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School Nutrition and Meal Cost Study
Study Design, Sampling, and Data Collection

Mathematica Policy Research • Abt Associates Inc. • Agralytica • April 2019

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LIST OF ACRONYMS

AMPM	Automated Multiple-Pass Method
ARS	USDA Agricultural Research Service
CACFP	Child and Adult Care Food Program
CAPI	Computer-assisted personal interview
CATI	Computer-assisted telephone interview
CCD	Common Core of Data
CN	Child nutrition
EMS	Electronic Menu Survey
FI	Field interviewer
FNS	Food and Nutrition Service
FNDDS	Food and Nutrient Database for Dietary Studies
FPED	Food Patterns Equivalent Database
FPID	Food Patterns Equivalent Ingredients Database
FY	Fiscal year
MOS	Measure of size
NSLP	National School Lunch Program
PES	Price Entry System
PIPS	Post-Interview Processing System
POS	Point of sale
PPS	Probability proportionate to size
PWS	Plate waste study
RA	Research associate
RR	Response rate
SBP	School Breakfast Program
SFA	School food authority
SLBCS	School Lunch and Breakfast Cost Study
SNDA	School Nutrition Dietary Assessment Study
SNM	School nutrition manager
SNMCS	School Nutrition and Meal Cost Study
SY	School year
TA	Technical associate
TI	Telephone interviewer
USDA	United States Department of Agriculture

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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 approximately 30 million Federally subsidized lunches and 15 million Federally subsidized breakfasts to children each school day (USDA FNS 2017a and 2017b). 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 fruit 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 a 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 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, parent and student satisfaction, plate waste, and student 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 of SY 2014–2015. Study findings are presented in four report volumes and a summary report. Volume 1 (Forrestal et al. 2019) provides information about school meal program operations and characteristics of 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 (Fox et al. 2019) describes student participation, satisfaction, plate waste, and dietary intakes. The summary report (Fox and Gearan 2019) highlights key findings across the four volumes.

This methodology report describes the design of the SNMCS, as well as sampling, recruitment, data collection, and data processing procedures. The remainder of this volume is organized into five chapters. Chapter 2 describes the sample design and selection of SFAs, schools, and students. Chapter 3 describes recruitment and data collection procedures and response rates. Chapter 4 describes processing of the menu survey data—the data collected from schools to assess the food and nutrient content of school meals—and Chapter 5 describes processing of the 24-hour dietary recall data collected from students. Finally, Chapter 6 describes the calculation of sample weights to obtain nationally representative estimates from the study sample. Technical documentation of the methods used to analyze data is included in the four report volumes that present findings related to each study objective.

2. SAMPLE DESIGN AND SELECTION

The overall objective of the SNMCS sample design was to provide nationally representative samples of public SFAs, schools, students (and their parents), and meals in the 48 contiguous states and the District of Columbia for SY 2014–2015. The sample was designed to provide statistically precise estimates while minimizing data collection costs and respondent burden. To achieve the goals of the SNMCS, data were collected from SFAs, schools, and students and their parents. In addition, data were collected on the types and amounts of food wasted (plate waste) in reimbursable lunches and breakfasts served to or selected by students. More-specific details about the data collection plan are provided in Chapter 3.

A. Overview of the Sample Design

The universe for the SNMCS includes public SFAs and schools participating in the NSLP, the students enrolled in these schools (and their parents), and the breakfasts and lunches served in these schools.[1] The data collected for the SNMCS from samples of these groups are used to provide unbiased and precise estimates at each level.

The sample was designed to yield observations on 502 unique SFAs,[2] 1,200 schools, 2,400 students and their parents, and plate waste observations of 5,040 and 3,360 lunches and breakfasts, respectively.[3] Most SFAs and schools were sampled for data collection from all the various survey instruments, whereas a subsample of SFAs and schools were sampled for data collection from just a select number of instruments. This approach, described in more detail below, maximizes statistical precision and data quality while minimizing respondent burden.

The sampling approach involved first randomly dividing a sampling frame of all SFAs into three separate groups (SFA subframes). Before doing so, the study team removed the five largest SFAs and SFAs serving charter schools from the frame. Figure 2.1 summarizes the three groups of SFAs included in the SFA subframes. The makeup of and data collection plans for each group are summarized below. Note that the five largest SFAs[4] were included in two of the three groups but all other SFAs were sampled in only one of the three groups:

---

[1] The study team excluded from the sampling universe SFAs serving only institutionalized populations and SFAs operated by States or the Federal government. Based on guidance from FNS, the team also excluded charter schools from the sampling universe for the school-, student-, and meal-level analyses. However, SFAs that serve charter schools only (as well as SFAs serving both regular and charter schools) were included for some SFA-level analyses. Private schools and SFAs serving only private schools only are not part of the SNMCS sampling universe and were excluded from all sampling frames.

[2] As explained further below, the five large (certainty selection) SFAs are included in both Groups 2 and 3.

[3] Sample sizes described in this chapter are stated in terms of numbers of *participating* SFAs, schools, students, and parents and the number of meals collected, unless otherwise noted. The sizes of the samples initially *selected* were larger and included main and backup selections and reserve sample selections to allow for nonparticipation due to ineligibility or noncooperation as described in more detail in Section C. Backup and reserve samples were released when needed to achieve the desired number of completes, and all were incorporated into calculations of weights and response rates.

[4] The five largest SFAs and their schools were selected to participate in both Group 2 and Group 3.

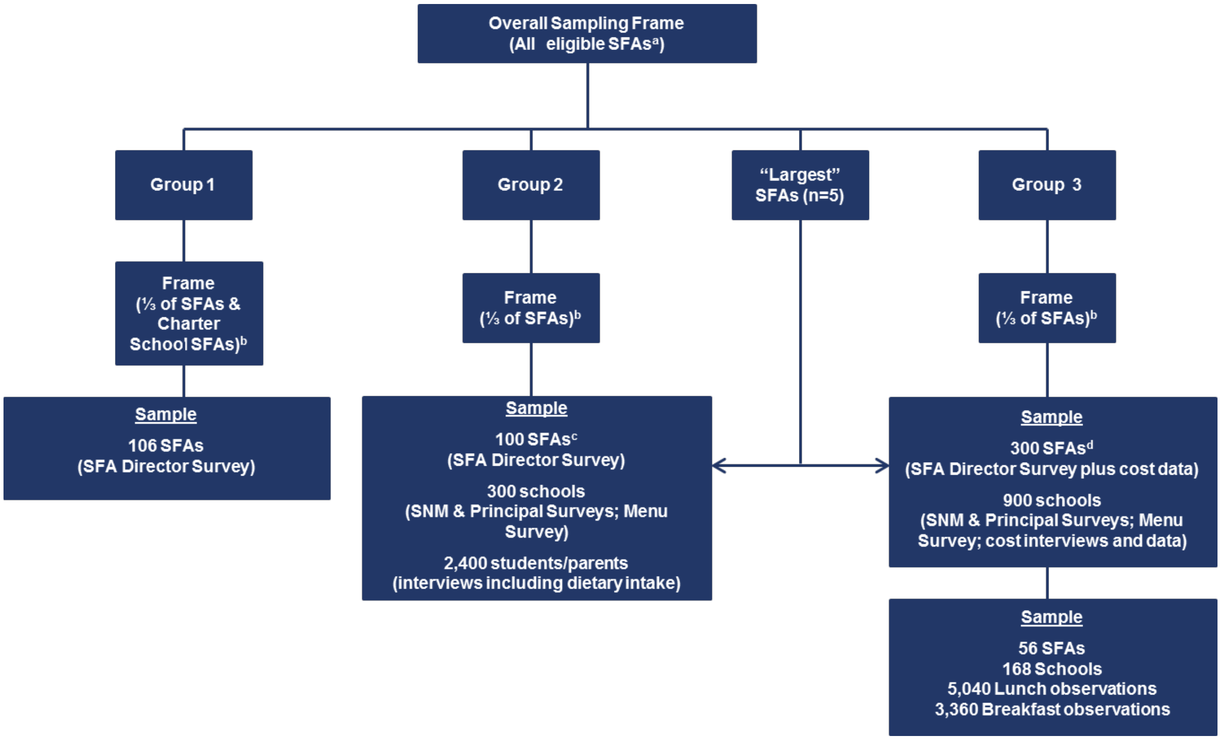
- **Group 1** included only SFAs. Group 1 SFAs were sampled to participate in the SFA Director Survey and to provide the precision required for estimates of SFA characteristics and policies, but did not participate in any of the school- or student-level data collection activities. SFAs that served only charter schools were represented in the Group 1 sample, but not in the Group 2 or Group 3 samples. The study team sampled enough SFAs to target 106 participating SFAs from Group 1.
- **Group 2** included SFAs, schools, and students and their parents. The Group 2 sample included the 5 largest SFAs and 15 schools sampled from those SFAs (3 schools per SFA), plus a sample of 95 other SFAs and 285 of their schools. Group 2 SFAs and schools were sampled to participate in the SFA Director Survey, the Menu Survey, the School Nutrition Manager (SNM) Survey, and the Principal Survey. In addition, in Group 2 schools, the study team targeted 2,400 complete interviews with students (and their parents).
- **Group 3** included SFAs, schools, and observations of plate waste in lunch and breakfast meals. The Group 3 sample included the 5 largest SFAs and 15 of their schools (different schools than those sampled for Group 2), plus a sample of 295 other SFAs and 885 of their schools. Group 3 SFAs and schools were sampled to participate in the SFA Director Survey, an expanded Menu Survey (which collected data needed to estimate meal costs), the SNM and Principal Surveys, and a number of additional staff interviews that collected detailed information about costs and revenues. A subset of Group 3 SFAs and schools were sampled for collection of competitive foods checklists and plate waste observations. For the plate waste observations, the study team targeted 5,040 NSLP lunches and 3,360 SBP breakfasts in 170 schools within 57 subsampled SFAs.

As discussed further in Chapter 3, not all sampled and released SFAs, schools, students, and parents participated in data collection. Table 2.1 shows the respondent universe, initial samples, and completed samples for each level and instrument. Chapter 3 describes data collection instruments in detail.

B. Sampling Frames

Selecting the samples required high-quality sampling frames at each stage. To select the samples of SFAs, the study team constructed a frame using data from the most recently available Form FNS-742 Verification Summary Report (SY 2012–2013 version) and data from the Common Core of Data (CCD) Local Education Agency (School District) Universe Survey, which is collected annually by the U.S. Department of Education's National Center for Education Statistics. A file from the Census Bureau—Small Area Income and Poverty Estimates—that contains school district-level estimates of school-age children in poverty supplemented this frame. The FNS-742 file contained 18,673 records. After exclusions and additions of some eligible school districts that were on the CCD but not the Form FNS-742, the SFA sampling frame contained 17,136 SFAs. The study team excluded SFAs from the frame if they were outside the contiguous (48) United States or the District of Columbia. Other exclusions included SFAs identified as operated by the Federal or State governments or serving institutionalized populations (for example, juvenile facilities), as well as SFAs serving private schools only.

Figure 2.1. Sample Design Summary



Note: Sample sizes refer to target number of participating SFAs, schools, students, lunch observations, and breakfast observations (actual number of participating SFAs, schools, students, and lunch and breakfast observations are provided in Table 2.1).

[a]SFAs serving public schools in the contiguous (48) United States plus the District of Columbia. SFAs serving only institutional populations, or operated by States or the federal government were excluded, along with SFAs serving only private schools.

[b]One-third of SFAs after the 5 largest SFAs were removed; Group 1 frame also included all SFAs serving charter schools only.

[c]Group 2 sample included the 5 largest SFAs and 15 schools from those SFAs, plus 95 other SFAs and 285 schools from those SFAs.

[d]Group 3 sample included the same 5 largest SFAs and 15 schools (different than the ones selected for Group 2) from those SFAs; in addition, 295 SFAs and 885 schools were targeted to participate.

The frame for selecting schools within SFAs was based on the CCD school-level file.[5] It contains information on schools' enrollment, grade configuration, and location, as well as demographic information about the student body. In some SFAs, the CCD might not be current due to recent school closures, mergers, or additions, or it could have inadequate information for constructing the school sampling frame. The school frames within SFAs were updated with new and closed schools once school recruitment within SFAs began and the study team was able to obtain more accurate, up-to-date school lists from the SFAs. New schools were given a chance of being selected into the school sample, and sampled schools that had since closed were dropped from the sample, as well as any schools not participating in the NSLP.

[5] Specifically, the study team used a file from the Public Elementary/Secondary School Universe Study to obtain a list of schools for all participating SFAs. If the schools were not available for a particular SFA, the team obtained the lists of schools directly from the SFA.

The sampling frames for students were based on student enrollment lists obtained from sampled schools.

Table 2.1. Respondent Universe, Released Samples, and Completed Samples

	Respondent Universe	Released Sample	Completed Sample
SFA Recruitment	15,260	633	548[a]
SFA Director Survey		548	518
SFA Cost Data		310	286
School Recruitment	93,780	1,284	1,282
Menu Survey		1,282	1,207
School Nutrition Manager Survey		1,282	1,210
A la Carte Checklist		1,282	1,210
Principal Survey		1,282	1,090
Competitive Foods Checklists			
Vending Machine Checklist		1,104[b]	858
Other Sources Checklist		1,104[b]	858
Cafeteria Observation Guide		1,282	1,257
School Cost Data		972	880
Student Recruitment	39,627,503	5,033	4,141
Child/Youth Interview, including Height and Weight		3,591[c]	2,165[d]
Parent Interview		2,165	1,850
24-Hour Dietary Recall			
First recall		3,591[c]	2,165
Second recall		889	583
Reimbursable Meal Sales Administrative Data		2,165	1,961
Plate Waste Observations[e]	NA		
Lunch		7,559	6,253
Breakfast		4,051	3,601

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

[a]This includes Group 1 SFAs that were not recruited in advance but were considered recruited upon completion of the SFA Director Survey.

[b]A subset of Group 3 schools were sampled for collection of competitive foods checklists.

[c]Initial sample includes recruited students who were released for data collection.

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

[e]The released plate waste sample represents all trays tagged for observation in 170 schools for lunch and 157 schools for breakfast. The completed sample excludes trays that were not returned after the meal period, trays that were observed in schools that had incomplete data for the Menu Survey (and were not included in the Menu Survey analysis), and trays with one or more items that could not be matched to the Menu Survey. The completed sample includes 165 schools for lunch and 154 schools for breakfast.

SFA = school food authority.

C. Sample Selection

1. Sampling SFAs

After preparing the sampling frame for SFAs, the study team selected SFAs in four steps: (1) identify the overall certainty SFA selections (discussed further below); (2) set aside any SFAs that serve only charter schools so they could be assigned to Group 1; (3) use random selection methods to assign the remaining (noncertainty) SFAs to the three sampling groups (or subframes); and (4) select one sample of SFAs from each of the three subframes. The study team selected the Group 1 sample of SFAs—those that were recruited to participate only in the SFA

Director Survey—using sequential random selection. Group 2 SFA sampling used stratified probability proportionate to size (PPS) selection of pairs of SFAs where student enrollment was the measure of size (MOS). Lastly, Group 3 SFAs were sampled using stratified PPS selection of pairs of SFAs where the square root of student enrollment was the MOS. Before PPS sampling, the study team stratified the Group 2 and Group 3 SFA subframes by SFA size category (based on the number of schools) so that smaller SFAs (those with fewer than six schools) were in one stratum, the larger SFAs (those smaller than the five largest SFAs but likely to be selected with certainty when the PPS samples were selected within Groups 2 and 3) in a second explicit stratum, and all other SFAs in a third. SFAs in the "small SFA" strata were undersampled (relative to their proportion of all SFAs) to reduce the chances of sampling SFAs with very few schools.

By design, each of the initial samples of SFAs was larger than the final sample required. Larger initial samples are required to account for sampled SFAs that might be ineligible, refuse to participate in the study, or have to be excluded from the study for other reasons. The sampling process must facilitate replacement of nonparticipating SFAs in an efficient manner that allows for calculating appropriate survey weights for analysis.

In the earlier related School Nutrition Dietary Assessment (SNDA) studies, attrition was dealt with by selecting pairs of similar SFAs and randomly assigning one from the pair to be initially contacted and the other to be a backup. Because there have been cases in which neither SFA in a pair can be recruited, the study team used this same strategy for Groups 2 and 3, but also supplemented the sampled pairs with a pool of additional replacement pairs. That is, the team selected twice the number of SFAs needed by pairing, plus an extra 10 percent of pairs to be used as replacements to prepare for cases in which neither SFA in a pair participated in the study.[6] SFAs in Groups 2 and 3 were formed into pairs prior to sampling using the following variables: FNS region, SFA size, urbanicity, and poverty level.

a. Selecting the Overall Certainty SFA Sample (Largest SFAs)

The study team established sampling rates based on sample allocation and MOS based on student enrollment and determined which SFAs would be selected with certainty.[7] These largest SFAs were identified and sampled with certainty and assigned to both Groups 2 and 3.[8] After forming subframes for Groups 2 and 3 and determining SFA selection probabilities for those groups, the team identified additional certainty selections to be made within one group or the other. These additional certainty selections were not considered to be part of the *overall* certainty SFAs.

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[6] In recruiting, if the main selection in a pair did not participate, the study team contacted and attempted to recruit the other SFA in that pair. The replacement sample SFAs were recruited and used in two circumstances: (1) neither SFA in a pair agreed to participate in the recruiting stage, or (2) a recruited SFA did not complete data collection. If replacement SFAs were not needed, they were notified near the end of data collection.

[7] In cases in which PPS methods are used, some sampling units (in this case SFAs) might have MOSs large enough that they are certain to be selected into the sample (that is, their probability of selection is 1.0).

[8] To allow for nonparticipation by one or more of these largest SFAs, the study team randomly designated two or more replacement pairs from the samples for "larger SFA" strata for Groups 2 and 3 to serve as potential replacements for the largest SFAs.

b. Selecting the Three Groups of SFAs

After the five largest SFAs (overall certainty selections) were designated and assigned to both Groups 2 and 3, the study team assigned all SFAs that serve only charter schools to the Group 1 frame. The team then used random sampling procedures to assign the remaining SFAs (excluding the largest certainty selections and those that serve only charter schools) to the Group 1, 2, and 3 frames. Chromy's sequential selection (available in SAS PROC SURVEYSELECT) was used to organize the frame into three subframes, each containing approximately[9] one-third of the remaining SFAs by sampling one-third of the remaining SFAs in the frame for each of the Groups. These three subframes served as the sampling frames for selecting the SFA samples for Groups 1, 2, and 3. Prior to sampling, the team formed SFAs into pairs within the Group 2 and 3 subframes using the following variables: FNS region, SFA size, urbanicity, and poverty level.

