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Integrated Study of School Meal Costs and Outcomes: Design, Cost, and Feasibility Plan

Volume 1: Final Report Volume 2: Appendices A-P

Contractor and Cooperator Report No. 77

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Abstract

The National School Lunch Program (NSLP) and School Breakfast Program (SBP) are designed to provide nutritionally balanced low-cost or free meals to children in public and nonprofit private schools and residential child care institutions. In recent years, the U.S. Department of Agriculture (USDA) has modernized school meal program nutrition standards and renewed emphasis on nutrition education as a part of the school meal programs. The proposed design for an integrated study of school meal costs and outcomes was intended to address the need for research on the success of school meals in meeting program goals, the cost of serving healthful meals that are accepted well by children, and the relationship of school menus and competitive foods to children's participation and diets. The study proposed to collect a broad range of data from nationally representative samples of School Food Authorities, schools, and students at a critical time in the development of the NSLP and SBP. The contractors pretested the study instruments in nine SFAs to confirm their feasibility. The estimated investment in the complete study was calculated at $12.4 million to $15.1 million in 2003. An integrated study would provide unprecedented opportunities to understand the relationships among program operations, meal quality, costs, and student outcomes. The proposed study design was estimated to save $2 million to $3 million over the combined cost of separate studies of meal costs and program outcomes.

Keywords: National School Lunch Program, NSLP, School Breakfast Program, SBP, child nutrition, food assistance, dietary intakes

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Executive Summary

The National School Lunch Program (NSLP) and School Breakfast Program (SBP) are designed to provide nutritionally balanced, low cost or free meals to children in public and nonprofit private schools and residential child care institutions. Each day during Fiscal Year 2002, the NSLP served about 28 million children, and the SBP served about 8 million children at a cost of approximately $8.4 billion in Federal funds and commodity assistance. In 1998, the Child Nutrition Reauthorization Act expanded the NSLP to provide cash reimbursements to schools for snacks served to children in qualified after-school care programs. Collectively, this report refers to these three programs as the USDA school meal programs. These programs are administered by the Food and Nutrition Service (FNS), USDA, the State Child Nutrition Agencies, and local School Food Authorities (SFAs).

The considerable public investment in the USDA school meal programs and their everyday presence in the lives of millions of American children make these programs a logical place to look for action to improve children's diets. In 1995, the USDA's FNS launched the *School Meals Initiative for Healthy Children* (SMI), which modernized USDA school meal program nutrition standards and, through the Team Nutrition Initiative, renewed emphasis on nutrition education as a part of the school meal programs. It has been argued that SFAs must spend more to serve school meals that both meet nutrition standards and appeal to children. However, the relationship of school meal costs to success in achieving program goals—that is, serving healthful meals that are well accepted by children—has never been thoroughly investigated. Furthermore, eleven years have passed since the last national study relating school menus and the availability of competitive foods to children's participation and diets.

To address these issues, the Economic Research Service (ERS), USDA, contracted with the team of Abt Associates Inc. and Mathematica Policy Research Inc. to design an integrated study of school meal program costs and outcomes. As described in this report, the proposed study would collect data on the operational characteristics, costs, and outcomes of the NSLP and the SBP, as well as important background information on the school environment in which they operate. It would also collect operational data on the After-school Snack Program. The Integrated Study would collect a broad range of data from nationally representative samples of SFAs, schools, and students at a critical time in the development of the NSLP and SBP.

The proposed study design is a feasible and efficient approach to addressing USDA's research needs. The research team successfully pretested the data collection in a varied group of SFAs. The estimated cost of the complete study, $12.4 to $15.1 million, would represent a substantial investment in knowledge about the results of the billions of dollars spent by USDA, the States, and the SFAs on the NSLP and SBP. The integrated approach would save $2 to $3 million over the combined cost of separate studies of meal costs and program outcomes, while providing unprecedented opportunities to understand the relationships between program operations, meal quality, costs, and student outcomes.

This Executive Summary describes the school meal program issues that would be addressed in the Integrated Study, the proposed study design, and the estimated costs of the Integrated Study and its components. The full Final Report of the design, cost, and feasibility study consists of two volumes. Volume I describes in depth the context for the study, the sampling plan, the study components, the

integration of study results, and the cost estimates and assumptions. Volume II includes the data collection instruments and supporting appendices.

Research Needed on School Meal Program Costs and Outcomes

In 1995, USDA issued the SMI final rule, which updated menu planning rules and options for the NSLP and SBP, and required school meals to meet nutrient standards based on the 1995 Dietary Guidelines for Americans. Under these standards, school lunches and breakfasts should contain no more than 30 percent of calories from fat and less than 10 percent of calories from saturated fat over a one-week period. The nutrient standards also recommend that school lunches provide one-third of the daily RDA for protein, vitamin A, vitamin C, iron, and calcium, as well as one-third of the daily calories/energy allowance, while school breakfasts should provide one-quarter of the daily RDA for those nutrients. The final rule provides more qualitative guidance on levels of sodium, cholesterol, dietary fiber, and total carbohydrates, to promote compliance with the Dietary Guidelines.

To meet the SMI nutrient standards, schools have five different menu planning options: (1) the traditional food-based menu planning system; (2) an enhanced food-based menu planning system; (3) nutrient standard menu planning (NSMP); (4) assisted nutrient standard menu planning (ANSMP); and (5) any other reasonable approach. The traditional food-based menu planning system requires that lunches offered to students include five meal components: milk, meat or meat alternates, grains and breads, and vegetables, fruits, and full-strength fruit juices. The enhanced food-based menu planning system is a variant that requires more servings of bread and grain products over the course of a week and larger servings of fruits and vegetables. Under NSMP, the SFA plans menus to meet nutrient standards with a USDA-approved computerized nutrient analysis system. With ANSMP, the SFA uses external assistance for menu development and nutrient analysis.

