percent and 34 percent, respectively, for floors).

Table 3.1. Students' Views on Lunchtime Environment

	Percentage of Students			
	Elementary School Students	Middle School Students	High School Students	All Students
Scheduled Lunch Period Is ...				
About right	82.6	88.2	82.3	83.5
Too late	6.3	5.9	4.3	5.7
Too early	8.2	4.7	7.6	7.5
Missing	2.9	1.2	5.8	3.3
Typical Length of Line to Get Lunch				
Short	10.5	6.8	3.9	7.4
Long	45.3	48.9	50.2	47.7
Depends on what is served	37.5	42.0	39.7	39.2
Don't have to wait in line	4.8	0.7	2.3	3.1
Missing	2.0	1.6	3.9	2.6
Enough Time to Eat Lunch After Getting Food and Sitting Down				
Yes	77.4	80.7	78.5	78.5
Sometimes	14.1	12.9	10.7	12.7
No	8.5	6.3	8.8	8.1
Missing	0.1	0.2	2.0	0.8
Usually Plenty of Seats and Tables	88.9	80.2	70.8	80.9
Get to Pick Where to Sit and Whom to Eat with	60.5	83.0	97.9	78.1
Sound Level				
About right	32.2	64.7	77.7	54.7
Too noisy	65.8	34.0	19.7	43.3
Too quiet	2.0	0.9	0.3	1.2
Missing	0.0	0.5	2.3	0.9
Cleanliness of Tables				
Always clean	35.9	40.3	33.4	36.0
Usually clean	22.7	33.3	37.3	29.9
Sometimes clean	31.5	24.8	22.5	27.0
Never clean	9.4	1.4	4.0	5.9
Missing	0.5	0.2	2.7	1.2
Cleanliness of Floor				
Always clean	17.0	20.7	23.3	20.0
Usually clean	21.7	35.2	39.6	30.7
Sometimes clean	44.5	39.4	28.5	37.9
Never clean	16.4	4.3	5.4	10.1
Missing	0.4	0.5	3.1	1.3
Number of Students	748	714	703	2,165

	Percentage of Students			
	Elementary School Students	Middle School Students	High School Students	All Students
Among Students That Ever Eat a School Lunch				
Food Servers and Cashiers Listen to You and Other Students				
Always	56.1	64.2	70.0	62.0
Often	15.7	14.8	13.5	14.9
Sometimes	21.9	16.9	13.3	18.3
Never	4.9	2.7	2.3	3.7
Missing	1.3	1.4	0.9	1.2
Food Servers and Cashiers Smile and Say Hello				
Always	37.6	43.6	47.9	42.0
Often	14.0	16.0	23.4	17.3
Sometimes	28.5	31.8	22.8	27.5
Never	18.5	7.8	5.8	12.5
Missing	1.3	0.8	0.1	0.8
Number of Students	643	584	506	1,733

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014–15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Among students who reported ever eating a school lunch, more than three-quarters (77 percent) reported that food servers and cashiers always or often listened to students, and more than half (59 percent) reported that food servers and cashiers always or often smile and say hello. However, just over 40 percent of students who have ever eaten a school lunch reported that food servers and cashiers never or only sometimes smile and say hello. The proportion of students who reported this concern was higher for elementary and middle school students than for high school students (48 and 40 percent, respectively, versus 29 percent).

B. Students' Views on Foods Served for Lunch

Students who reported having eaten a school lunch were asked their opinions about the foods served for lunch, including the availability of foods they like; the number of choices offered; and the look and smell of the food. About 40 percent of these students responded “always” or “often” to questions about whether the lunch menu included foods they liked (40 percent) and whether they liked the look (42 percent) and smell (43 percent) of the food (Table 3.2).³⁶ Overall, more than two-thirds (69 percent) reported that the serving line always or often had a type of milk they like. The prevalence of similar responses was somewhat lower for fruits (60 percent) and notably lower for vegetables (42 percent). Half of these students reported that there was always or often enough food choices available at lunch.

³⁶ Tables B.7 and B.8 provide comparable findings for all students regardless of whether they reported having eaten a school lunch, overall and by household poverty level.

Table 3.2. Views on Food Served for Lunch among Students Who Have Ever Eaten School Lunch

	Percentage of Students			
	Elementary School Students	Middle School Students	High School Students	All Students
Lunch Menu Includes Foods They Like				
Always	20.8	17.4	21.9	20.4
Often	16.7	25.3	21.1	19.8
Sometimes	53.2	51.7	50.7	52.1
Never	9.1	5.2	5.9	7.3
Missing	0.1	0.5	0.4	0.3
Like the Way the Food Looks				
Always	26.3	14.7	13.4	20.0
Often	18.5	26.2	24.5	21.9
Sometimes	43.0	51.7	54.1	48.2
Never	11.9	6.8	7.8	9.6
Missing	0.3	0.6	0.2	0.3
Like the Smell of the Food				
Always	26.6	18.2	17.5	22.1
Often	17.9	24.0	24.9	21.3
Sometimes	42.6	48.7	48.2	45.6
Never	12.8	7.0	8.5	10.3
Missing	0.1	2.2	0.9	0.8
Serving Line Has Milk They Like				
Always	62.5	62.8	54.0	60.0
Often	7.7	8.6	10.7	8.8
Sometimes	15.4	11.0	12.8	13.7
Never	13.3	15.5	19.9	15.7
Missing	1.0	2.0	2.7	1.7
Like the Fruits in the Serving Line				
Always	44.1	35.1	26.7	37.0
Often	18.8	24.2	27.6	22.6
Sometimes	30.7	35.2	36.8	33.5
Never	6.3	4.8	8.6	6.7
Missing	0.0	0.8	0.3	0.3
Fruits in Serving Line Look Good				
Always	50.6	40.3	31.4	42.7
Often	15.3	22.4	27.8	20.5
Sometimes	26.8	32.3	33.4	29.9
Never	7.2	4.5	7.3	6.7
Missing	0.1	0.5	0.1	0.2
Like the Vegetables in the Serving Line ^a				
Always	30.2	17.6	13.7	22.6
Often	17.7	17.5	23.8	19.5
Sometimes	35.8	44.8	39.9	38.9
Never	16.2	19.2	22.5	18.7
Missing	0.1	0.9	0.2	0.3
Vegetables in Serving Line Look Good ^a				
Always	35.7	24.9	20.2	28.8
Often	16.8	19.9	19.0	18.1
Sometimes	34.4	43.1	47.2	40.1
Never	12.7	11.6	13.4	12.7
Missing	0.4	0.4	0.2	0.3

	Percentage of Students			
	Elementary School Students	Middle School Students	High School Students	All Students
Enough Food Choices				
Always	34.3	33.4	27.9	32.2
Often	14.6	21.5	19.7	17.6
Sometimes	36.0	36.9	41.2	37.7
Never	14.2	7.7	11.2	12.0
Missing	0.8	0.5	0.1	0.5
Like the Taste of the Food				
Always	24.5	12.5	10.4	17.8
Often	18.2	25.4	25.9	22.0
Sometimes	49.8	60.2	61.3	55.5
Never	7.1	1.5	2.4	4.5
Missing	0.3	0.4	0.0	0.2
Saltiness of Food Served Is				
About right	82.7	80.8	72.9	79.4
Not salty enough	11.8	15.3	23.0	15.9
Too salty	5.2	3.2	3.7	4.3
Missing	0.3	0.6	0.5	0.4
Amount of Food (Portions)				
About right	80.1	75.8	58.6	72.7
Too little	13.2	22.6	39.1	23.0
Too much	6.6	0.9	1.7	3.9
Missing	0.2	0.7	0.6	0.4
Likes the Whole Grain Foods Available				
Always	26.6	18.8	20.7	23.2
Often	16.1	21.7	17.5	17.7
Sometimes	36.8	46.2	43.0	40.6
Never	17.3	11.8	18.0	16.4
Missing	3.2	1.5	0.9	2.2
Number of Students	643	584	506	1,733

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014–15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

^aThis question was asked about vegetables on the serving line other than french fries.

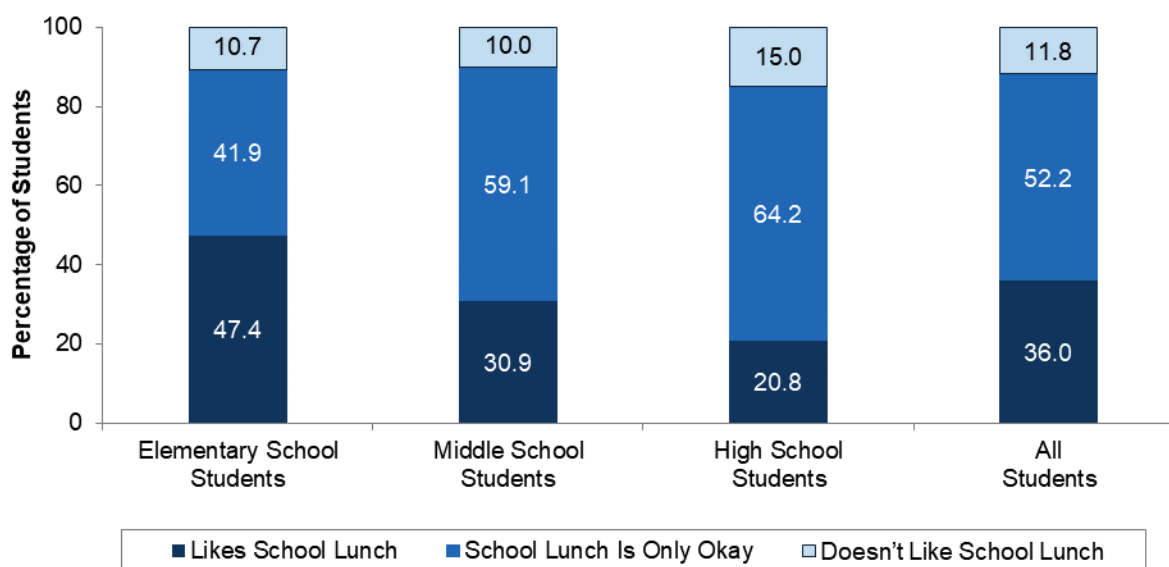
Overall, 40 percent of students who had ever eaten a school lunch reported that they liked the taste of the food often or always, 56 percent liked the taste of the food only sometimes, and 5 percent did not like the taste of the food (Table 3.2). The majority of students who had ever eaten a school lunch reported that the saltiness of the food and the size of the portions were about right (79 percent and 73 percent, respectively). However, more than half (57 percent) of students who had ever eaten a school lunch reported that they never or only sometimes liked the whole grain foods that were available. Findings related to the saltiness of meals and available whole grains were generally similar across school types, with elementary school students tending to have slightly more positive views than middle or high school students. However, there was notable variation across school types in opinions about the taste of the food and portion sizes. The percentage of students who thought the food always tasted good was substantially higher among elementary school students than either middle or high school students (25 percent versus 13 and 10 percent, respectively). In contrast, the percentage of students who thought portion sizes were

too small was notably higher for middle and high school students than for elementary school students (23 and 39 percent, respectively, versus 13 percent).

Students who had ever eaten a school lunch were asked their general opinion about the school lunch. More than one-third (36 percent) of students who had ever eaten a school lunch reported that they liked the school lunch, but more than half (52 percent) reported that the school lunch was only okay, and 12 percent said they did not like the school lunch (Figure 3.1).³⁷ Students' opinions about the school lunch varied by school type. For example, the percentage of elementary school students that reported liking the school lunch was more than twice as high as the percentage of high school students (47 percent versus 21 percent).³⁸ The percentage of students who reported liking the school lunch was also higher among students who participated in the NSLP on the target day, relative to nonparticipants (39 percent versus 29 percent; Figure 3.2).³⁹

Among students who have ever eaten a school lunch, more than one-third (36 percent) reported that they liked the school lunch, more than half (52 percent) reported that the school lunch was only okay, and 12 percent said they did not like the school lunch.

Figure 3.1. General Satisfaction with School Lunches among Students Who Have Ever Eaten School Lunch



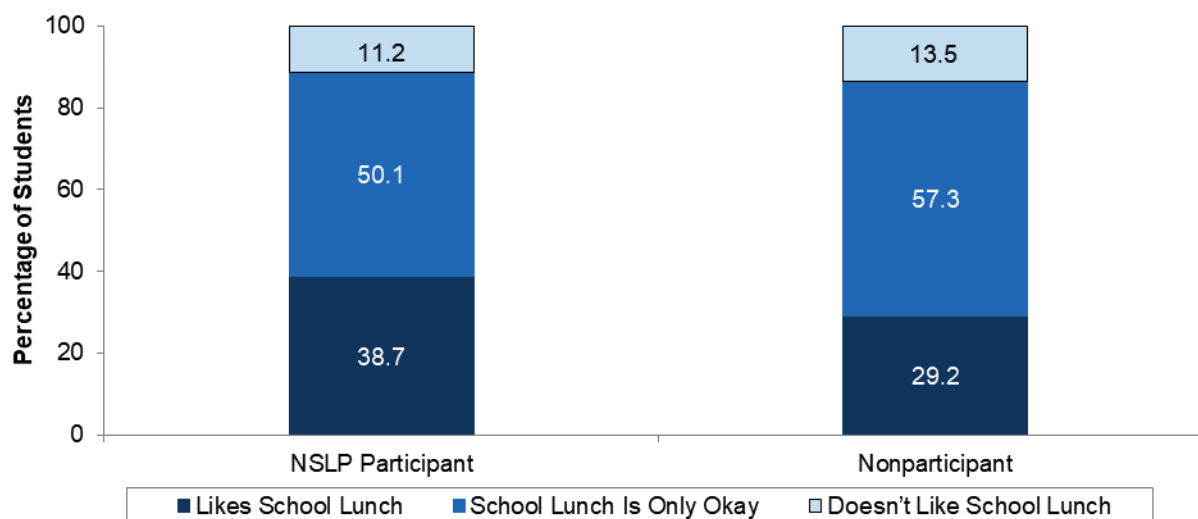
Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15.

³⁷ Potential responses were read to students in grades 4–12 (Do you like it, think it is only okay, or not like it?). Students in grades 1–3 were shown a response card that depicted facial expressions and the three response options.

³⁸ See Chapter 4 Section E for findings from an analysis that examined factors associated with student satisfaction with school lunches, overall and by school type.

³⁹ Table B.9 presents comparable findings for subgroups of students defined by usual participation status, gender, grade, race/ethnicity, household poverty level, and physical activity level.

Figure 3.2. General Satisfaction with School Lunches among Students Who Have Ever Eaten School Lunch, by Target-Day Participation Status



Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15.

C. Parents' Opinions about School Lunches

All parents were asked to share their opinions about the healthfulness of school lunches and their relative value.⁴⁰ Twenty percent of parents rated school lunches as very healthy, and more than half of parents (63 percent) rated school lunches as somewhat healthy (Table 3.3). Eleven percent of parents rated school lunches as not healthy, and 7 percent said they did not know about the healthfulness of school lunches (5 percent) or that it depended on what was being served (2 percent). Parents of elementary school students were more likely than parents of middle or high school students to rate school lunches as very healthy (25 percent versus 19 and 13 percent, respectively).

⁴⁰ The survey items that assessed parents' opinions about and satisfaction with school meals did not ask whether parents had ever eaten a school meal or ask about the sources of information that influenced their opinions/satisfaction.

Table 3.3. Parents' Views on School Lunches

	Percentage of Parents of			
	Elementary School Students	Middle School Students	High School Students	All Students
Healthiness of School Lunches				
Very healthy	24.8	18.8	13.1	19.5
Somewhat healthy	59.0	63.7	67.2	62.8
Not healthy	10.4	11.7	9.8	10.5
It depends	3.1	2.2	1.0	2.2
Don't know	2.8	3.6	8.9	5.1
Value of School Lunches				
A good value	21.1	18.2	14.5	18.2
A pretty good value	51.7	60.0	55.5	54.7
Not a good value	17.7	19.1	24.3	20.3
Gets lunch free (volunteered this information)	7.3	1.3	1.6	4.1
Don't know	2.2	1.4	4.1	2.7
Number of Parents	740	562	548	1,850
Among Parents Who Reported That Child Ever Eats a School Lunch				
School Lunches Are Served at a Convenient Time and Place				
Strongly agree	69.7	70.4	66.3	68.9
Agree somewhat	22.6	20.4	25.7	23.1
Disagree somewhat	4.8	4.7	6.7	5.3
Strongly disagree	2.9	4.4	0.7	2.6
Missing	0.0	0.0	0.5	0.2
Child Likes School Lunches				
Strongly agree	24.3	22.1	12.4	20.4
Agree somewhat	50.5	50.0	52.1	50.9
Disagree somewhat	15.0	17.5	22.2	17.6
Strongly disagree	9.4	8.1	11.8	9.8
Missing	0.7	2.4	1.4	1.3
Satisfaction with School Lunches				
Very satisfied	31.4	29.7	21.6	28.2
Somewhat satisfied	50.8	51.6	54.8	52.1
Somewhat dissatisfied	12.2	15.6	16.6	14.2
Very dissatisfied	5.4	3.1	6.6	5.3
Don't know	0.3	0.0	0.4	0.3
Number of Parents	651	459	394	1,504

Source: School Nutrition and Meal Cost Study, Parent Interview, school year 2014–15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Parents were also asked to report their general perceptions about the value of school lunches. Almost one in five parents (18 percent) thought that school lunches were a good value, and more than half (55 percent) thought school lunches were a pretty good value. However, one in five parents thought school lunches were not a good value.

More than half (55 percent) of parents reported that school lunches were a pretty good value, and 18 percent said they were a good value. However, one in five parents reported that school lunches were not a good value.

Parents who reported that their child had ever eaten a school lunch were asked about their general satisfaction with school lunches. More than two-thirds (69 percent) of these parents strongly agreed that school lunches were served at a convenient time and place. Twenty percent of parents strongly agreed that their child likes school lunches, and another 51 percent somewhat agreed with this statement. The percentage of parents who strongly agreed that their child likes the school lunch was higher among parents of elementary and middle school students than parents of high school students (24 and 22 percent, respectively, versus 12 percent). Most parents (80 percent overall) whose child had ever eaten a school lunch were very satisfied or somewhat satisfied with the lunches. However, the remaining 20 percent of these parents reported that they were somewhat or very dissatisfied with the lunches. The prevalence of dissatisfaction was somewhat higher among parents of high school students than parents of elementary or middle school students (23 percent versus 18 and 19 percent, respectively).

Parents who expressed dissatisfaction with school lunches were asked to report reasons for their dissatisfaction. More than half (60 percent) of parents who were dissatisfied with school lunches reported poor quality or taste of the lunches as the reason for their dissatisfaction (Table 3.4). More than one-third (36 percent) of these parents said they were dissatisfied because the school lunches are not healthy. Other reasons cited by more than 20 percent of parents who were dissatisfied included not enough choices (30 percent), not enough food/small portions (29 percent), and the fact that their child won't eat the lunch (24 percent).

Table 3.4. Parents' Reasons for Dissatisfaction with School Lunches

	Percentage of Parents of			
	Elementary School Students	Middle School Students	High School Students	All Students
Among Parents Who Reported that Child Has Ever Eaten a School Lunch				
Somewhat or Very Dissatisfied with School Lunches	17.5	18.7	23.1	19.4
Number of Parents	651	459	394	1,504

	Percentage of Parents of			
	Elementary School Students	Middle School Students	High School Students	All Students
Among Dissatisfied Parents, Reasons for Dissatisfaction^a				
Poor Quality/Taste	62.4	58.1	59.1	60.4
Not Healthy	35.6	32.4	38.2	35.9
Not Enough Choices	37.1	19.4	26.2	29.7
Not Enough Food/Small Portions	27.6	24.1	34.5	29.3
Child Won't Eat It	34.6	19.8	12.1	23.8
Not Good Value/Cost	29.2	13.2	13.3	20.4
Poor Presentation/Temperature	17.8	6.9	7.9	12.2
Not Enough Time/Schedule	11.4	8.3	4.1	8.2
Stigma/Child Gets Teased	1.5	0.0	0.0	0.7
Other	9.4	10.3	16.8	12.1
Food is processed/prepackaged	2.4	2.4	1.7	2.2
Dietary choice/allergies	0.0	0.0	0.4	0.2
Number of Parents	109	86	77	272

Source: School Nutrition and Meal Cost Study, Parent Interview, school year 2014–15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

^aMultiple responses were allowed. The interviewer selected responses from the list of possible answers.

D. Opinions about School Breakfasts

This section describes students' and parents' general opinions about school breakfasts.

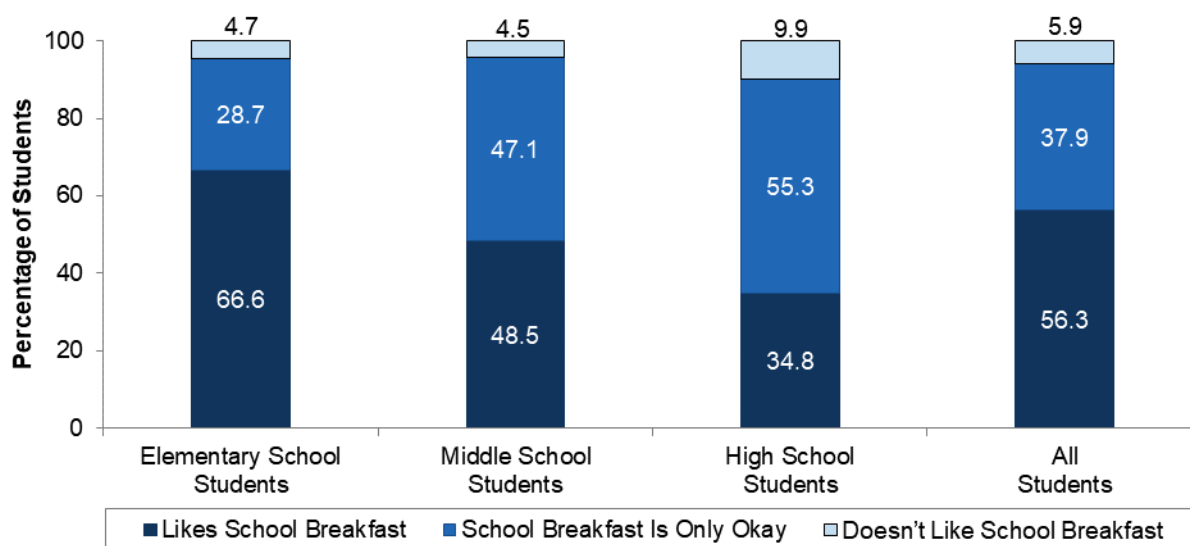
1. Students' Opinions of School Breakfasts

Students who attended a school that offered the SBP and reported that they had ever consumed a school breakfast were asked their general opinion about the school breakfast. Response options were similar to those used in assessing students' general opinions about school lunch (they like it, think it is only okay, or don't like it) (Figure 3.3). Similar to the pattern observed for lunch, students' opinions of the school breakfast varied by school type. The percentage of elementary school students who reported liking the school breakfast was notably higher than the percentage of high school students (67 percent versus 35 percent). However, relative to general opinions about the school lunch, percent versus 35 percent).

However, relative to general opinions about the school lunch, there was less variation in opinions about the school breakfast among students who did and did not participate in the SBP on the target day (Figure 3.4).⁴¹

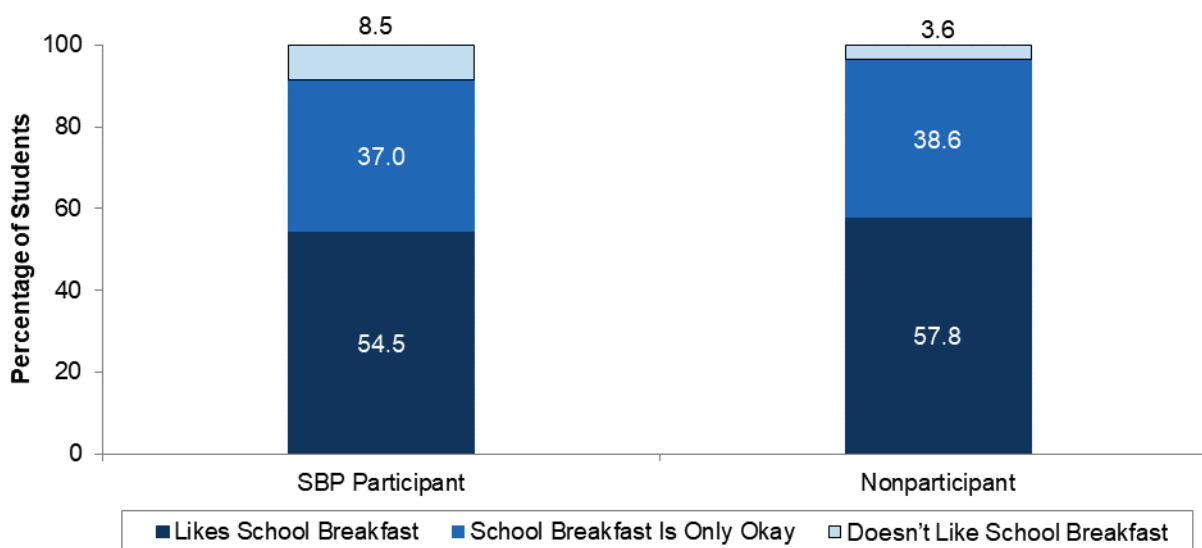
Students' opinions about school breakfast were more positive than their opinions about school lunch. Overall, more than half (56 percent) of students who had ever eaten school breakfast reported that they liked the school breakfast. More than one-third (38 percent) reported that the school breakfast was only okay, and only 6 percent said they did not like the school breakfast.

Figure 3.3. General Satisfaction with School Breakfast among Students Who Have Ever Eaten School Breakfast



Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15.

⁴¹ Table B.10 presents comparable findings for subgroups of students defined by usual participation status, gender, grade, race/ethnicity, household poverty level, and physical activity level.

Figure 3.4. General Satisfaction with School Breakfasts among Students Who Have Ever Eaten School Breakfast, by Target-Day Participation Status

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014-15.

Students who attended an SBP school and had consumed a school breakfast were also asked about time for eating breakfast and the general breakfast schedule. Most students reported that they had enough time to eat breakfast before classes started (84 percent) and that breakfast was served at an okay time (86 percent; Table 3.5).

Table 3.5. Students' Views on School Breakfast

	Percentage of Students			
	Elementary School Students	Middle School Students	High School Students	All Students
There Is Enough Time to Eat Breakfast Before Classes Start	81.9	93.2	82.3	83.9
School Breakfast Is Served				
At an okay time	84.3	89.3	87.4	85.9
Too early	8.4	4.8	8.1	7.7
Too late	6.4	5.9	4.5	5.9
Missing	1.6	0.3	0.0	1.0
Number of Students	426	246	242	914

Source: School Nutrition and Meal Cost Study, Child/Youth Interview, school year 2014–15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: The sample included only students who attended schools that offered the School Breakfast Program and reported having ever eaten a school breakfast.

2. Parents' Opinions of School Breakfasts

Parents whose child attended an SBP school and had consumed a school breakfast were asked to report their general opinions about the school breakfast. Similar to the opinions expressed by students, parents' opinions about school breakfasts were somewhat more positive than their opinions about school lunches. Twenty-nine percent of these parents rated school breakfasts as very healthy, and 59 percent rated school breakfasts as somewhat healthy (Table 3.6). Only 5 percent of parents rated school breakfasts as not healthy.

Almost three-quarters (73 percent) of parents strongly agreed that school breakfasts were served at a convenient time and place. Thirty percent of parents strongly agreed that their child likes school breakfasts, and another 57 percent somewhat agreed with this statement. The percentage of parents who strongly agreed that their child likes the school breakfast was higher among parents of elementary and middle school students than parents of high school students (31 and 36 percent, respectively, versus 19 percent). Most parents (87 percent) whose child had ever eaten a school breakfast were very satisfied or somewhat satisfied with the breakfasts. Only one in 10 parents were somewhat or very dissatisfied with the breakfasts.⁴² The prevalence of parental dissatisfaction with the school breakfast was similar across school types.

Table 3.6. Parents' Views on School Breakfasts

	Percentage of Parents of			
	Elementary School Students	Middle School Students	High School Students	All Students
Healthiness of School Breakfasts				
Very healthy	29.1	31.1	26.7	28.9
Somewhat healthy	57.5	62.2	62.1	59.4
Not healthy	5.3	4.9	5.4	5.3
It depends	2.0	0.3	0.7	1.4
Don't know	6.1	1.4	5.1	5.0
School Breakfasts Are Served at a Convenient Time and Place				
Strongly agree	73.2	77.0	67.9	72.7
Agree somewhat	18.4	18.7	19.7	18.7
Disagree somewhat	4.0	2.0	2.0	3.2
Strongly disagree	3.1	1.5	4.8	3.2
Missing	1.3	0.8	5.6	2.2
Child Likes School Breakfasts				
Strongly agree	31.3	35.7	19.2	29.4
Agree somewhat	56.9	51.1	59.8	56.5
Disagree somewhat	7.2	7.5	10.7	8.1
Strongly disagree	2.3	4.5	7.0	3.7
Missing	2.2	1.3	3.3	2.3
Satisfaction with School Breakfasts				
Very satisfied	43.2	37.9	34.0	40.2
Somewhat satisfied	44.4	50.1	49.7	46.6
Somewhat dissatisfied	10.0	9.4	10.9	10.1
Very dissatisfied	1.5	2.6	2.7	2.0
Don't know	0.9	0.0	2.7	1.1
Number of Parents	409	229	184	822

⁴² The Parent Interview did not collect information about parents' reasons for dissatisfaction with school breakfasts.

Source: School Nutrition and Meal Cost Study, Parent Interview, school year 2014–15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: The sample included only parents of students who attended a school that offered the School Breakfast Program and reported that the child had ever eaten a school breakfast.

E. Parents' Awareness of and Views on Competitive Foods

Foods and beverages that are sold to students during the school day outside of Federally reimbursable school meals are considered competitive foods. Competitive foods may be available for a la carte purchase in school cafeterias (in separate serving lines or in lines that also serve reimbursable meals) or sold in vending machines, school stores, snack bars, or fundraisers. In SY 2014–2015, schools started implementing the Smart Snacks in School requirements, which were designed to ensure that competitive foods are consistent with the *Dietary Guidelines for Americans*. Given the increased focus on competitive foods, it is important to understand the degree to which parents were familiar with the availability of competitive foods, as well as their opinions about the presence of competitive foods in schools.

Overall, most parents correctly reported the availability of vending machines (81 percent) at their child's school (Table 3.7). Incorrect assumptions about the availability of vending machines were more common among parents of middle and high school students than parents of elementary school students (33 and 26 percent, respectively, versus 8 percent). Fewer parents (64 percent) could correctly report the availability of a la carte foods during lunch.⁴³ This finding was primarily due to lack of awareness among elementary school parents. About half (51 percent) of these parents incorrectly reported the availability of a la carte foods in their children's schools. Most parents (84 percent) correctly reported the availability of school stores (that sell food and/or beverages) and snack bars in their children's schools. Incorrect assumptions about these sources of competitive food were more common among parents of middle and high school students than parents of elementary school students (20 percent and 25 percent, respectively, versus 10 percent).

Parents were asked whether vending machines should be allowed in schools for students to purchase snacks, such as chips and cookies, fruit juices, and sodas. Most parents of elementary school students (64 percent) said vending machines are a bad idea, and only 18 percent said they are a good idea (Table 3.8). In contrast, 41 to 54 percent of parents of middle and high school students said vending machines are a bad idea, and 36 to 45 percent said vending machines are a good idea. Relative to opinions about vending machines, larger percentages of middle and high school parents (63 to 69 percent) said allowing national brands, such as fast-food chains, in schools is a bad idea, and smaller percentages (20 to 27 percent) said it is a good idea.

⁴³ Parents were asked whether their child's school cafeteria "sells food that children can buy for lunch other than the regular school lunch."

Table 3.7. Parents' Awareness of Competitive Foods

	Percentage of Parents of			
	Elementary School Students	Middle School Students	High School Students	All Students
Awareness of Vending Machine Availability^a				
Parent correctly reported vending machines available	5.5	33.8	68.4	30.7
Parent correctly reported no vending machines available	86.1	33.6	5.5	50.7
Parent incorrectly reported vending machines available	2.0	11.9	9.0	6.1
Parent incorrectly reported no vending machines available	6.3	20.7	17.0	12.4
Number of Parents	716	462	438	1,616
Awareness of A la Carte Foods Availability During Lunch^b				
Parent correctly reported a la carte foods available	40.4	74.2	80.1	59.9
Parent correctly reported no a la carte foods available	7.2	1.3	0.0	3.7
Parent incorrectly reported a la carte foods available	1.0	0.6	0.1	0.7
Parent incorrectly reported no a la carte foods available ^c	51.4	23.9	19.7	35.7
Number of Parents	714	492	474	1,680
Awareness of School Store or Snack Bar Availability During Lunch^d				
Parent correctly reported school store or snack bar available	6.1	4.6	11.9	7.6
Parent correctly reported no school store or snack bar available	84.2	75.7	63.5	76.0
Parent incorrectly reported school store or snack bar available	3.2	12.9	12.6	8.2
Parent incorrectly reported no school store or snack bar available	6.5	6.9	12.0	8.3
Number of Parents	727	503	452	1,682

Source: School Nutrition and Meal Cost Study, A la Carte Checklist, Parent Interview, Principal Survey, school year 2014–15. Tabulations are weighted to be representative of public, non-charter schools offering the National School Lunch Program.

^aThis sample excluded 234 respondents who did not answer the question about the presence of vending machines.

^bThis sample excluded 170 respondents who did not answer the question about whether the school sells a la carte items. The survey question did not use the term “a la carte” but rather asked, “Does your child’s school cafeteria sell foods that children can buy for lunch other than the regular school lunch? These might be foods like hamburgers, french fries, pizza, or ice cream, for example.”

^cPatterns of incorrect parent reports were qualitatively similar when results were examined among parents of students attending schools that did not serve a la carte foods other than milk.

^dThis sample excluded 168 respondents who did not answer the question about the presence of snack bars or school stores.

Table 3.8. Parents' Views on Competitive Foods

	Percentage of Parents of			
	Elementary School Students	Middle School Students	High School Students	All Students
Allowing Vending Machines in Schools ^a				
Good idea	18.4	35.8	45.4	31.3
Bad idea	63.7	53.6	41.4	53.9
It depends	17.5	10.6	12.5	14.3
Don't know/no opinion	0.4	0.0	0.4	0.3
Allowing National Brands (For Example, Fast-Food Chains) in Schools				
Good idea	17.1	20.3	26.7	21.1
Bad idea	64.6	69.2	62.7	64.9
It depends	18.0	9.4	9.5	13.3
Don't know/no opinion	0.4	1.2	1.1	0.8
Number of Parents	740	562	548	1,850

Source: School Nutrition and Meal Cost Study, Parent Interview, school year 2014–15. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

^aParents were asked, "Some schools have vending machines where children can purchase snacks, such as chips and cookies, fruit juices and sodas. In many cases, the school receives money from the companies for allowing the machines to be placed in schools. In general, do you think it is a good idea or a bad idea to have vending machines available to students in schools such as the one your child attends?"

4. FACTORS ASSOCIATED WITH PARTICIPATION IN AND SATISFACTION WITH THE SCHOOL MEAL PROGRAMS

For the school meal programs to accomplish their policy goals, students must participate in the programs. Therefore, it is important to understand factors that may influence student participation as well as factors that may influence students' and parents' satisfaction with the school meal programs. Chapters 2 and 3 present descriptive information about participation rates in the school meal programs; characteristics of participants and nonparticipants; student- and parent-reported reasons for participation; and students' and parents' general opinions about the programs. This chapter presents findings from multivariate analyses that examined factors associated with student participation rates in the NSLP and SBP and factors associated with student and parent satisfaction with these programs.

The chapter begins (Section A) with an overview of the analytic approach used in implementing the multivariate analyses. Sections B and C present findings from analyses that examined factors associated with participation in the NSLP and SBP, respectively. Section D presents findings from an analysis that explored factors associated with students' awareness of who received free and reduced-price meals—a factor that may affect students' participation decisions. Section E summarizes key findings about factors associated with student satisfaction with school meals and, finally, Section F summarizes analogous findings related to parent satisfaction.

A. Overview of Analytic Approach

To address multiple study research questions about potential determinants of program participation and program satisfaction, the study team explored relationships between participation in and satisfaction with the school meal programs and key characteristics in four domains:

- Characteristics of the meals, including overall nutritional quality measured by total scores on the Healthy Eating Index (HEI)-2010, and compliance with updated nutrition standards^{44,45}
- Characteristics of school foodservice operations
- Characteristics of the school food environment
- Characteristics of students and institutional characteristics of their schools and SFAs.

For each of these domains, the study team identified an initial set of characteristics consisting of relevant variables from a variety of study instruments. Potential characteristics related to school

⁴⁴ The HEI-2010 is a diet quality index that measures conformance to key recommendations of the 2010 *Dietary Guidelines for Americans*. The HEI-2010 was used in this study to measure the overall nutritional quality of school meals (see Volume 2 of the SNMCS final report; Gearan et al. 2019) and students' diets (see Chapters 9 and 12 in this volume). The index is described in detail in Chapter 6, Section B.5 of this volume.

⁴⁵ The study team collaborated with FNS to identify a parsimonious set of variables to characterize compliance with NSLP and SBP nutrition standards, focusing on standards that were more challenging for one or more school types to meet and had sufficient variation within the sample. See Volume 2 of the SNMCS final report (Gearan et al. 2019) for a comprehensive description of the nutrition standards.

foodservice operations and the school food environment were selected if they had the potential to affect school meals in ways that were directly observable by students or affect students' perception of the meals. The final set of characteristics, shown in Table 4.1, was identified by eliminating, from the pool of potential characteristics, those which (1) contained valid values for a relatively low proportion of the sample, (2) exhibited insufficient variation within the sample, or (3) were highly correlated with other considered characteristics that better explained variation in the outcome of interest. Appendix C provides additional details on the exclusion criteria used in identifying the final set of variables as well as a technical description of the methods used to produce the results presented in this chapter.

Samples for these analyses included students and parents who had completed Child/Youth and Parent Interviews in schools where the SNM completed the Menu Survey. The number of students/parents and schools included in estimation samples depended on the proportion of students with valid data for each outcome analyzed.

Multivariate analyses were implemented using logistic regression and weights that accounted for the study's complex sample design. Because of the large number of characteristics of interest across the four domains and the interest in separate results by school type, separate regression models were run for each of the four domains and each of the six key outcomes (student participation in the NSLP/SBP, student satisfaction with the NSLP/SBP, and parent satisfaction with the NSLP/SBP). This approach allowed the study team to maintain sufficient degrees of freedom to estimate standard errors and test the statistical significance of associations. In addition to the key variables of interest in each domain, multivariate models included additional variables to control for key differences between individual students' demographic characteristics and the institutional characteristics of their corresponding schools and SFAs, which are not determined by the school or SFA but may be associated with participation in the school meal programs. (These control variables are identified in the bottom panel of Table 4.1). Therefore, these analyses estimate how participation and satisfaction were associated with a key variable of interest after controlling for differences in participation and satisfaction related to the demographic characteristics of students and the schools they attend.

All multivariate estimates are nationally representative of students (and their parents) in public, non-charter schools offering the NSLP. The study team estimated separate models for students across all schools and students within each specific school type. Because most of the characteristics examined in the analysis are school-level characteristics, results from these models are presented and discussed as regression-adjusted mean participation or satisfaction rates for specific types of schools. Supplementary tables provided in Appendix D report full sets of regression coefficients and standard errors for each multivariate model. Because the probability of finding significant associations by chance increases with the number of associations tested, findings for the many characteristics examined in this chapter should be considered exploratory and interpreted with caution. In addition, it is important to understand that significant associations do not imply causality. Given the cross-sectional design of this study, it is not possible to conclusively attribute associations observed between key characteristics in the four domains and the outcome of interest to the characteristic's influence on the outcome.

Table 4.1. Characteristics Included in Multivariate Analyses of Student Participation and Student/Parent Satisfaction

Key Characteristics of School Meals	
Overall Nutritional Quality of NSLP Lunches and SBP Breakfasts	
Total HEI-2010 Score of Average Lunch and Breakfast Prepared	
Compliance with Nutrition Standards	
NSLP Lunches	SBP Breakfasts
Met daily quantity requirement for grains	Met daily quantity requirement for grains
Met daily quantity requirement for meats/meat alternates	Met requirement that at least half of weekly grains are whole-grain rich
Met daily quantity requirement for vegetables	Met minimum calorie level
Met weekly requirement for meats/meat alternates	Met maximum calorie level
Met weekly requirement for vegetables	Met Target 1 sodium level
Met requirement that at least half of weekly grains are whole-grain rich	
Met minimum calorie level	
Met maximum calorie level	
Met Target 1 sodium level	
Types of Foods Offered	
NSLP Lunches	SBP Breakfasts
All daily menus offered raw vegetables	All daily menus offered cold cereal
Median number of vegetable choices offered per day	More than half of daily menus offered breakfast pastries or muffins
More than half of daily menus offered red or orange vegetables	At least one daily menu offered pizza or pizza products
At least one daily menu offered side salad bar	No daily menus offered French fries or similar products
No daily menus offered French fries or similar products	
Percentage of daily menus the offered pizza or pizza products	
At least one daily menu offered breaded meat item	
Key Characteristics of School Foodservice Operations	
Food Purchasing Characteristics	Menu Planning and Meal Service Characteristics
Uses tool(s) to facilitate selection and purchasing of healthy foods	Uses a cycle menu
Participates in a food purchasing cooperative	Participates in the Fresh Fruit and Vegetable Program
Has a pooling rights contract ^a	Receives meals from a production or central kitchen
Offers brand-name or chain restaurant foods in reimbursable meals	Uses a foodservice management company
Participates in Farm to School program	Uses the offer-versus-serve option
	Accommodates students with food allergies or special dietary needs
	Number of Smarter Lunchroom Techniques used ^a
	Price charged for paid meal
	Offers grab-and-go breakfasts ^b
	Offers option to eat breakfast in the classroom ^b

Key Characteristics of the School Food Environment	
Wellness Policies and Practices	Meal Service Practices
Has nutrition standards for school meals that exceed Federal standards	Length of meal period
Conducted a nutrition education activity in classroom or foodservice area	Other activities are scheduled during meal periods ^a
Operates a school garden ^a	Has more than one line or station that offers reimbursable meals or components of reimbursable meals ^a
	First bus arrives before or at the same time as start of breakfast service ^b
	Last bus arrives before or at the same time as the start of breakfast service ^b
Availability of Competitive Foods	
Sells a la carte foods other than milk	
Sells foods or beverages in vending machines	
Sells foods or beverages in school store or snack bar	
Has nutrition standards for competitive foods that exceed Smart Snacks in School standards	
Key Characteristics of Students, Schools, and SFAs (Also used as control variables in models that addressed other domains)	
Student Characteristics	SFA/School Characteristics
Race and ethnicity	Share of students approved for free or reduced-price meals
Gender	Urbanicity
Certified for free or reduced-price meals	School size
Is a picky eater ^c	FNS region
	Prices charged for reduced-price and paid meals ^{c,d}
Has food allergies or special dietary needs ^c	
Amount eaten, relative to students of the same age ^c	
Level of physical activity, relative to students of the same age ^c	
General health (parent-reported) ^{b,c}	

^aNSLP models only.

^bSBP models only.

^cIncluded as a student characteristic control variable in participation and satisfaction models only.

^dIncluded as an additional school characteristic control variable in models not focused on the school foodservice operations domain. FNS = Food and Nutrition Service; HEI = Healthy Eating Index; NSLP = National School Lunch Program; SBP = School Breakfast Program.

B. Factors Associated with NSLP Participation

This section presents findings from analyses that examined relationships between student participation in the NSLP and key characteristics in the four domains described above—(1) schools meals, (2) school foodservice operations, (3) the school food environment, and (4) students, schools, and SFAs (see Table 4.1). The outcome used in these analyses was target-day participation which, for most students, was based on school administrative records that documented whether the student participated in the NSLP on the day for which 24-hour dietary recall data were collected (see Chapter 2). The sample for these analyses included 2,139 students in 289 schools.

1. Relationships between NSLP Participation and Key Characteristics of NSLP Lunches

This analysis examined the relationship between student participation in the NSLP and (1) the overall nutritional quality of NSLP lunches, as measured by total HEI-2010 scores (hereafter referred to as “HEI-2010 scores” for simplicity), (2) compliance with selected NSLP nutrition standards, and (3) the types of food offered in daily NSLP menus. Findings are presented in Figure 4.1 and Table 4.2 and summarized below.

Overall Nutritional Quality of NSLP Lunches

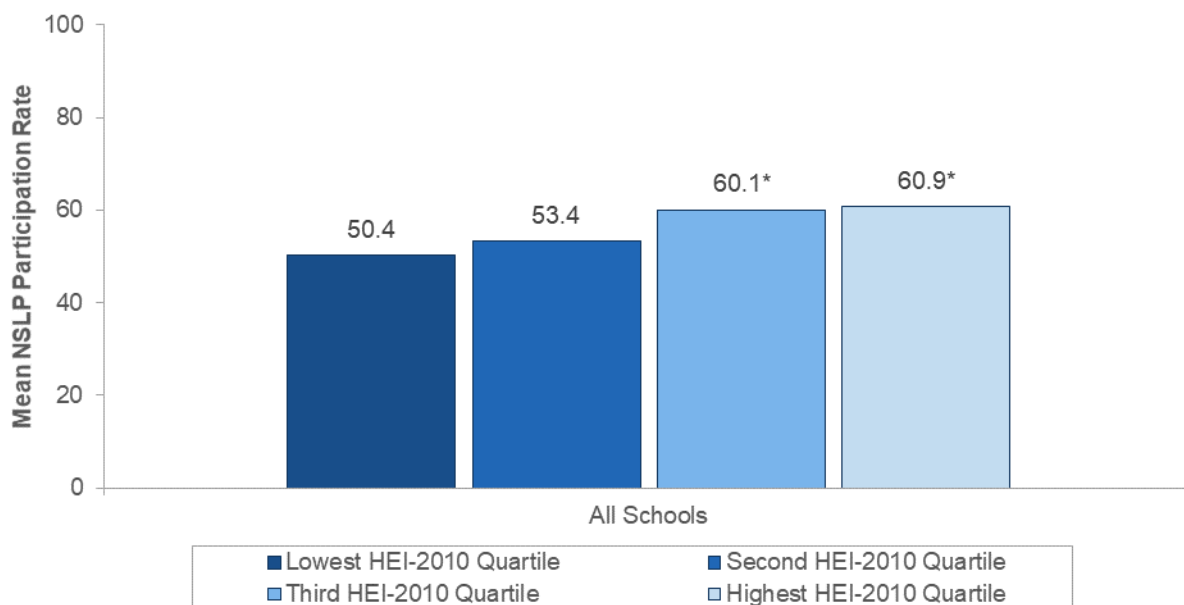
One of four confirmatory hypotheses identified for the SNMCS was that school meals of higher nutritional quality are associated with higher rates of student participation.⁴⁶ Findings from the multivariate analyses confirmed this hypothesis. Across all schools, NSLP lunches with HEI-2010 scores in the third or highest quartiles of the distribution were associated with significantly higher student participation rates, relative to NSLP lunches with HEI-2010 scores in the lowest quartile of the distribution.⁴⁷ Specifically, the average NSLP participation rate for schools with lunches in the highest quartile of the HEI-2010 distribution (scores between 85.8 and 92.8 out of a possible 100) was 61 percent, compared with 50 percent for schools with lunches in the lowest quartile of the distribution (scores between 64.9 and 79.5) (Figure 4.1). Similarly, the average NSLP participation rate for schools with lunches in the third quartile of the HEI-2010 distribution (scores between 83.1 and 85.7) was 60 percent, versus 50 percent for schools with lunches in the lowest quartile of the distribution. The general pattern of higher student participation rates in schools with lunches of higher nutritional quality was observed for all three school types. However, most of the associations between mean student participation rates and HEI-2010 scores were not statistically significant in models for specific school types

⁴⁶ The other confirmatory hypotheses focus on the relationships between (1) the nutritional quality and cost of school meals, (2) school meal participation and the quality of students’ diets, and (3) the nutritional quality of school meals and the quality of school meal participants’ diets. Findings related to the first hypothesis are discussed in Volume 3 of the SNMCS final report (Logan et al. 2019). Findings related to the second hypothesis are discussed in Chapters 9 and 12 in this volume, and findings related to the third hypothesis are discussed in Chapter 14 in this volume.

⁴⁷ The study team used quartiles of HEI-2010 scores because a continuous variable would have introduced a restrictive assumption, that is, that a 1 point increase from an initially low HEI-2010 score is associated with the same change in participation as a 1 point increase from an initially high HEI-2010 score. Using quartiles allowed for a less linear relationship that might vary across the distribution of HEI-2010 scores. Quartile cut points were chosen so that each range of HEI-2010 scores contained a sample large enough to detect statistically significant differences between, say, the highest and lowest quartiles.

(Table D.1). This is likely attributable to smaller samples of schools in the school-type-specific models and, in some cases, smaller differences in NSLP participation rates among schools with NSLP lunches of higher nutritional quality and those with the lowest quality.

Figure 4.1. Regression-Adjusted Mean Student NSLP Participation Rates by Quartile of Total HEI-2010 Scores for NSLP Lunches Prepared: All Schools



Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recalls: Day 1, and Menu Survey, school year 2014-2015. Estimates are weighted to be nationally representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: Estimates are regression-adjusted mean NSLP participation rates (as percentages) that control for demographic characteristics of each student, institutional characteristics of schools and SFAs, and the price charged by each school for a paid lunch.

The maximum possible score for the HEI-2010 is 100. The distribution of HEI-2010 scores for NSLP lunches was 64.9 to 79.5 for the lowest quartile, 79.6 to 83.0 for the second quartile, 83.1 to 85.7 for the third quartile, and 85.8 to 92.8 for the highest quartile.

*Difference in participation rates between schools in this category and schools in the lowest quartile of the HEI-2010 distribution is statistically different from zero at the 0.05 level.

HEI = Healthy Eating Index; NSLP = National School Lunch Program.

Compliance with NSLP Nutrition Standards

Overall, there were two significant associations between NSLP participation and compliance with the NSLP nutrition standards examined in this analysis (Table 4.2). Specifically, compliance with the daily requirement for meats/meat alternates was associated with a significantly higher NSLP participation rate (59 percent versus 49 percent). In contrast, compliance with the Target 1 sodium limit was associated with a significantly lower NSLP participation rate (54 percent versus 64 percent).

Table 4.2. Significant Relationships between Student NSLP Participation and Compliance with NSLP Nutrition Standards and Types of Foods Offered in NSLP Menus: Regression-Adjusted Mean NSLP Participation Rates

	Yes/ No	Elementary Schools	Middle Schools	High Schools	All Schools
Mean NSLP Participation Rate		71.3	52.0	38.4	56.0
Compliance of Daily and Weekly Lunch Menus with NSLP Nutrition Standards					
Met Daily Quantity Requirement for Meats/Meat Alternates	Y	72.7*	52.5	39.8	58.7*
	N	37.6	44.7	37.5	48.6
Met Daily Quantity Requirement for Vegetables	Y	76.6*	50.6	†	56.5
	N	61.4	53.2		54.8
Met Weekly Quantity Requirement for Meats/Meat Alternates	Y	66.9*	51.9	†	54.3
	N	76.9	52.1		57.7
Met Weekly Quantity Requirement for Vegetables	Y	63.6*	54.3	40.1	56.6
	N	89.3	36.5	32.2	53.4
Met Maximum Calorie Level	Y	70.1	49.7	41.6*	56.4
	N	73.0	56.3	19.8	54.8
Met Target 1 Sodium Limit	Y	70.6	52.9	35.3	53.8*
	N	75.1	48.7	47.3	63.9
Types of Foods Offered in Lunch Menus					
All Daily Menus Offered Raw Vegetables	Y	71.9	52.0	44.8*	55.0
	N	70.7	52.0	25.7	57.4
Median Number of Vegetable Choices Offered per Day					
2 or fewer (<i>reference category</i>)		75.7	52.4	52.9	57.3
3 to 4		68.1	52.1	39.3*	55.9
5 or more		40.9*	51.1	30.3*	53.6
More than Half of Daily Menus Offered Dark Green Vegetables or Legumes	Y	65.2**	55.0	39.9	54.9
	N	75.4	47.4	35.1	57.3
More than Half of Daily Menus Offered Red and Orange Vegetables	Y	75.7	51.7	46.0***	59.6*
	N	68.1	52.3	28.6	52.5
At Least One Daily Menu Offered Side Salad Bar	Y	66.4	36.6*	28.5	50.6
	N	72.1	54.0	40.4	56.9
Percentage of Daily Menus that Offered Pizza or Pizza Products					
Less than 20 percent (<i>reference category</i>)		73.3	44.5	29.6	56.7
Between 20 and 99 percent		66.5	46.4	40.4*	53.0
100 percent		87.5*	58.0	40.0	58.2
Number of Students		741	702	696	2,139
Number of Schools		104	91	94	289

Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recalls: Day 1, and Menu Survey, school year 2014-2015. Estimates are weighted to be nationally representative of all students in public, non-charter schools offering the National School Lunch Program.

Notes: Estimates are regression-adjusted mean NSLP participation rates (as percentages) that control for demographic characteristics of each student, institutional characteristics of schools and SFAs, and the price charged by each school for a paid lunch.

Variables with rows labeled “Y” and “N” report adjusted mean NSLP participation rates within schools that do and do not meet the variable criteria, respectively. Otherwise, regression-adjusted means are reported for each category within a variable. See Appendix C for more details on characteristic descriptions and selection methods.

*Difference in participation rates between schools with and without a dichotomous characteristic is statistically different from zero at the 0.05 level. For variables containing multiple categories, * denotes that the difference in participation rates between schools in the corresponding category and schools in the reference category is statistically different from zero at the 0.05 level.

† Variable was excluded from the model due to low within-sample variation or high correlation with another variable that better explained variation in NSLP participation.

NSLP = National School Lunch Program.

There were also some significant associations for specific school types. Among elementary schools, compliance with the daily quantity requirements for meats/meat alternates and vegetables was associated with significantly higher NSLP participations rates (73 percent versus 38 percent for meats/meat alternates and 77 percent versus 61 percent for vegetables). In contrast, compliance with the *weekly* quantity requirements for these two meal components was associated with significantly lower NSLP participation rates (67 percent versus 77 percent for meats/meat alternates and 64 percent versus 89 percent for vegetables). Taken together, these estimates suggest that, for both meats/meat alternates and vegetables, NSLP participation rates in elementary schools were not significantly different among schools that met both the daily and weekly requirements compared to schools that met neither requirement.

Among high schools, compliance with the maximum calorie level (meaning that the average calorie content of NSLP lunches did not exceed the maximum) was associated with a significantly higher NSLP participation rate relative to schools that did not meet this requirement (42 percent versus 20 percent).

There were no significant associations, overall or for specific school types, between NSLP participation rates and compliance with three other nutrition standards examined in this analysis—the daily quantity requirement for grains, the minimum calorie level, and the requirement that at least half of all grains must be whole grain-rich (Table D.1).

Types of Food Offered in NSLP Lunches

Overall, offering red or orange vegetables on more than half of daily lunch menus was associated with a significantly higher NSLP participation rate (60 percent versus 53 percent) (Table 4.2). For all schools combined, none of the other variables characterizing the types of food offered in NSLP lunches were associated with significant differences in NSLP participation rates. However, some significant associations were observed for specific types of schools. Among elementary and high schools, offering more daily vegetable choices was associated with significantly lower NSLP participation rates. Among elementary schools, the mean NSLP participation rate in schools that offered a median of 5 or more vegetable choices per day was 41 percent, compared with 76 percent in schools that offered a median of 2 or fewer vegetable choices per day. Among high schools, mean NSLP participation rates were 39 and 30 percent, respectively, in schools that offered 3 to 4 and 5 or more vegetable choices per day, compared with 53 percent in schools that offered 2 or fewer choices.

Among elementary schools, offering pizza and pizza products more often was associated with a significantly higher NSLP participation rate (88 percent for schools that offered pizza or pizza products every day versus 73 percent for schools that offered these items on fewer than 20 percent of daily menus). This general pattern was observed for middle and high schools as well, but the association was only statistically significant among high schools that offered pizza and pizza products 20 to 99 percent of the time in comparison to those that offered these items on fewer than 20 percent of daily menus (40 percent versus 30 percent).

Among elementary schools, offering dark green vegetables or legumes on more than half of daily menus was associated with a significantly lower NSLP participation rate (65 percent versus 75 percent). Among middle schools, offering a side salad bar on at least one menu day was associated with a significantly lower NSLP participation rate (37 percent versus 54 percent). Finally, among high schools offering raw vegetables every day was associated with a significantly higher NSLP participation rate (45 percent versus 26 percent).

There were no significant associations, overall or for specific school types, between NSLP participation rates and the two other characteristics of NSLP menus examined in this analysis—no daily menus offered French fries and similar potato products and at least one daily menu offered breaded meat (Table D.1).

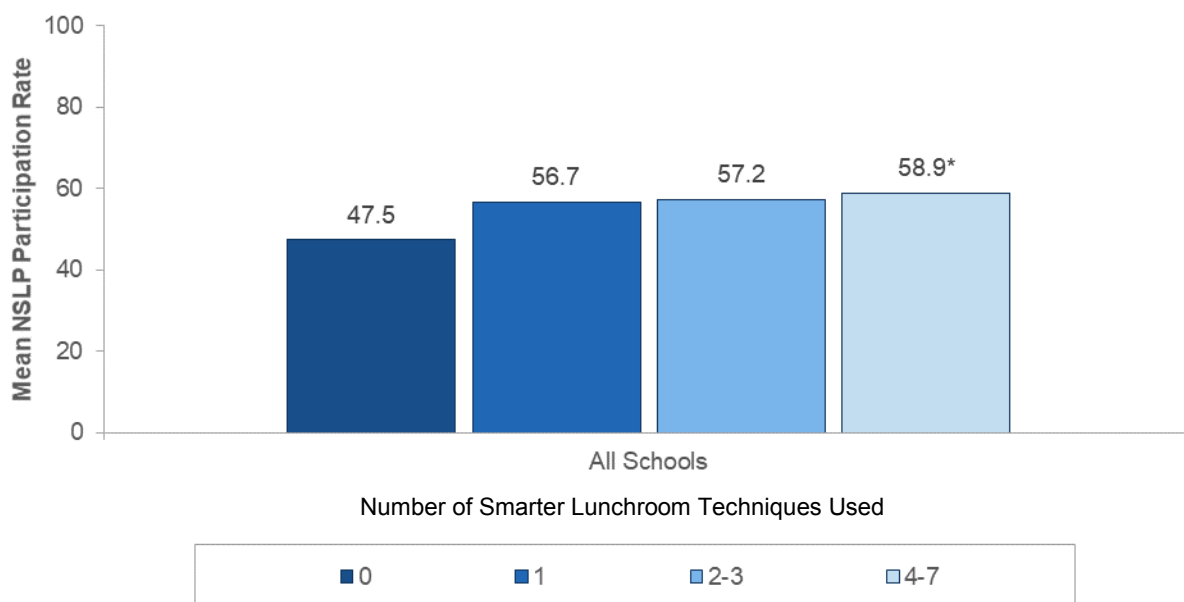
2. Relationships between NSLP Participation and Key Characteristics of School Foodservice Operations

The study team also examined the relationships between NSLP participation and key characteristics of school foodservice operations, including characteristics related to food purchasing, menu planning, and meal service. Findings are presented in Figure 4.2 and Table D.3 and summarized below.

Overall, use of HealthierUS School Challenge Smarter Lunchroom Techniques was associated with significantly higher NSLP participation rates. Smarter Lunchroom Techniques are intended to promote healthy food choices, and include strategies such as soliciting students' input on vegetable offerings and displaying dark green, red, and orange vegetables prominently among side dish offerings.⁴⁸ Mean NSLP participation rates ranged from 57 to 59 percent among schools that used one or more Smarter Lunchroom Techniques, compared to 48 percent among schools that did not use any of these techniques (Figure 4.2). Moreover, mean NSLP participation was significantly higher among schools that used 4 to 7 Smarter Lunchroom Techniques compared to schools that did not use these techniques (59 percent versus 48 percent). A pattern of higher participation rates in schools that used Smarter Lunchroom Techniques was observed for all school types; however, none of the comparisons among elementary or high schools were statistically significant (Table D.3).

⁴⁸ The SNMCS assessed schools' use of seven Smarter Lunchroom Techniques. See Volume 1 of the SNMCS final report (Forrestal et al. 2019).

Figure 4.2. Regression-Adjusted Mean Student NSLP Participation Rates by Use of HealthierUS School Challenge Smarter Lunchroom Techniques: All Schools



Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Recalls: Day 1, Cafeteria Observation Guide, and School Nutrition Manager Survey, school year 2014-2015. Estimates are weighted to be nationally representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: Estimates are regression-adjusted mean NSLP participation rates (as percentages) that control for demographic characteristics of each student, institutional characteristics of schools and SFAs, and the price charged by each school for a paid lunch.

*Difference in participation rates between schools in this category and schools that used zero Smarter Lunchroom Techniques is statistically different from zero at the 0.05 level.

NSLP = National School Lunch Program.

For all schools combined, offering brand-name or chain restaurant foods in reimbursable meals was associated with a significantly lower NSLP participation rate (41 percent versus 57 percent). This association was primarily driven by the large difference in high school participation rates between schools that offer these foods in reimbursable meals and those that do not (19 percent versus 41 percent).

Some significant associations between NSLP participation rates and characteristics of school foodservice operations were observed only for specific types of schools. Among elementary schools, presence of policies for accommodating students with food allergies or special dietary needs (reported by SNMs) was associated with a significantly higher participation rate (73 percent versus 53 percent). Among middle schools, the presence of a pouring rights contract⁴⁹ and participation in a Farm to School program were each associated with significantly higher participation rates (61 percent versus 48 percent and 67 percent versus 49 percent, respectively).

⁴⁹ Pouring rights contracts allow school districts to earn revenue by granting soft drink manufacturers exclusive rights to sell beverages (other than milk) in specific locations. In SY 2014-2015, 23 percent of SFAs had a pouring rights contract (Forrestal et al. 2019).

Among high schools, use of a cycle menu was associated with a significantly lower participation rate (33 percent versus 52 percent).

Overall, among schools that charged for paid lunches, there was no significant association between the price charged for a paid lunch and student NSLP participation.⁵⁰ The significance and direction of this relationship varied by price level and school type and did not reveal any consistent relationships between participation and prices charged for paid lunches.

There were no significant associations, overall or for specific school types, between NSLP participation and the five other characteristics of school foodservice operations examined in this analysis—use of Alliance for a Healthier Generation or similar tools for selecting and purchasing healthy foods; participation in a food purchasing cooperative; participation in the Fresh Fruit and Vegetable Program (included in elementary school analysis only); receiving fully or partially prepared meals from a production or central kitchen; and using the offer-versus-serve (OVS) option at lunch (which allows students to decline some components of a reimbursable meal).

3. Relationships between NSLP Participation and Key Characteristics of the School Food Environment

To assess the relationships between NSLP participation and key characteristics of the school food environment, the study team examined characteristics related to wellness policies and practices, availability of competitive foods, and meal service practices. Findings are presented in Table D.5 and summarized below.

Overall, the presence of nutrition standards for school meals that exceeded Federal standards was associated with significantly higher rates of NSLP participation (60 percent versus 53 percent), whereas the presence of standards for competitive foods that exceeded Smarter Snacks in School standards was associated with significantly lower rates of NSLP participation (50 percent versus 58 percent). This pattern of findings was observed for elementary, middle, and high schools separately; however, not all of the associations were statistically significant. The positive association between NSLP participation and more stringent nutrition standards for school meals was statistically significant among elementary schools (78 percent versus 68 percent) and high schools (48 percent versus 34 percent), and the negative association between NSLP participation and more stringent nutrition standards for competitive foods was statistically significant among high schools (28 percent versus 43 percent).

Among elementary schools, operation of a school garden was associated with a significantly lower NSLP participation rate (55 percent versus 73 percent).⁵¹ Among middle schools, availability of competitive foods in vending machines was associated with significantly lower

⁵⁰ A separate analysis, summarized in Volume 1 of the SNMCS final report (Forrestal et al. 2019), found that there was a significant association between the *paid* participation rate and the price charged for a paid lunch. Specifically, a 10 cent increase in the price of a paid lunch was associated with a decline of 0.7 percentage points in the rate of paid NSLP participation.

⁵¹ The association between NSLP participation and operation of a school garden was examined only among elementary schools. Although, nationally, some middle schools and high schools operated school gardens (see Volume 1 of the SNMCS final report (Forrestal et al. 2019)), this was true for less than 5 percent of the middle or high schools included in the multivariate analysis.

NSLP participation (46 percent versus 59 percent). The same pattern was observed for both elementary schools and high schools, but the differences in NSLP participation rates were not statistically significant.

The study team also explored the association between NSLP participation and the length of lunch periods (less than 30 minutes, 30 to 44 minutes, and 45 minutes or more). There was no consistent pattern in this association across school types, and only one of 8 associations was statistically significant.

There were no significant associations, overall or for specific school types, between NSLP participation rates and the three other characteristics of the school food environment examined in this analysis—the availability of a la carte foods (other than milk); the availability of competitive foods in a school store or snack bar; and scheduling of other activities (such as club meetings, tutoring sessions, and pep rallies) during lunch periods.

4. Relationships between NSLP Participation and Key Characteristics of Students, Schools, and SFAs

The final analysis that explored factors associated with NSLP participation focused on relationships between NSLP participation and characteristics of students (both sociodemographic characteristics and characteristics related to eating habits and physical activity) and institutional characteristics of schools. The sociodemographic characteristics of students and institutional characteristics of schools and SFAs are the same characteristics used as control variables in the multivariate analyses summarized in the preceding sections. Student characteristics related to eating habits and physical activity include characteristics that may influence students' decisions to participate in the school meal programs. Findings are presented in Table D.7 and summarized below.

Student Characteristics

Not surprisingly, students certified for free or reduced-price meals were significantly more likely to participate in the NSLP than students not certified to receive meal benefits. Overall, the difference in average NSLP participation rates for these two groups of students was 74 percent versus 40 percent. This pattern and significant association was observed for all three school types.

Overall, female students were significantly less likely to participate in the NSLP than male students (53 percent versus 59 percent). In addition, students who were reported (by parents) to be somewhat picky eaters were significantly more likely than students who were reported to be very picky eaters to participate in the NSLP (59 percent versus 52 percent). Both of these general patterns were observed for all three school types, but only one of the differences (males versus females in middle schools) was statistically significant.

Overall, students with larger appetites, relative to their peers, were significantly more likely to participate in the NSLP than students with typical or smaller appetites (61 percent versus 55

and 50 percent, respectively).⁵² The general pattern of students with larger appetites having the highest rate of NSLP participation was observed for all three school types, but the difference was statistically significant only among elementary school students and only for one of the comparisons.

Among elementary schools, students reported (by parents) to be about as active as other students of the same age had a significantly higher rate of NSLP participation than students who were reported to be less active (75 percent versus 58 percent). Overall and among elementary and middle schools, Hispanic students were significantly more likely than non-Hispanic, white students to participate in the NSLP (60 percent versus 54 percent overall, 77 percent versus 68 percent for elementary schools, and 63 percent versus 48 percent for middle schools). There was no significant association, overall or by school type, between NSLP participation rates and whether a student had food allergies or special dietary needs.

Institutional Characteristics of Schools and SFAs

Overall, controlling for whether individual students were approved for free or reduced-price meals, schools with 40 percent or more of students approved to receive meal benefits had a significantly higher NSLP participation rate than schools with less than 40 percent of students approved for meal benefits (60 percent versus 51 percent). In addition, schools in suburban and rural locations had significantly higher NSLP participation rates than schools in urban locations (59 percent for both suburban and rural schools versus 47 percent). These same patterns were observed for all three school types, but the differences in NSLP participation rates were not always statistically significant.

There was no consistent pattern, overall or across school types, in the association between NSLP participation and school size, and only one of 8 associations tested was statistically significant. The same was true for the association between NSLP participation and FNS region, with a total of 24 associations tested.

C. Factors Associated with SBP Participation

This section presents findings from analyses that explored factors associated with student participation in the SBP. The analyses were analogous to those described in the previous section on NSLP participation. Multivariate models included key characteristics used in the NSLP analyses if they were relevant to the SBP, and also included other characteristics specific to the SBP (see Table 4.1). The analysis sample included 1,989 students in 268 schools that offered the SBP.

1. Relationships between SBP Participation and Key Characteristics of SBP Breakfasts

This analysis examined the relationships between student participation in the SBP and (1) the overall nutritional quality of SBP breakfasts, (2) compliance with selected SBP nutrition

⁵² Students' relative appetites were assessed based on parent reports. Parents were asked to assess the amount of food their child usually eats relative to other children of the same age and gender, and to report whether their child ate a larger amount, the same amount, or a smaller amount.

standards, and (3) the types of food offered in daily SBP menus. Findings are presented in Table 4.3 and Table D.9 and summarized below.

Overall Nutritional Quality of SBP Breakfasts

As noted in the preceding section on factors associated with NSLP participation, one of four confirmatory hypotheses identified for the SNMCS was that school meals of higher nutritional quality are associated with higher rates of student participation. While this hypothesis was confirmed for the NSLP (Figure 4.1), there was no significant association between SBP participation rates and the nutritional quality of SBP breakfasts, overall, and no clear pattern of associations across school types (Table 4.3).

Table 4.3. Relationships between Student SBP Participation and the Nutritional Quality of SBP Breakfasts: Regression-Adjusted Mean SBP Participation Rates

	Elementary Schools	Middle Schools	High Schools	All Schools
Mean SBP Participation Rate	30.2	21.3	14.6	22.9
Total HEI-2010 Score of Average Breakfast Prepared				
Lowest Quartile—55.2 to 68.5 points (<i>reference category</i>)	26.7	18.8	15.5	22.9
Second Quartile—68.6 to 71.6 points	41.2*	23.0	9.3*	26.0
Third Quartile—71.7 to 74.9 points	24.7	24.8	19.1	22.0
Highest Quartile—75.0 to 87.4 points	28.8	19.6	12.0	21.0
Number of Students	692	633	664	1,989
Number of Schools	97	82	89	268

Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recalls: Day 1, and Menu Survey, school year 2014-2015. Estimates are weighted to be nationally representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: Estimates are regression-adjusted mean SBP participation rates (as percentages) that control for demographic characteristics of each student, institutional characteristics of schools and SFAs, and the price charged by each school for a paid breakfast.