Sampling SFAs for Group 1. The study team selected the Group 1 SFAs using a sequential random sampling design (that is, selecting with equal probability). This method best serves the purpose of the Group 1 sample, which is to add observations to the SFA director survey so that SFA characteristics across all three groups can be measured precisely. The team used implicit stratification on SFA size (based on the number of schools), FNS region, urbanicity, and charter-only SFA indicator to ensure proportionate representation in the sample of SFAs defined by these characteristics. The Group 1 sample contained no certainty selections because selection was done with equal probabilities.[10]

Sampling SFAs for Group 2. The Group 2 SFA sample included the 5 largest SFAs and a sample of 95 other SFA pairs selected using stratified PPS selection. Before selecting the final PPS sample, the study team identified certainty selections specific to Group 2 (beyond the 5 largest SFAs) and explicitly stratified those not sampled with certainty by SFA size. The PPS selection used total enrollment as the MOS, because the primary objective of the Group 2 sample is to provide a sample of students that will yield precise estimates of student-level outcomes. This PPS approach with enrollment as the MOS aimed for a sample of students selected with close to equal probabilities of selection. This leads to more precise estimates because it reduces the loss of precision due to unequal analysis weights.[11] Chromy's sequential selection procedure selected the Group 2 sample of SFAs within explicit strata, where more SFAs were sampled from the stratum with larger SFAs.

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[9] This statement comes with a few caveats. The Group 1 frame included more total SFAs because all SFAs that serve only charter schools were placed in Group 1. Because the study team sampled three times as many SFAs from Group 3 relative to Group 2 to achieve the desired precision for outcomes based solely on the Group 3 sample, the team allocated a larger number of SFAs to the Group 3 subframe. The allocation of SFAs to the subframes for Groups 2 and 3 was done so that the sampling did not lead to an excessive number of certainty selections in Group 3.

[10] The replacement sample for Group 1 was used if there was a shortfall in the number of SFAs participating in the SFA Director Survey.

[11] As discussed in a later section, the basic weight for the student sample will be the sampling weight (inverse of each student's probability of selection into the sample). Although there will be adjustments to the weights for nonresponse, starting with sampling weights that are close to equal will help reduce the variability of the final analysis weights.

Sampling SFAs for Group 3. The Group 3 sample of SFAs included the 5 largest SFAs and a sample of 295 other SFA pairs selected using stratified PPS selection. As with the Group 2 sample, the study team identified any certainty selections beyond the 5 largest SFAs before selecting the final PPS sample. The MOS was the square root of enrollment. This was the MOS used for the earlier School Lunch and Breakfast Cost Study II (SLBCS-II) and is appropriate to balance the precision of the two kinds of meal cost estimates that will be produced (one weighted by SFAs and the other by the number of reimbursable meals provided by SFAs). As with the Group 2 sample, the team stratified the frame before making other (noncertainty) selections, explicitly by SFA size, and selected the sample using the Chromy method within explicit strata, where more SFAs were sampled from the stratum with larger SFAs.

2. Sampling Schools

The study team sampled schools from both Group 2 and Group 3 SFAs. For most SFAs, the target was three participating schools per SFA. The CCD file of schools provided the basis of the sampling frame for each SFA on. Strata for sampling were based on school type (elementary, middle, and high schools[12]). Before sampling, the team removed from the school-level frames schools that served only prekindergarten or kindergarten students and special education schools. Schools that did not participate in NSLP or SBP or were residential or institutional (for example, served correctional facilities) were also ineligible. PPS sampling for Groups 2 and 3 used student enrollment as the MOS for Group 2 and the square root of enrollment as the MOS for Group 3.

As in the case of SFAs, sampling strategies for schools allowed for attrition (ineligibility and nonparticipation). Selections consisted of up to eight schools in each SFA using wave sampling where in Wave 1 the team selected a maximum of six schools from each SFA and three were selected for the main sample; in Wave 2, 4 schools for the main sample; and in Wave 3, 5 schools for the main sample (selecting all in cases where less schools existed in the SFA). For the Wave 1 sampling, in SFAs that serve all types (elementary, middle, and high school) and that contain at least two potentially eligible schools in each type, the team selected two schools from each type plus another pair from one of the types).[13] The initial three pairs of schools within a type served as the principal sample in the SFA; the fourth pair served as a reserve. Within each pair, the study team randomly assigned one school to be the main selection and the other to be the backup. In SFAs with eight or more schools but where one or more types (elementary, middle, or high school) have fewer than two schools, the main sample included three schools and the replacement sample three schools, plus a reserve of two schools. If there were four to six schools in an SFA, the team sampled four schools: three for the main sample and one reserve, the remainder being replacements. Reserve schools from other SFAs compensated for sampled SFAs where not enough schools were available to achieve a total of three participating schools.

[12] Schools where the lowest grade is K–3 or where the highest grade is ungraded or lower than 8 were treated as elementary schools for sampling purposes. Middle schools included those where the grade span is from grades 4 or 5 to grades 8 or higher and those serving only grades in the range 6–9. High schools included those where the lowest grade is 6 or higher and where the highest grade is 10 or higher.

[13] If only one school type had more than four schools, then that type was the source of the extra pair. If there were more than four schools in two or three types, the type of the extra pair was determined randomly. If there were only two nonselected schools of differing types, the study team selected them both as the extra pair.

The Group 2 and Group 3 samples each included 15 participating schools that were each from the five largest SFAs (30 schools were sampled and then each SFA's schools were randomly divided equally among Groups 2 and 3).[14] Group 2 included another 285 participating schools (for a total of 300 schools), and Group 3 included an additional 885 participating schools (for a total of 900 participating schools).[15]

3. Sampling Students

The study team selected the student sample from within the 310[16] participating Group 2 schools. The sampling frame in each school was a roster of students obtained from either school or district records. Students were sampled from a list of identification numbers, and those numbers were linked to names of sampled students; districts' requirements informed the consent process for selecting the student sample (see discussion in Chapter 3).

The goal for the student sample was to obtain completed interviews for at least 2,400 students and their parents, distributed equally (800 each) across school types (elementary, middle, and high schools), which served as sampling strata for the students.[17] To obtain 2,400 completes—defined as interviews with both student and parent—the team estimated that the study needed an initial sample of 3,663 students. This assumed parental consent obtained for 75 percent of sampled students (2,747) and that 96 percent[18] of consented students (2,637) would be eligible for the study and complete the interview—that is, they would be in school on the day for which the dietary recall interview was collecting information, would not be in an ineligible group, and would complete the interview. Sampled students ended up being ineligible for the survey if they left the school (moved, transferred, or dropped out), were in an ineligible group (such as a self-contained special education program), or were absent on the "target day" for dietary recall data. The study team assumed that after students were interviewed, interviews would be conducted with 91 percent of the parents overall,[19] leading to 2,400 completes for both

[14] One issue with sampling schools in the largest SFAs is that the methods the study team used for sampling schools differ between Groups 2 and 3. The team considered splitting the school sampling frames in the largest SFAs (as the SFA frame was split) before selection. However, the anticipated costs and benefits of that approach led the study team to propose using the Group 2 procedures to sample all schools in the five largest SFAs. The rationale for preferring Group 2 procedures over those for Group 3 is that the Group 2 sample has fewer schools and would be more adversely affected by having schools chosen in these SFAs using methods that differed from those used in other SFAs.

[15] In most cases, three pairs of schools were selected from each SFA, where one from each pair was selected for participation and the other served as a backup. However, additional schools were selected from larger sampled SFAs to balance out the fact that fewer than three schools were selected from smaller sampled SFAs.

[16] 310 schools were recruited into the sample, rather than the target of 300 schools, anticipating potential attrition of school participation at a later point in the study.

[17] As described in greater detail in Chapter 3, the Child/Youth Interview was in person and the Parent Interview was in-person for parents of elementary students and by telephone for parents of middle and high school students. The Day 1 Dietary Recall was in-person; the Day 2 Dietary Recall with a subset of students was by telephone (recalls with elementary school children included parental assistance).

[18] Ninety-eight percent of elementary and 95 percent of secondary students.

[19] Ninety-five percent of elementary and 89 percent of secondary student parents.

student and parent interviews. These assumptions used in building target samples were informed by experiences on the SNDA-III study.

The study team attempted to collect first dietary recall data from all sampled students. A second dietary recall was needed from a subsample of students to construct estimates of usual dietary intakes. The goal was to obtain a second dietary recall for 25 percent of students with full first-day completes, assuming telephone interviews attempts with about 708 students with an 85 percent response rate would yield the desired 600 second-day recalls (25 percent of the first-day sample).

4. Sampling Lunches and Breakfasts for the Plate Waste Study

The study team collected observational plate waste data in a subsample of SFAs recruited for Group 3 as described below. The final recruited sample comprised 62 SFAs and 3 schools per SFA (one elementary, middle, and high school in each), for a total of 186 schools in the plate waste study (PWS).

Operational considerations led to imposition of a number of eligibility criteria for schools in the PWS. Schools designated as pre-eligible for the PWS served at least 160 daily lunches to assure the feasibility of at least 30 lunch observations per school day. Meals had to be served in cafeterias, and students had to be required to consume the meals in the cafeteria because plate waste observation was infeasible in schools where students were allowed to disperse with their food throughout the school building or grounds. To avoid excluding too many otherwise eligible schools, breakfast service did not factor into eligibility restrictions.

The study team selected and recruited the PWS sample of SFAs in four phases: (1) select 48 SFAs for the main PWS sample from among those selected for the first wave of recruiting for the Objective 3 cost study, (2) select 8 SFAs for the main PWS sample from SFAs selected for Wave 2 of the cost study recruiting, (3) select 46 backup SFAs from among the remaining eligible SFAs in Waves 1 and 2 of the cost study recruiting, and (4) recruit 58 of the SFAs selected in the first three phases and selected and recruited four additional SFAs to complete the sample. These phases, plus the associated school sampling, are summarized in Table 2.2 and described below.

Table 2.2. Summary of Plate Waste Study Sampling

	Pre-eligible	Selected		Recruited	
Phase	SFAs	SFAs	Schools	SFAs	Schools
1: Selection from cost study Wave 1 Main SFA sample	94	48	144	27	81
2: Selection from cost study Wave 2 Main SFA sample	13	8	24	4	12
3: Selection of Backup SFAs for PWS from cost study Waves 1 and 2 Samples	51	46	138	27	81
Opportunistic supplements	N/A	N/A	N/A	4	12
Total	**158**	**102**	**306**	**62**	**186**

PWS = plate waste study; SFA = school food authority; N/A = not applicable.

The study team coordinated SFA PWS sampling with Waves 1 and 2 of the SFA recruiting for the cost study,[20] determining which *schools* in the Group 3 study sample were considered pre-eligible for the PWS, using criteria based on estimates of the expected number of usable observations of lunches. The team then identified as pre-eligible those SFAs recruited for Group 3 that had at least one eligible school for each school type within the set of main schools selected for the SFA for the cost study. Using these rules, 94 of the 251 main SFAs in Wave 1 of the Group 3 sample were found to be pre-eligible for the PWS.

The study team then selected 48 main SFAs for the PWS from the 94 that were pre-eligible for the PWS in Wave 1 of Group 3. The MOS was the weighted sum of projected PWS observations in the sample schools. Given a sample size of 48 SFAs, 13 SFAs with MOS > (0.65)/48 were selected with conditional certainty. PPS selection using SAS PROC SURVEYSELECT selected the other 35 SFAs.

Within these 48 SFAs, the study team selected a subsample of 144 main schools from the 173 already selected for the cost study. The MOS for the school sampling was constructed using three variables: (1) the SFA plate waste weight, which was the product of the weight for the SFA for the cost study and the inverse probability of selection of the SFA from the 94 pre-eligible SFAs within Wave 1 of Group 3, (2) the school base weight (based on the school's probability of selection for the cost study within the SFA), and (3) the projected meal observations at the school type. Based on this MOS, 115 schools were selected with certainty and 29 were randomly selected with PPS using SAS PROC SURVEYSELECT.

To complete the planned initial sample of 56 SFAs, the study team selected 8 additional SFAs for the PWS from the 13 pre-eligible SFAs recruited for the cost study in Wave 2.[21] The team used the same pre-eligibility criteria and sampling procedures as in selecting SFAs from Wave 1. The 13 SFAs included 3 selected with certainty and 5 of the remaining 10 SFAs selected in the same manner as discussed above for Wave 1. These 8 SFAs selected to complete the main SFA sample contained 30 main schools that were pre-eligible for the PWS using the rules discussed above. Because the PWS only wanted 3 main schools from each PWS SFA, the team selected 24 additional schools using the same school sampling procedures as discussed above for Wave 1.

The first two phases of the sample selection process resulted in selecting a total of 56 SFAs as the main PWS sample and left 51 SFAs available as backup PWS SFAs (out of the 107 SFAs pre-recruited in Waves 1 and 2 for the cost study and pre-eligible for the PWS). The study team matched these 51 SFAs to the 56 main PWA SFAs with a many-to-many matching procedure using the percentage of students certified for free or reduced-price meals. The many-to-many matching procedure matched 46 backup SFAs multiple times to the 56 main PWS SFAs, and each main PWS SFA had exactly four potential backups.

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[20] The study team assigned SFAs sampled for the SNMCS to one of three waves for recruiting. (SFAs were recruited for the SNMCS in two waves, with a third wave designated as a reserve.) Sampling for the PWS depended on SFAs being recruited for the cost study, so the PWS sampling followed the waves of recruiting.

[21] One of the largest SFAs that was recruited in Wave 1 was also included in this second round of PWS sampling due to logistical considerations.

3. DATA COLLECTION

This chapter describes recruitment and data collection procedures, training of data collection staff, and response rates. Section A describes the approach used in recruiting SFAs, schools, and students and their parents to participate in the SNMCS. Section B covers the procedures used to collect data from study participants. The remaining sections discuss the training of data collectors and response rates for each of the data collection instruments.

A. Recruiting Study Participants

As described in Section 2.A, the study included three sample groups: Group 1 included only SFAs; Group 2 included SFAs, schools, and parents/students; and Group 3 included SFAs and schools. Recruiting SFAs began immediately after the Office of Management and Budget granted approval for the study to begin recruitment and data collection.

1. SFA and School Recruitment

Prior to individual outreach, the study team contacted the School Nutrition Association and FNS regional offices for letters of endorsement or support. The team worked with FNS to gain support at the regional and state levels and confirmed SFA and school contact information with State CN directors.

Recruitment materials were mailed to all Group 2 and 3 SFA directors; Group 1 SFAs were not recruited in advance because they were only asked to complete a single data collection instrument, the SFA director survey. The mailing included an introductory letter from FNS, any letters of endorsement, a fact sheet about the project, and an enclosure with contact information for sampled schools. Recruiters made follow-up telephone calls to confirm receipt of the mailing, assess eligibility (that is, confirm that the SFA participates in the NSLP and none of the sampled schools are charter schools or residential facilities), describe study objectives, address any SFA concerns, explain the study timeline and participation requirements, confirm contact information for study schools,[22] and inquire about basic school food service characteristics (for example, participation in the SBP or whether meals are prepared in an off-site kitchen). During the calls, they also discussed monetary incentives, which are presented in Table 3.1.[23]

The recruiting process included executing memoranda of understanding with all Group 2 and Group 3 SFAs, as well as identifying school liaisons for Group 2 and a portion of Group 3 schools. The study team gathered information needed for planning data collection during recruitment, completing a Planning Interview in Group 2 and the School Nutrition Manager Pre-Visit Questionnaire in Group 3 to further screen schools for study eligibility and collect basic information used to classify schools for data collection. Other planning activities completed during recruitment included scheduling data collection target weeks, conducting student sampling and pursuing necessary parent and student consent processes in Group 2 schools,

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[22] For any sampled school in Groups 2 and 3 that had been closed, the study team substituted a replacement school. The team also asked the SFA director for the names of any schools newly opened and gave new schools an opportunity to be selected into the SFA's school sample. If any individual sampled schools did not participate in the NSLP, despite their SFA participating, they were replaced at this stage.

[23] The study team adhered to district guidelines where employees are prohibited from accepting incentives.

determining the configuration of kitchens in preparation for the Menu Survey, specifying data pulls of records necessary for completion of on-site cost-related data collection in Group 3 schools, and generally arranging the logistics for on-site and other data collection activities.

Table 3.1. Incentive Payments for School Staff

Incentive Group	Check Amount
SNMs, Menu Survey, Group 2	$50
Group 2 School Liaisons[a]	$75
SNMs, Expanded Menu Survey, Group 3	$100
Group 3 School Liaisons[b]	
Elementary schools	N/A
Middle schools, 10 or fewer vending machines (no more than 5 beverage or 5 snack machines)	$15
High schools, 10 or fewer vending machines (no more than 5 beverage or 5 snack machines)	$30
Middle/high schools, 6 or more vending machines (at least 6 beverage or 6 snack machines)	$35

[a]Group 2 liaisons assisted with student sampling and consent, arranged on-site data collection, and reported competitive foods information.

[b]Group 3 liaisons were limited to reporting competitive foods information only.

N/A = not applicable; SNM = school nutrition manager.

After recruitment, the study team sent a confirmation letter to the SFA director summarizing plans for study participation and the schedule for the SFA's data collection. It also included copies of the brochure and endorsement letters and asked the SFA director to distribute these to sampled schools.

A total of 488 SFAs were released for recruitment in the Group 2 and 3 samples, including five of the largest SFAs that were released in both groups. Forty-nine SFAs were found to be ineligible (not participating in NSLP, serving a residential population, comprised of charter schools, or other exceptional circumstances) and 404 agreed to participate in the study, resulting in a 92 percent recruitment rate among eligible SFAs in Groups 2 and 3 (Table 3.2). This rate is based on all SFAs that were ever part of the recruitment effort, including replacements for SFAs in the main sample that refused to participate. In SFAs that agreed to participate, nearly 100 percent of the sampled schools were successfully recruited, although not all of them successfully completed specific data collection activities (as shown in the next section of this chapter).