To realize the full benefits of the programs, children must consume the meals. The SMI also included the development of the Team Nutrition program, which is intended to promote nutrition education, to motivate children to make healthy food choices, and to provide school food service staff with training and technical support to serve healthy and appealing meals.

Research on the SMI has described changes in the nutrient content of meals and program operations, but no national study has examined its potential effects on program costs or the consumption of meals by students. The School Nutrition Dietary Assessment II (SNDA-II) collected data in 1998 on the extent to which menus met the nutrient standards imposed by the SMI. Results indicated progress in reducing fat and saturated fat content of meals, but fewer than one-quarter of schools served lunches that met either standard. Schools were more successful at breakfast time, with the majority serving breakfasts that met the fat and saturated fat standards. These results tell us what schools served children, but not how much meals cost or what children actually ate. Thus, we cannot tell whether school meals that met the standards cost more or were well accepted by children.

The School Meals Initiative Implementation Study provided important insights into the process of implementing the SMI and other recent program changes. This study found that 80 percent of districts reported increased costs for food following implementation of the SMI, but it did not provide sufficient information to attribute cost increases to inflation or program changes. The most recent national study of school meal program costs—the School Lunch and Breakfast Cost Study—was conducted in 1992-1993, before the SMI. The relationship of cost to serving meals that meet SMI

objectives has been studied only in small non-representative samples of SFAs, such as the Nutrient Standard Menu Planning Demonstration Study. The last nationally representative study of nutritional quality, children's participation, and children's intakes—the School Nutrition Dietary Assessment study (SNDA-I)—was conducted in 1991-1992.

Beyond the SMI, stakeholders have called attention to changes in the school environment that may affect the achievement of school meal program objectives. One major source of concern is the growth of food offerings—in cafeterias and elsewhere—that compete with USDA school meals ("competitive foods"). Other concerns focus on whether school meal participation and consumption have been affected by changes in the timing of when meals are served and the length of time to consume meals. These concerns have been heightened by recent statistics from the Centers for Disease Control showing that the prevalence of overweight among adolescents tripled from 5 percent in 1980 to 15 percent in 2000.

In sum, there is considerable interest among stakeholders in research to address questions such as the following:

- What are common school food service management and operation practices? How are they related to school meals' nutritional quality, costs, and student outcomes?
- What are common school policy and environmental factors that may be relevant to USDA school meal program operations? How are they related to school meals' nutritional quality, costs, and student outcomes?
- What are the costs of providing meals through the NSLP and SBP, and how are they associated with food service practices, nutritional quality, and student outcomes?
- What are levels of USDA school meal program participation and customer satisfaction, as measured by plate waste and other factors? How are these outcomes related to food service practices, nutritional quality, and costs?
- What is the contribution of meals provided in USDA programs to participants' dietary intakes? What is the overall nutritional quality of the diets of USDA school meal program participants? What is their weight status? How are these factors associated with USDA school meal program participation?

The Integrated Study of School Meal Costs and Outcomes, as proposed in this report, will address these questions by collecting information on school meal operations, costs, and outcomes through a unified design and sampling plan. It will allow an unprecedented level of analysis of the relationship of key operating characteristics (e.g. menu planning systems), costs, and outcomes—with outcomes including student participation, the nutritional quality of meals offered, plate waste, satisfaction, and the nutritional quality of foods consumed by students. It will give information to policy makers and program officials that they have long desired about the relationships between these factors and provide an improved knowledge base for making policy decisions about the school meal programs.

Although such a study has a high potential cost and would place substantial demands on SFAs and schools recruited to participate, no other approach can completely answer the critical questions of interest to policy makers, the public, and those who operate the programs. The Integrated Study would continue the evolution of research on the characteristics and outcomes of the school meal programs and provide the fullest range to date of the information crucial to effective program

decision-making. Moreover, although a single study of both costs and outcomes would be more expensive than previous studies, efficiencies in data collection mean that it would be less expensive than conducting separate cost and outcome studies.

Data Domains and Proposed Sources

The Integrated Study of School Meal Costs and Outcomes, as envisioned in this report, will collect nationally representative, cross-sectional data from a multi-stage sample. The data to be collected are described below, followed by a summary of the sample design and the data sources.

Data to address the research questions for the Integrated Study have been divided into twelve substantive areas, referred to as data domains. The first four are the domains of SFA and school data—the "supply side" of the school meal programs. They include the SFA and school environment and policies, food service practices, meals offered and served, and meal costs and revenues. The other eight domains are the domains of student data—the "demand side"—including participation, plate waste, satisfaction, food and nutrient intakes, weight and height, level of physical activity, food assistance program participation, and student and household socioeconomic characteristics. The Integrated Study will incorporate SFA and school data in the analysis of student data and vice versa.

The study will use the following conceptual model:

- The **socioeconomic environment and policies** of the SFA and school are treated as fixed external factors (at least in the short run).
- The socioeconomic environment and policies of the SFA and schools shape the **food service practices** of the SFA (i.e., how food services are provided).
- These factors affect the **nutritional characteristics of meals as offered** (i.e., the particular foods offered, the nutrients in these foods, and the range of choice).
- The SFA and school environment, food service practices, and meal characteristics affect **student participation.**
- The interaction between **nutritional characteristics of meals offered** and **student participation** shapes the **nutritional characteristics of meals served** (i.e., weighted nutrient content and other average characteristics of meals as taken by students).
- The SFA and school environment, food service practices, participation, and characteristics of meals offered affect **meal costs and revenues**.
- Student characteristics, school characteristics, and meal characteristics, along with the students' decision to participate, all affect students' **dietary outcomes** and their **satisfaction** with school meals (if they do participate).