*Difference in participation rates between schools in the corresponding category and schools in the reference category is statistically different from zero at the 0.05 level.

HEI = Healthy Eating Index; SBP = School Breakfast Program.

Compliance with SBP Nutrition Standards

Overall, only one of the compliance variables examined in this analysis—meeting the Target 1 sodium limit—was significantly associated with SBP participation (Table D.9). Average SBP participation was significantly higher in schools that met this standard than in schools that did not meet the standard (25 percent versus 18 percent). This pattern was also observed among elementary, middle, and high schools, but the difference in SBP participation rates was statistically significant only for elementary schools.

Among high schools, meeting the minimum calorie level for SBP breakfasts was associated with a significantly higher SBP participation rate (17 percent versus 9 percent). This general

pattern was also observed among middle schools and for all schools combined, but the differences in SBP participation were not statistically significant.⁵³

There were no significant associations, overall or for specific school types, between SBP participation rates and compliance with the three other nutrition standards examined in this analysis—daily quantity requirements for grains, compliance with the requirement that at least 50 percent of all grains be whole grain rich, and maximum calorie level (Table D.9).

Types of Food Offered in SBP Breakfasts

Overall and for all three school types, there were no statistically significant associations between SBP participation rates and the characteristics of SBP menus examined in this analysis (Table D.9). There was one isolated exception among middle schools, where offering cold cereal every day was associated with a significantly higher SBP participation rate (24 percent versus 13 percent).

2. Relationships between SBP Participation and Key Characteristics of School Foodservice Operations

This analysis examined relationships between student participation in the SBP and characteristics of school foodservice operations, including characteristics related to food purchasing, menu planning, and meal service. Findings are presented in Figure 4.3 and Table D.11 and summarized below.

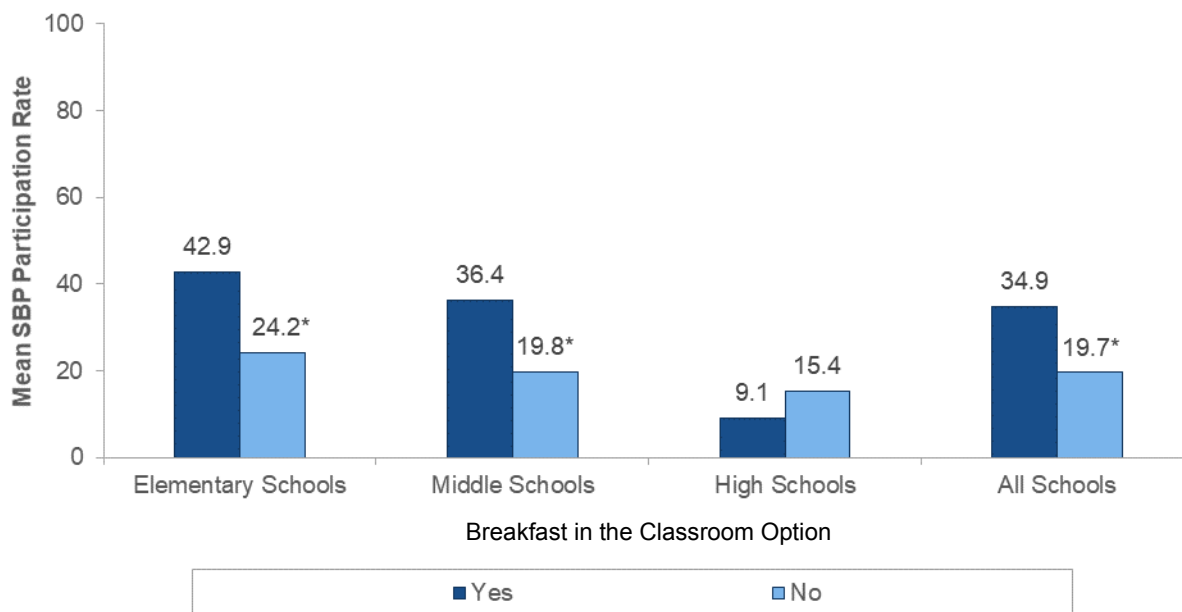
Schools may offer breakfast in the classroom or other locations outside the cafeteria in order to facilitate participation in the SBP, especially when bus schedules or other factors may limit the time that students have to go to the cafeteria for breakfast. Overall, the option of eating breakfast in the classroom was associated with a significantly higher SBP participation rate (35 percent versus 20 percent) (Figure 4.3). A significant association between SBP participation and the option of eating breakfast in the classroom was also observed among elementary schools (43 percent versus 24 percent) and middle schools (36 percent versus 20 percent).

Among high schools, there was no association between SBP participation and offering breakfast in the classroom. However, there was a significant and positive association between SBP participation and offering “grab-and-go” breakfasts—breakfasts with meal components pre-packaged for students to take away and eat in the classroom or elsewhere—(28 percent versus 12 percent) (Table D.11). Such breakfasts are two to three times more common in high schools than in elementary or middle schools (Forrestal et al. 2019).

Overall, there was a significant and positive association between SBP participation and using Alliance for a Healthier Generation or similar tools to select and purchase healthy foods (26 percent versus 21 percent). This general pattern was observed among all school types, but the difference in SBP participation rates was statistically significant only for elementary schools (36 percent versus 26 percent) and middle schools (35 percent versus 18 percent).

⁵³ Elementary schools lacked sufficient variation in this characteristic to produce estimates.

Figure 4.3. Regression-Adjusted Mean Student SBP Participation Rates by Use of the Breakfast in the Classroom Option



Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recalls: Day 1, and School Nutrition Manager Survey, school year 2014-2015. Estimates are weighted to be nationally representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: Estimates are regression-adjusted mean SBP participation rates (as percentages) that control for demographic characteristics of each student, institutional characteristics of schools and SFAs, and the price charged by each school for a paid breakfast.

*Difference in participation rates between schools that did and did not offer the option of eating breakfast in the classroom is statistically different from zero at the 0.05 level.

SBP = School Breakfast Program.

Among high schools, use of the OVS option at breakfast was associated with significantly lower SBP participation rates (13 percent versus 27 percent for high schools). As observed in the NSLP analysis, the use of a cycle menu was associated with a significantly lower SBP participation rate among high schools (13 percent versus 21 percent).

Not surprisingly, schools that offered free breakfasts to all students had a significantly higher SBP participation rate than a reference category of schools that charged \$1.25 or less for paid breakfasts (28 percent versus 19 percent). Overall, among schools that charged for paid breakfasts, there was no significant association between the price charged for a paid breakfast and student SBP participation.⁵⁴ The pattern of the relationship was not consistent across meal prices and only one of 12 associations tested was statistically significant.

There were no significant associations, overall or for specific school types, between SBP participation rates and the six other characteristics of school foodservice operations examined in

⁵⁴ A separate analysis, summarized in Volume 1 of the SNMCS final report (Forrestal et al. 2019), found that there was a significant association between the *paid* participation rate and the price charged for a paid breakfast. Specifically, a 10 cent increase in the price of a paid breakfast was associated with a decline of roughly 0.2 percentage points in the rate of paid SBP participation.

this analysis—participation in a food purchasing cooperative; offering brand-name or chain restaurant foods in reimbursable meals; participation in a Farm to School program; participation in the Fresh Fruit and Vegetable Program (included in elementary school analysis only); receiving fully or partially prepared meals from a production or central kitchen; and accommodating students with food allergies or special dietary needs.

3. Relationships between SBP Participation and Key Characteristics of the School Food Environment

This analysis examined relationships between SBP participation and characteristics of the school food environment, including characteristics related to wellness policies and practices, availability of competitive foods, and meal service practices. Findings suggest that there are no meaningful relationships between SBP participation and characteristics of the school food environment examined in this analysis (Table D.13). Of the 40 associations tested, overall and for specific school types, only one was statistically significant, which is about the rate one would expect to find statistical significance by chance alone.

4. Relationships between SBP Participation and Key Characteristics of Students, Schools, and SFAs

The final analysis that explored factors associated with SBP participation focused on relationships between participation and characteristics of students (both sociodemographic characteristics and characteristics related to eating habits and physical activity) and institutional characteristics of schools and SFAs. Findings are presented in Table D.15 and summarized below.

Student Characteristics

Consistent with findings from the analysis of factors associated with NSLP participation, students certified to receive free or reduced-price meals were significantly more likely to be SBP participants than students not certified to receive meal benefits. Overall, the difference in SBP participation rates for these two groups of students was 31 percent versus 9 percent. This pattern and significant association was observed for all three school types.

Overall, students who were reported (by parents) to eat smaller amounts than other children of the same age were significantly less likely to participate in the SBP than students who were reported to eat larger amounts (16 percent versus 30 percent). The same was true for students who reportedly ate the same about as other children of the same age (21 percent versus 30 percent). These patterns and statistically significant associations were observed among elementary school students (19 percent and 28 percent versus 43 percent). Overall and for all three school types, SBP participation rates were consistently lower for students that had food allergies or special dietary needs, but this association was not statistically significant.

There were no significant associations, overall or for specific school types, between SBP participation and gender, race/ethnicity, whether a student was considered to be a very picky eater, or whether a student was reported to be about as active as or more active than other students of the same age.

Institutional Characteristics of Schools and SFAs

Overall, there was a significant association between SBP participation and school size. Schools with fewer than 500 students had significantly higher rates of SBP participation than schools with 500 to 999 students or schools with 1,000 or more students (28 percent versus 22 percent and 18 percent, respectively). This general pattern was observed for all three school types, but not all of the associations were statistically significant.

Overall, controlling for whether individual students were approved for free or reduced-price meals, there was no significant relationship between SBP participation and the share of students approved to receive meal benefits. However, among elementary schools, this association was statistically significant—schools with 40 percent or more of students approved to receive free or reduced-price meals had significantly higher SBP participation rates than schools with less than 40 percent of students approved to receive meal benefits (32 percent versus 22 percent).

Among elementary schools and high schools, there were significant differences in SBP participation rates for some FNS regions compared to the reference Mid-Atlantic region. However, this is due to the fact that, when controlling for student and school characteristics, the Mid-Atlantic region was associated with the highest rate of SBP participation among elementary schools (44 percent) and the lowest rate among high schools (6 percent). There was no significant association, overall or for specific school types, between SBP participation and urbanicity.

D. Factors Associated with Students' Awareness of Who Received Free or Reduced-Price Meals

The analysis summarized in this section examined the extent to which students' awareness of who receives free or reduced-price meals was related to (1) student characteristics, (2) school characteristics, and (3) meal service characteristics—particularly those related to paid meal price and the availability of competitive foods, as these features may influence students' ability to identify students that receive free or reduced-price meals. The outcome used in this analysis was the percentage of students who were aware of which students receive free or reduced-price meals. Students who reported that some students pay less for lunch or get lunch for free (see Chapter 2, Figure 2.3) were considered to be aware of who receives free or reduced-price meals. The analysis sample included 1,166 students in 238 schools that did not offer free NSLP lunches to all students. Findings are presented in Table D.17 and summarized below.

Overall, few of the factors examined were associated with significant differences in the proportion of students who were aware of who received free or reduced-price meals. Perhaps not surprisingly, students in schools where 40 percent or more of students were approved for free or reduced-price meals were significantly more likely to be aware of which students received meal benefits, relative to students in schools with less than 40 percent of students approved for meal benefits (23 percent versus 15 percent). In addition, the percentage of students who were aware of who received meal benefits was significantly higher among students in schools that sold a la carte foods other than milk, relative to students in schools that did not sell a la carte foods (21 percent versus 10 percent). Finally, students in schools located in FNS's Northeast region were significantly less likely to be aware of who received meal benefits than students in schools located in the reference Mid-Atlantic region (8 percent versus 24 percent), though this difference

is primarily due to the fact that no students in elementary schools in the Northeast region were aware of which students received free or reduced-price meals.

There were other factors associated with whether a student was aware of which students receive free or reduced-price meals, but only among students in a specific school type. Among elementary school students, students in the “other” race category (those who did not identify as black, Hispanic, or white) were more likely than the reference group of white students to be aware of which students received free or reduced-price meals (37 percent versus 16 percent). Among middle school students, students who attended schools that offered brand-name or chain restaurant foods were significantly more likely to be aware of which students received meal benefits than students who attended schools that did not offer such foods (49 percent versus 21 percent).

There were also significant differences among middle school students who attended schools in FNS’s Southeast and Midwest regions, relative to students who attended schools in the reference Mid-Atlantic region (20 percent for Southeast and 16 percent for Midwest versus 43 percent for Mid-Atlantic). Among high school students, the following types of students were significantly more likely than their counterparts to be aware of which students received meal benefits—males (23 percent versus 14 percent) and students approved to receive meal benefits (23 percent versus 15 percent).

E. Factors Associated with Student Satisfaction

This section presents results of multivariate analyses that explored relationships between student satisfaction with school meals and key characteristics of the meals, schools, and students. The outcome used in this analysis was the percentage of students satisfied with school lunches or breakfasts. Students considered to be satisfied with school meals reported that they liked school lunches or breakfasts rather than saying they didn’t like the meal or that the meal was “just okay.”⁵⁵ The analysis samples were limited to students who ever reported eating a school meal (separate analyses were conducted for NSLP lunches and SBP breakfasts). Analysis samples included 1,711 students in 287 schools for the NSLP and 899 students in 245 schools for the SBP.

1. Factors Associated with Student Satisfaction with NSLP Lunches

Overall, there were few significant associations between student satisfaction with NSLP lunches and the characteristics examined in this analysis; however, some significant associations were noted for specific school types. Key findings are summarized below; detailed findings are presented in tables in Appendix D.

Key Characteristics of NSLP Lunches (Table D.19)

Overall, there was no significant relationship between student satisfaction with NSLP lunches and the overall nutritional quality of the lunches. This was also true for elementary schools and high schools. However, among middle schools, the percentage of students satisfied with school lunches was significantly higher among schools with HEI-2010 scores in the second,

⁵⁵ See Chapter 3, Figures 3.1 and 3.3.

third, and fourth quartiles of the distribution, relative to schools with HEI-2010 scores in the lowest quartile of the distribution (35 to 38 percent versus 20 percent).

Overall, there were no significant associations between student satisfaction with NSLP lunches and compliance with any of the nine NSLP nutrition standards examined in this analysis. However, some significant associations were observed for specific school types. Among elementary and middle schools, meeting the Target 1 sodium limit was associated with significantly lower levels of student satisfaction (43 percent versus 64 percent for elementary schools and 27 percent versus 49 percent for middle schools). This general pattern was also observed for high schools and all schools combined, but the associations were not statistically significant. Among middle schools, meeting the weekly quantity requirement for meats/meat alternates was associated with a significantly lower level of student satisfaction (27 percent versus 37 percent). Among high schools meeting the weekly quantity requirement for vegetables was associated with a significantly higher level of student satisfaction (27 percent versus 9 percent).

Overall, not offering French fries or similar potato products on any daily menu was associated with a significantly lower level of student satisfaction (30 percent versus 39 percent). In addition, offering breaded meat on at least one daily menu was associated with a significantly lower level of student satisfaction overall (34 versus 43 percent). The significant, negative association between student satisfaction and offering breaded meats was driven by a particularly large difference in satisfaction among high schools (18 percent versus 48 percent).

Among elementary schools, schools that offered a median of 5 vegetable choices per day had a significantly higher level of student satisfaction than a reference category of schools that offered a median of 2 or fewer vegetable choices per day (79 percent versus 42 percent). Student satisfaction rates were also generally higher for weekly menus that offered red or orange vegetables more than half of the days, but this association was only statistically significant among middle schools (40 percent versus 20 percent).

Key Characteristics of School Foodservice Operations (Table D.21)

Although NSLP participation rates overall were significantly higher in schools that used any number of HealthierUS Smarter Lunchroom Techniques (Figure 4.2), student satisfaction with NSLP lunches was generally lower in these schools, relative to schools that used no Smarter Lunchroom techniques. Overall, this association was statistically significant among schools that used 2 or 3 techniques compared to schools that used none (34 percent versus 44 percent). The pattern of student satisfaction being lower in schools that used HealthierUS Smarter Lunchroom Techniques was also observed among elementary schools and middle schools.

Among high schools, use of 1 Smarter Lunchroom Technique was associated with a particularly low level of satisfaction, relative to high schools that used none of the techniques (9 percent versus 32 percent). However, satisfaction rates in high schools that used 2 or more techniques were much closer to satisfaction rates in high schools that used none. This suggests that, among high schools, use of 1 technique may be correlated with unobservable factors that influenced student satisfaction with school lunches.

Among middle schools, participation in a food purchasing cooperative and use of a FSMC were both associated with significantly higher levels of student satisfaction (36 percent versus 24 percent and 45 percent versus 26 percent, respectively). Among high schools, offering brand-name or chain restaurant foods was associated with a significantly higher level of student satisfaction (45 percent versus 20 percent), whereas the use of a cycle menu was associated with a significantly lower level of satisfaction (18 percent versus 32 percent).

Overall, schools that offered free lunches to all students had a significantly lower level of student satisfaction than schools that charged \$2.25 or less for paid lunches (26 percent versus 38 percent). The pattern was observed for all three school types, but the association, relative to schools that charged \$2.25 or less for paid lunches, was statistically significant only for middle and high schools (15 percent versus 30 percent for middle schools; 6 percent versus 27 percent for high schools). There were no significant associations between student satisfaction and the price charged for a paid lunch.

Key Characteristics of the School Food Environment (Table D.23)

Overall, none of the characteristics of the school food environment examined in this analysis, including characteristics related to wellness policies and practices, availability of competitive foods, and meal service practices, were associated with significant differences in student satisfaction with NSLP lunches. The same was true for analyses of specific school types, where only one isolated significant association was found, among the 33 associations that were tested across school types.

Key Characteristics of Students, Schools, and SFAs (Table D.25)

Overall, gender was the only student characteristic analyzed that was associated with significantly different rates of student satisfaction with NSLP lunches. Females were less likely than males to be satisfied with NSLP lunches (31 percent versus 40 percent). This general pattern was observed for all three school types, but the association was statistically significant only among middle schools.

Overall, student satisfaction with NSLP lunches was significantly higher in the Northeast region, relative to the Mid-Atlantic reference group (53 percent versus 33 percent). This pattern was observed for all three school types, but was statistically significant only among elementary schools and middle schools. Among middle schools, student satisfaction was significantly higher in several regions compared to the Mid-Atlantic reference group, but this is likely due to Mid-Atlantic middle schools being associated with a particularly low level of satisfaction compared to middle schools in other regions.

2. Factors Associated with Student Satisfaction with SBP Breakfasts

Similar to the preceding analysis of NSLP lunches, there were relatively few significant associations, overall, between student satisfaction with SBP breakfasts and the characteristics examined in this analysis. However, there were some significant associations for specific types of schools. Key findings are summarized below and detailed findings are presented in tables in Appendix D.

Key Characteristics of SBP Breakfasts (Table D.27)

There was no significant association, overall or for specific school types, between the student satisfaction with SBP breakfasts and the nutritional quality of the breakfasts.

Overall, there was only one significant relationship between student satisfaction with SBP breakfasts and compliance with the five SBP nutrition standards examined in this analysis. Meeting the Target 1 sodium limit was associated with a significantly lower level of student satisfaction (53 percent versus 63 percent). This relationship was also observed for all three school types, with statistically significant differences in student satisfaction among students in elementary schools and high schools (58 percent versus 83 percent for elementary schools and 29 percent versus 54 percent for high schools).

For both middle schools and high schools, meeting the maximum calorie limit was associated with significantly higher levels of student satisfaction (59 percent versus 30 percent for middle schools and 48 percent versus 8 percent for high schools). Among middle schools, meeting the daily quantity requirement for grains was associated with a significantly lower level of student satisfaction (43 percent versus 62 percent).

Overall, offering pizza or pizza products on at least one daily menu was associated with a significantly lower rate of student satisfaction (51 percent versus 59 percent). The association between student satisfaction and the frequency of offering pizza and pizza products was driven by a relatively large difference in satisfaction among elementary school students (60 percent versus 70 percent). Finally, among elementary schools, offering cold cereal every day was associated with a significantly higher level of student satisfaction (74 percent versus 59 percent).

Key Characteristics of School Foodservice Operations (Table D.29)

Overall, there were no statistically significant associations between student satisfaction with SBP breakfasts and the characteristics of school foodservice operations examined in this analysis.

Among elementary schools, the presence of policies for accommodating students with food allergies or special dietary needs (reported by SNMs) was associated with a significantly lower rate of student satisfaction (63 percent versus 89 percent). Among middle schools, participation in a food purchasing cooperative was associated with a significantly higher rates of student satisfaction (57 percent versus 37 percent). Also among middle schools, offering brand-name foods and use of a FSMC were each associated with a significantly lower rate of student satisfaction (21 percent versus 51 percent and 31 percent versus 53 percent, respectively).

Key Characteristics of the School Food Environment (Table D.31)

There were few significant associations between student satisfaction with SBP breakfasts and characteristics of the school food environment examined in this analysis. For all schools combined, the only characteristic that was associated with student satisfaction was the timing of bus arrivals. Students in schools in which the last bus arrived before or at the same time as breakfast service started had a significantly lower level of student satisfaction than students in schools with later bus arrivals (that is, buses that arrived after breakfast service started) (47

percent versus 58 percent). This association was driven by elementary schools (54 percent versus 69 percent), and this pattern was not observed for middle schools or high schools.

Among elementary schools, the presence of competitive foods standards that exceeded the Federal Smart Snacks in School standards was associated with a significantly higher level of student satisfaction (83 percent versus 61 percent).⁵⁶ Among high schools, the availability of vending machines was associated with a significantly higher level of student satisfaction (39 percent versus 12 percent).

Key Characteristics of Students, Schools, and SFAs (Table D.33)

Overall, students in the “other” race category (those who did not identify as black, Hispanic, or white) were less likely than otherwise similar non-Hispanic white students to be satisfied with SBP breakfasts (36 percent versus 56 percent). This pattern was observed for students in each school type separately but was statistically significant only among elementary school students (35 percent versus 66 percent). Among middle schools, non-Hispanic black students were significantly more likely to be satisfied with SBP breakfasts relative to non-Hispanic white students (77 percent versus 38 percent).

Overall, students with better health (as reported by parents) generally had a higher level of satisfaction with SBP breakfasts. However this association was only statistically significant for students reported to be in “good” health compared to students reported to be in either “fair” or “poor” health (63 percent versus 45 percent).

Among high schools, schools with 1,000 or more students had a significantly lower level of student satisfaction than schools with fewer than 500 students (24 percent versus 57 percent). Also among high schools, schools located in FNS’s Northeast and Western regions had significantly higher levels of student satisfaction than high schools in the reference Mid-Atlantic region (63 and 74 percent versus 22 percent). In addition, high schools in rural locations also had a significantly lower level of student satisfaction than high schools in urban locations (28 percent versus 63 percent).

F. Factors Associated with Parent Satisfaction

This section presents results of multivariate analyses that explored relationships between parent satisfaction with school meals and key characteristics of the meals, schools, and students.⁵⁷ Because relatively few parents reported that they were very dissatisfied with school meal (see Chapter 3, Tables 3.3 and 3.6), the parent satisfaction outcome was structured as an ordinal response with three levels: (1) very satisfied, (2) somewhat satisfied, and (3) either somewhat or very dissatisfied. Ordered logit regressions were used to analyze the relationships between the characteristics of interest and parent satisfaction. With this type of analysis, variables that are found to be associated with significantly different rates of one response will

⁵⁶ The Smart Snacks in School standards specify nutrition standards for all foods sold in schools. The goal of the standards is to ensure that foods sold in competition with school meals are consistent with the *Dietary Guidelines for Americans*.

⁵⁷ The survey items that assessed parents’ satisfaction with school meals did not ask whether parents had ever eaten a school meal or ask about the sources of information that influenced their opinions/satisfaction.

almost always show statistically significant associations for all other possible outcome responses since the universe of respondents is balanced across response categories. For this reason, the discussion of findings focuses on the association between key characteristics of the meals, schools, and students and the percentage of parents who were “very satisfied” with school meals.

Moreover, because preliminary analyses revealed relatively few significant associations between parent satisfaction and the key characteristics examined in these analyses, relative to the preceding analyses of student participation and satisfaction, analyses of parent satisfaction focused on all schools combined. Analyses were limited to parents with students who had ever eaten a school meal (separate analyses were conducted for NSLP lunches and SBP breakfasts). Analysis samples included 1,793 parents of students in 288 schools for the NSLP and 802 parents of students in 235 schools for the SBP.

1. Factors Associated with Parent Satisfaction with NSLP Lunches

Overall, there were few significant associations between parent satisfaction with NSLP lunches and the characteristics examined in this analysis. Key findings are summarized below and detailed findings are presented in tables in Appendix D.

Key Characteristics of NSLP Lunches (Table D.35)

There was no consistent pattern of association between parent satisfaction and HEI 2010 scores for NSLP lunches. The proportion of parents who were very satisfied with NSLP lunches were somewhat lower among schools with HEI-2010 scores in the second, third, and highest quartiles of the distribution, relative to lunches with scores in the lowest quartile. However, the association between HEI-2010 scores and the percentage of parents who reported being very satisfied with NSLP lunches was statistically significant only for schools with scores in the second quartile, relative to schools in the lowest quartile (21 percent versus 27 percent). In contrast, the association between HEI-2010 scores and the percentage of parents who reported being not satisfied with NSLP lunches was significantly higher for schools with scores in the second quartile relative to schools in the lowest quartile (29 percent versus 23 percent). The fact that a significant relationship was not observed for the third and highest quartiles of the HEI-2010 distribution suggests that there is not a strong relationship between the nutritional quality of lunches and parent satisfaction with the lunches.

There were no significant relationships between parent satisfaction with NSLP lunches and compliance with any of the nine NSLP nutrition standards examined in this analysis. Significant associations between parent satisfaction and the types of foods offered in NSLP lunches were observed for two of the eight characteristics examined. Offering red or orange vegetables on at least half of daily NSLP menus and offering a side salad bar at least one day per week were each associated with significantly higher percentages of parents who reported being very satisfied with NSLP lunches—(28 percent versus 22 percent for the frequency of red or orange vegetables and 30 percent versus 24 percent for the frequency of side salad bars).

Key Characteristics of School Foodservice Operations (Table D.37)

Only three of the 14 characteristics of school foodservice operations examined were associated with significant differences in parent satisfaction with NSLP lunches. Participation in a food purchasing cooperative was associated with a significantly higher percentage of parents

who were very satisfied with NSLP lunches (28 percent versus 21 percent). In addition, the percentage of parents who were very satisfied with NSLP lunches was significantly lower among schools that received fully or partially prepared meals from a production or central kitchen (20 percent versus 25 percent). Finally, the price charged for paid NSLP lunches was negatively associated with parent satisfaction. Among schools that charged more than \$2.25 for a paid meal, between 20 and 21 percent of parents were very satisfied with school lunches, compared to 28 percent of parents in the reference group of schools that charged \$2.25 or less.

Key Characteristics of the School Food Environment (Table D.39)

Of the 10 characteristics of school food environments examined in this analysis, only one was associated with significant differences in parent satisfaction with NSLP lunches. The operation of a school garden was associated with a significantly lower percentage of very satisfied parents (14 percent versus 25 percent).

Key Characteristics of Students, Schools, and SFAs (Table D.41)

Parents of students that were certified for free or reduced-price meal benefits were significantly more likely to be very satisfied with NSLP lunches than parents of otherwise similar students that were not certified for meal benefits (31 percent versus 17 percent). Parents of students in rural schools were significantly less likely to be very satisfied with NSLP lunches than parents of students in urban schools (18 percent versus 25 percent), and parents of students in FNS's Southwest region were significantly more likely than parents of students in the reference Mid-Atlantic region to be very satisfied with NSLP lunches (29 percent versus 21 percent).

2. Factors Associated with Parent Satisfaction with SBP Breakfasts

Similar to the preceding analysis of NSLP lunches, there were relatively few significant associations between parent satisfaction with SBP breakfasts and the characteristics examined in this analysis. Key findings are summarized below and detailed findings are presented in tables in Appendix D.

Key Characteristics of SBP Breakfasts (Table D.43)

There was no significant association between parent satisfaction with SBP breakfasts and the nutritional quality of the breakfasts. Of the five SBP nutrition standards examined in this analysis, only one was significantly associated with parent satisfaction. Meeting the requirement that at least half of grains are whole grain-rich was associated with a significantly lower percentage of parents that were very satisfied with SBP breakfasts (40 percent versus 64 percent). There was only one significant association between parent satisfaction with SBP breakfasts and the characteristics of breakfast offerings examined in this analysis. Specifically, not offering French fries or similar potato products on daily menus was associated with a significantly higher percentage of parents who were very satisfied with SBP breakfasts, relative to schools that did offer these products (47 percent versus 38 percent), and a significantly lower percentage of parents who were not satisfied (10 percent versus 14 percent).

Key Characteristics of School Foodservice Operations (Table D.45)

Of the 12 characteristics of school foodservice operations examined in this analysis, only one—the availability of a “grab-and-go” breakfast option—was significantly associated with parent satisfaction with SBP breakfasts. Offering a “grab-and-go” option at breakfast was associated with a significantly higher percentage of parents who were very satisfied with SBP breakfasts (53 percent versus 40 percent). Isolated significant associations were observed between the price charged for a paid breakfast and parent satisfaction in two of the three school-type-specific models, but the patterns were not consistent across ranges of meal prices or across models.

Key Characteristics of the School Food Environment (Table D.47)

There were few significant associations between parent satisfaction with SBP breakfasts and characteristics of the school food environment examined in this analysis. The presence of nutrition standards for school meals that exceeded Federal standards was associated with a higher percentage of parents being very satisfied with SBP breakfasts (46 percent versus 38 percent). The availability of school stores and snack bars that sold foods and beverages was also associated with a higher percentage of parents being very satisfied with SBP breakfasts (50 percent versus 38 percent).

Key Characteristics of Students, Schools, and SFAs (Table D.49)

Few characteristics of students or schools were associated with significantly different levels of parent satisfaction with SBP breakfasts. Parents of students in rural schools were less likely to be very satisfied with SBP breakfasts than parents of students in urban schools (31 percent versus 44 percent). Parents of students in FNS’s Midwest region were significantly more likely to be very satisfied with SBP breakfasts than parents of students in the Mid-Atlantic reference region (50 percent versus 33 percent).

5. PLATE WASTE IN THE SCHOOL MEAL PROGRAMS

Plate waste is a measure of the amount of available food that is discarded (or not consumed). Some level of plate waste is inevitable in feeding programs like the school meal programs. Plate waste can be an important gauge of student satisfaction with meal offerings or can reflect menu planning that does not take students' food selection patterns into account. Moreover, the nutritional benefits of school meals cannot be realized if students do not eat an adequate proportion of foods provided (Buzby and Guthrie 2002). Plate waste varies as a function of individual student characteristics and preferences, but may also be influenced by policy and environmental factors at the school and SFA levels. For example, the OVS option, which allows students to decline some components of a reimbursable meal, is explicitly intended to reduce plate waste. Other factors that may affect plate waste include the time when meals are served and the amount of time students have to eat their meals (Cohen et al. 2015).

Since implementation of the updated nutrition standards starting in SY 2012–2013, some SFA directors and other stakeholders have been concerned about the potential for increased levels of plate waste in school meals (USDA, FNS 2016). The SNMCS is the first national study in more than two decades to examine plate waste in school meals, and is the first to examine the extent of plate waste since the updated nutrition standards went into effect.

This chapter begins with a brief overview of the methods used to collect and analyze the plate waste data (Section A). Additional details are provided in Appendix E. Sections B and C describe plate waste in NSLP lunches and SBP breakfasts, respectively, in terms of the types of foods wasted as well as the proportion of available calories, nutrients, and USDA Food Pattern food groups wasted. Section D presents results of multivariate analyses that examined the relationships between plate waste in the NSLP and key characteristics of the meals (including overall nutritional quality), school foodservice operations, and the school food environment. Section E presents findings for parallel multivariate analyses of plate waste in the SBP.

Tables and figures in the chapter present key results; supplementary tables are provided in Appendix F, as noted throughout the chapter. Findings for descriptive analyses are generally presented separately for elementary, middle, and high schools. Findings for multivariate analyses are generally presented for all schools combined. Supplementary tables provided in Appendix F summarize findings by school type.

A. Methods Used to Collect and Analyze Plate Waste Data

Plate waste observations were conducted in 170 schools that participated in the NSLP within 57 SFAs (3 schools per SFA in 56 SFAs and 2 schools per SFA in one SFA).⁵⁸ To ensure that the required number of reimbursable meals could be observed on one day, schools recruited for

⁵⁸ As described in this section and in Appendix E, the number of schools and SFAs included in the final analysis sample was smaller.

this part of the study had to serve a minimum number of reimbursable lunches per day.⁵⁹ In addition, meals had to be served in cafeterias, and students had to consume their meals in cafeterias so field interviewers could record information on foods taken and wasted from a single, central location. For these reasons, findings from the plate waste analyses are representative of public, non-charter schools that offer the NSLP, serve a minimum number of lunches per day,⁶⁰ and serve meals in cafeteria-based settings.

Observations were conducted in cafeterias on one day during a specific week when SNMs were completing the Menu Survey (see Chapter 1), which collected detailed data about the foods offered and served in reimbursable meals. Prior to conducting the observations, field interviewers recorded the name/description and portion size of all foods offered in reimbursable meals that day and purchased servings of non-packaged foods for use as visual points of reference for a single portion. Thus, field interviewers established a reference portion for a single portion of each food.

During meal periods, field interviewers stood near a point-of-sale or other predetermined location that allowed them to clearly observe trays that included reimbursable meals. The goal for lunch was 30 completed observations, and the goal for breakfast was 15 completed observations. To ensure that these goals were met, field interviewers observed 40 randomly selected lunch trays and 25 breakfast trays. Observations were spread evenly across all meal periods and serving lines.

For each observed tray, field interviewers recorded the specific foods students selected and the number of portions taken, based on the established reference portion. (Foods that were available only for a la carte purchase or obtained from other sources were not observed.) Observed trays were tagged and students were asked to return their trays to a designated area by the end of the meal period. Field interviewers also recorded the students' gender (based on observation). Field interviewers observed all returned trays and, using a validated method, visually estimated the proportion of solid foods remaining by recording 0 (no food remaining), 1 (all of the food remaining, that is, none was consumed), or $\frac{1}{4}$, $\frac{1}{2}$, or $\frac{3}{4}$.⁶¹ Amounts of remaining liquids were directly measured using a liquid measuring cup.

To analyze the plate waste data, the study team linked foods from each plate waste observation to the corresponding item in the school's Menu Survey data. The Menu Survey data provided the gram weight and calorie, nutrient, and USDA Food Pattern food group content of one portion of the food. The study team combined data on gram weights with information about

⁵⁹ The minimum number of lunches served per day in the final sample of schools included in the plate waste analysis were 157 lunches for elementary schools, 220 for middle schools, and 87 for high schools.

⁶⁰ Data for the full sample of schools that completed the SNMCS Menu Survey indicate that, in SY 2014-2015, more than three-quarters of all NSLP schools served the minimum number of lunches per day reflected in the plate waste sample (78 percent of elementary schools, 77 percent of middle schools, and 90 percent of high schools).

⁶¹ Hanks, Wansink, and Just (2014) compared three visual estimation methods for assessing plate waste in school lunches (quarter-waste method, half-waste method, and photographic method) to weighed plate waste. The method used in this study—the quarter-waste method, in which waste is measured in quarter-waste increments, was found to be the most reliable visual estimation method.

the number of portions taken and portions remaining to estimate the amount and percentage of each observed food that was wasted. Similarly, the study team combined data on calorie, nutrient, and USDA Food Pattern food group content with information about the number of portions taken/remaining to estimate the percentage of available calories, nutrients, and USDA Food Pattern food group equivalents that were wasted.

Menu Survey data were not available for some of the schools in which plate waste observations were conducted. In addition, some observed trays had to be dropped from the analysis because one or more items on the tray could not be matched to a food recorded in the Menu Survey. Thus, the final analysis sample included 165 schools and 6,253 trays for lunch and 154 schools and 3,601 trays for breakfast (some sampled schools did not offer the SBP). Even with these reductions, the final average number of trays observed per school (38 for lunch and 23 for breakfast) exceeded initial targets.

Because of the complex eligibility requirements for the plate waste sample, it was not possible to prepare standard unbiased sampling weights for the plate waste analysis. Instead, the study team used a regression-based approach to develop school-level weights for the descriptive analyses presented in Sections B and C. Findings presented in these sections are representative of public, non-charter schools that offer the NSLP, serve meals in cafeteria-based settings, and serve a minimum number of lunches per day. It was not possible to extend the regression-based approach to develop tray-level weights. Thus, tray-level analyses that examined factors associated with plate waste were unweighted. Findings from these analyses should be considered exploratory and interpreted with caution. Additional details about the collection and analysis of the plate waste data are provided in Appendix E.⁶²

B. Plate Waste in the NSLP

This section begins with a description of the amount of plate waste observed for specific types of food. Subsequent sections explore the implications of plate waste for the nutritional benefits the NSLP aims to deliver to participating students by describing (1) the percentage of available USDA Food Pattern food group equivalents wasted and (2) the percentage of available calories and nutrients wasted. The statistical significance of differences between elementary, middle, and high schools was tested.⁶³ The differences discussed in the text were significant at least at the 0.05 level, unless otherwise noted. Rules for flagging potentially unreliable point estimates were also applied (see Chapter 1).

1. Extent of Plate Waste for Specific Types of Food in NSLP Lunches

To describe the extent of plate waste in the NSLP, foods observed on the sample of lunch trays were grouped into seven major food groups: milk, vegetables, fruits and 100% fruit juices, combination entrées, separate grains/breads, meats and meat alternates, and desserts and other menu items. Foods in each major food group were then subdivided into minor groups based on

⁶² Additional details about the sampling and weighting of schools for the plate waste study are provided in the SNMCS methodology report (Zeidman et al. 2019).

⁶³ Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample design of the SNMCS.

characteristics that affect nutrient content, including ingredients and preparation methods. Table H.1 provides examples of the specific types of foods included in each minor food group category.

Table 5.1 presents data on the mean percentage of food wasted on the observed lunch trays, overall, and by school type. The estimates reflect school-level means. Observations were first averaged within each school to produce school-level estimates of average plate waste. These estimates were then averaged across all schools in the plate waste sample, overall and by school type. The table is limited to foods that appeared in at least five percent of daily NSLP menus and were observed on at least five percent of trays in one or more school types.

Overall, plate waste at lunch was highest for vegetables—an average of 31 percent of the vegetables included on observed trays was wasted—followed by milk (29 percent), fruits and 100% fruit juice (26 percent), and separate grains/breads (23 percent). Mean percentages wasted were lower for desserts and other menu items (20 percent), and were lowest for combination entrées and meats/meat alternates (16 percent and 14 percent, respectively). These findings are generally comparable to findings from studies that examined plate waste prior to implementation of the updated nutrition standards.⁶⁴ Moreover, small, local studies that examined plate waste before and after implementation of the updated nutrition standards found that levels of plate waste were reduced or unchanged.⁶⁵

Plate waste in the NSLP was highest for vegetables—an average of 31 percent of the vegetables included on observed trays was wasted—followed by milk (29 percent), fruits and 100% fruit juice (26 percent), and separate grains/breads (23 percent). Waste was lowest for combination entrées (16 percent) and meats/meat alternates (14 percent).

For each major food group, the mean percentage wasted was higher in elementary schools than in middle or high schools and was higher in middle schools than in high schools. The vast majority of these differences were statistically significant. This pattern of findings may be partially explained by differences in the use of the OVS option, which allows students to decline some components of a reimbursable meal as way of providing choice and reducing waste. OVS is mandatory for high schools but optional for elementary and middle schools (81 percent of all elementary and middle schools used OVS at lunch; Forrestal et al. 2019).⁶⁶ Findings from multivariate analyses presented in Section D.3 found that the use of OVS was associated with significantly lower levels of waste in elementary schools.

⁶⁴ St. Pierre et al. 1992 and General Accounting Office 1996.

⁶⁵ See Cullen, Chen, and Dave 2015, and Schwartz et al. 2015.

⁶⁶ Students in schools that do not use OVS cannot decline a required component of a reimbursable lunch, but they may be able to choose from two or more options. For example, students may select a specific type of milk or fruit.

Table 5.1. Mean Percentage of Observed Trays including Specific Foods and Mean Percentage of Observed Foods Wasted in NSLP Lunches

	Elementary Schools		Middle Schools		High Schools		All Schools	
	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted
Milk	89.8*	35.0*	77.5†	24.4†	66.9#	15.2#	82.7	28.9
Fat-free	75.3*	33.7*	59.1	23.7†	51.6#	13.7#	67.4	27.6
Flavored	69.8*	33.1*	55.9	22.3†	48.0#	12.7#	62.7	26.9
Unflavored	5.5	35.3	3.2^	42.3†	3.7	20.4^	4.8	33.5
Low-fat (1%)	14.5	43.4*	18.2	23.1	14.9	18.3#	15.2	34.3
Flavored	1.7^	14.5	6.1^	25.2^	2.7^	13.4	2.6^	17.9
Unflavored	12.8	43.8*	12.1	25.4	12.2	18.6#	12.6	35.0
Vegetables^a	68.3*	36.9*	54.2	25.2	45.5#	18.8#	60.9	30.9
Cooked vegetables ^a	52.7*	34.5*	38.7	20.4	38.7	18.9#	47.4	28.9
Starchy vegetables	31.3	27.7	23.4	18.3	26.5	12.5#	29.0	23.0
French fries and similar potato products	12.8^	17.3*	13.6^	5.3	16.5	7.0#^	13.8	12.4
Corn	5.3^	21.5	4.2^	34.3^	3.7^	7.9^	4.8^	19.1
White potatoes	8.8^	30.9	5.0^	18.7	3.4^	22.1^	7.0^	26.9
Green peas	5.1^	41.4	0.6^	31.2^	1.1^	16.2#^	3.5^	36.7
Red/orange vegetables	5.7^	40.1*	4.7^	16.1	4.4^	26.7	5.2^	34.0
Other vegetables	6.7^	38.0	8.2^	30.6	2.6^	33.5	6.0	35.7
String beans	6.7^	38.0	6.3^	34.5	1.5^	30.2	5.5^	36.4
Vegetable mixtures ^b	7.2^	58.9*	1.5^	21.4	2.1^	21.8#	5.1^	42.9
Raw vegetables	23.6	39.1	21.4†	30.3	10.2#	20.2#	20.2	33.4
Red/orange vegetables	8.7	35.4	7.5	24.8	5.0^	17.2#	7.7	30.2
Carrots	8.5	39.9*	6.9	21.6	4.7^	18.7#	7.4	32.8
Vegetable mixtures ^b	5.3	33.8	7.0	30.5	3.4	24.7	5.2	30.8
Dark green vegetables	6.7	31.3	5.2	20.5	1.4#	24.5	5.3	29.1
Other vegetables	5.8	39.9	2.7†	28.1	0.6	12.6#	4.1	34.0
Fruits and 100% Fruit Juices	82.1	28.8*	74.5	22.7†	69.9#	18.2#	78.2	25.5
Fresh fruit	34.6	32.5*	39.9	23.5	39.1	19.2#	36.5	27.3
Apple	14.6	31.5	19.3	29.4	18.9	24.7	16.3	28.8
Orange	7.8	32.6	5.9	21.8	4.2	18.4	6.7	26.5
Banana	5.4	27.3*	6.7	14.7	6.6	12.9#	5.9	20.3
Grapes	2.1	14.9	3.7	14.2	6.8	11.9	3.4	13.3
Canned fruit	42.6*	23.4	24.6	22.2	22.3#	16.0#	35.2	21.7
Peaches	6.0	25.0	6.1	22.1	4.8	20.1	5.7	23.4
Applesauce	13.4	23.8	5.3	14.8	7.0	16.9	10.7	20.8
Fruit cocktail	4.9	21.2	3.8	18.5	5.4	18.6	4.8	19.9
Pineapple	6.9	19.5	4.9	28.7†	1.7#	9.7	5.4	18.6
Mandarin oranges	5.7	7.6	1.3	33.2	2.8	9.3	4.3	11.6
100% Juice	9.0	31.4	14.0	18.3	16.0	11.3#	11.4	23.2

	Elementary Schools		Middle Schools		High Schools		All Schools	
	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted
Combination Entrées	59.8*	20.9*	75.7	12.5†	76.3#	7.7#	66.1	16.4
Entrée salads	1.6	40.4*	3.8	18.4	7.1#	21.2#	3.2	29.3
Sandwiches with plain meat or poultry	5.9	19.6	6.0	13.0	6.1	5.2#	6.0	14.4
Pizza	7.5*	15.0	19.8	8.5†	13.5	4.4#	10.8	8.6
Without meat	5.1	11.5	9.6	8.2†	8.4	3.7	6.6	7.2
With meat	2.4*	19.4	10.2	7.7	5.0	7.3	4.2	9.9
Mixtures with grain, meat/meat alternate and/or vegetables	9.1	28.3*	14.5	14.2	11.4	7.6#	10.5	19.7
Spaghetti with sauce; macaroni and cheese; and lasagna, ravioli, and stuffed shells	6.5	24.2	10.9	12.8	10.4	8.2#	8.1	16.7
Sandwiches with breaded meat, poultry, or fish	5.5	21.9*	5.5	8.1	9.7	5.3#	6.5	10.4
Mexican-style entrées ^c	6.4	17.0	4.8	14.2	6.3	16.9	6.1	16.5
Hamburgers	0.4	24.7*	3.2	10.7	5.1#	4.2#	1.9	10.9
Cheeseburgers and similar beef/pork sandwiches with cheese	5.6	13.2	5.2	11.1	7.1	5.9	5.9	10.2
Hot dogs and corn dogs	6.3	10.2	3.9	7.2	1.2	8.0	4.8	9.4
Pizza pockets, pizza sticks, and calzones	7.3	11.1*	2.3	5.2	4.5	5.9	5.9	8.5
Separate Grains/Breads	42.8*	25.6	19.2	21.0	29.6	16.3#	36.1	22.9
Breads, rolls, bagels, and other plain breads	23.3	25.7*	14.9	16.4	20.4	12.6#	21.3	20.8
Corn/tortilla chips	6.4*	27.4	0.0	NR	1.4	26.8	4.2	27.3
Meats/Meat Alternates	41.6*	18.4*	25.4	8.5	22.3#	5.9#	34.7	14.0
Chicken and turkey	26.7*	11.8	12.2	6.8	16.4	4.9#	22.1	9.1
Breaded/fried chicken nuggets, patties, and similar products	14.9*	10.0	4.1	8.1	6.0	3.1#	11.2	8.1
Plain (not breaded or fried) chicken and turkey	11.8	15.9	8.2	5.9	10.4	5.8	10.9	10.8
Other protein	5.5	31.5*	2.2	10.3	1.0	7.4#	4.0	24.4
Meat (plain or breaded/fried beef, pork)	3.8	15.0	7.0	10.7	4.5	5.0#	4.5	11.6
Desserts/Other Menu Items	8.1	28.7*	8.3	12.8	8.1	11.3#	8.1	19.7
Grain-based desserts ^d	7.3	28.4*	4.6	2.0†	4.5	9.8#	6.3	20.2
Number of Trays	2,186	2,186	2,109	2,109	1,958	1,958	6,253	6,253
Number of Schools	56	56	56	56	53	53	165	165

Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Note: Table is limited to food groups included in at least five percent of Menu Surveys and five percent of observed lunch trays for one or more school types.

^aIncludes 100% vegetable juices.

^bIncludes mixtures of vegetables from the dark green, red/orange, other, starchy, and beans/peas groups.

^cIncludes burritos, tacos, nachos, quesadillas, fajitas, and enchiladas.

^dIncludes cakes, brownies, fruit cobblers and crisps, granola bars and breakfast bars.

*Difference between elementary and middle schools is significantly different from zero at the 0.05 level.

†Difference between middle and high schools is significantly different from zero at the 0.05 level.

#Difference between elementary and high schools is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program; NR = Not reported because the percentage wasted could not be computed (since no trays included this food group).

^ Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

Milk

Milk was included in the majority of observed lunch trays (83 percent) and, overall, more than one-quarter (29 percent) of the milk included on observed lunch trays was wasted. Mean percentage wasted was highest for unflavored fat-free and low-fat milks (34 to 35 percent) and lowest for flavored low-fat milk (18 percent).⁶⁷

Elementary school lunch trays were more likely to include milk than lunch trays in either middle or high schools, and middle school lunch trays were more likely to include milk than high school lunch trays (90 percent, 78 percent, and 67 percent, respectively). In addition, the mean percentage of milk wasted was significantly higher in elementary schools than in middle or high schools, and was significantly higher in middle schools relative to high schools (35 percent, 24 percent, and 15 percent, respectively).

Vegetables

Overall, vegetables were included in more than half (61 percent) of observed lunch trays, and just under one-third (31 percent) of the vegetables included on observed lunch trays were wasted. Percentage wasted was notably lower for French fries and similar potato products relative to other types of vegetables (12 percent wasted versus 19 to 43 percent wasted). Mean percentage wasted was highest for cooked vegetable mixtures (43 percent) and cooked green peas (40 percent).

Elementary school lunch trays were more likely to include vegetables than were lunch trays in either middle or high schools (68 percent of trays versus 54 and 46 percent, respectively). The percentage of vegetables wasted was significantly higher in elementary schools than in middle or high schools (37 percent wasted versus 25 percent and 19 percent, respectively).

For most foods, levels of plate waste in the NSLP were consistently higher in elementary schools compared to middle and high schools, and in middle schools compared to high schools.

Fruits and 100% Fruit Juices

Fruit or 100% fruit juice was included in over three-quarters (78 percent) of observed lunch trays, and, overall, roughly one-quarter (26 percent) of the fruit/100% fruit juice included on observed lunch trays was wasted. Levels of plate waste were higher for fresh fruit than for canned fruit or 100% fruit juice (27 percent versus 22 and 23 percent, respectively). Mean percentage wasted was highest for fresh oranges and apples (27 to 29 percent) and was lowest for mandarin oranges and grapes (12 to 13 percent).

Elementary lunch school trays were more likely to include fruit or 100% fruit juice than lunch trays in high schools (82 percent of trays versus 70 percent). The pattern of plate waste was similar to the pattern observed for milk—mean percentage wasted was significantly higher

⁶⁷ Table 5.1 is limited to foods that were commonly offered and selected (see previous text). Mean waste may have been higher for foods that were less commonly offered and selected.

in elementary schools relative to middle or high schools, and was significantly higher in middle schools relative to high schools (29 percent, 23 percent, and 18 percent, respectively).

Combination Entrées

Two-thirds (66 percent) of observed lunch trays included a combination entrée, for example, sandwiches, mixed dishes, pizza, or entrée salads. The mean percentage wasted was notably lower for combination entrées than for milk, vegetables, or fruits/100% fruit juices. On average, 16 percent of the combination entrées included on observed lunch trays was wasted, compared to 29 percent of milk, 31 percent of vegetables, and 26 percent of fruits/100% fruit juices. Mean percentage wasted was notably higher for entrée salads than for other types of combination entrées (29 percent versus 7 to 20 percent).

Elementary school lunch trays were less likely to include combination entrées than were middle and high school lunch trays (60 percent of trays versus 76 percent for both middle and high schools). As observed for milk and fruit/100% fruit juice, mean percentage wasted for combination entrées was significantly higher in elementary schools than in either middle or high schools, and was significantly higher in middle schools than in high schools (21 percent, 13 percent, and 8 percent, respectively).

Separate Grains/Breads

More than one-third (36 percent) of observed lunch trays included a separate grain/bread—that is, a grain or bread that was not part of a combination entrée—and, on average, almost one-quarter (23 percent) of the separate grains/breads included on observed lunch trays was wasted. Mean percentage wasted for separate grains/breads was higher in elementary schools than in middle or high schools, and was higher in middle schools than in high schools. However, only the difference between elementary schools and high schools was statistically significant (26 percent versus 16 percent).

Meats/Meat Alternates

More than one-third (35 percent) of observed lunch trays included meats/meat alternates that were not part of a combination entrée. Compared to other major food groups, relatively little (14 percent) of the meats/meat alternates included on observed lunch trays was wasted. Relative to middle and high schools, a significantly larger share of elementary school lunch trays included meats/meat alternates (42 percent versus 25 and 22 percent, respectively). As observed for most of the other major food groups, the mean percentage of meats/meat alternates wasted was higher in elementary schools than in middle or high schools, and was higher in middle schools than in high schools. However, only the differences between elementary schools and middle and high schools were statistically significant (18 percent versus 9 and 6 percent, respectively).

Desserts/Other Menu Items

Overall, only eight percent of observed lunch trays included desserts or other menu items. On average, 20 percent of the desserts and other menu items included on observed lunch trays was wasted. In keeping with findings reported for most other major food groups, mean percentage wasted for desserts or other menu items was higher in elementary schools than in

middle or high schools, and higher in middle schools than high schools. However, only the differences between elementary schools and middle and high schools were statistically significant (29 percent versus 13 and 11 percent, respectively).

2. USDA Food Pattern Food Group Equivalents Wasted in NSLP Lunches

USDA Food Patterns describe the types and amounts of foods included in a dietary pattern that is consistent with the *Dietary Guidelines for Americans* (see Chapter 6). The USDA Food Patterns identify daily average amounts of foods to be consumed, in nutrient-dense forms, from five major food groups and their subgroups. They also provide an allowance for oils and a limit on empty calories—that is, calories from solid fats and added sugars. NSLP meals are planned using a meal pattern that is largely built around the USDA Food Pattern food groups⁶⁸, and are designed to provide 32 percent of students’ daily nutrient needs (Institute of Medicine 2010).

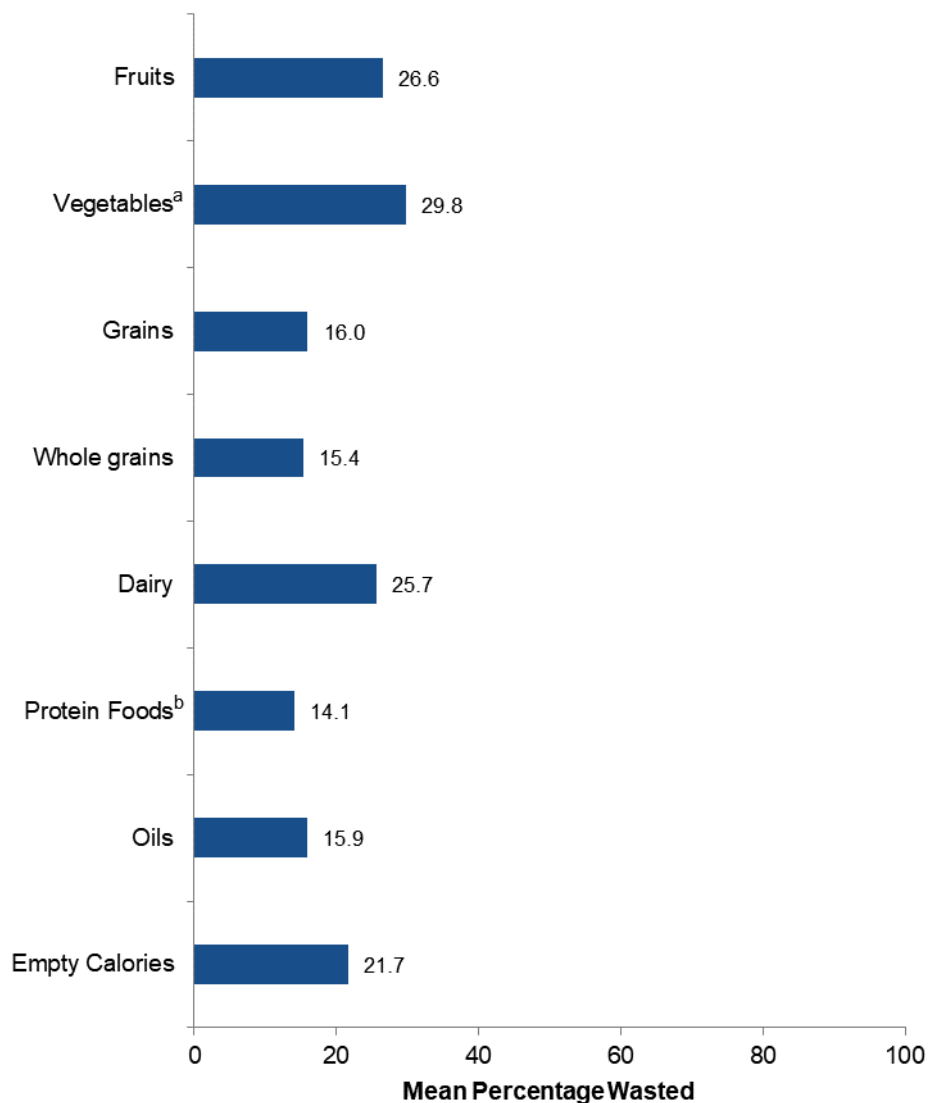
To assess the extent to which plate waste affects the ability of the NSLP to contribute to students’ consumption of recommended types and amounts of food, the study team estimated the amounts of USDA Food Pattern food group equivalents available in the foods included and remaining on observed lunch trays. The analysis estimated the percentages of available USDA Food Pattern food group equivalents that were wasted. For most USDA Food Pattern food groups, there was little variation in the mean amounts available on the lunch trays observed in elementary, middle, and high schools (Table F.1). The only exceptions were total grains and whole grains, where the mean amounts available were significantly higher in lunch trays observed in high schools than lunch trays observed in either elementary or middle schools (for total grains, 2.6 oz. equivalents versus 2.1 oz. equivalents, respectively, and for whole grains, 1.7 oz. equivalents versus 1.3 oz. equivalents).

The findings for USDA Food Pattern food groups were generally consistent with findings presented in the previous section on the extent of plate waste for specific types of food. Overall, waste was highest for vegetables—on average, 30 percent of the cup equivalents of vegetables available on the observed lunch trays was wasted (Figure 5.1). Percentages wasted were slightly lower for fruits and dairy (27 percent and 26 percent, respectively), and substantially lower for protein foods, total grains, whole grains, and oils (14 to 16 percent). On average, 22 percent of the empty calories available on the observed lunch trays was wasted.

On average, 30 percent of the cup equivalents of vegetables available on observed lunch trays was wasted. Mean percentages wasted were slightly lower for fruit and dairy (27 percent and 26 percent, respectively).

⁶⁸ There are two exceptions. In the NSLP, milk is considered a separate meal component, and other dairy foods such as yogurt and cheese are counted as meat alternates.

Figure 5.1. Mean Percentage of USDA Food Pattern Food Groups Wasted in NSLP Lunches, All Schools



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Notes: The USDA Food Pattern food groups are largely consistent with the meal components used in planning NSLP lunches, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

The fruits group includes both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

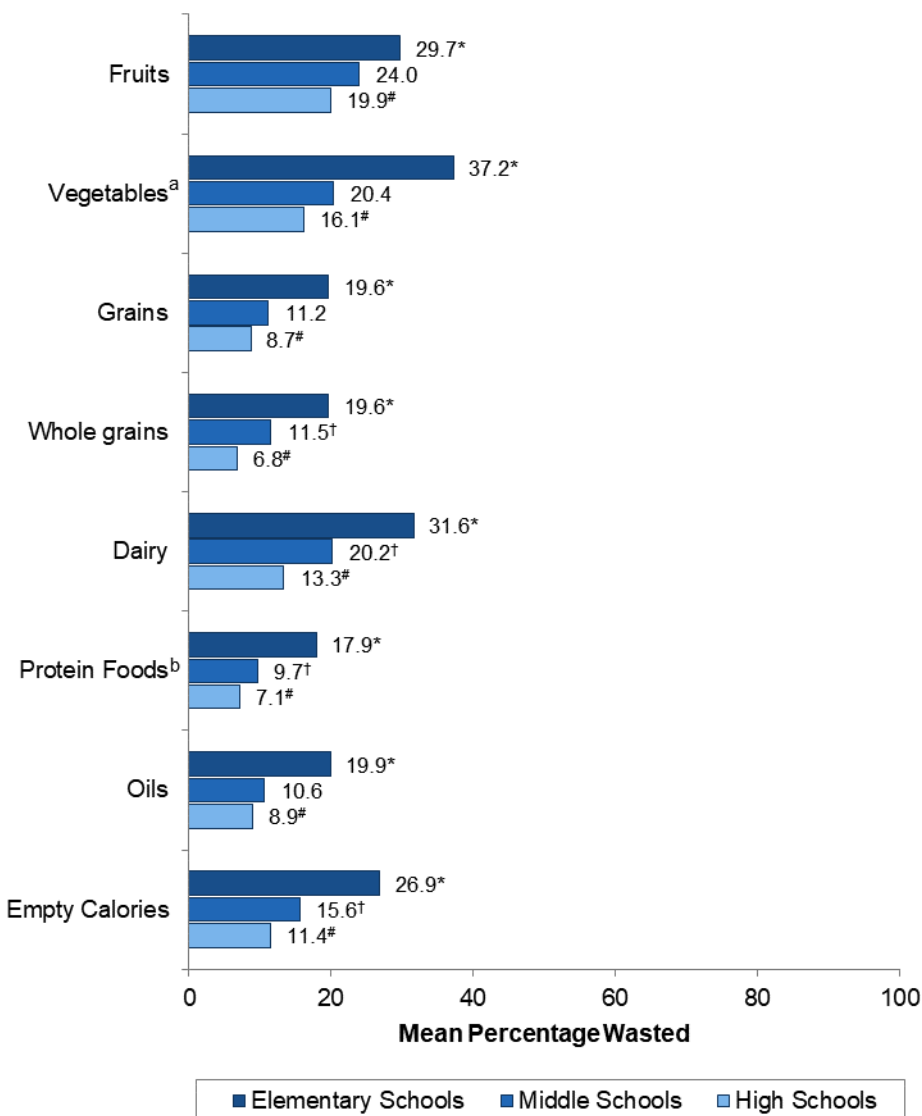
^aIncludes legumes credited as vegetables on the Menu Survey.

^bIncludes legumes credited as a meat alternate on the Menu Survey.

This general pattern was observed in all three school types. However, in keeping with plate waste findings for specific types of food, percentage wasted for all USDA Food Pattern food groups, as well as empty calories, was significantly higher in elementary schools than in either middle or high schools (Figure 5.2). The magnitude of the differences across school types was large. With one exception (fruits), the mean percentage of available USDA Food Pattern food groups wasted in elementary schools was more than two times higher than the mean percentage wasted in high schools and more than one and a half times higher than the mean percentage wasted in middle schools. There were also some significant differences between middle schools and high schools. On average, percentage wasted for available USDA Food Pattern food group equivalents was significantly higher in middle schools than in high schools for whole grains (12 percent versus 7 percent), dairy (20 percent versus 13 percent), and protein foods (10 percent versus 7 percent). This pattern was also observed for empty calories (16 percent versus 11 percent), especially empty calories from added sugars (19 percent versus 13 percent; Table F.2).

Patterns of waste observed for the vegetable subgroups were consistent with the pattern observed for vegetables overall. The mean percentage wasted was consistently higher for elementary schools than for either middle or high schools and, with one exception (legumes), all of these differences were statistically significant (Figure 5.3). For all vegetable subgroups, more than 30 percent of the cup equivalents available in elementary school lunch trays was wasted. In middle and high schools, the mean percentage wasted ranged from 15 to 23 percent. There was variation across school types in the vegetable subgroups with the highest and lowest percentage wasted. Vegetable subgroups with the lowest percentages wasted included starchy vegetables in elementary and middle schools, and red and orange vegetables in high schools. Vegetable subgroups with the highest percentages wasted included red and orange vegetables (elementary schools), dark green vegetables (middle schools), and legumes (high schools).

Figure 5.2. Mean Percentage of USDA Food Pattern Food Groups Wasted in NSLP Lunches, by School Type



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Notes: The USDA Food Pattern food groups are largely consistent with the meal components used in planning NSLP lunches, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

The fruits group includes both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

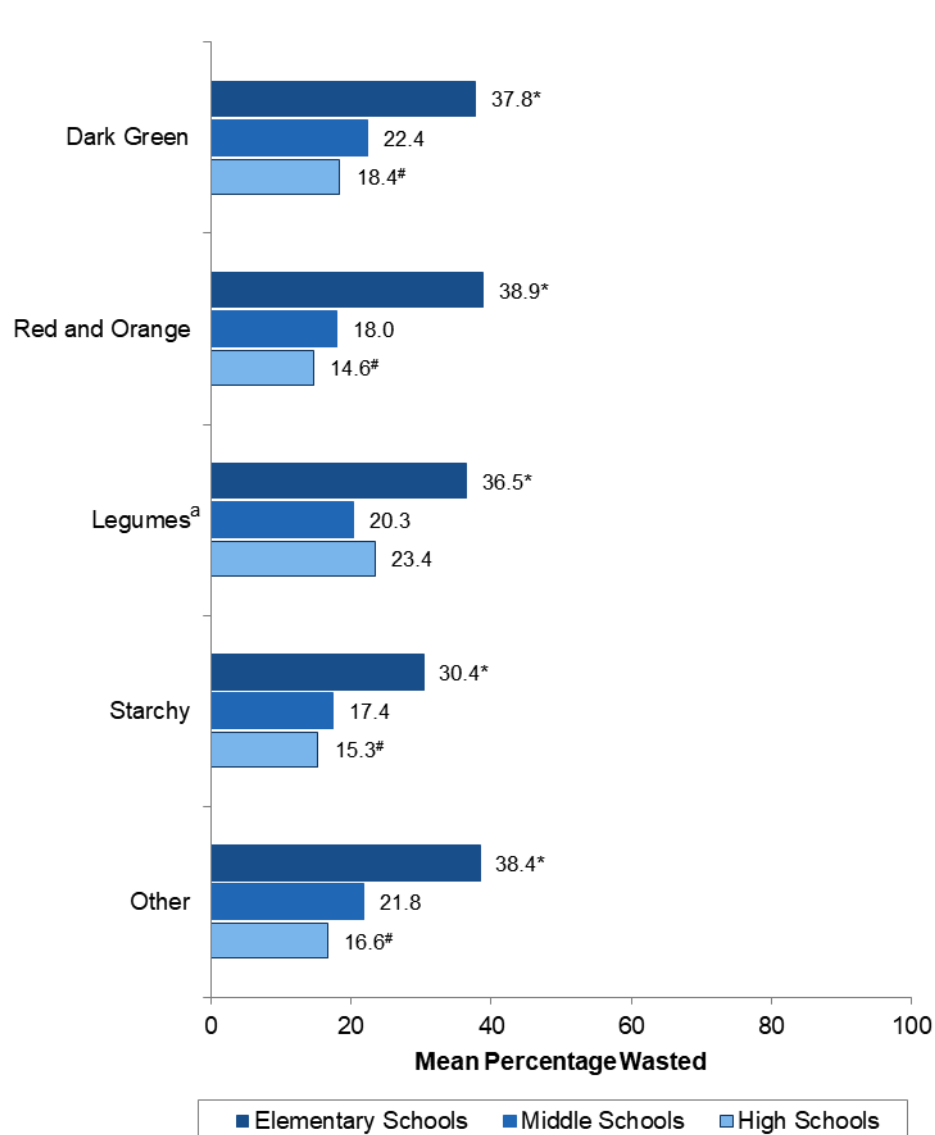
^aIncludes legumes credited as vegetables on the Menu Survey.

^bIncludes legumes credited as a meat alternate on the Menu Survey.

*Difference between elementary and middle schools is significantly different from zero at the 0.05 level.

[†]Difference between middle and high schools is significantly different from zero at the 0.05 level.

#Difference between elementary and high schools is significantly different from zero at the 0.05 level.

Figure 5.3. Mean Percentage of Vegetable Subgroups Wasted in NSLP Lunches

Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Note: None of the differences between middle schools and high schools are statistically significant.

^aIncludes legumes credited as vegetables on the Menu Survey.

*Difference between elementary and middle schools is significantly different from zero at the 0.05 level.

#Difference between elementary and high schools is significantly different from zero at the 0.05 level.

3. Calories and Nutrients Wasted in NSLP Lunches

The study team estimated the calorie and nutrient content of the foods available on the observed lunch trays and the foods wasted. These data were used to estimate the percentage of available calories and nutrients that were wasted. The average calorie and nutrient content of lunch trays observed in elementary and middle schools was similar (Table F.3). Not surprisingly, the lunch trays observed in high schools were significantly higher in calories than either elementary or middle school lunch trays. On average, the lunch trays observed in high schools also included significantly larger amounts of most nutrients than the lunch trays observed in elementary schools. There were fewer significant differences in the average nutrient content of lunch trays observed in middle and high schools. Findings on the mean percentage of available calories and key nutrients that were wasted are summarized below. Table F.4 provides data for additional nutrients.

