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Volume 4, Executive Summary of the Literature Review

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Abstract

This report provides a summary of a comprehensive review and synthesis of published research on the impact of USDA's domestic food and nutrition assistance programs on participants' nutrition and health outcomes. The outcome measures reviewed include food expenditures, household nutrient availability, dietary intake, other measures of nutrition status, food security, birth outcomes, breastfeeding behaviors, immunization rates, use and cost of health care services, and selected nonhealth outcomes, such as academic achievement and school performance (children) and social isolation (elderly). The report is one of four volumes produced by a larger study that includes Volume 1, Research Design; Volume 2, Data Sources; Volume 3, Literature Review; and Volume 4, Executive Summary of the Literature Review. The review examines the research on 15 USDA food assistance and nutrition programs but tends to focus on the largest ones for which more research is available: food stamps, school feeding programs, and the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Over half of USDA's budget—$41.6 billion in fiscal year 2003—was devoted to food assistance and nutrition programs that provide low-income families and children with access to a healthy diet.

Keywords: Dietary intake, food expenditures, nutrient availability, nutrient intake, nutritional status, nutrition and health outcomes, USDA's food assistance and nutrition programs

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Introduction

Since the mid-1940s, the U.S. Government has been committed to ensuring that its citizens neither go hungry nor suffer the consequences of inadequate dietary intake. Over the years, Federal programs have been implemented to meet this commitment. Today, the Federal nutrition safety net includes 16 distinct food assistance and nutrition programs (FANPs) (table 1). Administered by the Food and Nutrition Service (FNS), U.S. Department of Agriculture (USDA), together the 16 programs were funded at a level of about $38 billion in fiscal year (FY) 2002.[1] An estimated one in five Americans participated in one or more FANPs at some point during FY 2002 (Oliveira, 2003).

Although FANPs vary greatly in size, target population, and benefit-delivery strategy, all provide vulnerable groups of citizens with food, the means to purchase food, and/or with nutrition education (table 2).[2] All FANPs share the main goal of ensuring the health of vulnerable Americans by providing access to a nutritionally adequate diet. In 1998, FNS renewed its commitment to nutrition education in all FANPs, with the goal of increasing the role of the programs in improving the Nation's eating habits (USDA/FNS, 2003a). As part of this renewed focus, one of two key goals defined in the FNS strategic plan for 2000-05 is "improved nutrition for children and low-income people" (USDA/FNS, 2000a). Core objectives under this goal include improving food security, promoting healthy food choices among FANP participants, and improving the quality of meals, food packages, commodities, and other program benefits. This emphasis on nutrition and nutrition education differentiates the FANPs from other federally sponsored income support programs.

In recognition of the renewed emphasis on nutrition and nutrition education in the FANPs, as well as the increasing Federal focus on program accountability, USDA's Economic Research Service (ERS) contracted with Abt Associates Inc. to conduct the Nutrition and Health Outcomes Study. A major focus of the study was a comprehensive review and synthesis of existing research on the impact of FANPs on nutrition- and health-related outcomes (see p. 3 for an explanation of the term "outcomes"). This report summarizes key findings from that effort. Detailed reviews of relevant research, on which this summary is based, are published in a companion volume (Fox, Hamilton, and Lin, 2004).[3]

Objective and Scope of the Review

The objective of the literature review was to summarize current knowledge about the effects of FANP participation on nutrition- and health-related outcomes. The first step was a comprehensive literature search to identify

[1]The list of FANPs used here differs slightly from the list used by FNS. FNS considers the Nutrition Education and Training Program and the Team Nutrition Initiative to be part of the National School Lunch Program and the School Breakfast Program. FNS also operates the Disaster Relief Program, a program that is not considered in this review because its role in the nutrition safety net is substantively different from that of the other FANPs.

[2]Several programs also provide avenues for distributing surplus agricultural commodities.