Exhibit ES-1 identifies the principal research questions for each domain and the questions that integrate these domains. The data to be collected in each domain are further described below.

Exhibit ES-1

Study Data Domains and Research Questions

SFA and school environment and policies:

- What are the socioeconomic characteristics of participating SFAs and schools?
- What are the policies and practices of SFAs and schools concerning meal schedules, the cafeteria environment, competitive foods, and nutrition education and promotion?

Food service practices:

- How do school food service personnel plan, prepare, price, and serve school meals?
- What is the role of school food service in pricing and offering competitive foods?

Meals offered and served:

- What types of foods are offered and served in the NSLP and SBP? What is the nutrient composition of the average meal in the NSLP and SBP, as offered and as served?
- How well do school meals comply with nutritional standards for sources of food energy, vitamins and minerals, and other nutrients?

Food service costs and revenues:

- What is the average cost per meal in the NSLP and SBP? How much of the full cost per meal is reported in SFA accounts?
- What is the average revenue per meal in the NSLP and SBP? What share of total SFA revenues comes from the NSLP and SBP? Do non-reimbursable food sales subsidize school meals, or vice versa?

Plate waste:

- How much is wasted, on average, of the foods and nutrients served in school meals?

Student participation and satisfaction:

- What proportion of students participates in the NSLP and SBP?
- What do participants and non-participants like about the NSLP and SBP? What do they dislike?
- What factors affect school meal participation?

Students' dietary intakes:

- What is the overall quality of school meal participants' diets relative to nutritional standards? How do the nutrient intakes of participants compare with intakes of non-participants?
- What contributions do school meals make to participants' daily dietary intakes?
- How are students' diets related to weight status, activity levels, individual characteristics, and family characteristics?

Integrative research questions:

- How are food service practices related to school meals' nutritional quality, costs, and student outcomes?
- How are school policy and environmental factors related to school meals' nutritional quality, costs, and student outcomes?
- How are meal costs related to food service practices, nutritional quality, and student outcomes?
- How are levels of participation, customer satisfaction, and plate waste related to food service practices, nutritional quality, and costs?

SFA and School Environment

Research in this domain will explore the characteristics of the SFA and school environment—including socioeconomic features, institutional structure, policies, and facilities—as potential influences on school meal program operations and performance. The socioeconomics and institutional structure of the SFA and the school (such as enrollment and grade span) provides the context for the NSLP, the SBP and the After-school Snack Program. Relevant SFA and school policies include certification for free and reduced-price meals, special provisions providing free meals to all students, and meal schedules. The types and condition of facilities for serving school meals are also included in this domain. A particularly important topic is the availability of competitive foods to students in the cafeteria and through alternate sources such as vending machines.

Food Service Characteristics

The characteristics of the school food service operation—its structure and basic practices—will be used to describe how the school meal programs operate and to help explain differences in their costs and outcomes. The most basic food service characteristics are the availability of the NSLP, SBP and the After-school Snack Program. Other key characteristics of school food service include menu planning and meal production systems employed, purchasing practices, use of food service management companies, prices of school meals, food service department's role in offering competitive foods, food safety practices, and outreach and marketing for school meals.

Meals Offered and Served

This domain focuses on a key set of program outcomes—the characteristics of foods offered and served to students as part of NSLP and SBP meals. Topics in this domain include the number of choices students are offered for various menu elements (such as milk, entrées, fruits and vegetables); the use of fresh fruits and vegetables; the use of USDA donated commodities; the frequency with which students are offered a salad bar option or other self-serve foods; and the nutrient composition and quality of school lunches and breakfasts. Compliance with USDA standards is a particularly important program outcome in this domain. The study will assess school meals as offered, giving equal weight to all choices for each meal component; it will also assess meals as served, taking into account the proportion of meals taken by students that contain each item.

Food Service Costs and Revenues

Given their magnitude, the costs and revenues of USDA-reimbursable school meals and other food service will be one of the most important domains of research for the Integrated Study. Meal costs include all resources expended to operate the NSLP and SBP—food, production labor, administrative labor, other direct costs, and indirect costs. Revenues from school meals include USDA, State, and local subsidies; student payments; and the value of donated commodities. By answering research questions in this data domain, the study will update data on the relationship of school meal costs to USDA reimbursements and commodity assistance. SFAs also incur costs and receive revenues for sales of a la carte and other competitive foods, and the relationship of these costs and revenues to those of the school meal programs is an increasingly important topic.

Participation

In this domain, the Integrated Study will seek to understand the rates of student participation in the NSLP and SBP at the school and SFA levels; how these rates vary by student, school and food service characteristics; and the factors that affect individuals' school meal participation decisions.

Plate Waste

Plate waste is food that is served or selected but is not eaten. Some plate waste will always be observed in a food service setting, particularly when children are the customers. School food services cannot tailor portion sizes to the needs and preferences of each child. Furthermore, FNS considers school meals to be a good setting in which to introduce healthy foods to children, particularly fruits and vegetables, even when a substantial amount of these foods may be wasted. Nonetheless, assessing the types and extent of plate waste in school meals is of interest for three reasons: (1) as an indicator of customer satisfaction, (2) as an indicator of possibly inefficient resource use (for example, children not having enough time to eat), and (3) to help USDA improve menu items and nutrition education materials. The study will measure the percentages of foods and nutrients wasted.