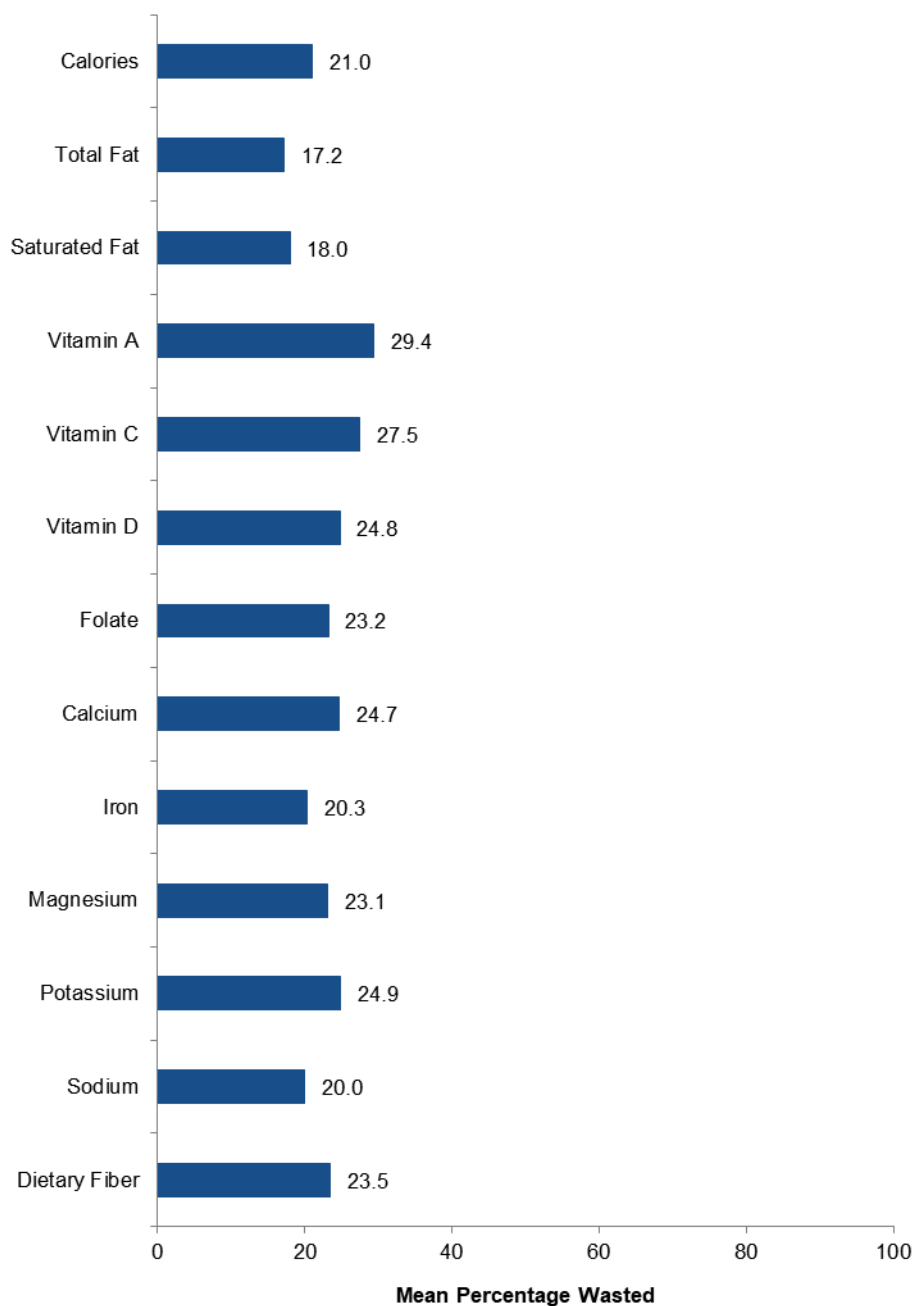
On average, about one-fifth (21 percent) of the calories available in NSLP lunches overall were wasted, as well as one-quarter or more of the available vitamin A, vitamin C, vitamin D, calcium, and potassium (Figure 5.4). Among the key nutrients examined, the average percentage wasted was lowest for total fat (17 percent), saturated fat (18 percent), iron (20 percent) and sodium (20 percent).

On average, about one-fifth (21 percent) of the calories available in NSLP lunches were wasted.

In keeping with the variation observed across school types in other plate waste outcomes, there was considerable variation across schools in the percentages of available calories and nutrients that were wasted. For calories and most of the nutrients examined, the average percentage wasted was significantly higher in elementary schools than in either middle or high schools, and was significantly higher in middle schools relative to high schools (Figure 5.5). The only exceptions were total fat and saturated fat, where differences between middle and high schools were not statistically significant.⁶⁹

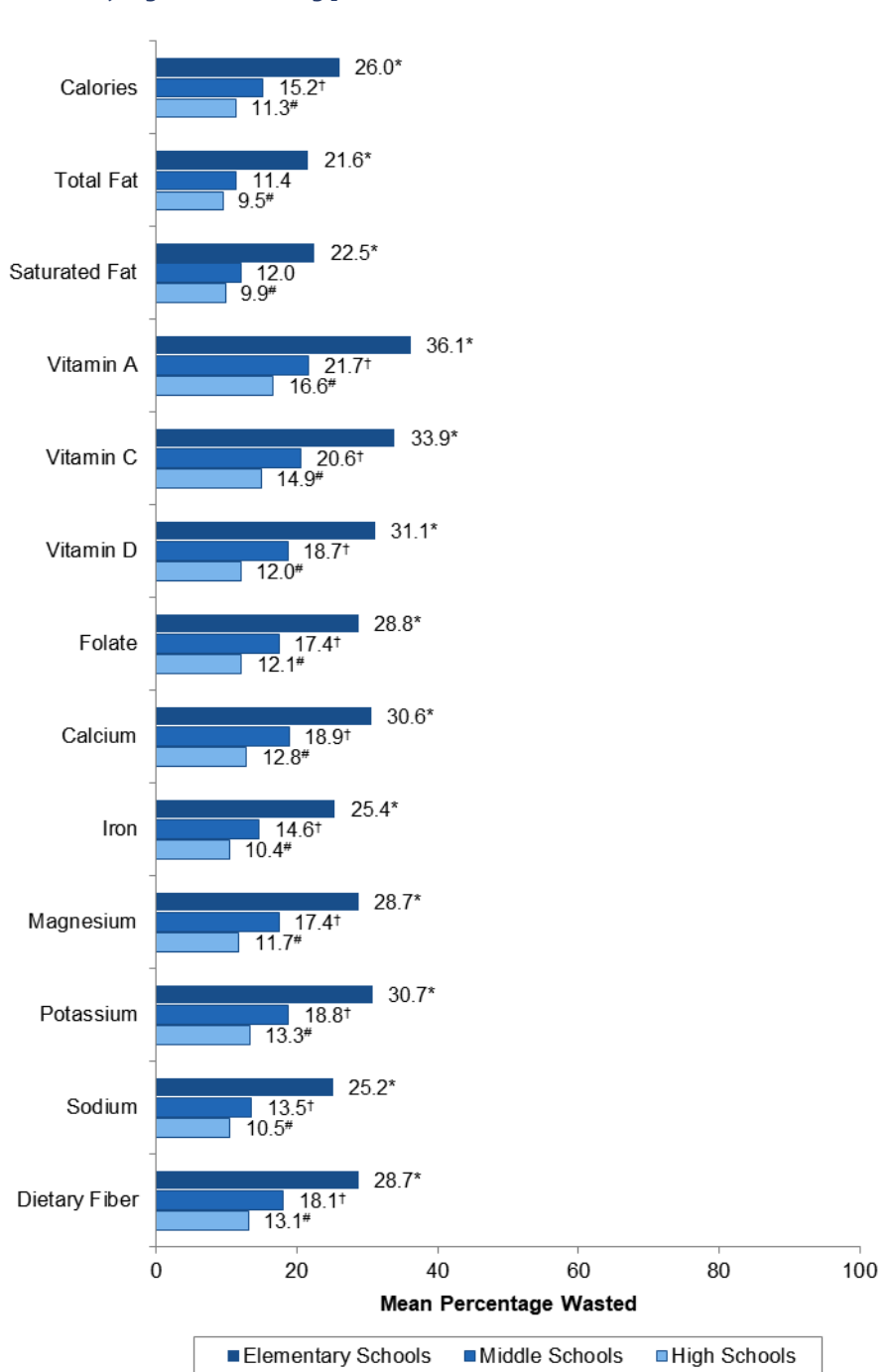
On average, more than one-quarter of the calories and nutrients available in elementary school lunches were wasted (with the exception of total fat and saturated fat). Mean percentages wasted were generally lower among middle and high schools. In these schools, 11 to 15 percent of the available calories were wasted and 10 to 22 percent of the available nutrients.

⁶⁹ Differences between middle schools and high schools were also not statistically significant for other types of fat or for vitamin E (Table F.4).

Figure 5.4. Mean Percentage of Calories and Key Nutrients Wasted in NSLP Lunches, All Schools

Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Figure 5.5. Mean Percentage of Calories and Nutrients Wasted in NSLP Lunches, by School Type



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

*Difference between elementary and middle schools is significantly different from zero at the 0.05 level.

†Difference between middle and high schools is significantly different from zero at the 0.05 level.

#Difference between elementary and high schools is significantly different from zero at the 0.05 level.

C. Plate Waste in the SBP

This section mirrors the preceding Section B on plate waste in the NSLP. It begins with a description of the amount of plate waste observed for specific types of food. Subsequent sections explore the percentage of available USDA Food Pattern food group equivalents wasted and the percentage of available calories and nutrients wasted.

1. Extent of Plate Waste for Specific Types of Food in SBP Breakfasts

Table 5.2 presents data on the mean percentage of food wasted on the observed breakfast trays, overall and by school type. The table is limited to foods that appeared in at least five percent of daily SBP menus and were observed on at least five percent of trays in one or more school types.

Overall, plate waste at breakfast was highest for milk (41 percent), followed by fruits and 100% fruit juice (27 percent). Mean percentages wasted were substantially lower for meats/meat alternates (19 percent), separate grains/breads (16 percent), and combination entrées (11 percent). The following text presents detailed findings for each major food group, and explores differences in plate waste across school types.

In the SBP, plate waste was highest for milk (41 percent), followed by fruits and 100% fruit juice (27 percent). Mean percentages wasted were substantially lower for meats/meat alternates (19 percent), separate grains/breads (16 percent), and combination entrées (11 percent).

Milk

Milk was included in three-quarters of the observed breakfast trays overall. On average, 41 percent of the milk included on observed breakfast trays was wasted. Mean percentage wasted was highest for unflavored fat-free milk (52 percent) and lowest for flavored fat-free milk (37 percent).⁷⁰ Elementary school breakfast trays were more likely to include milk than breakfast trays in either middle or high schools (84 percent versus 65 percent and 59 percent, respectively). In addition, similar to the pattern observed for lunch, the mean percentage of milk wasted was significantly higher in elementary schools than in middle or high schools, and was significantly higher in middle schools relative to high schools (49 percent, 36 percent, and 21 percent, respectively).

Vegetables, Fruits, and 100% Fruit Juices

Vegetables were rarely included in observed breakfast trays. Overall, 10 percent of the vegetables that were observed were wasted. The majority (91 percent) of observed breakfast trays included fruit or 100% fruit juice. Overall, 27 percent of the fruit/100% fruit juice included on observed breakfast trays was wasted. Levels of plate waste were higher for fresh and canned fruit than for 100% fruit juice (33 percent and 34 percent versus 25 percent). Mean percentage wasted was highest for fresh apples and canned applesauce (38 percent and 39 percent, respectively).

⁷⁰ Table 5.2 is limited to foods that were commonly offered and selected (see previous text). Mean waste may have been higher for foods that were less commonly offered and selected.

Table 5.2. Mean Percentage of Observed Trays including Specific Foods and Mean Percentage of Food Wasted in SBP Breakfasts

	Elementary Schools		Middle Schools		High Schools		All Schools	
	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted
Milk	84.1*	49.2*	65.0	36.2†	58.8#	21.4#	75.2	40.8
Fat-free	56.1*	47.4*	41.8	33.9†	38.7#	21.2#	49.8	39.5
Flavored	50.7*	45.4*	32.4	29.7†	33.4#	18.4#	43.8	36.6
Unflavored	5.5	64.0	9.4	44.6	5.3	27.8#	6.1	51.9
Low-fat (1%)	25.9	54.2*	21.0	39.4†	19.7	21.1#	23.7	44.7
Unflavored	25.3	54.4	18.6	42.7†	18.7	21.4#	22.7	45.5
Vegetables^a	0.8^	13.0	4.8^	6.0^	5.8^	11.4^	2.6^	10.0
Fruits and 100% Fruit Juices	92.4	34.0*	90.9	23.5†	86.0	11.4#	90.7	27.2
100% Juice	71.5	32.1*	71.7	21.2†	69.9	9.2#	71.2	25.0
Apple	39.0	32.8	31.8	22.5†	30.5	6.7#	35.9	25.5
Orange	22.4	31.0	19.3	23.7	23.9	12.4#	22.2	25.3
Grape	3.0^	22.5^	9.8	18.1	4.5^	7.2^	4.5	17.4
Fruit juice blend	7.3^	40.5*	10.3^	20.7†	9.9^	3.5#^	8.4	27.9
Fresh fruit	24.1	41.0	21.1	30.9†	22.0	18.8#	23.1	32.9
Apple	12.1	44.1	9.5	45.6†	12.5	22.0#	11.8	38.0
Orange	3.0^	39.9	6.2^	26.4	4.6^	18.2#^	3.9	29.0
Banana	5.6^	28.7^	4.9^	29.8†	4.5^	2.9#^	5.2^	23.1
Canned fruit	19.3	33.8	12.4	32.7	7.2#	33.5	15.4	33.6
Peaches and pears	4.2^	35.9	5.0^	28.2	3.8^	37.4	4.2^	35.0
Applesauce	7.7^	36.8	3.9^	38.5	0.9#^	54.8	5.5^	39.0
Fruit cocktail	5.7^	34.6	0.5^	49.5^	2.0^	29.1^	4.0^	34.1
Combination Entrées	16.3	14.9	28.4	9.1	35.3#	5.6#	22.6	10.8
Breakfast sandwiches	4.4^	16.4^	9.2^	7.0	14.1#	5.6	7.4	10.1
Pizza (with or without meat)	2.9	12.8	9.2	11.5	10.9#	3.4	5.8	8.5
Separate Grains/Breads	85.5*	18.1*	70.9	13.3	60.9#	9.7#	77.5	15.5
Cold cereal	36.9*	15.6	22.2	10.3	16.9#	5.1#	30.0	12.4
Sweetened	34.0*	14.8*	18.2	8.6	14.9#	4.8#	27.1	11.6
Pastries	8.8	10.1	8.5	10.3	10.3	5.9	9.1	8.9
Cinnamon buns	4.3	12.3	4.2	8.1	6.3	2.7	4.7	7.6
Pancakes, waffles, and French toast	13.0	9.0	14.7	14.4	6.1	9.3	11.7	10.1
Breads, rolls, bagels, and other plain breads	12.3	35.0	10.3	19.3	10.1	19.6	11.5	28.8
Granola bars	6.0	9.4	4.4	3.6	6.3	2.1	5.8	6.4
Muffins and sweet/quick breads	8.5	10.7	5.7	6.1	6.2	4.9	7.5	8.2
Crackers, croutons, and pretzels	9.1	29.3	9.3	18.3	6.6	22.1	8.5	25.8
Biscuits and cornbread	6.2	21.5	6.7	13.2	5.3	6.9#	6.1	16.5

	Elementary Schools		Middle Schools		High Schools		All Schools	
	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted	Mean Percentage of Trays	Mean Percentage Wasted
Meats/Meat Alternates	19.9	21.1	12.8	16.3	14.5	13.1	17.5	18.6
Yogurt	6.5	26.9	2.9	25.0	2.4	13.3	5.0	23.7
Low-fat/fat-free	5.6	22.7	2.9	25.0	1.9	4.8 [#]	4.3	19.8
Other protein ^b	7.5	25.3	4.8	12.9	8.7	14.8	7.4	20.8
Cheese	7.5 [*]	26.7	0.8	6.0	2.9	26.3	5.4	25.3
Eggs	0.0	NR	3.9	18.5	5.8 [#]	6.8	2.0	8.6
Sausage, frankfurters, and cold cuts	4.9	16.4	7.0	5.8	0.8	8.0	4.3	13.0
Sausage	4.9	16.4	7.0	5.8	0.8	8.0	4.3	13.0
Number of Trays	1,257	1,257	1,301	1,301	1,043	1,043	3,601	3,601
Number of Schools	51	51	54	54	49	49	154	154

Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Note: Table is limited to food groups included in at least five percent of Menu Surveys and five percent of observed breakfast trays for one or more school types.

^aIncludes 100% vegetable juices.

^bIncludes cheese, eggs, and nuts and seeds.

^{*}Difference between elementary and middle schools is significantly different from zero at the 0.05 level.

[†]Difference between middle and high schools is significantly different from zero at the 0.05 level.

[#]Difference between elementary and high schools is significantly different from zero at the 0.05 level.

NR = Not reported because the percentage wasted could not be computed (since no trays included this food group); SBP = School Breakfast Program

[^] Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

There were no significant differences between school types in the percentage of breakfast trays that included fruit or 100% fruit juice. The pattern of plate waste for fruits and 100% fruit juice was similar to the pattern observed for milk—mean percentage wasted was significantly higher in elementary schools relative to middle or high schools, and was significantly higher in middle schools relative to high schools (34 percent, 24 percent, and 11 percent, respectively).

Combination Entrées

Combination entrées, mainly breakfast sandwiches and breakfast pizzas, were included in close to one-quarter (23 percent) of observed breakfast trays. Mean percentage wasted was notably lower for combination entrées than for milk or fruit/100% fruit juice. On average, 11 percent of the combination entrées included on observed breakfast trays was wasted. Elementary school breakfast trays were less likely to include combination entrées than high school breakfast trays (16 percent versus 35 percent), and the mean percentage of entrées wasted was higher for elementary schools than for high schools (15 percent versus 6 percent).

Separate Grains/Breads

More than three-quarters (78 percent) of observed breakfast trays included a separate grain/bread, most often cold cereal or pastry. Compared to milk and fruit, plate waste was lower for grains/breads. Overall, 16 percent of the grains/breads included on breakfast trays was wasted. Breakfast trays in elementary schools were more likely than breakfast trays in middle or high schools to include separate grains/breads (86 percent versus 71 percent and 61 percent, respectively), and mean waste of separate grains/breads was also higher in elementary schools than in middle or high schools (18 percent versus 13 percent and 10 percent, respectively).

Meats/Meat Alternates

Fewer than one in five observed breakfast trays (18 percent) included meats/meat alternates (sausage, cheese, yogurt, eggs) and, on average, 19 percent of these foods were wasted. Overall, there were no significant differences across school types in the percentage of observed breakfast trays that included meats/meat alternates, or in the mean percentages wasted.

2. USDA Food Pattern Food Group Equivalents Wasted in SBP Breakfasts

For most USDA Food Pattern food groups, there was little variation in the mean amounts available in the breakfast trays observed in elementary, middle, and high schools (Table F.5). The only exceptions were dairy and empty calories from added sugars. For both of these measures, the mean amounts available in elementary school breakfast trays were significantly higher than the mean amounts available in middle or high school breakfast trays (1.0 cup equivalents of dairy versus 0.8 cup equivalents, respectively; and 67 empty calories from added sugars versus 56 and 52 empty calories from added sugars, respectively).

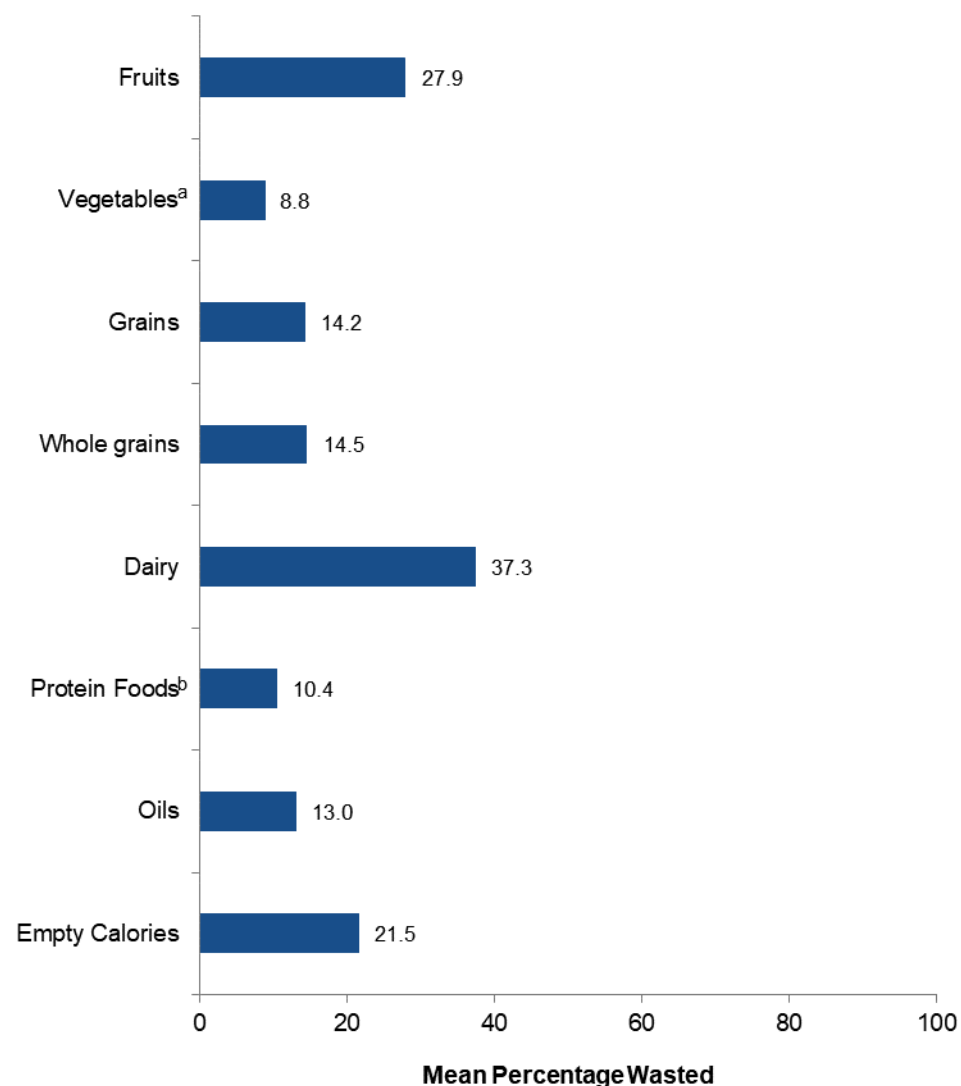
The findings for USDA Food Pattern food groups were generally consistent with findings presented in the previous section on the extent of plate waste for specific types of food. Overall, waste was highest for dairy—on average, 37 percent of the cup equivalents of dairy available on observed breakfast trays was wasted (Figure 5.6). Levels of waste were lower for fruits (28 percent) and substantially lower for total grains, whole grains, oils, and protein foods (10 to 15 percent). On average, 22 percent of the empty calories available on observed breakfast trays was wasted. Mean waste was lowest for vegetables (9 percent). However, as shown in Table F.5, vegetables were infrequently included on the observed breakfast trays.⁷¹

This general pattern of waste was observed in all three school types. However, waste of all USDA Food Pattern food groups except protein foods was significantly higher in elementary schools than in high schools (Figure 5.7). In addition, waste of USDA Food Pattern food groups was higher in middle schools than high schools for all food groups other than protein foods and oils. Waste of available empty calories was significantly higher in elementary schools than in either middle schools or high schools, and was significantly higher in middle schools than it was in high schools.

The magnitude of the differences across school types was large. With few exceptions, the mean percentage of available USDA Food Pattern food groups wasted in elementary schools was more than two times higher than the mean percentage wasted in high schools and at least 40 percent higher than the mean percentage wasted in middle schools. There were also large differences between middle schools and high schools. With the exception of oils and protein foods, the mean percentage of USDA Food Pattern food groups wasted in middle schools was one and a half to two times higher than the mean percentage wasted in high schools.

⁷¹ Analysis of detailed Menu Survey data found that most of the vegetables offered at breakfast were hash browns or similar potato-based products, but raw carrots were also offered (Gearan et al. 2019; see Chapter 2, Section B.2).

Figure 5.6. Mean Percentage of USDA Food Pattern Food Groups Wasted in SBP Breakfasts, All Schools



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

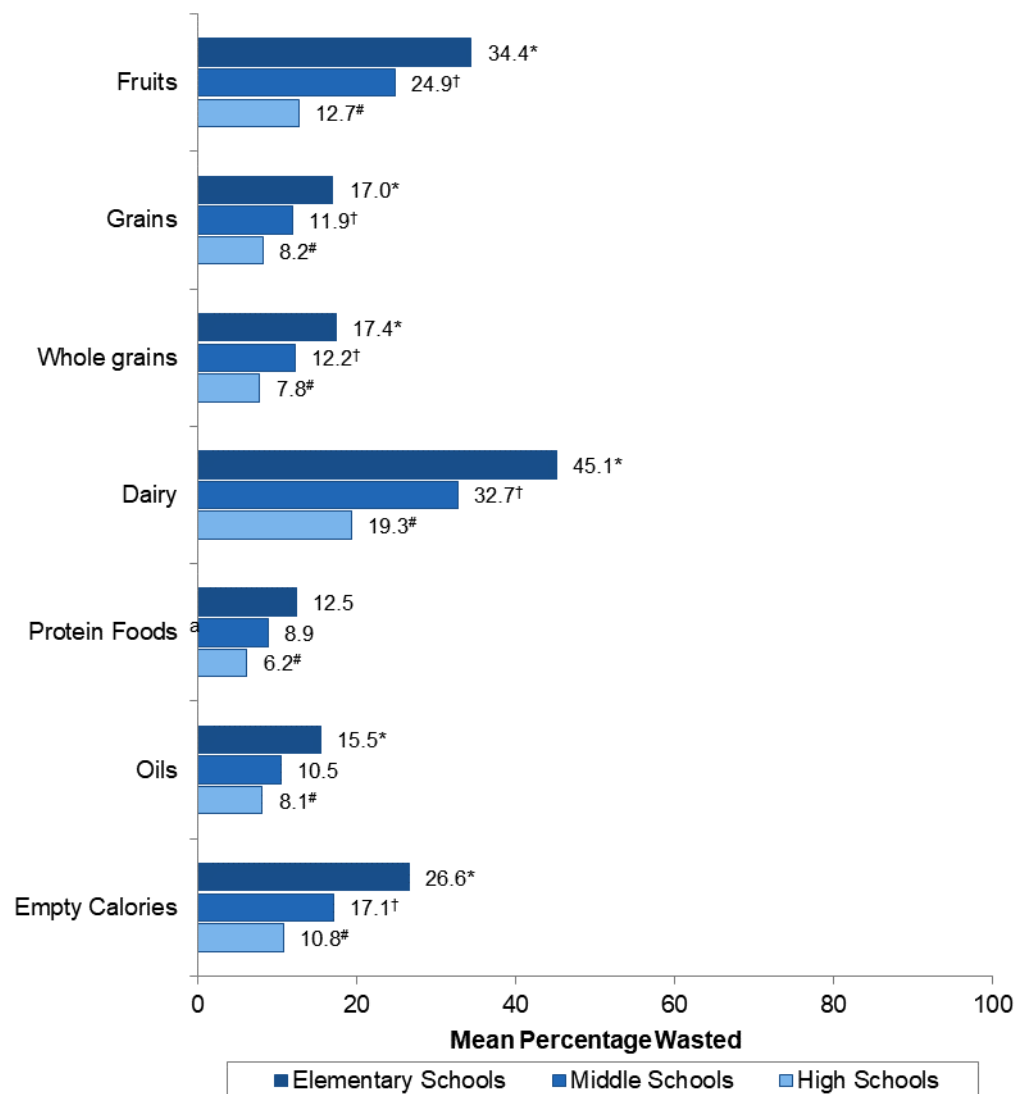
Notes: The USDA Food Pattern food groups are largely consistent with the meal components used in planning SBP breakfasts, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

The fruits group includes both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

^aIncludes legumes credited as vegetables on the Menu Survey.

^bIncludes legumes credited as a meat alternate on the Menu Survey.

Figure 5.7. Mean Percentage of USDA Food Pattern Food Groups Wasted in SBP Breakfasts, by School Type



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Notes: Vegetables are not included in the figure because they were rarely included in observed breakfast trays and none of the point estimates used in this analysis could be reliably estimated.

The USDA Food Pattern food groups are largely consistent with the meal components used in planning SBP breakfasts, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

The fruits group includes both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

^aIncludes legumes credited as a meat alternate on the Menu Survey.

*Difference between elementary and middle schools is significantly different from zero at the 0.05 level.

†Difference between middle and high schools is significantly different from zero at the 0.05 level.

#Difference between elementary and high schools is significantly different from zero at the 0.05 level.

3. Calories and Nutrients Wasted in SBP Breakfasts

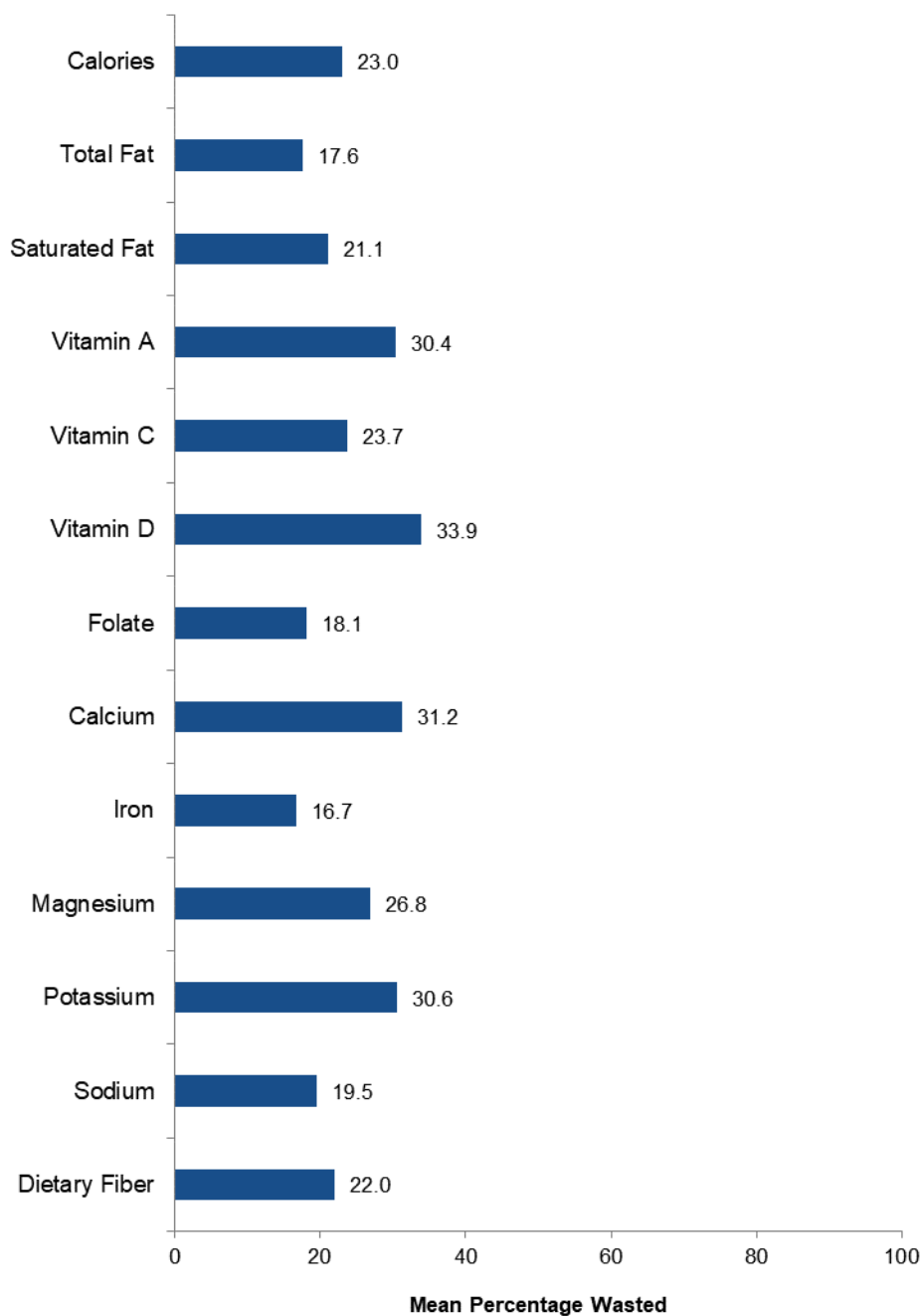
There were few significant differences in the average calorie and nutrient content of observed breakfast trays across school types (Table F.7). However, breakfast trays in elementary schools include significantly larger amounts of vitamin A and calcium than breakfast trays in either middle or high schools and significantly larger amounts of magnesium and potassium than trays in high schools. Findings on the mean percentage of available calories and key nutrients that were wasted are summarized below. Table F.8 provides data for additional nutrients.

On average, roughly one-quarter (23 percent) of the calories available in SBP breakfasts were wasted, as well as one-quarter or more of the available vitamin A, vitamin D, calcium, magnesium, and potassium (Figure 5.8). Among the key nutrients examined, the average percentage wasted was lowest for iron (17 percent), total fat (18 percent), and folate (18 percent).

In keeping with the variation observed across school types in levels of plate waste, there was considerable variation across schools in the percentage of available calories and nutrients that were wasted. For calories and all of the nutrients examined, the average percentage wasted was significantly higher in elementary schools than in either middle or high schools, and was significantly higher in middle schools relative to high schools (Figure 5.9).

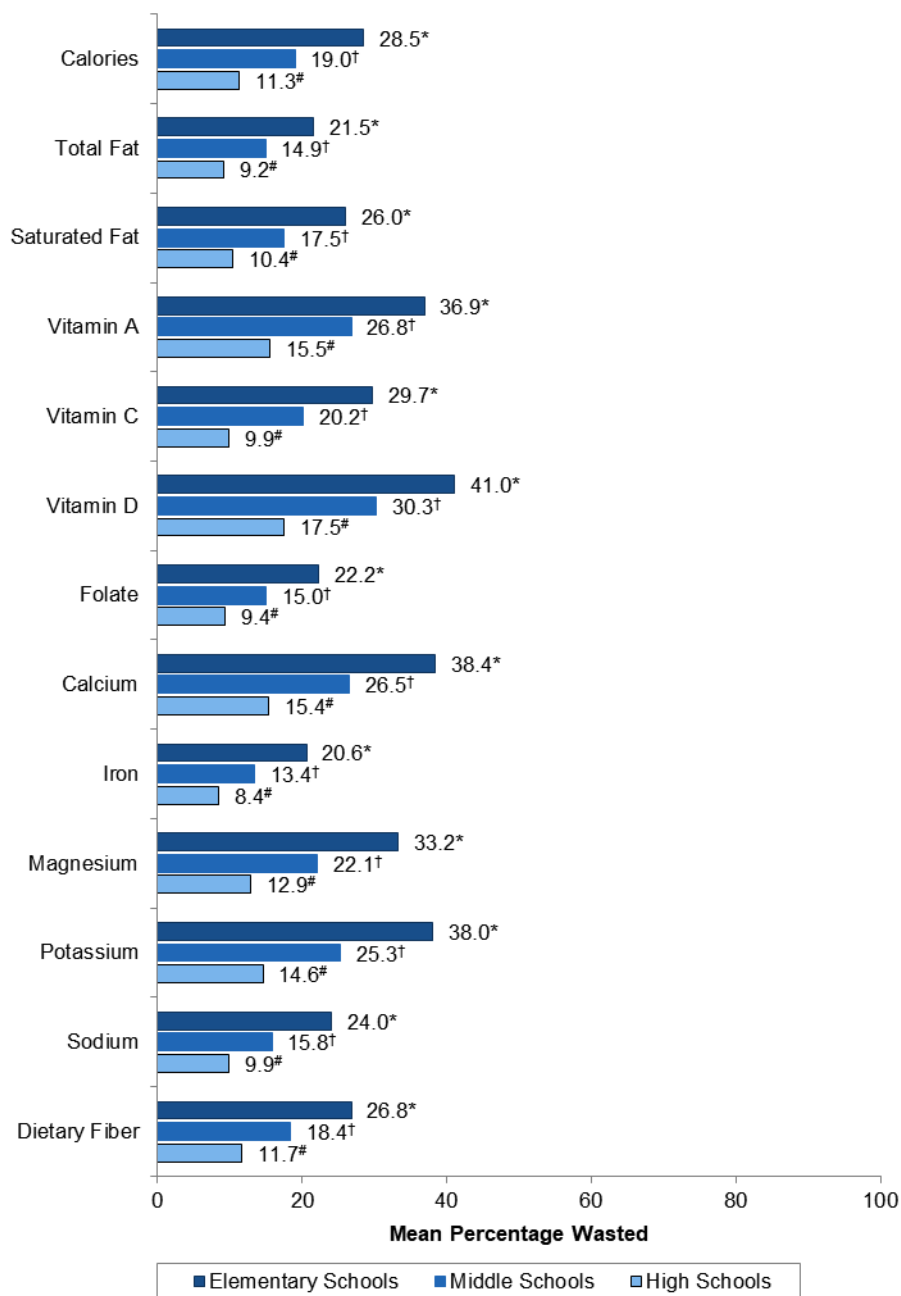
In elementary school breakfasts, mean percentages wasted were 30 percent or higher for vitamin A, vitamin C, vitamin D, calcium, magnesium, phosphorus, and potassium. As noted previously, the average percentage of calories and nutrients wasted were lower among middle and high schools. Mean percentages wasted ranged from 13 to 30 percent in middle school breakfasts and 8 to 18 percent in high school breakfasts.

Figure 5.8. Mean Percentage of Calories and Nutrients Wasted in SBP Breakfasts, All Schools



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Figure 5.9. Mean Percentage of Calories and Nutrients Wasted in SBP Breakfasts, by School Type



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. School-level tabulations are weighted to be nationally representative of public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

*Difference between elementary and middle schools is significantly different from zero at the 0.05 level.

†Difference between middle and high schools is significantly different from zero at the 0.05 level.

#Difference between elementary and high schools is significantly different from zero at the 0.05 level.

D. Factors Associated with Plate Waste in the NSLP

This section describes results of analyses that examined the relationships between plate waste in NSLP lunches and four key domains: (1) student gender, (2) characteristics of NSLP lunches, (3) characteristics of school foodservice operations, and (4) characteristics of the school food environment. Because gender was the only student-level characteristic available for the plate waste observations, the study team explored the association between plate waste and gender using descriptive analyses.⁷² Relationships between plate waste and the other three domains were explored in a multivariate framework.

Because there is no one composite measure of plate waste, the study team selected three key outcomes to include in these analyses: (1) the percentage of available calories wasted and, based on available USDA Food Pattern food groups, (2) the percentage of fruits and vegetables wasted, and (3) the percentage of dairy wasted. Calories was selected because previous studies have used calories as a summary measure to characterize overall levels of plate waste (Buzby and Guthrie 2002; Gordon et al. 2003; Cullen et al. 2015). USDA Food Pattern food groups for fruits and vegetables and dairy were selected because findings from the descriptive analyses (see Section B) showed that waste was highest for these groups in NSLP lunches. For the multivariate analyses, fruits and vegetables were combined into a single outcome because vegetables were observed on relatively few trays.

The study team estimated separate multivariate models to assess the relationships between plate waste in the NSLP and the meal- and school-level characteristics mentioned above. For each model, an initial set of characteristics was identified using relevant variables from the Plate Waste Observations, Menu Survey, Principal Survey, SNM Survey, Cafeteria Observation Guide, A la Carte Checklist, Vending Machine and Other Sources of Foods and Beverages Checklist, SFA Director Survey, School Nutrition Manager Cost Interview, and SFA Director and Business Manager Onsite and Follow-Up Cost Interview (see Chapter 1). The final set of variables was selected by eliminating variables which (1) did not have valid values for a relatively high proportion of the sample, (2) exhibited insufficient variation within the sample, or (3) were highly correlated with other considered variables that better explained variation in the extent of plate waste. Appendix E provides additional details on the variable exclusion criteria and a technical description of the multivariate analysis methods used to produce the results presented in this section and in Section E.

⁷² The collection of student-level characteristics for the plate waste study was limited to those that could be observed, like gender. The study design did not allow for the collection of other student characteristics that would have required parental and student consent.

The multivariate analyses were implemented using least squares regression at the tray level, with clustered standard errors to account for the clustering of trays within schools. Findings are presented as regression-adjusted mean percentages of calories and USDA Food Pattern food groups wasted. Supplementary tables provided in Appendix F report full sets of regression coefficients and standard errors for each multivariate model. Findings from these analyses should be considered exploratory. The probability of finding significant associations by chance increases with the number of associations tested and these analyses examined a large number of characteristics. Additionally, it is important to note that because these analyses were conducted using unweighted, tray-level data, the findings cannot be generalized outside of the plate waste sample included in this study (see Appendix E for more details).

Analyses that examined factors associated with plate waste were conducted using unweighted, tray-level data. Thus, findings cannot be generalized to the full population of schools participating in the NSLP.

The discussion generally focuses on characteristics that had a significant association for all schools combined. Estimates for models using all schools were more precise due to larger sample sizes and, therefore, better suited for detecting significant differences while controlling for other factors. Full tabulations that include estimates for all characteristics examined within each domain and by school type are provided in Appendix F.

The multivariate models included student gender as well as additional variables to control for differences between schools in terms of institutional and demographic characteristics that are not determined by the SFA but may be associated with plate waste in school meals. Therefore, these analyses estimate how plate waste is associated with a given characteristic in comparison to a school without that characteristic that is otherwise similar in terms of institutional and demographic characteristics.

1. Relationship between Plate Waste in NSLP Lunches and Student Gender

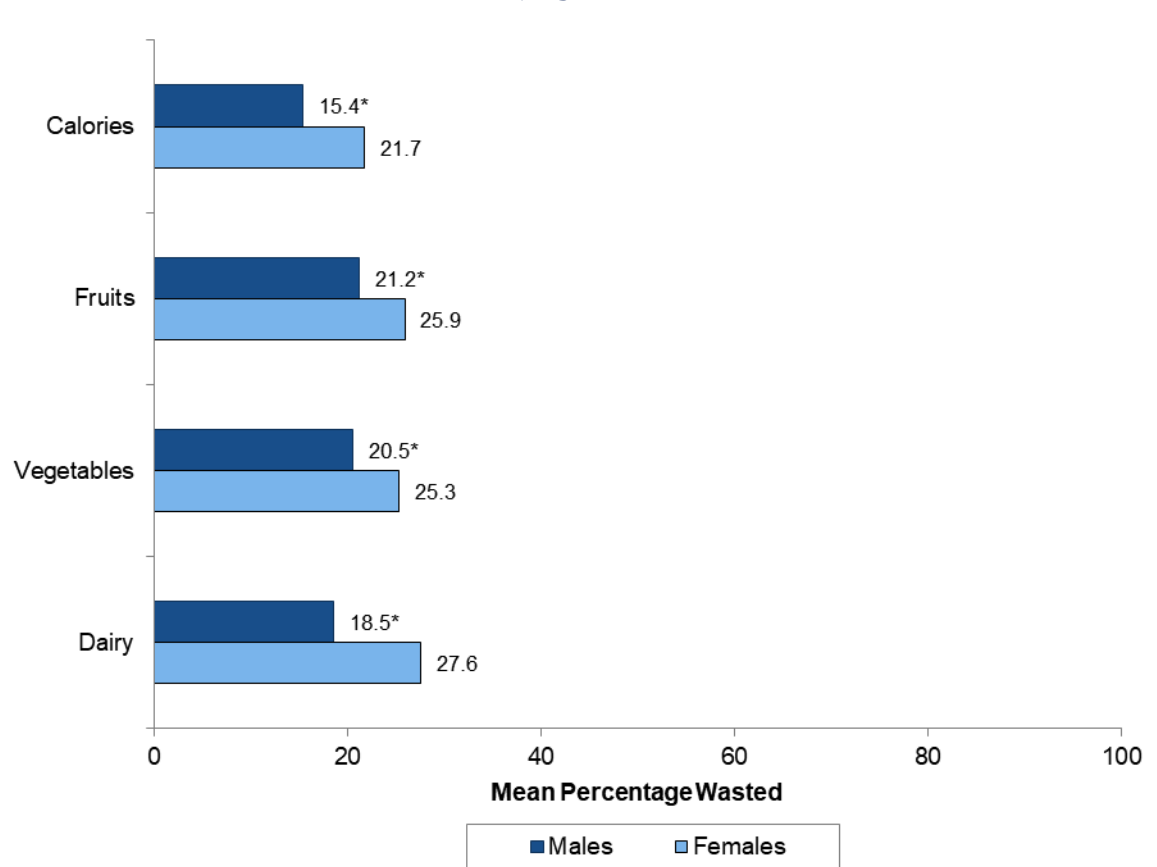
Plate waste can vary by individual student characteristics and preferences. As noted above, gender was the only student characteristic available for the plate waste observations, so the relationship between plate waste and gender was explored using descriptive cross-tabulations.

Overall, females wasted a significantly higher percentage of available calories than males (22 percent versus 15 percent) (Figure 5.10). A similar pattern was observed for fruits (26 percent versus 21 percent), vegetables (25 percent versus 21 percent), and dairy (28 percent versus 19 percent). The magnitude of the difference between females and males was largest for dairy (9 percentage points). Among middle and high schools, females wasted significantly higher percentages of calories, fruits, vegetables, and dairy than males (differences ranged from 5 to 10 percentage points; Table F.9). Among elementary schools; females wasted a significantly higher percentage of dairy than males (36 percent versus 29

Overall, females wasted significantly higher percentages of the calories, fruits, vegetables, and dairy available in NSLP lunches than males.

percent); however, differences between males and females were not statistically significant for fruits or vegetables.⁷³

Figure 5.10. Mean Percentage of Calories and Key USDA Food Pattern Food Groups Wasted in NSLP Lunches, by Student Gender: All Schools



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. Tray-level tabulations are unweighted and include clustered standard errors to account for clustering of trays within schools. Schools included in this unweighted analysis are public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools). Sample excludes 115 trays with missing data on gender.

Notes: The USDA Food Pattern food groups are largely consistent with the meal components used in planning NSLP lunches, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

The fruits group includes both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

*Difference between males and females is significantly different from zero at the 0.05 level.

⁷³ Tables F.9 and F.10 present findings for the full set of USDA Food Pattern food groups and nutrients examined in Section B, including findings by school type.

2. Relationships between Plate Waste in NSLP Lunches and Key Characteristics of the Lunches

This analysis examined the relationships between plate waste in NSLP lunches and (1) the overall nutritional quality of NSLP lunches, as measured by total HEI-2010 scores, (2) compliance with selected NSLP nutrition standards, and (3) the types of food offered in daily lunch menus. Table 5.3 presents regression-adjusted mean percentages of available calories and USDA Food Pattern food groups for fruits and vegetables and dairy wasted in NSLP lunches for characteristics where there was a significant association for at least one of these plate waste outcomes. Table F.11 includes estimates for all characteristics examined in this domain and estimates by school type.

Overall Nutritional Quality of NSLP Lunches

The total HEI-2010 score (hereafter referred to as “HEI-2010 score”) provides an overall measure of the nutritional quality of NSLP lunches prepared in each school. The analysis included indicators for two distinct levels of possible HEI-2010 scores for NSLP lunches: (1) scores that were at or above the median total score (82.3), reflecting lunches of higher nutritional quality, and (2) scores that were below the median total score, reflecting lunches of lower nutritional quality.

Overall, there were no significant associations between the percentages of calories, fruits and vegetables, or dairy wasted and the overall nutritional quality of NSLP lunches prepared (Table F.11). There were, however, statistically significant associations for specific types of schools. Among elementary schools and high schools, NSLP lunches that were at or above the median HEI-2010 score were associated with a significantly higher percentage of waste for fruits and vegetables, relative to NSLP lunches with HEI-2010 scores below the median (for elementary schools, 34 percent versus 29 percent; and for high schools, 30 percent versus 26 percent). Among middle schools, NSLP lunches that were at or above the median HEI-2010 score were associated with significantly higher percentages of waste for calories (25 percent versus 23 percent), fruits and vegetables (31 percent versus 26 percent), and dairy (33 percent versus 29 percent).

Compliance with NSLP Nutrition Standards

The study team collaborated with FNS to identify a parsimonious set of variables to characterize compliance with the nutrition standards, focusing on standards that were more challenging for one or more school types to meet and had sufficient variation within the sample.⁷⁴ Compliance with several NSLP nutrition standards was associated with lower levels of plate waste as measured by two or more outcomes (calories, fruits and vegetables, and dairy). Although statistically significant associations were not detected for all outcomes, the pattern of findings was consistent across outcomes (Table 5.3).

⁷⁴ Information on the nutrition standards for NSLP lunches is provided in Volume 2 of the SNMCS final report (Gearan et al. 2019).

Table 5.3. Significant Relationships between Plate Waste in NSLP Lunches and Key Characteristics of the Lunches: Regression-Adjusted Mean Percentage of Calories and Key USDA Food Pattern Food Groups Wasted

	Yes/No	All Schools		
		Calories	Fruits and Vegetables	Dairy
Mean Percentage Wasted in NSLP Lunches Prepared		18.5	23.9	22.8
Compliance of Daily and Weekly Lunch Menus with NSLP Nutrition Standards				
Met Daily Quantity Requirement for Meats/Meat Alternates	Y	17.1*	26.1	20.2
	N	20.6	30.7	23.4
Met Daily Quantity Requirement for Vegetables	Y	20.1*	31.8*	22.9
	N	17.5	25.0	20.7
Met Weekly Quantity Requirement for Vegetables	Y	16.8*	24.3*	20.4
	N	20.9	32.4	23.3
Met Target 1 Sodium Limit	Y	17.5*	25.9	19.4*
	N	20.1	30.9	24.2
Types of Foods Offered in Lunch Menus				
Number of Entrée Choices Offered on the Plate Waste Observation Day				
1 to 3 (<i>reference category</i>)		22.1	33.0	22.0
4 to 5		18.7*	28.3	20.6
6 or more		19.0	28.4	23.0
All Daily Menus Offered Raw Vegetables	Y	18.1	26.6*	21.1
	N	19.5	30.2	22.6
More than Half of Daily Menus Offered Pizza or Pizza Products	Y	18.2	26.1*	21.3
	N	19.4	30.6	22.4
Number of Trays	6,253	6,253	6,253	6,253
Number of Schools	165	165	165	165

Source: School Nutrition and Meal Cost Study, Plate Waste Observations and Menu Survey, school year 2014-2015. Tray-level tabulations are unweighted and include clustered standard errors to account for clustering of trays within schools. Schools included in this unweighted analysis are public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Notes: Estimates are regression-adjusted means that control for institutional and demographic characteristics of each school and their SFA. Variables with rows labeled "Y" and "N" report adjusted mean percentage of each outcome (calories, fruits, and dairy) wasted for schools that do and do not meet the variable criteria, respectively. Otherwise, regression-adjusted means are reported for each category within a variable. See Appendix E for more details on characteristic descriptions and selection methods.

Estimates for fruits and vegetables combine plate waste for the USDA Food Pattern fruits and vegetables groups.

*Denotes the difference within each outcome (mean percentage of calories, fruits and vegetables, and dairy wasted) between schools with and without a dichotomous characteristic is statistically different from zero at the 0.05 level. For variables containing multiple categories, * denotes that the difference in mean percentage within each outcome wasted between schools in the corresponding category and schools in the reference category is statistically different from zero at the 0.05 level.

NSLP = National School Lunch Program.

Meeting the daily quantity requirement for meats/meat alternates was associated with a significantly lower percentage of waste for calories (17 percent versus 21 percent). Findings for the daily and weekly vegetable requirements differed. Meeting the daily quantity requirement for vegetables was associated with significantly higher percentages of waste for calories (20 percent versus 18 percent) and fruits and vegetables (32 percent versus 25 percent), whereas, meeting the weekly quantity requirement for vegetables was associated with significantly lower percentages of waste for calories (17 percent versus 21 percent) and fruits and vegetables (24 versus 32 percent). Taken together, these estimates suggest that plate waste for calories and fruits and vegetables were not significantly different among schools that met both the daily and weekly quantity requirements for vegetables compared to schools that met neither requirement. Finally, meeting the Target 1 sodium limit was associated with significantly lower percentages of waste for calories (18 percent versus 20 percent) and dairy (20 percent versus 24 percent) (Table 5.3).

Types of Food Offered in NSLP Lunches⁷⁵

Several characteristics related to the types of foods offered in lunch menus were associated with significantly lower levels of waste. Offering 4 to 5 entrée choices on the plate waste observation day was associated with a significantly lower percentage of waste for calories, relative to offering only 1 to 3 entrée choices (19 percent versus 22 percent) (Table 5.3).

Offering raw vegetables every day was associated with significantly less waste of fruits and vegetables.

Offering raw vegetables every day was associated with a significantly lower percentage of waste for fruits and vegetables (27 percent versus 30 percent). Finally, offering pizza or pizza products on more than half of daily menus was associated with a significantly lower percentage of waste for fruits and vegetables (26 percent versus 31 percent).

3. Relationships between Plate Waste in NSLP Lunches and Key Characteristics of School Foodservice Operations and School Food Environments

This analysis examined the relationships between plate waste in NSLP lunches and key characteristics of (1) school foodservice operations, including food purchasing, menu planning, and meal service characteristics; and (2) school food environments, including wellness policies and practices, availability of competitive foods, and meal service practices. Table 5.4 presents regression-adjusted mean percentages of available calories and USDA Food Pattern food groups for fruits and vegetables and dairy wasted in NSLP lunches for characteristics where there was a significant association for at least one of these plate waste outcomes. Tables F.15 and F.19 include estimates for all characteristics examined in this domain and estimates by school type.

⁷⁵ The school-level characteristics examined related to the types of foods offered in lunch menus were consistent with those used in similar multivariate analyses for other study objectives. However, this analysis also explored several characteristics that were specific to the day of the plate waste observation.

Table 5.4. Significant Relationships between Plate Waste in NSLP Lunches and Key Characteristics of School Foodservice Operations and the School Food Environment: Regression-Adjusted Mean Percentage of Calories and Key USDA Food Pattern Food Groups Wasted

	Yes/No	All Schools		
		Calories	Fruits and Vegetables	Dairy
Mean Percentage Wasted in NSLP Lunches Prepared		18.5	23.9	22.8
Menu Planning and Meal Service Characteristics				
School Uses Cycle Menus	Y	19.0	24.9*	23.6
	N	18.2	17.7	27.1
Number of Challenges in Meeting the Updated Nutrition Standards that SFA Rated as 3 or Higher on a Scale of 1 (Not a Challenge) to 5 (Significant Challenge)				
4 or less (<i>reference category</i>)		17.1	23.8	20.4
5 to 7		19.8	22.4	26.0*
8		17.4	20.2	24.7
Price Charged for Paid Lunches				
School Offered Free Lunch to All Students		21.2*	23.2	27.9*
\$2.25 or less (<i>reference category</i>)		16.5	21.6	22.1
\$2.26 to \$2.50		16.6	20.6	21.9
\$2.51 or more		15.9	20.4	23.0
Wellness Policies and Practices				
School Conducted a Nutrition Education Activity in the Classroom or Foodservice Area	Y	17.2*	29.0*	19.4*
	N	19.4	31.9	23.0
Competitive Foods				
School Sells Foods and Beverages in Vending Machine	Y	17.7	28.2*	20.5
	N	18.9	32.7	21.9
School Sells Foods and Beverages in School Store and/or Snack Bar	Y	18.4	32.3*	20.5
	N	18.2	28.6	22.0
SFA Has Standards for Competitive Foods that Exceed Smart Snacks in School Standards	Y	19.3*	31.8	22.9
	N	17.3	29.1	19.5
Meal Service Practices				
Time Lunch Period Starts				
Before 11:30 a.m. (<i>reference category</i>)		19.7	31.9	22.5
Between 11:30 a.m. and 11:59 p.m.		18.5	30.4	21.0
12:00 p.m. and after		18.1*	30.5	21.4
Number of Trays	6,253	6,253	6,253	6,253
Number of Schools	165	165	165	165

Source: School Nutrition and Meal Cost Study, Plate Waste Observations, School Food Authority Director Survey, School Nutrition Manager Survey, Principal Survey, Cafeteria Observation Guide, A la Carte Checklist, Vending Machine and Other Sources of Foods and Beverages Checklist, school year 2014-2015. Tray-level tabulations are unweighted and include clustered standard errors to account for clustering of trays within schools. Schools included in this unweighted analysis are public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a

minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Notes: Estimates are regression-adjusted means that control for institutional and demographic characteristics of each school and their SFA. Variables with rows labeled “Y” and “N” report adjusted mean percentage of each outcome (calories, fruits, and dairy) wasted for schools that do and do not meet the variable criteria, respectively. Otherwise, regression-adjusted means are reported for each category within a variable. See Appendix E for more details on characteristic descriptions and selection methods.

Estimates for fruits and vegetables combine plate waste for the USDA Food Pattern fruits and vegetables groups.

*Denotes the difference within each outcome (mean percentage of calories, fruits and vegetables, and dairy wasted) between schools with and without a dichotomous characteristic is statistically different from zero at the 0.05 level. For variables containing multiple categories, * denotes that the difference in mean percentage within each outcome wasted between schools in the corresponding category and schools in the reference category is statistically different from zero at the 0.05 level.

NSLP = National School Lunch Program; SFA = school food authority.

Menu Planning and Meal Service Characteristics

There were several significant associations between plate waste and characteristics of school foodservice operations. Use of cycle menus was associated with a significantly higher percentage of waste for fruits and vegetables (25 percent versus 18 percent) (Table 5.4). In addition, the percentage of dairy wasted in SFAs where the director perceived more substantial challenges in meeting the updated nutrition standards was significantly higher than in SFAs where the director perceived fewer challenges (26 percent (5 to 7 challenges) versus 20 percent (4 or fewer challenges)). Finally, offering free lunches to all students was associated with significantly higher percentages of waste for calories and dairy, relative to schools that charged \$2.25 or less for paid lunches (for calories, 21 percent versus 17 percent; and, for dairy, 22 percent versus 28 percent).

There were statistically significant associations between the use of OVS at lunch and some plate waste outcomes among elementary and middle schools (Table F.15). Among elementary schools, the use of OVS at lunch was associated with significantly lower percentages of waste for calories (26 percent versus 32 percent) and fruits and vegetables (24 percent versus 35 percent). In contrast, the use of OVS in middle schools was associated with a significantly higher percentage of waste for dairy (26 percent versus 20 percent).

Wellness Policies and Practices

Conducting a nutrition education activity in a classroom or the foodservice area was associated with significantly lower levels of plate waste. Levels of waste were significantly lower (by 2 to 4 percentage points) for calories, fruits and vegetables, and dairy in schools where nutrition education activities were conducted (Table 5.4).

Conducting a nutrition education activity in a classroom or the foodservice area was associated with significantly lower proportions of waste for calories, fruits and vegetable, and dairy.

Competitive Foods

Findings related to competitive foods were mixed. Selling foods and beverages in vending machines was associated with a significantly lower percentage of waste for fruits and vegetables (28 percent versus 33 percent), while selling foods and beverages in school stores or snack bars was associated with a significantly higher percentage of waste for fruits and vegetables (32

percent versus 29 percent) (Table 5.4). The percentage of calories wasted was significantly higher in schools where SFA directors reported having standards for competitive foods that exceeded Smart Snacks in School standards (19 percent versus 17 percent).

Meal Service Practices

Lunch periods that started later in the day (12:00 PM and later) were associated with a significantly lower percentage of calories wasted than lunch periods that started before 11:30 AM (18 percent versus 20 percent) (Table 5.4). Overall, there was no significant association between the length of the lunch period and any of the plate waste outcomes. Some statistically significant associations were observed across school types, but the patterns were not consistent (Table F.19).

E. Factors Associated with Plate Waste in the SBP

This section describes results of analyses that parallel those reported in Section D but focus on SBP breakfasts (rather than NSLP lunches). The analyses examined the relationships between plate waste in SBP breakfasts and four key domains: (1) student gender, (2) characteristics of SBP breakfasts, (3) characteristics of school foodservice operations, and (4) characteristics of the school food environment. Because gender was the only student-level characteristic available for the plate waste observations, the study team explored the association between plate waste and gender using descriptive analyses.⁷⁶ Relationships between plate waste and the other three domains were explored in a multivariate framework.

Findings for the multivariate analyses are presented as regression-adjusted estimates of the mean percentage of calories and USDA Food Pattern food groups wasted. The discussion generally focuses on characteristics that had a significant association for all school combined. Full tabulations that include estimates for all characteristics examined within each domain and by school type are provided in Appendix F. Technical details about the multivariate analyses are discussed in Section D and Appendix E. As stated previously, findings from these analyses should be considered exploratory and cannot be generalized outside of the plate waste sample included in this study.

1. Relationship between Plate Waste in SBP Breakfasts and Student Gender

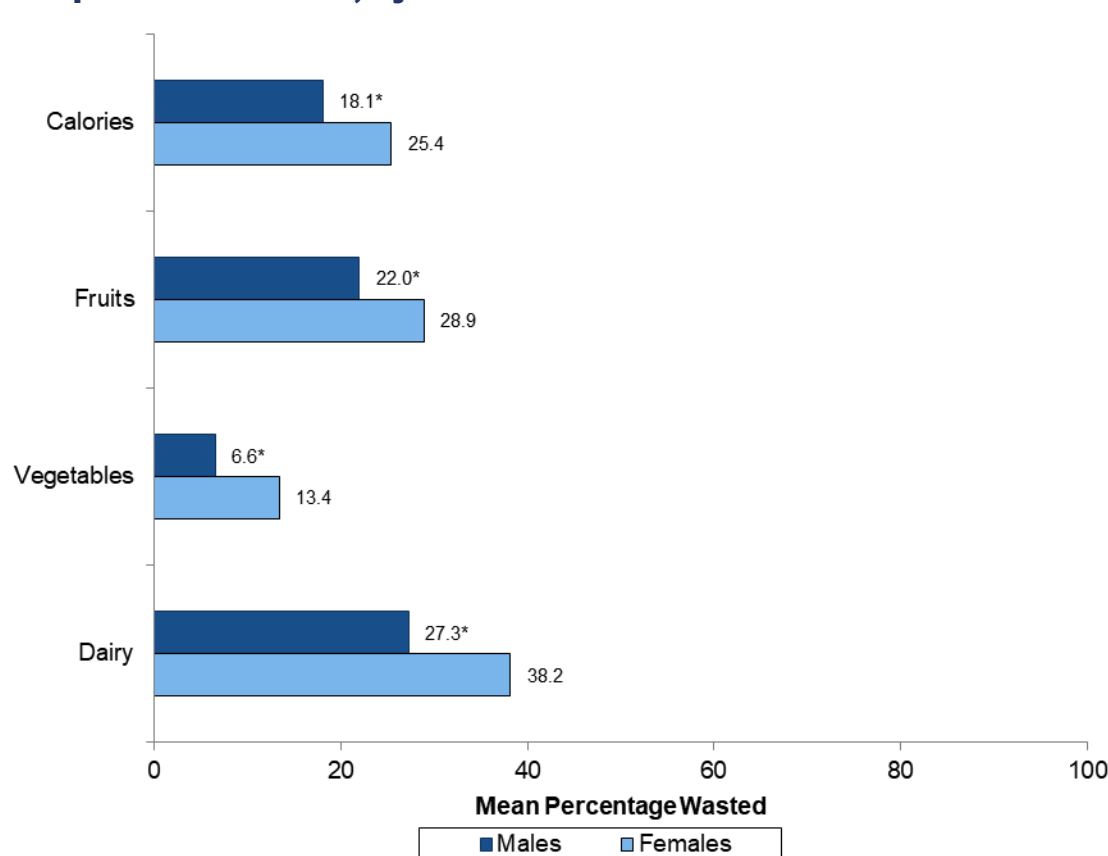
Plate waste can vary by individual student characteristics and preferences. As noted above, gender was the only student characteristic collected during plate waste observations, so the relationship between plate waste and gender was explored using descriptive cross-tabulations.

⁷⁶ The collection of student-level characteristics for the plate waste study was limited to those that could be observed, like gender. The study design did not allow for the collection of other student characteristics that would have required parental and student consent.

Overall, females wasted a significantly higher percentage of available calories than males (25 percent versus 18 percent) (Figure 5.11). A similar pattern was observed for fruits (29 percent versus 22 percent), vegetables (13 percent versus 7 percent), and dairy (38 percent versus 27 percent). The magnitude of the difference between females and males was largest for dairy (11 percentage points).⁷⁷

Overall, females wasted significantly higher percentages of the calories, fruits, vegetables, and dairy available in SBP breakfasts than males.

Figure 5.11. Mean Percentage of Calories and Key USDA Food Pattern Food Groups Wasted in SBP, by Student Gender: All Schools



Source: School Nutrition and Meal Cost Study, Plate Waste Observations, school year 2014-2015. Tray-level tabulations are unweighted and include clustered standard errors to account for clustering of trays within schools. Schools included in this unweighted analysis are public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools). Sample excludes 60 trays with missing data on gender.

Notes: The USDA Food Pattern food groups are largely consistent with the meal components used in planning SBP breakfasts, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

The fruits group includes both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

*Difference between males and females is significantly different from zero at the 0.05 level.

⁷⁷ Tables F.23 and F.24 present findings for the full set of USDA Food Pattern food groups and nutrients examined in Section C, including findings by school type.

2. Relationships between Plate Waste in SBP Breakfasts and Key Characteristics of the Breakfasts

This analysis examined the relationships between plate waste in SBP breakfasts and (1) the overall nutritional quality of SBP breakfasts as measured by total HEI-2010 scores, (2) compliance with selected SBP nutrition standards, and (3) the types of food offered in daily breakfast menus. Table 5.5 presents regression-adjusted mean percentages of available calories and USDA Food Pattern food groups wasted in SBP breakfasts for characteristics where there was a significant association for at least one of the plate waste outcomes—(1) the percentage of available calories wasted and, based on available USDA Food Pattern food groups, (2) the percentage of fruits wasted, and (3) the percentage of dairy wasted.⁷⁸ Table F.25 includes estimates for all characteristics examined in this domain and estimates by school type.

There were few significant associations between plate waste in the SBP and characteristics of the breakfasts. There was no significant association between the overall nutritional quality of SBP breakfasts, measured by HEI-2010 scores, and any of the plate waste outcomes (Table F.25). Overall, there was only one significant association between plate waste and compliance with SBP nutrition standards—meeting the minimum calorie level was associated with a significantly higher percentage of waste for fruits (Table 5.5).

Offering 1 entrée choice at breakfast was associated with a significantly higher percentage of waste for fruits relative to offering no entrée choice (21 percent versus 17 percent) (Table 5.5). In contrast, offering 2 or more entrée choices was associated with a significantly lower percentage of waste for dairy relative to offering no entrée choice (16 percent versus 23 percent). Finally, offering breakfast pastries or muffins on more than half of daily menus was associated with a significantly lower percentage of waste for calories (14 percent versus 17 percent).

⁷⁸ The parallel analyses of NSLP lunches included a combined measure of the percentage of fruits and vegetables wasted. Vegetables were excluded from the SBP outcome because they were observed on relatively few trays.

Table 5.5. Significant Relationships between Plate Waste in SBP Breakfasts and Key Characteristics of the Breakfasts: Regression-Adjusted Mean Percentage of Calories and Key USDA Food Pattern Food Groups Wasted

	Yes/No	All Schools		
		Calories	Fruits	Dairy
Mean Percentage Wasted in SBP Breakfasts Prepared		21.3	25.2	32.1
Compliance of Daily and Weekly Breakfast Menus with SBP Nutrition Standards				
Met Minimum Calorie Level	Y	17.1	24.9*	22.0
	N	13.9	17.0	15.8
Types of Foods Offered in Breakfast Menus				
Number of Entrée Choices Offered on Plate Waste Observation Day				
None (<i>reference category</i>)		15.6	17.2	23.0
1		16.3	21.4*	22.3
2 or more		14.7	20.4	15.5*
More than Half of Daily Menus Offered Breakfast Pastries or Muffins	Y	14.2*	19.6	18.0
	N	16.8	22.2	19.8
Number of Trays	3,601	3,601	3,601	3,601
Number of Schools	154	154	154	154

Source: School Nutrition and Meal Cost Study, Plate Waste Observations, and Menu Survey, school year 2014-2015. Tray-level tabulations are unweighted and include clustered standard errors to account for clustering of trays within schools. Schools included in this unweighted analysis are public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Notes: Estimates are regression-adjusted means that control for institutional and demographic characteristics of each school and their SFA. Variables with rows labeled “Y” and “N” report adjusted mean percentage of each outcome (calories, fruits, and dairy) wasted for schools that do and do not meet the variable criteria, respectively. Otherwise, regression-adjusted means are reported for each category within a variable. See Appendix E for more details on characteristic descriptions and selection methods.

*Denotes the difference within each outcome (mean percentage of calories, fruits, and dairy wasted) between schools with and without a dichotomous characteristic is statistically different from zero at the 0.05 level. For variables containing multiple categories, * denotes that the difference in mean percentage within each outcome wasted between schools in the corresponding category and schools in the reference category is statistically different from zero at the 0.05 level.

SBP = School Breakfast Program.

3. Relationships between Plate Waste in SBP Breakfasts and Key Characteristics of School Foodservice Operations and School Food Environments

This analysis examined the relationships between plate waste in SBP breakfasts and key characteristics of (1) school foodservice operations, including food purchasing, menu planning, and meal service characteristics; and (2) school food environments, including wellness policies and practices, availability of competitive foods, and meal service practices. Table 5.6 presents regression-adjusted mean percentages of available calories and USDA Food Pattern food groups for fruits and dairy wasted in SBP breakfasts for characteristics where there was a significant association for at least one of these plate waste outcomes. Tables F.29 and F.33 include estimates for all characteristics examined in this domain and estimates by school type.

There were several significant associations between plate waste in the SBP and characteristics of school foodservice operations and school food environments. Characteristics that were associated with lower levels of plate waste included participation in the Farm to School Program, SFAs analyzing the nutrient content of menus, and using OVS (Table 5.6). Participation in the Farm to School Program was associated with lower percentages of waste for calories (15 percent versus 19 percent) and dairy (18 percent versus 25 percent), and SFAs analyzing the nutrient content of menus was associated with a significantly lower percentage of waste for dairy (17 percent versus 27 percent). The use of OVS at breakfast was associated with lower percentages of waste for calories (15 percent versus 19 percent) and fruits (14 percent versus 23 percent). Overall, there was no significant association between the length of the breakfast period and any of the plate waste outcomes; however, longer breakfast periods were associated with lower levels of waste for some outcomes among elementary and high schools. Breakfast periods in elementary schools that were 26 to 39 minutes were associated with significantly lower levels of plate waste for calorie and fruits than breakfast periods that were less than 25 minutes (for calories, 26 percent versus 32 percent; and for fruits, 17 percent versus 28 percent) (Table F.33). Among high schools, breakfast periods that were 40 minutes or more were associated with a significantly lower level of plate waste for fruits than those lasting less than 25 minutes (18 percent versus 27 percent).