[3]The Nutrition and Health Outcomes Study produced six other reports. Two are companion volumes to this report. One of the reports reviews the research designs available to researchers interested in studying the effects of FANPs (Hamilton and Rossi, 2002), and the other describes existing data sources that might be useful in these endeavors (Logan, Fox, and Lin, 2002). Four additional reports summarize the nutrition and health characteristics of low-income populations, using data from the third National Health and Nutrition Examination Survey (NHANES-III). The reports cover Food Stamp Program participants and nonparticipants (Fox and Cole, 2004a), WIC participants and nonparticipants (Cole and Fox, 2004a), school-age children (Fox and Cole, 2004b), and older adults (Cole and Fox, 2004b).

Table 1—Federal food assistance and nutrition programs

Program	Year begun[1]	FY 2002 costs[2]	FY 2002 participation[2]
		$ millions	
National School Lunch Program (NSLP)	1946[3]	6,857[4]	28,006,873 lunches per day
Special Milk Program (SMP)	1955	16	112,781,614 total half pints
Commodity Supplemental Food Program (CSFP)	1968	110	427,444 participants per month
Summer Food Service Program (SFSP)	1968	263	121,865,417 total meals and snacks
Food Stamp Program (FSP)	1974	20,677	19,099,524 participants per month[5]
Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)	1975	4,319[6]	7,490,841 participants per month
School Breakfast Program (SBP)	1975	1,566[4]	8,144,384 breakfasts per day
Nutrition Services Incentive Program (NSIP)[7]	1975	152	252,748,643 total meals[8]
Nutrition Education and Training Program (NET)	1977	0	0
Food Distribution Program on Indian Reservations (FDPIR)	1977	69	110,122 participants per month
Child and Adult Care Food Program (CACFP)	1978[9]	1,852[4]	1,691,448,979 total child meals and snacks; 44,570,764 total adult meals and snacks
Nutrition Assistance Program in Puerto Rico, American Samoa, and the Northern Marianas (NAP)	1981	1,362[10]	Not available
The Emergency Food Assistance Program (TEFAP)	1981[11]	435[12]	611 million total pounds of food distributed
WIC Farmers' Market Nutrition Program (FMNP)	1992	25[13]	2+ million total participants[13]
Team Nutrition Initiative (TN)	1995	10[14]	Not available
Senior Farmers' Market Nutrition Program (SFMNP)	2002	13[15]	Not available

[1]Year of permanent authorization. Several food assistance and nutrition programs started as pilot projects before being established as permanent programs.

[2]Unless otherwise noted, data on costs and participation were obtained from USDA/FNS administrative data for FY 2002 (http://www.fns.usda.gov/pd, accessed April 2003). Reported costs include all cash benefits/reimbursements, food/commodity costs (as applicable), and administrative costs.

[3]In 1998, the program began covering snacks served in after-school programs. In FY 2002, a total of 122,914,873 snacks were served.

[4]In FY 2002, an additional $124 million was spent on State administrative expenses for the NSLP, the SBP, and the CACFP.

[5]Individuals in participating households.

[6]Excludes estimated cost of WIC Farmers' Market Nutrition Program (FMNP), based on FY 2002 appropriation for FMNP.

[7]Formerly known as the Nutrition Program for the Elderly (NPE). In FY 2003, administration for the program was transferred to the U.S. Department of Health and Human Services. FNS continues to supply commodities and financial support to the program.

[8]Total meals for FY 2001, the latest year for which FNS collected data.

[9]The adult day care component was added in 1989. In 1999, the program expanded to serve children living in homeless shelters.

[10]The FY 2002 grant for Puerto Rico was $1,351 million, the grant for American Samoa was $5.3 million, and the grant for the Northern Marianas was $6.1 million.

[11]Until 1996, FNS operated a separate Commodity Distribution Program for Charitable Institutions, Soup Kitchens, and Food Banks. Under the Personal Responsibilities and Work Opportunities Reconciliation Act (PRWORA), this program was merged into TEFAP.