The study team recruited Group 3 SFAs for participation in the PWS in addition to general study recruitment. As described in Chapter 2, SFAs were selected for the PWS as main and backup sample. Recruitment resulted in 31 participants of the 56 main PWS SFAs, 27 participants of the 46 backup PWS SFAs, and 4 additional SFAs outside of the main and backup PWS samples, for a total of 62 SFAs.[24] Within these 62 SFAs, 186 schools were recruited to participate in the PWS.

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[24] In order to achieve the final sample of 62 recruited SFAs, replacement rules were expanded by allowing Group 3 SFAs from Wave 3 to be part of the PWS as well as some of the 5 potential backup SFAs that had not been matched to any of the main PWS SFAs.

Table 3.2. Final SFA and School Recruitment Samples

	Number of SFAs/Schools					
	Recruited	Closed	Ineligible	Refused	Total	Percentage of eligible SFAs/schools recruited
Group 2						
SFAs[a]	99	N/A	6	14	119	87.6
Schools	310	6	13	2	331	99.4
Elementary	111	4	4	0	119	100.0
Middle	98	2	3	1	104	99.0
High	101	0	6	1	108	99.0
Group 3						
SFAs[a]	310	N/A	43	21	374	93.7
Schools	972	13	49	0	1,034	100.0
Elementary	363	2	14	0	379	100.0
Middle	310	3	7	0	320	100.0
High	299	8	28	0	335	100.0
Total						
SFAs[a]	404	N/A	49	35	488	92.0
Schools	1,282	19	62	2	1,365	99.8
Elementary	474	6	18	0	498	100.0
Middle	408	5	10	1	424	99.8
High	400	8	34	1	443	99.8

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

Note: Counts include Groups 2 and 3 only. Group 1 included only SFA-level data collection and one instrument (SFA Director Survey). SFAs in Group 1 were not recruited in advance of being asked to complete the SFA Director Survey.

[a]Five of the largest SFAs were sampled in both Group 2 and 3 and are included in both groups' counts; all five of these districts were recruited. Different schools from these districts were included in each group, so no schools are double-counted in this table.

N/A = not applicable; SFA = school food authority.

2. Student and Parent Recruitment

Recruitment of students and parents for dietary recalls and interviews began after the study team obtained student rosters from the SFA or school to use in selecting the sample. After randomly selecting students in each school (see Chapter 2), the study team worked with the school liaisons to obtain consent from parents to participate (along with their child) in the study. The team used a passive consent process whenever possible, providing parents or students the opportunity to decline to participate or opt out, although active consent was required by 31 (out of 310) schools in the Group 2 sample. Group 2 school liaisons were contacted before any direct outreach to parents and students to discuss the importance of the study and to solicit the liaisons' input on the best means of contacting parents. When documentation of active consent was required, liaisons, if willing, tracked returned consent forms, were available to field questions from parents (or refer them to the study team), and made follow-up contacts for unreturned forms.

Typically, each selected household received a mailed (or distributed via the school's preferred method) consent packet, including an invitation letter, a letter from the principal or district endorsing the study (if available), a study brochure tailored to parents with answers to frequently asked questions, a toll-free telephone number, a link to a study Facebook page, and parental consent and child assent forms. Recruiting materials were in both English and Spanish. Parents and/or students who did not wish to participate returned their signed forms in a postage-paid return envelope addressed to Mathematica that was included in the materials. When active consent was required (that is, when the district required the parent or guardian to provide permission for the minor to participate in the study), the preferred method for obtaining consent was verbally, through digitally recorded telephone calls, ideally following a mailing. When needed, adaptations to this approach based on district-specific requirements included obtaining a hard-copy signature either before or at the time of the interview.

Table 3.3 presents the incentive payment schedule for students and parents, payable upon successful completion of all data collection activities.

Table 3.3. Incentive Payments for Students and Parents

Sample Type	Incentive
Elementary School Students	$5
Elementary School Parents	$30
Middle/High School Students	$15 (or $20 if interviewed on Saturdays)[a]
Middle/High School Parents	$15 (by mailed check)
Second Dietary Recalls for Child/Parent Grouping	$25 plus measuring cups/spoons
Second Dietary Recalls for Middle/High School Students	$15 plus measuring cups/spoons

Note: Dollar amounts were provided as gift cards unless otherwise noted. A second-day dietary recall was completed with a subset of respondents in order to estimate usual dietary intakes.

[a]Some middle/high school students were interviewed on Saturdays to reflect Friday dietary intakes.

Recruitment for Group 2 students and parents was tracked at the student level. A student was considered successfully recruited when consent was obtained for that student, whether or not he or she participated in any data collection activities. A total of 5,033 students were targeted for recruitment. Of those, 4,141 provided consent, 236 opted out of participating, and 656 were in an active consent school and did not return their consent forms. Table 3.4 presents the final student recruitment samples.

Table 3.4. Final Student Recruitment Samples

	Number of Students				
	Recruited	Opted out	No response	Total	Percentage of students recruited
Students	4,141	236	656	5,033	82.3
Elementary	1,471	105	195	1,771	83.1
Middle	1,331	77	186	1,594	83.5
High	1,339	54	275	1,668	80.3

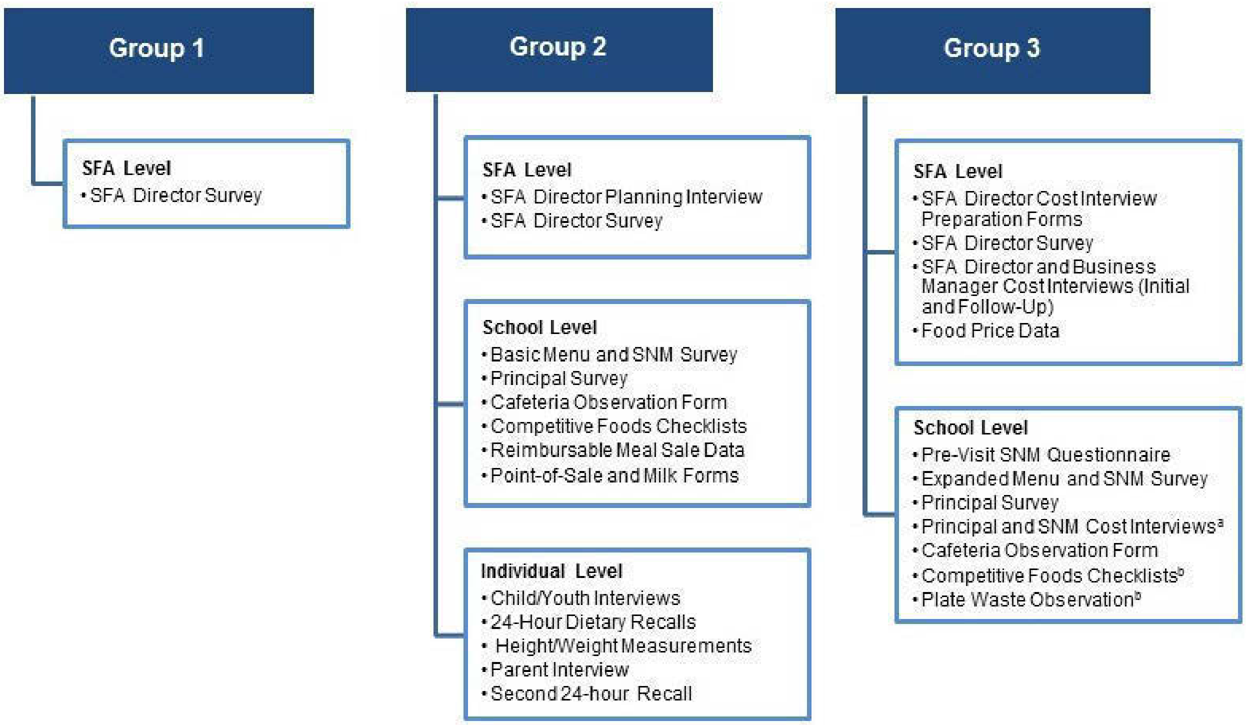
Source: School Nutrition and Meal Cost Study, school year 2014–2015.

Note: Counts include Group 2 only. No student-level data were collection in Groups 1 or 3.

B. Data Collection Procedures

The data collection approach is illustrated in Figure 3.1. Most data were collected over the period January to June 2015. Planning and pre-visit interviews took place in conjunction with SFA and school recruiting from September 2014 to February 2015. Group 3 SFAs completed follow-up interviews to collect final data on costs and revenues for SY 2014–2015 in fall and winter of SY 2015–2016. Table 3.5 provides an overview of the data collection instruments used in the study, and the subsequent text describes the instruments, grouped by the study's four research objectives.

Figure 3.1. Summary of Data Collection Activities by Group



[a]State education or Child Nutrition agencies were contacted to provide information on indirect cost rates of SFAs in their States—what the SFAs' reported costs cover and whether unreported costs are direct or indirect.

[b]Competitive foods checklists and plate waste observations were completed in a subsample of Group 3 schools.

SNM = school nutrition manager; SFA = school food authority.

Table 3.5. 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		
Vending Machine Checklist	School liaisons	Hard copy
Other Sources of Foods and Beverages Checklist	School liaisons	Hard copy
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 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 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.

1. Foodservice Operations and School Nutrition Environments

SFA directors in all three data collection groups, along with principals and SNMs in Groups 2 and 3, provided data, via self-administered web-based surveys, needed to characterize the school environment; foodservice operating policies and practices; and other characteristics of SFAs, schools, and students. SFAs and schools provided information about their experiences implementing the new competitive foods standards. The following instruments were used to address objective 1:

- **SFA Director Survey.** Group 1 SFA directors were sent an introductory letter about the study and an email invitation to complete the SFA Director Survey on the web, as they were not contacted during recruitment. SFA directors in Group 2 and 3 schools were invited to complete the SFA Director Survey during or shortly after the on-site data collection to ensure that the data collected about districts' 6 cents certification status were accurate for the period covered in the on-site "target week." Emails and telephone reminders to sample members encouraged participation, offering assistance via a toll-free help line and project email address.
- **School Nutrition Manager Survey.** The SNM Survey collected information about the characteristics of school kitchens, implementation of new meal and competitive food requirements, meal pricing, scheduling of meal periods, and nutrition promotion activities. It was integrated into the Menu Survey (discussed later in this chapter).
- **A la Carte Checklist.** The A la Carte Checklist documented whether a la carte foods were available to students at breakfast and/or lunch and, if so, the specific foods and beverages that were available. SNMs were asked to complete the checklist as part of the Menu Survey on one randomly selected day during the target week.
- **Competitive Foods Checklists.** The Competitive Foods Checklists, consisting of the Vending Machine Checklist and Other Sources of Food and Beverages Checklist, collected information about the number of competitive foods venues present in schools and the specific foods and beverages available in each venue. School liaisons in all Group 2 schools and a subset of Group 3 schools were asked to complete these hard-copy checklists in person during the target week, although they could also fax or email the completed forms later.
- **Principal Survey.** The Principal Survey collected information on mealtime policies, other activities scheduled during mealtimes, vending machines, school stores and snack bars, requirements for nutrition education and physical education, opportunities for physical activity during the school day, and school wellness policies. The Principal Survey deployed on a schedule similar to that of the SFA Director Survey, sending reminders via email and telephone. Principals completed the survey on the web.
- **Cafeteria Observation Guide.** Field interviewers (FIs) used the Cafeteria Observation Guide to record observations about the characteristics of school cafeteria facilities and capture the use of HealthierUS School Challenge Smarter Lunchroom techniques. The Cafeteria Observation Guide also collected data to assess compliance with the new serving line requirements. This guide was completed by FIs while on-site during the target week. FIs observed one randomly selected breakfast period (or 30 minutes of breakfast service if there was no designated breakfast period) and one randomly selected lunch period.

2. Nutritional Quality of School Meals

To collect data needed to assess the food and nutrient content and overall nutritional quality of school meals and afterschool snacks, SNMs completed a web-based Menu Survey.[25] The Menu Survey collected detailed information about the foods offered and served in reimbursable meals and afterschool snacks during one school week, called the "target week."[26] Due to holidays or other school closings, some schools completed the survey for only three or four days.

a. Overview of the Menu Survey

The Menu Survey was completed by Group 2 and Group 3 schools. Throughout the week-long data collection period, SNMs received intensive support from specially trained technical associates (TAs).

The Menu Survey used for study Objective 2 included the following forms:

- **Daily Meal Counts Form.** This collected the number of reimbursable breakfasts and lunches served at the school, by reimbursement category, each day of the target week. It also collected information on sales from non-reimbursable foods each day.
- **Reimbursable Foods Form for Lunch and Breakfast.** These forms were used to identify foods and beverages offered and served to students in reimbursable meals each day of the target week. Separate forms were completed for breakfast and lunch. The form was designed to collect, for each food and beverage offered, descriptive details needed for an accurate nutrient analysis, portion size, contributions to the meal pattern requirements, product information for specific types of commercially prepared foods, and the number of portions prepared, served in reimbursable meals, sold a la carte or to adults, left over, and wasted.
- **Recipe Form.** This form collected information about foods prepared from scratch or by combining two or more ingredients. The form asked for detailed information about the ingredients and amounts included in the recipe. Respondents could also provide copies of their own printed recipes via fax or mail, instead of completing the Recipe Form. Instructions emphasized the need to edit printed recipes to reflect any changes to ingredients or amounts during preparation.
- **Self-Serve/Made-to-Order Bar Form.** This form collected detailed information about self-serve bars such as salad bars and condiment bars, as well as made-to-order bars such as deli or sandwich bars. Respondents were asked to complete this form for each unique type of bar offered throughout the target week.
- **NSLP Afterschool Snack Form.** This form captured detailed information on foods offered and served in reimbursable afterschool snacks during the target week. Respondents that provided afterschool snacks through the NSLP were asked to complete the form each day snacks were offered and served.

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

[26] The Menu Survey collected additional information on SFA and school characteristics (as described in the previous section) and on non-reimbursable foods (as described in the next section).

The Menu Survey was designed to be completed online, using the Electronic Menu Survey (EMS). Prior to the target week, respondents viewed online training videos that described procedures for completing the Menu Survey forms and instructions for obtaining help at any time. Hard-copy forms were available for respondents who were unable or unwilling to complete the survey online. The EMS was a user-friendly system that included a number of features aimed at reducing burden on the respondent. For example, the forms presented to the respondent in the EMS were customized to match each school's foodservice program, based on responses to an initial set of questions. As respondents completed the forms each day, the system generated lists of foods that required recipe information (Recipe Form) or product information (for certain types of commercially prepared foods) so that information was provided only once per unique menu item. The EMS included a dashboard that allowed respondents to track their progress throughout the target week and easily identify remaining activities for the day or week. In addition, each form in the EMS included verification checks that alerted the respondent to missing or out-of-range data.

b. Menu Survey Data Collection Procedures

TAs had direct responsibility for working with respondents to ensure the timely completion of the Menu Survey. In general, one TA was responsible for all schools within an SFA. TAs provided respondents with technical assistance at key points during the data collection process.

- **Prior to the target week,** TAs initiated contact with the respondent to provide additional details about the Menu Survey, describe the online training for the EMS, and answer any initial questions. After the respondent completed the online training, the TA followed up to answer any questions and reminded the respondent to begin completing the survey on Monday. For respondents that completed a hard-copy survey, TAs scheduled and conducted a detailed telephone training on completing the hard-copy Menu Survey forms.
- **During the target week,** TAs monitored progress with the Menu Survey forms. TAs contacted respondents via email or telephone to answer questions or to follow up with respondents not completing forms in a timely manner. They also provided encouragement and assistance.
- **After the target week,** TAs reminded respondents to complete all remaining forms, as needed. TAs ensured that all relevant forms had been completed and that all recipes (if being submitted via fax or mail) had been received.

Once the TAs verified that the Menu Surveys were completed, the surveys were transferred to the team of nutrition research associates (RAs), who were responsible for reviewing the completed surveys, conducting data retrieval with respondents, and preparing the surveys for data entry (additional information is provided in Chapter 4).

3. School Meal Costs and Revenues

An expanded version of the Menu Survey described in the previous section was used with Group 3 schools. The Expanded Menu Survey contained all the elements of the Menu Survey used with Group 2 schools, but collected additional information needed to estimate the total food costs of each meal served during the target week, including both reimbursable meals and non-reimbursable foods and beverages sold to students or adults. In cases in which a sampled school received food from a production kitchen that was not sampled for this study, the SNM in that production kitchen was asked to complete the core Expanded Menu Survey forms (excluding the Non-Reimbursable Foods Form/Non-Reimbursable Foods Inventory).

a. Expanded Menu Survey

The Expanded Menu Survey forms used for study Objective 3 included the following items, which were part of the EMS, and completed by SNMs:

- **Non-Reimbursable Foods Form/Non-Reimbursable Foods Inventory.** To capture information about the types and amounts of non-reimbursable foods and beverages served strictly a la carte or sold to adults/others, SNMs completed one of two forms:[27] (1) the Non-Reimbursable Foods Form, used to record the number of servings sold each day of non-reimbursable foods prepared from a recipe or removed from their original package or (2) the Non-Reimbursable Foods Inventory, used to record daily inventory information for commercially manufactured non-reimbursable foods sold in their original packaging.
- **Expanded NSLP Afterschool Snack Form.** Schools that offered NSLP afterschool snacks completed this form. For the Expanded Menu Survey, the form also collected additional information on the foods offered to provide more-precise cost estimates, including product codes and manufacturer/brand and recipe information. This form also asked production kitchens to record the number of portions sent off site.
- **Child and Adult Care Food Program (CACFP) Afterschool Snack and Supper Form.** The Expanded Menu Survey also included an afterschool snack and supper form for schools that offered afterschool snacks and/or suppers through the CACFP. The form for CACFP snacks and suppers was very similar to the Expanded NSLP Afterschool Snack Form, but the set of prelisted food items was expanded to include foods likely to be offered in suppers (in addition to snacks). The form also collected product codes, manufacturer/brand, and recipes that were used to estimate food costs attributable to CACFP.