Table 5.6. Significant Relationships between Plate Waste in SBP Breakfasts and Key Characteristics of School Foodservice Operations and the School Food Environment: Regression-Adjusted Mean Percentage of Calories and Key USDA Food Pattern Food Groups Wasted

	Yes/No	All Schools		
		Calories	Fruits	Dairy
Mean Percentage Wasted in SBP Breakfasts Prepared		21.3	25.2	32.1
Food Purchasing Characteristics				
School Participates in Farm to School Program	Y	14.9*	16.2	18.1*
	N	19.4	20.5	25.0
Menu Planning and Meal Service Characteristics				
SFA Conducts Nutrient Analysis of Menus	Y	15.5	†	16.6*
	N	18.8	†	26.5
Number of Challenges in Meeting the Updated Nutrition Standards that SFA Rated as 3 or Higher on a Scale of 1 (Not a Challenge) to 5 (Significant Challenge)				
4 or less (<i>reference category</i>)		12.9	9.6	16.9
5 to 7		17.6*	17.6*	21.1
8		16.7*	19.1*	22.0
School Uses Offer-Versus-Serve at Breakfast	Y	15.0*	13.7*	19.0
	N	19.3	23.0	24.1
School Accommodates Students with Food Allergies and Special Dietary Needs	Y	17.5	22.0*	22.3
	N	16.8	14.7	20.8
Wellness Policies and Practices				
School Operates a School Garden	Y	22.9*	23.9	27.8
	N	16.8	17.4	25.3

	Yes/No	All Schools		
		Calories	Fruits	Dairy
Competitive Foods				
School Sells Foods Other than Milk on an A la Carte Basis	Y	20.3	19.1	29.9*
	N	19.4	22.2	23.2
SFA Has Standards for Competitive Foods that Exceed Smart Snacks in School Standards	Y	21.6*	22.2	28.3
	N	18.1	19.1	24.9
Number of Trays	3,601	3,601	3,601	3,601
Number of Schools	154	154	154	154

Source: School Nutrition and Meal Cost Study, Plate Waste Observations, Principal Survey, School Nutrition Manager Survey, Cafeteria Observation Guide, A la Carte Checklist, Vending Machine and Other Sources of Foods and Beverages Checklist, School Food Authority Director Survey, School Nutrition Manager Cost Interview, and SFA Director and Business Manager Onsite and Follow-Up Cost Interview, school year 2014-2015. Tray-level tabulations are unweighted and include clustered standard errors to account for clustering of trays within schools. Schools included in this unweighted analysis are public, non-charter schools that offer the National School Lunch Program, serve reimbursable meals in cafeteria-based settings, and serve a minimum number of lunches per day (at least 175 lunches in elementary schools, 220 lunches in middle schools, and 87 lunches in high schools).

Notes: Estimates are regression-adjusted means that control for institutional and demographic characteristics of each school and their SFA. Variables with rows labeled "Y" and "N" report adjusted mean percentage of each outcome (calories, fruits, and dairy) wasted for schools that do and do not meet the variable criteria, respectively. Otherwise, regression-adjusted means are reported for each category within a variable. See Appendix E for more details on characteristic descriptions and selection methods.

*Denotes the difference within each outcome (mean percentage of calories, fruits and vegetables, and dairy wasted) between schools with and without a dichotomous characteristic is statistically different from zero at the 0.05 level. For variables containing multiple categories, * denotes that the difference in mean percentage within each outcome wasted between schools in the corresponding category and schools in the reference category is statistically different from zero at the 0.05 level.

SBP = School Breakfast Program; SFA = school food authority.

Characteristics that were associated with higher levels of plate waste include greater perceived challenges in meeting the updated nutrition standards; accommodating students with food allergies and special dietary needs; operating a school garden; selling a la carte foods other than milk; and having nutrition standards for competitive foods that exceed the Smart Snacks in School standards (Table 5.6). The percentages of calories and fruits wasted were significantly higher than in SFAs in where the director perceived more substantial challenges in meeting the updated nutrition standards than in SFAs where the director perceived fewer challenges (for calories 17 to 18 percent versus 13 percent; and for fruits, 18 to 19 percent versus 10 percent). Accommodating students with food allergies and special dietary needs was associated with a significantly higher percentage of waste for fruits (22 percent versus 15 percent). Operating a school garden and having standards for competitive foods that exceeded Smart Snacks in School standards were both associated with a significantly higher percentage of waste for calories (for school gardens, 23 percent versus 17 percent; and for competitive foods standards, 22 percent versus 18 percent). Finally, selling foods other than milk on an a la carte basis was associated with a significantly higher percentage of waste for dairy (30 percent versus 23 percent).

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6. METHODS USED TO ASSESS DIETARY INTAKES OF SCHOOL MEAL PARTICIPANTS AND NONPARTICIPANTS

The goal of the school meal programs is to provide students with nutritious meals. The updated nutrition standards for NSLP lunches and SBP breakfasts that took effect starting in SY 2012–2013 were designed to better reflect the *Dietary Guidelines for Americans* and to enhance the diet and health of school children (USDA, FNS 2012). Thus, it is important to examine the dietary intakes of school children and assess whether their usual diets meet current recommendations for both nutrient adequacy and diet quality. It is also important to examine the role of the school meal programs in the diets of the students who participate in them. The remaining chapters of this report volume present findings on students' dietary intakes and compare intakes of NSLP and SBP participants and nonparticipants. The analyses are based on 24-hour dietary recalls collected from students. Section A describes the methods used to collect and process the 24-hour dietary recall data. Section B describes the methods used to assess the dietary intakes of school meal participants and nonparticipants.

A. Dietary Intake Data

The study team collected and processed 24-hour dietary recall data using USDA's Dietary Intake Data System (Raper et al. 2004). The following section summarizes the approach for collecting and processing these data; additional details are available in the SNMCS methodology report (Zeidman et al. 2019).

1. Data Collection

Students completed an in-person 24-hour dietary recall to provide information about foods and beverages consumed during a midnight-to-midnight recall period.⁷⁹ All 24-hour recalls covered intakes on school days. Trained interviewers used USDA's Automated Multiple-Pass Method (AMPM) to collect the data. Middle and high school students completed the 24-hour recall independently in one interview and reported the previous day's intake (from midnight to midnight). Elementary school students completed the dietary recall in two parts. They completed the first part—about foods and beverages consumed from the time the student woke up through lunch—as soon as possible after their lunch period. They completed the second part—about foods and beverages consumed during the rest of the 24-hour period—with parental assistance, usually the following day. For a representative subset (approximately 27 percent) of students, the study team collected a second dietary recall over the telephone using AMPM. This additional data allowed for the estimation of usual food and nutrient intakes (detailed in Section B).

In addition to information on the foods and beverages consumed, the 24-hour dietary recall also collected information on the time each item was consumed, the reported eating occasion (for example, breakfast, lunch, dinner, or snack), and where each item was obtained. For items obtained at school, students were asked to identify a specific location in the school (for example, a cafeteria line that served reimbursable meals, a vending machine, or a school store).

⁷⁹ The 24-hour dietary recall did not collect information on the intake of dietary supplements.

2. Data Processing

The study team processed the 24-hour dietary recalls using USDA's Survey Net, a computer-assisted coding and nutrient analysis system. Descriptive food details that students and parents provided during the AMPM interview were used to code foods and amounts in Survey Net. Reported foods and beverages were then linked to the Food and Nutrient Database for Dietary Studies (FNDDS; version 2011–2012) to obtain data on calorie and nutrient content, and to the Food Patterns Equivalents Database and Food Patterns Equivalents Ingredient Database (FPED and FPID; versions 2011–2012) to obtain data on food group content (based on USDA Food Pattern food groups).

The team subsequently matched foods obtained from reimbursable school lunches and breakfasts to the corresponding items reported in the school's Menu Survey. Nutrient and food group values were then updated with data for the specific item that the school offered. This process ensured that the dietary intake data represented as accurately as possible the nutrient and food group content of foods obtained in reimbursable meals. For example, rather than assigning sandwiches or pizzas obtained at school with the "default" or average values available in FNDDS and FPED/FPID, the nutrient and food group values of the sandwiches and pizzas actually served in each student's school were used. Thus, if a student reported a school-offered cheeseburger that was actually made with a lower fat hamburger patty or pizza that was made with whole grains or reduced-fat cheese, this was reflected in the dietary intake data.

3. Defining Breakfast and Lunch Foods

Foods considered to be part of breakfast and lunch meals were identified in students' dietary recalls. The study team based the rules for defining breakfast and lunch foods on those used in the third School Nutrition and Dietary Assessment (SNDA-III) study. Breakfast and lunch foods were identified primarily by the reported time and name of the eating occasion. Specifically, breakfast foods were identified as any foods reported between 5:00 and 9:30 a.m. and foods reported between 9:30 and 10:30 a.m. and called "breakfast" by the student. There were a small number of breakfasts reported earlier in the day (for example, between 4:00 and 5:00 a.m.) and later in the day (for example, between 10:30 and 11:15 a.m.), and these were also counted as breakfast foods. Lunch foods included all foods reported between 10:00 a.m. and 2:00 p.m., unless reported as "breakfast," and all foods reported between 2:00 and 3:30 p.m. and called "lunch." A small number of lunches were reported earlier in the day (for example, 9:15 a.m.) and later in the day (between 3:30 and 5:30 p.m.) and were also counted as lunch foods. Students may have reported more than one breakfast or lunch (for example, a breakfast at home and a breakfast at school); all reported foods were identified as breakfast or lunch foods using the above rules. Students who did not consume any foods at breakfast or lunch were excluded from analyses that examined meal-specific dietary intakes.

B. Analysis Methods

This section describes the standards used to assess whether students' nutrient and food group intakes on school days met current recommendations and standards for nutritional adequacy and diet quality. It also describes the methods used to estimate usual daily nutrient and food group intakes, average nutrient and food group intakes from breakfast and lunch meals, and Healthy Eating Index (HEI)-2010 scores. It concludes with a discussion of the methods used to compare the dietary intakes of school meal participants and nonparticipants.

1. Standards Used to Assess the Prevalence of Acceptable, Inadequate, and Excessive Nutrient Intakes

To assess the prevalence of acceptable, inadequate, and excessive nutrient intakes, the study team compared students' usual daily nutrient intakes on school days with the Dietary Reference Intakes (DRIs) and selected recommendations of the 2010 *Dietary Guidelines for Americans*.⁸⁰ The DRIs are the most up-to-date scientific standards for determining whether diets meet nutrient requirements without being excessive. The DRIs standards used in this study include the following:

1. Estimated Average Requirement (EAR)
2. Adequate intake (AI)
3. Tolerable upper intake level (UL)
4. Acceptable macronutrient distribution range (AMDR)
5. Estimated Energy Requirement (EER)

Table 6.1 defines these standards and how they are used to assess usual daily nutrient intakes. The DRIs provide standards for the amounts of nutrients healthy individuals should consume, based on age, gender, and life stage (Institute of Medicine 2006). The study team used the following DRI age and gender groups to analyze students' dietary intakes⁸¹:

- Children 4 to 8 years
- Males 9 to 13 years
- Females 9 to 13 years
- Males 14 to 18 years
- Females 14 to 18 years
- Males 19 to 30 years⁸²
- Females 19 to 30 years

In addition, the 2010 *Dietary Guidelines for Americans* provide quantitative recommendations (as maximum limits) for intakes of saturated fat (as a percentage of total calories), sodium, and cholesterol (USDA and DHHS 2010). Table 6.2 summarizes the nutrients included in the analysis of students' usual daily nutrient intakes and the standard used in assessing those intakes.

⁸⁰ The 2010 *Dietary Guidelines for Americans* were in effect when data for this study were collected.

⁸¹ When applying the DRIs, the study team assumed that females were not pregnant or lactating.

⁸² The sample included a small number of 19 year olds (n = 13). For these students, the DRIs for males and females ages 19 to 30 years were used.

Table 6.1. Dietary Reference Intake Standards Used to Assess Usual Daily Nutrient Intakes

DRI	Definition
Estimated Average Requirement (EAR)	The EAR is the average daily nutrient intake level estimated to meet the requirement of half of the healthy individuals in a particular life stage and gender group. The proportion of a group with usual daily intakes less than the EAR provides an estimate of the prevalence of inadequate usual intakes for that group.
Adequate Intake (AI)	The AI is the recommended average intake level assumed to be adequate for healthy individuals in a life stage and gender group, based on observed or experimentally determined estimates of intake. An AI is defined when the data available for a particular nutrient are insufficient to estimate requirements and establish an EAR. Unlike an EAR, the AI cannot be used to estimate the prevalence of adequate or inadequate nutrient intakes. Instead, assessment focuses on comparing mean usual intakes with the AI. Populations with mean usual daily intakes that meet or exceed AI levels can be assumed to have high levels of nutrient adequacy. However, when mean usual daily intakes fall below the AI, no firm conclusions can be drawn about the adequacy of usual intakes.
Tolerable Upper Intake Level (UL)	The UL is the maximum level of daily nutrient intake that is likely to pose no risk of adverse health effects for nearly all individuals in a population group. As intake increases above the UL, the potential risk of adverse effects may increase. The proportion of a group with usual daily intakes above the UL provides an estimate of the prevalence of excessive usual intakes for that group.
Acceptable Macronutrient Distribution Range (AMDR)	The AMDRs define ranges of usual macronutrient intakes that are associated with reduced risk of chronic disease, while providing adequate intakes of other essential nutrients. The DRIs define AMDRs for intakes of macronutrients as percentages of total calorie intake. Acceptable usual daily intakes fall within the lower and upper bounds of the AMDR. Usual intakes that fall below or exceed the AMDR may increase risk of chronic diseases.
Estimated Energy Requirement (EER)	The EER is the average dietary energy (or calorie) intake that is predicted to maintain energy balance in a healthy individual of a defined age, gender, weight, height, and level of physical activity consistent with good health. Assessment of calorie intake focuses on a comparing usual daily calorie intakes and EERs.

Source: Institute of Medicine (2006).

DRI = Dietary Reference Intake.

Table 6.2. Standards Used to Assess Usual Daily Intakes of Specific Nutrients

Nutrient	EAR	AI	UL	AMDR	EER	DG
Calories (Energy)					X	
Macronutrients						
Total fat				X		
Saturated fat				X		X
Linoleic acid				X		
Alpha-linolenic acid				X		
Carbohydrate				X		
Protein	X			X		
Vitamins						
Vitamin A	X					
Vitamin C	X					
Vitamin E	X					
Vitamin B ₆	X					
Vitamin B ₁₂	X					
Folate	X					
Niacin	X					
Riboflavin	X					
Thiamin	X					
Minerals						
Calcium	X					
Iron	X					
Magnesium	X					
Phosphorus	X					
Potassium		X				
Sodium		X	X			X
Zinc	X					
Other Dietary Components						
Dietary fiber		X				
Cholesterol						X

AI = Adequate Intake; AMDR = Acceptable Macronutrient Distribution Range; DG = 2010 *Dietary Guidelines for Americans* recommendation; EAR = Estimated Average Requirement; EER = Estimated Energy Requirement; UL = Tolerable Upper Intake Level.

2. Standards Used to Assess Usual Daily Intakes of USDA Food Pattern Food Groups

The *Dietary Guidelines for Americans* promote overall health through recommendations based on diet and exercise. A healthy diet limits sodium, saturated fat, cholesterol, added sugar, and refined grains, and includes a variety of fruits and vegetables, whole grains, fat-free or low-fat dairy, and lean protein foods (USDA and DHHS 2010). The USDA Food Patterns were developed to help individuals carry out the recommendations set forth in the *Dietary Guidelines for Americans*; they identify daily average amounts of foods to be consumed, in nutrient-dense forms, from five major food groups and their subgroups.

USDA Food Pattern recommendations for individuals depend on calorie requirements, which are determined by age, gender, and activity level. The system includes 12 Food Patterns—ranging from 1,000 to 3,200 calories—that are designed to meet the needs of individuals 2 years of age and older, as well as those at risk for developing chronic disease. In this report, the study team used the USDA Food Patterns for 1,800, 2,000, and 2,400 calories as reference standards for elementary, middle, and high school students, respectively. The Institute of Medicine (IOM)

used these calorie levels in developing recommendations for the nutrition standards for school meals that took effect in SY 2012–2013 (IOM 2010).⁸³

Table 6.3 presents USDA Food Pattern recommendations for the three calorie levels. The USDA Food Patterns specify five major food groups: fruits (including 100% juice), vegetables, grains, dairy, and protein foods. All foods in the Food Pattern food groups are assumed to be in their most nutrient-dense form, meaning their fat-free or lowest-fat form, with no added sugar (Bowman et al. 2014). The fruit and vegetable groups include all fresh, canned, dried, frozen, and juiced fruits and vegetables. The grains group includes all enriched or whole grains and products made from grains, such as breads, cereals, and crackers. The dairy group includes all fluid milk products including lactose-reduced, lactose-free, and calcium-fortified soy milk; yogurts; dairy desserts; and cheeses. Protein foods include meat, poultry, seafood, eggs, nuts and seeds, and processed soy products. Legumes can be part of either the protein group or the vegetable group.

Table 6.3. USDA Food Patterns Used to Assess Usual Daily Food Group Intakes

	Daily Recommended Amounts ^a		
	Elementary School Students	Middle School Students	High School Students
Calorie Level	1,800	2,000	2,400
Fruits (cups/day) ^b	1.5	2.0	2.0
Vegetables (cups/day)	2.5	2.5	3.0
Dark green (cups/week) ^a	1.5	1.5	2.0
Red and orange (cups/week) ^a	5.5	5.5	6.0
Legumes (cups/week) ^a	1.5	1.5	2.0
Starchy (cups/week) ^a	5.0	5.0	6.0
Other (cups/week) ^a	4.0	4.0	5.0
Grains (oz/day)	6.0	6.0	8.0
Whole grains (oz/day)	3.0	3.0	4.0
Dairy (cups/day)	3.0	3.0	3.0
Protein Foods (oz/day)	5.0	5.5	6.5
Oils (tsp/day)	5.0	6.0	7.0
Empty Calories (calories/day)	161	258	330

Source: U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. USDA Food Patterns, September 2011.

Note: USDA Food Patterns are based on the 2010 *Dietary Guidelines for Americans*.

^aRecommendations for vegetable subgroups are weekly amounts.

^bIncludes both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

cups = cup equivalents; oz = ounce equivalents; tsp = teaspoons.

⁸³ The Institute of Medicine (IOM) is now referred to as the Health and Medicine Division (HMD) of the National Academies of Science. Throughout this report, we refer to the IOM because that was the name of the organization when it developed recommendations for the updated nutrition standards for school meals.

Vegetables are broken into five subgroups:

1. Dark green vegetables, including broccoli, romaine lettuce, and other leafy greens
2. Red and orange vegetables, including carrots, tomatoes, red peppers, and sweet potatoes
3. Legumes, including beans and peas such as chickpeas, pinto beans, and lentils
4. Starchy vegetables, including white potatoes, corn, and green peas
5. Other vegetables, including a variety of vegetables, such as iceberg lettuce, avocados, onions, cucumbers, and green beans

Additionally, the Food Patterns specify a target for whole grains, an allowance for oils, and a suggested maximum limit for empty calories—defined as calories from solid fats and added sugars. All recommended amounts are daily quantities, except for the vegetable subgroups, which are recommended weekly amounts (USDA, CNPP 2011).

3. Estimating Usual Daily Intakes of Nutrients and Food Groups

The DRIs and USDA Food Pattern recommendations are intended to be met over time and applied to measures of usual daily intakes. Data from a single 24-hour recall provides only a snapshot of a person's intake—not their usual daily intake—because intakes of specific nutrients and food groups vary from day to day. Experts in diet assessment have found that data from a single 24-hour recall will lead to biased estimates of the proportion of a group with usual daily intakes above or below a standard (Beaton et al. 1983). To mitigate the limitations of a single 24-hour recall, the study team used a method developed by the National Cancer Institute (NCI) to estimate students' usual daily intakes of nutrients and food groups on school days (Freedman et al. 2010; Tooze et al. 2006 and 2010; National Cancer Institute 2015). The NCI method requires that at least a subset of the population has two 24-hour recalls and applies a measurement error model to estimate and remove the within-person variation in dietary intake to estimate the distribution of usual daily intakes (Dodd et al. 2006).

Usual daily intakes were estimated separately for school meal participants and nonparticipants overall and in the age and gender subgroups defined in the DRIs, as well as for subgroups defined by school type and gender. For nutrients, usual daily intake distributions were compared with the relevant DRI standards or 2010 *Dietary Guidelines for Americans* recommendation (Table 6.2) to estimate the percentages of participants and nonparticipants with acceptable, inadequate, or excessive usual daily intakes. Usual food group intakes were compared with USDA Food Pattern recommendations for the three calorie levels described previously (Table 6.3) to assess the extent to which usual daily food group intakes conformed with recommendations. Appendices H, I, K, and L provide detailed tabulations from the usual intake analyses that include means, standard errors, and distributions for school meal participants and nonparticipants by DRI age and gender groups and by school type and gender.

4. Estimating Mean Nutrient and Food Group Intakes at Lunch, Breakfast, and Over 24 Hours

The study team conducted analyses to examine the contribution of breakfasts and lunches to students' total daily (24-hour) intakes of nutrients and food groups. These meal-specific analyses used the rules described in Section A to identify foods that were consumed as part of breakfast

and lunch. The nutrient and food group values for foods included in each meal were summed to create meal-level totals for each student. To gain insights into the potential contributions of school meals to students' 24-hour intakes, the study team also estimated the proportion of total 24-hour nutrient and food group intakes that were contributed by lunch and breakfast. Meal-specific analyses excluded students who did not consume the meal being examined.

5. Estimating Healthy Eating Index-2010 Scores for Lunch, Breakfast, and Over 24 Hours

The HEI-2010 is a diet quality index that measures conformance to key recommendations of the 2010 *Dietary Guidelines for Americans*.⁸⁴ The USDA has adopted it as a tool to monitor the quality of foods consumed by the U.S. population overall, as well as progress toward healthier eating habits among food assistance program participants (Guenther et al. 2007). The HEI-2010 is based largely on the USDA Food Patterns. It consists of 12 components, each reflecting a key aspect of diet quality, and a total score that measures overall diet quality. The standards used in assigning HEI-2010 component scores are expressed on a density basis (that is, amounts per 1,000 calories or as a percentage of total calories) rather than absolute amounts of foods. The use of such standards in assessing diet quality reflects the recommendation that individuals should strive to meet food group and nutrient guidelines while maintaining calorie balance, rather than meeting these recommendations simply by consuming large quantities of food.

Table 6.4 shows the components included in the HEI-2010, the maximum score for each component, and the scoring criteria corresponding to the minimum and maximum scores for each component. Nine of the 12 components included in the HEI-2010 are adequacy components that focus on meeting food group and nutrient needs without exceeding calorie requirements. The adequacy components include the following:

- Total fruit, including juice
- Whole fruit
- Total vegetables
- Greens and beans
- Whole grains
- Dairy
- Total protein foods
- Seafood and plant proteins
- Fatty acids

⁸⁴ The study team used the HEI-2010, because the 2010 *Dietary Guidelines for Americans* were in effect when data for this study were collected.

The three remaining components, referred to as moderation components, measure dietary components that individuals are encouraged to limit, including refined grains, sodium, and empty calories.

Table 6.4. Healthy Eating Index-2010 Components and Standards for Scoring

HEI-2010 Component ^a	Maximum Score	Standard for Maximum Score	Standard for Minimum Score of Zero
Adequacy Components (higher score indicates higher consumption)			
Total fruit ^b	5	≥ 0.8 cup equiv. / 1,000 kcal	No fruit
Whole fruit ^c	5	≥ 0.4 cup equiv. / 1,000 kcal	No whole fruit
Total vegetables ^d	5	≥ 1.1 cup equiv. / 1,000 kcal	No vegetables
Greens and beans ^d	5	≥ 0.2 cup equiv. / 1,000 kcal	No dark green vegetables, beans, or peas
Whole grains	10	≥ 1.5 ounce equiv. / 1,000 kcal	No whole grains
Dairy ^e	10	≥ 1.3 cup equiv. / 1,000 kcal	No dairy
Total protein foods ^f	5	≥ 2.5 ounce equiv. / 1,000 kcal	No protein foods
Seafood and plant proteins ^{f,g}	5	≥ 0.8 ounce equiv. / 1,000 kcal	No seafood or plant proteins
Fatty acids ^h	10	(PUFAs + MUFAs) / SF > 2.5	(PUFAs + MUFAs) / SF < 1.2
Moderation Components (higher score indicates lower consumption)			
Refined grains	10	≤ 1.8 ounce equiv. / 1,000 kcal	≥ 4.3 ounce equiv. / 1,000 kcal
Sodium	10	≤ 1.1 gram / 1,000 kcal	≥ 2.0 grams / 1,000 kcal
Empty calories ⁱ	20	≤ 19% of energy	≥ 50% of energy
Total Score	100		

Source: U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, Fact Sheet Number 2, February 2013.

^aIntakes between the minimum and maximum standard are scored proportionately.

^bIncludes 100 percent fruit juice.

^cIncludes all forms except juice.

^dIncludes any beans and peas not counted as Total Protein Foods.

^eIncludes all milk products, such as fluid milk, yogurt, cheese, and fortified soy beverages.

^fBeans and peas are included here (and not with vegetables) when the Total Protein Foods standard is otherwise not met.

^gIncludes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted toward Total Protein Foods.

^hRatio of poly- and monounsaturated fatty acids (PUFAs and MUFAs) to saturated fat (SF).

ⁱCalories from solid fats, alcohol, and added sugars; threshold for counting alcohol is > 13 grams/1,000 calories.

Equiv. = equivalent; HEI = Healthy Eating Index; kcal = calories; MUFA = monounsaturated fatty acid; PUFA = polyunsaturated fatty acid; SF = saturated fat.

Maximum scores for the various components range from 5 to 20; minimum scores are zero. Scores for intakes between the minimum and maximum standards are scored proportionately. For example, an intake that is halfway between the criteria for the maximum and minimum scores yields a score that is half the maximum score. For all components, higher scores indicate better conformance with *Dietary Guidelines for Americans* recommendations, and thus, higher

diet quality. For the adequacy components, higher scores reflect higher intakes, and higher scores for the moderation components reflect lower consumption (which is more desirable). Scores for each of the 12 components are summed to yield a total HEI-2010 score, with a maximum of 100.

The HEI-2010 was used to describe the nutritional quality of the lunches, breakfasts, and overall diets consumed by NSLP and SBP participants and nonparticipants. The study team estimated mean HEI-2010 total and component scores for the foods consumed at lunch, at breakfast, and over 24 hours for participants and propensity score weighted comparison group of nonparticipants using the population ratio method (Guenther et al. 2013). Meal-specific analyses excluded students who did not consume the meal being examined. For most components, this method involved calculating mean intakes of calories, nutrients, and food groups for the population and subpopulations of interest, and then calculating the ratios of the means with calories in the denominator, and comparing ratios with HEI standards for scoring. For fatty acids and empty calories, mean intakes were compared to HEI standards for scoring. For each component, the percentage of the maximum possible score was also estimated by dividing the mean score by the maximum score.

6. Comparing Dietary Intakes of Program Participants and Nonparticipants

A major focus of the analysis of students' dietary intakes is to assess the impact of school meal participation on students' dietary intakes. Because students who participate in the school meal programs likely differ from nonparticipants in important ways, both observable and unobservable, it is possible that the dietary intakes of these two groups would differ even if participants obtained meals from sources other than school meals programs. To control for these underlying differences, the study team used inverse probability weighting (IPW; Cook et al. 2009; DuGoff, Schuler, and Stuart 2014) to match school meal participants and nonparticipants as closely as possible, thereby minimizing differences in the underlying characteristics of the two groups. This approach modeled propensity scores—the predicted probability of an individual's program participation—as a function of observable characteristics believed to influence program participation. The study team constructed IPW weights for each sampled student. These weights were then used to construct appropriate matched comparison groups before estimating the average effect of program participation on participants' outcomes, relative to this otherwise similar group of nonparticipants. Importantly, this approach used the entire sample of nonparticipants in all analyses that compare diet-related outcomes of participants and nonparticipants. Appendix G provides more details on the propensity score model and approach used in these analyses.

For most analyses, the statistical significance of differences between NSLP and SBP participants and the matched comparison groups of nonparticipants was tested. Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample design of the study. The differences discussed in the text are significant at least at the 0.05 level, unless otherwise noted. These test results provide an important gauge of underlying population differences; however, they are not a definitive measure of true differences and should not be interpreted as causal effects of the NSLP or SBP. Important differences may remain in characteristics that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest differences between participants and matched

nonparticipants even if they are not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

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7. FOOD INTAKES OF NSLP PARTICIPANTS AND NONPARTICIPANTS

This chapter describes food intakes of NSLP participants—students who consumed an NSLP lunch on the day reflected in the 24-hour recall—and matched comparison groups of nonparticipants on school days in SY 2014–2015.⁸⁵ It details the types of foods that students most commonly consumed at lunch, as well as the contribution of lunch foods to students' 24-hour intakes of USDA Food Pattern food groups. It also describes students' usual daily food group intakes relative to recommended USDA Food Patterns. The analysis is based on 24-hour dietary recalls collected from students. Chapter 6 describes the methods used to collect these data and to assess usual daily food group intakes.

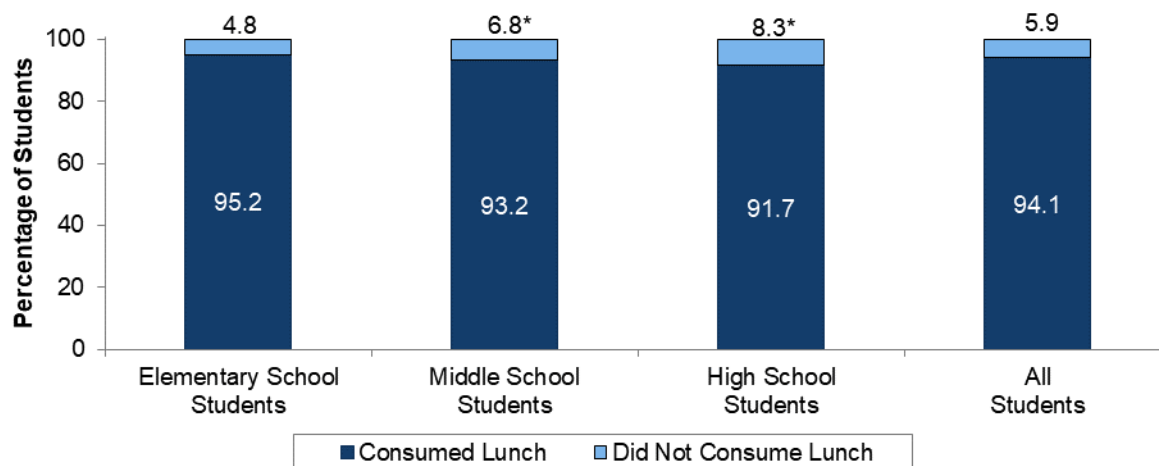
Tables and figures in this chapter present key results; supplementary tables are provided in Appendix H and noted within the chapter. The statistical significance of differences between NSLP participants and the matched comparison groups of nonparticipants was tested.⁸⁶ Rules for flagging potentially unreliable point estimates, described in Chapter 1, have also been applied. The differences discussed in the text are significant at least at the 0.05 level, unless otherwise noted. These test results provide an important gauge of underlying population differences; however, they are not a definitive measure of true differences and should not be interpreted as causal effects of the NSLP. Although propensity score weighting techniques were used to control for measured differences between NSLP participants and nonparticipants (Appendix G), important differences may remain in characteristics that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest differences between participants and weighted nonparticipants even if they are not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

A. Percentage of Students Who Did and Did Not Eat Lunch

By definition, all NSLP participants consumed an NSLP lunch on the day referenced in the 24-hour recall (the target day). In addition, more than 90 percent of students in the matched comparison group of nonparticipants consumed a non-NSLP lunch on the target day (Figure 7.1). The difference in lunch consumption was statistically significant among middle and high school students, where 7 and 8 percent of matched nonparticipants, respectively, did not consume lunch on the target day.

⁸⁵ Propensity score matching was used to construct matched comparison groups of nonparticipants. Appendix G describes the methods.

⁸⁶ Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample design of the SNMCS.

Figure 7.1. Percentage of Matched NSLP Nonparticipants Who Consumed a Lunch

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Differences in the percentage of participants and matched nonparticipants that consumed and did not consume a lunch are significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

B. Types of Foods Consumed at Lunch

To examine the types of foods students consumed at lunch, the study team grouped reported foods into seven major food groups: milk; vegetables; fruits and 100% fruit juices; combination entrées; grains/breads; meats and meat alternates; and desserts, snacks, and beverages other than milk or 100% juice. Foods in each major food group were then subdivided into minor groups based on characteristics that affect nutrient content, including ingredients and preparation methods. Table H.1 provides examples of the specific types of foods included in each minor food group category.

The summary tabulation presented in Table 7.1 is limited to foods/food groups that were consumed by at least 5 percent of NSLP participants or matched nonparticipants (who consumed a lunch) in one or more school types.⁸⁷ For both NSLP participants and the matched comparison group of nonparticipants, the analysis included all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. The analysis excluded students who did not consume a lunch. Key findings for each major food group are discussed below.

⁸⁷ Table H.2 presents a supplementary descriptive tabulation that breaks out subgroups of nonparticipants by the main source of their lunch foods (home, outside of school, or school).

Table 7.1. Foods Most Commonly Consumed at Lunch by NSLP Participants and Matched Comparison Group of Nonparticipants

	Percentage of Students Consuming Food at Lunch							
	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Milk	74.7	27.9*	58.5	26.2*	49.7	16.2*	65.6	23.3*
Fat-free	54.1	16.7*	37.3	17.8*	34.4	10.4*	46.2	15.0*
Flavored	48.6	14.1*	29.6	12.6*	25.9	9.2*	39.5	11.8*
Unflavored	5.6	<3	7.7	5.2 ^	8.5	<3*	6.7	3.2*
Low-fat (1%)	20.5	10.6	21.0	6.6^*	15.2	<3*	19.4	7.0*
Unflavored	18.5	6.7^*	20.3	6.5^*	15.2	<3*	18.1	5.0*
Vegetables	47.5	15.8*	38.6	25.4	35.2	22.5*	42.8	21.3*
Starchy vegetables	22.6	<3*	26.4	12.1*	25.3	11.8*	24.0	7.0*
French fries and similar potato products	5.7	<3*	17.7	10.6	14.2	9.9	10.1	5.8*
White potatoes	6.6	<3*	7.6	<3*	10.0	<3*	7.6	<3*
Corn	8.6	<3*	<3	<3	<3	<3	5.7	<3*
Red/orange vegetables	12.2	8.7 ^	4.2 ^	6.9 ^	5.0 ^	7.2	9.0	8.6
Carrots	9.4	5.8 ^	<3	5.0 ^	4.2 ^	5.3 ^	6.8	6.3
Other vegetables	9.0	<3*	5.1	<3*	<3	5.6	6.8	3.5
Dark green vegetables	7.3	3.8 ^	<3	5.3 ^	<3	<3	4.6	4.2
Broccoli	5.5	3.6 ^	<3	<3	<3	<3	3.4	2.6
Other leafy greens	<3	<3	<3	5.0 ^	<3	<3	<3	<3
Side salads	6.3	<3*	5.0	<3*	4.4 ^	<3*	5.6	<3*
Fruits and 100% Fruit Juices	63.4	52.4	53.6	40.4*	47.2	36.1*	57.7	46.6*
Fresh fruit	41.6	40.7	32.1	32.2	26.3	24.8	36.1	32.9
Apples	15.3	17.3	19.8	15.5	17.3	6.2*	16.7	12.8
Oranges	14.3	6.9^*	5.6	3.6 ^	<3	4.0 ^	9.9	5.9*
Grapes	4.8	4.9 ^	3.1 ^	7.6	<3	7.6*	3.6	6.2
Strawberries	<3	6.6 ^	<3	<3	<3	<3*	1.6	3.6
Canned fruit	15.0	5.6^*	15.0	5.7^*	13.5	6.8*	14.7	8.0*
Applesauce	7.2	<3	4.3 ^	<3	<3	<3	5.2	3.4
100% juice	10.9	10.4	13.7	3.3^*	12.0	6.5	11.7	9.2
Apple juice	6.6	3.1 ^	8.2	<3*	4.1 ^	3.6 ^	6.3	3.9
Orange juice	<3	6.1 ^	<3	<3	4.2 ^	<3	2.5	3.3

	Percentage of Students Consuming Food at Lunch							
	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Combination Entrées	70.6	69.8	64.6	65.9	69.8	71.4	69.3	69.8
Pizza	14.3	5.3 ^	15.7	8.9	19.8	6.6*	15.9	6.9*
Pizza with meat	6.1	<3	7.4	6.1 ^	12.2	4.6**	7.8	3.9*
Pizza without meat	8.2	3.6 ^	8.3	3.7 ^	7.6	<3*	8.1	3.2*
Mixtures with grain, meat/ meat alternate, and/or vegetables ^a	12.4	<3*	5.2	4.2 ^	9.5	11.7	10.3	5.4
Sandwiches with breaded meat, poultry, or fish	5.1	<3*	14.5	4.4**	7.1	8.5	7.4	3.9*
Mexican-style entrées ^b	7.9	<3	10.2	5.0 ^	<3	5.1 ^	7.1	4.6
Sandwiches with plain meat, poultry, or fish	6.2	24.5*	4.7 ^	24.5*	11.5	22.2*	7.2	23.4*
Cheeseburgers, hamburgers, and similar beef/pork sandwiches	8.4	4.1 ^	5.6	<3*	5.4 ^	5.7	7.2	3.5*
Hot dogs and corn dogs	8.1	<3	<3	<3	<3	<3	5.2	<3*
Peanut butter sandwiches	3.5 ^	16.9*	3.0 ^	14.8*	6.7	7.9	4.1	14.9*
Prepackaged meals ^c	<3	9.3**	<3	<3	<3	<3	<3	3.9*
Grains/Breads	29.3	36.6	23.6	40.9*	31.1	37.0	28.6	40.1*
Breads, rolls, bagels, and other plain breads	12.6	8.1 ^	6.9	3.2 ^	5.0 ^	5.5 ^	9.7	7.0
Whole grain-rich breads, rolls, bagels, and other plain breads	9.1	<3*	6.2	<3*	3.8 ^	<3	7.3	<3*
Not whole grain-rich breads, rolls, bagels, and other plain breads	3.5 ^	8.1 ^	<3	<3	<3	3.1 ^	2.4	5.9
Crackers, croutons, and pretzels	6.1	16.3*	5.1	11.8*	4.6 ^	12.9*	5.5	15.8*
Corn/tortilla chips	3.2 ^	7.1 ^	4.0 ^	8.6	7.6	6.8	4.4	6.8
Granola bars and breakfast bars	<3	4.5 ^	<3	9.9*	7.6	11.2	2.8	8.5*
Muffins and sweet/quick breads	<3	5.4 ^	<3	<3	<3	<3	<3	2.9
Biscuits and cornbread	<3	<3	<3	5.0 ^	<3	<3	<3	<3

	Percentage of Students Consuming Food at Lunch							
	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Meats/Meat Alternates	27.6	27.1	31.1	21.5	26.9	21.8	28.1	27.1
Chicken and turkey	17.5	4.9 ^a	23.7	14.2	13.9	7.5	17.9	9.1 [*]
Breaded/fried chicken nuggets, patties, and similar products	13.6	4.2 ^a	20.8	7.5 [*]	12.9	5.1 ^{aa}	14.8	6.0 [*]
Plain (not breaded/ fried) chicken and turkey	3.7 [^]	<3	<3	6.3 [^]	<3	<3	2.5	2.7
Cheese	4.8	4.2 [^]	<3	<3	5.5 [^]	4.9 [^]	4.4	5.4
Yogurt	<3	9.7 ^a	<3	<3 [*]	<3	4.3 [^]	<3	6.5 [*]
Desserts, Snacks, and Other Beverages	48.8	76.7 [*]	40.7	74.4 [*]	52.6	74.4 [*]	48.2	75.4 [*]
Beverages other than milk and 100% juice	31.4	72.7 [*]	25.3	59.9 [*]	32.5	60.2 [*]	30.5	64.2 [*]
Water ^d	28.1	46.6 [*]	20.5	38.1 [*]	22.7	39.2 [*]	25.3	42.1 [*]
Juice drinks (not 100% juice)	<3	23.9 [*]	3.2 [^]	11.7 [*]	<3	9.1 [*]	<3	16.4 [*]
Sports and energy drinks	<3	<3	<3	7.0 ^{aa}	3.2 [^]	5.9	<3	4.6 [*]
Carbonated soda	<3	<3	<3	5.1 [^]	4.2 [^]	8.5	1.8	4.7 [*]
Snack chips and popcorn	11.9	12.5	5.7	22.1 [*]	10.9	20.9 [*]	10.5	18.6 [*]
Candy	6.4	6.8 [^]	3.9 [^]	10.0 [*]	8.7	8.9	6.5	8.9
Cookies, cakes, and brownies	5.1	17.9 [*]	6.7	21.9 [*]	9.7	16.4	6.5	19.3 [*]
Dairy-based desserts ^e	3.9	8.7 [^]	5.1	<3 [*]	<3	5.0 ^{aa}	3.4	5.3
Other desserts ^f	3.8	6.9 [^]	3.5 [^]	5.7 [^]	<3	<3	3.2	6.2
Number of Students	540	204	406	277	308	362	1,254	843

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

For both NSLP participants and the matched comparison group of nonparticipants, the analysis included all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

Table is limited to food groups consumed by at least 5 percent of participants or nonparticipants for one or more school types.

^aIncludes macaroni and cheese; spaghetti with sauce; lasagna, ravioli, and stuffed shells; and mixtures with poultry, beef, or pork with rice or noodles.

^bIncludes burritos, tacos, nachos, quesadillas, fajitas, and enchiladas.

^cIncludes Lunchables and similar boxed meals.

^dIncludes bottled and tap water.

^eIncludes pudding, ice cream, ice cream cones and bars, and frozen yogurt.

^fIncludes ice pops, snow cones, Jello, and fruit leather/snacks.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

[^]Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1. When these rules are applied, percentages close to 0 or 100 are often flagged. In this table, flagged percentages between 0 and 3 percent are displayed as <3.

1. Milk

In elementary, middle, and high schools alike, NSLP participants were significantly more likely than matched nonparticipants to consume milk at lunch. Across all school types, NSLP participants were two to three times more likely than matched nonparticipants to consume milk at lunch. Among NSLP participants, the percentage of students who consumed milk at lunch was highest in elementary schools (75 percent) and lowest in high schools (50 percent). The percentage of nonparticipants who consumed milk at lunch was substantially lower (16 to 28 percent).

NSLP participants were two to three times more likely than matched nonparticipants to consume milk at lunch.

For all subgroups of students, the type of milk most frequently consumed was flavored fat-free milk. Overall, 40 percent of NSLP participants and 12 percent of matched nonparticipants consumed flavored fat-free milk at lunch.

2. Vegetables

Overall, and in elementary and high schools, NSLP participants were significantly more likely than matched nonparticipants to consume vegetables at lunch. A similar pattern was observed in middle schools, but the difference was not statistically significant. Among elementary school students, NSLP participants were three times more likely than matched nonparticipants to consume vegetables at lunch (48 percent versus 16 percent). Among high school students, the difference between NSLP participants and matched nonparticipants was smaller (35 percent versus 23 percent).

With one exception (matched nonparticipants in elementary schools), starchy vegetables—including French fries and similar potato products, other white potatoes, and corn—were the type of vegetables most commonly consumed. Because consumption of other types of vegetables was relatively uncommon at lunch, it was not possible to generate reliable point estimates for the percentage of students in each subgroup who consumed each of the vegetable subgroups.

3. Fruits and 100% Fruit Juices

Overall, NSLP participants were significantly more likely than matched nonparticipants to consume fruit or 100% juice at lunch (58 percent versus 47 percent). This difference was driven by differences among middle school and high school students (54 percent versus 40 percent and 47 percent versus 36 percent, respectively). Among elementary school students, there was no statistically significant difference between NSLP participants and matched nonparticipants in the percentage of students who consumed fruit at lunch. For all subgroups of students, fresh fruit was more commonly consumed at lunch than either canned fruit or 100% fruit juice.

4. Combination Entrées

NSLP participants and matched nonparticipants were equally likely to consume a combination entrée at lunch. However, there were some significant differences in the types of entrées consumed. Among elementary school students, NSLP participants were significantly more likely than matched nonparticipants to consume mixtures with grain/meat/vegetables and sandwiches with breaded meat, poultry, or fish, and were significantly less likely to consume

sandwiches with plain meat, poultry, or fish; peanut butter sandwiches; and pre-packaged meals (which include Lunchables and similar products). A generally similar pattern was observed among middle school students. Among high school students, significant differences were observed in the percentage of students who consumed pizza at lunch. NSLP participants were about three times as likely as matched nonparticipants to consume pizza at lunch (20 percent versus 7 percent). These findings are consistent with the fact that NSLP participants consume prepared meals that generally include options that are served hot, while the lunches many nonparticipants consume include home-prepared or purchased entrées.

5. Grains/Breads

Overall, NSLP participants were significantly less likely than matched nonparticipants to consume a separate grain or bread item at lunch—that is, a grain or bread that was not part of a combination entrée (29 percent versus 40 percent). This pattern was observed (but not necessarily statistically significant) in all school types. The difference between NSLP participants and matched nonparticipants was most pronounced for middle schools (24 percent versus 41 percent). This difference was largely driven by consumption of crackers, croutons, and pretzels by matched nonparticipants (6 percent versus 16 percent, overall). Among middle school students, matched nonparticipants were also more likely than NSLP participants to consume granola bars and breakfast bars.

Although NSLP participants were less likely than matched nonparticipants to consume a separate grain or bread item at lunch, NSLP participants were more likely than matched nonparticipants to consume a whole grain-rich bread, roll, bagel, and other plain bread. Overall, 7 percent of NSLP participants consumed a whole grain-rich grain/bread item at lunch. Consumption of these items was rare among matched nonparticipants (therefore, all point estimates in the table are flagged and presented as <3).

NSLP participants were more likely than matched nonparticipants to consume a separate whole grain-rich grain/bread item at lunch.

6. Meats and Meat Alternates

There were no significant differences between NSLP participants and matched nonparticipants in the percentage of students that consumed a separate meat or meat alternate item (not part of a combination entrée) at lunch. However, there were some significant differences in the types of meats/meat alternates consumed. In all three types of schools, NSLP participants were significantly more likely than matched nonparticipants to consume breaded chicken nuggets, patties, and similar products (15 percent versus 6 percent overall). Overall, and among elementary school students, NSLP participants were significantly less likely than matched nonparticipants to consume yogurt.

7. Desserts, Snacks, and Other Beverages

NSLP participants were significantly less likely than matched nonparticipants to consume desserts, snacks, and beverages other than milk or 100% juice at lunch. Overall, less than half (48 percent) of all NSLP participants consumed these types of foods, compared with 75 percent of matched nonparticipants. This pattern was observed for all three types of schools. A main driver of this difference is the fact that matched nonparticipants were more than twice as likely as NSLP participants to consume a beverage other than milk or 100% juice at lunch (64 percent versus 31 percent overall). For both NSLP participants and matched nonparticipants, the most commonly consumed “other” beverage was water, but matched nonparticipants were significantly more likely than NSLP participants to consume water at lunch (25 percent versus 42 percent). Matched nonparticipants were also more likely than participants to consume juice drinks, sports and energy drinks, and carbonated soda. These differences in beverage consumption are not unexpected, given the previously described differences in the percentage of NSLP participants and matched nonparticipants who consumed milk at lunch.

NSLP participants were significantly less likely than matched nonparticipants to consume desserts, snacks, and beverages other than milk or 100% juice at lunch.

Overall, NSLP participants were significantly less likely than matched nonparticipants to consume snack chips and popcorn (11 percent versus 19 percent) or cakes, cookies, or brownies at lunch (7 percent versus 19 percent). This general pattern was observed for all three types of schools, but the differences between NSLP participants and matched nonparticipants were not always statistically significant. Among middle school students, NSLP participants were less likely than matched nonparticipants to consume candy (about 4 percent versus 10 percent) and more likely to consume dairy-based desserts (5 percent versus less than 3 percent).

C. Intakes of USDA Food Pattern Food Groups at Lunch and Contribution to 24-Hour Intakes

USDA Food Patterns describe the types and amounts of foods included in a dietary pattern that is consistent with the *Dietary Guidelines for Americans* (see Chapter 6). The patterns identify daily average amounts of foods to be consumed, in nutrient-dense forms, from five major food groups and their subgroups. They also provide an allowance for oils and a limit on empty calories—that is, calories from solid fats and added sugars.

To assess the relative contribution of lunches consumed by NSLP participants and matched nonparticipants to amounts recommended in the USDA Food Patterns, the study team estimated mean amounts of USDA Food Pattern food groups consumed by NSLP participants and matched nonparticipants who consumed a lunch, as well as the relative contribution of these lunch intakes to total 24-hour intakes. These analyses excluded students who did not consume a lunch. A

USDA Food Pattern Food Groups and Subgroups

Vegetables
 Dark green
 Red and orange
 Legumes
 Starchy
 Other
Fruits
Grains
 Whole grains
Dairy
Protein Foods

separate analysis, summarized in Section D, assessed students' usual daily intakes of USDA Food Pattern food groups relative to recommended intakes.⁸⁸

1. Mean Intakes of USDA Food Pattern Food Groups at Lunch

Among students who consumed a lunch on the target day, there were generally no statistically significant differences between NSLP participants and matched nonparticipants in the mean amounts of vegetables or fruits consumed at lunch (Table 7.2). However, among elementary school students, the lunches consumed by NSLP participants contained significantly more vegetables, on average, than lunches consumed by matched nonparticipants (0.3 cup equivalents versus 0.1 cup equivalents).

NSLP participants consistently had lower mean lunch intakes of grains than matched nonparticipants. However, not all of the differences were statistically significant. At the same time, however, NSLP participants consistently had significantly higher mean lunch intakes of whole grains than matched nonparticipants (1.0 oz equivalents versus 0.6 oz equivalents, overall). In addition, NSLP participants had consistently higher mean lunch intakes of dairy (0.9 cup equivalents versus 0.6 cup equivalents, overall).

Overall, NSLP participants had significantly lower mean lunch intakes of protein foods (1.3 oz equivalents versus 1.8 oz equivalents). This pattern was observed for all three school types, but none of the school-type-specific differences were statistically significant. The same was true for mean lunch intakes of oils (1.4 tsp versus 2.1 tsp, overall) although, in this case, the difference among middle school students was statistically significant (1.5 tsp versus 2.1 tsp).

On average, NSLP participants consumed significantly fewer empty calories at lunch than matched nonparticipants (106 calories versus 168 calories). This pattern was observed for all three school types. With one exception (middle schools and calories from solid fats), the significant differences between NSLP participants and matched nonparticipants held for both empty calories from solid fats and empty calories from added sugars.

2. Proportion of 24-Hour Intakes of USDA Food Pattern Food Group Intakes Contributed by Lunch

Lunches consumed by NSLP participants contributed 30 to 55 percent of students' 24-hour intakes of the main USDA Food Pattern food groups (Figure 7.2).⁸⁹ With the exception of high school students, lunches consumed by NSLP participants made significantly larger contributions to total 24-hour intakes of vegetables than lunches consumed by matched nonparticipants. The difference between NSLP participants and matched nonparticipants was largest for elementary school students (32 percent versus 14 percent). Overall, lunches consumed by NSLP participants also made significantly larger contributions to 24-hour intakes of red and orange vegetables and starchy vegetables, relative to lunches consumed by matched nonparticipants (Table H.4). These differences were largely driven by differences among elementary school students.

⁸⁸ Tables H.16 and H.17 present additional data for subgroups of students defined by household poverty level.

⁸⁹ Table H.3 presents data on the mean amounts of USDA Food Pattern food groups consumed over 24 hours.

Table 7.2. Mean Amounts of USDA Food Pattern Food Groups Consumed at Lunch by NSLP Participants and Weighted Comparison Group of Nonparticipants

	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Vegetables (cups)	0.3	0.1*	0.3	0.2	0.4	0.5	0.3	0.3
Dark green (cups)	0.0	0.0 ^	0.0 ^	0.0 ^	0.0 ^	0.1 ^	0.0	0.0
Red and orange (cups)	0.1	0.1*	0.1	0.1	0.1	0.1	0.1	0.1
Legumes (cups)	0.0 ^	0.0 ^	0.0 ^	0.0 ^	0.0 ^	0.0 ^	0.0	0.0 ^
Starchy (cups)	0.1	0.0**	0.1	0.1	0.2	0.1	0.1	0.1
Other (cups)	0.1	0.0*	0.1	0.0*	0.1	0.1 ^	0.1	0.1
Fruits (cups) ^a	0.5	0.6	0.5	0.4	0.5	0.4	0.5	0.5
Grains (oz)	1.9	2.6	2.1	2.4	2.4	2.8*	2.1	2.8*
Whole grains (oz)	0.9	0.6*	1.1	0.6*	1.1	0.7*	1.0	0.6*
Dairy (cups)	0.9	0.6*	0.8	0.5*	0.9	0.7*	0.9	0.6*
Protein Foods (oz)	1.2	1.6	1.4	1.5	1.6	2.0	1.3	1.8*
Oils (tsp)	1.2	1.9	1.5	2.1*	1.8	2.2	1.4	2.1*
Empty Calories (kcal)	103	157*	93	126*	122	197*	106	168*
Calories from solid fats (kcal)	47	69*	48	53	57	100*	50	80*
Calories from added sugars (kcal)	56	88*	45	73*	65	96*	56	88*
Number of Students	540	204	406	277	308	362	1,254	843

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Lunch intakes for both NSLP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

The USDA Food Pattern food groups are largely consistent with the meal components used in planning NSLP lunches, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

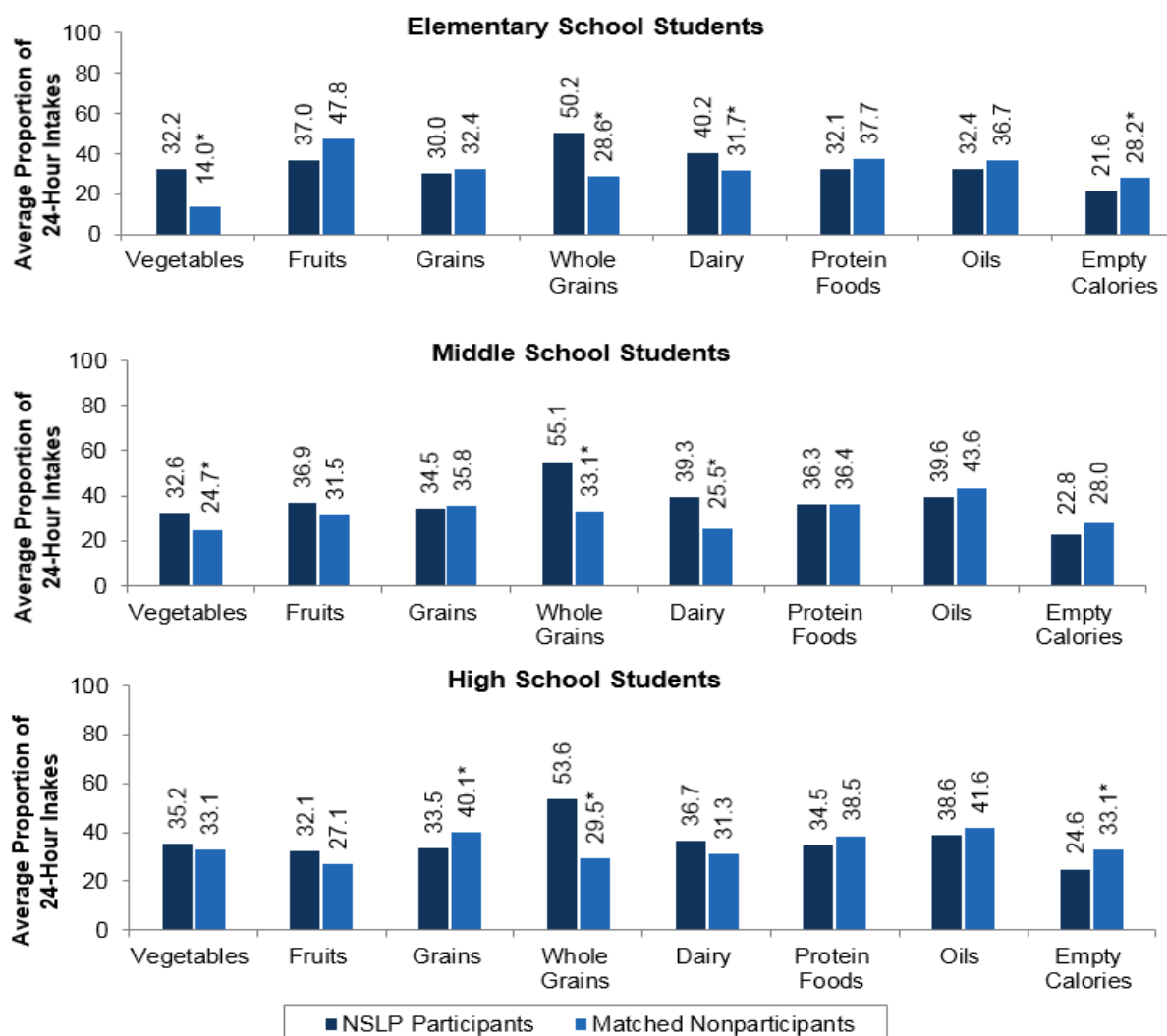
^aIntakes of fruit include both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

cups = cup equivalents; oz = ounce equivalent; NSLP = National School Lunch Program; tsp = teaspoon.

^Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

Figure 7.2. Mean Proportion of 24-Hour Intakes of USDA Food Pattern Food Groups Contributed by Lunch: NSLP Participants and Weighted Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Lunch intakes for both NSLP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. The USDA Food Pattern food groups are largely consistent with the meal components used in planning NSLP lunches, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

Intakes of fruit include both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

The average contribution of lunches consumed by NSLP participants and matched nonparticipants to 24-hour intakes of fruit ranged from 27 to 48 percent across school types, and none of the differences between NSLP participants and matched nonparticipants were statistically significant.

On average, lunches consumed by NSLP participants made smaller contributions to 24-hour intakes of grains than lunches consumed by matched nonparticipants. This pattern was observed for all three school types but was statistically significant only among high school students (34 percent versus 40 percent).

For all three groups of students, lunches consumed by NSLP participants made significantly larger contributions to 24-hour intakes of whole grains than lunches consumed by matched nonparticipants. The size of the difference between groups was substantial and ranged from 22 to 24 percentage points (for example, 55 percent versus 33 percent for middle school students).

For all three groups of students, lunches consumed by NSLP participants made significantly larger contributions to 24-hour intakes of whole grains than lunches consumed by matched nonparticipants.

Among elementary school and middle school students, NSLP lunches contributed significantly larger shares of 24-hour intakes of dairy than lunches consumed by matched nonparticipants (39 to 40 percent versus 26 to 32 percent). The same pattern was observed among high school students, but the difference between NSLP participants and matched nonparticipants was not statistically significant.

In general, lunches consumed by NSLP participants made smaller contributions to 24-hour intakes of protein foods than lunches consumed by matched nonparticipants. None of the differences within school type were statistically significant, but the differences were significant for all students combined (34 percent versus 40 percent; Table H.4). The same pattern of findings was observed for oils (35 percent versus 40 percent; Table H.4).

Lunches consumed by NSLP participants made smaller contributions to 24-hour intakes of empty calories than lunches consumed by matched nonparticipants. This difference was statistically significant among elementary school students and high school students (22 to 25 percent versus 28 to 33 percent). Among elementary school students, this finding was driven mainly by a difference in empty calories from added sugars (25 percent versus 33 percent), and among high school students, the finding was driven mainly by a difference in empty calories from solid fats (23 percent versus 32 percent; Table H.4).

D. Usual Daily Intakes of USDA Food Pattern Food Groups

Using the methods described in Chapter 6, the study team estimated students' usual daily intakes of USDA Food Pattern food groups. All students, including those who did not consume a lunch, were included in these analyses. Tables H.6–H.15 provide data on means and full distributions of usual intakes of USDA Food Pattern food groups for NSLP participants and matched nonparticipants in the age and gender subgroups used in the DRIs,⁹⁰ as well as for groups defined by school type and gender.⁹¹

To assess the extent to which usual daily food group intakes of NSLP participants and matched nonparticipants conformed with recommended USDA Food Patterns, the study team estimated the mean proportion of recommended amounts usually consumed by each group of students. As Chapter 6 describes, the USDA Food Patterns for 1,800, 2,000, and 2,400 calories were used as reference standards for elementary, middle, and high school students, respectively. Key findings from this analysis are summarized below.

Usual daily vegetable intakes of NSLP participants and matched nonparticipants were low—providing only 35 to 42 percent of recommended amounts, on average (Figure 7.3). Usual daily fruit intakes of both NSLP participants and matched nonparticipants provided considerably larger proportions of recommended amounts but, with the exception of elementary school students, mean usual intakes of all groups provided less than 70 percent of recommended daily amounts of fruit. There were no statistically significant differences between NSLP participants and matched nonparticipants in usual daily intakes of vegetables or fruits.

With the exception of matched nonparticipants in high schools, students' usual daily intakes of grains met or exceeded recommended amounts. Exceeding recommended amounts can contribute to excess calorie intake. Students' usual daily intakes of whole grains were notably lower—providing only 29 to 57 percent of recommended amounts—however, NSLP participants in all three school types had significantly higher usual daily intakes of whole grains than matched nonparticipants (43 to 57 percent of recommended amounts versus 29 to 45 percent).

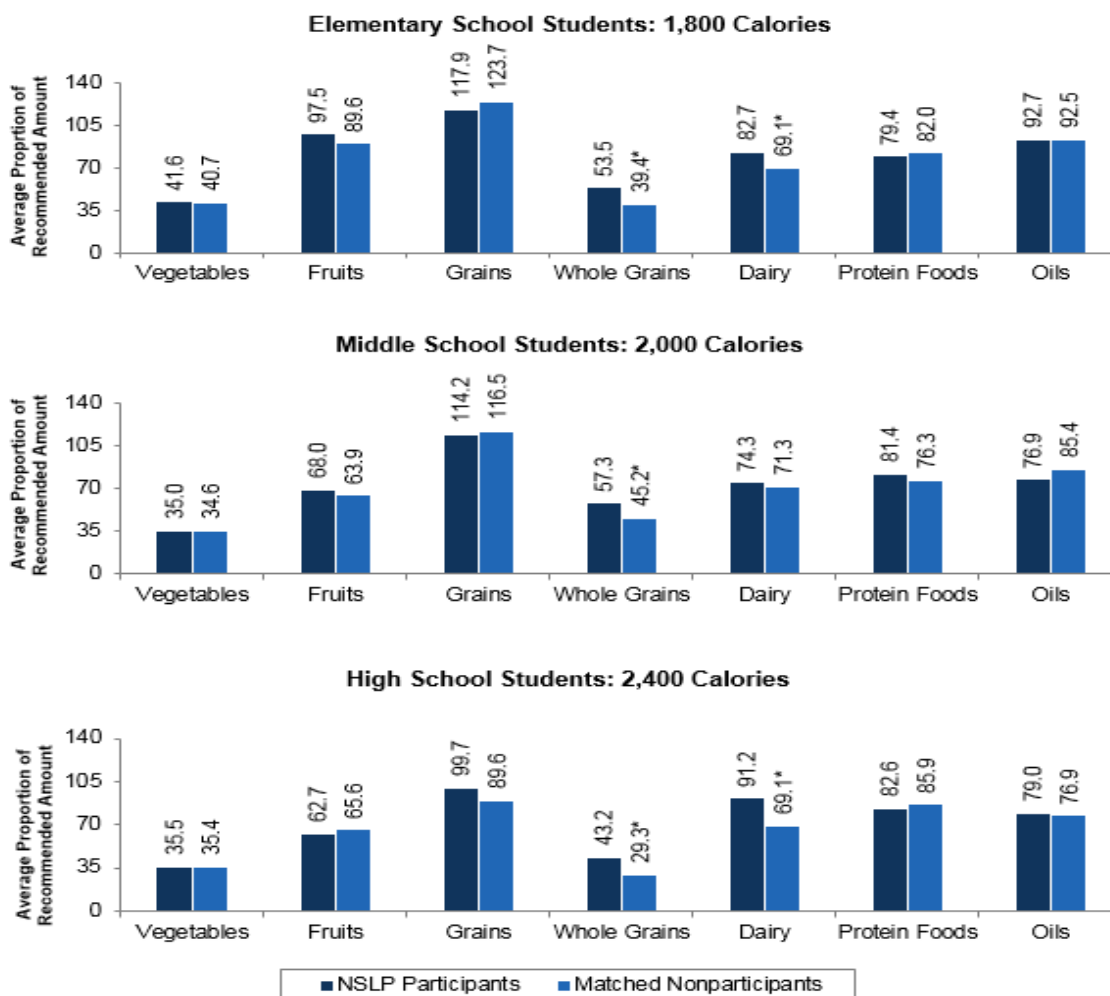
Although usual daily intakes of whole grains were low relative to recommendations, NSLP participants in all three school types had significantly higher usual daily intakes of whole grains than matched nonparticipants.

Students' usual daily intakes of dairy provided 69 to 91 percent of recommended amounts. Among elementary and high school students, usual daily intakes of NSLP participants were significantly higher for dairy, relative to recommendations, than usual daily intakes of matched nonparticipants. The difference was 83 percent of recommended amounts versus 69 percent for elementary school students, and 91 percent versus 69 percent for high school students.

⁹⁰ Both genders, 6 to 8 years; males 9 to 13 years; females 9 to 13 years; males 14 to 18 years; and females 14 to 18 years.

⁹¹ Usual intake distributions of dark green vegetables, starchy vegetables, and legumes could not be reliably estimated because so few students consumed these foods. These vegetable subgroups are included in the (total) vegetables group. In this analysis, all legumes were counted as vegetables.

Figure 7.3. Usual Daily Intakes of USDA Food Pattern Food Groups: Mean Proportion of Recommended Amounts Consumed by NSLP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Usual nutrient intakes were estimated using the NCI method (Tooze et al. 2010; Freedman et al. 2010). USDA Food Pattern recommendations assign individuals to a calorie level based on their gender, age, and activity level (USDA, CNPP 2011). The Food Patterns for 1,800, 2,000, and 2,400 calories were used as reference standards for assessing usual food group intakes of elementary, middle, and high school students, respectively (IOM 2010). The USDA Food Pattern food groups are largely consistent with the meal components used in planning NSLP lunches, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

Intakes of fruit include both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

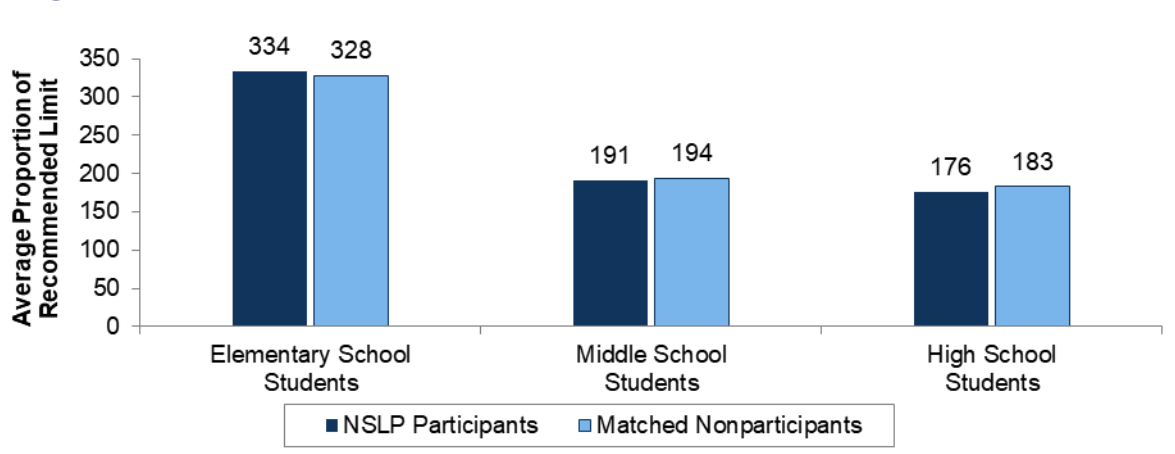
*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NCI = National Cancer Institute; NSLP = National School Lunch Program.

For protein foods and oils, students' usual daily intakes provided 76 to 93 percent of recommended amounts, and there were no statistically significant differences between NSLP participants and matched nonparticipants.

For all groups of students, usual daily intakes of empty calories exceeded the recommended maximum limit by a considerable margin (Figure 7.4). This finding was especially true for elementary school students whose usual daily intake of empty calories was more than three times the recommended maximum. This finding is partially driven by the fact that younger students have lower overall calorie requirements and thus less room in their diets for empty calories. Middle and high school students, who have a higher calorie requirements and a greater allowance for empty calories, consumed 1.8 to 1.9 times the recommended maximum for empty calories. There were no statistically significant differences between NSLP participants and matched nonparticipants in usual daily intakes of empty calories.

Figure 7.4. Usual Daily Intakes of Empty Calories: Mean Proportion of Recommended Maximum Limit Consumed by NSLP Participants and Weighted Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Usual nutrient intakes were estimated using the NCI method (Tooze et al. 2010; Freedman et al. 2010). USDA Food Pattern recommendations assign individuals to a calorie level based on their gender, age, and activity level (USDA, CNPP 2011). The Food Patterns for 1,800, 2,000, and 2,400 calories were used as reference standards for assessing usual food group intakes of elementary, middle, and high school students, respectively (IOM 2010). None of the differences between participants and the matched comparison group of nonparticipants are significantly different from zero at the 0.05 level.

NCI = National Cancer Institute; NSLP = National School Lunch Program.

8. NUTRIENT INTAKES OF NSLP PARTICIPANTS AND NONPARTICIPANTS

This chapter describes nutrient intakes of NSLP participants—students who consumed an NSLP lunch on the day reflected in the 24-hour recall—and matched comparison groups of nonparticipants on school days in SY 2014–2015.⁹² The chapter describes the average nutrient content of lunches consumed by participants and matched nonparticipants, as well as the contribution of lunches to total calorie and nutrient intakes over 24 hours. It also presents findings on the prevalence of inadequate or excessive nutrient intakes, based on an assessment of students' usual daily nutrient intakes. The analysis is based on 24-hour dietary recalls collected from students. Chapter 6 describes the methods used to collect and analyze these data.

Tables and figures in the chapter present key results; supplementary tables are provided in Appendix I and noted within the chapter. The statistical significance of differences between NSLP participants and the matched comparison groups of nonparticipants was tested.⁹³ Rules for flagging potentially unreliable point estimates, described in Chapter 1, have also been applied. The differences discussed in the text were significant at least at the 0.05 level, unless otherwise noted. These test results provide an important gauge of underlying population differences; however, they are not a definitive measure of true differences and should not be interpreted as causal effects of the NSLP. Although propensity score matching techniques were used to control for measured differences between NSLP participants and nonparticipants (Appendix G), important differences may remain in characteristics that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest differences between participants and matched nonparticipants even if they are not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

A. Nutrient Intakes at Lunch

In assessing the nutrient intakes of NSLP participants and matched nonparticipants, the study team first examined the mean amounts of calories and nutrients consumed at lunch among NSLP participants and matched nonparticipants who consumed a lunch. Key findings are summarized below.⁹⁴

⁹² Propensity score matching was used to construct matched comparison groups of nonparticipants. Appendix G describes the methods.