[12]In FY 2002, FNS donated an additional $16 million in commodities to disaster relief and charitable institutions.

[13]Cost reflects FY 2003 appropriation. Source: http://www.fns.usda.gov/wic/FMNP/FMNPfaqs.htm, accessed April 2003.

[14]FY 2002 appropriation. Source: L. French (2002). Personal communication.

[15]Based on FY 2002 appropriation ($15 million) and residual carried over into FY 2003 ($1.7 million). Source: http://www.fns.usda.gov/wic/Senior FMNP/SFMNPFY02.htm and SFMNPFY03.htm, accessed April 2003.

potentially relevant research for each FANP.[4] The search covered published research papers and books, research reports to government agencies, and unpublished works, such as doctoral dissertations, working papers of research institutes, and conference presentations.[5]

Several hundred citations were identified through the initial search of selected computerized databases. However, many did not deal directly with the core objective of this review and were excluded from further consideration. These citations included, for example, general program descriptions, program manuals, research on program participation or participant characteristics, and research on program operations, costs, and integrity. In addition, research that involved FANP participants but did not explicitly compare participants and nonparticipants was excluded.

This winnowing process narrowed the list of citations to research that explicitly examined the impact of FANP participation by comparing nutrition- and health-related outcomes of program participants and nonparticipants. Program-specific authors identified other relevant citations as they reviewed papers and reports.

Overview of the Literature on Nutrition and Health Outcomes

An extensive amount of research has assessed the impact of specific FANPs on nutrition and health, but the coverage is neither comprehensive nor even. Table 3 shows the number of studies identified for each program and the major outcomes examined. Outcomes can be grouped into six categories:

- Household food expenditures.
- Household nutrient availability.
- Individual dietary intake.
- Measures of nutrition and health status other than dietary intake (food security, birth outcomes, nutritional status, and health status).
- Health-related behaviors.
- Other relevant, but not specifically health-related, outcomes.

[4]The Senior Farmers' Market Nutrition Program was not included in the search because the program was not established until 2002.

[5]The initial search was conducted in 1999 and updated in 2002 before preparation of the final version of the report. The 2002 update included only published research. Additional published research was incorporated before publication of the report in 2004.

The last category includes cognitive development and school-related performance among children, social isolation among the elderly, and nutrition knowledge or attitudes (examined for only the programs focused specifically on nutrition education—the Nutrition Education and Training Program and the Team Nutrition Initiative).

Conclusions from studies that have examined the impact of FANP participation on nutrition and health status must be interpreted with caution. Establishing causality between FANP participation and long-term nutrition and health outcomes requires that data support a logical time sequence. For long-term outcomes (measures that develop over time, such as linear growth and body weight), FANP participation must precede the outcome for a reasonable period of time and be of sufficient intensity to provide a plausible basis for a hypothesized impact. In addition, reliable assessment of impacts on such measures as linear growth and nutritional biochemistries requires at least two measurements, one before and one after participation. Finally, a complex interplay of diet, heredity, and environment influence nutrition and health status, which makes the task of determining the specific impacts of FANPs on these long-term outcomes a challenge. Comparable concerns exist for studies that have examined the impact of FANP participation on food security status.

As table 3 illustrates, the Food Stamp Program (FSP) and the Special Supplemental Nutrition Program for Women Infants and Children (WIC) have been studied extensively, and a broad number of outcomes have been examined. For several other programs, impact research is totally or virtually nonexistent. For some of these programs, such as the Food Distribution Program on Indian Reservations (FDPIR), the Commodity Supplemental Food Program (CSFP), and the Special Milk Program (SMP), little research of any kind is available. For other programs, including the Child and Adult Care Food Program (CACFP), the Summer Food Service Program (SFSP), and The Emergency Food Assistance Program (TEFAP), research is available, but none of it has focused on measuring program impacts on individual participants or their households.