Additionally, onsite FIs completed the Self-Serve/Made-to-Order Bar Form in schools that operated self-serve or made-to-order food bars,[28] where varying amounts and types of foods are selected by each student. These data were needed to accurately assess the amount of each individual food on the bar that was produced, selected, and left over. FIs measured and recorded all individual foods (by weight, volume, or unit) produced or available on the bar at the start of service, the amounts added to refresh the bar during service, the amounts left over after service and saved for later use, and the amounts discarded. (The complete record of food usage is referred to as *food disappearance data*.) FIs in Group 3 schools observed and collected the food disappearance data on the day they were in the school, using this hard-copy form. In schools that offered different types of food bars each day, a second FI collected data for a second food bar on

[27] Seven schools completed both forms.

[28] A food bar is defined here as a distinct self-service serving line or station where students portion all or most food items themselves (such as a salad or pasta bar) or a made-to-order bar or line where a food preparer makes hot or cold sandwiches that are individualized for each student (such as a sandwich or grill bar).

the day they were on-site. Food disappearance data and the reported number of servings from the bar were used to estimate the average serving size for each food on the bar, and this information was used to estimate the average cost per serving. Some schools offered a self-serve/made-to-order bar on a day that the FIs were not on-site to collect the disappearance data. For these days, the SNM completed the Self-Serve/Made-to-Order Bar Form that was part of the Menu Survey.[29] During the coding process for the food and nutrient analysis, coders assigned default amounts to the foods on these forms to yield the average composition of a serving from the bar which, in turn, was used like a recipe to estimate the average cost per serving when food disappearance data were not available.

b. SFA Director and Business Manager On-Site Cost Interview

The SFA Director and Business Manager On-Site Cost Interview collected detailed information on a variety of cost-related topics in Group 3 SFAs. These data were used to calculate costs by category (food, labor, other direct costs, indirect costs, and off-budget costs) and by meal under study Objective 3. Trained FIs administered this interview in person to the SFA director and/or business manager during the target week.

The interview included six modules divided into two hard-copy booklets. Booklet 1 included modules that could often be completed by the SFA director without input from the business manager. Booklet 2 included modules that often required the input of a business manager.

Booklet 1 included the following:

- **Staffing and Operations Interview.** FIs completed this interview with SFA directors and collected information on the following topics:
  - General foodservice operations
  - Use of branded foods
  - Use of fresh fruits and vegetables
  - Afterschool snacks
  - Enrollment and food inventory data
  - Financial management
- **Food Price and USDA Foods Checklist.** This form was used to create a list of the district's food vendors and the types of foods they provided for foodservice. FIs worked with respondents to create this list, then provided a copy of the form to the respondent along with instructions for collecting food price documentation. Respondents were encouraged to provide monthly statements or price agreements but could also provide copies of invoices as needed. Food price documentation was collected for all food received within the month prior to the on-site visit, as well as for three months of USDA Foods received. FIs collected this documentation while on-site and reconciled it with the completed checklist.

[29] To ensure that the required data were available for both the nutritional and cost analyses, SNMs completed the Self-Serve/Made-to-Order Bar Form from the Menu Survey for all unique bars offered during the target week.

- **SFA Director Cost Interview.** This form collected information on the time central foodservice staff spent on various foodservice related tasks throughout the year. FIs worked with respondents to capture for each central foodservice staff member, the percentage of foodservice hours spent on activities in each task category. Respondents provided salary information for staff captured during this interview. This interview was also conducted with SNMs in each central kitchen that supplied food to a sampled Group 3 school.

Booklet 2 included the following:

- **SFA Indirect Cost Questionnaire.** This questionnaire collected detailed information about indirect cost rates, including restricted and unrestricted indirect rates and the specific expenses covered under each rate. Respondents were asked to provide information for SY 2014–2015.
- **Preliminary Foodservice Expense Statement.** During the site visit, FIs worked with respondents to map foodservice expenses into standard categories using either the foodservice expense statement for fiscal year (FY) 2014–2015 to date or for the prior fiscal year, to aid in abstracting information from the final foodservice expense statement for FY 2014–2015.
- **Off-Budget District Staff Interview.** District staff who did not fall under the foodservice department budget could still support the foodservice department by providing services such as payroll and accounting, contracting, human resources, custodial and maintenance support, and computer support. This interview captured estimates of the amount of time these staff spent on off-budget tasks. Respondents were able to provide either total off-budget time and percentage of off-budget time spent on each task, or total off-budget time spent on specific tasks per day, week, month, or year. Respondents also provided salary information for staff captured during this interview.

c. Principal Cost Interview

To estimate the time that non-foodservice school staff spend on foodservice-related activities, FIs administered a staffing cost interview to principals in sampled schools during their site visit. The interview was completed on paper and captured detailed information on the amount of time per day, week, month, or year that non-foodservice school staff spent on activities such as the following:

- Work related to applications or direct certification for free or reduced-price meals
- Collecting meal payments
- Counting and claiming reimbursable meals
- Menu planning or nutrition education
- Assisting in the cafeteria by supervising students during meals, cleaning, or managing cafeteria staff
- Ordering, storing, or transporting food

Principals also provided salary information for staff whose activities were captured during this interview.

d. School Nutrition Manager Cost Interview

During the on-site visit, FIs conducted staff cost interviews with the SNM in each of the sampled Group 3 schools. The SNM Cost Interview collected information on the amount of time cafeteria and kitchen staff spent on activities during the school week by building a daily schedule for their staff. SNMs also provided salary information for staff discussed during this interview.

e. SFA Director and Business Manager Follow-up Cost Interview

Starting in August 2015, sample SFA directors were contacted and asked to email or fax the final foodservice expense and revenue statements for FY 2014–2015. Respondents also completed a self-administered questionnaire that captured information on meal counts and Fresh Fruit and Vegetable Program costs.

Project staff used information collected as part of the initial SFA Director and Business Manager Interview to abstract the final foodservice expense statement and to provide the proper skip pattern for follow-up questions regarding expenses and indirect costs. SFA directors and/or business managers were then interviewed via telephone from October 2015 through early February 2016. Trained telephone interviewers (TIs) asked respondents to update information on final indirect cost rates and their application, as well as any specific questions arising from the abstraction of the final expense statement. TIs also worked with respondents to abstract the final revenue statement into standard categories of revenue.

4. Student Participation and Satisfaction, Plate Waste, and Students' Dietary Intakes

In Group 2 schools, the study team interviewed students and their parents to collect information on student characteristics, dietary intakes, and participation in and satisfaction with school meals. A 24-hour dietary recall collected information on students' dietary intakes. Data collection activities differed somewhat for elementary school students and middle and high school students. This discussion references *parents*, recognizing that some responding individuals were actually legal guardians or other caregivers who were the most familiar with what students eat outside of school. Elementary school students are referenced as *children* and middle and high school students as *youth*. Children in kindergarten and prekindergarten were omitted from the study because of concerns about their ability to provide accurate dietary recall information.

The target number of completes per school was 8 students; approximately 16 were sampled to account for students being absent, having transferred out of school, refusing to participate, lacking parental consent, or being otherwise unavailable during data collection. FIs attempted data collection in the order that students were sampled, stopping when the target number of completes for the school was reached. Students were ineligible for data collection if they were absent on the target recall day (because students did not have the option to consume school meals during the recall period) or transferred; data collection was also not attempted for students who did not have parental consent.

Student data collection typically occurred in a single day at a school. The main exceptions were for youth whose dietary recall interviews were sometimes conducted on a Saturday to collect data about Friday's meals (because the recalls asked secondary school students about dietary intakes over the preceding day). All student and parent instruments were available in English and Spanish. Spanish-speaking respondents were interviewed by certified bilingual interviewers. The plate waste observations were conducted by trained field interviewers and included randomly sampled students/trays (see Section 4d).

a. Student and Parent Interviews

In the Child/Youth Interview, students were asked about the reasons for participating (or not) in school meals, perceived stigma of receiving free or reduced-price meals, and satisfaction with the meals. This was conducted in person as a computer-assisted personal interview (CAPI) during the school day.

In the Parent Interview, parents were also asked about their child's participation in the school meal programs and satisfaction with school meals, student characteristics, demographics, participation in other nutrition assistance programs, and household income and food security. Parents of younger children were also asked about children's dietary, physical activity, and health behaviors. Parents of children were interviewed in person using CAPI in the afternoon or evening after the target day; parents of youth were interviewed over the telephone using computer-assisted telephone interviewing (CATI) following student data collection.

b. Twenty-four Hour Dietary Recalls

Students reported all dietary intakes spanning a midnight-to-midnight recall period to provide an estimate of students' intakes of food energy and nutrients on a typical school day. Data were collected using USDA's Automated Multiple-Pass Method (AMPM) CAPI at the same meeting as the Child/Youth Interview. The AMPM program was modified to include specific school locations (for example, reimbursable cafeteria line, vending machine, school store) to aid in identifying foods and beverages obtained at school. Youth (students in middle and high schools) completed the 24-hour recall independently in one interview reporting on the prior day, but children (elementary school students) completed the 24-hour recall in two parts. The first part was completed on the target reporting day as soon as possible after lunch and covered food and beverages consumed from the time of waking through lunch, and the second part was completed with parental assistance the following day (or within 48 hours) and covered foods and beverages consumed during the rest of the target day (from midnight to the time the child woke up [if any] and after the child was interviewed on the recall day until midnight). Schools spanning elementary and middle school grades, such as kindergarten through 8th grade, followed the child recall protocol for all students.

FIs used a Food Model Booklet, measuring cups and spoons, and a ruler to assist students in reporting portion sizes. The Food Model Booklet included two-dimensional drawings of various sizes of glasses, mugs, bowls, mounds, circles, and other shapes. In addition, the study team provided a food diary to parents of elementary school students. The food diary asked the parent to record, for each food and beverage the child ate from midnight to midnight: (1) the time of day; (2) name, brief description, and brand if applicable; and (3) where the food was eaten. This simple nonquantitative form served as a memory aid for the parent and child when reporting foods that the child consumed. FIs also obtained copies of school lunch and breakfast menus for the target day, to use as an additional memory aid if a student reported consuming a school meal but had difficulty recalling the specific items consumed.

To estimate usual daily food group and nutrient intakes, a second 24-hour recall was completed for a representative subsample (approximately 27 percent) of students. These second recalls were conducted over the telephone 3 to 10 days after the initial 24-hour recall. Students selected to complete the second recalls were given the Food Model Booklet and other measuring aids to take home so they could be used in reporting portion sizes. Parents of elementary school children were also provided with a second food diary.

c. Other Data Collection

FIs collected height and weight data from students at the conclusion of the first dietary recall and child/youth interview. Standing height was measured with a portable stadiometer to the nearest centimeter and weight was measured using an electronic digital-display floor scale that measured to the nearest 0.2 pound. Data were collected by trained FIs using standardized equipment and protocols across sites. FIs took at least two weight and standing height measurements; a third measurement was taken if the difference between the first two was greater than one pound or two centimeters, respectively. FIs also recorded any potential issues with the measurements, such as bulky clothing, an arm or leg cast, or if the student would not remove his or her shoes.

FIs also collected administrative data to document students' participation in the school NSLP and SBP on the target day and their certification status. The Reimbursable Meal Sale Data Request determined, for sampled students in Group 2 schools, whether the students received reimbursable breakfasts and/or lunches and their meal certification statuses. These data determined target day school meal participation and meal certification status among sampled students. FIs collected this information for the target day from the school point of sale (POS) systems while on-site, or else followed up by telephone to request this information after the target week.

d. Plate Waste Observations

Plate waste observations collected information on the proportion of foods wasted in reimbursable meals. Plate waste observations were conducted in Group 3 schools. Within each school, FIs spread their observations over all meal serving periods and lines, and within these, randomly selected samples of lunches (and breakfasts in schools that served breakfast) on a single day. On the day selected for plate waste observations, FIs attempted to observe an equal proportion of the targeted number of observations (15 breakfasts and 40 lunches) in each meal period, using the expected number of meals per period and the targeted observations per period to determine the sampling rate for trays. For example, if a school had two lunch periods with 100 lunches served in each period, the FI attempted to observe every fifth tray in order to get 20 observations per period and a total of 40 lunches observed. When a cafeteria had multiple serving lines with different foods leading to different cashiers, the FIs divided their time in each meal period equally across cashiers.

FIs recorded data on a hard-copy Plate Waste Observation Form. The plate waste booklet included data entry points for FIs to record the following observations:

- School, meal, and day identifiers that allow linking the data with the correct nutrient strings
- Meal periods
- Food list and food descriptions, including portion sizes observed by the FIs
- Student gender
- Amount taken and wasted by each student with a tagged tray, as well as whether the tray was returned to FI for waste observation

In addition, FIs recorded notes regarding what might have made data collection unique that day. For example, in some cases, breakfasts could not be observed because the students were permitted to take their breakfasts outdoors on the day of observation. FIs also noted cases where students with tagged prenumbered trays did not return their trays. The booklets also contained a column for the EMS line number to facilitate the nutrient string merge.

FIs collected plate waste data during site visits to SFAs selected for the PWS component. A brief pre-visit telephone interview obtained key planning information. For each meal, the FI listed all foods and drinks included in reimbursable meals on the Plate Waste Observation Form based on menu review, serving line observations, and discussions with SNMs. During the meal period, FIs stood near a POS or a predetermined location that enabled them to clearly observe the student selection for the meal. Following the intervals established by the student sampling plan, FIs counted and tagged trays for observation. FIs used prenumbered tray tags to match observations of foods served to foods uneaten (plate waste) on that same tray.

FIs recorded foods served and the *number of portions* taken by the student, focusing on reimbursable meals only. FIs also instructed each sampled student where to leave the tray after the meal and to throw out nothing. At the end of the meal service period, FIs recorded the amount of food left on each tagged tray on the matched observation number in the Plate Waste Observation Form using fractions between 0 (all consumed) and 1 (none consumed). This represented *the fraction of the total number of portions taken* by the student that remained at the end of the meal (that is, was wasted).

In collecting plate waste data, FIs visually observed the amount of food wasted and measured liquids wasted to determine the fraction that was wasted. Visual determination of the fraction of food wasted was enhanced by using portioned servings of foods purchased by FIs, which served as a visual point of reference for a single portion size. FIs measured liquids wasted with measuring cups or the serving container, such as a milk carton, to aid in determining the fraction wasted.

Following data collection and review, data processing staff linked the foods in the plate waste observations to the foods reported in the EMS to create analysis files linking nutrient and food group data to observed foods taken and wasted by sampled students. In cases where the observed portion size was substantially different from the portion size reported in the EMS, the portion size observed by the FIs was used to avoid skewed results.

C. Training of Data Collection Staff

The study team conducted training sessions to prepare interviewers and TAs for data collection. Separate training sessions were held for the following data collection staff:

- Field interviewers for Group 2 Sites
- Field interviewers for Group 3 Sites
- Technical associates
- Telephone interviewers for the Parent Interview
- Telephone interviewers for the SFA Director and Business Manager Follow-up Cost Interview

Each training session provided basic background on the study, as well as detailed reviews of data collection procedures for relevant instruments.

1. Field Interviewer Training for Group 2 Sites

Training for Group 2 FIs included three components: (1) advance online training, which FIs completed independently; (2) five-day in-person training; and (3) a post-training webinar. Training focused on the field interviewer data collection instruments: the Child/Youth and in-person Parent Interviews, height and weight measurements, the Cafeteria Observation Guide, and the First Dietary Recall.

The online training comprised 14 modules that provided background information on the study and an orientation to the data collection instruments, including the Child/Youth Interview, Parent Interview, 24-Hour Dietary Recall, Height and Weight Measurements, and Cafeteria Observation Guide. These modules included PowerPoint presentations with audio, as well as reading, homework assignments, and quizzes. FIs were required to complete the online modules prior to the in-person training.

The in-person training included a mix of large and small group sessions, role plays, practice exercises, and practice interviews with elementary school students. To ensure that FIs would be proficient in administering 24-hour dietary recalls and using the AMPM software, a substantial amount of time was devoted to these components. Staff were required to certify on three different instruments: (1) cafeteria observations, (2) height and weight measurements, and (3) 24-hour dietary recalls with AMPM software.

The webinar focused on operational procedures that FIs needed for their target weeks in school districts, such as working with school liaisons, managing their interviewing schedule, and using study documents such as contact sheets and data collection plans. All certified interviewers attended. Due to the size of the FI group, there were two webinars, with half of the group at each session.

2. Field Interviewer Training for Group 3 Sites

Group 3 FIs completed an eight-day training, with the final two days on conducting plate waste observations for a specialized set of FIs. The training covered the overall background of the SNMCS study, an introduction to administering cost instruments, and detailed instruction on all data collection instruments to be administered by FIs during data collection.

The training included walkthroughs of the instruments, small-group and one-on-one mock exercises, and large-group discussions. Certification quizzes were administered at the end of each day to monitor field staff understanding of key concepts and to identify staff that needed additional help or training on the data collection processes. Help centers were available each evening to provide individualized assistance with learning how to administer the instrument and clarify questions or concerns. The next morning, study team members reviewed key take-away messages from the previous day.

3. Field Interviewer Training Follow-up

As a follow-up to the Group 2 and Group 3 FI trainings, the study team distributed follow-up documents to each group of FIs that described updates to the data collection procedures in response to FI questions and feedback from FNS staff attending the training, as well as important reminders for operating in the field. Group 2 FIs received additional AMPM practice exercises to maintain and improve proficiency with the instrument before going into the field.

4. Technical Associate Training

The TA training was held in person and lasted for three days. The training was designed to do the following:

- Develop an understanding of the Menu Survey and EMS in order to answer questions and provide technical assistance to respondents
- Develop proficiency in responding to phone and email interactions before, during, and after the target week
- Develop proficiency with the TA portal to track activities and record additional information from respondents

The training included lectures, demonstrations, paired role plays, and practice exercises that covered both the EMS and the TA portal. TA staff were certified in conducting TA activities.

5. Telephone Interviewer Training for the Parent Interview

TIs were responsible for administering parent interviews to the parents of youth interviewed in person at schools, and for administering second dietary recalls to a subset of students who completed in-person recalls. The TI training included two components: 1) an advance, online training that TIs completed independently, and 2) a four-day in-person training. The online training was comprised of five modules that focused on study background and an orientation to the parent interview and second dietary recall data collection tools.

At the in-person training, trainers reviewed the CATI parent interview and the dietary recall in a large group setting, practiced and conducted paired role plays, and conducted mock dietary recalls with parents and students. TIs were required to certify proficiency in the second dietary recall using AMPM software.