Satisfaction

Data on satisfaction include: the overall level of satisfaction of students and parents with the meals offered by their schools, the attitudes toward specific aspects of the programs, and the changes they would like to see. Among non-participants, the study will explore the reasons for choosing not to take school meals, including the possibility that receiving free or reduced-price meals may be perceived as a source of stigma.

Food and Nutrient Intakes

Research questions in this domain concern the role of the school meal programs and competitive foods in students' diets. Specifically, this domain includes the overall quality of USDA school meal participants' diets in terms of both nutrients and foods consumed; the contributions that school meals make to participants' overall dietary intakes and the types of foods that they eat; how school meal participation is associated with the quality of children's diets; how the quality of schoolchildren's diets is affected by the consumption of competitive foods (i.e., foods sold in schools that are not part of a reimbursable meal); and how variation in school food service practices and nutrition education activities are associated with dietary intakes.

Weight and Height

The weight status of students (summarized by the Body Mass Index, or BMI) and the risk of underweight or overweight are important concerns for the school meal programs. Because of the limitations of the study's cross-sectional design, the weight status data on participants and non-participants will be used only to suggest differences to be studied in future research and to provide the basis for assessment of dietary intakes.

Level of Physical Activity

Children who are physically active have greater energy needs than those who are not, all else equal. The strong link between physical activity and good health and weight control at all ages places great importance on describing how students' physical activity is associated with their diets. Physical activity is also an important control variable for assessing the effects of school meals on dietary intakes. This domain includes measures of TV watching and computer/video game use and questions on frequency of vigorous and moderate physical activity adapted from other large-scale surveys.

Food Assistance Program Participation

As another way to understand the population served by the school meal programs, the study will examine the relationship between household participation in food assistance programs and student receipt of free or reduced-price school meals. This domain includes both participation in USDA programs (such as the Food Stamp Program and the Special Supplemental Nutrition Program for

Women, Infants and Children) and use of emergency food assistance provided with a combination of public and private resources.

Student and Household Socioeconomic Characteristics

This domain comprises characteristics of the student population and the community that may affect the opportunities and challenges for the school meal programs. Key household characteristics such as household size, the number of adults, and household income are needed to assess poverty. Income (relative to poverty) is very important as a factor related to eligibility for free and reduced-price meals. In addition, parents' employment and work schedules, even after controlling for income, may have important implications for eating habits in the home and SBP and NSLP participation, in part because they may affect whether the parents have time to prepare breakfast or pack a lunch before school. Other household characteristics that will be collected for use as control variables include: (1) language spoken at home and/or country of origin, which would further control for cultural differences; (2) participation in other public income support and medical assistance programs, a factor that affects family resources available for food; (3) parents' education; and (4) measures of household food preparation and serving practices, such as how often the family eats the main meal together.

Sampling and Data Collection

The study will be conducted in two phases. Phase 1 will be the Preliminary Survey, which will collect data needed for Phase 2 sampling and for analyses requiring the largest sample of SFAs. Phase 2 will include surveys, interviews, and observations at the SFA, school, kitchen, and student levels.

The study design groups the Phase 2 data collection into three levels of increasing intensity, so as to balance the need for precision with the cost and burden of data collection.

- Level 1 comprises mail surveys with telephone follow-up of SFA directors, school principals, and kitchen managers. Level 1 will include 672 SFAs and 2,016 schools.
- Level 2 comprises interviews to be conducted on-site with SFA directors, school principals, and kitchen managers. This level also includes on-site observations of the cafeteria environment and alternate food sources. Level 2 will include 392 SFAs and 1,176 schools. In addition, plate waste data will be collected in a subsample of 60 SFAs and 180 schools.
- Level 3 comprises interviews to be conducted on-site in 100 SFAs and 300 schools with 2,400 students and their parents.

The samples of SFAs and schools for the Level 2 and Level 3 data collection will be separate, but these SFAs and schools will be part of the Level 1 sample. This will allow integrated analysis of data from the three levels, while minimizing the burden on individual schools.

Exhibit ES-2 summarizes the data collection planned for the Integrated Study. For each phase and level, the exhibit lists the topics covered in each data collection activity. These activities and the corresponding samples are described below, and the level of precision for key estimates from each source is indicated.