Limitations of Available Research

Many studies of the effects of FANP participation on nutrition- and health-related outcomes share three key limitations. These limitations include research design and the potential for selection bias, the relative age of the available research, and the standards used to assess dietary intake.

Table 2—Populations served and benefits provided by Federal food and nutrition assistance programs

Program	Target population	Income-eligibility requirement (percent of Federal poverty guideline)	Benefits provided
Food Stamp Program	Low-income households	≤130%[1]	Electronic benefits for use in purchasing food for home consumption[2] Nutrition education may be offered
WIC program	Low-income pregnant, breastfeeding, and postpartum women; infants; children ages 1-4	≤185%[3]	Supplemental foods, nutrition education, and referrals to health care and social services
Child Nutrition Programs			
National School Lunch Program	School-age children	≤130% receive free meals/snacks 131-185% receive reduced-price meals/snacks >185% may participate but pay full-price for meals/snacks	Lunches that meet specific nutrition standards[4] After-school snacks
School Breakfast Program	School-age children	≤130% receive free meals 131-185% receive reduced-price meals >185% may participate but pay full-price for meals	Breakfasts that meet specific nutrition standards[4]
Child and Adult Care Food Program	Children and adults attending licensed, nonresidential day care facilities, homeless shelters, and after-school programs[5]	Any child or adult in participating center may participate. Reimbursements to providers are based on relative poverty status of populations they serve[6]	Meals and snacks that meet defined meal patterns
Summer Food Service Program	Low-income school-age children	Any child attending an approved feeding site may participate[7]	Free meals and snacks that meet defined meal patterns
Special Milk Program	School-age children enrolled in schools that do not participate in other Child Nutrition Programs or who attend part-day programs that do not allow them to receive meals	≤130% receive free milk 131-185% receive reduced-price milk >185% may participate but pay full-price for milk	½ pint of milk
Food Distribution Programs			
Commodity Supplemental Food Program	Low-income pregnant and postpartum women, infants, children up to their 6th birthday, and adults ages 60 and older	≤130% for adults ages 60 and older ≤185% for women, infants, and children	Commodity foods, nutrition education, referrals to health care and social services
Food Distribution Program on Indian Reservations	Low-income American Indian or non-Indian households living on reservations[8]	≤130%	Commodity foods (alternative to the FSP)

See notes at end of table.

Continued—

Table 2—Populations served and benefits provided by Federal food and nutrition assistance programs—Continued

Program	Target population	Income-eligibility requirement (percent of Federal poverty guideline)	Benefits provided
The Emergency Food Assistance Program	Low-income individuals and families	Determined by States[9]	Commodity foods distributed through food banks, food pantries, emergency kitchens, and homeless shelters
Nutrition Services Incentive Program	Adults ages 60 and older	None	Cash or commodities to support provision of meals through the Elderly Nutrition Program[10]
Nutrition Education Programs			
Team Nutrition Initiative	School-age children, parents, school foodservice workers, teachers, and administrators	None	Nutrition education
Nutrition Education and Training Program	School-age children, school foodservice workers, teachers, and administrators	None	Nutrition education
Other			
Nutrition Assistance Program in Puerto Rico, American Samoa, and the Northern Marianas	Low-income households in Puerto Rico, American Samoa, and the Northern Marianas	Determined by individual commonwealths	Cash subsidies (replacement for the FSP)
WIC Farmers' Market Nutrition Program	WIC participants and eligible nonparticipants who are on waiting lists[11]	≤185%[12]	Coupons for use in purchasing locally grown fresh fruits, vegetables, and herbs
Senior Farmers' Market Nutrition Program	Adults ages 60 and older	≤185%	Coupons for use in purchasing locally grown fresh fruits, vegetables, and herbs

[1]Must also meet certain resource, work-related, and categorical requirements.