⁹³ Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample design of the SNMCS.

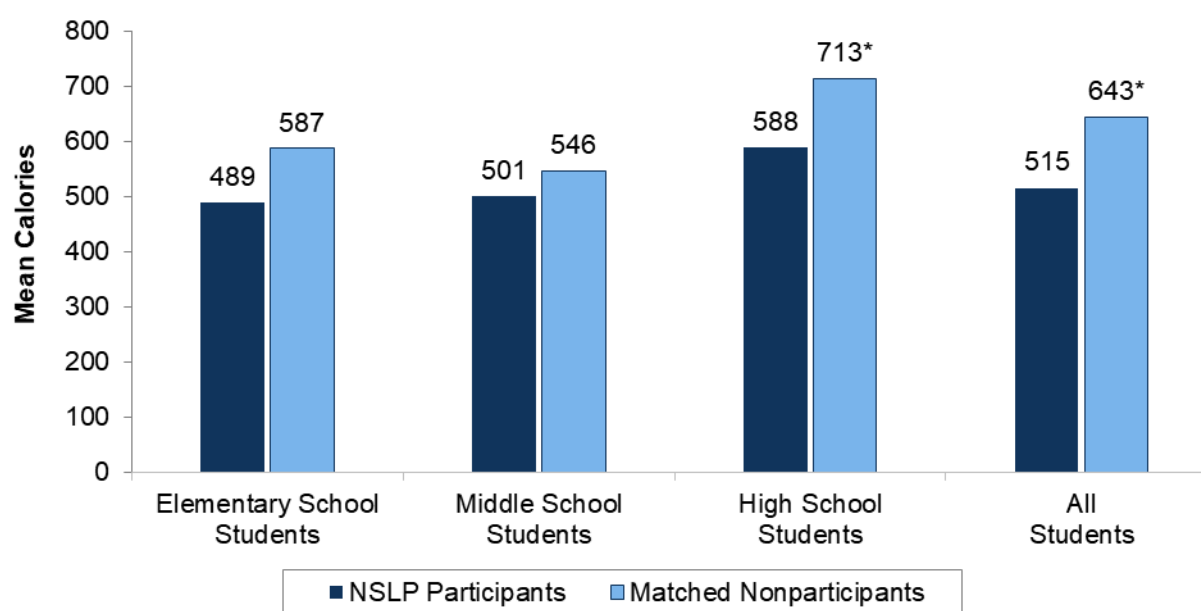
⁹⁴ Table I.2 presents a supplementary descriptive tabulation that breaks out subgroups of nonparticipants by the main source of their lunch foods (home, outside of school, or school).

1. Calories and Macronutrients

NSLP participants consumed lunches that provided significantly fewer calories than lunches consumed by matched nonparticipants (Figure 8.1). This finding was true for elementary, middle, and high school students, but was statistically significant only for high school students and all students combined. Overall, lunches consumed by NSLP participants provided 128 fewer calories, on average, than lunches consumed by matched nonparticipants (515 calories versus 643 calories). The difference in calories was similar for lunches consumed by high school students (588 calories versus 713 calories).

Overall, lunches consumed by NSLP participants were lower in calories, total fat, and saturated fat than lunches consumed by matched nonparticipants.

Figure 8.1. Mean Calories Consumed at Lunch by NSLP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

In addition, lunches consumed by NSLP participants, overall, provided less total fat, saturated fat, and carbohydrate (in total grams) than lunches consumed by matched nonparticipants (Table 8.1). Similar patterns were observed for elementary, middle, and, especially, high school students examined separately; however, differences were not always statistically significant.

Table 8.1. Mean Nutrients Consumed at Lunch by NSLP Participants and Matched Comparison Group of Nonparticipants

	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Calories (kcal)	489	587	501	546	588	713*	515	643*
Macronutrients								
Total Fat (g)	15	21*	17	20	20	27*	17	24*
Saturated Fat (g)	5	7*	5	5	6	9*	5	7*
Monounsaturated Fat (g)	5	7*	6	7*	7	9*	6	8*
Polyunsaturated Fat (g)	4	6	5	6	6	7	5	6*
Linoleic acid (g)	4	5	5	5	5	6	4	6*
Alpha-linolenic acid (g)	0.4	0.5	0.5	0.4	0.5	0.5	0.4	0.5
Carbohydrate (g)	69	82	66	75	78	93*	71	87*
Protein (g)	22	20	23	20*	27	27	23	23
Macronutrients: Percentage of Calories								
Total Fat	26.8	29.4	29.8	31.6	29.2	32.7*	28.0	31.2*
Saturated Fat	8.6	9.4	8.9	9.0	9.0	10.0	8.7	9.6*
Monounsaturated Fat	9.0	10.1	10.2	11.6*	9.9	10.9*	9.5	10.8*
Polyunsaturated Fat	7.7	8.0	9.4	9.2	8.4	9.1	8.2	8.7
Linoleic acid	6.8	7.2	8.4	8.3	7.6	8.2	7.3	7.9
Alpha-linolenic acid	0.7	0.7	0.8	0.7*	0.8	0.7	0.7	0.7
Carbohydrate	56.8	58.3	53.6	54.9	53.8	52.9	55.5	55.4
Protein	19.1	14.5*	18.8	15.1*	18.8	15.7*	19.0	15.0*
Vitamins								
Vitamin A (mcg RAE)	174	98*	132	117	163	217	163	147
Vitamin C (mg)	22	24	18	14	18	23	20	23
Vitamin D (mcg)	5.1	1.1*	4.3	2.1*^	3.0	2.4	4.5	1.8*
Vitamin E (mg AT)	1.7	2.6*	1.8	2.6*	2.4	3.0	1.9	2.8*
Vitamin B ₆ (mg)	0.5	0.4	0.4	0.5	0.5	0.8	0.5	0.5
Vitamin B ₁₂ (mcg)	1.4	0.7*	1.1	0.7*	1.4	2.0	1.3	1.1*
Folate (mcg DFE)	97	125	90	110	112	141*	99	137*
Niacin (mg)	5	6	6	7	7	10	6	8*
Riboflavin (mg)	0.6	0.5*	0.5	0.4*	0.6	0.8	0.6	0.6
Thiamin (mg)	0.4	0.4	0.4	0.4	0.5	0.5	0.4	0.5*

	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Minerals								
Calcium (mg)	360	301	322	268*	394	358	361	321
Iron (mg)	3.1	3.8	3.1	3.4	3.7	4.4*	3.3	4.1*
Magnesium (mg)	85	80	84	77	101	97	89	87
Phosphorus (mg)	435	370	412	359*	492	471	444	411
Potassium (mg)	764	649*	715	638	837	846	772	730
Sodium (mg)	770	908	794	902	1,015	1,263*	833	1,057*
Zinc (mg)	3.0	2.6	2.9	2.4*	3.4	3.3	3.1	2.9
Other Dietary Components								
Dietary Fiber (g)	6	5	6	5	6	6	6	6
Dietary Fiber Density (g/1,000 calories)	13	12	12	11	11	10*	12	10*
Cholesterol (mg)	44	36	47	36	51	67*	46	48
Number of Students	540	204	406	277	308	362	1,254	843

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

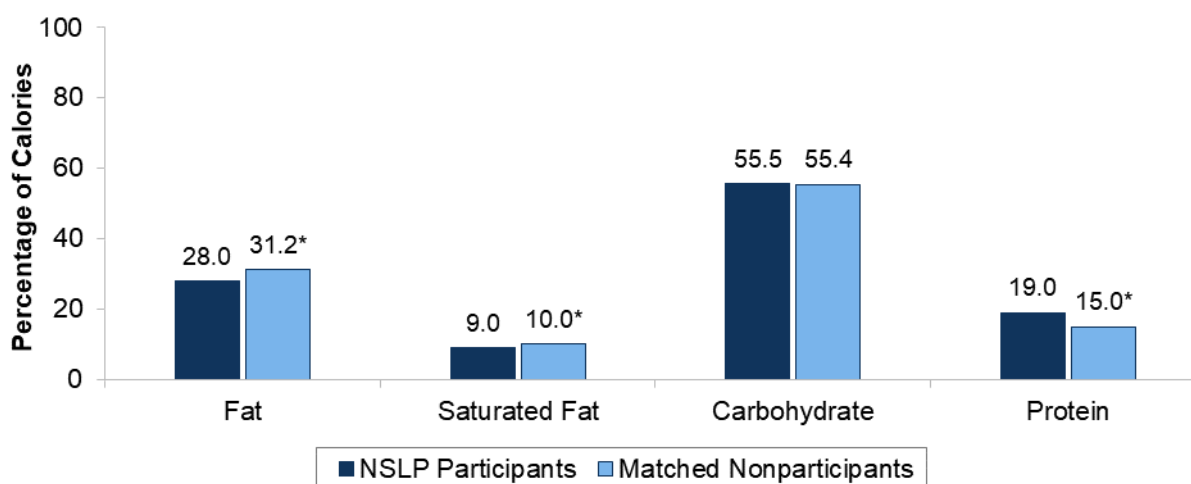
Lunch intakes for both NSLP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

AT = alpha-tocopherol; DFE = dietary folate equivalents; NSLP = National School Lunch Program; RAE = retinol activity equivalents.

Because NSLP participants consumed fewer calories at lunch than matched nonparticipants, it is useful to compare macronutrient intakes measured as a percentage of calories (Figure 8.2). Overall, lunches consumed by NSLP participants provided a smaller percentage of calories from total fat than lunches consumed by matched nonparticipants (28 percent versus 31 percent), and a smaller percentage of calories from saturated fat (9 percent versus 10 percent). The average amount of saturated fat consumed at lunch by NSLP participants was consistent with the *Dietary Guidelines for Americans* recommendation for saturated fat (less than 10 percent of total calories). Lunches consumed by NSLP participants provided a larger percentage of calories from protein than lunches consumed by matched nonparticipants (19 percent versus 15 percent), and a comparable percentage of calories from carbohydrates.

Figure 8.2. Mean Percentage of Calories from Total Fat, Saturated Fat, Carbohydrate, and Protein in Lunches Consumed by NSLP Participants and Matched Comparison Group of Nonparticipants: All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

2. Vitamins and Minerals

Lunches consumed by NSLP participants in elementary and middle schools provided significantly greater amounts of several vitamins and minerals, on average, than lunches consumed by matched nonparticipants. In elementary schools, this finding was true for vitamins A, D, and B₁₂; riboflavin; and potassium (Table 8.1). In middle schools, lunches consumed by NSLP participants provided greater amounts of vitamins D and B₁₂, riboflavin, calcium, phosphorus, and zinc than lunches consumed by matched nonparticipants. These findings are consistent with patterns observed in the types of foods consumed by NSLP participants and matched nonparticipants at lunch—particularly, higher rates of consumption for milk, vegetables, pizza, and meat-based sandwiches among NSLP participants (see Table 7.1).

With the exception of vitamin E, lunch intakes of all of the other vitamins and minerals examined in this analysis were comparable for NSLP participants and matched nonparticipants in elementary and middle schools. Vitamin E was consumed at lower levels by NSLP participants than matched nonparticipants. A likely explanation for this difference is a significantly higher consumption of peanut butter sandwiches (nuts are high in vitamin E) among matched nonparticipants in elementary and middle schools (see Table 7.1).

Among elementary and middle school students, lunches consumed by NSLP participants provided significantly larger amounts of several vitamins and minerals. There were few significant differences in the vitamin and mineral content of lunches consumed by high school students.

Among high school students, there were few significant differences in mean intakes of vitamins and minerals at lunch, possibly because matched nonparticipants in high schools consumed more calories. The lunches consumed by NSLP participants in high schools were significantly lower in folate and iron, on average, than lunches consumed by matched nonparticipants. NSLP participants in high schools also consumed lunches that were lower in sodium.

3. Dietary Fiber and Cholesterol

There were no significant differences between NSLP participants and matched nonparticipants in total dietary fiber intake at lunch (Table 8.1). However, lunches consumed by NSLP participants overall and NSLP participants in high schools had a significantly higher nutrient density for fiber (g/1,000 calories) than lunches consumed by matched nonparticipants (11–12 g/1,000 calories versus 10 g/1,000 calories). This pattern, which was also observed among elementary and middle school students but not statistically significant, is consistent with higher lunch intakes of whole grains among NSLP participants (see Table 7.2).

Among high school students, NSLP participants had a significantly lower intake of cholesterol at lunch, on average, than matched nonparticipants (51 mg versus 67 mg). This difference likely reflects consumption of more cholesterol-rich foods by matched nonparticipants. Matched nonparticipants had a caloric intake that was 25 percent higher than participants, but their cholesterol intake was 31 percent higher.

B. Nutrient Intakes Over 24 Hours

To gain insights into the potential contributions of NSLP lunches to students' total nutrient intakes, the study team examined mean amounts of calories and nutrients consumed by NSLP participants and nonparticipants over 24 hours (on the target day), as well as the proportion of 24-hour intakes contributed by lunch. A separate analysis, summarized in Section C, estimated the prevalence of inadequate and excessive usual daily intakes among NSLP participants and matched nonparticipants.⁹⁵

1. Mean Nutrient Intakes Over 24 Hours

Twenty-four hour intakes of NSLP participants and matched nonparticipants were comparable in calories and macronutrients (Table 8.2). There were only two isolated instances of significant differences between NSLP participants and matched nonparticipants across all subgroups of students.

NSLP participants and matched nonparticipants had comparable 24-hour intakes of calories and macronutrients.

Among elementary school students, mean 24-hour intakes of vitamins D, B₆, and B₁₂, calcium, phosphorus, and potassium were significantly higher for NSLP participants than for matched nonparticipants (Table 8.2). With the exception of potassium, the same pattern was observed for all students combined. Mean lunch intakes of all of these nutrients were generally higher for NSLP participants than matched nonparticipants and, as discussed in the preceding section, many of those differences were statistically significant (Table 8.2). This finding suggests that the differences NSLP lunches made in students' intakes of these nutrients at lunch persisted over 24 hours, especially among elementary school students.

Among middle school students, mean 24-hour intakes of cholesterol were significantly higher among NSLP participants than matched nonparticipants (Table 8.2). This finding is consistent with the pattern observed in lunch intakes (Table 8.1), although the difference between mean cholesterol intakes of NSLP participants and matched nonparticipants at lunch was not statistically significant.

⁹⁵ Tables I.44 and I.45 present additional data for subgroups of students defined by household poverty level.

Table 8.2. Mean Amounts of Calories and Nutrients Consumed over 24 Hours by NSLP Participants and Matched Comparison Group of Nonparticipants

	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Calories (kcal)	1,937	1,860	1,844	1,821	2,170	2,100	1,975	1,980
Macronutrients								
Total Fat (g)	67	67	66	63	79	77	70	71
Saturated Fat (g)	23	23	22	21	27	26	24	24
Monounsaturated Fat (g)	23	22	23	22	27	27	24	24
Polyunsaturated Fat (g)	16	16	16	16	19	18	17	17
Linoleic acid (g)	14	14	15	14	17	16	15	15
Alpha-linolenic acid (g)	1.4	1.4	1.4	1.3	1.6	1.5	1.4	1.4
Carbohydrate (g)	269	254	247	251	279	278	267	269
Protein (g)	73	68	72	68	92	81	78	73
Macronutrients: Percentage of Calories								
Total Fat	30.4	30.7	32.1	31.1	31.7	32.2	31.0	31.4
Saturated Fat	10.3	10.6	10.7	10.1	10.8	10.6	10.5	10.6
Monounsaturated Fat	10.5	10.3	10.9	10.9	10.8	11.0	10.6	10.7
Polyunsaturated Fat	7.3	7.5	8.1	7.8	7.7	7.8	7.5	7.6
Linoleic acid	6.5	6.7	7.2	7.0	6.8	6.9	6.7	6.8
Alpha-linolenic acid	0.6	0.6	0.7	0.6	0.7	0.6	0.7	0.6
Carbohydrate	55.8	55.6	53.4	55.0*	52.4	53.3	54.5	54.8
Protein	15.5	15.1	16.2	15.2	17.1	15.7	16.0	15.2*
Vitamins								
Vitamin A (mcg RAE)	652	599	581	566	649	651	637	634
Vitamin C (mg)	87	87	76	70	71	86	81	82
Vitamin D (mcg)	9.9	5.3*	8.5	6.8	7.7	6.5	9.1	6.3*
Vitamin E (mg AT)	6.8	7.1	6.7	7.1	8.6	8.5	7.2	7.7
Vitamin B ₆ (mg)	1.9	1.7*	1.9	1.9	2.2	2.2	2.0	1.9
Vitamin B ₁₂ (mcg)	5.4	4.3*	5.2	4.9	6.1	5.4	5.5	5.0*
Folate (mcg DFE)	541	568	514	581	600	569	550	592
Niacin (mg)	22	22	23	23	27	26	23	24
Riboflavin (mg)	2.2	2.0	2.1	1.9	2.4	2.3	2.2	2.1
Thiamin (mg)	1.6	1.5	1.6	1.6	1.9	1.6	1.7	1.6

	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Minerals								
Calcium (mg)	1,137	996*	1,060	1,007	1,293	1,106*	1,159	1,066*
Iron (mg)	15.1	14.7	14.5	14.5	16.3	15.1	15.3	15.4
Magnesium (mg)	270	249	250	250	312	282	276	264
Phosphorus (mg)	1,398	1,244*	1,304	1,273	1,637	1,415	1,437	1,336*
Potassium (mg)	2,502	2,224*	2,269	2,271	2,675	2,491	2,499	2,370
Sodium (mg)	3,015	2,949	2,844	3,031	3,588	3,462	3,119	3,166
Zinc (mg)	10.9	10.1	11.1	9.9	12.7	11.1	11.4	10.7
Other Dietary Components								
Dietary Fiber (g)	18	16	16	15	18	17	17	16
Dietary Fiber Density (g/1,000 calories)	9	9	9	8	8	8	9	9
Cholesterol (mg)	187	209	202	163*	239	234	202	208
Number of Students	540	208	406	308	308	395	1,254	911

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

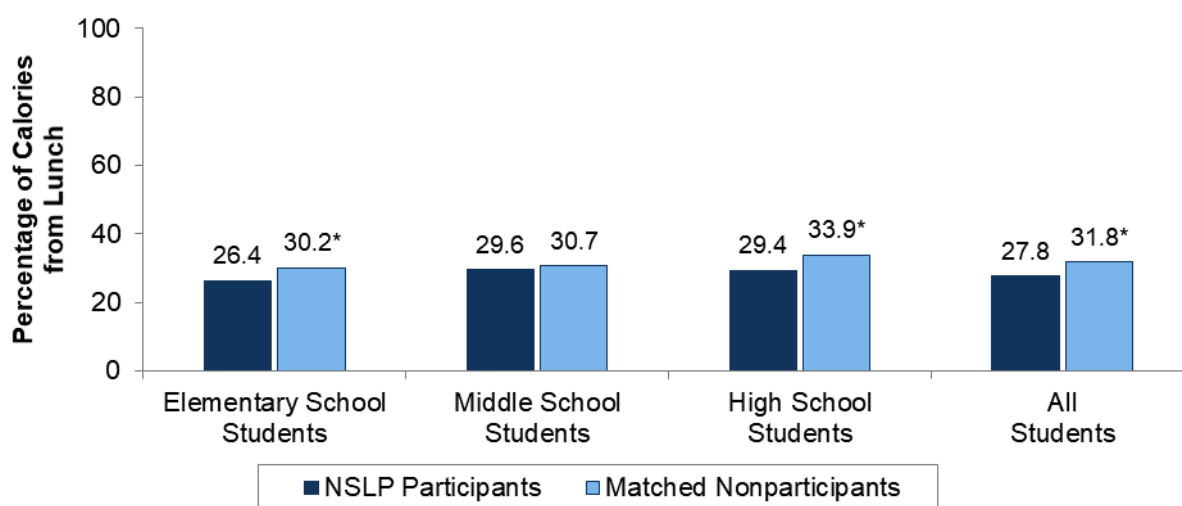
*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

AT = alpha-tocopherol; DFE = dietary folate equivalents; NSLP = National School Lunch Program; RAE = retinol activity equivalents.

2. Mean Proportion of 24-Hour Intakes Contributed by Lunch

On average, lunches consumed by NSLP participants contributed a smaller proportion of 24-hour calorie intakes than lunches consumed by matched nonparticipants (28 percent versus 32 percent overall; Figure 8.3).^{96,97} With the exception of middle school students, this difference was statistically significant. This finding is consistent with the previously reported finding that lunches consumed by NSLP participants were lower in calories than lunches consumed by matched nonparticipants (Table 8.1). Given that mean 24-hour calorie intakes were comparable, this findings also indicates that NSLP participants obtained more of their calories from other meals and snacks than matched nonparticipants did.

Figure 8.3. Mean Proportion of 24-Hour Calorie Intakes Contributed by Lunch: NSLP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

Other differences between NSLP participants and nonparticipants in the contribution of lunch to 24-hour intakes are also consistent with the patterns observed for lunch intakes. For example, NSLP participants obtained a smaller proportion of their 24-hour intakes of total fat from lunch (Table I.1). This difference was statistically significant for students overall (27 percent versus 32 percent) as well as for high school students (29 percent versus 36 percent). A similar pattern was observed for saturated fat (25 percent versus 20 percent overall, and 27

⁹⁶ The analysis excluded nonparticipants who did not consume a lunch.

⁹⁷ Table I.3 presents a supplementary descriptive tabulation that examines contributions of lunches consumed by subgroups of nonparticipants defined by the main source of their lunch foods (home, outside of school, or school).

versus 34 percent for high school students). The fact that mean 24-hour intakes of total fat and saturated fat were comparable for NSLP participants and matched nonparticipants (Table 8.2) indicates that the positive effects of lunches that were lower in total fat and saturated fat were not maintained over 24 hours, as NSLP students consumed more of these macronutrients from other meals and snacks than matched nonparticipants did.

Although lunches consumed by NSLP participants overall contributed a smaller proportion of students' 24-hour intakes of calories, NSLP participants obtained a larger proportion of their 24-hour intakes of vitamins A, D, and B₁₂; riboflavin; phosphorus; and potassium from lunch than did nonparticipants (Table I.1). This finding is consistent with the patterns observed for differences between the two groups in both lunch and 24-hour intakes.

C. Prevalence of Acceptable, Inadequate, and Excessive Usual Daily Intakes

Using the methods described in Chapter 6, the study team estimated usual daily intakes of calories and nutrients for both NSLP participants and matched nonparticipants. All students, including those who did not consume a lunch, were included in these analyses. Tables I.6–I.42 provide data on means and full distributions of usual calorie and nutrient intakes for both groups of students in the age and gender subgroups used in the DRIs,⁹⁸ as well as subgroups defined by school type and gender.

Using these usual daily intake distributions, the study team estimated the proportion of NSLP participants and matched nonparticipants with acceptable, inadequate, and excessive usual daily intakes, relative to age- and gender-specific DRIs. Key findings are summarized below.

Dietary Reference Intakes (DRIs)

AI = Adequate Intake

*AMDR = Acceptable
Macronutrient Distribution
Range*

*EAR = Estimated Average
Requirement*

*UL = Tolerable Upper
Intake Level*

1. Usual Intakes of Calories Relative to Estimated Energy Requirements

Assessment of self-reported energy intakes is difficult. In theory, populations that are in energy balance (not gaining or losing weight) should have average usual energy intakes that are roughly equivalent to corresponding EERs. However, it is well recognized that individuals tend to misreport food intake in dietary surveys (IOM 2005). Under-reporting tends to be greatest among females, people who are overweight or obese, and people with low incomes. There is some evidence that under-reporting is associated with omission of foods perceived to be “bad,” such as foods high in fat and/or sugar.

In addition, it is difficult to accurately estimate EERs without information about individuals' customary levels of physical activity. For this analysis, the study team applied assumptions about physical activity that the IOM used in developing recommendations for updated nutrition standards for school meals (IOM 2010). Students 6 to 10 years of age were assumed to have an

⁹⁸ Both genders, 6 to 8 years; males 9 to 13 years; females 9 to 13 years; males 14 to 18 years; and females 14 to 18 years. The sample included a small number of 19 year-olds. In assessing usual daily intakes of these students, appropriate age- and gender- specific DRIs were used (males 19 to 30 years and females 19 to 30 years), but in Tables I.6–I.42, these 13 students are included with students 14 to 18 years.

“active” level of physical activity, and all older students were assumed to have a “low active” level of physical activity. Estimated EERs (Table I.4) were not significantly different for NSLP participants and matched nonparticipants. Mean calorie intakes for all groups of students were below estimated EERs, which suggests under-reporting of true intakes. The gap between estimated EERs and mean usual calorie intakes, which was higher for middle and high school students than elementary school students, was similar for NSLP participants and matched nonparticipants.

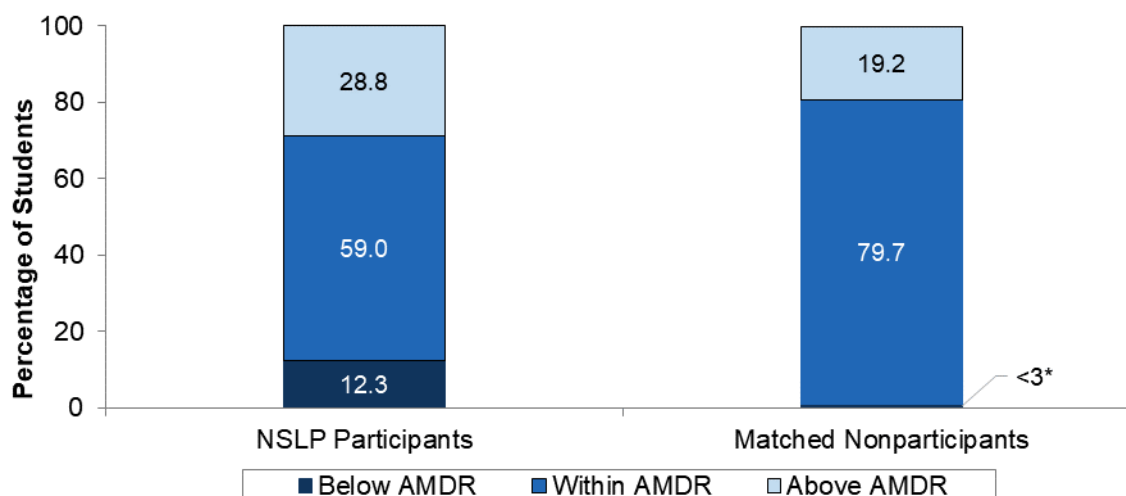
2. Usual Intakes of Macronutrients

To assess usual intakes of macronutrients, the study team compared usual daily macronutrient intakes of NSLP participants and matched nonparticipants to AMDRs defined in the DRIs (see Chapter 6). Acceptable usual intakes were defined as intakes that fell within the AMDR. Usual daily intakes of carbohydrate and protein were also compared with EARs. Because there is no DRI for saturated fat, the *Dietary Guidelines for Americans* recommendation was used as a benchmark to define acceptable intakes.

The majority of both NSLP participants and matched nonparticipants had acceptable usual intakes of macronutrients, and there were few significant differences between the two groups (Table I.43). Usual daily intakes of total fat fell within the AMDR for 84 percent of NSLP participants and 78 percent of matched participants. Usual daily fat intakes that were not within the AMDR were more likely to be excessive (more fat as a percentage of total calories than recommended) than inadequate. Thirteen percent of NSLP participants and 17 percent of matched nonparticipants had excessive usual daily intakes of total fat. None of these differences were statistically significant. Overall, 3 to 5 percent of students had usual daily intakes of total fat that were low relative to the AMDR. Among high school students, NSLP participants were significantly more likely than matched nonparticipants to have low usual daily intakes of total fat (Figure 8.4). The usual intake distributions (Table I.7) show that this pattern was observed among both male and female high school students (differences in the usual intake distribution tables were not tested for statistical significance).

Usual intakes of protein and carbohydrate generally conformed with dietary standards, but several groups of students had excessive daily intakes of total fat and saturated fat.

Overall, about 60 percent of students had usual daily intakes of saturated fat that exceeded the *Dietary Guidelines for Americans* recommendation (Table I.43). Findings were comparable for NSLP participants and matched nonparticipants. More than 85 percent of NSLP participants and matched nonparticipants had acceptable usual daily intakes of linoleic acid (an essential fatty acid). However, among elementary school students, NSLP participants were more likely than matched nonparticipants to have acceptable usual daily intakes of linoleic acid (95 percent versus 72 percent) and were less likely to have usual daily intakes that exceeded or fell below the AMDR.

Figure 8.4. Usual Intakes of Total Fat Relative to the AMDRs: High School Students

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

AMDR = Acceptable Macronutrient Distribution Ranges; NSLP = National School Lunch Program.

^Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1. When these rules are applied, percentages close to 0 or 100 are often flagged. In this figure, flagged percentages between 0 and 3 percent are displayed as <3.

3. Usual Intakes of Vitamins and Minerals

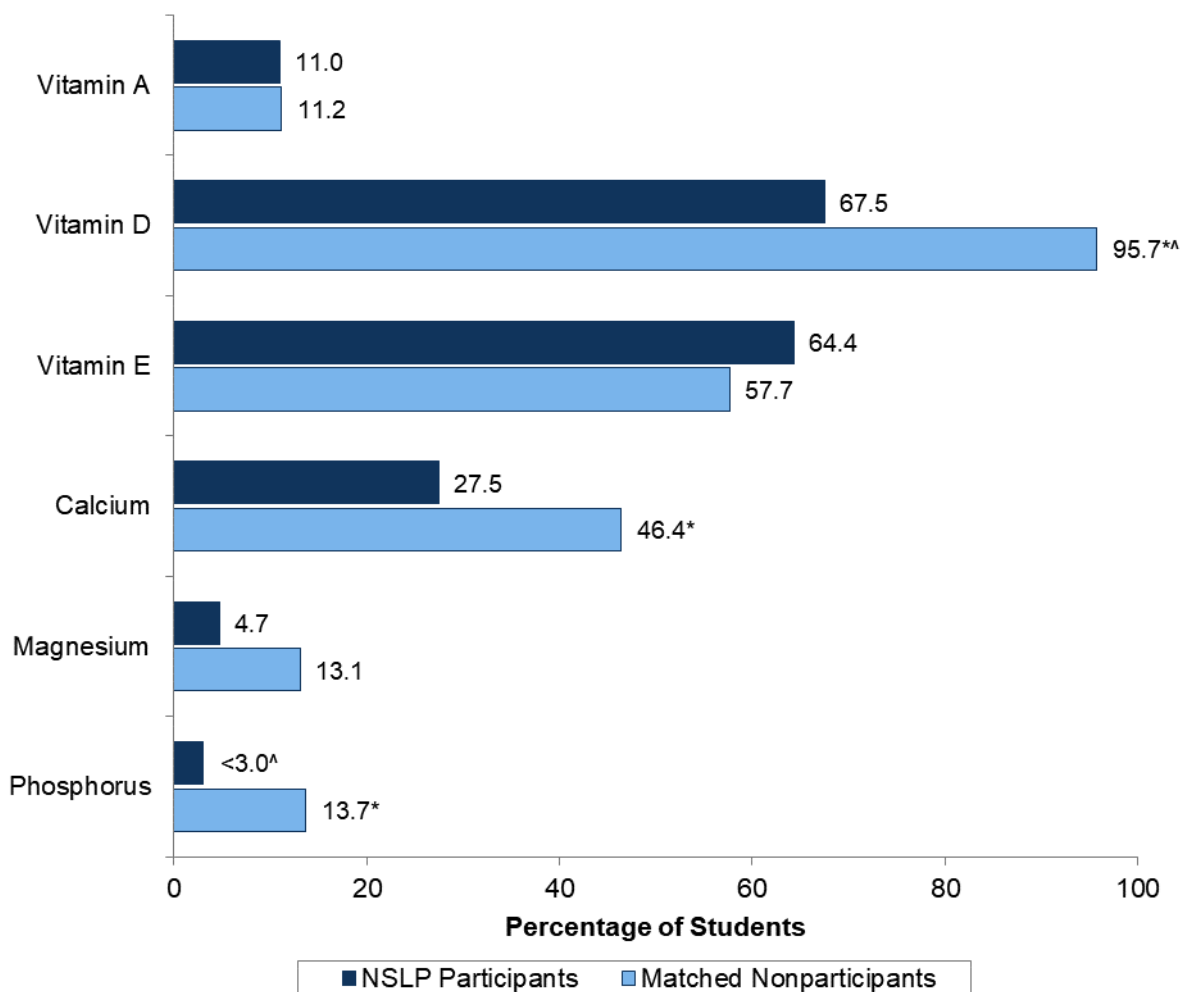
For most of the vitamins and minerals examined in this study, the analysis compared usual daily intakes of NSLP participants and nonparticipants with EARs to estimate the prevalence of usual daily intakes that were inadequate (less than the EAR; see Chapter 6). Findings discussed in the text focus on vitamins and minerals for which the prevalence of inadequacy exceeded 10 percent for at least one group of students.

The prevalence of inadequate intakes of vitamins and minerals was least common among elementary school students. In this group, the prevalence of inadequacy exceeded 10 percent for both NSLP participants and nonparticipants for vitamins A, D, and E, and calcium (Figure 8.5). In addition, more than 10 percent of matched nonparticipants had inadequate usual intakes of magnesium and phosphorus. About 60 percent of both NSLP participants and matched nonparticipants in elementary schools had inadequate usual intakes of vitamin E.⁹⁹ NSLP

⁹⁹ Devaney et al. (2007) pointed out that the diets of most of the U.S. population do not meet the EAR for vitamin E, yet vitamin E deficiency is rare. They noted limitations of both the data used to establish the EAR and the data used to assess vitamin E intakes.

participants in elementary schools were significantly less likely than matched nonparticipants to have inadequate usual intakes of vitamin D (68 percent versus 96 percent), calcium (28 percent versus 46 percent), and phosphorus (less than 3 percent versus 14 percent).

Figure 8.5. Prevalence of Inadequate Usual Daily Intakes of Vitamins and Minerals among NSLP Participants and Matched Comparison Group of Nonparticipants: Elementary School Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. The figure is limited to nutrients that had a prevalence of inadequacy of more than 10 percent for at least one group.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

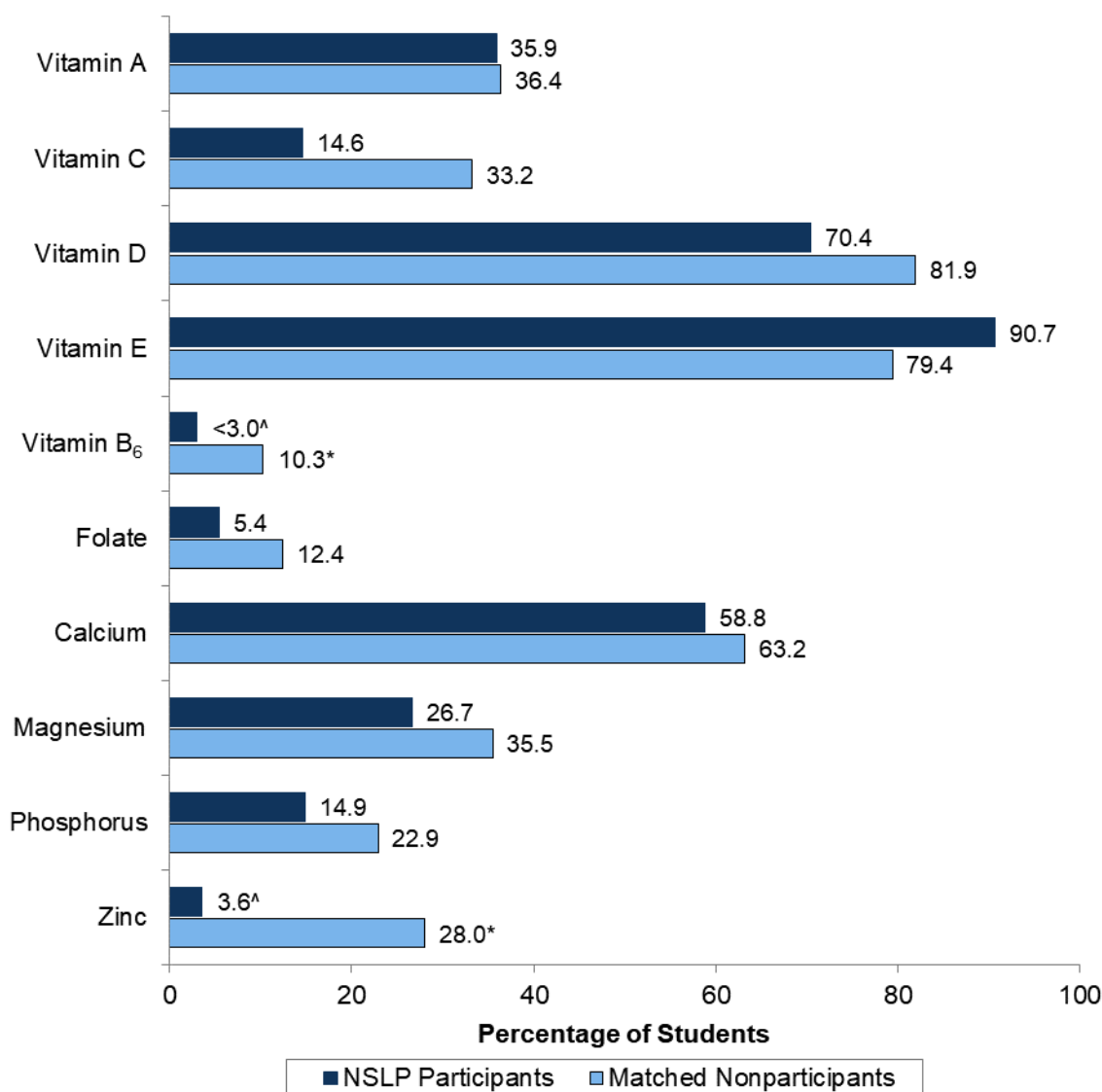
[^]Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1. When these rules are

applied, percentages close to 0 or 100 are often flagged. In this figure, flagged percentages between 0 and 3 percent are displayed as <3.

Among middle school students, the prevalence of inadequate intakes exceeded 10 percent for both NSLP participants and matched nonparticipants for seven of the 15 vitamins and minerals examined (Table I.43). Among matched nonparticipants, the prevalence of inadequate intakes exceeded 10 percent for an additional three vitamins and minerals. Seventy percent or more of NSLP participants and matched nonparticipants had inadequate intakes of vitamins D and E (Figure 8.6). About 60 percent of both NSLP participants and matched nonparticipants had inadequate intakes of calcium, and 36 percent of both NSLP participants and nonparticipants had inadequate intakes of vitamin A. NSLP participants in middle schools were significantly less likely than matched nonparticipants to have inadequate usual intakes of vitamin B₆ (less than 3 percent versus 10 percent) and zinc (4 percent versus 28 percent).

High school students—who have the highest nutrient requirements relative to the other age groups considered in this study—had the greatest prevalence of inadequate vitamin and mineral intakes. For NSLP participants, the prevalence of inadequate intakes exceeded 10 percent for seven of the 15 vitamins and minerals examined; for matched nonparticipants, the prevalence of inadequate intakes exceeded 10 percent for 13 vitamins and minerals (Table I.43). Like students in elementary and middle schools, 70 percent or more of NSLP participants and matched nonparticipants had inadequate intakes of vitamins D and E (Figure 8.7). Nearly half of both NSLP participants and matched nonparticipants had inadequate intakes of vitamin A, and more than 60 percent of both NSLP participants and matched nonparticipants had inadequate intakes of magnesium. NSLP participants in high schools were significantly less likely than matched nonparticipants to have inadequate usual intakes of vitamin B₆ (less than 3 percent versus 13 percent), vitamin B₁₂ (less than 3 percent versus 16 percent), folate (8 percent versus 30 percent), niacin (less than 3 percent versus 7 percent), riboflavin (less than 3 percent versus 12 percent), thiamin (less than 3 percent versus 19 percent), calcium (40 percent versus 57 percent), phosphorus (17 percent versus 31 percent), and zinc (9 percent versus 33 percent).

Figure 8.6. Prevalence of Inadequate Usual Daily Intakes of Vitamins and Minerals among NSLP Participants and Matched Comparison Group of Nonparticipants: Middle School Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

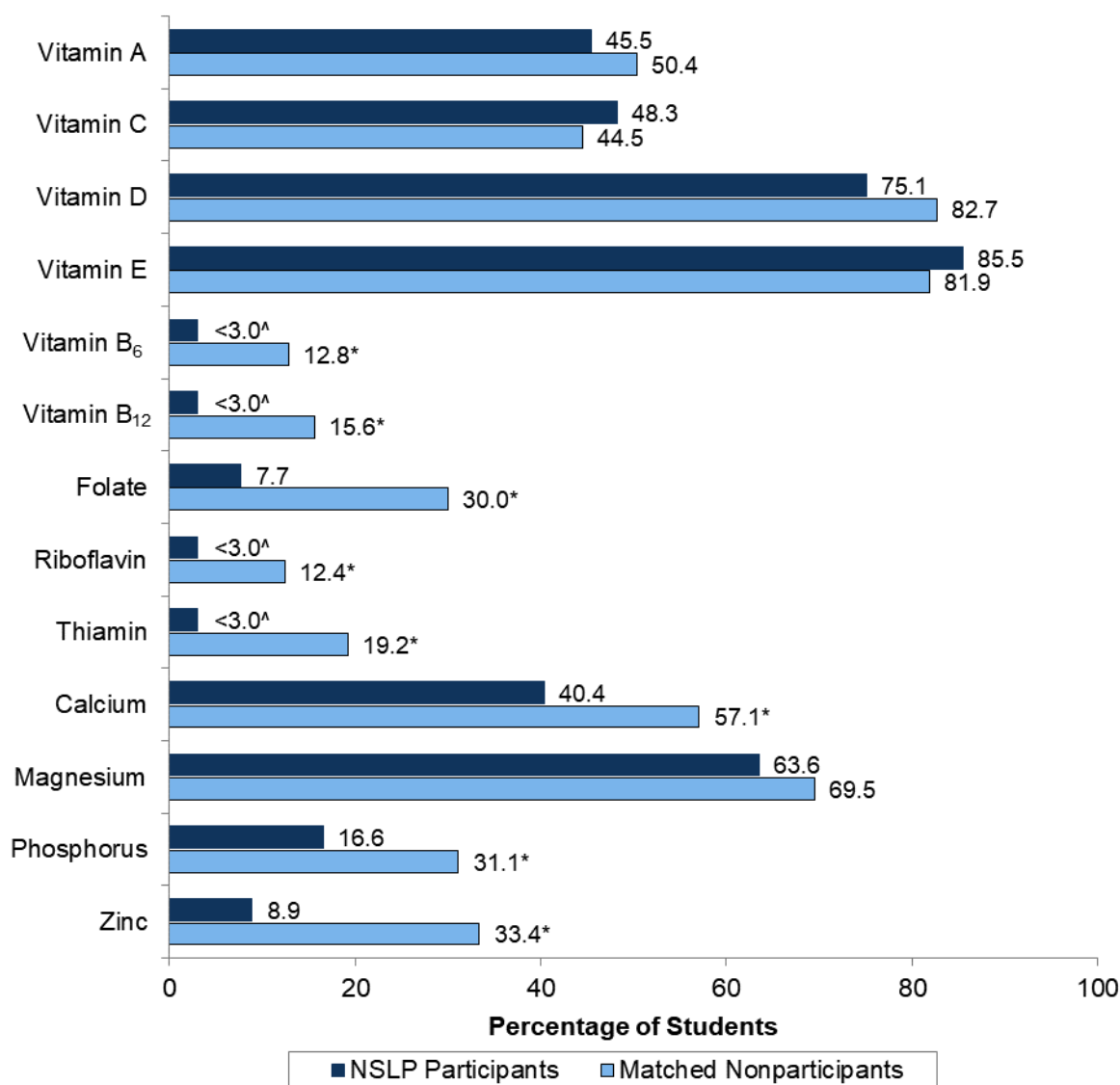
Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. The figure is limited to nutrients that had a prevalence of inadequacy of more than 10 percent for at least one group.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

[^]Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1. When these rules are applied, percentages close to 0 or 100 are often flagged. In this figure, flagged percentages between 0 and 3 percent are displayed as <3.

Figure 8.7. Prevalence of Inadequate Usual Daily Intakes of Vitamins and Minerals among NSLP Participants and Matched Comparison Group of Nonparticipants: High School Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. The figure is limited to nutrients that had a prevalence of inadequacy of more than 10 percent for at least one group.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

[^]Point estimate is considered less precise than point estimates that are not flagged because the sample size is small or the coefficient of variation is large. In this figure, flagged percentages between 0 and 3 are displayed as <3. The rules used in flagging estimates are described in Chapter 1.

4. Usual Intakes of Potassium and Dietary Fiber

EARs are not defined for potassium or dietary fiber. The analysis compared usual daily intakes of these two nutrients with AIs defined in the DRIs. Mean usual intakes that are equivalent to 100 percent or more of the AI indicate that the prevalence of inadequacy is likely to be low. However, if mean usual intakes fall below 100 percent of the AI, no firm conclusion can be drawn about the prevalence of inadequate intakes.

Potassium. Overall, mean usual daily intake of potassium as a percentage of the AI was about 55 percent for all NSLP participants and matched nonparticipants. NSLP participants in elementary schools had significantly higher intakes as a percentage of AIs than matched nonparticipants (59 percent of the AI versus 54 percent) (Table I.43).

Dietary Fiber. Mean usual dietary fiber intakes of all groups of students fell below 100 percent of the AI as well as the 14 grams per 1,000 calorie benchmark on which the AIs for dietary fiber are based (Table I.43). NSLP participants in middle schools had significantly higher mean usual intakes of dietary fiber per 1,000 calories than matched nonparticipants (65 percent of the AI versus 60 percent).

5. Usual Intakes of Sodium and Cholesterol

For both sodium and cholesterol, public health concerns center around risks associated with excessive intakes rather than ensuring adequate intakes. The analysis compared usual sodium intakes with the UL defined in the DRIs and compared usual intakes of sodium and cholesterol with the maximum daily limits specified in the 2010 *Dietary Guidelines for Americans*.¹⁰⁰

Sodium. Overall, more than 81 percent of NSLP participants and matched nonparticipants had usual sodium intakes that exceeded the UL and the maximum limit recommended in the 2010 *Dietary Guidelines for Americans* (Table I.43). There were no significant differences between NSLP participants and matched nonparticipants in the prevalence of excessive usual daily intakes of sodium.

Cholesterol. Across subgroups of students, the prevalence of usual daily cholesterol intakes that exceeded the maximum limit recommended in the 2010 *Dietary Guidelines for Americans* ranged from 5 to 20 percent (Table I.43). The prevalence of excessive cholesterol intakes was consistently highest among high school students (13 to 20 percent), and there were no significant differences between NSLP participants and matched nonparticipants.

¹⁰⁰ This analysis made comparisons to the 2010 *Dietary Guidelines for Americans* recommended limit on cholesterol because these recommendations were in effect when data for this study were collected. The 2015–2020 *Dietary Guidelines for Americans* do not place a limit on cholesterol.

9. HEALTHY EATING INDEX SCORES FOR NSLP PARTICIPANTS AND NONPARTICIPANTS

One of four confirmatory hypotheses defined for the SNMCS is that consumption of school meals is associated with higher quality diets.¹⁰¹ This chapter presents findings from analyses that addressed this hypothesis for the NSLP by comparing the nutritional quality of diets consumed by NSLP participants—students who consumed an NSLP lunch on the day reflected in the 24-hour recall—and matched comparison groups of nonparticipants on school days in SY 2014–2015.¹⁰² Analyses examined both the nutritional quality of lunches consumed by NSLP participants and nonparticipants, as well as the overall nutritional quality of 24-hour intakes for these groups. (Chapter 12 presents findings from parallel analyses of SBP participants and matched nonparticipants).

The HEI-2010 was used to describe the nutritional quality of the lunches and overall diets consumed by NSLP participants and matched nonparticipants. As described in Chapter 6, the HEI-2010 is a diet quality index that measures conformance with key recommendations of the 2010 *Dietary Guidelines for Americans*.¹⁰³ It consists of 12 component scores (see text box), each reflecting a key aspect of diet quality, and a total score that measures overall diet quality. Nine of the 12 components focus on adequacy and measure intake of food groups and nutrients needed for good health. The remaining three components focus on moderation and measure intake of dietary components that individuals are encouraged to limit.

Maximum scores for the components range from 5 to 20, and the total score, which is computed by summing scores for each of the 12 components, has a maximum of 100. For all components, higher scores indicate better conformance with recommendations of the *Dietary Guidelines for Americans* and, thus, higher diet quality. For the three moderation components in the HEI-2010, higher scores reflect lower concentrations of refined grains, sodium, and empty calories.

HEI-2010 Components (maximum score):

Adequacy Components:

Total Fruit (5)
Whole Fruit (5)
Total Vegetables (5)
Greens and Beans (5)
Whole Grains (10)
Dairy (10)
Total Protein Foods (5)
**Seafood and Plant
Proteins (5)**
Fatty Acids (10)

Moderation Components:

Refined Grains (10)
Sodium (10)
Empty Calories (20)

¹⁰¹ The other confirmatory hypotheses focus on the relationships between (1) the nutritional quality and cost of school meals, (2) the nutritional quality of school meals and student participation, and (3) the nutritional quality of school meals and the quality of school meal participants' diets. Findings related to the first hypothesis are discussed in Volume 3 of the SNMCS final report (Logan et al. 2019). Findings related to the second hypothesis are discussed in Chapter 4 in this volume, and findings related to the third hypothesis are discussed in Chapter 14 in this volume.

¹⁰² Propensity score matching was used to construct matched comparison groups of nonparticipants. Appendix G describes the methods.

¹⁰³ The study team used the HEI-2010, because the 2010 *Dietary Guidelines for Americans* were in effect when data for this study were collected.

Using data from the single 24-hour dietary recall collected for all students, the study team estimated total and component HEI-2010 scores for participants and matched nonparticipants using the population ratio method (Guenther et al. 2013). The study team estimated HEI-2010 scores for the foods consumed at lunch (among students who consumed a lunch) and over 24 hours (for all students, including those who did not consume a lunch). Chapter 6 provides additional information on the HEI-2010 and the methods used for this analysis.

Figures in this chapter present key results; supplementary tables are provided in Appendix J and noted within the chapter. The statistical significance of differences between NSLP participants and the matched comparison groups of nonparticipants was tested.¹⁰⁴ Rules for flagging potentially unreliable point estimates, described in Chapter 1, have also been applied. The differences discussed in the text are significant at least at the 0.05 level, unless otherwise noted. These test results provide an important gauge of underlying population differences; however, they are not a definitive measure of true differences and should not be interpreted as causal effects of the NSLP. Although propensity score matching techniques were used to control for measured differences between NSLP participants and nonparticipants (Appendix G), important differences may remain in characteristics that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest differences between participants and matched nonparticipants even if they are not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

A. HEI-2010 Scores for Lunch

The study team estimated mean HEI-2010 total and component scores for the lunches consumed by NSLP participants and matched nonparticipants. For both NSLP participants and matched nonparticipants, the analysis included all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. The analysis excluded students who did not consume a lunch.

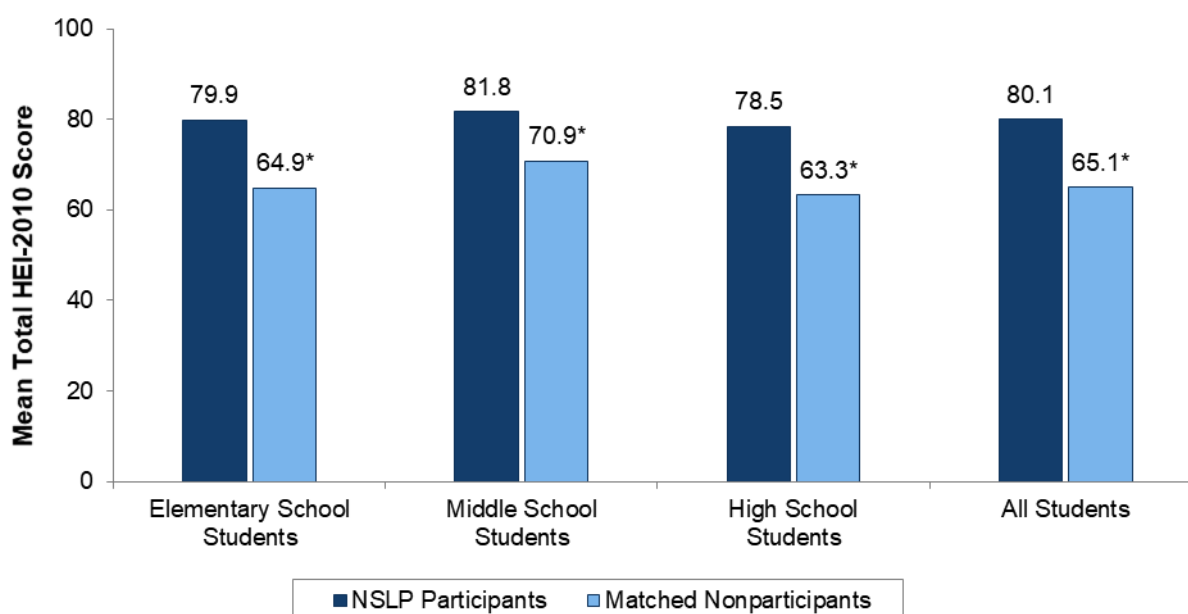
¹⁰⁴ Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample design of the SNMCS.

1. Total Scores

Overall, the lunches consumed by NSLP participants achieved a significantly higher mean total score on the HEI-2010 than lunches consumed by matched nonparticipants (80.1 versus 65.1) (Figure 9.1). This pattern was observed for all three school types. Across all school types, the lunches consumed by NSLP participants received mean total HEI-2010 scores that were 11 to 15 points higher than the lunches consumed by matched nonparticipants. As a point of reference, the average total HEI-2010 score for the overall diets consumed by the U.S. population as a whole in 2011–2012 was 59.0, and the average score for children was 55.1 (USDA, CNPP 2016).

Total HEI-2010 scores provide a summary measure of the nutritional quality of students' lunches. The lunches consumed by NSLP participants achieved a significantly higher total HEI-2010 score than the lunches consumed by matched nonparticipants.

Figure 9.1. Mean Healthy Eating Index-2010 Scores for Lunches Consumed by NSLP Participants and Matched Comparison Group of Nonparticipants: Total Scores



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Lunch intakes for both NSLP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

Healthy Eating Index-2010 scores are based on lunch intakes. Higher total scores reflect higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

2. HEI-2010 Component Scores

The study team estimated mean scores for each of the 12 HEI-2010 components for lunches consumed by NSLP participants and matched nonparticipants (Tables J.1–J.4). In presenting findings, scores are expressed as a percentage of the maximum possible score.

Adequacy Components

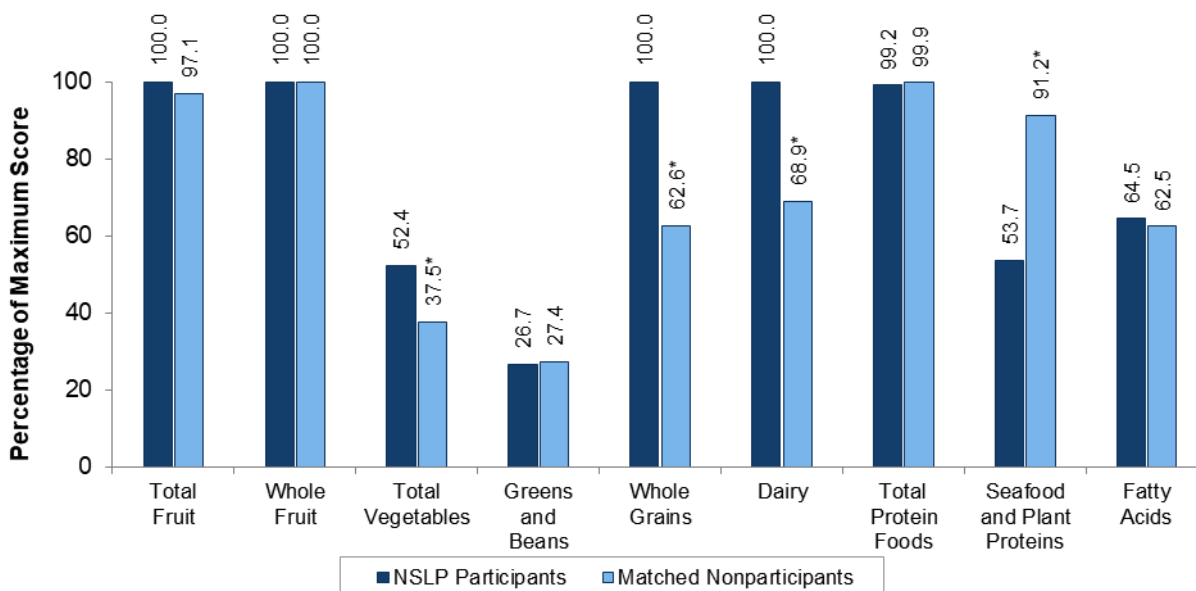
Overall, the lunches consumed by both NSLP participants and matched nonparticipants achieved perfect or near perfect scores for total fruit, whole fruit, and total protein foods (97 to 100 percent of maximum scores), and the lunches consumed by NSLP participants also achieved perfect scores for whole grains and dairy (Figure 9.2). For both groups of students, scores for lunch intakes were lowest for greens and beans (27 percent for both groups).

The lunches consumed by NSLP participants received significantly higher scores than the lunches consumed by matched nonparticipants for total vegetables (52 percent of the maximum score versus 38 percent), whole grains (100 percent versus 63 percent), and dairy (100 percent versus 69 percent). The higher scores for total vegetables and dairy at lunch are consistent with the fact that NSLP participants were more likely than matched nonparticipants to consume vegetables and milk at lunch (Table 7.1). Conversely, the lunches consumed by NSLP participants received a significantly lower score than matched nonparticipants for seafood and plant proteins (54 percent versus 91 percent). This finding may be driven in part by the lower proportion of NSLP participants who consumed peanut butter sandwiches at lunch relative to matched nonparticipants (Table 7.1).

The lunches consumed by NSLP participants received significantly higher scores than the lunches consumed by matched nonparticipants for total vegetables, whole grains, and dairy.

Findings for the HEI-2010 adequacy components varied somewhat by school type. Among elementary school students, the lunches consumed by NSLP participants received significantly higher scores than the lunches consumed by matched nonparticipants for total vegetables (54 percent of the maximum score versus 22 percent), whole grains (100 percent versus 63 percent), and dairy (100 percent versus 73 percent), but received a significantly lower score for seafood and plant proteins (50 percent versus 95 percent) (Table J.2). The pattern of findings was similar among middle school students, but the difference between NSLP participants and matched nonparticipants in the score for total vegetables was not statistically significant (Table J.3). Among high school students, the lunches consumed by NSLP participants received significantly higher scores than those consumed by matched nonparticipants for total fruit (97 percent versus 76 percent), whole grains (100 percent versus 64 percent), and dairy (100 percent versus 70 percent), but received a significantly lower score for greens and beans (15 percent versus 48 percent) (Table J.4).

Figure 9.2. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for Lunches Consumed by NSLP Participants and Matched Comparison Group of Nonparticipants: Adequacy Components, All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Lunch intakes for both NSLP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

Healthy Eating Index-2010 scores are based on lunch intakes. Higher scores for adequacy components reflect higher intakes and, thus, higher diet quality.

Legumes were first counted as protein foods until the standard was met, and then remaining legumes were counted as vegetables.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

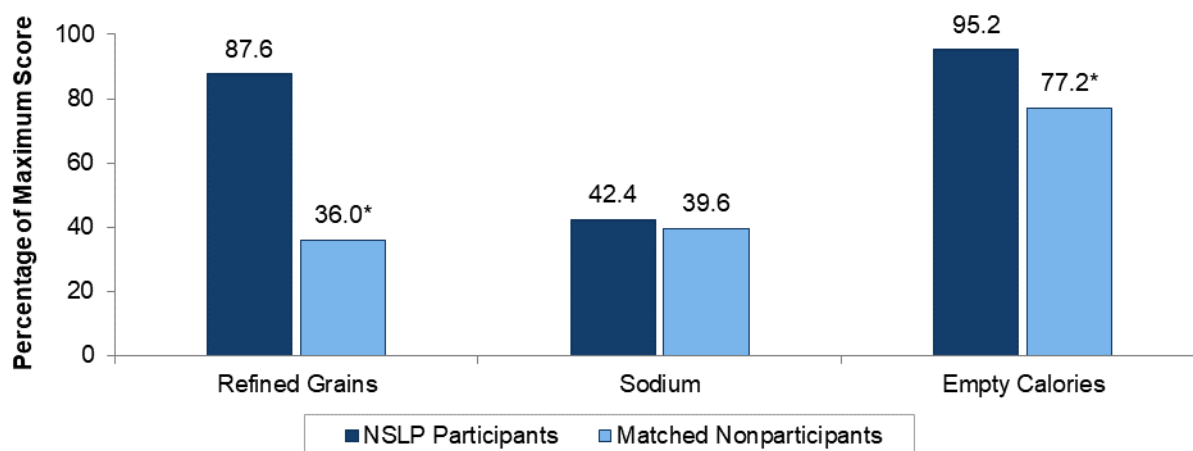
NSLP = National School Lunch Program.

Moderation Components

Overall, the lunches consumed by NSLP participants had significantly lower concentrations of refined grains and empty calories than the lunches consumed by matched nonparticipants (88 percent of the maximum score for refined grains versus 36 percent; and 95 percent versus 77 percent for empty calories) (Figure 9.3). Lunches consumed by NSLP participants achieved a near-perfect score for empty calories (95 percent). The difference in sodium scores for lunches consumed by NSLP participants and matched nonparticipants was not statistically significant. These patterns were also observed for all three school types (Tables J.2–J.4).

The lunches consumed by NSLP participants had significantly lower concentrations of refined grains and empty calories than the lunches consumed by matched nonparticipants.

Figure 9.3. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for Lunches Consumed by NSLP Participants and Matched Comparison Group of Nonparticipants: Moderation Components, All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Lunch intakes for both NSLP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at lunch. For NSLP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable lunch, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. Healthy Eating Index-2010 scores are based on lunch intakes. Higher scores for moderation components reflect lower intakes and, thus, higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

B. HEI-2010 Scores Over 24 Hours

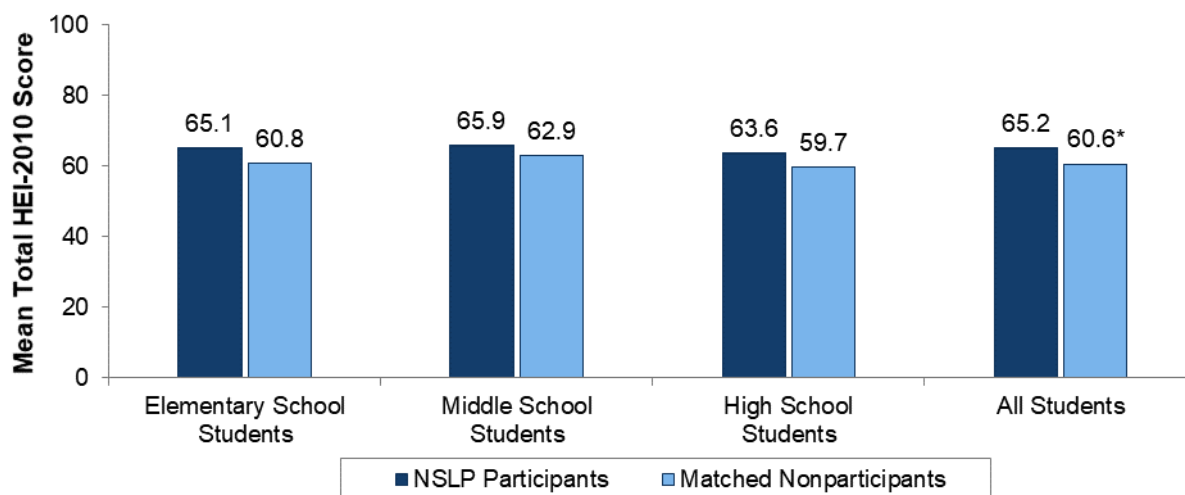
Some of the positive, significant differences observed in HEI-2010 scores for lunches consumed by NSLP participants and matched nonparticipants could be offset by what students consumed for other meals and snacks throughout the day. To gain additional insights into how students' lunch intakes may influence their overall diets, the study team estimated total and component HEI-2010 scores for 24-hour intakes of NSLP participants and matched nonparticipants. All students, including those who did not consume a lunch, were included in the analysis.

1. Total Scores

The positive and significant difference in mean total HEI-2010 scores observed among NSLP participants and matched nonparticipants at lunch persisted over 24 hours, although the magnitude of the difference was smaller than at lunch (65.2 versus 60.6 for 24-hour intakes (Figure 9.4), compared to 80.1 versus 65.1 for lunch intakes (Figure 9.1). This finding confirmed the hypothesis that consumption of NSLP lunches was associated with higher quality diets. This pattern was observed for all three school types, but none of the school-type-specific differences were statistically significant.

The positive and significant difference in mean total HEI-2010 scores observed among NSLP participants and matched nonparticipants at lunch persisted over 24 hours.

Figure 9.4. Mean Healthy Eating Index-2010 Scores for 24-Hour Intakes for NSLP Participants and Matched Comparison Group of Nonparticipants: Total Scores



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Healthy Eating Index-2010 scores are based on daily intakes. Higher total scores reflect higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

2. HEI-2010 Component Scores

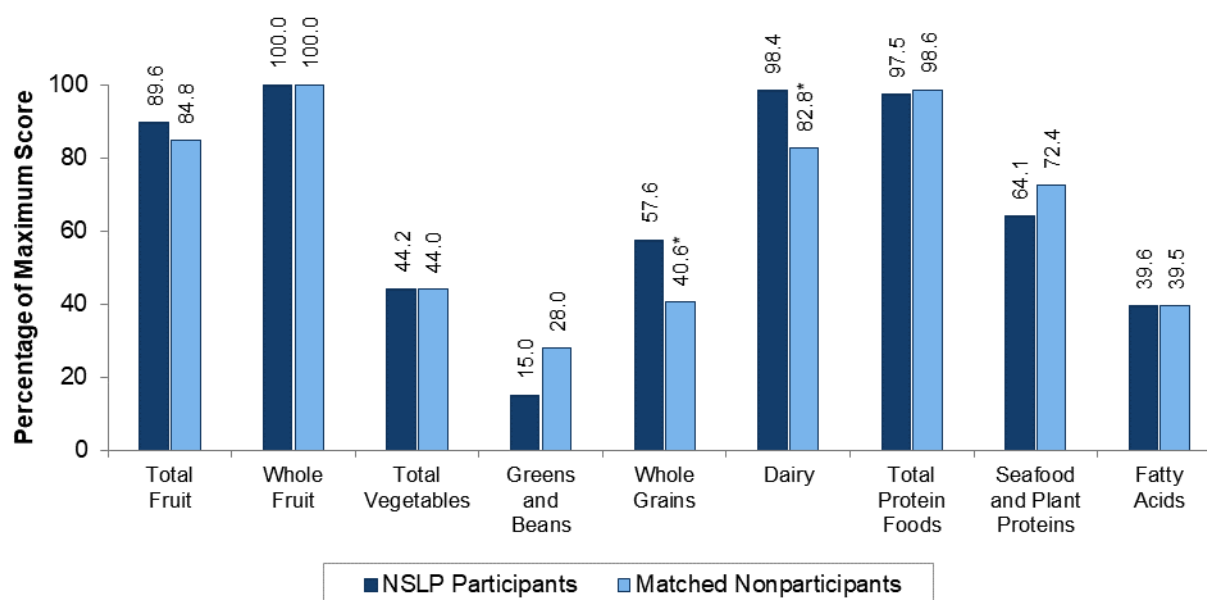
Adequacy Components

The positive and significant differences between NSLP participants and matched nonparticipants observed at lunch for whole grains and dairy (Figure 9.2) persisted over 24 hours (Figure 9.5), but the magnitude of the differences was smaller. For whole grains, there was a 17 percentage point difference in scores over 24 hours, compared with a 37 percentage point difference at lunch (58 percent versus 41 percent for 24-hour intakes of NSLP participants and matched nonparticipants, respectively, compared to 100 percent versus 63 for lunch intakes). Similarly for dairy, the differences between NSLP participants and nonparticipants were 16 and 31 percentage points for intakes over 24 hours and at lunch, respectively (98 percent versus 83 percent for 24-hour intakes, compared to 100 percent versus 69 percent for lunch intakes).

The positive and significant differences between NSLP participants and matched nonparticipants observed at lunch for whole grains and dairy persisted over 24 hours.

The positive and significant difference observed at lunch for total vegetables (Figure 9.2) did not persist over 24 hours (Figure 9.5). A comparison of mean scores for lunches and 24-hour intakes suggest that, relative to lunches, the concentrations of vegetables in other meals and snacks were lower for NSLP participants and higher for matched nonparticipants, resulting in comparable concentrations of vegetables in 24-hour intakes.

Figure 9.5. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for 24-Hour Intakes for NSLP Participants and Matched Comparison Group of Nonparticipants: Adequacy Components, All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 20142015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Healthy Eating Index-2010 scores are based on daily intakes. Higher scores for adequacy components reflect higher intakes and, thus, higher diet quality.

Legumes were first counted as protein foods until the standard was met, and then remaining legumes were counted as vegetables.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

Findings for the HEI-2010 adequacy components varied by school type:

- Among elementary school students, the positive and significant difference observed at lunch between NSLP participants and matched nonparticipants for dairy persisted over 24 hours, but the differences for vegetables, whole grains, and seafood and plant proteins did not (Table J.6).
- The positive and significant differences observed for whole grains and seafood and plant proteins in lunches consumed by NSLP participants and matched nonparticipants in middle schools persisted over 24 hours, but the difference for dairy did not (Table J.7).
- Among high school students, positive and significant differences observed at lunch for whole grains and dairy persisted over 24 hours, but the difference for total fruit did not (Table J.8). The significant difference observed at lunch for greens and beans also persisted over 24 hours for high school students.

Significant differences between NSLP participants and matched nonparticipants that did not persist over 24 hours suggest that, relative to lunches, the concentrations of vegetables, whole grains, dairy, or total fruit in other meals and snacks were lower for NSLP participants and higher for matched nonparticipants, resulting in comparable concentrations of these components over 24 hours. Conversely, for seafood and plant proteins (for elementary school students) and greens and beans (for high school students), the concentration of this component in other meals and snacks was higher for NSLP participants and lower for matched nonparticipants, resulting in comparable concentrations over 24 hours.