Exhibit ES-2

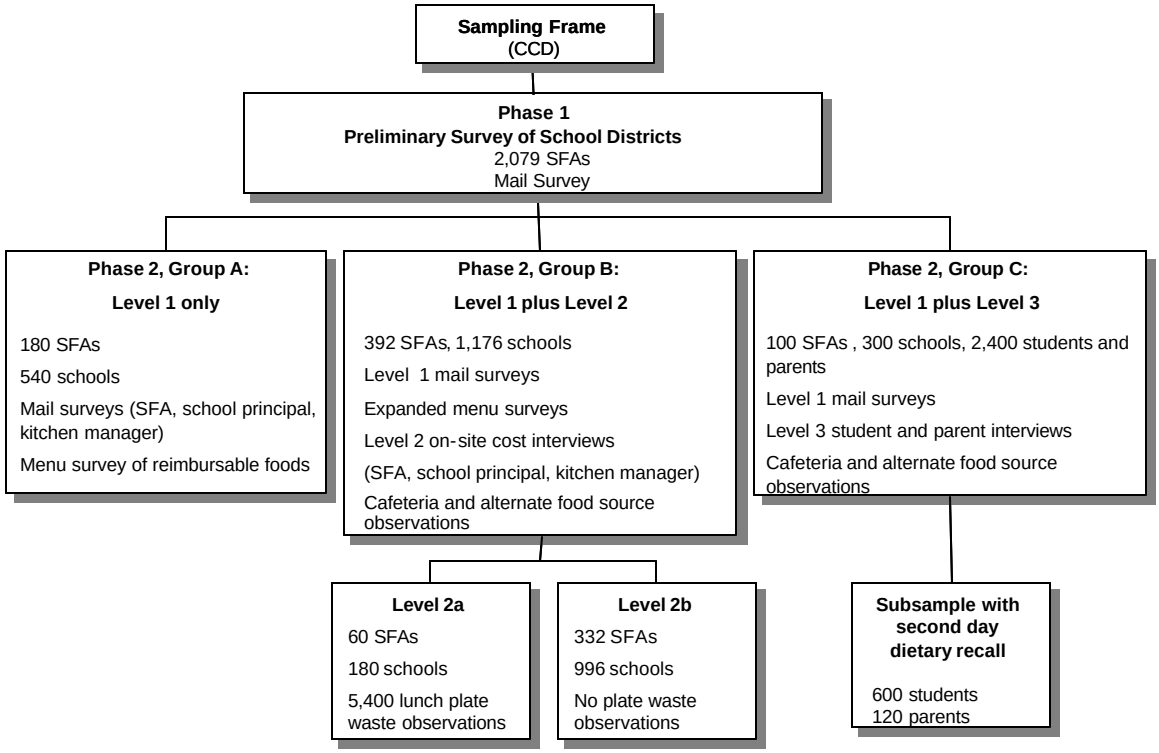
Summary of Data Collection for the Integrated Study of School Meal Costs and Outcomes

Study Phase and Level	Data Collection	Research Topics
Phase 1	Preliminary Survey of School Districts	Meal pricing, costs and revenues Employee benefits and cost reporting Geographic differences in meal costs Use of food service management companies Menu planning, production systems, and other food service practices After-school Snack Program operations
Phase 2		
Level 1	Survey of SFA Directors	School district environment Policies on meal pricing, competitive foods, and nutrition education and promotion Menu planning, production systems, food safety, and other food service practices SFA costs and revenues Experience and qualifications of SFA managers
	Principal Survey	Cafeteria environment Policies and practices on meal scheduling, competitive foods, and nutrition education and promotion Availability and contents of vending machines and other alternative food sources
	Kitchen Manager Survey	Meal production and serving practices Meal pricing and schedules Nutrition education and promotion Availability and contents of vending machines Experience and qualifications of kitchen managers
	Basic Menu Survey	Types of foods served and nutrient composition of reimbursable meals Competitive foods offered a la carte
Level 2	Expanded Menu Survey	Types of foods served and nutrient composition of reimbursable meals Competitive foods offered a la carte Costs of foods served in reimbursable and other meals
	On-Site Cost Interviews and Follow-up Survey	Labor and other costs of food service operations Costs and revenues of reimbursable meals and other food service
Level 2 and Level 3	Cafeteria and Alternate Food Source Observations	Cafeteria environment at breakfast and lunch Availability and contents of vending machines and other alternative food sources
Level 2a	Plate Waste Observations	Quantity and percent of food wasted in reimbursable meals
Level 3	Student and Parent Interviews	Patterns and influences of student participation Dietary intakes, diet quality, and contribution of school meals Weight status, activity levels, food assistance, and other individual/family characteristics

Exhibit ES-3 displays the organization of the sampling design and data collection, and the relationships of the levels of the study. This exhibit shows the sample sizes and key instruments for each level.

Exhibit ES-3

Sample Design Summary



As shown in the exhibit, SFAs and schools in Phase 2 of the study will fall into the following groups:

- Group A, Level 1 data only—180 SFAs and 540 schools
- Group B, Level 1 and 2 data—392 SFAs and 1,176 schools, with 60 SFAs and 180 schools also in the subsample for plate waste (Level 2a)
- Group C, Level 1 and 3 data plus Cafeteria and Alternate Food Source Observations (as in Level 2 schools)—100 SFAs and 300 schools.

SFA Data Collection

SFAs will be sampled and recruited to participate, both as direct respondents and by giving consent for contact with their schools. A two-phase approach will be used to collect SFA-level data.

Phase 1 will be a Preliminary Survey of SFAs to collect information on key characteristics needed to draw an efficient sample for Phase 2. The Preliminary Survey also will collect data for analysis of regional differences in school meal costs, use of food service management companies, and operation of the After-school Snack Program. The Preliminary Survey sample of 2,079 SFAs will be stratified by FNS region and poverty level. This sample is designed to provide regional estimates of the mean cost per NSLP lunch with a margin of error of ±$0.10 (assuming a mean of $2) at the 95 percent confidence level for each of the seven FNS regions.

In Phase 2, the Level 1 subsample of 672 SFAs in the Preliminary Survey sample will be selected and recruited for further data collection at the SFA, school and student levels. This subsample will be stratified by FNS region, poverty level, and menu planning system. A self-administered Level 1 mail survey will be sent to all SFA directors recruited for this subsample. The sample of 672 SFAs will be large enough to produce population estimates of proportions in each Level 1 domain within ±10 percentage points at the 95 percent confidence level in each of the seven FNS regions.

School Data Collection

Level 1. Within the 672 sampled SFAs, 2,016 schools will be sampled and recruited for Level 1 surveys of food service and school personnel. The study will include one school per SFA at each of three grade levels: elementary, middle, and high schools. While the Level 1 surveys will be self-administered, training and assistance will be provided by telephone or on-site. The major school-level survey instrument (the Menu Survey) will collect information on foods offered and served during a randomly selected "target" week for reimbursable meals ("meals offered and served") including menus, recipes, ingredients, production, and reimbursable servings. For Level 1 data at the school level, the estimated margin of error for population percentages is ± 2.7 percentage points at the 95 percent confidence level (assuming a design effect of 1.5, due to clustering of schools within SFAs).