[2]In mid-2004, a nationwide changeover from the use of food stamps (coupons) to the use of electronic benefits was completed.

[3]Must also be certified by a recognized health care professional to have a nutritional risk. Participation is not guaranteed. Local programs can serve only as many participants as their funding will allow. Priority system is used to fill slots when funding is tight.

[4]Participating schools receive cash subsidies for each meal served (and donated commodities for each lunch served), including those served to students who pay full price. Reimbursement rates are higher for meals served to students free or at a reduced price than for meals served at full price.

[5]Nonprofit child care centers are eligible to participate in the CACFP, as are for-profit centers in which at least 25 percent of the center's enrollment or licensed capacity receive either Title XX funds or are eligible for free or reduced-price meals.

[6]Providers receive cash subsidies for every meal and snack served. Centers are reimbursed based on the financial need of the children and adults they serve, using the income-eligibility and meal-reimbursement rates used in the NSLP and SBP. Homes are reimbursed based on the economic need of providers and the children they serve. Homes located in low-income areas or operated by providers with incomes <185 percent of poverty are reimbursed at higher rates than other homes.

[7]Most feeding sites are located in areas where at least 50 percent of the children are from households with incomes ≤185 percent of poverty or in programs where 50 percent of the enrolled children are eligible to receive free or reduced-price meals, using the income-eligibility criteria defined for the NSLP and SBP. Residential summer camps may receive reimbursement for meals and snacks served to children whose documented household income makes them eligible for free or reduced-price meals.

[8]Low-income households that contain at least one member of a federally recognized tribe and reside in approved areas near reservations or in Oklahoma may also participate.

[9]Under TEFAP, USDA makes commodity foods available to States. States provide the food to local agencies they have selected, and these agencies distribute the food to the public, either in prepared meals or for home consumption. Each State sets criteria for determining which households are eligible to receive food for home consumption. However, recipients of prepared meals are considered to be needy and are not subject to a means test.

[10]The NSIP supports the Elderly Nutrition Program operated by the U.S. Department of Health and Human Services, Administration on Aging. ENP sites, rather than individuals, participate in the NSIP.

[11]The WIC Farmers' Market Nutrition Program (FMNP) is not available in all WIC sites. In FY 2003, 36 States, the District of Columbia, Puerto Rico, Guam, and five Indian Tribal Organizations operated the FMNP.

[12]Must also be certified, by a recognized health care professional, to have a nutritional risk.

Table 3—Number of studies by program and outcome

Program	Household food expenditures	Household nutrient availability	Individual dietary intake	Measures of nutrition and health status other than dietary intake: Food security	Birth outcomes	Nutrition status[1]	Health status[2]	Health behaviors[3]	Other[4]
Food Stamp Program (FSP)	32	14	26	14	2	8	2	0	0
WIC program[5]	2	2[6]	25	2	39	28	10	15	5
National School Lunch Program (NSLP)	3	0	18	0	0	8	0	0	1
School Breakfast Program (SBP)	0	0	15	1	0	4	2	0	8
Child and Adult Care Food Program (CACFP)	0	0	0	0	0	0	0	0	0
Summer Food Service Program (SFSP)	0	0	0	0	0	0	0	0	0
The Emergency Food Assistance Program (TEFAP)	0	0	0	0	0	0	0	0	0
Nutrition Services Incentive Program (NSIP)[7]	0	0	14	1	0	6	1	0	3
Nutrition Assistance Program in Puerto Rico, American Samoa, and the Northern Marianas (NAP)	2	3	0	0	0	0	0	0	0
Commodity Supplemental Food Program (CSFP)	0	0	0	0	1	1	0	1	0
Food Distribution Program on Indian Reservations (FDPIR)	0	0	0	0	0	0	0	0	0
WIC Farmers' Market Nutrition Program (FMNP)	0	0	2[8]	0	0	0	0	0	0
Special Milk Program (SMP)	0	0	2[8]	0	0	0	0	0	0
Team Nutrition (TN)/Nutrition Education and Training Program (NET)	0	0	6[8]	0	0	0	0	0	6

Notes: Many studies examined more than one outcome. Counts reflect the number of studies that included at least one measure in this category.