6. Telephone Interviewer Training for the SFA Director and Business Manager Follow-up Cost Interview

In October 2015, six interviewers selected from those who participated in the Group 3 on-site data collection were trained to conduct the SFA Director and Business Manager Follow-up Cost Interview. Training lasted three days, and was conducted via webinar. The training included a review of the on-site data collection activities, an overview of the abstraction process used for the expense and indirect cost interviews, and detailed instruction on administering the interview. Each interviewer conducted a one-on-one mock interview over the phone with a member of the study team. Question and answer sessions were scheduled at the end of each segment of training. A certification quiz was administered at the end of the third day to assess the interviewer understanding of key concepts.

D. Response Rates

Final completed sample sizes and response rates are shown in Table 3.6. Overall, SFAs and schools were very cooperative with data collection. Gaining cooperation from students and parents was more challenging, especially in schools that required active parental consent.

Table 3.6. Completed Sample Sizes and Response Rates

Research Objective/Instrument	Initial Sample	Completed Sample	Weighted Response Rate (%)
Foodservice Operations and School Nutrition Environments			
SFA Director Survey	548[a]	518	95.7
School Nutrition Manager Survey	1,282	1,210	96.9
A la Carte Checklist	1,282	1,210	96.9
Principal Survey	1,282	1,090	87.2
Competitive Foods Checklists			
Vending Machine Checklist	1,104	858	83.0
Other Sources Checklist	1,104	858	83.0
Cafeteria Observation Guide	1,282	1,257	94.6
Nutritional Quality of School Meals			
Menu Survey	1,282	1,207	96.2
School Meal Costs and Revenues[b]			
SFA Cost Estimates	310	286[c]	89.6
School Cost Estimates	972	880[d]	91.3
Student Participation, Satisfaction, and Dietary Intakes			
Child/Youth Interview, including Height and Weight	3,591[e]	2,165[f]	63.6
Parent Interview	2,165	1,850	88.5
24-Hour Dietary Recall			
First recall	3,591[e]	2,165	63.6
Second recall	889	583	68.7
Reimbursable Meal Sales Administrative Data	2,165	1,961	89.5
Plate Waste Observations[g]			
Lunch	7,559	6,253	82.7[h]
Breakfast	4,051	3,601	88.9[h]

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 response rates for individual instruments reflect the percentage of eligible SFAs, schools, students, or parents that completed each instrument. SFAs and schools were eligible to complete individual instruments if they were recruited and agreed to participate in the study. Students and parents were eligible if the student was present at school on the target day and the case was pursued (that is, not part of unattempted backup student sample).

[a]Initial sample for the SFA Director Survey includes all participating SFAs in Groups 1, 2 and 3. Group 1 SFAs that did not complete the SFA Director Survey are not considered recruited into the study and are not reported in this table. Fifty Group 1 SFAs did not complete the SFA Director Survey and are included in the released sample for SFA recruitment reported in Table 2.1. 144 Group 1 SFAs completed the SFA Director Survey.

[b]The cost variables are constructed using a combination of data from the various instruments. The SFA and school are the units of analysis at which nonresponse is measured. In some cases, missing data can be imputed for less critical instruments that were not completed, but that was rarely necessary.

[c]A total of 24 SFAs representing 65 sampled schools were dropped from the final sample. Before the follow-up cost interview, 22 SFAs (61 schools) were dropped because they had insufficient menu survey data. The criteria for inclusion were (a) for SFAs with 3 or 4 sampled schools, at least 2 schools with menu survey data, or (b) for SFAs with 1 or 2 sampled schools, at least 1 school with menu survey data. One SFA (2 schools) was dropped because of a missing expense statement. One SFA (2 schools) was dropped because both sampled schools were missing SNM survey data.

[d]In addition to the 65 schools described above, 27 schools were dropped from SFAs that were included in the analysis. Of these 27 schools: 16 did not have sufficient menu survey data; 4 did not have sufficient SNM survey data; 1 did not have sufficient principal survey data; 4 did not have sufficient production kitchen data; and 2 were missing breakfast count data in both the menu survey and follow-up cost interview.

[e]Initial sample includes recruited students who were released for data collection.

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

[g]Plate waste observations were completed in a sample of 170 schools for lunch and 157 schools for breakfast. The final analysis sample included 165 schools for lunch and 154 schools for breakfast.

[h]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. Response rates for plate waste observations are unweighted.

SFA = school food authority; SNM = school nutrition manager.

4. PROCESSING OF MENU AND PRICE DATA

The Menu Survey data assessed the food and nutrient content and overall nutritional quality of meals and afterschool snacks under study Objective 2 and the cost of producing school meals under study Objective 3. The procedures for nutrient coding of Menu Survey data involved several stages, described in Section 4.A. First, the study team reviewed submitted Menu Surveys for completeness and made attempts to retrieve missing data. After data retrieval, final edits to the Menu Survey in the EMS prepared the surveys for data entry. Next, the team entered Menu Survey data into USDA's Survey Net system using standardized procedures to obtain nutrient and food group amounts for each food reported on a menu. Lastly, cleaning the Menu Survey data led to constructing raw data files.

For Objective 3, the study team assigned prices to foods served in sample schools during the target week, so that the costs of reimbursable and non-reimbursable meals could be computed. This price-coding process used food price documentation[30] provided by SFAs and data on foods served from the Menu Survey. The team used the Menu Survey data to construct files of single items (served as purchased) and recipes (with ingredients). Separate procedures were used to assign prices to commercially purchased single items, commercially purchased recipe ingredients, direct-delivered USDA Foods, and processed items containing USDA Foods. For commercially purchased items, coders compared the foods from the Menu Survey with the available food price documentation for that SFA and entered purchase cost information for the best available item. Because food price documentation was often not sufficiently detailed for USDA foods, prices for these foods were assigned using master lists of standard (median or midpoint) values. Review of all price data assured consistency in coding and checked outliers to identify and correct entry errors.

A. Procedures for Nutrient Coding

1. Staffing and Training

A senior and junior nutritionist directed a team of nutrition RAs and supervisors who were responsible for processing the Menu Survey data. RAs had a bachelor's degree in nutrition, dietetics, or a related field, or had prior experience with school foodservice or school nutrition studies. Supervisors had advanced nutrition degrees and previous research experience.

RAs and supervisors were trained on specific procedures related to (1) review, data retrieval, and editing of the Menu Surveys and (2) entry of Menu Surveys into Survey Net. All training sessions were led by the senior and junior nutritionists, and detailed training manuals were provided to all attendees.

The first phase of the project included two eight-hour training sessions to instruct RAs on standardized procedures for reviewing the Menu Survey data in the EMS, conducting data retrieval, and updating information in the EMS to prepare surveys for entry in Survey Net. These sessions covered background topics, including a study overview and key concepts such as meal pattern contributions and reimbursable versus a la carte menu items, detailed description of each

[30] Food price documentation from an SFA could include monthly statements, price agreements, bid lists, vendor price contracts or invoices.

Menu Survey form and instructions for completing the forms in the EMS, and navigating in the EMS. Coders were then trained on specific procedures for reviewing each Menu Survey form in the EMS, conducting data retrieval with respondents, and updating data in the EMS.

Training for the second phase of the project involved three eight-hour sessions on procedures for entering Menu Surveys into Survey Net. These sessions focused on procedures for searching for and entering foods and portion sizes, entering special placeholder food codes for commercially prepared foods and self-serve food bars, modifying recipes, and linking foods that were offered together.

Both trainings included group instruction and demonstration, supervised hands-on practice, and practice exercises. All practice exercises were reviewed and checked by the senior and junior nutritionists or supervisors during training. After training, RAs completed additional practice exercises before beginning work with live data.

2. Review, Data Retrieval, and Editing

RAs ensured the quality, completeness, and accuracy of the Menu Survey data using a three-step process: (1) reviewing items flagged in the EMS and conducting additional checks on the data using systematic procedures, (2) following up with the respondent via telephone or email to retrieve any missing data or clarify any ambiguous information, and (3) updating data in the EMS to finalize the Menu Surveys prior to Survey Net entry. For respondents that completed a hard-copy Menu Survey, the process involved an additional step. Before completing these steps, RAs first entered data from the hard-copy surveys into the EMS.

RAs were responsible for all schools within an SFA because of the potential for similarities in the menus and recipes across the schools and the possibility that the same respondent completed multiple Menu Surveys for schools in the same SFA. RAs reviewed the data provided by each school using a printout from the EMS that summarized all data entered by the respondent (referred to as the EMS printout). The EMS printout included flags that identified instances of missing or invalid data not resolved during data collection or data retrieval. RAs reviewed in detail the EMS printout on a form-by-form basis, using standardized procedures. When reviewing each form and field, RAs followed specific rules on when to check forms for other days or other schools within an SFA, or to follow up with the respondent to obtain missing information or clarify ambiguities. RAs also flagged questions or outstanding issues for supervisor review.

In many cases, RAs could use information from another form or day to resolve missing or ambiguous data to limit the number of questions asked during data retrieval with the respondent. For example, if a food description or portion size of a food was missing or vague, RAs checked to see if the same food was offered on other days of the week and filled in the information accordingly. During the review of the EMS printouts, RAs created detailed lists of issues that needed follow-up with the respondent. RAs attempted some data retrieval with most schools.

RAs first contacted respondents via email and provided a bulleted list of questions or issues that were identified during the review phase. Respondents were asked to either respond to questions via email or schedule a convenient time to discuss the questions with the RA over the phone. After data retrieval, RAs updated data in the EMS based on the information provided by the respondent. For a number of schools, respondents were unwilling or unable to participate in data retrieval efforts to provide missing data or clarify ambiguities in the data. In these cases, RAs followed standardized procedures for finalizing (to the extent possible) the EMS data prior to Survey Net entry. For a number of data elements, data were left as missing and dealt with during Survey Net entry or data cleaning.

3. Entering Data into Survey Net

Once a Menu Survey was reviewed, edited, and finalized in the EMS, RAs followed standardized procedures to enter data into Survey Net. Survey Net (version 4.2) is linked to the Food and Nutrient Database for Dietary Studies (FNDDS, version 2011–2012) and provides food codes, descriptions, gram weights, and nutrient values for each food. Because much of the information needed for analyzing the menu data was in electronic format in the EMS, Survey Net was used only to obtain nutrient values and gram weights for each menu item. During Survey Net entry, RAs entered a unique line number to provide an important link between the data collected in the EMS for each menu item, the food and nutrient data from Survey Net, and the price data from the Price Entry System (PES), an application created for the price-coding process. RAs entered data into Survey Net on foods offered in reimbursable meals and afterschool snacks. This included data from the Reimbursable Foods Forms for lunch and breakfast, Self-Serve/Made-to-Order Bar Form, NSLP Afterschool Snack Form, and CACFP Afterschool Snack and Supper Form.

In Survey Net, a separate file was created for each school's menu data, with separate records for daily lunch, breakfast, snack, and supper menus. Food items were matched to the closest food in the database, taking into account reported characteristics of the food, such as the form (for example, fresh, canned, frozen), the preparation method (for example, oven-baked or deep fried), and characteristics that affect nutrient content (for example, low-fat or nonfat, low sodium, rich in whole grains). To expedite the process of searching for and selecting the appropriate food in the database, RAs used provided food codes for commonly reported foods. RAs also followed a set of study-specific coding guidelines to standardize the entry of foods and portion sizes, which are described in the sections that follow.

a. Missing Food Descriptions, Portion Sizes, and Recipes

When information needed to code a food in Survey Net was not available in the Menu Survey, the study team established study-specific defaults. Defaults were needed when (1) Survey Net identified food characteristics that were not collected in the Menu Survey (for example, whether corn was white or yellow) and (2) food details or portion sizes were still missing after data retrieval and final editing of the EMS. In addition, when the respondent did not provide recipes for menu items, default school recipes were entered for the menu item. Additional information on default recipes is provided in the next section. When possible, defaults were based on guidelines developed for SNDA-IV and updated as necessary to reflect current foodservice practices and guidance materials from FNS.

b. Modifying Recipes

Database recipes were modified to more closely match a menu item reported by a school. RAs followed study-specific guidelines to decide if recipe modification was necessary and allowed. These guidelines are summarized in Table 4.1. Recipe modifications involved changes to the type of ingredient (for example, low-sodium turkey for regular turkey) and the amount of an ingredient (for example, a four-ounce beef patty for a two-ounce patty).

Certain types of menu items were targeted for recipe modification for this study. The selection of allowed modifications was based primarily on the importance of modifications to the overall fat, whole grain, and sodium content of the menus. Another consideration was the difference in amounts of meat and meat alternates and bread/grains in school-prepared sandwiches, Mexican entrees, and entrée salads, given that the Survey Net recipes differed considerably from recipes typically used in school food service.

To facilitate recipe modification for entrée items such as sandwiches and Mexican entrees, the study team created a set of study-specific school base recipes in Survey Net prior to data entry. These recipes were constructed to include the types and amounts of ingredients that were commonly served in school meals. RAs used the school base recipes to further modify the types and/or amounts of ingredients to better match those used in a school's recipes. Given the variety of ingredients and amounts used in entrée salads, RAs modified these recipes to exactly match the school's recipe. If a recipe was not provided for a menu item, RAs entered the school base recipe if one existed (with no modifications to ingredient types or amounts), or they selected default food code for the type of food.

There were limits to the feasibility of modifying recipes depending on how the recipe existed in Survey Net. For example, for recipes that yielded more than one serving (a quantity recipe), modifications were limited to changes in the types of ingredients.

c. Linking Foods Served Together

Respondents were asked to identify foods that were paired with or offered only with specific menu items on a menu day—for example, crackers that were offered only with a chef's salad or a cheese stick that was offered only with a peanut butter sandwich. This information was needed for the analysis when assessing compliance with the meal pattern requirements. During Survey Net entry, RAs used special "linking" codes to identify foods that were offered or paired together. Linking codes were also assigned to individual components of prepackaged meals and foods that could not be coded using a single food code in Survey Net (for example, yogurt parfait with fruit and granola) to facilitate aggregation for nutrient analysis. Different linking codes were assigned based on the types of foods being linked.

Table 4.1. Recipe Modification Guidelines

Menu Item	Allowed Modifications to the *Type* of Ingredient							
	Type of Fat Used	Fat Not Used in Preparation[a]	Type of Meat	Type of Cheese	Type of Bread/Grain	Type of Vegetable	Type of Milk	Type of Mayonnaise or Salad Dressing
Vegetables and Dry Beans or Peas	√	√						
Pasta	√	√						
Whipped/Mashed Potatoes	√	√					√	
Garlic Bread	√	√						
Macaroni and Cheese, Other Mixed Dishes with Cheese and Grain	√	√		√	√		√	
Mixed Dishes with Meat and Grain			√	√	√			
Pudding or “Cream” Soups							√	
Salads – Not Lettuce-Based								√
Sandwiches	√		√	√	√			√
Mexican Entrees	√		√	√	√			
Entrée Salads			√	√		√		

Menu Item	Allowed Modifications to the *Amount* of an Ingredient[b]				
	Amount of Meat/Meat Alternate	Amount of Cheese	Amount of Bread/Grain	Amount of Vegetable	Deletion of Higher Fat Ingredients
Sandwiches	√	√	√		√
Mexican Entrees	√	√	√		√
Entrée Salad	√	√		√	√

[a]Fat could be deleted from a recipe only if a food code for “fat not added” did not exist already in Survey Net.

[b]Modifications to ingredient amounts were made only to school base recipes when the school provided a single serving recipe (or a recipe that could easily be converted to single serving). Ingredient amounts could not be modified in recipes that yielded more than one serving (that is, quantity recipes).

d. Commercially Prepared School Foods

Many schools use commercially prepared foods that are formulated specifically for school foodservice, sometimes with less fat, more vitamins or minerals, or added protein, and especially with more whole grains. As a result, the nutrient and food group content of these foods is not always well represented in the options available in FNDDS, the nutrient database linked to Survey Net. The Menu Survey asked respondents to provide product information (brand or manufacturer name and product code) for specific types of commercially prepared foods that were likely to be specially formulated for school foodservice and not well represented in FNDDS. Reported products were then categorized into groups based on product type and nutrient characteristics (for example, distinguishing between products that were rich in whole grains or had reduced fat content). The most commonly reported products within each group were identified and researched online to obtain nutrient information, and a list of ingredients. Product information for 250 foods was then compiled and sent to USDA's Agricultural Research Service (ARS) for further analysis. ARS provided complete nutrient and food group profiles for each food.

During entry in Survey Net, RAs entered special "placeholder" food codes for these commercially prepared products to distinguish them from similar foods that were prepared from a recipe. The study team then used the nutrient and food group data from ARS to construct average nutrient and food group profiles for each group of products and replace the profiles for the placeholder foods that had been entered in Survey Net.

e. Self-Serve Food Bars

Foods offered on self-serve food bars were entered separately from other menu items. For each food bar, default portion sizes were assigned to individual food items based on the minimum portions required for the type of meal component offered (vegetables, fruits, meat/meat alternates, and grains). For other foods that did not contribute to the meal pattern (for example, condiments, salad dressings, or desserts/snacks), default portion sizes were assigned based on defaults developed for other menu items.

If more than one option within a meal component group was offered, a recipe was created for the meal component group. The recipe "ingredients" consisted of a full portion of each item from the meal component group available on the food bar, and the recipe yield (number of servings) equaled the total number of items or ingredients. For example, for a sandwich bar that offered a choice of turkey, ham, or tuna, a recipe was created to represent an average serving of meat from the bar. An average serving from the entire self-serve food bar was the simple sum of the average nutrients per serving for each of the meal components offered on the bar.

4. Quality Control Procedures

To ensure the quality of the Menu Survey data, supervisors conducted quality control checks after coders reviewed and edited Menu Surveys in the EMS and after foods were entered in Survey Net. Initially, supervisors completed a 100 percent quality control review of each RA's work and provided detailed feedback on performance. This process was repeated until an accuracy level of 90 percent or better was achieved. Supervisors followed a similar procedure for the quality control review of entry of self-serve food bars. Ten percent of Menu Surveys received a 100 percent quality control review in each phase of the data processing. In addition, supervisors individually reviewed and approved every recipe modification created by RAs.

To maintain standardized procedures, RAs attended periodic meetings and received updates clarifying issues that were identified or procedures that had changed. Coding guidelines were updated regularly to reflect new issues as they arose. In addition, RAs flagged any questionable or unresolved issue for supervisor review. The senior and junior nutritionist met with supervisors regularly to discuss progress and resolve challenging coding issues.