Level 2. In a subsample of 392 SFAs and 1,176 schools, Level 2 data for the direct measurement of the full cost of school meals will be collected in addition to the basic Level 1 SFA and school surveys. For analysis of food costs, the study will use an expanded version of the Menu Survey to collect data on both reimbursable and non-reimbursable foods, and contractor staff will provide on-site assistance in completing the survey to kitchen staff. The data collectors who provide on-site assistance also will conduct interviews with SFA administrators, principals, and kitchen managers on labor costs and other expenses in support of food service operations, including both reported and unreported costs. In the cost study (Level 2) subsample of schools, additional data on the food service environment –including the cafeteria and alternate food sources—will be collected by direct observation. Final costs and revenues for the study year will be collected via a follow-up mail survey of Level 2 SFA directors.

For Level 2 school data, population percentages will be estimated with a margin of error of ±3.5 percentage points. For the cost per NSLP lunch, the conservative projection of the 95 percent confidence interval for a mean of $2.00 is plus or minus $0.063. The minimum detectable difference in the mean cost per lunch between key subgroups of schools (by grade level or menu planning system) ranges from $0.18 to $0.22, depending on the size of the subgroups.

From among the SFAs selected for the cost study (Level 2), a subsample of 60 SFAs and 180 schools will be selected for an observational study of plate waste. Data collectors will weigh portions of foods and observe plate waste for a sample of NSLP lunches and, where available, SBP breakfasts. With 30 lunch plate observations per school, this sample will provide a total of 5,400 lunch plate waste observations. The estimated coefficient of variation for mean calories wasted is 4.8 percent overall, 5.6 percent for each grade level, and less than 8 percent for male high school participants.

Student Data Collection, Level 3

Within the subsample of SFAs selected for the Menu Survey and other Level 1 data collection, a subsample of 100 SFAs and 300 schools will be selected for the Level 3 data collection, which will

focus on the Student and Parent Interviews. Participating and non-participating students will be sampled within the Level 3 subsample of schools.

Subject to parental consent, 2,400 students and their parents will be interviewed to collect 24-hour dietary recall data for students and other information from students and their parents. The study is designed to provide a sample of 180 high school participant boys, the level needed to provide a coefficient of variation of no more than 8 percent on a 50 percent population characteristic for subgroups of high school students by gender. The overall sample size takes into account the expected participation rates by grade level and the need for an even number of interviews per school. For all students, the estimated coefficient of variation is 4.1 percent for a 50 percent characteristic, with a design effect of 3.8. Estimated coefficients of variation for mean nutrient values are 5 percent or less for subgroups and 2.5 percent or less for all students.

The interview procedures will depend on the age of the student. For older students (ages 12 to 18), the entire 24-hour recall will be obtained from the student, but supplementary food preparation information will be obtained from the student's parent (or another person who is the most knowledgeable adult in the student's household). For younger students (ages 6 to 11), a combination of student recall and parent/guardian recall will be used to construct the 24-hour dietary intake. Dietary recalls may include measures of plate waste for school meals, in place of or in addition to plate waste observations. The student interviews will include age-appropriate questions on school meal participation and satisfaction or reasons for non-participation. For older students, the interviews will include questions on physical activity levels; for younger students, this information will be obtained in the parent interviews. Data collectors will measure the height and weight of each sampled student. The parent interviews will include questions on satisfaction with school meal program performance, food assistance program participation, and the socioeconomic characteristics of the student and the household.

Since a single day's recall does not provide reliable data on the distribution of usual intakes, a subsample of 600 students will be interviewed for a second day of 24-hour dietary intake data, and statistical techniques will be applied to these data to estimate the distribution of usual intakes.

Data Collection Pretest

All instruments for the Integrated Study were pretested in April, 2003 with up to nine respondents. The participating SFAs were located in eight states spread over the seven FNS regions. Each respondent was debriefed on the clarity of the questions, the burden of responding, and suggestions for improvements to the study. The pretest demonstrated the feasibility of all aspects of the planned data collection and provided information to refine the wording and formatting of instruments and instructions.

Analysis and Reporting

The analysis for the Integrated Study will include standard descriptive analyses of surveys and observational checklists, specialized methods and software for nutrient and cost analyses, and integrative analyses using descriptive and multivariate methods.

Descriptive Analyses of Surveys and Observational Checklists

Survey data and observational checklists will be edited, entered, cleaned, and compiled into analysis files. Descriptive tabulations will be computed using appropriate weights to account for sampling probabilities and non-response at the SFA, school, and student levels. Statistical tests of differences between groups will be conducted using SUDAAN or similar software to take the sampling design into account.

The timing of the Preliminary Survey will permit some analyses to be conducted before the rest of the data collection is complete. These analyses will examine the following topics:

- the relationship of food service costs to SFA location, size, revenues, and practices
- SFA participation and patterns of operation in the After-school Snack Program
- use of food service management companies
- key financial practices of SFAs, including meal pricing, cost reporting, and employee benefits, and wage rates.

For SFAs and schools, the most important subgroups are defined by poverty level, menu planning system, and grade span or level; urbanicity, enrollment size, and FNS region are also important. For students, the most important subgroups are defined by age or grade level, participation in NSLP/SBP, and (for older students) gender; subgroup estimates by eligibility for free or reduced-price meals are also important.