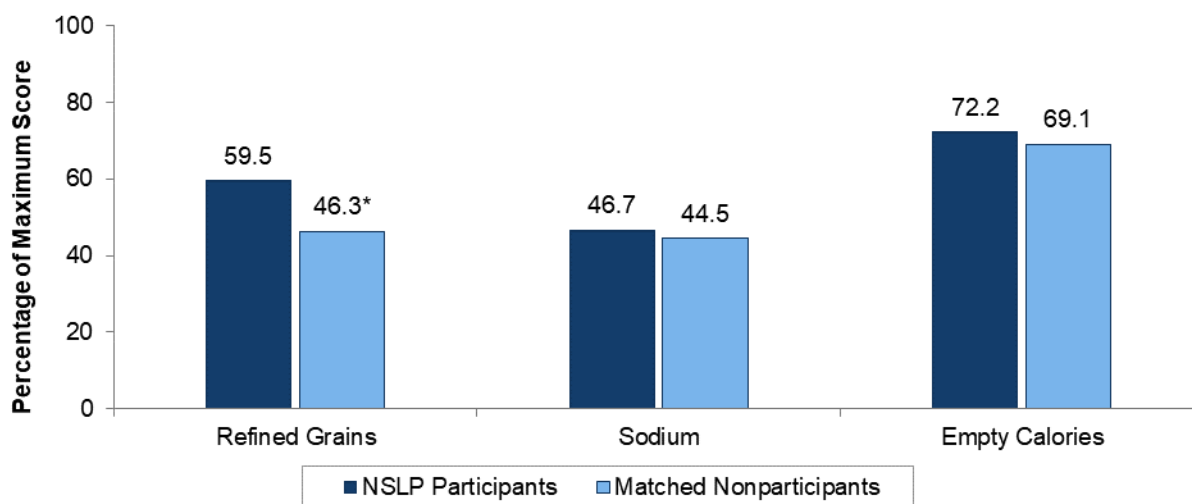
Moderation Components

The positive and significant difference between NSLP participants and matched nonparticipants observed at lunch for refined grains (Figure 9.3) persisted over 24 hours (Figure 9.6), but the magnitude of the differences was smaller. At lunch, the difference in the scores for refined grains was 49 percentage points (88 percent versus 39 percent), whereas over 24 hours, the difference was 14 percentage points (60 percent versus 46 percent). The positive and significant difference between NSLP participants and matched nonparticipants observed at lunch for empty calories (Figure 9.3) did not persist over 24 hours (Figure 9.6). A comparison of mean scores for lunches and 24-hour intakes suggests that, relative to lunches, the concentrations of empty calories in other meals and snacks

The positive and significant difference between NSLP participants and matched nonparticipants observed at lunch for refined grains persisted over 24 hours, but the difference for empty calories did not.

were higher for both groups of students, particularly for NSLP participants. Overall, neither NSLP participants nor matched nonparticipants came close to achieving the maximum possible scores for any of the moderation components for 24-hour intakes (scores ranged from 45 to 72 percent of the maximum) (Figure 9.6).

Figure 9.6. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for 24-Hour Intakes for NSLP Participants and Matched Comparison Group of Nonparticipants: Moderation Components, All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 20142015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Healthy Eating Index-2010 scores are based on daily intakes. Higher scores for moderation components reflect lower intakes and, thus, higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

These general patterns were observed among elementary and middle school students; for high school students, however, the difference for refined grains did not persist over 24 hours (Tables J.6–J.8). In addition, among middle school students, the concentration of sodium in NSLP participants' diets over 24 hours was significantly lower relative to matched nonparticipants' diets, but this difference was not observed at lunch.

10. FOOD INTAKES OF SBP PARTICIPANTS AND NONPARTICIPANTS

This chapter describes food intakes of SBP participants—students who consumed an SBP breakfast on the day reflected in the 24-hour recall—and matched comparison groups of nonparticipants on school days in SY 2014–2015.¹⁰⁵ It details the types of foods that students most commonly consumed at breakfast, as well as the contribution of breakfast foods to students' 24-hour intakes of USDA Food Pattern food groups. It also describes students' usual daily food group intakes relative to recommended USDA Food Patterns. Findings are based on 24-hour dietary recalls collected from students. Methods used to collect and analyze these data are described in Chapter 6.

Tables and figures in this chapter present key results; supplementary tables are provided in Appendix K and noted within the chapter. The statistical significance of differences between SBP participants and the matched comparison groups of nonparticipants was tested.¹⁰⁶ Rules for flagging potentially unreliable point estimates, described in Chapter 1, have also been applied. The differences discussed in the text are significant at least at the 0.05 level, unless otherwise noted. Although statistically significant differences between SBP participants and matched nonparticipants provide an important gauge of underlying population differences, they are not a definitive measure of true differences and should not be interpreted as causal effects of the SBP. Although propensity score matching techniques were used to control for measured differences between SBP participants and nonparticipants (Appendix G), important differences may remain in characteristics that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest a meaningful difference between participants and matched nonparticipants even if the difference is not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

Additionally, whether differences between SBP participants and nonparticipants are statistically significant can be partially driven by small SBP sample sizes or the correlation between SBP and NSLP participation. Because fewer students participate in the SBP than in the NSLP, smaller SBP sample sizes (511 SBP participants versus 1,254 NSLP participants) may result in observed differences between SBP participants and matched nonparticipants that are not statistically significant, even if there are true underlying differences in the population. On the other hand, because 87 percent of SBP participants and 48 percent of nonparticipants participated in the NSLP (Table D.9), NSLP participation may contribute to any observed differences in usual daily food group intakes of SBP participants and matched nonparticipants. This could overestimate the extent to which true underlying differences between SBP participants and nonparticipants are attributable to the SBP.

¹⁰⁵ Propensity score matching was used to construct matched comparison groups of nonparticipants. Appendix G describes the methods.

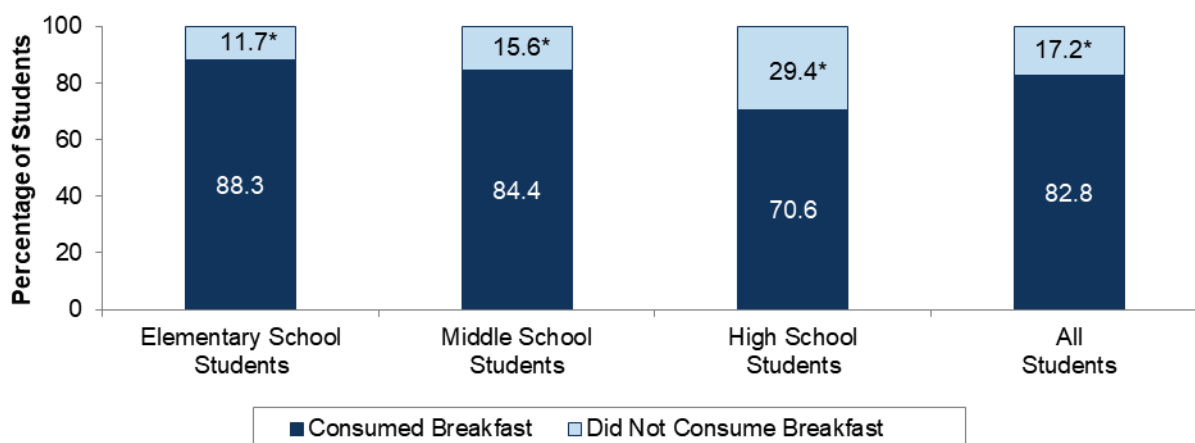
¹⁰⁶ Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample design of the SNMCS.

A. Percentage of Students Who Did and Did Not Eat Breakfast

By definition, all SBP participants consumed an SBP breakfast on the day referenced in the 24-hour recall (the target day). Relative to SBP participants, matched nonparticipants were significantly less likely to consume breakfast on the target day. This was true for all three school types (Figure 10.1). Breakfast consumption was highest among elementary and middle school students (88 and 85 percent, respectively), and lowest among high school students (71 percent). Thus, more than one in ten nonparticipants in elementary and middle schools (12 and 16 percent, respectively) and more than one-quarter (29 percent) of nonparticipants in high schools did not consume breakfast on the target day.

Among students who did not participate in the SBP, more than one in ten elementary and middle school students and more than one-quarter of high school students did not consume any type of breakfast.

Figure 10.1. Percentage of Matched SBP Nonparticipants Who Consumed a Breakfast



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Differences in the percentages of participants and matched nonparticipants that consumed and did not consume a breakfasts are significantly different from zero at the 0.05 level.

SBP = School Breakfast Program

B. Types of Foods Consumed at Breakfast

To examine the types of foods students consumed at breakfast, the study team grouped reported foods into seven major food groups: milk, vegetables, fruits and 100% fruit juices, combination entrées, grains/breads, meats and meat alternates, and desserts, snacks, and beverages other than milk and 100% juice. The study team then subdivided foods in each major food group into minor groups based on characteristics that affect nutrient content, including

ingredients and preparation methods. Table H.1 provides examples of the specific types of foods included in each minor food group category.

The summary tabulation presented in Table 10.1 is limited to foods/food groups that were consumed by at least 5 percent of SBP participants or matched nonparticipants (who consumed a breakfast) in one or more school types.¹⁰⁷ Breakfast intakes for both SBP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. The analysis excluded students who did not consume a breakfast. Key findings for each major food group are discussed below. The vegetable group is not included in Table 10.1 because vegetables were not commonly consumed at breakfast.

1. Milk

Overall, slightly more than half of SBP participants (59 percent) and matched nonparticipants who consumed a breakfast (53 percent) consumed milk at breakfast. The percentage of students who consumed milk at breakfast was highest in elementary and middle schools (55 to 63 percent) and lowest in high schools (46 to 53 percent).

Although there were no significant differences between SBP participants and matched nonparticipants in the percentage of students who consumed milk at breakfast, there were significant differences in the types of milk students consumed. Overall, SBP participants were significantly more likely than matched nonparticipants to consume low-fat milk (29 percent versus 22 percent) or fat-free milk, especially flavored fat-free milk (17 percent versus 3 percent). In contrast, matched nonparticipants were more likely to consume 2% milk (12 percent versus 6 percent) or whole milk (12 percent versus 4 percent).

2. Fruits and 100% Fruit Juices

Overall, SBP participants were about twice as likely as matched nonparticipants to consume fruit or 100% fruit juice at breakfast (60 percent versus 32 percent). This difference was driven largely by a difference in consumption of 100% fruit juice. Almost half (48 percent) of all SBP participants consumed 100% fruit juice at breakfast, compared with less than one-quarter (20 percent) of matched nonparticipants. Overall and for all three school types, there were no significant differences between SBP participants and matched nonparticipants in the percentage of students who consumed fresh fruit at breakfast. Overall, SBP participants were more likely than nonparticipants to consume canned fruit at breakfast (5 percent versus less than 3 percent).

¹⁰⁷ Table K.1 presents a supplementary descriptive tabulation that breaks out data for the subgroup of matched nonparticipants that obtained more than half of their breakfast foods from home. Sample sizes were too small to produce reliable estimates for subgroups of matched nonparticipants who obtained more than half of their breakfast foods outside of school, at school, or from other sources.

Table 10.1. Foods Most Commonly Consumed at Breakfast by SBP Participants and Matched Comparison Group of Nonparticipants

	Percentage of Students Consuming Foods at Breakfast							
	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Milk	62.8	57.2	54.5	62.0	52.6	46.4	59.0	53.4
Low-fat (1%)	30.6	28.4	28.3	19.4	25.7	12.6*	29.0	21.8*
Unflavored	29.8	28.3	27.9	19.2	25.7	12.4*	28.5	21.7*
Fat-free	28.3	7.2*	12.2 ^	8.4	16.4	6.5	22.7	6.8*
Flavored	22.3	<3*	9.9 ^	3.9 ^	10.5 ^	4.5 ^	17.4	2.9*
Unflavored	6.5 ^	4.3	3.8 ^	4.5	5.9 ^	<3	5.9	3.9
2%	<3	9.9*	13.8 ^	18.4	8.4 ^	18.3*	5.6	11.9*
Unflavored	<3	9.7*	12.5 ^	17.9	8.4 ^	18.1*	5.3	11.6*
Whole	4.9 ^	11.4*	3.1 ^	13.9*	4.1 ^	7.8	4.4	12.1*
Unflavored	4.3 ^	11.0*	<3	13.9*	4.1 ^	7.8	3.8 ^	11.8*
Other milk beverage ^a	<3	<3	6.1 ^	<3	<3	<3	<3	2.4
Fruits and 100% Fruit Juices	64.0	34.1*	47.8	27.5*	59.5	27.6*	60.0	32.3*
100% juice	48.9	20.6*	41.0	19.0*	49.2	16.1*	47.5	19.7*
Orange juice	18.9	13.0	19.4	13.0	24.4	12.3*	20.2	13.8*
Apple juice	26.5	3.1^*	13.3 ^	4.9	18.9	<3*	22.3	3.2*
Grape juice	<3	3.7 ^	6.2 ^	<3*	5.9 ^	<3	3.5 ^	1.7
Fresh fruit	20.2	15.4	14.4	9.8	13.5 ^	12.4	17.6	14.3
Apples	7.8 ^	4.6	5.6 ^	3.0 ^	6.1 ^	4.1 ^	7.0	4.2
Bananas	4.6 ^	4.7	<3	3.6 ^	4.8 ^	6.8	4.3	5.4
Oranges	5.5 ^	<3	4.4 ^	<3	<3	<3	4.3	2.9
Canned fruit	6.4 ^	<3*	<3	<3	3.3 ^	<3	4.8	<3*
Combination Entrées	18.7	9.8*	23.4	9.8*	31.1	15.7	22.4	12.0*
Breakfast sandwiches	5.2 ^	<3	9.6 ^	<3*	8.9 ^	5.8	6.8	3.7
Pizza	4.4 ^	<3	3.7 ^	<3	14.4	<3	6.6	<3
Grains/Breads	71.8	83.1*	78.8	69.5	58.3	67.8	70.0	77.0
Cold cereal	34.0	44.0	36.4	41.3	18.4	29.8	30.9	39.6*
Sweetened	30.6	35.5	34.0	34.6	9.9 ^	21.5*	26.4	31.4
Unsweetened	3.9 ^	8.5	<3	6.8	9.0 ^	8.3	4.8	8.1
Sweet rolls, toaster pastries, donuts, fruit turnovers, Danishes	10.2	10.9	18.0	4.5*	7.4 ^	13.1	11.0	9.6
Pancakes, waffles, and French toast	14.3	9.7	9.8 ^	10.5	6.1 ^	5.9	11.6	8.7
Granola bars and breakfast bars	5.2 ^	4.1 ^	<3	4.3 ^	10.8 ^	7.8	6.1	4.9
Breads, rolls, bagels, and other plain breads	6.0 ^	10.5	5.4 ^	5.2	7.8 ^	8.6	6.3	10.0

	Percentage of Students Consuming Foods at Breakfast							
	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Muffins and sweet/quick breads	5.1 [^]	<3	<3	<3	8.7 [^]	<3 [*]	5.4	1.9
Hot cereal	<3	4.8	5.4 [^]	<3	<3	<3	<3	3.8
Crackers, croutons, and pretzels	8.6 [^]	8.5	5.8 [^]	<3 [*]	<3	3.3 [^]	6.3	6.2
Meats/Meat Alternates	13.3	16.0	8.0 [^]	14.1	21.0	16.5	14.1	16.0
Eggs	<3	4.6	3.6 [^]	7.0	10.6 [^]	7.3	4.8	6.1
Sausage and bacon ^b	4.1 [^]	3.8 [^]	3.8 [^]	6.2	<3	<3	3.8 [^]	4.0
Desserts, Snacks, and Other Beverages	46.1	46.3	41.0	46.2	48.1	53.6	45.6	48.8
Beverages other than milk and 100% juice	40.3	41.6	36.2	43.4	44.4	49.8	40.5	44.6
Water ^c	31.7	27.7	32.7	32.2	32.1	37.9	32.0	30.7
Coffee and tea	3.7 [^]	6.6	<3	5.6	5.9 [^]	8.9	3.9 [^]	6.9
Juice drinks (not 100% juice)	<3	8.9 [*]	<3	3.3 [^]	4.8 [^]	3.2 [^]	<3	7.1 [*]
Candy	3.1 [^]	3.3 [^]	4.9 [^]	3.4 [^]	4.4 [^]	4.0 [^]	3.7 [^]	3.6
Cookies, cakes, and brownies	5.1 [^]	5.7	<3	<3	<3	3.6 [^]	3.5 [^]	4.1
Number of Students	228	466	144	459	139	435	511	1,360

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Breakfast intakes for both SBP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

Table is limited to food groups consumed by at least 5 percent of participants or nonparticipants for one or more school types.

^aIncludes soy milk, almond milk, cocoa made with milk, milk shakes, and smoothies made with dairy.

^bBacon is not considered a meat/meat alternate in the SBP meal requirements.

^cIncludes bottled and tap water.

^{*}Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the * 0.05 level.

SBP = School Breakfast Program.

[^]Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1. When these rules are applied, percentages close to 0 or 100 are often flagged. In this table, flagged percentages between 0 and 3 percent are displayed as <3.

3. Combination Entrées

SBP participants in elementary and middle schools were significantly more likely than matched nonparticipants to consume a combination entrée at breakfast (19 and 23 percent, respectively, versus 10 percent). The only combination entrées consumed at breakfast by at least 5 percent of SBP participants or matched nonparticipants in one or more school types were breakfast sandwiches and pizza.

4. Grains/Breads

A majority of both SBP participants and matched nonparticipants (70 and 77 percent, respectively) consumed a separate grain or bread item at breakfast—that is, a grain or bread product that was not part of a combination entrée. Among elementary school students, SBP participants were significantly less likely than matched nonparticipants to consume a separate grain or bread product (72 percent versus 83 percent). This difference was largely driven by higher consumption of cold cereal and plain breads, rolls, or bagels among matched nonparticipants. Overall, SBP participants were less likely than matched nonparticipants to consume cold cereal at breakfast (31 percent versus 40 percent). Middle school SBP participants were significantly more likely than matched nonparticipants to consume sweet rolls, toaster pastries, donuts, fruit turnovers, or Danishes (18 percent versus 5 percent).

5. Meats and Meat Alternates

Overall, about 15 percent of both SBP participants and matched nonparticipants consumed a separate meat or meat alternate (not part of a combination entrée) at breakfast. The most commonly consumed items in this category were eggs and bacon or sausage.¹⁰⁸

6. Desserts, Snacks, and Other Beverages

Overall, close to half (46 to 49 percent) of SBP participants and matched nonparticipants consumed a dessert, snack, or beverage other than milk or 100% juice at breakfast. The most frequently consumed item in this category was water which, overall, was consumed by 31 to 32 percent of students in both groups. Overall and among elementary school students, SBP participants were significantly less likely than matched nonparticipants to consume juice drinks (not 100% juice) at breakfast.

C. Intakes of USDA Food Pattern Food Groups at Breakfast and Contribution to 24-Hour Intakes

USDA Food Patterns describe the types and amounts of foods included in a dietary pattern that is consistent with the *Dietary Guidelines for Americans* (see Chapter 6). The patterns identify daily average amounts of foods to be consumed, in nutrient-dense forms, from five

¹⁰⁸Bacon is not considered a meat/meat alternate in the SBP meal requirements.

major food groups and their subgroups. They also provide an allowance for oils and a limit on empty calories—that is, calories from solid fats and added sugars.

To assess the relative contribution of breakfasts consumed by SBP participants and matched nonparticipants to amounts recommended in the USDA Food Patterns, the study team estimated mean amounts of USDA Food Pattern food groups consumed by SBP participants and matched nonparticipants who consumed a breakfast, as well as the relative contribution of these breakfast intakes to total 24-hour intakes. These analyses excluded students who did not consume a breakfast. A separate analysis, summarized in Section D, assessed students' usual daily intakes of USDA Food Pattern food groups relative to recommended intakes.¹⁰⁹

USDA Food Pattern Food Groups and Subgroups

Vegetables

Dark green

Red and orange

Legumes

Starchy

Other

Fruits

Grains

Whole grains

Dairy

Protein Foods

1. Mean Intakes of USDA Food Pattern Food Groups at Breakfast

Overall, breakfasts consumed by SBP participants contained significantly more fruit, on average, than breakfasts consumed by matched nonparticipants (0.5 cup equivalents versus 0.4 cup equivalents). This general pattern was noted for all three school types, and was statistically significant among elementary school students and high school students (Table 10.2). The difference between SBP participants and nonparticipants was greatest for high school students (0.6 cup equivalents versus 0.4 cup equivalents).

On average, breakfasts consumed by SBP participants and matched nonparticipants contained comparable amounts of grains (1.5 to 1.6 oz equivalents, overall). Middle school students were an exception; in this subgroup, SBP participants had significantly higher mean breakfast intakes of grains than matched nonparticipants (1.6 oz equivalents versus 1.1 oz equivalents). In addition, SBP participants consistently had higher mean breakfast intakes of whole grains than matched nonparticipants (0.6 to 0.7 oz equivalents versus 0.3 to 0.4 oz equivalents). This difference was statistically significant for all subgroups except elementary school students.

On average, breakfasts consumed by SBP participants contained significantly larger amounts of fruit and whole grains than breakfasts consumed by matched nonparticipants.

Mean breakfast intakes were comparable for SBP participants and matched nonparticipants for dairy (0.7 to 0.8 cup equivalents, overall), protein foods (0.4 cup oz equivalents), oils (0.6 tsp), and empty calories (114 to 120 calories). Among elementary school students, SBP participants had significantly lower mean breakfast intakes of empty calories from solid fat than matched nonparticipants (43 calories versus 59 calories).

¹⁰⁹ Tables K.15 and K.16 present additional data for subgroups of students defined by household poverty level.

Table 10.2. Mean Amounts of USDA Food Pattern Food Groups Consumed at Breakfast by SBP Participants and Matched Comparison Group of Nonparticipants

	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Fruits (cups) ^a	0.5	0.4*	0.4	0.3	0.6	0.4*	0.5	0.4*
Grains (oz)	1.5	1.5	1.6	1.1*	1.9	1.6	1.6	1.5
Whole grains (oz)	0.6	0.4	0.6	0.3*	0.7	0.4*	0.6	0.4*
Dairy (cups)	0.8	0.6	0.7	0.7	0.9	0.8	0.8	0.7
Protein Foods (oz)	0.3	0.3	0.4	0.4	0.6	0.5	0.4	0.4
Oils (tsp)	0.6	0.5	0.5	0.4	0.6	0.7	0.6	0.6
Empty Calories (kcal)	106	117	122	104	129	139	114	120
Calories from solid fats (kcal)	43	59*	53	49	65	71	50	61
Calories from added sugars (kcal)	63	58	69	55	64	67	64	59
Number of Students	228	466	144	459	139	435	511	1,360

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Breakfast intakes for both SBP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

The vegetable group is not included in the table because vegetables were rarely consumed at breakfast and reliable point estimates could not be generated.

The USDA Food Pattern food groups are largely consistent with the meal components used in planning SBP breakfasts, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

^aIntakes of fruit include both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the * 0.05 level.

cups = cup equivalents; oz = ounce equivalent; SBP = School Breakfast Program; tsp = teaspoon.

[^]Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

2. Proportion of 24-Hour Intakes of USDA Food Pattern Food Group Intakes Contributed by Breakfast

For both SBP participants and nonparticipants who consumed a breakfast, breakfasts made the largest contributions to 24-hour intakes of fruit (18 to 39 percent), whole grains (21 to 41 percent), and dairy (26 to 39 percent) (Figure 10.2).¹¹⁰ In all three school types, breakfasts consumed by SBP participants made significantly larger contributions to total 24-hour intakes of fruit than breakfasts consumed by matched nonparticipants. The difference between SBP participants and matched nonparticipants was largest for high school students (39 percent versus 23 percent). In addition, among middle and high school students, breakfasts consumed by SBP participants made significantly larger contributions to 24-hour intakes of whole grains, relative to breakfasts consumed by matched nonparticipants. Again, the difference between SBP participants and matched nonparticipants was largest for high school students (41 percent versus 22 percent).

The average contributions of breakfasts consumed by SBP participants and matched nonparticipants were comparable for total grains, dairy, protein foods, oils, and empty calories, ranging from a low of 7 to 10 percent for protein foods to a high of 26 to 39 percent for dairy. Among elementary school students, breakfasts consumed by SBP participants contributed significantly fewer empty calories from solid fat, on average, than breakfasts consumed by matched nonparticipants (16 percent versus 23 percent; Table K.3).

D. Usual Daily Intakes of USDA Food Pattern Food Groups

Using the methods described in Chapter 6, the study team estimated students' usual daily intakes of USDA Food Pattern food groups. All students, including those who did not consume a breakfast, were included in these analyses. Tables K.5–K.14 provide data on unadjusted means and full distributions of usual intakes of most USDA Food Pattern food groups for SBP participants and matched nonparticipants in the age and gender subgroups used in the DRIs,¹¹¹ as well as for groups defined by school type and gender. Usual intake distributions could not be reliably estimated for dark green vegetables, starchy vegetables, and legumes because so few students consumed these foods. These vegetable subgroups are included in usual intake distributions for the (total) vegetables group.¹¹² In addition, for some subgroups of students, usual intake distributions could not be reliably estimated for whole grains.

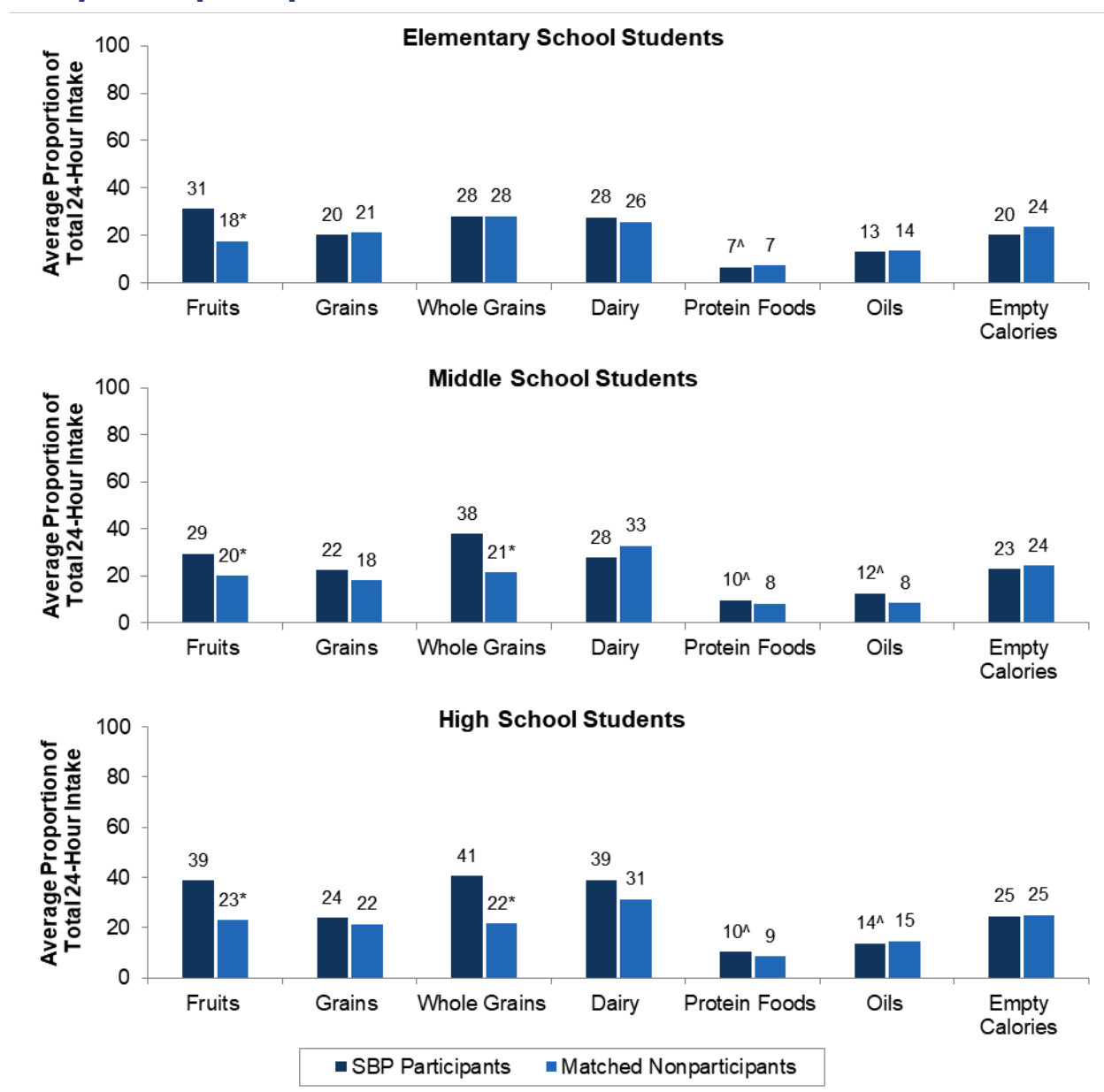
To assess the extent to which usual daily food group intakes of SBP participants and matched nonparticipants conformed with recommended USDA Food Patterns, the mean proportion of recommended amounts usually consumed by each group of students was estimated. As described in Chapter 6, the USDA Food Patterns for 1,800, 2,000, and 2,400 calories were used as reference standards for elementary, middle, and high school students, respectively. Key findings from this analysis are summarized below.

¹¹⁰ Table K.2 presents data on the mean amounts of USDA Food Pattern food groups consumed over 24 hours.

¹¹¹ Both genders, 6 to 8 years; males 9 to 13 years; females 9 to 13 years; males 14 to 18 years; and females 14 to 18 years.

¹¹² In this analysis, all legumes were counted as vegetables.

Figure 10.2. Mean Proportion of 24-Hour Intakes of USDA Food Pattern Food Groups Contributed by Breakfast: SBP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Breakfast intakes for both SBP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. Data for the vegetable group are not shown because vegetables were not commonly consumed at breakfast. Data are available in Table K.3.

The USDA Food Pattern food groups are largely consistent with the meal components used in planning SBP breakfasts, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

Intakes of fruit include both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

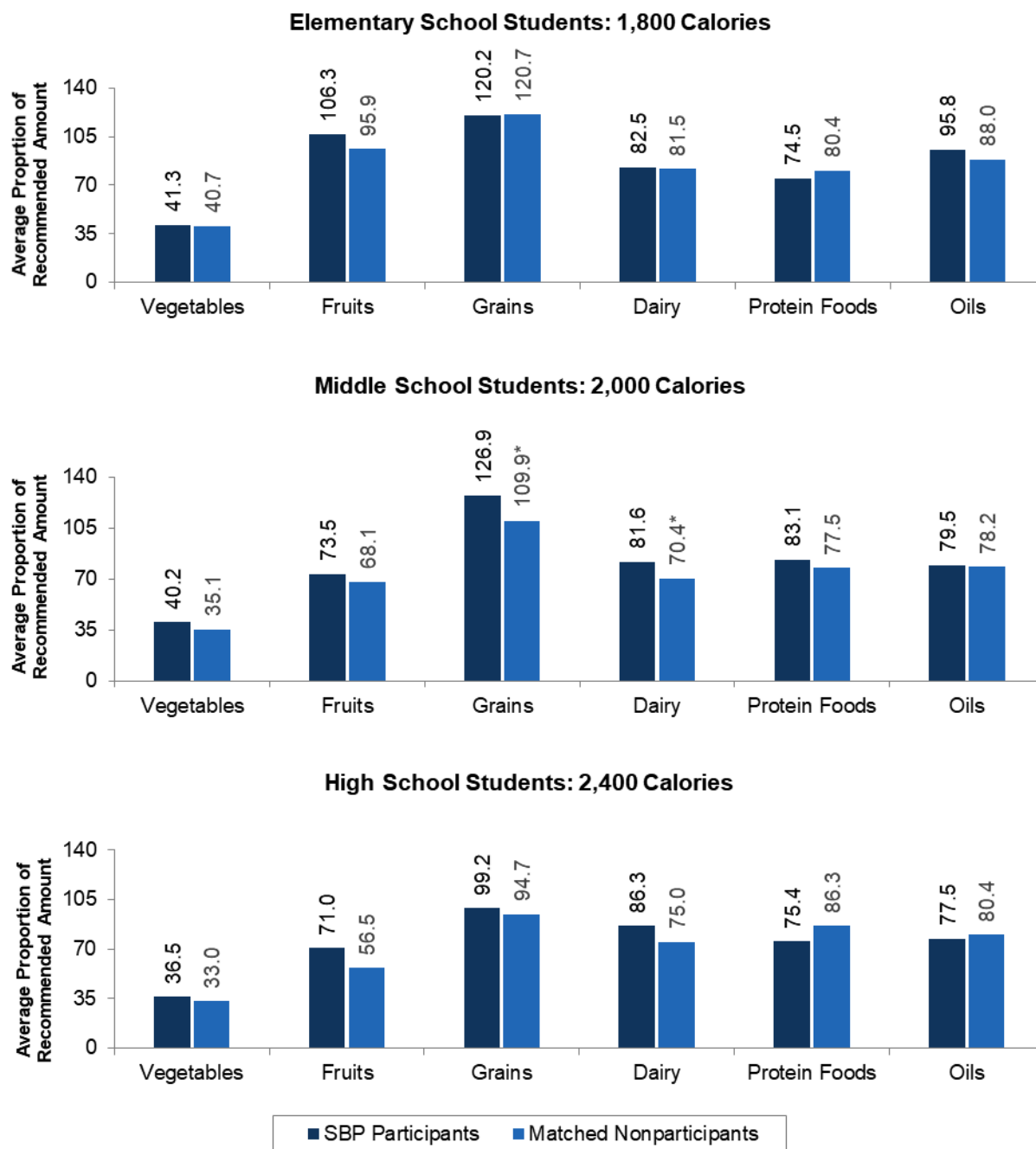
^Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

Usual daily vegetable intakes of SBP participants and matched nonparticipants were low—providing only 33 to 41 percent of recommended amounts, on average (Figure 10.3). Usual daily intakes of both SBP participants and matched nonparticipants provided considerably larger proportions of recommended amounts of fruits (57 to 106 percent). Students' usual daily intakes of grains came very close to meeting or exceeded recommended amounts (95 to 127 percent). Exceeding recommended amounts is not a positive finding because excess consumption of any food group can contribute to excess calorie intake or inadequate consumption of other food groups. With the exception of matched nonparticipants in middle schools, students' usual daily intakes of dairy, protein foods, and oils provided three-quarters or more of recommended amounts.

There were relatively few statistically significant differences between SBP participants and matched nonparticipants in the usual consumption of USDA Food Pattern food groups, relative to recommendations. Among elementary and high school students, there were no statistically significant differences in usual daily intakes of USDA Food Pattern food groups. Among middle school students, usual daily intakes of SBP participants were significantly higher in total grains and dairy, relative to recommendations, than usual daily intakes of matched nonparticipants. The differences were 127 percent versus 110 percent for total grains and 82 percent versus 70 percent for dairy. For all students combined, usual daily intakes of SBP participants provided a significantly larger share of the recommended amounts of whole grains than usual daily intakes of matched nonparticipants (54 percent versus 43 percent; Table K.4).

For all students combined, usual daily intakes of SBP participants provided a significantly larger share of the recommended amounts of whole grains than usual daily intakes of matched nonparticipants.

Figure 10.3. Usual Daily Intakes of USDA Food Pattern Food Groups: Mean Proportion of Recommended Amounts Consumed by SBP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Usual nutrient intakes were estimated using the NCI method (Tooze et al 2010; Freedman et al. 2010).

USDA Food Pattern recommendations assign individuals to a calorie level based on their gender, age, and activity level (USDA, CNPP 2011). The Food Patterns for 1,800, 2,000, and 2,400 calories were used as reference standards for assessing usual food group intakes of elementary, middle, and high school students, respectively (IOM 2010).

The USDA Food Pattern food groups are largely consistent with the meal components used in planning NSLP lunches, with two exceptions: (1) fluid milk is considered a separate meal component, and (2) other dairy foods such as yogurt and cheese are counted as meat alternates.

Intakes of fruit include both whole fruit (any fresh, canned, dried, or frozen fruit) and 100% fruit juice.

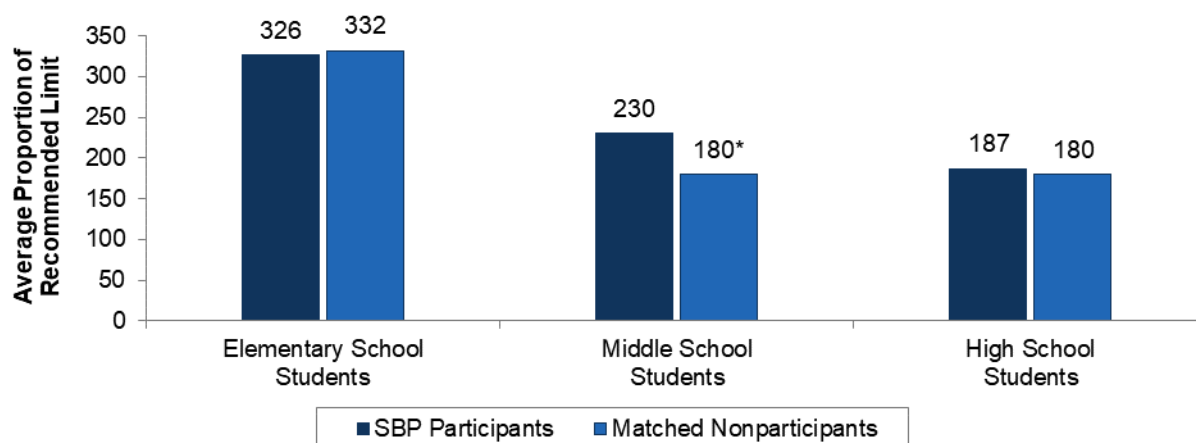
Data for whole grains are not shown because usual intake distributions could not be reliably estimated for several subgroups. See Table K.4.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NCI = National Cancer Institute; SBP = School Breakfast Program.

For all groups of students, usual daily intakes of empty calories exceeded the recommended maximum limit by a considerable margin (Figure 10.4). This finding was especially true for elementary school students whose usual daily intake of empty calories was more than three times the recommended maximum. This finding is partially driven by the fact that younger students have lower overall calorie requirements and, thus, less room in their diets for empty calories. Middle and high school students, who have higher calorie requirements and a greater allowance for empty calories, consumed 1.8 to 2.3 times the recommended maximum for empty calories. Among middle school students, SBP participants had significantly higher usual daily intakes of empty calories than matched nonparticipants (230 percent of the recommended maximum limit versus 180 percent).

Figure 10.4. Usual Daily Intakes of Empty Calories: Mean Proportion of Recommended Maximum Limit Consumed by SBP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Usual nutrient intakes were estimated using the NCI method (Tooze et al 2010; Freedman et al. 2010). USDA Food Pattern recommendations assign individuals to a calorie level based on their gender, age, and activity level (USDA, CNPP 2011). The Food Patterns for 1,800, 2,000, and 2,400 calories were used as reference standards for assessing usual food group intakes of elementary, middle, and high school students, respectively (IOM 2010).

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NCI = National Cancer Institute; SBP = School Breakfast Program.

11. NUTRIENT INTAKES OF SBP PARTICIPANTS AND NONPARTICIPANTS

This chapter describes nutrient intakes of SBP participants—students who consumed an SBP breakfast on the day reflected in the 24-hour recall—and matched comparison groups of nonparticipants on school days in SY 2014–2015.¹¹³ The chapter describes the average nutrient content of breakfasts consumed by participants and matched nonparticipants, as well as the contribution of breakfasts to total calorie and nutrient intakes over 24 hours. It also presents findings on the prevalence of inadequate or excessive nutrient intakes, based on an assessment of students' usual daily nutrient intakes. The analysis is based on 24-hour dietary recalls collected from students. Chapter 6 describes the methods used to collect and analyze these data.

Tables and figures in the chapter present key results; supplementary tables are provided in Appendix L and noted within the chapter. The statistical significance of differences between SBP participants and the matched comparison groups of nonparticipants was tested.¹¹⁴ Rules for flagging potentially unreliable point estimates, described in Chapter 1, have also been applied. The differences discussed in the text were significant at least at the 0.05 level, unless otherwise noted. These test results provide an important gauge of underlying population differences; however, they are not a definitive measure of true differences, and should not be interpreted as causal effects of the SBP. Although propensity score matching techniques were used to control for measured differences between SBP participants and nonparticipants (Appendix G), important differences may remain in characteristics that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest differences between participants and matched nonparticipants even if they are not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

Additionally, whether differences between SBP participants and nonparticipants are statistically significant can be partially driven by small SBP sample sizes or the correlation between SBP and NSLP participation. Because fewer students participate in the SBP than in the NSLP, smaller SBP sample sizes (511 SBP participants versus 1,254 NSLP participants) may result in observed differences between SBP participants and matched nonparticipants that are not statistically significant, even if there are true underlying differences in the population. On the other hand, because 87 percent of SBP participants and 48 percent of nonparticipants participated in the NSLP (Table D.9), NSLP participation may contribute to any observed differences in 24-hour intakes of SBP participants and matched nonparticipants or in the prevalence of inadequate or excessive nutrient intakes. This could overestimate the extent to which true underlying differences between SBP participants and nonparticipants are attributable to the SBP in particular.

¹¹³ Propensity score matching was used to construct matched comparison groups of nonparticipants. Appendix G describes the methods.

¹¹⁴ Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample design of the SNMCS.

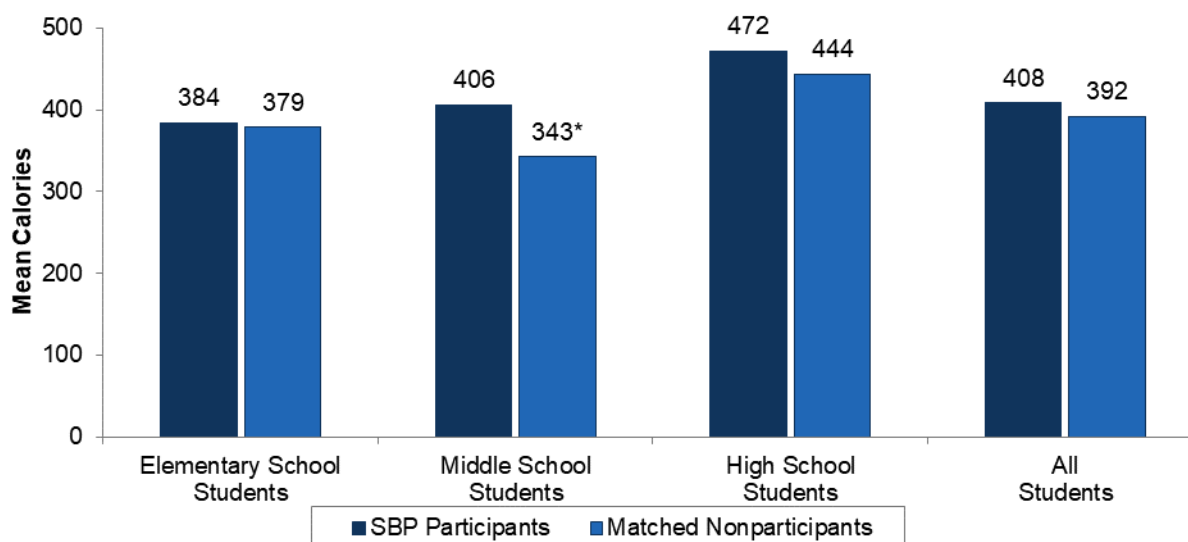
A. Nutrient Intakes at Breakfast

In assessing the nutrient intakes of SBP participants and matched nonparticipants, the study team first examined the mean amounts of calories and nutrients consumed at breakfast among SBP participants and matched nonparticipants who consumed a breakfast. Key findings are summarized below.¹¹⁵

1. Calories and Macronutrients

Overall, breakfasts consumed by SBP participants provided approximately the same number of calories, on average, as breakfasts consumed by matched nonparticipants (about 400 calories; Figure 11.1). However, findings differed by school type. Among elementary school students, breakfasts consumed by SBP participants and matched nonparticipants provided comparable amounts of calories (about 380). Breakfasts consumed by SBP participants in middle schools provided 63 more calories, on average, than breakfasts consumed by matched nonparticipants (406 calories versus 343 calories), and this difference was statistically significant. Breakfasts consumed by SBP participants in high schools provided more calories than breakfasts consumed by matched nonparticipants (472 calories versus 444 calories), but the difference was not statistically significant.

Figure 11.1. Mean Calories Consumed at Breakfast by SBP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

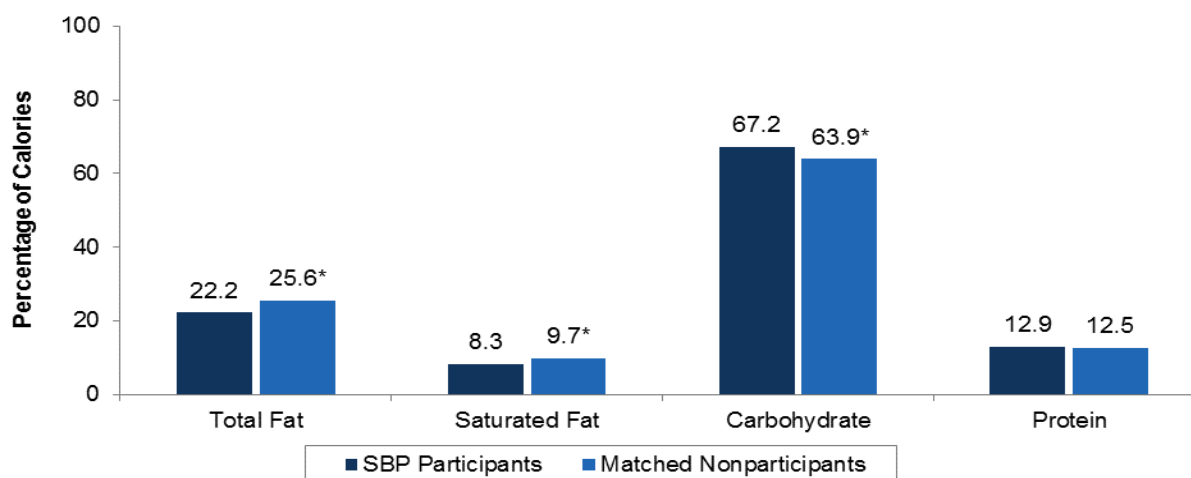
¹¹⁵ Table L.3 presents a supplementary descriptive tabulation that breaks out data for matched nonparticipants who obtained more than half of their breakfast foods from home.

Breakfasts consumed by SBP participants and matched nonparticipants provided comparable amounts of total fat, saturated fat, and protein (in grams) as breakfasts consumed by matched nonparticipants (Table 11.1). Breakfasts consumed by SBP participants provided more carbohydrate than breakfasts consumed by matched nonparticipants; however, differences were statistically significant only for middle school students (66 grams versus 54 grams).

Overall, breakfasts consumed by SBP participants provided fewer calories from total fat (22 percent versus 26 percent) and saturated fat (8 percent versus 10 percent), and more calories from carbohydrate (67 percent versus 64 percent), than breakfasts consumed by matched nonparticipants (Figure 11.2). This pattern of findings was largely driven by differences among elementary school students (Table 11.1). For all three school types, the average amount of saturated fat consumed at breakfast by SBP participants was consistent with the *Dietary Guidelines for Americans* recommendation for saturated fat (less than 10 percent of total calories).

Overall, breakfasts consumed by SBP participants and matched nonparticipants were comparable in calories, but breakfasts consumed by SBP participants provided fewer calories from total fat and saturated fat.

Figure 11.2. Mean Percentage of Calories from Total Fat, Saturated Fat, Carbohydrate, and Protein in Breakfasts Consumed by SBP Participants and Matched Comparison Group of Nonparticipants: All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

Table 11.1. Mean Nutrients Consumed at Breakfast by SBP Participants and Matched Comparison Group of Nonparticipants

	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Calories (kcal)	384	379	406	343*	472	444	408	392
Macronutrients								
Total Fat (g)	10	12	11	10	14	14	11	12
Saturated Fat (g)	4	5	4	4	6	5	4	5
Monounsaturated Fat (g)	3	4	4	3	5	5	4	4
Polyunsaturated Fat (g)	2	2	2	2*	3	3	2	2
Linoleic acid (g)	2	2	2	2*	2	3	2	2
Alpha-linolenic acid (g)	0.2	0.2	0.2	0.2*	0.2	0.2	0.2	0.2
Carbohydrate (g)	64	59	66	54*	71	65	66	60
Protein (g)	12	11	13	12	17	16	13	13
Macronutrients: Percentage of Calories								
Total Fat	20.6	25.7*	24.0	23.6	25.0	26.2	22.2	25.6*
Saturated Fat	7.6	9.7*	8.9	9.8	9.9	9.6	8.3	9.7*
Monounsaturated Fat	6.7	8.8*	7.8	7.8	8.5	9.1	7.3	8.8*
Polyunsaturated Fat	5.1	5.1	5.6	4.2*	5.1	5.5	5.2	5.2
Linoleic acid	4.4	4.6	5.0	3.7*	4.5	4.9	4.6	4.6
Alpha-linolenic acid	0.5	0.5	0.5	0.4*	0.4	0.4	0.5	0.5
Carbohydrate	69.5	64.5*	66.0	64.4	62.4	62.6	67.2	63.9*
Protein	12.6	12.1	12.0	13.7	14.3	13.1	12.9	12.5
Vitamins								
Vitamin A (mcg RAE)	205	252	257	265	240	257	223	254
Vitamin C (mg)	25	25	26	25	32	24	27	25
Vitamin D (mcg)	3.0	2.6	2.9	2.9	2.9	2.9	3.0	2.7
Vitamin E (mg AT)	0.9	1.3*	0.9	1.1	1.5	1.6	1.0	1.4*
Vitamin B ₆ (mg)	0.5	0.6	0.7	0.7	0.6	0.7	0.6	0.6
Vitamin B ₁₂ (mcg)	1.7	2.0	2.1	2.2	1.9	2.1	1.8	2.0
Folate (mcg DFE)	147	237*	215	244	244	225	182	233*
Niacin (mg)	5	6*	6	6	6	6	5	6*
Riboflavin (mg)	0.7	0.8	0.8	0.8	0.8	0.8	0.7	0.8
Thiamin (mg)	0.4	0.5*	0.6	0.5	0.6	0.6	0.5	0.5

	Elementary School Students		Middle School Students		High School Students		All Students	
	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants	Participants	Nonparticipants
Minerals								
Calcium (mg)	333	294	318	306	447	358	356	310
Iron (mg)	4.4	5.9*	5.6	5.2	5.7	5.5	4.9	5.6
Magnesium (mg)	59	55	59	54	77	69	63	58
Phosphorus (mg)	315	291	305	289	398	369	332	309
Potassium (mg)	559	490	533	480	629	568	570	508*
Sodium (mg)	435	478	483	435	659	568	495	505
Zinc (mg)	2.4	3.2*	3.0	3.2	3.6	3.2	2.8	3.2
Other Dietary Components								
Dietary Fiber (g)	3	3	3	3*	4	3	3	3
Dietary Fiber Density (g/1,000 calories)	9	9	9	8	8	8	9	8
Cholesterol (mg)	30	35	43	47	66	63	41	47
Number of Students	228	466	144	459	139	435	511	1,360

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Breakfast intakes for both SBP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

AT = alpha-tocopherol; DFE = dietary folate equivalents; RAE = retinol activity equivalents; SBP = School Breakfast Program.

2. Vitamins and Minerals

Overall, breakfasts consumed by SBP participants provided significantly larger amounts of potassium than breakfasts consumed by nonparticipants (Table 11.1). The reverse was true for vitamin E, folate, and niacin. Findings for vitamin E, folate, and niacin were largely driven by differences among elementary school students. In this group, breakfasts consumed by SBP participants provided significantly smaller amounts of vitamin E, folate, niacin, thiamin, iron, and zinc than breakfasts consumed by matched nonparticipants. For middle and high school students, there were no statistically significant differences in the average vitamin and mineral content of breakfasts consumed by SBP participants and matched nonparticipants.

The higher potassium intake of SBP participants versus matched nonparticipants was statistically significant for all students combined (570 mg versus 508 mg).

3. Dietary Fiber and Cholesterol

There were no substantively meaningful differences between SBP participants and matched nonparticipants in average fiber intakes at breakfast (measured in total g or g/1,000 calories; Table 11.1). There were also no significant differences between SBP participants and matched nonparticipants in average cholesterol intakes at breakfast.

B. Nutrient Intakes Over 24 Hours

To understand the potential contributions of SBP breakfasts to students' total nutrient intakes, the study team examined mean amounts of calories and nutrients consumed by SBP participants and nonparticipants over 24 hours (on the target day), as well as the proportion of 24-hour intakes contributed by breakfast.¹¹⁶ A separate analysis, summarized in Section C, estimated the prevalence of inadequate and excessive usual daily intakes among SBP participants and matched nonparticipants.¹¹⁷

1. Mean Nutrient Intakes Over 24 Hours

For elementary and high school students, 24-hour intakes of calories, macronutrients, vitamins, and minerals were comparable for SBP participants and matched nonparticipants (Table L.1). Among middle school students, however, mean 24-hour intakes of calories were significantly higher for SBP participants than for matched nonparticipants (2,061 calories versus 1,747 calories, a difference of 18 percent). The additional 314 calories consumed by SBP participants resulted in significantly higher absolute intakes of all macronutrients (except polyunsaturated fats) and all vitamin and minerals, relative to matched nonparticipants. Most of the differences in vitamin and mineral intakes were statistically significant (Table L.1).

¹¹⁶ Table L.4 presents a supplementary descriptive tabulation that breaks out data for matched nonparticipants who obtained more than half of their breakfast foods from home.

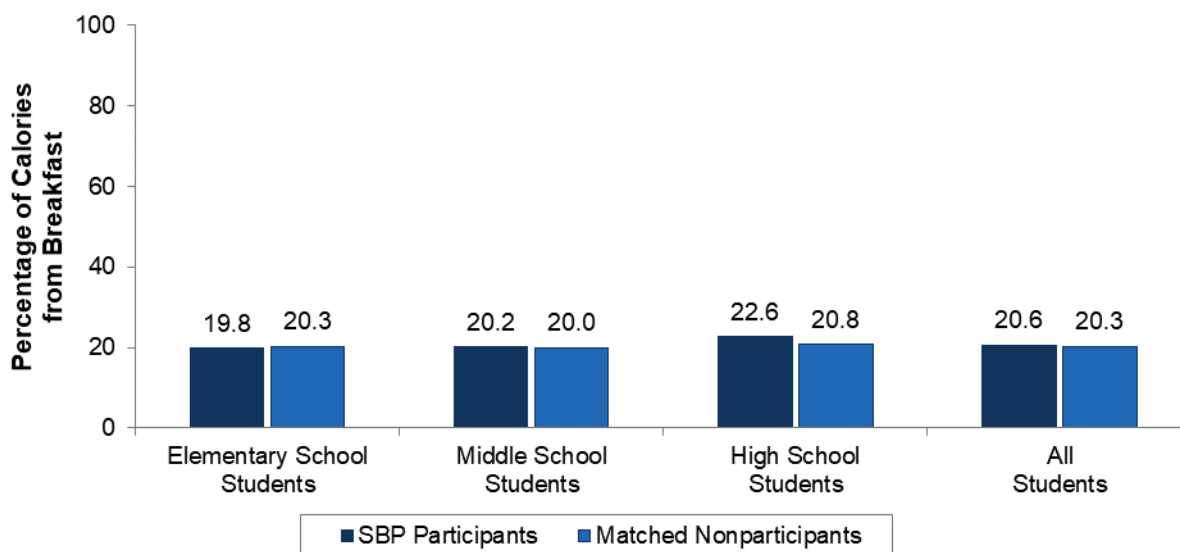
¹¹⁷ Tables L.45 and L.46 present additional data for subgroups of students defined by household poverty level.

2. Mean Proportion of 24-Hour Intakes Contributed by Breakfast

Breakfasts consumed by SBP participants and matched nonparticipants contributed similar proportions of 24-hour calorie intakes (about 20 percent; Figure 11.3).¹¹⁸ On average, breakfasts consumed by SBP participants contributed a smaller proportion of 24-hour intakes of total fat and saturated fat than breakfasts consumed by matched nonparticipants (Table L.2). This is consistent with the patterns observed for breakfast intakes (Figure 11.2).

Breakfasts consumed by SBP participants and matched nonparticipants contributed about 20 percent of students' calorie intakes over 24 hours.

Figure 11.3. Mean Proportion of 24-Hour Calorie Intakes Contributed by Breakfast: SBP Participants and Matched Comparison Group of Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. None of the differences between participants and the matched comparison group of nonparticipants are significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

¹¹⁸ The analysis excluded nonparticipants who did not consume a breakfast.

There are few significant differences between SBP participants and matched nonparticipants in the mean proportion of 24-hour intakes of vitamins and minerals contributed by breakfast (Table L.2). Significant differences were observed for all schools combined, elementary schools, and middle or high schools for vitamin C and folate. A few isolated differences were observed for other nutrients in one school type.

C. Prevalence of Acceptable, Inadequate, and Excessive Usual Daily Intakes

Using the methods described in Chapter 6, the study team estimated usual daily intakes of calories and nutrients for both SBP participants and matched nonparticipants. All students, including those who did not consume a breakfast, were included in these analyses. Tables L.7–L.43 provide data on means and full distributions of usual calorie and nutrient intakes for both groups of students in the age and gender subgroups used in the DRIs,¹¹⁹ as well as subgroups defined by school type and gender.

Using these usual daily intake distributions, the study team estimated the proportion of SBP participants and matched nonparticipants with acceptable, inadequate, and excessive usual daily intakes, relative to age-and-gender-specific DRIs. Key findings are summarized below.

Dietary Reference Intakes (DRIs)

AI = Adequate Intake

*AMDR = Acceptable
Macronutrient Distribution
Range*

*EAR = Estimated Average
Requirement*

*UL = Tolerable Upper
Intake Level*

1. Usual Intakes of Calories (Energy) Relative to Estimated Energy Requirements

Assessment of self-reported energy (calorie) intakes is difficult. Populations that are in energy balance (not gaining weight) should have usual daily energy intakes that are roughly equivalent to EERs. However, as discussed in Chapter 8, it is well recognized that food intakes are often misreported in dietary surveys. In addition, it is difficult to accurately estimate EERs without detailed information about usual levels of physical activity. For this analysis, the study team applied assumptions about physical activity that the IOM used in developing recommendations for updated nutrition standards for school meals (IOM 2010). Students 6 to 10 years of age were assumed to have an “active” level of physical activity, and all older students were assumed to have a “low active” level of physical activity. Estimated EERs, shown in Table L.5, were not significantly different for SBP participants and matched nonparticipants.

Estimated mean usual calorie intakes were below EERs for all groups of students, which suggests under-reporting of true intakes. Mean calorie intakes as a percentage of EERs were not significantly different for SBP participants and matched nonparticipants. The gap between estimated EERs and mean usual calorie intakes, which was highest for middle school students, was not significantly different for SBP participants and matched nonparticipants.

¹¹⁹ Both genders, 6 to 8 years; males 9 to 13 years; females 9 to 13 years; males 14 to 18 years; and females 14 to 18 years. The sample included a small number of 19 year-olds. In assessing usual daily intakes of these students, appropriate age- and gender- specific DRIs were used (males 19 to 30 years and females 19 to 30 years), but in Tables L.7–L.43, these 13 students are included with students 14 to 18 years.

2. Usual Intakes of Macronutrients

To assess usual intakes of macronutrients, the study team compared usual daily macronutrient intakes of SBP participants and matched nonparticipants to AMDRs defined in the DRIs (see Chapter 6). Acceptable usual intakes were defined as intakes that fell within the AMDR. Usual daily intakes of carbohydrate and protein were also compared with EARs. Because there is no DRI for saturated fat, the *Dietary Guidelines for Americans* recommendation was used as a benchmark to define acceptable intakes.

The majority of both SBP participants and matched nonparticipants had acceptable usual daily intakes of macronutrients.

The majority of both SBP participants and matched nonparticipants had acceptable usual intakes of macronutrients, and there were few significant differences between the two groups (Table L.44). Usual daily intakes of total fat fell within the AMDR for 91 percent of SBP participants and 81 percent of matched nonparticipants. Usual daily fat intakes that were not within the AMDR were more likely to exceed the upper end of the AMDR (more fat as a percentage of total calories than recommended) than to fall below the lower end. Seven percent of SBP participants and 15 percent of nonparticipants had excessive usual daily intakes of fat.

Overall, about 60 percent of students had usual daily intakes of saturated fat that exceeded the *Dietary Guidelines for Americans* recommendation (Table L.44). Findings were comparable for SBP participants and matched nonparticipants. More than 90 percent of SBP participants and matched nonparticipants had acceptable usual daily intakes of linoleic acid (an essential fatty acid), and about 60 percent of SBP participants and matched nonparticipants had acceptable usual daily intakes of alpha-linolenic acid.

Nearly all SBP participants and matched nonparticipants had acceptable usual daily intakes of carbohydrates and protein. However, among high school students, SBP participants were more likely than matched nonparticipants to have acceptable usual daily intakes of carbohydrates, and were less likely to have usual daily intakes that fell below the lower end of the AMDR.

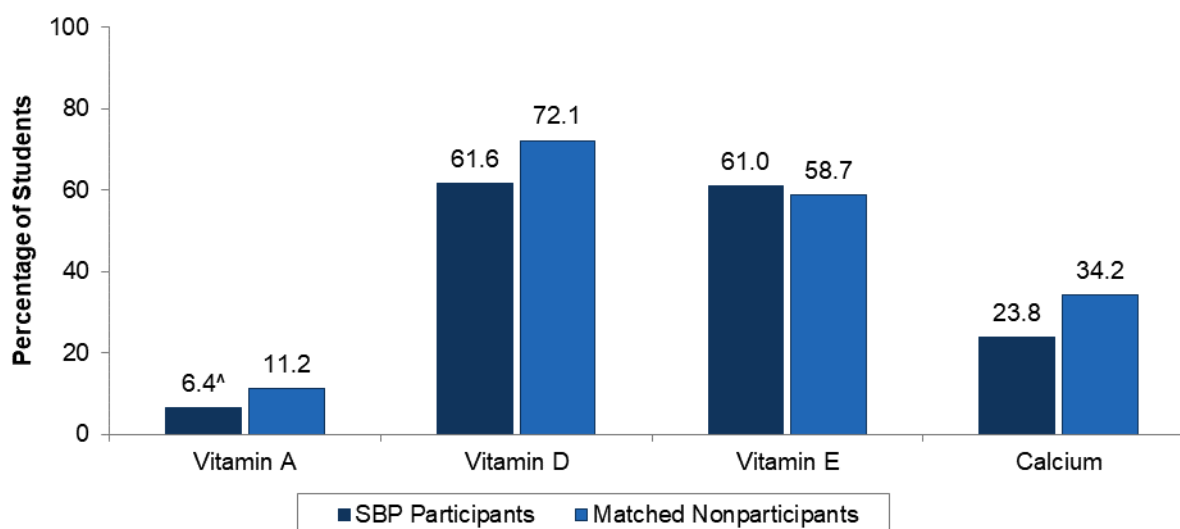
3. Usual Intakes of Vitamins and Minerals

For most of the vitamins and minerals examined in this study, the analysis compared usual daily intakes of SBP participants and nonparticipants with EARs to estimate the prevalence of usual daily intakes that were inadequate (less than the EAR; see Chapter 6).

Among elementary school students, the prevalence of inadequate usual intakes exceeded 10 percent for both SBP participants and matched nonparticipants for vitamin D, vitamin E, and calcium (Figure 11.4).¹²⁰ In addition, the prevalence of inadequate intake of vitamin A was above 10 percent for matched nonparticipants. None of the differences between SBP participants and matched nonparticipants were statistically significant

¹²⁰ Devaney et al. (2007) pointed out that the diets of most of the U.S. population do not meet the EAR for vitamin E, yet vitamin E deficiency is rare. They noted limitations of both the data used to establish the EAR and the data used to assess vitamin E intakes.

Figure 11.4. Prevalence of Inadequate Usual Daily Intakes of Vitamins and Minerals among SBP Participants and Matched Nonparticipants: Elementary School Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. The figure is limited to nutrients that had a prevalence of inadequacy of more than 10 percent for at least one group.

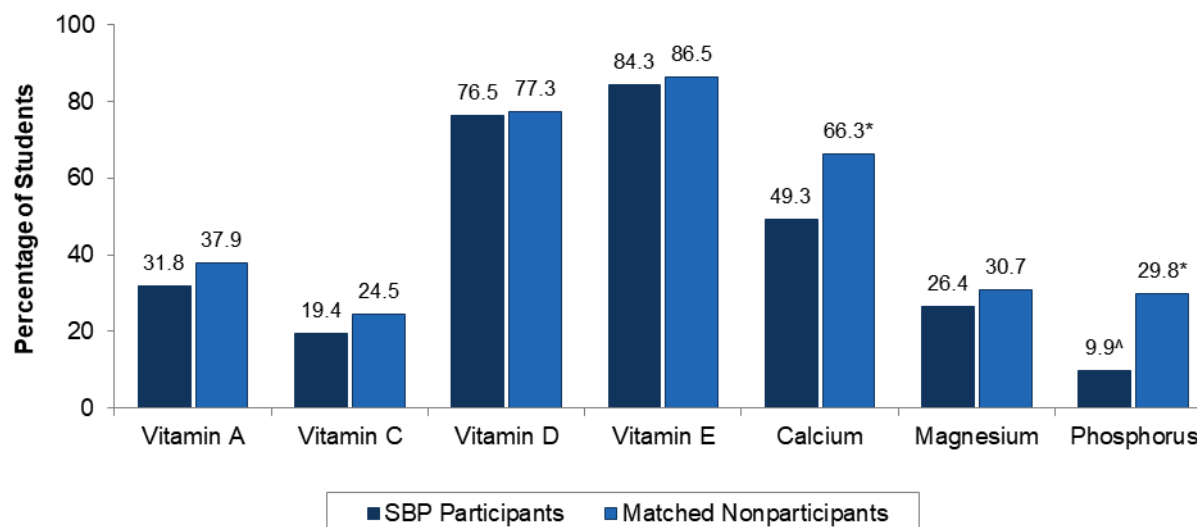
None of the differences between participants and the matched comparison group of nonparticipants were significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

[^] Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

Among middle school students, the prevalence of inadequate intakes exceeded 10 percent for SBP participants and matched nonparticipants for seven of the 15 vitamins and minerals examined (Figure 11.5). For both groups of students, the prevalence of inadequacy was highest for vitamin D (more than three-quarters of students) and vitamin E (more than 80 percent of students). Most of the differences between SBP participants and matched nonparticipants were not statistically significant. Calcium and phosphorus were exceptions. For both of these nutrients, SBP participants in middle schools were significantly less likely than matched nonparticipant to have inadequate intakes (for calcium, 49 percent versus 66 percent, and for phosphorus, 10 percent versus 30 percent).

Figure 11.5. Prevalence of Inadequate Usual Daily Intakes of Vitamins and Minerals among SBP Participants and Matched Nonparticipants: Middle School Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. The figure is limited to nutrients that had a prevalence of inadequacy of more than 10 percent for at least one group.

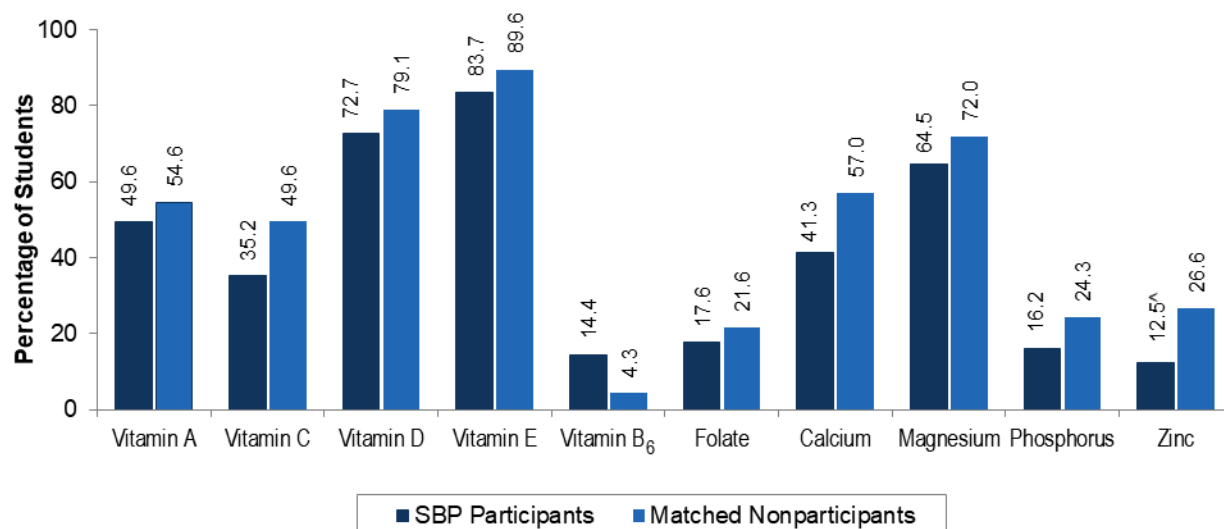
*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

^A Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

High school students—who have the highest nutrient requirements relative to the other age groups considered in this study—had the greatest prevalence of inadequate intakes. Among SBP participants, the prevalence of inadequacy exceeded 10 percent for 10 of the 15 vitamins and minerals examined (Figure 11.6). With the exception of vitamin B₆, the same was true for matched nonparticipants. Similar to elementary and middle school students, high school students had high rates of inadequacy for vitamins D and E. They also had high rates of inadequate usual intakes of magnesium (65 percent or more of students), vitamin A (50 percent or more), and vitamin C (35 percent or more). None of the differences between SBP participants and matched nonparticipants were statistically significant.

Figure 11.6. Prevalence of Inadequate Usual Daily Intakes of Vitamins and Minerals among SBP Participants and Matched Nonparticipants: High School Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1 and Day 2, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. None of the differences between participants and the matched comparison group of nonparticipants are significantly different from zero at the 0.05 level.

The figure is limited to nutrients that had a prevalence of inadequacy of more than 10 percent for at least one group.

SBP = School Breakfast Program.

[^] Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

4. Usual Intakes of Potassium and Dietary Fiber

EARs are not defined for potassium or dietary fiber. The analysis compared usual daily intakes of these two nutrients were compared with the AIs defined in the DRIs. Mean usual intakes that are equivalent to 100 percent or more of the AI indicate that the prevalence of inadequacy is likely to be low. However, if mean usual intakes fall below 100 percent of the AI, no firm conclusion can be drawn about the prevalence of inadequate intakes.