After RAs entered all the menu data into Survey Net, a detailed set of data checks identified any potential coding errors, including duplicate entries, missing foods, invalid portion sizes, and out-of-range nutrient values. Supervisors reviewed and corrected problem cases.

5. Create Raw Data Files

After the Menu Survey data from Survey Net were final, the Survey Net files were merged with the data collected in the EMS to construct raw food-level data files. Additional data cleaning and preparation steps were then performed to create final raw data files for the Menu Survey.

To obtain data on the food group content of menu items (for example, cups of fruit and teaspoons of oil), the study team linked foods to the Food Patterns Equivalents Database (FPED, version 2011-2012). As described previously, data from ARS was used to construct average food group profiles for certain types of commercially prepared foods. Food group data for modified recipes are not provided in FPED. To obtain accurate food group data for these foods, ingredients in modified recipes were first linked to FPED or the Food Patterns Equivalents Ingredients Database (FPID, version 2011-2012) and then summed to create new recipe-level totals.

Two sets of variables in the Menu Survey data required additional cleaning and imputation—data on meal pattern contributions and data on the number of portions of food that were prepared for and served in reimbursable meals. The meal pattern contribution variables were key data elements used to assess compliance with the nutrition standards for school meals under study Objective 2. The number of portions variables were key data elements used to construct estimates of the nutrient and food group content of meals prepared and served under study Objective 2.[31] Respondents had difficulty providing these data, which resulted in high rates of missing and poor-quality data. Given the importance of these variables to the Objective 2 analysis, the study team developed and implemented cleaning and imputation procedures to improve the quality of the data.

a. Meal Pattern Contribution Data

The Menu Survey collected data on the meal pattern contribution of each menu item—cups of fruits, vegetables, and vegetable subgroups, and ounce equivalents of meat/meat alternates and grains. The assignment of foods to meal component groups (for example, fruits, vegetables,

[31] The methods used to assess compliance with the nutrition standards are described in an appendix in the Volume 2 report.

entrees, grains) facilitated the first step of cleaning and imputation of missing data. Within each meal component group, meal pattern contribution variable reviews assessed whether (1) foods were credited toward the correct meal pattern group(s) (for example, fruits were contributing to the fruit group, and vegetables were contributing to correct vegetable subgroups) and (2) credited amounts were consistent with the reported portion size (for example, 1/2 cup of carrots contributed 1/2 cups of red/orange vegetables). The Food Buying Guide for Child Nutrition Programs and Exhibit A of the Whole Grain Resource for the National School Lunch and School Breakfast Programs provided guidance on crediting foods and amounts. For fluid milk, meal pattern contribution amounts were not collected in the Menu Survey and were constructed based on the reported portion size.

When meal pattern contributions were missing for complex foods, such as commercially prepared entree and meat items, or were implausible (for example, a 3-ounce corndog credited as 2 ounce equivalents of meat and 2 ounce equivalents of grain), the study team imputed amounts of meat and grain based on Child Nutrition labels for similar products and the gram weight of the reported food. The team also imputed meal pattern contribution data for all self-serve food bars. In keeping with the way self-serve bars were entered for the purposes of nutrient analysis, imputation of meal pattern contributions assumed that a serving from the bar satisfied daily or weekly requirements for every meal pattern group included in the bar. Thus, creditable amounts for each component on the bar were imputed based on the daily or weekly minimum requirements for the meal pattern group and school type.

b. Number of Portions Data

For each menu item, respondents were asked to provide data on the total number of portions prepared, as well as the number of portions served in reimbursable meals, served a la carte or to adults, left over, and wasted. Schools that prepared foods for other schools were also asked to provide data on the number of portions sent off-site. The Objective 2 analysis used data on the number of portions prepared for and served in reimbursable meals. The Objective 3 analysis used data on the number of portions served in reimbursable meals, as well as the number of portions served a la carte or to adults, left over, wasted, and sent off-site.

Initial checks ensured that the number of portions data were internally consistent—that is, the total number of portions prepared was equal to the sum of the other variables (served in reimbursable meals, served a la carte or to adults, left over, wasted, and, if applicable, sent off-site). If there were discrepancies, the study team used the sum of the portions for the detailed categories to update the total number of portions prepared.

To facilitate the cleaning and imputation of these variables, foods were reviewed within each meal component group for a menu day. Foods that were reported but had zero portions prepared were dropped from the menu day.[32] Foods that had missing values for all or most of the number of portions variables were reviewed to determine if the food was actually offered that

[32] Foods that were prepared but only sent off-site were also dropped from the Objective 2 analysis but were retained for the Objective 3 analysis.

day.[33] Information from the other foods within the meal component group with nonmissing data on the menu day was the basis for decisions on whether to keep or drop a food with missing values. For example, if one of four entrée items had missing data, the study team compared the sum of the number of entrees served (with nonmissing data) to the total number of reimbursable meals served that day. If the menu day already included at least one entrée per reimbursable meal, the team assumed that the entrée with missing data was not actually offered that day and dropped it from the data.

For foods that were retained in the data, the study team imputed data on the number of portions served in reimbursable meals based on data from other menu days for the same school, or school-level averages that were based on data from schools with nonmissing data. All imputations were done within the meal component group for a given menu day. If a menu day had high levels of missing or incomprehensible data or it appeared that key menu items were not reported, the menu day dropped from the analysis.

After imputing or dropping missing values, the study team constructed a variable for the number of portions prepared for reimbursable meals for each menu item (because these data were not collected). This variable was estimated by summing the number of portions served in reimbursable meals with a proportion of the portions that were leftover and wasted. For milk, the number of portions prepared for reimbursable meals was assumed equivalent to the number of reimbursable meals planned for the day (that is, a serving of milk was planned for every reimbursable meal). The relative proportion of each milk type served as the basis for the number of portions assigned to different types of milk.

The study team performed additional checks within meal component groups to identify menu days that had possible under- or overreporting on the number of portions prepared for and served in reimbursable meals. Distributions of ratios of (1) the number of portions prepared for reimbursable meals to the number of meals planned and (2) the number of portions served in reimbursable meals to the number of meals served were reviewed by meal component group to identify menu days with outliers. Review of extreme outliers (less than the 5th percentile or greater than the 95th percentile) determined whether adjustments were needed to account for under- or overreporting. If an adjustment was needed to the number of portions prepared and/or served for the items within a meal component group, the study team computed an adjustment factor for the group. The adjustment factor was based either on data for other menu days in the school (if other menu days had plausible values) or school-level averages (if a school had multiple menu days that were outliers). The team then adjusted the values for individual menu items based on the existing distribution of servings of items within a meal component group.

[33]Missing values for most or all of the number of portions variables for some foods likely resulted from respondents entering foods on daily menus prior to the actual menu day or prior to meal service. If the food was not actually prepared and the respondent did not delete the food from the EMS (and it was not resolved during data retrieval), it appeared with missing values in the data.

B. Procedures for Price Coding

1. Staffing and Training

Coders were required to have backgrounds in accounting and/or finance. The interview process included a test requiring candidates to demonstrate an understanding of the job requirements by using actual SNMCS food price documentation to calculate serving costs. The coding supervisor was experienced from a previous FNS school food pricing project.

The coding trainer led two days of data entry training in April 2015. The training familiarized coders with the objectives of the work, the types of food price documentation they would be working with, ways in which information is presented in the documentation, and procedures to code and enter price information. Each coder was given a full set of reference materials, including a manual, the USDA Food Buying Guide, and a web-based application for converting weights.

The coding supervisor directly oversaw the coders and reviewed coded data throughout the coding process. In addition, the coding trainer reviewed each coder's efforts during the first month to identify issues that required correction.

2. Price Coding Database

The study team created two files of foods from the Expanded EMS data, including the Reimbursable Foods Forms for breakfast and lunch, the Snack Form, the Non-Reimbursable Foods Form, and the Non-Reimbursable Foods Inventory. The Single Item Foods data set contained one record for each unique food that was served as an individual item ("single items") by each SFA. These data were extracted directly from the EMS. The Recipe data set contained the recipes and ingredients for foods identified by the SFA or nutrient coding RAs as being prepared from recipes. The data processing subcontractor extracted the recipe and ingredient data from Survey Net files. Both the Single Item Foods and Recipe data sets were loaded into the PES.

Each of the two price data sets (Single Item Foods and Recipes) included commercially purchased ("commercial") items, direct-delivered ("brown box") USDA Foods, and processed USDA Foods. The coders used separate pricing procedures for single commercial items, recipes, direct-delivered USDA Foods, and processed USDA Foods, as discussed below. They used the same procedures for all single commercial items, including foods offered in reimbursable meals and non-reimbursable items from the Non-Reimbursable Foods Form and Non-Reimbursable Foods Inventory.

FIs obtained food price documentation for purchased and USDA Foods from SFAs during the on-site data collection. Data processing staff scanned the food price documentation and created an index of documents. The PES incorporated this index and provided access to the scanned documentation.

3. Price Coding for Single Commercial Items

To price commercial foods via the PES, coders reviewed the scanned food price documentation one food at a time, looking up prices for foods served and entering unit size, units per case, case cost, and number of servings per unit. The PES then computed the cost per serving. The coders also linked the food price documentation with the food's price to the item and included any relevant notes. In addition, flags were also available to note where items were missing and/or substituted, and to override a commodity setting.

The price coders used a set of references to maintain consistency of data entry. The USDA Food Buying Guide, for example, was used as a key reference to generate servings from bulk items purchased (for example, according to the guide, number 10 cans of pears yield 47.6 servings of 2 oz.). Other references included a list of weight conversion factors for common ingredients.

The coding team also built shared resources to address coding challenges as they arose. Where the designated reference materials did not suffice to price foods, a team member would research the appropriate reference value and add it to the resource lists shared by the coding team. Sometimes, items on the food price documentation did not exactly match the item listed as served. In these cases, there was a list of allowable substitutes—for example, a different cereal with the same unit size, or a chicken patty of a slightly different size.

The PES had flags available for coders to note missing items, missing price documentation, and instances where prices for similar items were used. The coders noted likely serving size mistakes; however, the items were priced at the size given (that is, prorated from standard values). Where multiple items on the food price documentation could match the food served, the rule was to price using the price for the item with largest invoice total (that is, the most commonly purchased version of the food). Take, for example, a menu listing "canned peaches" and price documentation with entries for both canned peaches in heavy syrup, and canned peaches in light syrup. In this example, the entry with the highest dollar total, meaning the largest dollar total on the invoice, (i.e. unit price multiplied by units purchased), was used to price the menu item. Commercial discounted items were priced with the discount only if the discount was directly linked to the item on the food price documentation.

Foods purchased through the Department of Defense Fresh program were priced and noted. Directly delivered USDA Foods (brown-box) items were priced using a reference price list. For processed USDA Foods, coders entered prices and discounts in the notes, and this information was used later in determining the prices for these foods (see discussion below).

4. Price Coding for Recipes

To determine prices for recipes, coders worked with the PES and food price documentation to price individual ingredients. Coders entered the item size, items per case, and cost per case for purchased ingredients, linked the documentation page, and calculated and entered the item weight in kilograms. The system calculated the cost of that ingredient's portion in the recipe, as well as the cost of the recipe as a whole.

There were instances where single-item foods were included in the recipes database. In these cases, the recipe was overridden and priced as a single-item food. There were also occasions where individual ingredients needed to be added or deleted. For example, a pizza recipe would include ingredients for the crust, but the food price documentation might indicate that the SFA bought pizza shells instead of making crusts from scratch. In this case, the pizza shell was added to the recipe, and individual ingredients such as flour and water were deleted.

Many recipes required adjustments for yields to account for changes in weight due to moisture added or lost in preparation (for example, pasta, rice, gravies, chicken/egg salads). For these, standard conversions were used from a default weights list. Finally, there were some no-cost or low-cost items (for example, water, certain spices) that were not priced because their cost was immaterial.

5. Price Coding for USDA Foods

USDA Foods identified in the Single Item and Recipe databases included directly delivered “brown box” and processed items made with USDA Foods (“processed USDA Foods”). In the EMS, single items and recipes were flagged if they contained USDA Foods. The directly delivered commodities were priced along with other single-item foods and recipe ingredients, but the processed commodities were left for price imputation at the end of the coding process, because most invoices with processed commodities provided insufficient data to precisely determine the gross price, the actual discount, and the net price paid by the SFA.

Coders treated foods as USDA Foods if they were flagged as such in the PES unless an override of an item’s USDA status was needed. For example, if an item was flagged but only available on a commercial invoice, the USDA Food flag was removed and the item was priced using the commercial invoice. In contrast, if an item was not identified as a USDA Food but only showed up on USDA invoices, then it was flagged as a USDA Food and priced accordingly.

For directly delivered USDA Foods, USDA provided the coding team with a data file listing shipment quantities and prices for SY 2014–2015. For each unique food, the total amount shipped was divided by the total value of shipments to generate an average price for that food. The team then used these prices to price the directly delivered USDA Foods.

For processed foods containing USDA Foods, the study needed both the gross price (before rebate or discount) and the amount of the discount (or rebate) for USDA Foods used in producing the food. As noted, most food price documentation provided insufficient information on processed USDA Foods to allow coders to determine the actual prices and discounts applicable to the food. However, two large suppliers consistently provided clear invoices. The study team determined that the best way to price processed USDA Foods was to develop a master price list including a single price set (with a gross, discount, and net price per pound) for each such food. The team developed this master list by reviewing the available invoice data and identifying a median or midpoint value for gross price and discount, and then used this list to price all processed USDA Foods. For single-item foods, the team created a separate file of processed USDA Foods price data that was merged with the PES. For recipes, the master prices for processed USDA ingredients were entered directly into the database itself, so that recipe prices would be calculated automatically by the PES and available in the data extract for analysis.

6. Quality Control

For the first month of coding, the coding supervisor and trainer reviewed all data entries thoroughly to ensure coders were following guidelines, to ensure consistent coding, and to address issues that arose. After that, coders had ongoing access to a coding supervisor, and they all worked in close proximity so that they could work together to address issues quickly.

Approximately two-thirds of the way through the single-item food coding process, an outlier analysis identified potential coding mistakes. Approximately 1 percent of the values required correcting.

When all items except processed USDA Foods had been priced, the coding supervisor reviewed all records in the Single Item and Recipe databases SFA by SFA, looking for mistakes and making notes consistent where necessary. The goal was to make sure every line was filled consistently and accurately using the coding rules. After both data sets were reviewed, another outlier analysis reviewed the top and bottom 10 percent of data values for mistakes and corrected them.

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5. PROCESSING OF 24-HOUR DIETARY RECALL DATA

This chapter describes the methods used to process the 24-hour dietary recall data, to assess the food and nutrient intakes of school meal program participants and nonparticipants under study Objective 4. Processing the data involved coding the dietary recalls in USDA's Survey Net system to obtain nutrient and food group data for each food reported in a recall. The study team then cleaned the dietary recall data and constructed raw data files. The same version of Survey Net that was used for processing the Menu Survey data (version 4.2) was also used for dietary recall data processing. This version of Survey Net is linked to the FNDDS version 2011–2012.

All aspects of the dietary recall data processing tasks are described in this chapter, including coder staffing and training, procedures for coding the data, quality control procedures, and data cleaning. This chapter also includes a description of the procedures for linking the dietary recall data with the Menu Survey data, which improved the accuracy of the nutrient and food group content of foods consumed by students from reimbursable meals.

A. Staffing and Training

A senior and a junior nutritionist directed the processing of the SNMCS dietary recall data. A team of nutrition RAs and one supervisor were responsible for coding the dietary recall data. The supervisor had an advanced nutrition degree and previous research experience. RAs had at least a bachelor's degree in nutrition, dietetics or a related field, or previous experience in food service, as well as a range of computer skills.

The senior and junior nutritionist trained the RAs and the supervisor on standard procedures for using Survey Net and study-specific procedures for coding dietary recalls. The training involved two eight-hour sessions to instruct RAs on the data coding procedures. The first session covered procedures for navigating Survey Net, searching for and entering foods and portion sizes, flagging foods for supervisor review, and following coding guidelines. The second training session covered topics including modifying recipes, quality control procedures, and complete coding of full batches of practice recalls that were based on real data. Both training sessions included group instruction and demonstration, supervised hands-on practice, and practice exercises demonstrating each topic. All exercises were checked by the nutritionists. RAs completed additional exercises, which were checked by the supervisor, before beginning work with live data. Detailed training manuals were provided, and supplementary resources were created throughout the coding phase as needed.

B. Coding Procedures

The 24-hour dietary recall data were collected and processed using USDA's Dietary Intake Data System (Raper et al 2004). This system includes three main components:

1. The AMPM, a computer-assisted interview used to collect dietary intake data (described in Chapter 3)
2. The Post-Interview Processing System (PIPS), which extracts the recall information from Microsoft Access database files, automatically assigns food codes and amounts to certain foods, and formats the data for further coding

3. Survey Net, the computer-assisted food coding and nutrient analysis system, which includes USDA's FNDDS

The recall data from AMPM interviews were processed through PIPS, batched by school, and made available to the RA supervisor. Each batch was logged into an Excel database and tracked through the various coding and quality review steps. An RA was responsible for coding all recalls within a single batch (that is, for a single school).

1. Coding Foods and Amounts

RAs coded the recalls in Survey Net to assign an appropriate food code and amount consumed to each item reported. Information about each food reported during AMPM interviews was visible in a text box at the top of the Survey Net screen. During PIPS processing, some commonly reported foods were automatically linked to the appropriate Survey Net food code. RAs reviewed auto-coded foods to ensure that the correct food code and amount were assigned. For foods that needed to be coded manually, RAs searched the Survey Net database for the food with the closest match and then entered the appropriate amount based on the information reported. RAs were trained on effective searching methods to efficiently find the correct food in the database. If a food could not be found in the database or there were questions about whether the code selected was the best match, the RA flagged the food for supervisor review.

For some foods, RAs modified recipes to more accurately reflect the item's nutrient content. RAs followed specific guidelines regarding allowed modifications and modification procedures. Allowable modifications are shown in Table 5.1 and included changes to the type of fat used in preparation, the deletion of fat if not used, and the type of milk used to prepare items such as beverages or pudding. The modification guidelines were adapted from those in USDA's *Survey Net Operations Manual* for Survey Net version 4.0 (USDA ARS n.d.). The list of allowable modifications differed from those used when processing the Menu Survey data.