Nutrient Analyses

For analyses of nutrient data from the Menu Survey and the Student and Parent Interviews, the Integrated Study will use two sets of nutrient standards. The study will apply the SMI standards for calories, protein, vitamins A and C, calcium, iron, fat, and saturated fat, plus the National Research Council *Diet and Health* recommendations for protein, carbohydrate, cholesterol, and sodium. Use of these standards will show the extent of progress toward the goals of the SMI and will allow comparisons to previous studies that used the same standards. The Integrated Study also will apply the nutrient standards that have been updated since the adoption of the SMI rule, including the Institute of Medicine's new framework for dietary assessment and planning, the Dietary Reference Intake (DRI) standards for micronutrients and macronutrients. In keeping with the DRI framework, students' activity levels will be considered in analyses relating caloric intake to energy requirements. The study will also relate students' food consumption to the Food Guide Pyramid recommendations. The distribution of usual dietary intakes will be estimated using the two days of dietary recalls for a subsample of students.

The study design assumes the use of the Nutrient Data System, Research Version (NDS-R) to analyze the nutrient content of menus and to collect and analyze dietary intakes. USDA is also considering the use of the Automated Multi-Pass Method (AMPM) software and Survey Net coding system for collecting and analyzing dietary intakes, supplemented by the Food Intake and Analysis System (FIAS) as the tool for menu analysis. The AMPM/Survey Net system is not currently available for users outside of the government.

Meal Cost Analyses

The analyses of meal costs will use the methods developed by previous national studies to directly measure and estimate the reported and full costs of NSLP lunches and SBP breakfasts. Food and

production labor costs of NSLP lunches, SBP breakfasts, and other meals for sample schools will be estimated from food and labor usage data for those schools and for production kitchens serving the sampled schools, combined with SFA data on ingredient prices and wages. School-level data on administrative (non-production) labor will be included in the school-level estimates. SFA-level costs will be allocated between reimbursable and other meals based on the data from sample schools in the SFA. All costs for NSLP lunches and SBP breakfasts will be converted to costs per meal.

Integrative Analyses

A major reason for conducting an Integrated Study of School Meal Costs and Outcomes is to examine relationships among the various domains studied, to help policymakers assess the most cost-effective ways for the NSLP and SBP to reach their goals of providing nutritious meals and promoting the health of the nation's schoolchildren. For example, the data will permit detailed analysis of the relationships between district- and school-level characteristics of food service programs, school environments and policies, and children's diets. In addition, the data will allow investigation of the relationship between serving meals that meet various SMI standards and costs per meal. Furthermore, the extensive background data that will be available on district, school, and student characteristics may allow researchers to isolate the effects of school policies by controlling for related characteristics through multivariate models.

The study will approach integrative analysis in two complementary ways: descriptive analysis (using cross-tabulations) and multivariate analysis. Descriptive analyses will address questions of the relationship of school environment and policies to school-level participation, and relate school and food service characteristics to the nutritional characteristics of school meals. The Integrated Study will employ descriptive analysis to relate meal characteristics, costs, participation, and plate waste. Single-equation and multi-equation multivariate analyses will explore the relationships of school environment and policies, food service characteristics, and student characteristics to school meal costs and outcomes.

Descriptive Analysis of the Nutritional Quality, Acceptance, and Costs of School Meals. A particularly important question requiring integrative analysis is: how much does it cost to serve healthy meals that students will eat? The first step in answering this question is to analyze the relationship of nutrient characteristics of meals to student participation and plate waste. Then the analysis will look at measures of what students will eat, including the average nutrient characteristics of meals as served, the participation rate in the NSLP and SBP, and the proportion of food wasted.

The study will develop several criteria for dividing schools between those that serve "healthy meals that students will eat" (Group A) and those that do not (Group B). For example, Group A might be schools that meet selected SMI standards and NRC recommendations, and have a participation rate above the median. The descriptive analysis will then compare average meal costs between Group A and Group B, and appropriate tests of statistical significance will be performed, taking into account the sampling design.

Multivariate Analysis. The study will examine costs and outcomes as a function of student and school characteristics and school food service characteristics, using single-equation multivariate models. The large samples and the richness of the data collection planned for this study make the multivariate modeling approach quite strong, but the risks of collinearity among variables and selection bias will have to be addressed. The major defense against selection bias is the great variety, depth, and detail of the data that will be observed or collected in surveys, and thoughtful

consideration of all potentially relevant factors. The analysis methods will take into account the complex sampling design and, for student outcomes, the fact that students are nested within schools.

At the school level, single-equation models will examine the relationships of school policies, food service characteristics, and student/community characteristics to the following variables:

- **nutritional quality of meals** (e.g., percent of calories from fat)
- directly estimated **school-level costs of reimbursable meals**
- **daily student participation at the school level** during the target week (with time of year and day of week as additional control variables).

In addition, the multivariate modeling will include SFA-level analysis of **total food production costs** reportedly incurred by SFAs as a function of numbers of reimbursable meals, a la carte revenue, and SFA characteristics (including FNS region), to generate indirect estimates of the cost of producing a reimbursable meal.

Individual-level multivariate models will examine the relationship of individual and family characteristics, school policies, and food service characteristics to the following variables:

- student-level **participation** choice
- **intakes of key nutrients** over 24 hours, at breakfast, and at lunch
- **plate waste** as observed or as reported by the student, overall or for students taking food from specific food groups.

Recursive models will be used to examine the relationships among the school meal characteristics, costs, and outcomes. By modeling participation in relation to the characteristics of meals offered, for example, the study will show how factors such as percent of calories from fat in meals offered, availability of fresh fruit and vegetables, and use of whole grain products are related to students' decisions to participate. Student dietary intakes will be modeled both in direct relation to meal characteristics and in a two-stage model, to show whether students who participate in the school meal programs, given the meals offered, in fact have better intakes. Recursive models will take into account the possible effects of meal characteristics—such as use of fresh produce and fat content—on meal costs and plate waste.