Potassium. Overall, mean usual daily intakes of potassium were equivalent to 58 percent and 55 percent of the AI for SBP participants and nonparticipants, respectively (Table L.44). The difference between SBP participants and matched nonparticipants in mean usual daily intakes of potassium was significant only for middle school students (54 percent of the AI versus 49 percent).

Dietary Fiber. Across all groups of students, mean usual dietary fiber intakes ranged from 51 to 66 percent of the AI (Table L.44). Among middle school students, SBP participants had significantly higher mean usual daily intakes of dietary fiber than matched nonparticipants (58 percent of the AI versus 51 percent).

5. Usual Intakes of Sodium and Cholesterol

For both sodium and cholesterol, public health concerns center around risks associated with excessive intakes rather than ensuring adequate intakes. The analysis compared usual sodium intakes with the UL defined in the DRIs, and compared usual intakes of sodium and cholesterol with the maximum daily limits specified in the 2010 *Dietary Guidelines for Americans*.¹²¹

Sodium. Overall, more than 93 percent of SBP participants and matched nonparticipants had usual sodium intakes that exceeded the UL and the maximum limit recommended in the 2010 *Dietary Guidelines for Americans* (Table L.44). There were no significant differences between SBP participants and matched nonparticipants in the prevalence of excessive usual daily intakes of sodium.

Cholesterol. Relatively few students had usual daily intakes of cholesterol that exceeded the maximum limit recommended in the 2010 *Dietary Guidelines for Americans* (5 to 8 percent, overall; Table L.44). The prevalence of excessive cholesterol intakes was highest among high school students (14 to 17 percent). There were no significant differences between SBP participants and matched nonparticipants in the prevalence of excessive usual daily intakes of cholesterol.

¹²¹ This analysis made comparisons to the 2010 *Dietary Guidelines for Americans* recommended limit on cholesterol because these recommendations were in effect when data for this study were collected. The 2015–2020 *Dietary Guidelines for Americans* do not place a limit on cholesterol.

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12. HEALTHY EATING INDEX SCORES FOR SBP PARTICIPANTS AND NONPARTICIPANTS

One of four confirmatory hypotheses defined for the SNMCS is that consumption of school meals is associated with higher quality diets.¹²² This chapter presents findings from an analysis that addressed this hypothesis for the SBP by comparing the overall nutritional quality of diets consumed by SBP participants—students who consumed a SBP breakfast on the day reflected in the 24-hour recall—and matched comparison groups of nonparticipants on school days in SY 2014–2015.¹²³ Analyses examined both the nutritional quality of breakfasts consumed by SBP participants and nonparticipants, as well as the overall nutritional quality of 24-hour intakes for these groups. (Chapter 9 presents findings from a parallel analysis of NSLP participants and matched nonparticipants).

The HEI-2010 was used to describe the nutritional quality of the breakfasts and overall diets consumed by SBP participants and matched nonparticipants. As described in Chapter 6, the HEI-2010 is a diet quality index that measures conformance with key recommendations of the 2010 *Dietary Guidelines for Americans*.¹²⁴ It consists of 12 component scores (see text box), each reflecting a key aspect of diet quality, and a total score that measures overall diet quality. Nine of the 12 components focus on adequacy and measure intake of food groups and nutrients needed for good health. The remaining three components focus on moderation and measure intake of dietary components that individuals are encouraged to limit.

HEI-2010 Components (maximum score):

Adequacy Components:

Total Fruit (5)
Whole Fruit (5)
Total Vegetables (5)
Greens and Beans (5)
Whole Grains (10)
Dairy (10)
Total Protein Foods (5)
Seafood and Plant Proteins (5)
Fatty Acids (10)

Moderation Components:

Refined Grains (10)
Sodium (10)
Empty Calories (20)

Maximum scores for the components range from 5 to 20, and the total score, which is computed by summing scores for each of the 12 components, has a maximum of 100. For all components, higher scores indicate better conformance with recommendations of the *Dietary Guidelines for Americans* and, thus, higher diet quality. For the three moderation components in the HEI-2010, higher scores reflect lower concentrations of refined grains, sodium, and empty calories.

¹²² The other confirmatory hypotheses focus on the relationships between (1) the nutritional quality and cost of school meals, (2) the nutritional quality of school meals and student participation, and (3) the nutritional quality of school meals and the quality of school meal participants' diets. Findings related to the first hypothesis are discussed in Volume 3 of the SNMCS final report (Logan et al. 2019). Findings related to the second hypothesis are discussed in Chapter 4 in this volume, and findings related to the third hypothesis are discussed in Chapter 14 in this volume.

¹²³ Propensity score matching was used to construct matched comparison groups of nonparticipants. Appendix G describes the methods.

¹²⁴ The study team used the HEI-2010, because the 2010 *Dietary Guidelines for Americans* were in effect when data for this study were collected.

Using data from the single 24-hour dietary recall collected for all students, the study team estimated total and component HEI-2010 scores for participants and matched nonparticipants using the population ratio method (Guenther et al. 2013). The study team estimated HEI-2010 scores for the foods consumed at breakfast (among students who consumed a breakfast) and over 24 hours (for all students, including those who did not consume a breakfast). Chapter 6 provides additional information on the HEI-2010 and the methods used for this analysis.

Figures in this chapter present key results; supplementary tables are provided in Appendix M and noted within the chapter. The statistical significance of differences between SBP participants and the matched comparison groups of nonparticipants was tested.¹²⁵ Rules for flagging potentially unreliable point estimates, described in Chapter 1, have also been applied. The differences discussed in the text are significant at least at the 0.05 level, unless otherwise noted. These test results provide an important gauge of underlying population differences; however, they are not a definitive measure of true differences and should not be interpreted as causal effects of the SBP. Although propensity score matching techniques were used to control for measured differences between SBP participants and nonparticipants (Appendix G), important differences may remain in characteristics that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest differences between participants and matched nonparticipants even if they are not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

Additionally, whether differences between SBP participants and nonparticipants are statistically significant can be partially driven by small SBP sample sizes or the correlation between SBP and NSLP participation. Because fewer students participate in the SBP than in the NSLP, smaller SBP sample sizes (511 SBP participants versus 1,254 NSLP participants) may result in observed differences between SBP participants and matched nonparticipants that are not statistically significant, even if there are true underlying differences in the population. On the other hand, because 87 percent of SBP participants and 48 percent of matched nonparticipants participated in the NSLP (see Table 2.11), NSLP participation may contribute to any observed differences in HEI-2010 scores of SBP participants and matched nonparticipants. This could overestimate the extent to which true underlying differences between SBP participants and nonparticipants are attributable to the SBP.

A. HEI-2010 Scores for Breakfast

The study team estimated mean HEI-2010 total and component scores for the breakfasts consumed by SBP participants and matched nonparticipants. For both SBP participants and matched nonparticipants, the analysis included all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. The analysis excluded students who did not consume a breakfast.

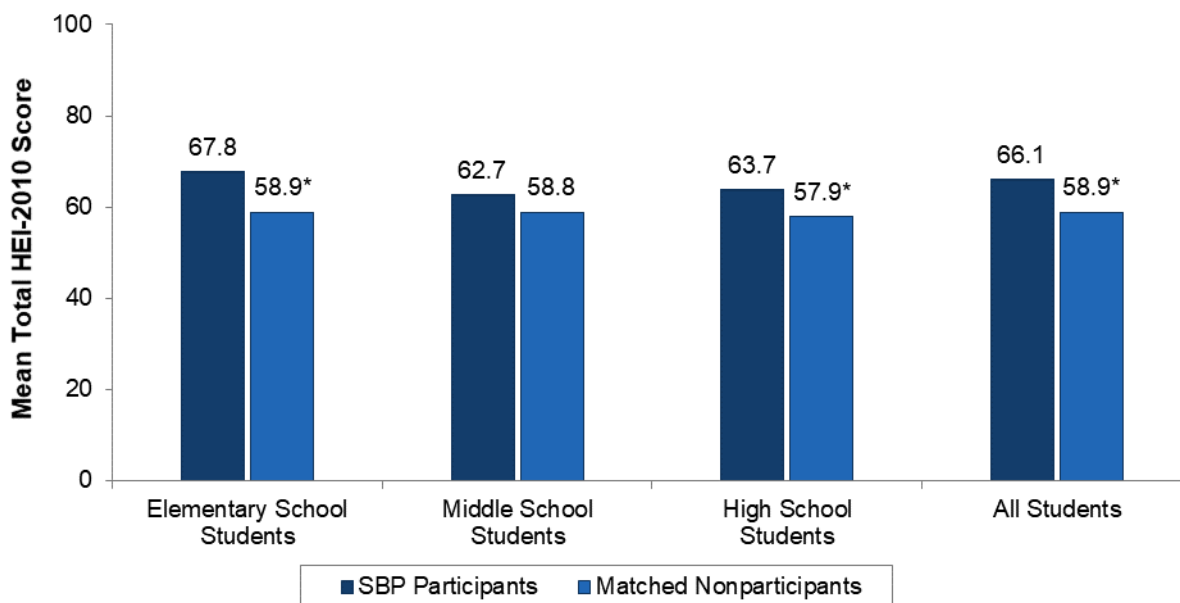
¹²⁵ Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample design of the SNMCS.

1. Total Scores

Overall, the breakfasts consumed by SBP participants achieved a significantly higher mean total score on the HEI-2010 than breakfasts consumed by matched nonparticipants (66.1 versus 58.9) (Figure 12.1). This pattern persisted across all three school types and the differences were significant for elementary and high school students. For both groups of students, total HEI-2010 scores were lower for breakfasts than for lunches. This is not surprising, given that several of the food groups assessed in the HEI-2010's adequacy components—for example, vegetables, greens and beans, and seafood and plant proteins—are typically not consumed at breakfast (see Table 10.1).

The breakfasts consumed by SBP participants achieved a significantly higher total HEI-2010 score than the breakfasts consumed by matched nonparticipants.

Figure 12.1. Mean Healthy Eating Index-2010 Scores for Breakfasts Consumed by SBP Participants and Matched Comparison Group of Nonparticipants: Total Scores



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Breakfast intakes for both SBP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. Healthy Eating Index-2010 scores are based on breakfast intakes. Higher total scores reflect higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

2. HEI-2010 Component Scores

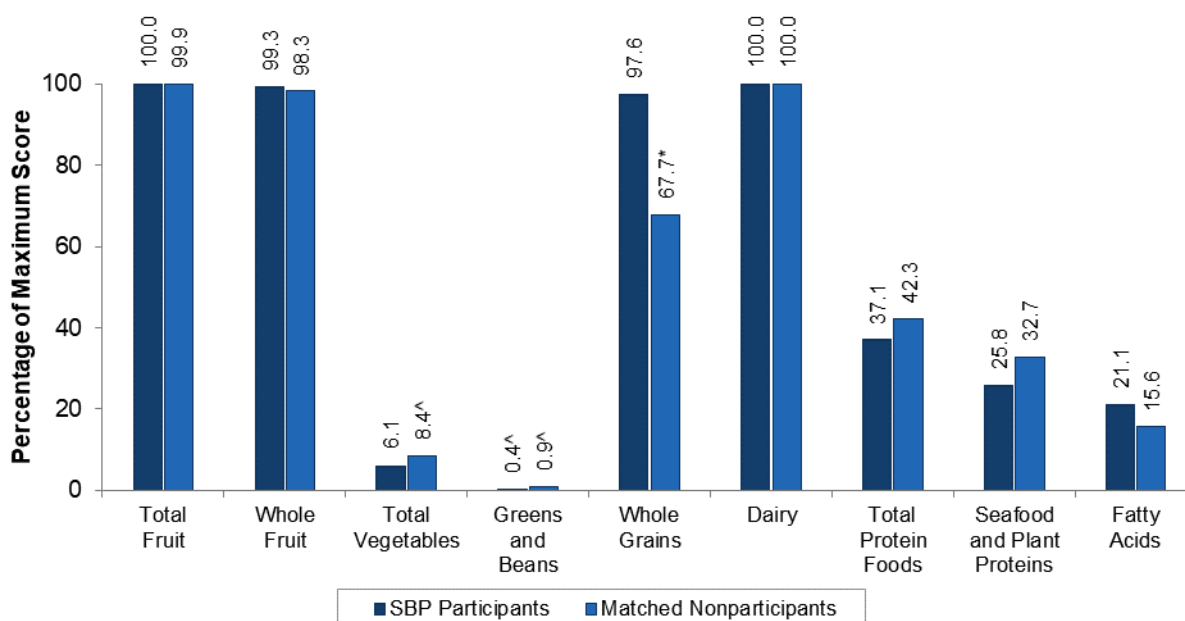
The study team estimated mean scores for each of the 12 HEI-2010 components for breakfasts consumed by SBP participants and matched nonparticipants (Tables M.1–M.4). In presenting findings, scores are expressed as a percentage of the maximum possible score.

Adequacy Components

Overall, the breakfasts consumed by both SBP participants and matched nonparticipants achieved perfect or near perfect scores for total fruit, whole fruit, and dairy (98 to 100 percent of maximum scores), and the breakfasts consumed by SBP participants also achieved a near perfect score for whole grains (Figure 12.2). The breakfasts consumed by SBP participants had a significantly higher concentration of whole grains than breakfasts consumed by matched nonparticipants (98 percent versus 68 percent). This pattern was observed for students in all three school types (Tables M.2–M.4). For both groups of students, scores for breakfast intakes were lowest for total vegetables (6 to 8 percent for both groups) and greens and beans, which is consistent with the fact that these components are typically not consumed at breakfast (see Table 10.1).

The breakfasts consumed by SBP participants had significantly higher concentrations of whole grains than the breakfasts consumed by matched nonparticipants and lower concentrations of refined grains and empty calories.

Figure 12.2. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for Breakfasts Consumed by SBP Participants and Matched Comparison Group of Nonparticipants: Adequacy Components, All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Breakfast intakes for both SBP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school.

Healthy Eating Index-2010 scores are based on breakfast intakes. Higher scores for adequacy components reflect higher intakes and, thus, higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

^ Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

SBP = School Breakfast Program.

Moderation Components

Overall, the breakfasts consumed by SBP participants had lower concentrations of refined grains and empty calories than the breakfasts consumed by matched participants (78 percent of the maximum score versus 61 percent for refined grains; and 71 percent versus 62 percent for empty calories) (Figure 12.3). The difference in sodium scores for breakfasts consumed by SBP participants and matched nonparticipants was not statistically significant.

Findings for the HEI-2010 moderation components varied somewhat by school type. Among elementary school students, the breakfasts consumed by SBP participants received a significantly higher score for refined grains than the breakfasts consumed by matched nonparticipants (82 percent versus 62 percent) (Table M.2). None of the differences among middle school students were statistically significant (Table M.3). Among high school students, the breakfasts consumed by SBP participants had a significantly lower concentration of empty calories than those consumed by matched nonparticipants (73 percent versus 60 percent) (Table M.4).

B. HEI-2010 Scores Over 24 Hours

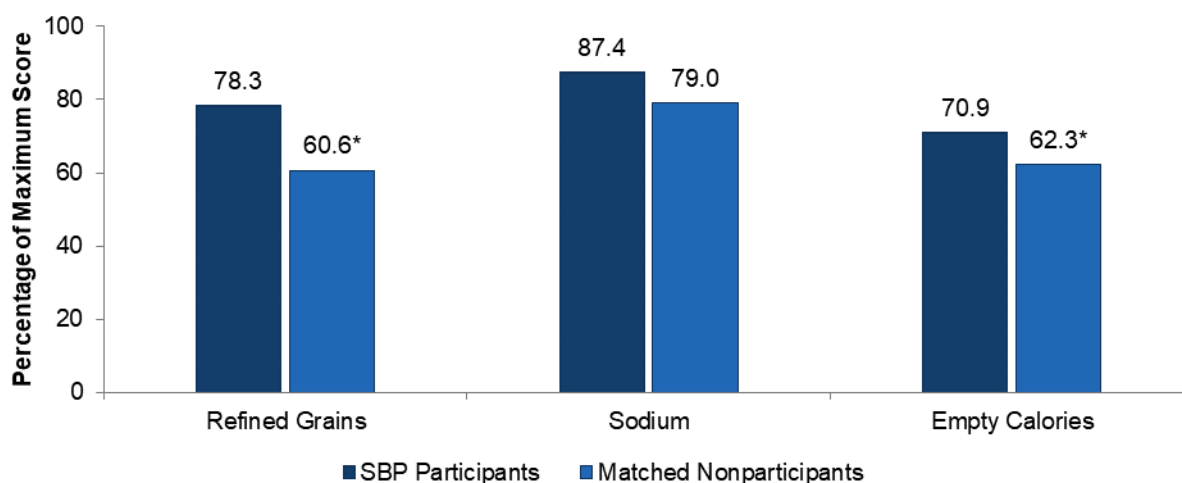
Some of the positive, significant differences observed in HEI-2010 scores for breakfasts consumed by SBP participants and matched nonparticipants could be offset by what students consumed for other meals and snacks throughout the day. To gain additional insights into how students' breakfast intakes may influence their overall diets, the study team estimated total and component HEI-2010 scores for 24-hour intakes of SBP participants and matched nonparticipants. All students, including those who did not consume a breakfast, were included in the analysis.

1. Total Scores

Overall and for elementary school students, the significant difference in mean total HEI-2010 scores observed among SBP participants and matched nonparticipants at breakfast (Figure 12.1) did not persist over 24 hours (Figure 12.4). However among high school students, the positive and significant difference did persist.

The positive and significant difference in mean total HEI-2010 scores observed among SBP participants and matched nonparticipants at breakfast persisted over 24 hours for high school students only.

Figure 12.3. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for Breakfasts Consumed by SBP Participants and Matched Comparison Group of Nonparticipants: Moderation Components, All Students



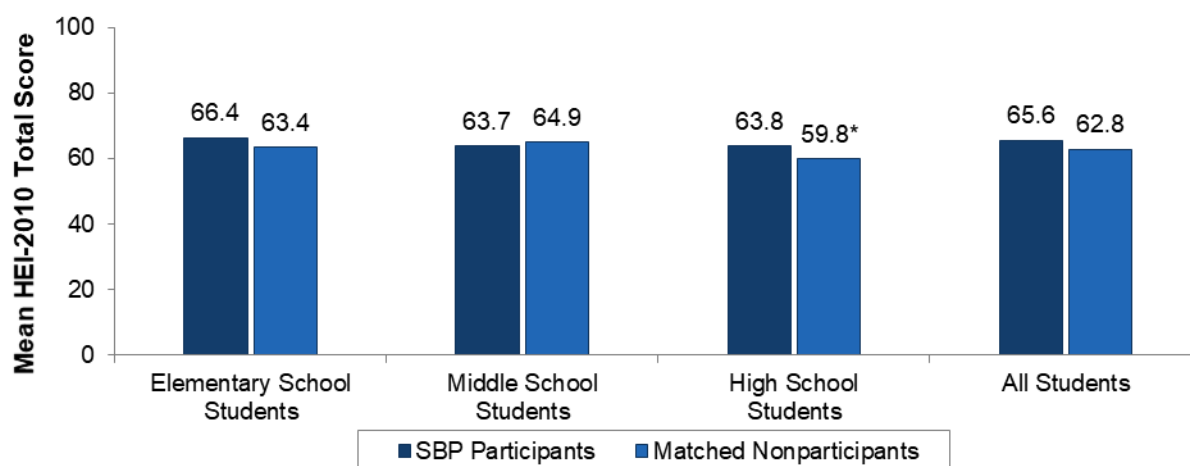
Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample excludes students who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Breakfast intakes for both SBP participants and the matched comparison group of nonparticipants include all foods and beverages consumed at breakfast. For SBP participants, this may include, in addition to foods and beverages obtained as part of a reimbursable breakfast, foods and beverages obtained from non-reimbursable sources at school, from home, and/or from other sources outside of school. Healthy Eating Index-2010 scores are based on breakfast intakes. Higher scores for moderation components reflect lower intakes and, thus, higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

Figure 12.4. Mean Healthy Eating Index-2010 Scores for 24-Hour Intakes for SBP Participants and Matched Comparison Group of Nonparticipants: Total Scores



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Healthy Eating Index-2010 scores are based on daily intakes. Higher total scores reflect higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

2. HEI-2010 Component Scores

Adequacy Components

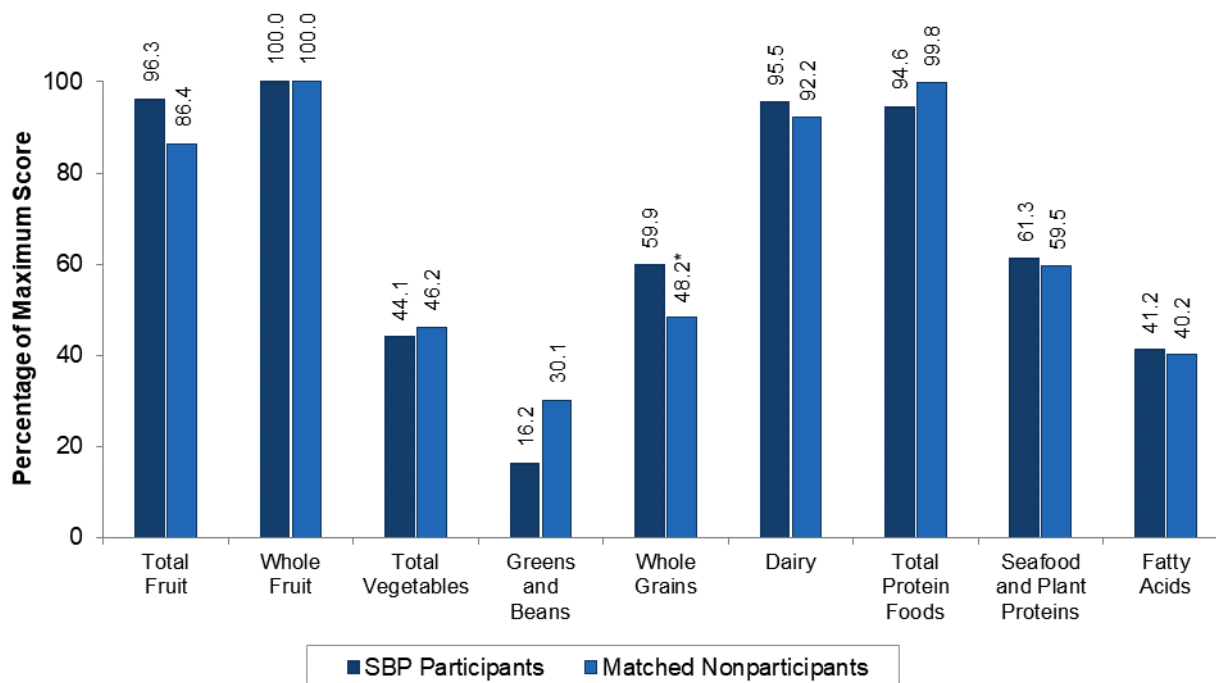
Overall, the positive and significant difference in the scores for whole grains observed at breakfast between SBP participants and matched nonparticipants persisted over 24 hours (Figure 12.2), but the magnitude of the difference was smaller (Figure 12.5). There was a 12 percentage point difference in scores for whole grains over 24 hours, compared with a 30 percentage point difference at breakfast (60 percent versus 48 percent for 24-intakes of SBP participants and matched nonparticipants, respectively, compared to 98 percent versus 68 percent for breakfast intakes).

Overall and for elementary school students, the positive and significant difference in mean scores for whole grains observed among SBP participants and matched nonparticipants at breakfast persisted over 24 hours.

This pattern was also observed for elementary school students (Table M.6), but not for middle or high school students (Tables M.7 and M.8). A comparison of mean scores for breakfasts and 24-hour intakes among middle and high school students suggest that, relative to breakfasts, the concentrations of whole grains in other meals and snacks were lower for SBP participants and higher for matched nonparticipants, resulting in comparable concentrations of

whole grains in 24-hour intakes. For high school students, SBP participants' had a significantly higher score for total fruit over 24 hours than matched nonparticipants' diets (86 percent versus 68 percent; Table M.8), but this difference was not observed at breakfast (Table M.4).

Figure 12.5. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for 24-Hour Intakes for SBP Participants and Matched Comparison Group of Nonparticipants: Adequacy Components, All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Healthy Eating Index-2010 scores are based on daily intakes. Higher scores for adequacy components reflect higher intakes and, thus, higher diet quality. Legumes were first counted as protein foods until the standard was met, and then remaining legumes were counted as vegetables.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

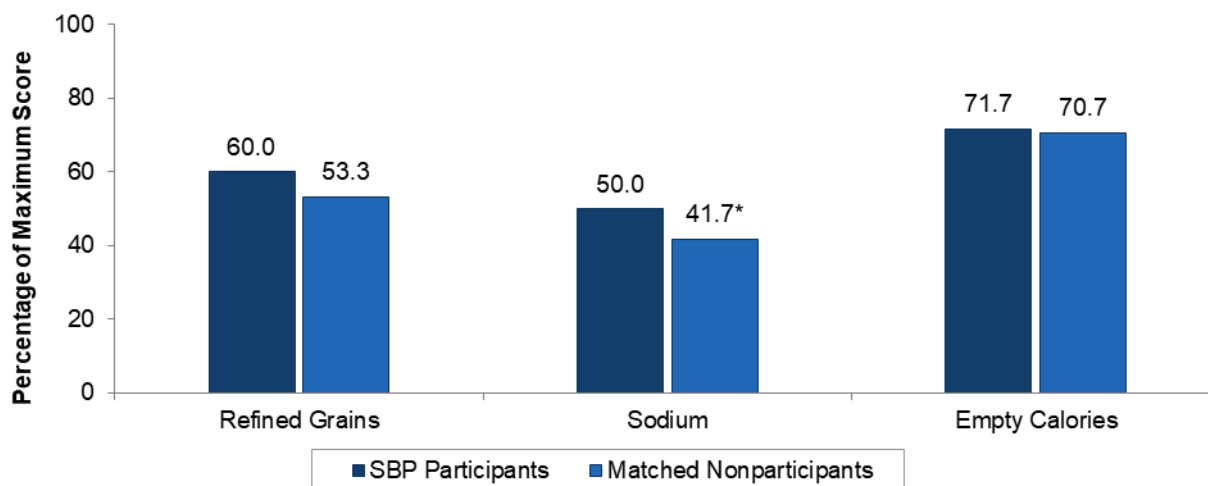
SBP = School Breakfast Program.

Moderation Components

The positive and significant differences between SBP participants and matched nonparticipants observed at breakfast for refined grains and empty calories (Figure 12.3) did not persist over 24 hours (Figure 12.6). However, SBP participants had a significantly higher score than matched nonparticipants for sodium (50 percent versus 42 percent) (Figure 12.6), but this difference was not observed at breakfast (Table M.5).

Overall, neither SBP participants nor matched nonparticipants came close to achieving the maximum possible scores for any of the moderation components (scores ranged from 42 to 72 percent of the possible maximum score) (Figure 12.6).

Figure 12.6. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, for 24-Hour Intakes for SBP Participants and Matched Comparison Group of Nonparticipants: Moderation Components, All Students



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 20142015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Healthy Eating Index-2010 scores are based on daily intakes. Higher scores for moderation components reflect lower intakes and, thus, higher diet quality.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

Findings for the HEI-2010 moderation components varied somewhat by school type:

- Among elementary school students, the positive and significant difference observed at breakfast between SBP participants and matched nonparticipants for refined grains did not persist over 24 hours (Table M.6). However, SBP participants in elementary schools had a significantly higher score than matched nonparticipants for sodium (54 percent versus 44 percent) (Table M.6), but this difference was not observed at breakfast (Table M.2).
- Similar to breakfast intakes, there were no significant differences observed among middle school students over 24 hours (Table M.7).

Among high school students, the positive and significant difference observed at breakfast for empty calories did not persist (Table M.8). A comparison of mean scores for breakfasts and 24-hour intakes of high school students suggests that, relative to breakfasts, the concentrations of empty calories in other meals and snacks were lower for matched participants, resulting in comparable concentrations of empty calorie in 24-hour intakes.

13. CONSUMPTION OF COMPETITIVE FOODS

Foods and beverages that are sold to students during the school day outside of Federally reimbursable school meals are considered competitive foods. Competitive foods may be available for a la carte purchase in school cafeterias (in separate serving lines or in lines that also serve reimbursable meals) or sold in vending machines, school stores, snack bars, or fundraisers. Prior research has shown that competitive foods, which often include low-nutrient, energy-dense (LNED) foods such as chips, candy, desserts, and sports drinks, can play a major role in the diets of school children (Larson and Story 2010; Fox et al. 2009a).

In response to concerns about the potential negative impact of competitive foods on the quality of students' diets, the HHS required USDA to establish, for the first time, nutrition standards for all foods sold in schools. The proposed Smart Snacks in School rule was published in the Federal Register in 2013 (USDA, FNS 2013). The goal of the standards is to ensure that foods sold in competition with school meals are also consistent with the *Dietary Guidelines for Americans*. The interim final rule took effect in SY 2014–2015 and the final rule was published in July 2016.

The design of the SNMCS was finalized before the Smart Snacks in School standards were developed. For this reason, the analyses presented in this chapter do not consider these standards and instead focus on competitive foods as defined in a secondary analysis of SNDA-III data (Fox et al. 2009a; see Section A).¹²⁶ The chapter describes the prevalence of competitive food consumption among NSLP and SBP participants—students who consumed an NSLP lunch or SBP breakfast on the day reflected in the 24-hour recall—and matched nonparticipants; the contribution of competitive foods to students' intakes of calories, nutrients, and USDA Food Pattern food groups; the overall diet quality of students who did and did not consume competitive foods; and the types of students most likely to consume competitive foods. All data are based on the single 24-hour dietary recall collected from all students. The methods used to collect these data are described in Chapter 6.

Figures and tables in the chapter present key results; supplementary tables are provided in Appendix N and noted within the chapter. The statistical significance of differences between school meal participants and the matched comparison groups of nonparticipants was tested.¹²⁷ Rules for flagging potentially unreliable point estimates, described in Chapter 1, have also been applied. The differences discussed in the text were significant at least at the 0.05 level, unless otherwise noted. These test results provide an important gauge of underlying population differences, but they are not a definitive measure of true differences, and should not be interpreted as causal effects of the NSLP or SBP. Although propensity score matching techniques were used to control for measured differences between school meal participants and matched nonparticipants (see Appendix G), important differences may remain in characteristics

¹²⁶ Chapter 3 in Volume 1 of the SNMCS final report (Forrestal et al. 2019) describes SFAs' experiences in implementing the Smart Snacks in School standards and describes the types of competitive foods available in schools.

¹²⁷ Statistical significance was determined on the basis of two-tailed tests that accounted for the complex sample design of the SNMCS.

that were not measured. In addition, among subgroups with small sample sizes, patterns of differences across groups, or a difference for a particular outcome that is substantive in magnitude, may suggest differences between participants and matched nonparticipants even if they are not statistically significant at the 0.05 level. At the same time, a small number of significant differences would be expected by chance when testing multiple comparisons.

A. Identifying Competitive Foods

Prior to conducting 24-hour recalls with students, field interviewers identified all of the potential sources on a school campus where students could obtain foods and beverages, and assigned a specific code to each source so they could be identified in the 24-hour recall data. Based on information provided by SNMs, field interviewers also assigned codes that differentiated sources that sold only competitive foods, sources that sold only reimbursable meals, and mixed sources that sold both reimbursable meals and competitive foods. For each mixed source, field interviewers indicated whether most, about half, or a small amount of the foods sold were part of reimbursable meals. Vending machines were differentiated by location: in the cafeteria, within 20 feet of the cafeteria, or some other location. School stores and snack bars were identified separately, as were food carts and other points of sale where all foods and beverages were sold on a strictly a la carte basis.

The study team used a multi-step process to identify competitive foods in the 24-hour recall data. First, foods obtained from non-school sources (for example, home and restaurants) as well as foods obtained from school sources that offered only reimbursable meals were excluded from consideration (that is, they were coded as non-competitive foods). Second, foods obtained from school sources that sold only competitive foods (for example, vending machines and school stores), as well as foods that students reported obtaining from class parties, school fundraisers, or from teachers were coded as competitive foods. Third, building on the approach used by Fox et al. (2009a) in analyzing data from SNDA-III, the study team identified foods obtained from mixed sources—sources that offered both reimbursable meals and foods for a la carte purchase—that were likely to be competitive foods. The study team identified foods obtained from these sources that were not included in the detailed Menu Survey data provided by SNMs (see Chapter 1), and used a series of decision rules, summarized below, to identify foods in this “not on menu” group that were likely to have been competitive foods¹²⁸:

- Foods that were obtained from mixed sources where most of the food was sold as part of a reimbursable meal were removed from consideration (they were coded as non-competitive foods).
- Foods that did not appear on any of the lunch and breakfast menus provided by the 1,207 schools in the study were coded as competitive foods. This included items like bottled water, fruit drinks (not 100% juice), cookies, ice cream, and candy.
- Foods that are not required components of school meals but are sometimes offered (desserts, snack chips/popcorn, fruit drinks) were coded as competitive foods if comparable items were not included in any of the menus for reimbursable meals for that specific school.

¹²⁸ Condiments and salad dressings were not included in this exercise unless they were served with a specific menu item.

- For the residual foods that did not appear on a specific school's menu but did appear on at least one lunch or breakfast menu from other schools, a series of rules (Figure 13.1) was used to identify likely competitive foods.

Figure 13.1. Final Decision Rules Used to Identify Competitive Foods Obtained from Sources that Offered Both Reimbursable Meals and Competitive Foods

A food or beverage obtained from a mixed source, was not on the school's menu, and was not previously classified as a competitive food or excluded from consideration was coded as a competitive food if any of the following conditions applied:

- All of the other items the student obtained at school (from any location) were competitive
- All of the other items the student obtained from the same location were competitive
- The item *was not* consumed at breakfast or lunch and was either obtained from a location other than the location where lunch/breakfast was obtained or was the only food the student obtained at school
- The item *was* consumed at lunch or breakfast but the item was:
 - Obtained from a different location than the main components of the meal
 - Not part of one of the meal component groups used in menu planning and was the only item not on the menu
 - A second lunch entrée
 - Part of a lunch that did not include an entrée
- The item was French fries or a similar fried potato product and was the only food reported for lunch or breakfast that was not on the menu (other than water, condiments, or other competitive foods) or was not consumed at lunch or breakfast

Note: The SNMCS design was finalized before the Smart Snacks in School standards were developed. So the SNMCS did not include an assessment of whether available competitive foods met these standards. In addition, some of the definitions of competitive foods used in this analysis differ from Smart Snacks in School definitions. For example, under the Smart Snacks in School standards, a second lunch entrée would not be considered a competitive food if it was purchased on the day of service or the day after service.

For nonparticipants, any foods that were not coded as competitive after the above rules were implemented were coded as competitive foods.¹²⁹ While this definition of competitive foods was designed to be as comprehensive as possible, it may underestimate the prevalence of competitive foods among NSLP and SBP participants because there is no way to definitively identify foods that were offered in reimbursable meals but purchased by participants on an a la carte basis.

¹²⁹ For a small number of nonparticipants whose target-day participation status differed under an alternative definition of participation explored in a supplementary analysis (see Appendix A, Section A.2), residual foods remaining at this point in the coding process were not coded as competitive foods.

B. Consumption of Competitive Foods among NSLP Participants and Matched Nonparticipants

This section describes the prevalence of competitive food consumption among NSLP participants and matched nonparticipants, the types of competitive foods consumed by each group of students, and the contribution of competitive foods to students' intakes of calories, nutrients, and USDA Food Pattern food groups. In addition, the final part of this section compares the overall diet quality of students who did and did not consume competitive foods using the HEI-2010. All competitive foods were obtained at school sometime during the school day. Most competitive foods were consumed at the time they were acquired, but some were consumed at other locations times of the day and in other locations. Because of small sample sizes of competitive food consumers in some subgroups of students, findings in all but the first section are not broken out by school type.

1. Proportion of Students Who Consumed Competitive Foods

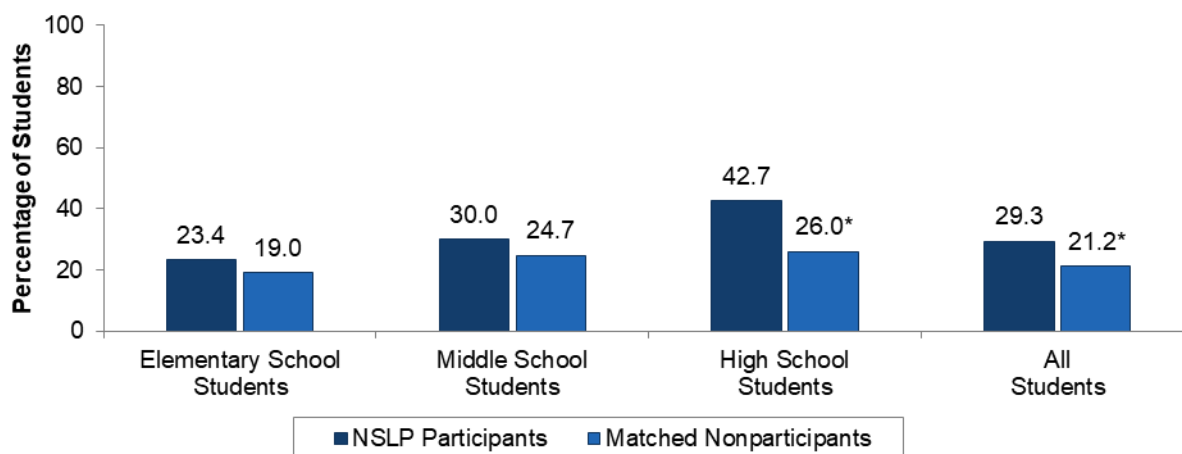
Overall, NSLP participants were significantly more likely than matched nonparticipants to consume one or more competitive foods (29 percent versus 21 percent; Figure 13.2).¹³⁰ This pattern was observed for all three school types, but the difference was largely concentrated among high school students (43 percent versus 26 percent). Less than one-quarter of elementary school students consumed competitive foods (23 and 19 percent of NSLP participants and matched nonparticipants, respectively), and less than one-third of middle school students did so (30 and 25 percent of NSLP participants and matched nonparticipants, respectively).

Overall, NSLP participants were significantly more likely than matched nonparticipants to consume one or more competitive foods (29 percent versus 21 percent). This pattern was observed for all three school types, but the difference was largely concentrated among high school students (43 percent versus 26 percent).

For all subgroups of students, the leading source of competitive foods was cafeteria lines that sold both reimbursable meals and a la carte foods and beverages (Table N.1). Overall, only 2 to 3 percent of students reported a competitive food that was obtained from a vending machine. The prevalence of foods and beverages from vending machines was highest among high school students (9 percent of NSLP participants and 5 percent of matched nonparticipants). Overall, only 1 to 3 percent of students reported a competitive food that was obtained from a school store, snack bar, food cart, or some other venue that did not also offer reimbursable school meals, and only 3 to 4 percent of students reported a competitive food that was obtained from a fundraiser, class party, or as a reward. Among students who consumed competitive foods, the vast majority (81 percent of NSLP participants and 87 percent of matched nonparticipants) consumed competitive foods at lunch.

¹³⁰ Table N.13 presents additional data for subgroups of students defined by household poverty level.

Figure 13.2. Proportion of NSLP Participants and Matched Comparison Group of Nonparticipants Who Consumed One or More Competitive Foods



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program.

Note: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

2. Types of Competitive Foods Consumed

The study team grouped competitive foods into the seven major food groups used in analyzing the types of foods students consumed at lunch and breakfast—milk, vegetables, fruits and 100% fruit juices, combination entrées, grains/breads, meats and meat alternates, and desserts, snacks, and beverages other than milk and 100% juice. The study team then subdivided foods in each major food group into minor groups based on characteristics that affect nutrient content, including ingredients and preparation methods.¹³¹ Table 13.1 summarizes the types of competitive foods that were most commonly consumed by NSLP participants and matched nonparticipants. The table is limited to foods/food groups that were consumed by at least five percent of NSLP participants or matched nonparticipants who consumed competitive foods. Findings should be interpreted with caution because, due to small sample sizes, point estimates could not be reliably estimated for many minor food groups.

More than one in five matched nonparticipants who consumed a competitive food consumed milk (23 percent), and a similar proportion (21 percent) consumed fruit or 100% fruit juice (most often fresh fruit). Fewer matched nonparticipants who consumed competitive foods reported consuming combination entrées or meats/meat alternates (6 and 7 percent, respectively). NSLP participants rarely reported obtaining these foods outside of reimbursable meals, that is, as a competitive food.

¹³¹ Table H.1 provides examples of the specific types of foods included in each minor food group.

Table 13.1. Competitive Foods Most Commonly Consumed by NSLP Participants and Matched Comparison Group of Nonparticipants

	Percentage of Students	
	NSLP Participants	Matched Nonparticipants
Milk	<3	22.8*
Fat-free	<3	10.7*
Flavored	<3	6.6 [^]
Low-fat (1%)	<3	8.3 [^]
Unflavored	<3	8.3 [^]
Fruits and 100% Fruit Juices	5.4 [^]	20.6*
Fresh fruit	<3	14.4*
Apples	<3	9.0 [^]
Combination Entrées	<3	5.7 [^]
Grains/Breads	12.0	12.1
Meats/Meat Alternates	3.9 [^]	6.6 [^]
Desserts, Snacks, and Other Beverages	86.3	58.3*
Beverages other than milk and 100% fruit juice	33.9	30.6
Bottled water	22.6	15.7
Sports and energy drinks	3.1 [^]	5.3 [^]
Juice drinks (not 100% juice)	<3	6.9 [^]
Snack chips and popcorn	19.1	7.4 [^]
Candy	10.3	10.3
Dairy-based desserts ^a	10.7	4.0 [^]
Cookies, cakes, and brownies	16.9	11.8
Other desserts ^b	9.1	<3*
Number of Students	361	221

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes students who consumed at least one competitive food, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Table is limited to food groups consumed by at least five percent of participants or nonparticipants.

^aIncludes pudding, ice cream, ice cream cones and bars, and frozen yogurt.

^bIncludes ice pops, snow cones, gelatin, and fruit leather/snacks.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

[^] Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1. When these rules are applied, percentages close to 0 or 100 are often flagged. In this table, flagged percentages between 0 and 3 percent are displayed as <3.

The majority of NSLP participants who consumed competitive foods (86 percent) consumed foods that were categorized as desserts, snacks, and other beverages. Such foods were also the most commonly consumed competitive foods among matched nonparticipants, but the overall prevalence was significantly higher for NSLP participants than matched nonparticipants (86 percent versus 58 percent). Within this major food group, the most common competitive foods were beverages other than milk and 100% fruit juice. About one-third of competitive food consumers in both groups reported an item in this category. Among NSLP participants who consumed competitive foods, the most commonly reported item in this group was bottled water (23 percent). Among matched nonparticipants who consumed competitive foods, 16 percent consumed bottled water, and approximately 5 to 7 percent consumed sports/energy drinks or juice drinks (not 100% juice). Other items included in the desserts, snacks, and other beverages category included snack chips and popcorn; candy; dairy-based desserts; cookies, cakes, and brownies; and other desserts. Among competitive food consumers, NSLP participants were more likely than matched nonparticipants to consume most of these foods.

For both NSLP participants and matched nonparticipants, desserts, snacks, and other beverages were the most commonly consumed competitive foods. However, the overall prevalence of these foods was significantly higher for NSLP participants than matched nonparticipants (86 percent versus 58 percent).

3. Calorie, Nutrient, and Food Group Content of Competitive Foods

The SNMCS did not collect information from schools about the nutrient profiles of the competitive foods available to students (which could have been used to assess about how well competitive foods conformed with the Smart Snacks in School standards) because the standards did not exist at the time the study design was finalized. For this reason, estimates of the calorie, nutrient, and food group content of competitive foods consumed by students are based on the closest item in the nutrient database that was used to code and analyze the 24-hour recalls. These estimates likely represent upper-bounds of the calorie, total fat, saturated fat, and sodium content of competitive foods consumed by students because the items available in schools may have been lower in calories and these nutrients than the items available in the database. Similarly, these estimates likely represent lower-bounds of whole grains and, potentially, other USDA Food Pattern food groups because the items available in schools may have had higher concentrations of these food groups than the items available in the database.

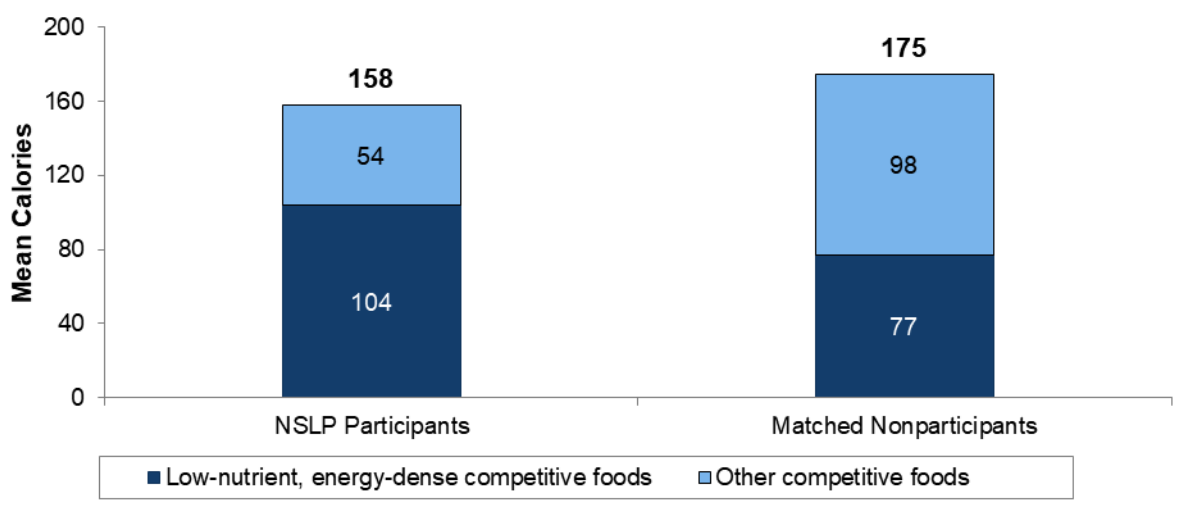
On average, both NSLP participants and matched nonparticipants who consumed competitive foods obtained more than 150 calories from these foods (Figure 13.3). NSLP participants consumed slightly less calories from competitive foods than matched nonparticipants, but the difference was not statistically significant (158 calories versus 175 calories). In keeping with the preceding findings on the types of competitive foods consumed by NSLP participants and matched nonparticipants, a greater share of the competitive food calories consumed by NSLP participants came from LNEF foods—66 percent (104 of 158 calories) versus 44 percent (77 of 175

Among students who consumed competitive foods, both NSLP participants and matched nonparticipants obtained more than 150 calories from these foods.

calories). Similarly, the competitive foods consumed by NSLP participants were lower in vitamin D, calcium, and potassium, on average, than the competitive foods consumed by matched nonparticipants, and they provided fewer cup equivalents of dairy (0.1 cup equivalents versus 0.3 cup equivalents; Tables N.2 and N.3).¹³²

It is difficult to compare these findings to previous studies because of differences in how NSLP participants, matched nonparticipants, and competitive foods were defined. However, the most comparable prior analysis found that, in SY 2004–2005, students overall consumed an average of 177 calories from LNE competitive foods (Fox et al. 2009a). The substantially lower calorie intake from LNE competitive foods observed in this analysis (77 to 104) may suggest that the Smart Snacks in School standards are having the desired effect of lowering students' intakes of empty calories at school.

Figure 13.3. Mean Calories Obtained from Competitive Foods: NSLP Participants and Matched Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes students who consumed at least one competitive food, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Low-nutrient/energy-dense foods include all candy, cakes/cookies/brownies and other baked desserts, pies, muffins, donuts, sweet rolls, toaster pastries, frozen desserts, snack chips (unless low-fat), French fries, and caloric beverages other than milk or 100% fruit juice.

None of the differences between participants and the matched comparison group of nonparticipants are significantly different from zero at the 0.05 level.

NSLP = National School Lunch Program.

¹³² Tables N.4 and N.5 provide information on the proportion of lunch and 24-hour intakes of nutrients and USDA Food Pattern food groups, respectively, contributed by competitive foods consumed by NSLP participants and matched nonparticipants.

4. Diet Quality of Students Who Did and Did Not Consume Competitive Foods

To gain insight about the potential influence of competitive foods on the overall quality of students' diets, the study team compared HEI-2010 scores, based on 24-hour intakes, for students who did and did not consume competitive foods. These comparisons were done separately for NSLP participants and matched nonparticipants.¹³³ The HEI-2010 is a diet quality index that measures conformance to key recommendations of the 2010 *Dietary Guidelines for Americans* (see Chapter 6). It consists of 12 component scores and a total score. Nine of the 12 components are adequacy components that focus on meeting food group and nutrient needs without exceeding calorie requirements. The remaining three components are referred to as moderation components and measure dietary components that individuals are encouraged to limit.

Among NSLP participants, HEI-2010 scores were comparable for students who did and did not consume competitive foods. Both groups of NSLP participants had perfect or near-perfect mean scores (scores equivalent to 89 to 100 percent of the possible maximum) for total fruit, whole fruit, dairy, and total protein foods (Figure 13.4).¹³⁴ In addition, despite the fact that the vast majority of NSLP participants who consumed competitive foods consumed LNEF foods, mean scores for empty calories were comparable for NSLP participants who did and did not consume competitive foods (71 and 73 percent of the possible maximum, respectively; Figure 13.5). This suggests that NSLP participants who did not consume competitive foods consumed LNEF foods or other foods that contribute empty calories from other foods.¹³⁵ Overall, both groups of NSLP participants had a total HEI-2010 score of 65 (out of a possible 100; Figure 13.6).

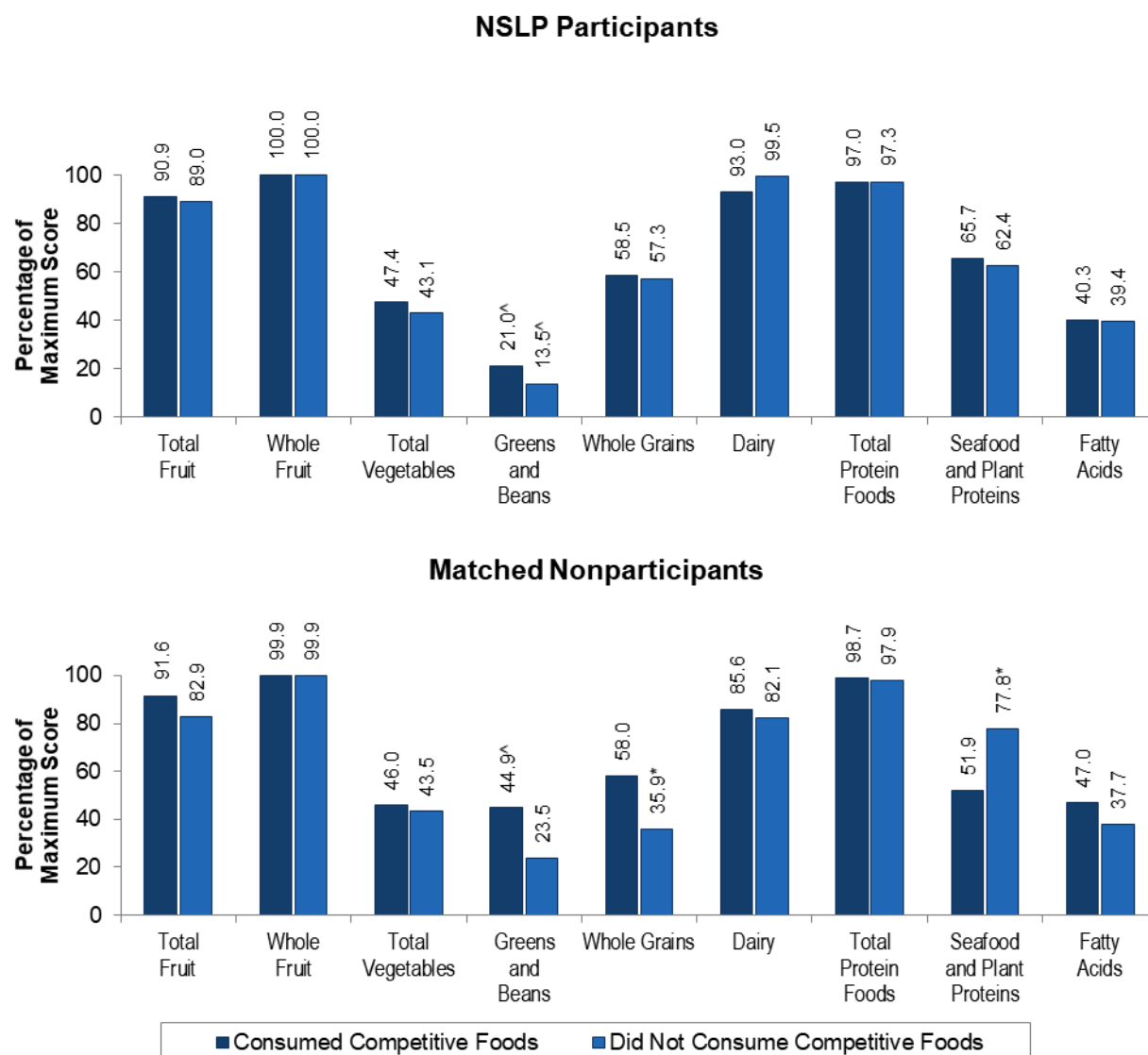
Among matched nonparticipants, there were some significant differences in HEI-2010 scores for students who did and did not consume competitive foods. Specifically, relative to matched nonparticipants who did not consume competitive foods, matched nonparticipants who did consume competitive foods had a higher mean score for whole grains (58 percent of the maximum possible score versus 36 percent), and a lower mean score for seafood and plant proteins (52 percent versus 78 percent; Figure 13.4). In addition, competitive food consumers had a significantly higher mean score for the HEI-2010 overall (65 out of a possible 100 versus 59; Figure 13.6). Indeed, nonparticipants who consumed competitive foods had higher mean scores than nonparticipants who did not consume competitive foods for all of the HEI components except whole fruit, seafood and plant proteins, and sodium (Figures 13.4 and 13.5), although not all of the differences were statistically significant. It is difficult to attribute these differences to consumption of competitive foods, given the relatively modest contributions these foods made to students' total 24-hour intakes (Tables N.4 and N.5). Moreover, nonparticipants who did not consume a competitive food are a select subgroup of students because, unlike the other three subgroups of students examined in this analysis, they didn't obtain *any* foods from school (that is, they did not consume a reimbursable lunch and they did not consume competitive foods). The analysis summarized in section B.5 provides insights about how these students differ from students who do consume competitive foods.

¹³³ Chapter 9 describes HEI-2010 scores for NSLP participants and matched nonparticipants overall.

¹³⁴ Table N.6 provides data on mean scores for the HEI-2010.

¹³⁵ LNEF foods are not the only foods that contribute empty calories. For example, flavored milk includes empty calories from added sugars and whole milk includes empty calories from solid fats.

Figure 13.4. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, among NSLP Participants and Matched Comparison Group of Nonparticipants, by Consumption of Competitive Foods: Adequacy Components



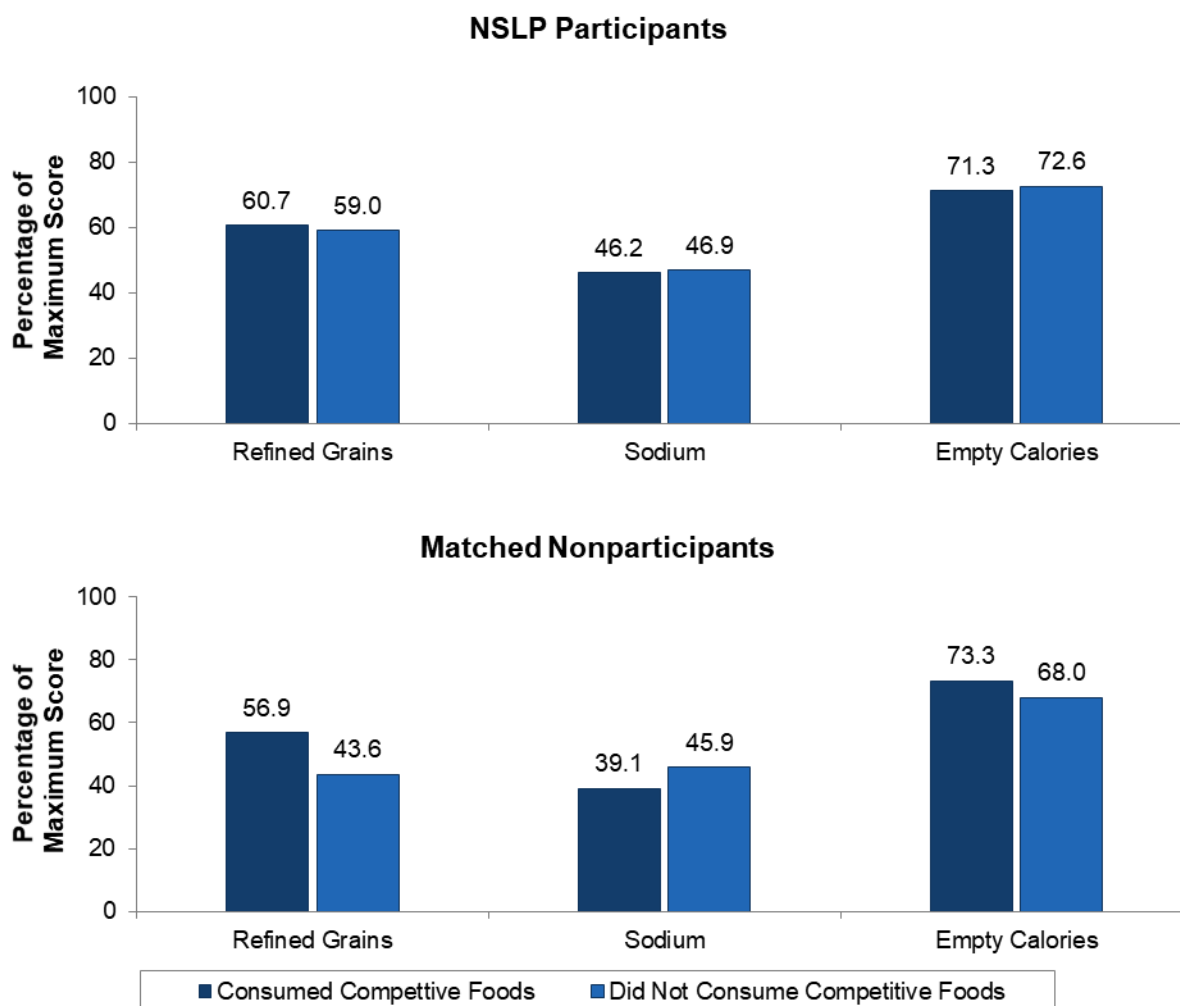
Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Healthy Eating Index-2010 scores are based on daily intakes. Higher scores for adequacy components reflect higher intakes, and thus, higher diet quality.

*Difference between students who did and did not consume competitive foods is significantly different from zero at the 0.05 level.

[^] Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

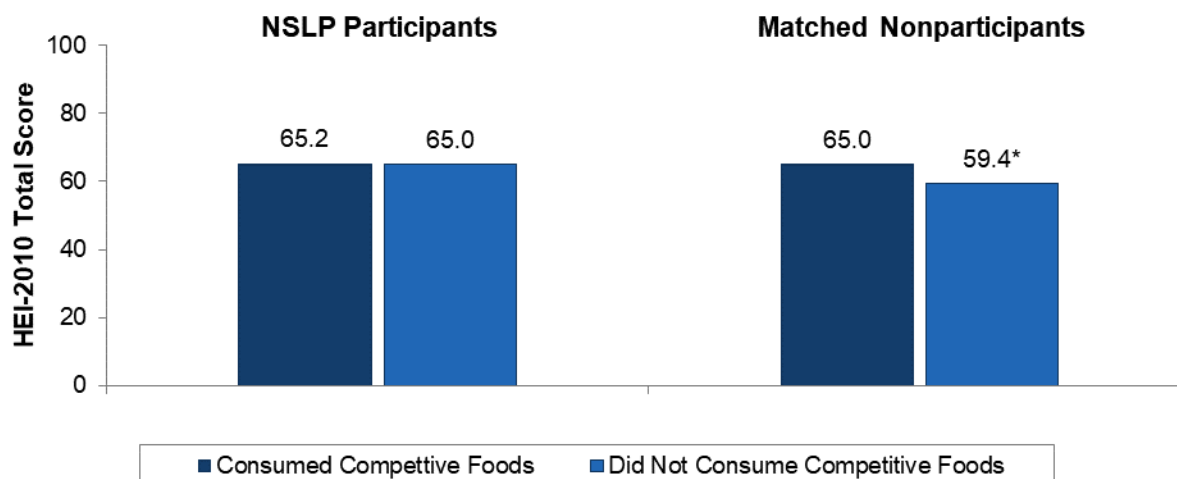
Figure 13.5. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, among NSLP Participants and Matched Comparison Group of Nonparticipants, by Consumption of Competitive Foods: Moderation Components



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Healthy Eating Index-2010 scores are based on daily intakes. Higher scores for moderation components reflect lower intakes, and thus, higher diet quality. None of the differences between students who did and did not consume competitive foods are significantly different from zero at the 0.05 level.

Figure 13.6. Mean Healthy Eating Index-2010 Scores, as a Percentage of Maximum Scores, among NSLP Participants and Matched Comparison Group of Nonparticipants, by Consumption of Competitive Foods: Total Scores



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes all students, including those who did not consume a lunch.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between NSLP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Healthy Eating Index-2010 scores are based on daily intakes. Higher total scores reflect higher diet quality.

*Differences between students who did and did not consume competitive foods is significantly different from zero at the 0.05 level.

C. Consumption of Competitive Foods among SBP Participants and Matched Nonparticipants

This section describes the prevalence of competitive food consumption among SBP participants and matched nonparticipants, the types of competitive foods consumed by each group of students, and the contribution of competitive foods to students' intakes of calories, nutrients, and USDA Food Pattern food groups. In addition, the final part of this section compares the overall diet quality of students who did and did not consume competitive foods using the HEI-2010. All competitive foods were obtained at school sometime during the school day. Most competitive foods were consumed at the time they were acquired, but some were consumed at other locations times of the day and in other locations. Because of small sample sizes of competitive food consumers in some subgroups of students, findings in all but the first section are not broken out by school type.

1. Proportion of Students Who Consumed Competitive Foods

There were no significant differences between SBP participants and matched nonparticipants in the proportion of students who consumed competitive foods. Overall, slightly more than one-quarter of students in each group consumed one or more competitive foods (27 percent of SBP participants and 26 percent of matched nonparticipants, respectively; Table N.7).¹³⁶ For both SBP participants and matched nonparticipants, consumption of competitive foods was highest in high schools (38 percent and 34 percent, respectively) and lowest in elementary schools (23 percent and 22 percent, respectively). For all subgroups of students, the leading source of competitive foods was cafeteria lines that sold both reimbursable meals and a la carte foods and beverages. Among SBP participants and matched nonparticipants who consumed competitive foods, the majority (74 percent of SBP participants and 83 percent of matched nonparticipants) consumed competitive foods at lunch. Fewer than one in five SBP participants and one in ten matched nonparticipants consumed a competitive food at breakfast.

There were no significant differences between SBP participants and matched nonparticipants in the proportion of students who consumed competitive foods.

2. Types of Competitive Foods Consumed

Table 13.2 summarizes the types of competitive foods that were most commonly consumed by SBP participants and matched nonparticipants. The table is limited to foods/food groups that were consumed by at least five percent of SBP participants or matched nonparticipants who consumed competitive foods. Findings should be interpreted with caution because, due to small sample sizes, point estimates could not be reliably estimated for many minor food groups.

Among competitive food consumers, SBP participants were less likely to consume milk as a competitive food than matched nonparticipants (2 percent versus 6 percent; Table 13.2). The vast majority of both SBP participants (83 percent) and matched nonparticipants (79 percent) who consumed competitive foods consumed foods that were categorized as desserts, snacks, and other beverages. Similar to the pattern observed for consumption of competitive foods among NSLP participants and nonparticipants (Table 13.1), the most common competitive foods in this category—consumed by about one-third of competitive food consumers in both groups of students—were beverages other than milk and 100% fruit juice. Among SBP participants who consumed competitive foods, 23 percent consumed bottled water. Among matched nonparticipants who consumed competitive foods, 16 percent consumed bottled water and 7 percent consumed sports/energy drinks. Other items included in the desserts, snacks, and other beverages category included candy; snack chips and popcorn; cookies, cakes, and brownies; dairy-based desserts; and other desserts.

¹³⁶ Table N.14 presents additional data for subgroups of students defined by household poverty level.

Table 13.2. Competitive Foods Most Commonly Consumed by SBP Participants and Matched Comparison Group of Nonparticipants

	Percentage of Students	
	SBP Participants	Matched Nonparticipants
Milk	1.8	5.6*
Fruits and 100% Fruit Juices	5.7 ^	7.4
Vegetables	<3	5.3
Grains/Breads	10.4 ^	12.9
Granola bars and breakfast bars	5.7 ^	<3
Meats/Meat Alternates	7.3 ^	5.4
Desserts, Snacks, and Other Beverages	82.7	79.0
Beverages other than milk and 100% juice	33.1	31.5
Bottled water	22.9	15.5
Sports and energy drinks	3.7 ^	7.0
Candy	15.9	8.8
Snack chips and popcorn	17.0	20.0
Cookies, cakes, and brownies	16.1	14.0
Dairy-based desserts ^a	8.1 ^	7.5
Other desserts ^b	5.8 ^	7.4
Number of Students	149	433

Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes students who consumed at least one competitive food, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used.

Table is limited to food groups consumed by at least five percent of participants or nonparticipants.

^aIncludes pudding, ice cream, ice cream cones and bars, and frozen yogurt.

^bIncludes ice pops, snow cones, Jello, and fruit leather/snacks.

Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the * 0.05 level.

SBP = School Breakfast Program.

^ Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1. When these rules are applied, percentages close to 0 or 100 are often flagged. In this table, flagged percentages between 0 and 3 percent are displayed as <3.

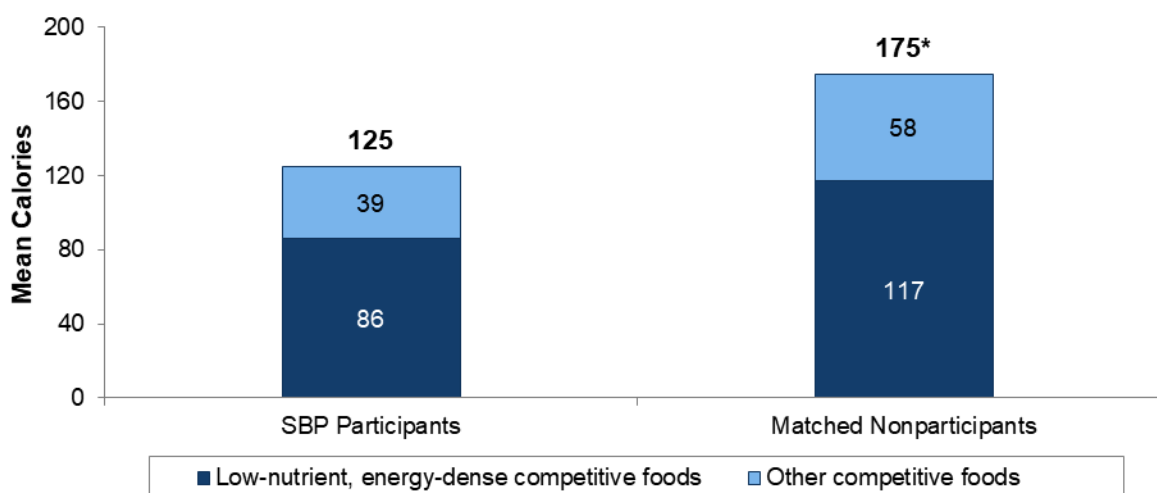
3. Calorie, Nutrient, and Food Group Content of Competitive Foods

Among competitive food consumers, SBP participants obtained significantly fewer calories from competitive foods than matched nonparticipants (125 calories versus 175 calories; Figure 13.7). Although SBP participants and matched nonparticipants who consumed competitive foods obtained comparable shares of their competitive food calories from LNEED foods—69 percent (86 of 125 calories) for SBP participants and 67 percent (117 of 175 calories) for matched nonparticipants—the competitive foods consumed by SBP participants were lower in total fat, folate, iron, potassium, and sodium, on

Among competitive food consumers, SBP participants obtained significantly fewer calories from competitive foods than matched nonparticipants (125 calories versus 175 calories).

average, than the competitive foods consumed by matched nonparticipants, and they provided fewer ounce equivalents of total grains (0.4 oz equivalents versus 0.5 oz equivalents; Tables N.8 and N.9).¹³⁷ As noted in the preceding section on the calorie, nutrient, and food group content of competitive foods consumed by NSLP participants and matched nonparticipants, estimates of the calorie, total fat, saturated fat, and sodium content of competitive foods likely represent upper-bound estimates, and estimates of the whole grain content, and potentially the content of other USDA food pattern food groups, likely represent lower-bound estimates.

Figure 13.7. Mean Calories Obtained from Competitive Foods: SBP Participants and Matched Nonparticipants



Source: School Nutrition and Meal Cost Study, 24-Hour Dietary Recalls: Day 1, school year 2014-2015. Tabulations are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Sample includes students who consumed at least one competitive food, including those who did not consume a breakfast.

Notes: The comparison group of matched nonparticipants was constructed using inverse probability weighting to control for differences between SBP participants and nonparticipants in personal, family, and school characteristics. See Appendix G for more detail on the propensity score model and the covariates used. Low-nutrient/energy-dense foods include all candy, cakes/cookies/brownies and other baked desserts, pies, muffins, donuts, sweet rolls, toaster pastries, frozen desserts, snack chips (unless low-fat), French fries, and caloric beverages other than milk or 100% fruit juice.

*Difference between participants and the matched comparison group of nonparticipants is significantly different from zero at the 0.05 level.

SBP = School Breakfast Program.

¹³⁷ Tables N.10 and N.11 provide information on the proportion of lunch and total 24-hour intakes of nutrients and USDA Food Pattern food groups, respectively, contributed by competitive foods consumed by SBP participants and matched nonparticipants.