After assigning the correct food code to a reported food, RAs entered the amount consumed. Food amounts could be entered by weight, volume, shape, or dimensions in inches, and Survey Net then converted and stored the weight in grams. During AMPM interviews, a food model booklet was sometimes used to help respondents accurately describe the quantity of food consumed. The booklet contains drawings of measuring aids such as bowls, glasses, circles, wedges, and other shapes in various sizes and assigns a code to each model. When a student reported an amount consumed using the food model booklet, RAs entered these codes directly into Survey Net. RAs also used Survey Net guidelines for imprecise measures, such as a "swallow" of juice or a "handful" of crackers, to translate the reported amount into the equivalent gram weight.

In addition to the quality control procedures described below, real-time automated checks built in to Survey Net also helped ensure accurate coding of food amounts. If a gram weight entered was unusually large or small, the entry triggered a flag and a dialog box appeared, prompting the RA to verify that the amount entered was accurate.

Table 5.1. Recipe Modification Guidelines for 24-Hour Dietary Recalls

Food Group	Type of Fat Used	Fat Not Used in Preparation[a]	Type of Milk Used in Preparation	Milk or Soy Milk Replacing Water
Beverages—milk based (breakfast drinks, milk shakes, latte, cappuccino, etc.)			√	
Oatmeal				√ (for soy milk)
Other cooked cereal (grits, cream of wheat, cream of rice, etc.)			√	√ (only to replace water in recipe)
Condensed soups				√
Dry beans, peas, other legumes	√	√		
Fried chicken (home recipe)	√	√		
Gravy (homemade)	√	√		
Pudding/custard—(home recipe or dry mix)			√	
Scalloped potato, au gratin potato, potato croquette, home fries, roasted potato		√		
Some mixed dishes	√	√		
Sweet potato	√	√		
Vegetables	√	√		

Source: Adapted from *Survey Net Coding Guidelines Manual* (USDA ARS 2011).

[a]Fat could be deleted from a recipe only if a food code for “fat not added” did not exist in Survey Net.

2. Missing Foods or Amounts

If a reported food could not be coded using existing food codes or recipe modifications, RAs selected the closest match in Survey Net and the food was flagged for supervisor review. Supervisors reviewed the items and resolved the issue, consulting with the nutrition staff when necessary to determine the best match for the food. When food descriptions or amounts were missing, or the information reported was contradictory or vague, RAs used coding guidelines to determine the likely food or amount consumed. Providing a standard set of coding guidelines also promoted consistency across data files coded by different RAs. These guidelines reflected coding situations that had occurred in past food intake surveys. As the data processing progressed, the nutrition staff and supervisor established additional coding guidelines as needed.

If the amount reported could not be entered using any of the methods described above, RAs selected the “quantity not specified” option in Survey Net. The “quantity not specified” option was used in instances when the amount consumed of an item was not reported (reported as “don’t know”). This option represents the average or typical amount of an item consumed by persons of all ages.

C. Quality Control Procedures

Several steps were taken to ensure the quality of the dietary recall data. Initially, the supervisor conducted a 100 percent quality control review of each RA's work and provided feedback. The review ensured that, for each food, the proper food code was selected, the portion size was correctly entered, recipes were modified according to guidelines, and relevant coding guidelines were applied. Each coder's work continued to receive 100 percent quality control reviews and feedback until performance reached an accuracy level of 95 percent or better. Ten percent of recalls received a 100 percent quality control review during coding. In addition, the supervisor reviewed and approved each recipe modification that was created.

The supervisor was available at every shift to answer RAs' questions and resolve coding issues as they arose. Coding guidelines were updated and disseminated on an ongoing basis to reflect new issues that arose during the coding process and their resolution. Weekly meetings between the supervisor and staff nutritionists were held to develop new coding guidelines and resolve challenging coding issues.

After coding the dietary recalls in Survey Net, a detailed set of data checks identified any potential coding errors. Survey Net's analysis system performed systematic checks of data integrity. The resulting error report identifies records with uncoded foods, missing portion sizes, and recipe modifications that have not been approved by a supervisor. Problem cases were reviewed and corrected by the supervisor. The analysis program was rerun until all batches had been checked and all errors were resolved. Cleaning runs were also developed to check for extreme nutrient values that may have resulted from entry errors, and outliers were reviewed for potential coding errors. The study team only recoded data when there was an obvious coding error or there was clear evidence that the reported portion was implausible.

After the dietary recall data were finalized, additional preparation steps created final raw data files for analysis. To obtain data on the food group content of foods, the study team linked foods to FPED, using the same procedures described in Chapter 4 for the Menu Survey Data. As described in the next section, foods obtained from reimbursable meals were matched to the Menu Survey data.

D. Linking 24-Hour Recall and Menu Survey Data

After cleaning the dietary recall data and creating raw data files, the study team matched foods and beverages obtained at school (from sources where reimbursable items were sold) to the corresponding food from the school's menu data. The primary goal of matching the recall data with the menu data was to ensure that the nutrient and food group content of foods obtained from reimbursable lunches and breakfasts was accurately represented in the dietary intake data. For example, rather than sandwiches or pizzas obtained at school being consistently represented by the "default" or average values available in the FNDDS, the nutrient values of the sandwiches and pizzas from the corresponding school's menu data were used. Thus, if a student reported a school-offered cheeseburger that was actually made with a lower fat hamburger patty or pizza made with whole grains or reduced-fat cheese, this was reflected in the dietary intake data. A secondary goal was to assist in creating a measure of target day participation using the approach used in SNDA-III. This approach uses several data sources to determine whether reported foods were obtained as part of a reimbursable meal.

The process of linking the recall and menu data involved several steps and required manual coding and careful quality control review throughout the process. First, the study team identified foods obtained at school from reimbursable food sources. Before conducting dietary recalls, FIs recorded the physical locations in a school where students could obtain food on the POS Form. Each location was recorded using a common coding structure to distinguish between locations that sell reimbursable or non-reimbursable items (or both). During the recall, AMPM prompted the interviewer to ask for the specific source for foods obtained at school, and the interviewer entered the corresponding code from the POS Form into AMPM. Prior to matching dietary recall data to menus, the dietary recall data were limited to items obtained from reimbursable sources at school.

For all recalls from students within a school, the study team then compared individual foods to the corresponding day's menu data. To determine if a food matched to the school's menu, programming steps and manual review compared the food descriptions. Foods that appeared to be "on the menu" were flagged and linked to the corresponding menu item. The approach to matching differed depending on whether the food was (1) a single food, such as a slice of pizza or a commercially prepared burrito, or (2) a multicomponent food that included several components, each of which was coded separately in the recall, such as a sandwich or salad. Multicomponent foods were the most complicated to deal with because these foods were entered into Survey Net differently for recalls and menus. In the recall data, the AMPM interview prompts students for details about each component consumed as part of a multicomponent food, and each component was entered and coded separately (bread, peanut butter, and jelly). In the menu data, multicomponent foods were entered as recipes, resulting in a single entry for each multicomponent food (peanut butter and jelly sandwich). Thus, a linking system was developed to link multiple foods or components in the recalls with one food in the menus.

For recall foods that were linked to corresponding menu items, three different methods updated nutrient and food group values. For foods that could reasonably be considered as "units" (for example, pieces of pizza, prepared burritos, cookies, sandwiches), the recall unit (or fraction/multiples thereof) was replaced with an equivalent "menu" unit, replacing the reported portion size, nutrients, and food group content using the portion size from the menu. For foods that were reported by volume or by other "non-unit" measures using cups, bowls, and mounds, the study team used the reported portion size, in combination with the nutrient and food group values for the associated menu item, to estimate the nutrient content of the food consumed. In these cases, the reported recall portion size remained the same, only nutrient and food group values were replaced using menu nutrients and food group content was converted to match the portion size in the recall. For example, the nutrients and food group content for a cup of macaroni and cheese reported in the recall was replaced by the nutrients and food group content from the menu macaroni and cheese, using a conversion factor to convert the nutrient and food group content from the menu to match the portion size reported in the recall.

For recall foods that were reported as multiple components but did not include all of the components included in the corresponding menu item, the study team was unable to replace the nutrients and food groups using values from the associated menu item. Examples include situations where a student reported a hamburger patty and a roll but the corresponding menu item was a cheeseburger with a whole grain bun, or a student reported eating the entire hamburger patty but only half the roll. Instead, nutrient and food group replacement was done at the component level—for example, separately for the hamburger patty and for the whole grain roll. This type of nutrient and food group content replacement was done on a limited basis, focusing on commercially prepared meat products and whole grain breads in entrée items.

6. CALCULATION OF SAMPLE WEIGHTS

The study team constructed analysis weights for each survey instrument and each other type of data collected at the SFA, school, student, parent, or meal observation levels. Weights are needed for analysis because of sampling methods with differential selection probabilities (for example, stratified PPS sampling techniques) and because of some level of nonresponse at all levels. Differential sampling and nonresponse rates can cause situations where estimates made with unweighted responses will be biased. The team constructed weights designed to bring the weighted distributions of the samples at all levels back in line with the corresponding population distributions and reduce, to the greatest extent possible, the potential for bias resulting from the sampling design or nonresponse.

The weights for each data collection instrument were the products of several factors designed to correct for differences in probabilities of selection and response propensities:

- The sampling weight, or inverse of probability of selection, corrects for differential sampling and release.
- Nonresponse weighting adjustments are designed to correct for different response rates among different groups within the sample.
- Post-stratification adjustments to known or estimated population totals are designed to correct for any sampling frame undercoverage or other misalignments remaining after other weighting adjustments are made.
- Trimming procedures will detect (and trim) extremely large (outlier) weights that can increase the design effects[34] and/or give certain cases undue influence on weighted estimates made with sample data.

In addition to these adjustments, composite weights combined observations across groups for some SFA- and school-level data.

A. SFA Weights

The study team first constructed SFA weights within each group,[35] then used a composite weight to combine observations on the SFA director survey across Groups 1, 2, and 3. The first weighting factor was each SFA's sampling weight (the inverse of its probability of selection within its group). The next factor was a nonparticipation adjustment (or adjustments) at the SFA level: this factor adjusted first within sampled pairs of SFAs; a second nonparticipation factor adjusted for any nonparticipation not corrected by the paired adjustments. The next step was to ratio-adjust the weights for the SFA sample in each group so that the sum of weights (for all but the five largest SFAs and charter school SFAs) was the same for all groups. After the ratio

[34] A design effect is the ratio of the variance under the sampling design used to the variance under the assumption of simple random sampling.

[35] SFA weights for the largest certainty SFAs were constructed separately from those for the SFAs in the three sample groups.

adjustment, raked[36] weights controlled for the population distributions by FNS region, SFA enrollment category, urbanicity, and SFA poverty level category. As a final step, the team trimmed any outlier weights. To construct the SFA Director Survey weight, the SFA weight was adjusted for nonresponse to this survey. A compositing factor combined SFA Director Survey weights across the groups so that each group contributed proportionately to the overall estimate.[37]

To construct the SFA-level weight, the study team defined

SFAW1 = Sampling Weight = $1/P_{ghi}$

SFAW2 = $PairAdj_{ghi}$

SFAW3 = Remaining response rate (RR) Adjustment = $1/RR_{ghij}$,

where P_{ghi} is the probability of selection and release of the ith SFA pair in stratum h in Group g (also incorporating the probability of inclusion in the group g frame); $PairAdj_{ghi}$ is an adjustment for sample release and SFA eligibility and participation within pairs of sampled SFAs; and RR_{ghij} is a weighted adjustment for any remaining nonparticipation (not addressed within pairs) for cell j, where cells are defined according to SFA charter status (whether SFAs are charter-only or not) and FNS region.

Table 6.1. Pair Adjustments for SFA Weights

Number Released in a Pair of SFAs (0, 1, or 2)	Number Eligible	Number Participating	Adjustment Factors
1	0	0	0 for ineligible
1	1	0	1 for nonparticipating[c]
1	1	1	2 for participating 0 for other[a]
2	0	0	0 for each
2	2	1	2 for participating 0 for other[b]
2	1	1	1 for participating 0 for ineligible
2	2	2	1 for each participating
2	2	0	1 for each[c]
2	1	0	1 for nonparticipating[c] 0 for ineligible

Note: The sum of the adjustment factors should be 2 unless none were released or one or more were ineligible.
[a]Based on half of the pair being released.
[b]Based on both being released and 1 responding.
[c]Nonresponse to be dealt with outside of pair adjustments.

[36] Raking is a process where the weights are adjusted so that the sum of the weights equal known population totals for the variables included in the raking procedure.

[37] The composite adjustment approach the study team used is described in more detail below.

The participation-adjusted weight (SFAWTghij) for the ith SFA in group g, stratum h, and cell j, was then defined as

$$SFAWT_{ghij} = SFAW1*SFAW2*SFAW3 = (1/P_{ghi}) * (PairAdj\_{ghi}) * (1/RR_{ghij})$$

The next weighting step was to ratio-adjust the weights for the SFA sample in each group so that the sum of weights (for all but the five largest SFAs and charter-only SFAs) was the same for all groups. This step made use of both participating SFAs and ineligible SFAs. The adjustment factor was defined as

$$PostFactor\_{g} = N\_SFA / N\_SFA\_samp\_{g},$$

where N_SFA is the estimated eligible population of SFAs[38] (excluding the five largest and charter SFAs) and $N\_SFA\_samp\_{g}$ is the sum of $SFAWT_{ghij}$ over all values of i, j, and h within group g. The post-stratified SFA weight was then

$$PSSFAWT_{ghij} = SFAWT_{ghij} * PostFactor\_{g}.$$

After this initial ratio adjustment, an additional raking adjustment to the weights in each of the three groups controlled for the frame distributions of FNS region, SFA enrollment, urbanicity, and SFA poverty level. This step also made use of both participating SFAs and ineligible SFAs. The raked-adjusted weight was

$$RAKEDPSWT_{ghij} = PSSFAWT_{ghij} * RakeAdj\_{ghij},$$

where $RakeAdj\_{ghij}$ is the raking adjustment for the ith SFA in group g, stratum h, and cell j.

At this point, the study team examined weights to determine the need for trimming. Weights were trimmed if they were greater than the mean plus 3 times the standard deviation of the weights (defined as $Trim\_{g}$ for group g), with the trimmed weight redistributed among other sample members. The initial trimmed weight $TRIMRAKEDPSWT_{ghij}$ was equal to $RAKEDPSWT_{ghij}$ if $RAKEDPSWT_{ghij}$ was less than or equal to 3 standard deviations above the mean and was given the value of $Trim\_{g}$ otherwise. The trimmed weight with an additional ratio adjustment was

$$GRPSFAWT_{ghij} = TRIMRAKEDPSWT_{ghij} * PostFactorTrim\_{g},$$

where $PostFactorTrim\_{g}$ is the ratio adjustment for group g after the trimming so that the sum of the trimmed weights was equal to the estimated population total. At this point, each of the group samples of participating SFAs was a properly weighted sample representative of the whole SFA frame (excluding the five largest SFAs and the charter-only SFAs).

[38] The study team had to estimate the total number of eligible SFAs in the universe using the SFA frame and information on the weighted number of SFAs that were eligible vs. ineligible among the sampled SFAs. The estimated number of SFAs in the universe is given in Table 2.1 in Chapter 2. The team used the Group 1 estimate for this purpose, as it had equal sampling weights and therefore no design effect due to sampling.

To construct weights for the SFA Director Survey, the study team performed an additional nonresponse adjustment to eligible participating SFAs within groups to account for additional attrition. For the ith SFA, the team defined the nonresponse adjustment $DSNRadj_{\_l}$ as the nonresponse adjustment factor for cell l, where l is defined based on FNS region and SFA size. The nonresponse adjusted SFA weight for the SFA Director Survey was

$$GRPSFADSWT_{ghil} = GRPSFAWT_{ghij} * DSNRadj_{\_l}.$$

A compositing factor (CF_g) allows for combined estimates across the three groups for the SFA Director Survey. The study team applied factors L_g (g = 1, 2, 3) to the SFAs in each of the three groups. L_g was defined so that $0.0 < L_g <1.0$ and the sum of the L_g was equal to one. The values of L_g can be chosen to minimize the variance of combined estimates across the three groups.[39] The study team initially selected values of L_g to minimize the variance but that resulted in a value that was much smaller for Group 2 than for Groups 1 and 3. Slightly adjusted values gave more weight to Group 2 and slightly less weight to Groups 1 and 3. L_g for group 1 was 0.34 for group 1 non-charter SFAs, 0.22 for group 2 SFAs, and 0.44 for group 3 SFAs. The final SFA weight for the director survey for the ith SFA was

$$FINALSFADSWT_i = GRPSFADSWT_{ghijl} * CF_g,$$

where CF_g is 1 if the SFA is one of the five largest SFAs (selected with certainty) or a charter SFA and $CF_g = L_g$ otherwise if the SFA is in group g.

An enrollment-weighted SFA weight was also constructed. This weight took the final SFA weight $GRPSFAWT_{ghij}$ for eligible participating SFAs, applied the composite factor CF_g, and then multiplied by the SFA's student enrollment as found on the SFA sampling frame.

B. School Weights

The study team used similar procedures for constructing school-level weights for Groups 2 and 3. Each school was first assigned its SFA weight.[40] This SFA weight was then adjusted to reflect the probability of selection of each school within an SFA and school level, then adjusted for nonparticipation. The final school weight was ratio-adjusted within the group to reflect the number of eligible schools and then trimmed. As with weight construction for the SFA director survey, a composite weight allows for estimates from Principal and other school-level Surveys combined across Groups 2 and 3.

[39] If $L_g = \dfrac{n_g / Deff_g}{\sum_{g=1}^{3}(n_g / Deff_g)}$ is set where $Deff_g$ is the design effect completed within g, and n_g is the number of observations in g, it will minimize the variance of combined estimates (approximately).

[40] Adjusted for sampling and nonparticipation and raking adjustments, but not reflecting trimming or the composite factor.

The beginning weight for school k in the ith SFA was defined as

$SCHWT_{ghik} = RAKEDPSWT_{ghij}$

for group g and stratum h.