Estimating the causal effects of school meal policies and participation is more challenging. Although such models may be worth pursuing, particularly for short-term outcomes, the entire Integrated Study is not designed to focus on these questions. The cross-sectional design of the study, which is very strong for providing a national picture of how the school meal programs operate, is much weaker for assessing their impacts (or even the impacts of specific school policies). Nevertheless, it is possible in principle to use multiple-equation models to address these issues.

The study will explore the possibility of using instrumental variables (IV) models to adjust for selection bias, provided appropriate data are available. In particular, the IV approach will be explored for modeling student participation and dietary intakes. There are several types of IV estimation approaches, but all involve jointly modeling the decision to participate in a school meal and the dietary outcome of interest. The limitations of this approach are, first, the need to have some

variables that affect the participation decision but do not otherwise affect dietary intakes (known as "instruments" or "identifying variables"), and second, the frequent result that IV models give different results with different specifications (i.e., findings are not robust).

The study will attempt to develop a multi-equation structural model for the costs and outcomes measured at the school level. The single-equation modeling efforts will provide the groundwork for specifying the equations in the structural model, showing which school and community characteristics are most important in affecting the various outcomes. The validity of a structural model depends on the correctness of the assumptions that particular factors affect some outcomes and not others (identifiers). As the study contractor and USDA examine the relationships in the data, they will further assess whether such a structural model is indeed feasible, and whether data exist to identify such a model with confidence.

Estimated Cost of the Integrated Study

This section presents estimates of the cost of the Integrated Study of School Meal Costs and Outcomes. The design study contractors have prepared these estimates on the basis of the preceding description of the study and experience from past studies using similar methods. These estimates reflect the following fundamental assumptions, as well as the detailed plans for the study presented in the Final Report:

- The Preliminary Survey, sampling, and recruiting will be undertaken in the 2003-2004 school year, and the main data collection will be conducted in the 2004-2005 school year.
- The Nutrition Data System for Research (NDS-R) will be used for dietary recall interviews and for processing Menu Survey data.
- School officials, students and parents will be compensated for study participation according to the amounts proposed in the study design.
- The range of costs estimated for each study component reflects the varying degrees of uncertainty about the expected costs.
- The cost estimates include allowance for normal escalation of costs due to inflation.

Exhibit ES-4 presents cost estimates for the Integrated Study. For the Preliminary Survey, the cost estimate includes study startup, initial sampling, data collection and processing, construction of the Level 1 sample frame, and other preliminary analysis. The sampling and recruiting task includes all other sampling and recruiting of SFAs and schools. The estimate for the synthesis report includes cross-domain analyses, multivariate analyses, and synthesis of results. For all other study components, the cost estimates include data collection, data processing, descriptive analysis, and

Exhibit ES-4

Estimates of Costs for Integrated Study of School Meal Costs and Outcomes

Study Component	Low Cost Estimate ($million)	High Cost Estimate ($million)
Preliminary survey	0.5	0.6
Sampling and recruiting	0.8	1.1
SFA and principal surveys	0.4	0.5
Menu and kitchen manager surveys	2.8	3.6
Level 2 data (Cost interviews, observation of cafeterias and alternate food sources, and analysis of meal costs and revenues)	3.0	3.9
Plate waste (observational method)	0.5	0.6
Student and parent interviews	4.0	4.5
Synthesis report	0.3	0.3
Total	**12.4**	**15.1**

Note: Sum of items may not match total due to rounding.

reporting on data collection and descriptive analysis. In addition, the Menu Survey, Cost Interview, and Student Interview costs include compensation or gifts to respondents, and the Plate Waste Observation costs include payment to schools for sample foods to be weighed.

As the table indicates, the estimated total cost of the Integrated Study is $12.4 to $15.1 million. The largest components are the Menu and Kitchen Manager Survey, the Level 2 data, and the student and parent interviews.

The estimated cost of the plate waste observation component is $0.5 to $0.6 million. This is the incremental cost of data collection and analysis, which build on the Level 2 data collection and the Menu Survey analysis of the nutrient content of foods. Thus, the study cost would be reduced by about $0.5 million if the domain of plate waste were entirely eliminated, but a separate plate waste study would cost much more than $0.5 million. A cost of about $0.1 million would be added if the plate waste recall method were used; this represents the additional analysis cost, given that there is no material impact on the data collection cost.

Although components of the study have separate cost estimates, each component relies on other components and does not stand on its own. The Integrated Study design results in efficiencies in collecting data for each study component. Thus, deleting a component from the study might reduce the total cost of the study by less than the estimated cost of the deleted component. Put another way, doing components of the study separately would be more costly than doing them as part of the Integrated Study and would eliminate opportunities for integrative analyses.

The Integrated Study would represent a substantial investment in knowledge and would be more efficient than previous approaches. The study would provide a wealth of knowledge about the results of the billions of dollars spent by USDA, the States, and the SFAs on the NSLP and SBP. The integrated approach would save $2 to $3 million over the combined cost of separate studies of meal costs and program outcomes, such as have been conducted in the past. Most of these savings come from using the Menu Survey for both the measurement of meal costs and the assessment of meal quality.

The Integrated Study would provide unprecedented opportunities to understand the relationships between program operations, meal quality, costs, and student outcomes. It would be the first national study to address the principal challenge faced by the school meal programs: how to serve healthy, varied, economical meals that today's diverse students will eat.