4. Diet Quality of Students Who Did and Did Not Consume Competitive Foods

To gain insight about the potential influence of competitive foods on the overall quality of students' diets, the study team compared HEI-2010 scores for students who did and did not consume competitive foods. These comparisons were done separately for SBP participants and matched nonparticipants.¹³⁸

Among SBP participants who did and did not consume competitive foods, mean total scores for the HEI-2010 were comparable (65 to 66 out of a possible 100; Table N.12). The same was generally true for the various component scores, but mean scores for dairy were an exception. On average, SBP participants who consumed competitive foods had lower mean scores for dairy than SBP participants who did not consume competitive foods (85 percent of the maximum possible score versus 98 percent). Among matched nonparticipants who did and did not consume competitive foods, competitive foods consumers had a higher mean total score for the HEI-2010 (65 versus 62, out of a possible 100), but the difference was not statistically significant (Table N.12). With one exception, mean scores for the various HEI-2010 components were also comparable for the two groups of matched nonparticipants. For the refined grains component, SBP matched nonparticipants who consumed competitive foods had a significantly higher mean score than matched nonparticipants who did not consume competitive foods (60 percent of the maximum possible score versus 51 percent). Given the relatively modest contribution of competitive foods to students' 24-hour intakes (Tables N.10 and N.11), it is not surprising that consumption of competitive foods had little impact on overall diet quality.

D. Types of Students Most Likely to Consume Competitive Foods

This section presents findings from a multivariate analysis that explored the types of students most likely to consume competitive foods. The analysis examined the relationships between student characteristics, including characteristics of the schools students attended, and consumption of any type of competitive food.

1. General Analytic Approach

The general analytical approach mirrored other multivariate analyses reported in Chapter 4 and described in Appendix C. The outcome was a binary variable that indicated whether a student consumed any type of competitive foods. The analysis sample included 2,139 students with a completed 24-hour dietary recall (day 1) in 289 schools in which the SNM had completed the Menu Survey.

Multivariate models explored associations between consumption of competitive foods and a range of student characteristics and school characteristics related to the availability of competitive foods:

¹³⁸ Chapter 12 describes HEI-2010 scores for SBP participants and matched nonparticipants overall.

Student Characteristics

- Race and ethnicity
- Gender
- Certification status for free or reduced-price meals
- NSLP and SBP participation status
- Household receipt of benefits from one or more public assistance programs¹³⁹
- Whether student has food allergies or special dietary needs
- Amount student eats, relative to others of the same age (parent-reported)
- Whether the student is a picky eater (parent-reported)
- Students' level of physical activity, relative to others of the same age (parent-reported)

School Characteristics Related to Competitive Foods

- Sells a la carte foods other than milk
- Sells foods or beverages in vending machines
- Sells foods or beverages in school store or snack bar
- Offers brand-name or chain restaurant foods in reimbursable meals

Multivariate analyses were implemented using logistic regression and weights that accounted for the study's complex sample design. Separate regression models were run for each school type as well as for all schools combined. In addition to the key characteristics of students and schools shown above, multivariate models included school and SFA demographic and institutional characteristics (school size, urbanicity, share of students approved for free and reduce-price meals, and FNS region) to control for differences in schools that might indirectly influence a student's decision to substitute school meals with competitive foods. Therefore, this analysis estimates how likely students are to consume competitive foods after controlling for differences in the characteristics of the schools they attend.

The multivariate estimates are nationally representative of all students in public, non-charter schools offering the NSLP. Because the probability of finding significant associations by chance increases with the number of associations tested, findings should be considered exploratory. Associations between consumption of competitive foods and student demographics, such as race, should be interpreted with caution. These associations may at least partially be driven by differences in school food environments of schools that happened to be correlated with different student demographics. In addition, it is important to understand that significant associations do not imply causality. Given the cross-sectional design of this study, it is not possible to conclusively attribute associations observed between key characteristics of schools and the

¹³⁹ Households were considered to have received public assistance if the parent reported receiving SNAP, TANF, WIC, or Medicaid benefits.

likelihood of consuming competitive foods to the influence of this characteristic on students' food choices.

2. Findings

Findings are presented in Table N.15 as regression-adjusted percentages of students consuming competitive foods.¹⁴⁰ Key findings are summarized below.

Student Characteristics

Overall, non-Hispanic black students were significantly more likely to consume competitive foods than the reference group of non-Hispanic, white students (33 percent versus 25 percent). This pattern was also observed among middle school and high school students. Among high school students, non-Hispanic black students were almost twice as likely as non-Hispanic white students to consume competitive foods (52 percent versus 29 percent; difference was statistically significant). Among middle school students, there was an 11-percentage point difference between these groups (37 percent versus 26 percent), but the difference was not statistically significant.

Overall, females were significantly more likely than males to consume competitive foods (30 percent versus 23 percent). This pattern was observed for all three school types, although the difference for middle schools was negligible, and the difference was statistically significant only for high schools (40 percent versus 27 percent).

Findings related to NSLP participation status were generally consistent with findings from the descriptive analyses presented in Sections B. Overall, NSLP participants were significantly more likely than nonparticipants to consume competitive foods (32 percent versus 20 percent). This pattern was consistent with the descriptive findings reported in Figure 13.2, and was observed for all three school types. However, in the multivariate analysis, which controlled for additional student and school characteristics, the differences between NSLP participants and nonparticipants were larger, and the differences were statistically significant for elementary school students (25 percent of NSLP participants versus 11 percent of nonparticipants) as well as high school students (43 percent versus 27 percent).

Findings related to SBP participation were also consistent with descriptive analyses presented in Section C. Similar to the descriptive findings (Table N.7), there was no significant association between SBP participation and the likelihood of consuming competitive foods.

Overall, students who were reported (by a parent) to eat larger amounts of food than other students of the same age were significantly more likely to consume competitive foods than students reported to eat a smaller amount than their peers (29 percent versus 19 percent). This pattern was observed for all three school types, but the differences were not statistically significant in any of the school-type-specific models.

¹⁴⁰ Table N.16 reports a full set of regression coefficients and standard errors for each multivariate model.

School and SFA Characteristics

Overall, students in higher poverty schools (40 percent or more of students approved for free or reduced-price meal benefits) were significantly less likely than students in lower poverty schools (less than 40 percent of students approved for meal benefits) to consume competitive foods (23 percent versus 31 percent). The same general pattern was observed for all three school types, but the differences were statistically significant only for students in elementary schools (18 percent versus 29 percent) and high schools (26 percent versus 38 percent).

Some significant associations between school characteristics and the likelihood of consuming competitive foods were observed among students in specific school types. Among elementary schools, students in schools where all lunches were provided for free were significantly more likely to consume competitive foods than a reference group of students in schools that charged less than \$2.25 for a paid lunch (32 percent versus 18 percent). Among elementary schools, students in FNS's Northeast, Southeast and Western regions were significantly more likely than the reference group of students in FNS's Mid-Atlantic region to consume competitive foods (24 to 29 percent compared to 10 percent). Among middle schools, students in the Northeast region were significantly less likely than students in the Mid-Atlantic region to consume competitive foods (8 percent versus 37 percent). Among high schools, students in the Southwest region were significantly more likely than students in the Mid-Atlantic region to consume competitive foods (53 percent versus 23 percent).

There were no statistically significant associations between consumption of competitive foods and school size, urbanicity, or the price charged for a paid lunch. Moreover, after controlling for student-level characteristics and other school and SFA characteristics, there was no significant association between the consumption of competitive foods and the availability of competitive foods through a la carte sales, vending machines, or school stores and snack bars. The same was true for the availability of brand-name or chain restaurant foods in reimbursable meals (which may also be available for a la carte purchase).

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14. FACTORS ASSOCIATED WITH THE QUALITY OF SCHOOL MEAL PARTICIPANTS' DIETS

Chapters 7 through 13 described the food and nutrient intakes of school meal participants and nonparticipants on school days in SY 2014–2015, as well as the overall nutritional quality of their diets. To maximize the potential impact of school meals on participants' diets, it is useful to understand factors that may influence the nutritional quality of diets consumed by NSLP and SBP participants. This chapter presents findings from multivariate analyses that explored this issue, with an emphasis on factors that are under the control of program operators.

The chapter begins (Section A) with an overview of the analytic approach used in implementing the multivariate analyses. Sections B and C present findings from analyses that examined factors associated with the nutritional quality of NSLP and SBP participants' diets, respectively. Section D presents findings from a supplementary analysis that examined associations between the overall nutritional quality of all students' diets and nutrition outreach activities and wellness policies.

A. Overview of Analytic Approach

The nutritional quality of school meal participants' diets was measured based on total HEI-2010 scores for 24-hour intakes on the target school day. As described in Chapters 9 and 12, the HEI-2010 is a diet quality index that measures conformance with key recommendations of the 2010 *Dietary Guidelines for Americans*. A higher total score indicates better conformance with these recommendations and, thus, higher diet quality. The maximum possible total score for the HEI-2010 is 100.¹⁴¹

The study team assessed the relationships between total HEI-2010 scores and key characteristics in four domains:

- Characteristics of the meals, including overall nutritional quality also measured by total scores on the HEI-2010, and compliance with updated nutrition standards¹⁴²
- Characteristics of school foodservice operations
- Characteristics of the school food environment
- Characteristics of students and institutional characteristics of their schools and SFAs.

For each of these domains, the study team identified an initial set of characteristics consisting of relevant variables from a variety of study instruments (see Chapter 4, Table 4.1). Potential

¹⁴¹ For the multivariate analyses presented in this chapter, HEI-2010 scores were estimated differently than they were estimated for the descriptive analyses presented in Chapters 9 and 12. The descriptive analyses estimated HEI-2010 scores at the population level. For the multivariate analyses, HEI-2010 scores were estimated for each individual student to provide an estimate of the overall nutritional quality of each student's diet.

¹⁴² The study team collaborated with FNS to identify a parsimonious set of variables to characterize compliance with NSLP and SBP nutrition standards, focusing on standards that were more challenging for one or more school types to meet and had sufficient variation within the sample. See Volume 2 of the SNMCS final report (Gearan et al. 2019) for a comprehensive description of the nutrition standards.

characteristics related to school foodservice operations and the school food environment were selected if they had the potential to affect school meals in ways that were directly observable by students or affect students' perception of the meals. The final set of characteristics included in the analyses was identified by eliminating, from the pool of potential characteristics, those which (1) contained valid values for a relatively low proportion of the sample, (2) exhibited insufficient variation within the sample, or (3) were highly correlated with other considered characteristics that better explained variation in total HEI-2010 scores. Appendix C provides additional details on the exclusion criteria used in identifying the final set of variables as well as a technical description of the methods used to produce the results presented in this chapter.

Samples for the main analyses (Sections B and C) included students who (1) were identified as school meal participants (separate analyses were conducted for NSLP and SBP participants),¹⁴³ (2) had a completed 24-hour dietary recall (Day 1); and (3) attended schools where the SNM completed the SNM Survey and the Menu Survey. This is a subset of students from the nationally representative sample of students in public, non-charter schools offering the NSLP. Multivariate analyses were implemented using least squares regression and weights that accounted for the study's complex sample design. Because of the large number of characteristics of interest across the four domains and the interest in separate results by school type, separate regression models were run for each of the four domains and for NSLP participants and SBP participants. This approach allowed the study team to maintain sufficient degrees of freedom to estimate standard errors and test the statistical significance of associations.

In addition to the key variables of interest in each domain, multivariate models included additional variables to control for differences between individual students' demographic characteristics and the institutional characteristics of their corresponding schools and SFAs, which are not determined by the SFA but may be associated with the nutritional quality of students' diets. (These control variables are identified in the bottom panel of Table 4.1). Therefore, these analyses estimate how the nutritional quality of students' diets was associated with a key variable of interest after controlling for differences in students' dietary intakes related to the demographic characteristics of students and characteristics of the schools they attend.

The study team estimated separate models for students across all schools and students within each specific school type. Because most of the characteristics examined in the analysis are school-level characteristics, results from these models are presented and discussed as regression-adjusted mean total HEI-2010 scores for school meal participants in specific types of schools. Supplementary tables provided in Appendix O report full sets of regression coefficients and standard errors for each multivariate model. Because the probability of finding significant associations by chance increases with the number of associations tested, findings for the many characteristics examined in this chapter should be considered exploratory and interpreted with caution. In addition, it is important to understand that significant associations do not imply causality. Given the cross-sectional design of this study, it is not possible to conclusively

¹⁴³ Based on target-day participation which, for most students, is based on school administrative records that documented whether a sampled student participated in the NSLP or SBP on the day for which 24-hour dietary recall data were collected (see Chapter 2).

attribute associations observed between key characteristics in the four domains and the nutritional quality of participants' diets to the characteristic's influence on participants' diets.

B. Factors Associated with the Nutritional Quality of NSLP Participants' Diets

This section presents findings from analyses that examined relationships between the overall nutritional quality of NSLP participants' diets (based on 24-hour intakes) and characteristics in the four key domains described above. The sample included 1,240 NSLP participants in 276 schools.

1. Relationships between the Nutritional Quality of NSLP Participants' Diets and Key Characteristics of NSLP Lunches

This analysis examined the relationship between the overall nutritional quality of NSLP participants' diets and (1) the overall nutritional quality of NSLP lunches (also measured based on total HEI-2010 scores; hereafter referred to as "HEI-2010 scores" for simplicity), (2) compliance with selected NSLP nutrition standards, and (3) the types of food offered in daily NSLP menus. Findings are presented in Table 14.1 and summarized below.

Overall Nutritional Quality of NSLP Lunches

One of four confirmatory hypotheses identified for the SNMCS was that school meals of higher nutritional quality are associated with overall diets of higher nutritional quality among school meal participants.¹⁴⁴ Findings from this analysis did not confirm this hypothesis for NSLP lunches and NSLP participants. Overall, NSLP participants in schools with lunches in the highest quartile of the HEI-2010 distribution (scores between 86.8 and 92.8) had average HEI-2010 scores that were 2.7 points lower (55.6 points versus 58.3 points) than the average HEI-2010 score for NSLP participants in schools with NSLP lunches in the lowest quartile of the HEI-2010 distribution (scores between 64.9 and 79.5).¹⁴⁵ A similar pattern was observed for all three school types, but the association between the nutritional quality of NSLP lunches and the nutritional quality of NSLP participants' diets was statistically significant only for high schools, where the difference between mean HEI-2010 scores for students in schools in the highest and lowest quartiles of the distribution was the largest (51.7 points versus 58.8 points).

¹⁴⁴ The other confirmatory hypotheses focus on the relationships between (1) the nutritional quality and cost of school meals, (2) the nutritional quality of school meals and student participation, and (3) school meal participation and the quality of students' diets. Findings related to the first hypothesis are discussed in Volume 3 of the SNMCS final report (Logan et al. 2019). Findings for the second hypothesis are discussed in Chapter 4 in this volume, and findings related to the third hypothesis are discussed in Chapters 9 and 12 in this volume.

¹⁴⁵ The study team used quartiles of HEI-2010 scores because a continuous variable would have introduced a restrictive assumption, that is, that a 1 point increase from an initially low HEI-2010 score is associated with the same change in participation as a 1 point increase from an initially high HEI-2010 score. Using quartiles allowed for a less linear relationship that might vary across the distribution of HEI-2010 scores. Quartile cut points were chosen so that each range of HEI-2010 scores contained a sample large enough to detect statistically significant differences between, say, the highest and lowest quartiles.

Table 14.1. Relationships between the Nutritional Quality of NSLP Participants' Diets and Key Characteristics of NSLP Lunches: Regression-Adjusted Mean Total HEI-2010 Scores

	Yes /No	Elementary Schools	Middle Schools	High Schools	All Schools
Overall Nutritional Quality of Prepared NSLP Lunches					
Total HEI-2010 Score of Average Lunch Prepared					
Lowest Quartile—64.9 to 79.5 points (<i>reference category</i>)		58.8	57.9	58.8	58.3
Second Quartile—79.6 to 83.0 points		58.5	57.2	56.2	57.0
Third Quartile—83.1 to 85.7 points		57.8	59.8	56.0	58.0
Highest Quartile—85.8 to 92.8 points		56.1	56.6	51.7*	55.6*
Compliance of Daily and Weekly Lunch Menus with NSLP Nutrition Standards					
Met Daily Quantity Requirement for Grains	Y	57.9	59.2	56.5	57.5
	N	57.8	57.1	55.0	57.1
Met Daily Quantity Requirement for Meats/Meat Alternates	Y	58.0	57.9	55.4	57.9
	N	55.8	61.0	55.3	55.0
Met Daily Quantity Requirement for Vegetables	Y	58.6	58.8	†	57.5
	N	56.8	55.7		57.0
Met Weekly Quantity Requirement for Meats/Meat Alternates	Y	57.9	56.3*	†	56.7
	N	57.8	60.4		58.1
Met Weekly Quantity Requirement for Vegetables	Y	57.9	57.7	56.0	57.5
	N	57.8	60.8	52.3	56.7
Met Requirement that at Least Half of Weekly Grains Are Whole Grain-Rich	Y	58.2*	57.9	56.2*	57.6
	N	52.2	59.6	46.9	53.6
Met Minimum Calorie Level	Y	58.0	57.5	56.8	57.9
	N	57.3	59.8	54.8	56.2
Met Maximum Calorie Level	Y	57.8	59.4	†	57.4
	N	57.9	55.6		57.0
Met Target 1 Sodium Limit	Y	59.4*	57.3	56.3	58.0*
	N	52.5	60.8	53.3	55.2
Types of Foods Offered in Lunch Menus					
All Daily Menus Offered Raw Vegetables	Y	55.3*	59.3*	55.1	56.6
	N	59.7	55.8	55.9	58.1
Median Number of Vegetable Choices Offered per Day					
2 or fewer (<i>reference category</i>)		56.0	56.9	56.2	56.2
3 to 4		61.2*	59.6	54.0	58.4
5 or more		58.8	56.4	56.8	57.8
More than Half of Daily Menus Offered Dark Green Vegetables or Legumes	Y	57.1	57.3	56.3	56.9
	N	58.3	59.7	52.5	57.7
More than Half of Daily Menus Offered Red and Orange Vegetables	Y	57.4	59.1	54.3	57.6
	N	58.1	56.6	57.3	57.0

	Yes /No	Elementary Schools	Middle Schools	High Schools	All Schools
At Least One Daily Menu Offered Side Salad Bar	Y	55.3	56.7	55.6	57.6
	N	58.3	58.2	55.3	57.2
No Daily Menus Offered French Fries or Similar Potato Products	Y	58.6	55.3	54.7	56.5
	N	57.4	58.8	55.6	57.7
Percentage of Daily Menus that Offered Pizza or Pizza Products					
Less than 20 percent (<i>reference category</i>)		57.7	61.0	54.8	57.2
Between 20 and 99 percent		59.0	51.9*	55.5	57.1
100 percent		51.6*	59.2	55.5	57.6
At Least One Daily Menu Offered Breaded Meat (as Separate Choice or as Part of a Sandwich)	Y	58.5	58.2	54.8	57.4
	N	55.9	55.9	58.3	56.9
Number of Students		535	402	303	1,240
Number of Schools		102	88	86	276

Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recalls: Day 1, and Menu Survey, school year 2014-2015. Multivariate estimates use the subset of students who participated in the National School Lunch Program on the target day among a weighted nationally representative sample of students in public, non-charter schools offering the National School Lunch Program.

Notes: Estimates are regression-adjusted means that control for demographic characteristics of each student and institutional characteristics of their school and SFA. Variables with rows labeled “Y” and “N” report adjusted mean total HEI-2010 scores for NSLP participants in schools that do and do not meet the variable criteria, respectively. Otherwise, regression-adjusted means are reported for each category within a variable. See Appendix C for more details on characteristic descriptions and selection methods.

For the HEI-2010, the maximum possible total score is 100. A higher total score indicates higher nutritional quality of NSLP participants' diets.

*Difference in mean HEI-2010 scores for NSLP participants in schools with and without a dichotomous characteristic is statistically different from zero at the 0.05 level. For variables containing multiple categories, * denotes that the difference in mean HEI-2010 scores between NSLP participants in schools in the corresponding category and schools in the reference category is statistically different from zero at the 0.05 level.

† Variable was excluded from the model due to low within-sample variation or high correlation with another variable that better explained variation in total HEI-2010 scores for NSLP participants.

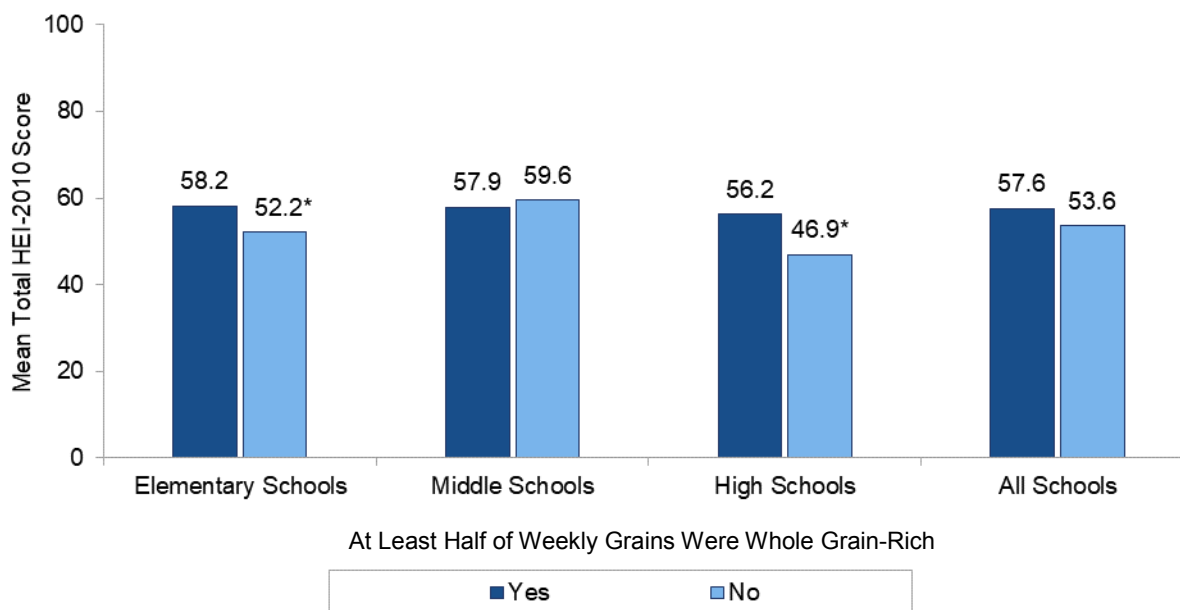
HEI = Healthy Eating Index; NSLP = National School Lunch Program.

Compliance with NSLP Nutrition Standards

Overall, of the nine compliance measures included in this analysis, only one—meeting the Target 1 sodium limit—was associated with a significantly higher average HEI-2010 score for NSLP participants (58.0 points versus 55.2 points). This association was largely driven by a difference among NSLP participants in elementary schools (59.4 points versus 52.5 points).

Other compliance measures were associated with significantly higher HEI-2010 scores for NSLP participants in specific school types. Among elementary and high schools, NSLP participants in schools that met the requirement that at least half of all grains are whole grain-rich had significantly higher average HEI-2010 scores than participants in schools that did not meet this requirement (58.2 points versus 52.2 points for elementary schools and 56.2 points versus 46.9 points for high schools) (Figure 14.1). Among middle schools, meeting the weekly requirement for meats/meat alternates was associated with a significantly lower average HEI-2010 score for NSLP participants (56.3 points versus 60.4 points).

Figure 14.1. Regression-Adjusted Mean Total HEI-2010 Scores for NSLP Participants' Diets by Compliance of NSLP Lunches with Requirement That at Least Half of Weekly Grains Are Whole Grain-Rich



Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recalls: Day 1, and Menu Survey, school year 2014-2015. Multivariate estimates use the subset of students who participated in the National School Lunch Program on the target day among a weighted nationally representative sample of students in public, non-charter schools offering the National School Lunch Program.

Notes: Estimates are regression-adjusted means that control for demographic characteristics of each student and institutional characteristics of their school and SFA.

For the HEI-2010, the maximum possible total score is 100. A higher total score indicates higher nutritional quality of NSLP participants' diets.

*Difference in mean HEI-2010 scores for NSLP participants in schools that did and did not meet the requirement that at least half of all weekly grains are whole grain-rich is statistically different from zero at the 0.05 level.

HEI = Healthy Eating Index; NSLP = National School Lunch Program.

Types of Food Offered in NSLP Lunches

Overall, there were no significant associations between NSLP participants' HEI-2010 scores and the characteristics of NSLP menu offerings included in this analysis. Among elementary schools, offering more daily vegetable choices was associated with higher HEI-2010 scores, and this difference was statistically significant for NSLP participants in schools that offered a median of 3 to 4 vegetable choices per day, compared with participants in schools that offered a median of 2 or fewer choices per day (61.2 points versus 56.0 points). Among middle schools, offering pizza or products on more than 20 percent of daily menus, but not every day, was associated with a significantly lower HEI-2010 score for NSLP participants (51.9 points versus 61.0 points). Among elementary schools and middle schools, there was a significant association between average HEI-2010 scores for NSLP participants and offering raw vegetables every day, but the direction of the association was not consistent.

2. Relationships between the Nutritional Quality of NSLP Participants' Diets and Key Characteristics of School Foodservice Operations

This analysis examined relationships between the overall nutritional quality of NSLP participants' diets and characteristics of school foodservice operations, including characteristics related to food purchasing, menu planning, and meal service. Overall, there were few significant associations between the nutritional quality of NSLP participants' diets and characteristics of school foodservice operations. Findings are presented in Table O.2 and summarized below.

Overall, only two of the 13 characteristics of school foodservice operations examined in this analysis were associated with significant differences in average HEI-2010 scores for NSLP participants—use of HealthierUS School Challenge Smarter Lunchroom Techniques¹⁴⁶ and the presence of policies to accommodate students with food allergies or special dietary needs.¹⁴⁷ Overall, the average HEI-2010 score for NSLP participants was significantly higher in schools that used at least four HealthierUS School Challenge Smarter Lunchroom Techniques than in schools that did not use any such techniques (58.8 points versus 55.2 points). A similar and statistically significant association was observed among elementary schools and high schools (62.2 points versus 51.5 points for elementary schools and 58.4 points versus 50.0 points for high schools). Among elementary schools, HEI-2010 scores for NSLP participants in schools that used 1 or 2 to 3 Smarter Lunchroom Techniques were also significantly higher than the score for NSLP participants in schools that used no Smarter Lunchroom Techniques (56.4 points and 59.6 points, respectively, versus 51.5 points).

Overall, the presence of policies to accommodate students with food allergies or special dietary needs was associated with a significantly lower average HEI-2010 score for NSLP participants (57.0 points versus 60.2 points). This pattern was observed for all three school types, but the association was only statistically significant for high schools (54.9 percent versus 61.1 percent).

Several other characteristics of school foodservice operations were associated with differences in the nutritional quality of NSLP participants' diets, but only for specific school types. Participation in the Fresh Fruit and Vegetable Program—observed among elementary schools only—was associated with a significantly higher HEI-2010 score for NSLP participants (60.2 points versus 56.9 points). Among middle schools, participation in a food purchasing cooperative and OVS at lunch were each associated with a mean participant HEI-2010 score that was significantly lower (56.4 points versus 60.3 points and 57.0 points versus 68.1 points, respectively). Some statistically significant differences in NSLP participants' HEI-2010 scores were observed between schools charging different prices for paid lunches; however, these relationships were not consistent across increasingly higher paid lunch prices.

¹⁴⁶ Smarter Lunchroom Techniques are intended to promote healthy food choices, and include strategies such as soliciting students' input on vegetable offerings and displaying dark green, red, and orange vegetables prominently among side dish offerings. The SNMCS assessed schools' use of seven Smarter Lunchroom Techniques. See Volume 1 of the SNMCS final report (Forrestal et al. 2019).

¹⁴⁷ One significant association was observed between the price charged for paid lunches and the nutritional quality of NSLP participants' diets, but there was no consistent pattern across ranges of meal price.

3. Relationships between the Nutritional Quality of NSLP Participants' Diets and Key Characteristics of the School Food Environment

To assess the relationships between the nutritional quality of NSLP participants' diets and key characteristics of the school food environment, the study team examined characteristics related to wellness policies and practices, availability of competitive foods, and meal service practices. Findings are presented in Table O.4 and summarized below.

There were few significant associations between the nutritional quality of NSLP participants' diets and the school food environment. Overall, NSLP participants in schools with more than one line or station that offered reimbursable meals had a significantly higher mean HEI-2010 score than participants in schools with only one line or station for reimbursable meals (58.4 points versus 55.9 points). Among high schools, conducting a nutrition education activity in a classroom or the foodservice area was associated with a significantly higher mean HEI-2010 score for NSLP participants (57.5 points versus 53.3).

4. Relationships between the Nutritional Quality of NSLP Participants' Diets and Key Characteristics of Students, Schools, and SFAs

The final analysis that explored factors associated with the nutritional quality of NSLP participants' diets focused on relationships between NSLP participants' total HEI-2010 scores and characteristics of the students (both sociodemographic characteristics and characteristics related to eating habits and physical activity) and characteristics of the their schools and SFAs. The sociodemographic characteristics of students and institutional characteristics of schools and SFAs are the same characteristics used as control variables in the multivariate analyses summarized in the preceding sections. Student characteristics related to eating habits and physical activity include characteristics that may influence students' dietary intake. Findings are presented in Table O.6 and summarized below.

Student Characteristics

Overall, NSLP participants who were reported (by parents) to be somewhat picky eaters had a higher mean HEI-2010 score than NSLP participants who were reported to be very picky eaters (58.2 points versus 55.0 points). This general pattern was observed for all three school types, but the difference in mean HEI-2010 scores between very picky eaters and somewhat picky eaters was statistically significant only among high schools. In addition, among both middle and high schools, NSLP participants who were not considered to be picky eaters had significantly higher mean HEI-2010 scores than participants who were considered to be picky eaters (60.4 points versus 54.1 points for middle school NSLP participants, and 59.4 points versus 49.8 points for high school NSLP participants).

Institutional Characteristics of Schools and SFAs

Overall, NSLP participants in schools with more than 500 students had higher mean HEI-2010 scores than NSLP participants in schools with fewer than 500 students, but this difference was only statistically significant only for the comparison between participants in schools with 500 to 999 students and schools with fewer than 500 students (57.8 points versus 55.3 points). This finding was primarily driven by significant difference among elementary schools in these size categories (59.2 points versus 55.5 points).

Among high schools, NSLP participants in the Southeast and Mountain Plains FNS regions had significantly lower mean HEI-2010 scores (52.8 and 48.5 points, respectively), relative to participants in the reference Mid-Atlantic region (58.6 points).

C. Factors Associated with the Nutritional Quality of SBP Participants' Diets

This section is analogous to the previous section but focuses on factors associated with the nutritional quality of SBP participants' diets. The analysis sample included 500 SBP participants in 195 schools that offered the SBP.

1. Relationships between the Nutritional Quality of SBP Participants' Diets and Key Characteristics of SBP Breakfasts

This analysis examined the relationship between the nutritional quality of SBP participants' diets and key characteristics of SBP breakfasts, including overall nutritional quality, compliance with selected nutrition standards for SBP meals, and the types of foods offered. Findings are presented in Figure 14.2 and Table O.8 and summarized below.

Overall Nutritional Quality of SBP Breakfasts

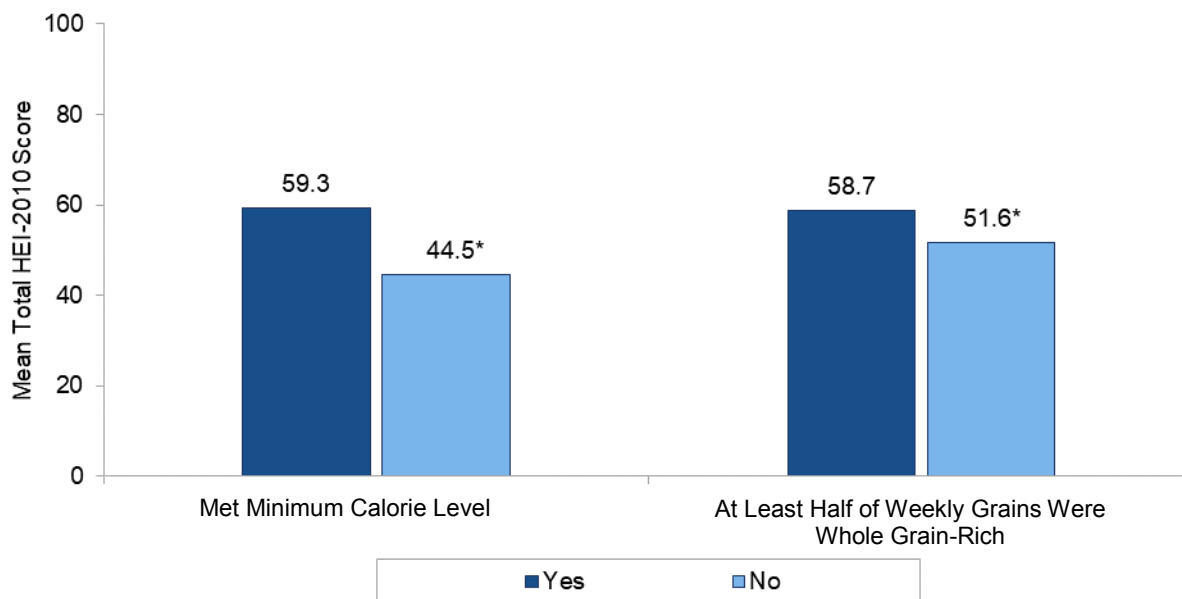
Overall, there was no significant association between the nutritional quality of SBP breakfasts and the overall nutritional quality of SBP participants' diets, and there was no consistent pattern in this relationship across school types.

Compliance with SBP Nutrition Standards

Overall, meeting the minimum calorie level and meeting the requirement that half of all grains be whole grain-rich were each associated with significantly higher total HEI-2010 scores for SBP participants (Figure 14.2). The difference for SBP participants in schools that did and did not meet the minimum calorie level was 59.3 points versus 44.5 points and the difference for SBP participants in schools that did and did not meet the requirement that at least half of all grains be whole grain-rich was 58.7 points versus 51.6 points. Both of these patterns were observed across school types, but associations between compliance and the nutritional quality of SBP participants' diets were not always statistically significant. The general pattern of the association between the nutritional quality of participants' diets and compliance with the whole grain-rich requirement was consistent with the pattern observed for NSLP participants (see Table 14.1).

Associations between the nutritional quality of SBP participants' diets and other measures of compliance with SBP nutrition standards were observed for specific school types. Among middle schools, meeting the daily quantity requirement for grains was associated with significantly lower HEI-2010 scores among SBP participants (55.3 points versus 63.0 points), and meeting the maximum calorie level was associated with significantly higher scores (60.2 points versus 50.8 points). Among both middle and high schools, meeting the Target 1 limit for sodium was associated with significantly lower HEI-2010 scores among SBP participants (54.5 points versus 64.8 points for middle schools and 52.9 points versus 62.1 points for high schools).

Figure 14.2. Regression-Adjusted Mean Total HEI-2010 Scores for SBP Participants' Diets by Compliance of SBP Breakfasts with Minimum Calorie Level and Requirement That at Least Half of Weekly Grains Are Whole Grain-Rich: All Schools



Source: School Nutrition and Meal Cost Study, Reimbursable Meal Sale Form, 24-Hour Dietary Recalls: Day 1, and Menu Survey, school year 2014-2015. Multivariate estimates use the subset of students who participated in the School Breakfasts Program on the target day among a weighted nationally representative sample of students in public, non-charter schools offering the National School Lunch Program.

Notes: Estimates are regression-adjusted means that control for demographic characteristics of each student and institutional characteristics of their school and SFA. For the HEI-2010, the maximum possible total score is 100. A higher total score indicates higher nutritional quality of SBP participants' diets.

*Difference in mean HEI-2010 scores for SBP participants in schools that did and did not meet the minimum calorie level or weekly whole grain-rich requirement is statistically different from zero at the 0.05 level.

HEI = Healthy Eating Index; SBP = School Breakfast Program.

Types of Food Offered in SBP Breakfasts

There were few consistent patterns in the associations between the quality of SBP participants' diets and the types of foods offered in SBP breakfasts, and only one of 16 associations tested was statistically significant.

2. Relationships between the Nutritional Quality of SBP Participants' Diets and Key Characteristics of School Foodservice Operations

This analysis examined the relationship between the nutritional quality of SBP participants' diets and characteristics of school foodservice operations, including characteristics related to food purchasing, menu planning, and meal service. Findings are presented in Table O.10 and summarized below.

Overall, the only foodservice characteristic that was significantly associated with the nutritional quality of SBP participants' diets was the option of eating breakfast in the classroom. Specifically, the availability of this option was associated with significantly higher HEI-2010

scores among SBP participants (60.9 points versus 57.0 points). This association was largely driven by elementary schools.

Significant associations between other characteristics of foodservice operations and the quality of SBP participants' diets were observed for middle schools or high schools, but not elementary schools. Among middle schools, receipt of fully or partially prepared meals from satellite or central kitchens was associated with a significantly lower mean HEI-2010 score among SBP participants (48.2 points versus 58.0 points).

Among high schools, the use of a cycle menu was associated with a significantly higher mean HEI-2010 score among SBP participants (58.4 points versus 51.5 points). In contrast, participation in a Farm to School program and the availability of Grab-and-Go breakfasts were each associated with a significantly lower mean HEI-2010 score for SBP participants in high schools (52.6 points versus 57.3 points and 52.2 points versus 57.3 points, respectively). Higher prices for a paid breakfast was also associated with significantly lower HEI-2010 scores among SBP participants' in high schools. Paid breakfast prices between \$1.50 and \$1.99, and prices of \$2.00 or more were each associated with a significantly lower mean HEI-2010 scores (53.6 and 49.8 points, respectively), compared to prices of less than \$1.25 (61.5 points).

3. Relationships Between the Nutritional Quality of SBP Participants' Diets and Key Characteristics of the School Food Environment

To assess the relationships between the nutritional quality of SBP participants' diets and key characteristics of the school food environment, the study team examined characteristics related to wellness policies and practices, availability of competitive foods, and meal scheduling practices. Findings are presented in Table O.12 and summarized below.

Overall, there were few significant associations between the nutritional quality of SBP participants' diets and the school food environment. The presence of nutrition standards that exceeded Federal requirements was associated with a significantly higher mean HEI-2010 score for SBP participants (60.9 points versus 56.9 points). This pattern was observed across all three school types, but the association was only statistically significant for elementary schools (62.2 points versus 57.8 points).

Overall, the availability of a la carte foods (other than milk) was associated with significantly lower mean HEI-2010 scores for SBP participants overall (57.2 points versus 62.7 points). This pattern was also observed among elementary schools (57.0 points versus 65.4 points) and high schools (55.3 points versus 70.2 points).

Among middle schools, bus schedules in which the last bus arrives to school before or during breakfast were associated with significantly lower mean HEI-2010 scores for SBP participants (44.6 points versus 58.3 points). Among high schools, availability of competitive foods in vending machines was associated with significantly lower mean HEI-2010 scores for SBP participants (55.2 points versus 62.0).

4. Relationships Between the Nutritional Quality of SBP Participants' Diets and Key Characteristics of Students, Schools, and SFAs

The final analysis that explored factors associated with the nutritional quality of SBP participants' diets focused on relationships between SBP participants' total HEI-2010 scores and characteristics of the students (both sociodemographic characteristics and characteristics related to eating habits and physical activity) and characteristics of the schools they attended. The sociodemographic characteristics of students and institutional characteristics of schools and SFAs are the same characteristics used as control variables in the multivariate analyses summarized in the preceding sections. Student characteristics related to eating habits and physical activity include characteristics that may influence students' dietary intake. Findings are presented in Table O.14 and summarized below.

Student Characteristics

Overall, none of the student characteristics examined in this analysis were significantly associated with the quality of SBP participants' diets. Some significant associations between student characteristics and the quality of SBP participants' diets were observed for specific types of schools; however, the pattern of findings was not consistent across school types. Among high schools only, SBP participants who were reported (by parents) to be somewhat picky eaters had a significantly higher mean HEI-2010 score than SBP participants who were reported to be very picky eaters (58.8 points versus 52.7 points).

Institutional Characteristics of Schools and SFAs

Overall, SBP participants in suburban schools had a significantly higher mean HEI-2010 score, relative to participants in urban schools (61.2 points versus 55.1 points). This general pattern was observed for all three school types, but was statistically significant only among middle schools (62.8 points versus 55.3 points).

Overall, SBP participants in schools with 500 to 999 students had significantly higher mean HEI-2010 scores than SBP participants in schools with fewer than 500 students (60.9 points versus 54.0 points). This finding was primarily driven by SBP participants in elementary schools (63.8 points versus 53.7 points). A similar pattern was not observed among middle schools or high schools.

Among middle schools and high schools, there were significant differences in SBP participants' mean HEI-2010 scores for some FNS regions compared to the reference Mid-Atlantic region. Among middle schools, SBP participants in the Midwest region had a significantly higher mean score than participants in the Mid-Atlantic region (65.7 points versus 54.4 points). Among high schools, SBP participants in the Northeast region had a significantly lower mean HEI-2010 score than participants in the Mid-Atlantic region (47.1 versus 61.4).

D. Relationships between the Nutritional Quality of Students' Diets and Nutrition Outreach

In theory, the school meal programs can only influence students' diets if students consume the meals. However, it is possible that nutrition outreach activities implemented by school foodservice programs and wellness policies that are required for SFAs operating school meal

programs may influence food choices of both participants and nonparticipants. This section describes findings from a multivariate analysis that examined the relationships between the nutritional quality of students' diets (participants and nonparticipants combined) and the following practices and policies related to nutrition outreach and wellness practices and policies:

Nutrition Outreach

- School has a nutrition advisory council
- School provides information on the school meal programs to families or the public
- School foodservice staff conduct a nutrition education activity in a classroom or the foodservice area

Wellness Policies and Practices

- School has a wellness policy in addition to SFA wellness policy
- SFA wellness policy includes a nutrition promotion component
- SFA wellness policy includes plan for informing the public about policy content and implementation.

As with the analyses described in previous sections, this analysis also controlled for differences between students in terms of demographic characteristics and institutional characteristics of their schools and SFAs that are not determined by the SFA, but which may be associated with the nutritional quality of students' diets. The analysis included a sample of 2,107 students with a completed 24-hour dietary recall (day 1) in 284 schools in which the SNM had completed the Menu Survey. Findings are presented in Table O.16 and summarized below.

Overall, there were no significant associations between the nutritional quality of students' diets and the nutrition outreach practices and wellness policies and practices examined in this analysis. The same was true for elementary schools and middle schools examined separately. However, among high schools, there were significant associations between the nutritional quality of students' diets and two nutrition outreach practices and one related to wellness policies. Specifically, the presence of a nutrition advisory council and the provision of information on school meals to families and the public were each associated with a significantly higher mean HEI-2010 score for high school students (54.8 points versus 51.5 points and 54.4 points versus 48.2 points, respectively). In addition, the inclusion of a nutrition promotion component in SFA wellness policies was associated with a significantly higher mean HEI-2010 score for high school students (54.1 points versus 49.9 points).

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15. CHANGES IN STUDENTS' DIETARY INTAKES SINCE THE THIRD SCHOOL NUTRITION DIETARY ASSESSMENT (SY 2004–2005)

The SNMCS is the first nationally representative, comprehensive assessment of students' dietary intakes since major reforms in the school meal programs began in SY 2012–2013, including updated nutrition standards. To offer perspective on how the updated standards may have influenced students' dietary intakes, this chapter compares the dietary intakes of NSLP and SBP participants and nonparticipants in SY 2014–2015 and SY 2004–2005 using data from the SNMCS and SNDA-III, respectively. SNDA-III is the most recent prior national assessment of students' diets (Gordon et al. 2007). In collecting and processing data for the SNMCS, a conscious effort was made to use methods that were comparable to SNDA-III. However, observed differences in estimated dietary intakes at the two points in time may be due to multiple factors, including improvements in food composition databases, differences in the techniques used to control for measured differences in characteristics of school meal participants and nonparticipants, and secular changes. For this reason, findings should be interpreted with caution and not viewed as definitive indications of impacts of the updated nutrition standards.

The SNMCS and SNDA-III used different approaches to identify school meal participants—that is, students who consumed a school meal on the day covered in the 24-hour recall. In the SNMCS, administrative records were the primary means for identifying school meal participants. In SNDA-III, school meal participants were defined based on the number and types of foods students reported obtaining at school. As described in Appendix A, the two approaches to identifying school meal participants yielded very similar results in the SNMCS sample. So, while it is important to recognize this methodological difference between the SNMCS and SNDA-III, it is not expected to have a meaningful impact on the findings presented in this chapter.

The SNMCS used propensity score matching to control for differences between participants and nonparticipants in personal, family, and school characteristics. SNDA-III used propensity score matching for some analyses and multivariate regression for others. To minimize potential confounding from differences in the approach used to control for differences between participants and nonparticipants, the study team limited comparisons in this chapter to outcome measures that were part of SNDA-III analyses that used propensity score matching (see Appendix G for additional details). The analysis examined the following outcomes:

- Prevalence of acceptable, inadequate, and excessive usual daily nutrient intakes
- Mean scores for selected Healthy Eating Index (HEI) components

All analyses are based on 24-hour dietary recalls that covered intakes on school days (SY 2004–2005 for SNDA-III and SY 2014–2015 for SNMCS). Outcomes are examined separately for NSLP participants and matched nonparticipants and for SBP participants and matched nonparticipants and focus on changes over time. The statistical significance of differences in outcomes for participants and matched nonparticipants between SY 2004–2005 and SY 2014–2015 was tested.¹⁴⁸ Differences discussed in the text were significant at least at the 0.05 level,

¹⁴⁸ Statistical significance was determined on the basis of two-tailed tests. These tests accounted for the complex sample designs of both studies.

unless otherwise noted. It was not possible to assess the statistical significance of differences in outcomes for all nutrients examined at both points in time because tables in the SNDA-III report (Gordon et al. 2007) did not report standard errors for point estimates that were reported as <3 or >97.

A. Prevalence of Acceptable, Inadequate, and Excessive Usual Daily Nutrient Intakes among NSLP Participants and Matched Nonparticipants

This analysis compared the prevalence of acceptable, inadequate, and excessive usual daily nutrient intakes of NSLP participants and matched nonparticipants in SY 2004–2005 (SNDA-III) and SY 2014–2015 (SNMCS). Both studies compared usual nutrient intake distributions with the relevant DRI standards or *Dietary Guidelines for Americans* recommendations (see Chapter 6) to estimate the percentages of participants and matched nonparticipants with acceptable, inadequate, or excessive usual daily intakes. All students, including those who did not consume a lunch, were included in these analyses.

Dietary Reference Intakes (DRIs)

AI = Adequate Intake

**AMDR = Acceptable
Macronutrient Distribution
Range**

**EAR = Estimated Average
Requirement**

**UL = Tolerable Upper
Intake Level**

Figures in this section present key findings for NSLP participants and matched nonparticipants overall. Tables P.2 through P.4 provide data for NSLP participants and matched nonparticipants in each school type.

1. Macronutrients

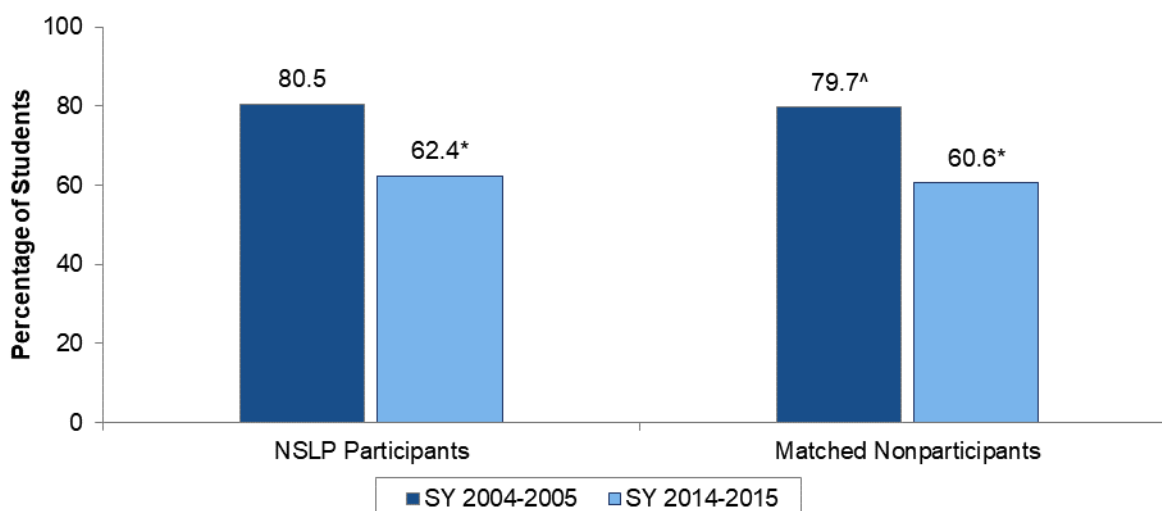
To assess the prevalence of acceptable usual intakes of macronutrients (total fat, carbohydrate, protein, linoleic acid, and alpha-linolenic acid), the analysis compared usual daily macronutrient intakes with the AMDRs defined in the DRIs (see Chapter 6). Acceptable usual intakes were defined as intakes that fell within the AMDR. The *Dietary Guidelines for Americans* define a maximum limit on the percentage of calories from saturated fat. This recommendation (less than 10 percent of total calories) was used to assess the prevalence of excessive usual daily intakes of saturated fat.

Overall and for each school type, changes in the percentages of NSLP participants and matched nonparticipants with acceptable usual intakes of total fat, carbohydrate, and protein between SY 2004–2005 and SY 2014–2015 were not statistically significant (Tables P.1–P.4). For both NSLP participants and matched nonparticipants, the percentages of students with acceptable usual intakes of linoleic acid and alpha-linolenic acid increased significantly over time (for linoleic acid, from 68 to 94 percent among NSLP participants, and from 69 to 85 percent among matched nonparticipants; for alpha-linolenic acid, from 25 to 62 percent among NSLP participants, and from 18 to 57 percent among matched nonparticipants). For both of these nutrients, the percentages of students with intakes below the AMDRs decreased significantly over time. This pattern was also observed for NSLP participants in elementary schools, for both groups of students in middle schools for linoleic acid only, and for NSLP participants in high schools for alpha-linolenic acid only (Tables P.2–P.4). For both of these nutrients, the percentages of students with intakes below the AMDRs decreased significantly over time.

Overall, the prevalence of excessive usual intakes of saturated fat decreased significantly between SY 2004–2005 and SY 2014–2015 for both NSLP participants and matched nonparticipants (from 81 to 62 percent and from 80 to 61 percent, respectively; Figure 15.1). This decrease over time was observed for NSLP participants and matched nonparticipants in each school type, but the difference was statistically significant only for NSLP participants in high schools (Table P.4).

Overall, the prevalence of excessive usual daily intakes of saturated fat decreased significantly between SY 2004–2005 and SY 2014–2015 for both NSLP participants and matched nonparticipants

Figure 15.1. Comparison of the Percentage of NSLP Participants and Matched Comparison Group of Nonparticipants with Excessive Usual Daily Intakes of Saturated Fat in SY 2004–2005 and 2014–2015: All Students



Source: Data for school year 2004–2005 were estimated using data from the third School Nutrition Dietary Assessment Study (SNDA-III) (Gordon et al. 2007), and are representative of all students in public NSLP schools in SY 2004–2005. Data for school year 2014–2015 are from the School Nutrition and Meal Cost Study (24-Hour Dietary Recalls: Day 1 and Day 2), and are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Samples includes all students, including those who did not consume a lunch.

Note: SNDA-III and SNMCS both used propensity score approaches to construct samples of matched nonparticipants. See Appendix G for more details.

*Difference between SY 2004–2005 and SY 2014–2015 is significantly different from zero at the * 0.05 level.

NSLP = National School Lunch Program; SNDA = School Nutrition Dietary Assessment Study; SNMCS = School Nutrition and Meal Cost Study; SY = school year.

^ Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

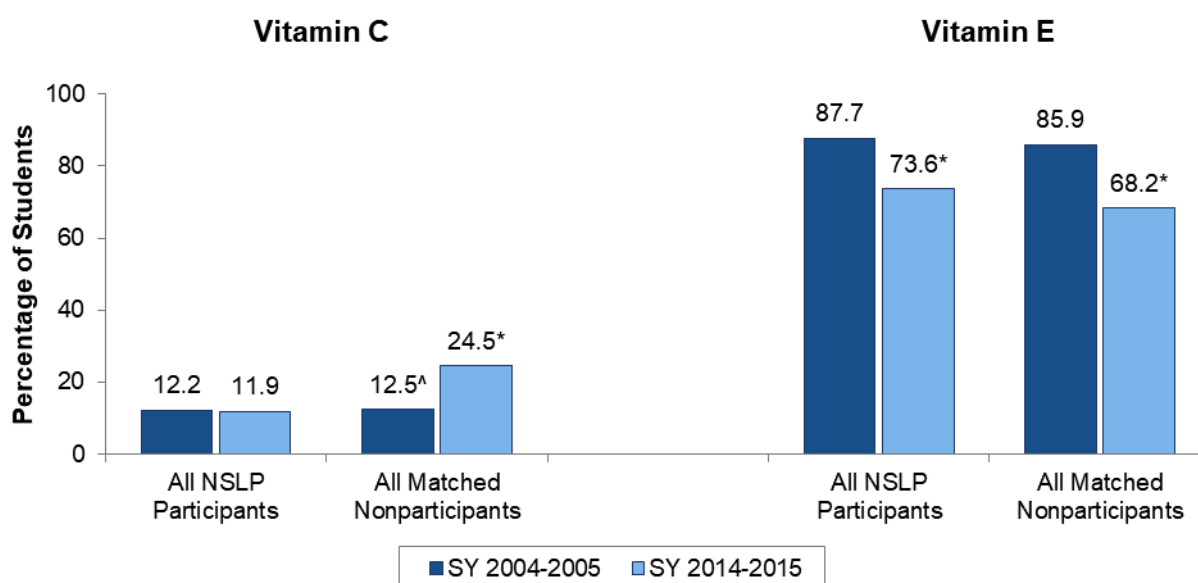
2. Vitamins and Minerals

For most vitamins and minerals examined in this analysis, the prevalence of inadequate intakes is defined as the proportion of the population with usual daily intakes that fell below nutrient-specific EARs. There were few significant changes in the prevalence of inadequate usual daily intakes of vitamins and minerals for either NSLP participants or matched nonparticipants between SY 2004–2005 and SY 2014–2015 (Tables P.1 through P.4). There

were, however, notable changes over time in the prevalence of inadequate intakes of vitamin C, vitamin E, and magnesium.

For all students combined, the percentage of matched nonparticipants with inadequate usual intakes of vitamin C increased significantly—from 13 to 25 percent—between SY 2004–2005 and SY 2014–2015 (Figure 15.2). There was no comparable change for NSLP participants overall; however, the percentage of NSLP participants in high schools with inadequate usual intakes of vitamin C increased by 17 percentage points over time (from 32 to 48 percent) (Table P.4).

Figure 15.2. Comparison of the Percentage of NSLP Participants and Matched Comparison Group of Nonparticipants with Inadequate Usual Daily Intakes of Vitamin C and Vitamin E in SY 2004–2005 and 2014–2015: All Students



Source: Data for school year 2004–2005 were estimated using data from the third School Nutrition Dietary Assessment Study (SNDA-III) (Gordon et al. 2007), and are representative of all students in public NSLP schools in SY 2004–2005. Data for school year 2014–2015 are from the School Nutrition and Meal Cost Study (24-Hour Dietary Recalls: Day 1 and Day 2), and are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Samples includes all students, including those who did not consume a lunch.

Note: SNDA-III and SNMCS both used propensity score approaches to construct samples of matched nonparticipants. See Appendix G for more details.

*Difference between SY 2004–2005 and SY 2014–2015 is significantly different from zero at the * 0.05 level.

NSLP = National School Lunch Program; SNDA = School Nutrition Dietary Assessment Study; SNMCS = School Nutrition and Meal Cost Study; SY = school year.

[^] Point estimate is considered less precise than estimates that are not flagged because the sample size is small or the coefficient of variation is large. The rules used in flagging estimates are described in Chapter 1.

For both NSLP participants and matched nonparticipants overall, the prevalence of inadequate usual intakes of vitamin E decreased significantly between SY 2004–2005 and SY 2014–2015 (from 88 to 74 percent and from 86 to 68 percent, respectively). This general pattern was observed for all three school types, but differences were statistically significant only among

NSLP participants and matched nonparticipants in elementary schools and nonparticipants in middle schools (Tables P.2 and P.3).¹⁴⁹

Finally, the prevalence of inadequate usual intakes of magnesium decreased significantly between SY 2004–2005 and SY 2014–2015 for NSLP participants and matched nonparticipants in middle schools (from 43 to 27 percent and from 62 to 36 percent, respectively; Table P.3) and high schools (from 78 to 64 percent and from 84 to 70 percent, respectively; Table P.4).

3. Calcium, Potassium, and Dietary Fiber

The analysis compared usual daily intakes of calcium, potassium, and dietary fiber with the AIs to estimate the prevalence of inadequate intakes. If the usual mean intake is equal to 100 percent or more of the AI, the prevalence of inadequacy is likely to be low. If the usual mean intake falls below 100 percent of the AI, no firm conclusions can be drawn about the adequacy of usual intakes. In SY 2004–2005, it was not possible to assess the prevalence of inadequate usual intakes of calcium because an EAR had not yet been defined (an EAR was defined in 2011; IOM 2011). Therefore, this analysis compared mean usual intakes of calcium with the AI.

Between SY 2004–2005 and SY 2014–2015, usual daily intakes of calcium, as a percentage of the AI, remained relatively constant among NSLP participants (103 and 104 percent of the AI, respectively) and increased significantly among matched nonparticipants (87 to 94 percent of the AI, respectively) (Table P.1). For middle school students, usual daily intakes of calcium, as a percentage of the AI, decreased significantly among NSLP participants (from 88 to 82 percent), and increased significantly among nonparticipants (from 64 to 80 percent) (Table P.3).

There was a small but statistically significant decrease (3 percentage points) over time in mean usual intakes of potassium among NSLP participants overall (from 60 to 57 percent of the AI). This pattern was also observed among NSLP participants in middle schools (Table P.3).

Usual daily intakes of dietary fiber increased significantly for both NSLP participants and matched nonparticipants between SY 2004–2005 and SY 2014–2015 (from 51 to 61 percent of the AI for NSLP participants and from 45 to 58 percent of the AI for matched nonparticipants). This pattern was also observed for both NSLP participants and nonparticipants in each school type (Tables P.2 to P.4).

Usual daily intakes of dietary fiber increased significantly for both NSLP participants and matched nonparticipants between SY 2004–2005 and SY 2014–2015.

¹⁴⁹ Devaney et al. (2007) pointed out that the diets of most of the U.S. population do not meet the EAR for vitamin E, yet vitamin E deficiency is rare. They noted limitations of both the data used to establish the EAR and the data used to assess vitamin E intakes.

4. Sodium

The analysis compared usual daily intakes of sodium with the UL to estimate the prevalence of excessive sodium intakes. Overall, the large percentages of NSLP participants and matched nonparticipants with excessive usual sodium intakes remained about the same between SY 2004–2005 and SY 2014–2015 (95 and 96 percent and 88 and 86 percent, respectively) (Table P.1). However, among high school students, the percentage of NSLP participants with excessive usual sodium intakes decreased significantly (from 96 to 88 percent) (Table P.4).

Overall, the large percentages of NSLP participants and matched nonparticipants with excessive usual sodium intakes remained about the same between SY 2004–2005 and SY 2014–2015. However among high school students, the percentage of NSLP participants with excessive usual sodium intakes decreased significantly.

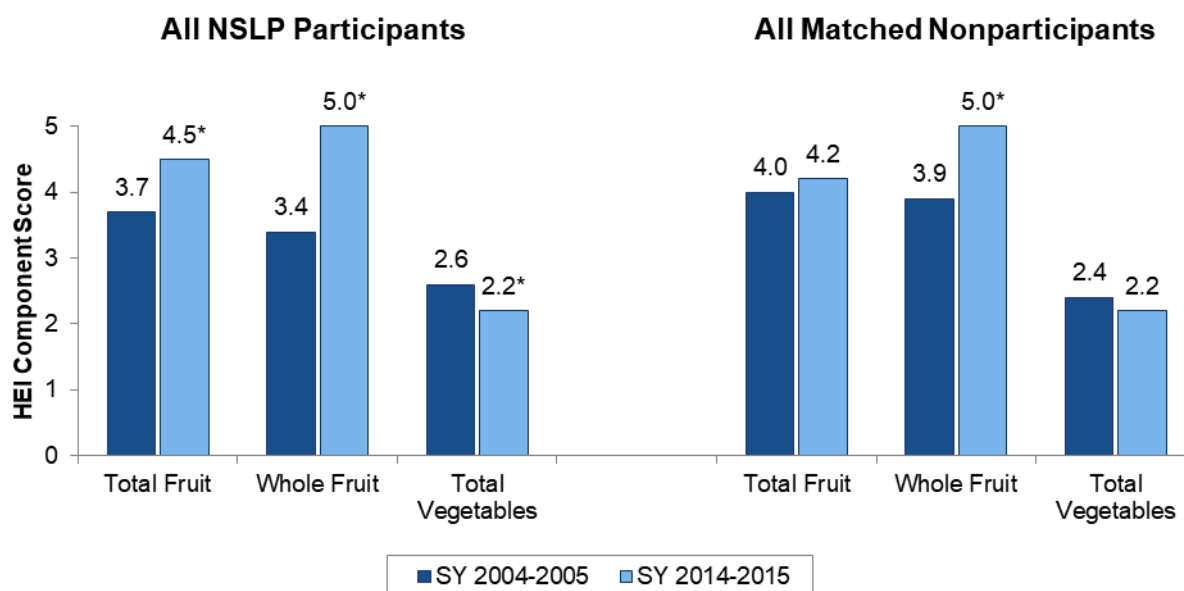
B. Healthy Eating Index Scores for NSLP Participants and Nonparticipants

The HEI is a measure of diet quality that assesses conformance to key recommendations of the *Dietary Guidelines for Americans* (see Chapter 6). The HEI has been updated over time to reflect changes in the specific dietary recommendations included in the *Dietary Guidelines for Americans*. The SNMCS used the 2010 version (HEI-2010), because the 2010 *Dietary Guidelines for Americans* were in effect when data were collected (SY 2014–2015). Fox and colleagues (2009b) used the HEI-2005 to examine students' diet quality in SY 2004–2005 using data from SNDA-III. Due to differences between the HEI-2005 and HEI-2010 in components and scoring standards, comparisons of HEI scores was feasible only for four components that were scored consistently in the two HEI measures: (1) total fruit, (2) whole fruit, (3) total vegetables, and (4) dairy. All students, including those who did not consume a lunch, were included in the analysis.

Overall, and for each school type, scores for whole fruit increased significantly between SY 2004–2005 and SY 2014–2015 for both NSLP participants and matched nonparticipants (from 3.4 to 5.0 points out of a possible 5, and from 3.9 to 5.0 points, respectively) (Figure 15.3 and Table P.5). Among NSLP participants, the score for total fruit also increased significantly over time (from 3.7 to 4.5 points out of a possible 5). This increase was observed for NSLP participants in each school type, but the differences were statistically significant only among elementary and middle school students (Table P.5). The scores for total fruit also increased significantly among matched nonparticipants in high schools (from 2.8 to 3.9 out of 5) (Table P.5).

Overall, and for each school type, scores for whole fruit increased significantly for both NSLP participants and nonparticipants between SY 2004–2005 and SY 2014–2015. Among NSLP participants, the score for total fruit also increased significantly over time.

Figure 15.3. Comparison of Mean Healthy Eating Index Scores for Selected Components for NSLP Participants and Matched Comparison Group of Nonparticipants in SY 2004–2005 and SY 2014–2015: All Students



Source: Data for school year 2004–2005 were estimated using data from the third School Nutrition Dietary Assessment Study (SNDA-III) (Fox et al. 2009b), and are representative of all students in public NSLP schools in SY 2004–2005. Data for school year 2014–2015 are from the School Nutrition and Meal Cost Study (24-Hour Dietary Recalls: Day 1), and are weighted to be representative of all students in public, non-charter schools offering the National School Lunch Program. Samples includes all students, including those who did not consume a lunch.

Notes: SNDA-III and SNMCS both used propensity score approaches to construct samples of matched nonparticipants. See Appendix G for more details.

Healthy Eating Index scores are based on daily intakes. Higher scores for total fruit, whole fruit, and total vegetables (adequacy components) reflect higher intakes, and thus, higher diet quality.

*Difference between SY 2004–2005 and SY 2014–2015 is significantly different from zero at the * 0.05 level.

NSLP = National School Lunch Program; SNDA = School Nutrition Dietary Assessment Study; SNMCS = School Nutrition and Meal Cost Study; SY = school year.

There was a small but statistically significant decrease (0.4 points) in the scores for total vegetables among NSLP participants between SY 2004–2005 and SY 2014–2015 (from 2.6 to 2.2 points out of 5) (Figure 15.3). This pattern was also observed for NSLP participants in middle and high schools (Table P.5).

For all students combined, scores for dairy remained relatively constant over time for both NSLP participants and matched nonparticipants (Table P.5). However, among NSLP participants in high schools, there was a significant increase in the score for dairy (from 7.8 to 9.8 points out of a possible 10).

C. Prevalence of Acceptable, Inadequate, and Excessive Usual Daily Nutrient Intakes among SBP Participants and Matched Nonparticipants

This analysis compares the prevalence of acceptable, inadequate, and excessive usual daily nutrient intakes of SBP participants and matched nonparticipants in SY 2004–2005 (SNDA-III)

and SY 2014–2015 (SNMCS). All students, including those who did not consume a breakfast, were included in these analyses. Tables P.6 through P.9 provide data for SBP participants and nonparticipants overall and by school type for both points in time.

1. Macronutrients

Overall, changes between SY 2004–2005 and SY 2014–2015 in the percentages of SBP participants and matched nonparticipants with acceptable usual intakes of total fat, carbohydrate, and protein were not statistically significant (Table P.6). However, among SBP participants in middle schools, the percentage of students with acceptable usual intakes of total fat increased significantly over time (from 64 to 89 percent) (Table P.8).

Among both SBP participants and matched nonparticipants, the percentages of students with acceptable usual intakes of linoleic acid and alpha-linolenic acid increased significantly over time (for linoleic acid, from 70 to 95 percent among SBP participants, and from 63 to 90 percent among matched nonparticipants; for alpha-linolenic acid, from 27 to 65 percent among SBP participants, and from 24 to 59 percent among nonparticipants) (Table P.6). For both of these nutrients, the percentages of students with intakes below the AMDRs decreased significantly over time. With the exception of linoleic acid among high school students, this general pattern was observed for SBP participants and matched nonparticipants in each school type, but the differences were not always statistically significant (Tables P.7–P.9).

Overall, the prevalence of excessive usual daily intakes of saturated fat decreased significantly between SY 2004–2005 and SY 2014–2015 for SBP participants (from 72 percent to 58 percent; Table P.6). This change was driven mainly by a change over time among SBP participants in elementary schools (from 76 percent to 51 percent; Table P.7). Among middle school students, the prevalence of excessive usual intakes of saturated fat for SBP matched nonparticipants decreased by 30 percentage points (from about 86 percent to 56 percent; Table P.8).

2. Vitamins and Minerals

Overall and among elementary school students, the prevalence of inadequate usual intakes of vitamin E decreased significantly over time for both SBP participants and matched nonparticipants (Tables P.6 and P.7).¹⁵⁰ There were a number of significant changes between SY 2004–2005 and SY 2014–2015 in the prevalence of inadequate usual intakes of other vitamins and minerals among matched nonparticipants in middle and high schools. Among middle school students, the percentage of matched nonparticipants with inadequate usual intakes of magnesium and zinc decreased significantly over time (from 57 to 31 percent, and from 26 to 7 percent, respectively) (Table P.8). The percentage of matched nonparticipants in high schools with inadequate usual intakes of folate and zinc increased significantly between SY 2004–2005 and SY 2014–2015 (Table P.9). Lastly, the percentage of SBP participants in high schools with inadequate usual intakes of vitamin C increased over time (from 10 to 35 percent).

¹⁵⁰ As noted previously, Devaney et al. (2007) pointed out that the diets of most of the U.S. population do not meet the EAR for vitamin E, yet vitamin E deficiency is rare. They noted limitations of both the data used to establish the EAR and the data used to assess vitamin E intakes.

3. Calcium, Potassium, and Dietary Fiber

There were no statistically significant changes over time in mean usual intakes of calcium among SBP participants or matched nonparticipants (Table P.6). Overall, mean usual intakes of potassium decreased significantly among SBP participants (from 63 to 58 percent of the AI), but none of the differences for students in different types of schools were statistically significant (Tables P.7–P.9). For both SBP participants and matched nonparticipants, overall and by school type, mean usual intakes of dietary fiber increased significantly over time (Tables P.6–P.9).

4. Sodium

Overall, prevalence of excessive sodium intakes did not change significantly over time among SBP participants. However, the prevalence of excessive sodium intakes increased significantly among matched nonparticipants (from 87 to 96 percent) (Table P.6). None of the differences observed between SBP participants and matched nonparticipants in each school type were statistically significant (Table P.7–P.9).

Overall, the prevalence of excessive sodium intakes did not change significantly over time among SBP participants. However, the prevalence of excessive sodium intakes increased significantly among matched nonparticipants.

D. Healthy Eating Index Scores for SBP Participants and Nonparticipants

Overall, mean scores for total fruit and whole fruit increased significantly between SY 2004–2005 (SNDA-III) and SY 2014–2015 (SNMCS) for both SBP participants and matched nonparticipants (Table P.10).¹⁵¹ This general pattern was observed for all three school types, but the differences were not always statistically significant. Among SBP participants, there was a small but statistically significant decrease over time in the score for total vegetables (from 2.6 to 2.2 points out of a possible 5).

Overall, the score for dairy did not change significantly between SY 2004–2005 and SY 2014–2015 for SBP participants. However, among matched nonparticipants, the score for dairy increased significantly over time (from 7.8 to 9.2 points out of a possible 10). This pattern was also observed among matched nonparticipants in elementary and middle schools. Among SBP participants in high schools, the score for dairy increased by 2 points (from 7.3 to 9.3 points out of 10) over time.

¹⁵¹ All students, including those who did not consume a breakfast, were included in these analyses.

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