The study team then adjusted the SFA weight to reflect the probability of each school k's selection (P_{ghik})[41] within group g, stratum h, and SFA i and the participation rate. The selection probability incorporated the probability of selection of new schools not on the original sampling frame into the sample, and the corresponding retention probability of originally sampled programs in SFAs where new schools were present. The participation rate was calculated within school levels within an FNS region (RR_CS). Thus, the participation-adjusted school weight was

$NRSCHWT_{ghik} = SCHWT_{ghik} * 1/P_{ghik} * 1/RR\_CS.$

The participation-adjusted school weight was then ratio-adjusted using an adjustment factor defined as

$PostFactorSch_g = Nsch / Nsch\_samp\_{_g},$

where Nsch is the estimated eligible population total of schools and $Nsch\_samp\_{_g}$ is the sum of $NRSCHOOLWT_{ghik}$ in group g.[42]

$PSNRSCHWT_{ghik} = NRSCHWT_{ghik} * PostFactorSch_g,$

After this initial ratio adjustment, an additional raking adjustment to the weights in group 2 controlled for the school-level distributions of FNS region, enrollment, urbanicity, and SFA poverty level in group 3. The raked-adjusted weight was

$RAKEDPSNRSCHWT_{ghik} = PSNRSCHWT_{ghik} * RakeAdj\_{_{ghk}},$

where $RakeAdj\_{_{2hk}}$ is the raking adjustment for the kth school in group 2 and stratum h, and $RakeAdj\_{_{3hk}} = 1$ for all schools in group 3.

The raked weight, $RAKEDPSNRSCHWT_{ghik,}$ was then trimmed to account for outlier weights using the same trimming procedures as those used for the SFA weights. The initial trimmed school weight $TRIMPSNRSCHWT_{ghik}$ was equal to $RAKEDPSNRSCHWT_{ghik}$ if $RAKEDPSNRSCHWT_{ghik}$ was less than or equal to 3 standard deviations above the mean (a value of $Trim\_Sch\_{_g}$ for group g) and was given the value of $Trim\_Sch\_{_g}$ otherwise. After trimming, an additional ratio adjustment enabled the sum of the school weights within each

[41] As noted in Chapter 2, the sampling of schools allowed for new schools to be selected into the sample (schools not initially in the school-level frame) once SFA recruitment had commenced. The probability of school selection into the sample reflected this additional sampling step.

[42] As with the SFAs, the study team had to estimate the total number of eligible schools in the universe using the school frame and information on the weighted number of schools that were eligible vs. ineligible among the sampled schools. The estimated number of schools in the universe is given in Table 2.1 in Chapter 2. This estimated number of schools is based on Group 3.

group (Group 2 and 3) to sum to the estimated total population of eligible schools. The trimmed school weight after an additional ratio adjustment was

$$GRPSCHWT_{ghik} = TRIMPSNRWT_{ghik} * PostFactorSchTrim\_{}_{g},$$

where $PostFactorSchTrim\_{}_{g}$ is the adjustment factor for group g so that the sum of $GRPSCHWT_{ghik}$ within group g is equal to Nsch.

For school-level data collection that took place in both Groups 2 and 3, the study team performed an additional nonresponse adjustment for each instrument to eligible participating schools within each group to account for additional attrition. For the kth school, the team defined the instrument I nonresponse adjustment $INRadj\_{}_{n}$ as the nonresponse adjustment factor for cell n, where n is defined based on FNS region and school level. The nonresponse adjusted SFA weight for the each school-level instrument was

$$GRPSCHIWT_{ghin} = GRPSCHWT_{ghik} * INRadj\_{}_{n}.$$

As with the SFAs, a composite weight covered Group 2 and 3 schools. This used a procedure similar to that used for constructing SFA-level composite weights; however, one key difference was that only Groups 2 and 3 were combined because no schools were sampled in Group 1. The final composite school weight for instrument I in school k was

$$FINALSCHIWT_{k} = GRPSCHIWT_{ghin} * SCHCF_{g},$$

where $SCHCF_{g} = 0.25$ for group 2 and 0.75 for group 3.

An enrollment-weighted school weight was also constructed. This weight took the final school weight $GRPSCHWT_{ghik}$ for eligible participating schools, applied the composite factor $SCHCF_{g}$, and then multiplied by the school's student enrollment as found on the school sampling frame.

For the meal price analyses, the final school weights were further adjusted for nonresponse to account for schools without information on meal prices. This included a subset of the final set of eligible participating schools that either did not serve reduced-price or paid meals, or were otherwise missing data on the prices charged for reduced-price or paid meals.

C. Student/Parent Weights

Only Group 2 included a sample of students and their parents. The study team constructed student and parent weights for the student and parent interview data. The starting weight for the student weights was the school-level weight $GRPSCHWT_{ghik}$.[43] The team then adjusted for probabilities of selection and nonresponse of students within schools. Nonresponse adjustments at the individual level were informed by a nonresponse analysis, which suggested that nonresponse adjustments should be made within cells based on FNS region and school type.

[43] Adjusted for sampling and nonresponse, but not reflecting ratio adjustments, trimming, or the composite factor.

The starting weight for student m's weight was the final school-level weight, first adjusted for a handful of schools in which no students were sampled or released:

$STUWT_{hikm} = GRPSCHWT'_{ghik}$.

The study team then adjusted for probabilities of selection and release within schools, and various stages of nonresponse, and defined

$NRSTUWT_{hikm} = STUWT_{hikm} * 1/P_{hikm} * 1/RR\_cstu$,

where P_{hikm} is student m's probability of selection and release within stratum h, SFA i, and school k, and RR_cstu is the response rate within the response cell the student is assigned to based on FNS region and school type. The RR factor actually represents a series of nonresponse adjustments, first for parental consent, then for student eligibility determination, and finally for student response among those determined to be eligible. The weights were then trimmed and then ratio-adjusted to the estimated population total of students, using similar procedures to those used for the SFA and school-level weights. The final student weight was

$FINALSTUWT_m = NRSTUWT_{hikm} * TrimStu * PostFactorStu$.

The base weight for the parent weights was the final student weight FINALSTUWTm. The student weights were adjusted for additional nonresponse among parents.

$PARENTWT_{hikm} = FINALSTUWT_m * 1/PARENTRR\_cstu$

D. Cost Study Weights

The study team constructed three sets of weights for use in preparation of school meal cost estimates: (1) a set of school-level weights to be used to aggregate school-level cost component estimates up to the SFA level, (2) SFA-level weights needed to estimate national average costs and to support exploratory and confirmatory analyses of the relationships between SFA characteristics and SFA-level average meal costs, and (3) school-level weights needed to estimate national average costs at the school level and support exploratory analyses of the relationships between school characteristics and school-level average meal costs. This section describes, in the order just discussed, calculating these three weights.

1. Within-SFA Cost Study School Weights

To estimate SFA-level average meal costs and revenues, school type (elementary, middle, and high) was assumed the most important factor in cost variation. As discussed in the sampling section (Chapter 2), the study team had made a strong effort to have at least one school from each of the three types. To prepare the SFA-level averages, the chief decision was how to combine average costs from these three school strata. For this purpose, the team decided to estimate a proxy for meal costs using a formula that imputes the amount of federal reimbursement for each stratum if all meals were reimbursed at the free meals rates.[44]

For each school in Groups 2 and 3 with a positive menu survey weight—using counts of reimbursable breakfasts, lunches, and snacks served and the federal free meals reimbursement rate for each meal/snack type—the study team estimated R_i, the imputed reimbursement at the free meals rate for meals and snacks served during the reference period.[45] Let N_i be total enrollment for school *i*. Let w_{Mi} be the menu survey weight for school *i*. Let δ_{ki} be a set of three binary indicators for school *i* belonging to type *k* (1 = elementary, 2 = middle, 3 = high).

The study team then calculated national estimates of per capita reimbursements for each school level as

$$C_k = \frac{\sum_i w_{Mi} R_i \delta_{ki}}{\sum_i w_{Mi} N_i \delta_{ki}} \text{ for } k = 1,2,3 \cdot$$

The CCD provided recent estimates of enrollment in each Group 3 SFA *j* by school type. Let these three SFA enrollment figures be denoted as $E_{kj}, k = 1,2,3$. The study team then estimated the share of imputed reimbursements at the free meals rate received by the SFA for schools in each type as

$$S_{kj} = \frac{C_k E_{kj}}{\sum_\ell C_\ell E_{\ell j}},$$

where summing over the ℓ subscript means summing over all three school types within the SFA.

Let n_{kj} be the number of schools with adequate cost data in SFA *j* and school type *k* (as defined in the discussion of national cost study school weights below) and let $\mathbf{1}\left(n_{kj} > 0\right)$ indicate whether this count is greater than 0.

[44] This approach implicitly assumes that the free meal reimbursement rate is a reasonable proxy for the average cost per meal.

[45] For this imputation, the study team used the regular NSLP rate with certification for the extra 6 cents and the regular SBP rate.

Then, the within-SFA cost weight for each sampled school is

$$w_{wCkj} = \mathbf{1}\left(n_{kj} > 0\right)\frac{S_{kj}}{n_{kj}}\frac{\sum_{\ell} S_{\ell j}}{\sum_{\ell}\mathbf{1}\left(n_{\ell j} > 0\right)S_{\ell j}}.$$

If there is exactly one school from each type with adequate cost data in the SFA, then the weights for the three schools are simply S_{1j}, S_{2j}, and S_{3j}.

2. National Cost Study SFA Weights

The cost study SFA weights started from an intermediate weight developed for the SFA Director Survey. This intermediate weight consists of adjustments for probability of SFA selection, SFA recruitment failure, SFA substitution, nonresponse to the SFA Director Survey, ratio adjustment, raking, and trimming. It differs from the final weight for the SFA Director Survey in that weights for Group 3 SFAs were not composited with weights for Group 1 and 2 SFAs. In section A of this chapter, this weight is labeled as GRPSFAWT_{ghij}.

For brevity, let W_{3Di} be this intermediate weight. For the cost study, an SFA was regarded as a respondent if (1) at least two schools within the SFA had completed the SNM Cost Interview and Menu Surveys,[46] (2) the SFA provided a financial statement for the target year, (3) there was a Principal Cost Interview from at least one school, and (4) the SFA director completed the follow-up SFA Cost Interview Preparation Form. With this definition, of the 310 Group 3 SFAs with completed SFA Director Surveys, 286 were cost study respondents and 24 were cost study nonrespondents. Let δ_{3Di} be a binary indicator for cost study response (that is, a variable that is equal to 1 for respondents and to 0 for nonrespondents).

Propensity modeling was performed in terms of frame variables. This found a relationship, albeit a weak one, between nonresponse propensity and both W_{3Di} and urbanicity. Smaller SFAs with large weights were more likely to be nonrespondents. After controlling for SFA size, suburban SFAs were also slightly less cooperative than rural SFAs. The study team addressed this potential source of nonresponse bias by adjusting W_{3Di} for the modeled probability of response. The logistic regression was fit in SAS/SurveyLogistic. Because W_{3Di} appeared as a predictor in the model, the logistic regression ran unweighted. Output propensities were used to form four strata from the 310 SFAs. Within each of the four strata, the weighted response rate was calculated. This smoothed response propensity was given to every SFA as $\hat{\pi}_{3Di}$. The team then calculated the final cost study SFA-level weight as

$$W_{3DFi} = \frac{\delta_{3Di}W_{3Di}}{\hat{\pi}_{3Di}}.$$

[46] For SFAs with one or two schools, the SFA was considered to have sufficient school-level meal production cost data if one school completed the Menu Survey and the SNM Cost Interview.

No additional trimming was performed because the increase in variation in weights was modest. The largest nonresponse adjustment factor was 1.20.

3. National Cost Study School Weights

The cost study school weights started from an intermediate Group 3 school weight (prior to compositing with Group 2) based on response status at the end of administration of the SNM, Menu, and Principal Surveys, defined as Phase I of data collection. This intermediate weight reflects the unconditional probability of selection for the school across the SFA and school sampling and recruitment, and nonresponse to the Phase I school surveys. Specifically, if there was a response to any of the three Phase I instruments, then the school was counted as a respondent for purposes of calculating this intermediate weight. After nonresponse, it was ratio-adjusted and trimmed. For more detail on the calculation of this weight, see Section B of this chapter, where it is labeled as $GRPSCHWT_{ghik}$.

For brevity, let W_{3Si} be this intermediate weight, based on response status through Phase I of data collection. For a school to be counted as a respondent for purposes of national cost study school weights, it required the SFA to be a respondent for the cost study (that is, $\delta_{3Di} = 1$) and for the SNM at the school to have completed the Menu Survey and the SNM Cost Interview.[47] With this definition, of the 972 schools with nonzero values of W_{3Si}, 880 were respondents for the cost study and 92 were nonrespondents. Let δ_{3Si} be a binary indicator for cost study response (that is, a variable that is equal to 1 for the 879 respondents and to 0 for the 93 nonrespondents).

The study team performed propensity modeling in terms of $\hat{\pi}_{3Di}$ and school-level frame variables. In addition to a strong relationship to $\hat{\pi}_{3Di}$, a weak relationship was found to percentage of minority students. Schools with a large minority population were slightly less likely to respond after controlling for SFA urbanicity and SFA size. Adjusting W_{3Si} for the modeled probability of response addressed this potential source of nonresponse bias. The logistic regression was fit with W_{3Si} as the weight in SAS/SurveyLogistic. Output propensities were used to form four strata from the 972 schools. Within each of the four strata, the weighted RR was calculated. This smoothed response propensity was given to every SFA as $\hat{\pi}_{3Si}$. The study team then calculated the final cost study SFA-level weight as

$$W_{3SFi} = \frac{\delta_{3Si} W_{3Si}}{\hat{\pi}_{3Si}}.$$

[47] Although the Principal Cost Interview is also important for measuring full school-level costs, the study team imputes these data where they are missing.

No additional trimming was performed because the increase in variation in weights was modest. The largest nonresponse adjustment factor was 1.17.

E. Plate Waste Observation Weights

The complex restrictions on SFA eligibility for the PWS, as discussed in Chapter 2, made it impossible to prepare standard unbiased sampling weights for this sample. To do so would require that the probabilities of selection for each SFA and school be calculable, but they were not. The probability of selection of an SFA for the PWS depended on the probability that the group of schools sampled for the cost study included at least one eligible school of each school type (elementary, middle, high) where school eligibility (for the PWS) was defined in terms of lunch volumes and lunch-serving patterns. This was impossible to calculate because the lunch volumes and lunch-serving patterns were unknown for unsampled schools. In theory, it may have been possible to determine the eligibility of every school in every SFA selected for the cost study. However, this would have created a substantial response burden in large SFAs and could have jeopardized overall cooperation with the cost study.

Because it was not possible to create standard sampling weights for the PWS, an alternative model-based approach was used to create school-level weights for the PWS. By construction, the sample design for the PWS favors SFAs where most/all schools were large and required cafeteria seating for lunch. The alternative approach to weight construction brings the weighted distribution of schools in the PWS into alignment with distributions for all schools in the nation that were likely eligible for the PWS, in terms of the characteristics considered in sampling (FNS region, school size, urbanicity, and district poverty level) as well as quintiles of predicted school-level mean calories wasted per meal.

School-level weights for the PWS analysis were derived using the following steps:

Step 1. Using the sample of 166 schools that participated in the PWS and completed the menu survey, the study team built a model for total calories wasted in the school in terms of key school characteristics as well as salient features of the menu and school foodservice practices potentially related to plate waste.[48] The final model included the following variables:

- School level (elementary, middle, and high)
- Universal free breakfast (a binary indicator for whether all students in the school received free breakfast)
- The interaction of district poverty rate with universal free breakfast
- A binary indicator of whether any Smarter Lunchroom techniques were employed

[48] The analysis sample included a total of 166 schools—165 had lunch observations and 154 had breakfast observations. One school had breakfast observations, but not lunch observations.

- Grain ounce-equivalents as a proportion of lunch calories[49]

  Step 2. The team applied results of the Step 1 model to the full set of 1,037 Group 2 and 3 schools that (1) completed a menu survey and (2) served enough lunches to be eligible for the PWS[50] to obtain predicted calories wasted in each school.

  Step 3. The study team classified each school into one of five categories of wastefulness based on the predictions from Step 2. In the first stratum, predicted waste was 10.1 percent of energy with a standard deviation of 0.9 percentage points. In the fifth stratum, predicted waste was 28.8 percent of energy with a standard deviation of 2.8 percentage points. The intermediate strata had predicted waste rates of 12.7, 17.3, and 23.5 percent.

  Step 4. The study team also classified each school along other relevant dimensions (FNS region, district poverty level, and school type (elementary, middle, or high)).

  Step 5. The study team used the school-level menu survey weight for each school to obtain national estimates (control totals) of the number of schools in each of the categories created in Steps 3 and 4.

  Step 6. Finally, the study team raked the 166 PWS sample schools to force agreement with the control totals computed in Step 5. This resulted in weights that make the PWS sample schools representative of all schools in the study population with respect to the relevant dimensions described in Steps 3 and 4, including a predicted wastefulness category.[51]

The school-level weights generated using this six-step process were used in analyses that estimated the mean amounts of individual foods, USDA Food Pattern food groups, and calories and nutrients wasted per meal (lunch and breakfast), overall, and by school type. Regression analyses that used tray-level estimates to examine predictors of plate waste were unweighted.

[49] Several other variables and interactions were tested and found not to be significant, including FNS region, urbanicity, school size, number of reimbursable meals served, SBP participation, universal free lunch and breakfast participation, offer-vs-serve (OVS) at breakfast and lunch, binary indicator for use of one or more smarter lunchroom techniques, mean lunch duration, offsite meal preparation, locations students are allowed to go during their lunch period, food pattern equivalent content of lunches other than grains (added sugars, empty calories, dark green vegetables, dairy, oils, and saturated fat, expressed as proportions of total lunch calories), and the interaction of OVS variables with FNS region, urbanicity, and district poverty rate.

[50] The instrumentation used in the Menu Survey was different from that used to screen schools for eligibility for the PWS, so it was not possible to restrict the tabulations to schools with lunch volumes and serving patterns required for selection into the PWS. Instead, the smallest observed volume in the Menu Survey was used to define the following thresholds for lunch volumes: 157 daily lunches served for elementary schools; 220 daily lunches served for middle schools; and 87 daily lunches served for high schools.

[51] This procedure worked better for analysis of waste at lunch than at breakfast given that fewer schools had useable breakfast plate waste data.

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