The Senior Farmers' Market Nutrition Program is not included in this summary because it was not established until 2002 and was not included in the literature review.

[1]Includes nutritional biochemistries, measures of height and/or body weight, and composite measures of nutritional risk.

[2]Includes measures of general or specific health status and use of health care services.

[3]Includes breastfeeding initiation and duration and immunization status.

[4]Includes measures that are not health-specific, such as school attendance, cognitive development/performance, social isolation, and nutrition knowledge and/or attitudes. Research that examined impacts on nutrition knowledge and/or attitudes was considered only for the FANPs that are specifically devoted to nutrition education—the Team Nutrition Initiative and the Nutrition Education and Training Program.

[5]For the WIC Program, studies were counted within four participant groups: prenatal women, infants and children, postpartum women (both breastfeeding and nonbreastfeeding), and undifferentiated. Thus, studies that examined outcomes in more than one participant group are counted more than once.

[6]These studies looked at diet-related outcomes at the household level, not household nutrient availability per se. One study looked at dietary quality, and the other looked at food use.

[7]These studies are actually studies of the Elderly Nutrition Program, the program sponsored by the U.S. Department of Health and Human Services, Administration on Aging. The NSIP and its precursor, the Nutrition Program for the Elderly (NPE) contribute commodity and cash assistance to the ENP.

[8]These studies (with the exception of one SMP study) included measures of self-reported eating behaviors—for example, usual or recent consumption of fruits and vegetables—rather than detailed assessments of dietary intake.

Research Design and the Potential for Selection Bias

The research designs used in most of the available research limit the confidence that can be placed in the findings. The randomized experiment is recognized as the "gold standard" of program evaluation, but this design is virtually nonexistent in FANP research.

The fundamental requirement of randomized experimentation is that the program service be deliberately withheld from some people who are otherwise like the people who receive the service. Potential program participants are randomly assigned to either receive (treatment group) or not receive (control group) program benefits. Random assignment is difficult to implement in FANP research. It generally cannot be done in entitlement programs, such as the FSP, the National School Lunch Program (NSLP), and the School Breakfast Program (SBP), because law and regulation require that program benefits or services be provided to everyone who meets eligibility requirements and takes the necessary steps to qualify.

Nonentitlement programs can pose similar problems. For nonentitlement programs that approach full saturation, such as WIC, finding a reasonably representative set of nonparticipants to whom the program could be considered unavailable can be virtually impossible. Moreover, if program services would normally be provided to everyone who applies and is eligible, withholding services from people who might apply may be considered unethical.

Because of these constraints, the reviewed literature included only one study that used a randomized experiment to evaluate the impacts of a specific FANP on the nutrition and health outcomes of program participants.[6] This study was completed during the early years of the WIC program (Metcoff et al., 1985). A randomized experiment was feasible in this case because, at the time, the demand for WIC participation at the study site exceeded the available funding.

A few studies have used randomized experiments to estimate the impact of demonstrations or pilot programs, rather than of a FANP per se. These demonstrations typically represented policy initiatives that were tested on a limited scale before full-scale implementation. The most prominent examples are demonstrations of cashing out food stamps—the so-called "cashout" studies (Fraker et al., 1992; Ohls et al., 1992)—and a recent pilot project in which school breakfasts were offered free to all school children, regardless of household income—the so-called "universal-free breakfast" demonstration (McLaughlin et al., 2002). While results of such studies possess all the strengths associated with the randomized experiment design, the results cannot always be applied to the FANP involved. Evaluations of demonstration projects do not compare program participants and nonparticipants. Rather, they compare the status quo—or the program as it exists without the modification introduced by the demonstration—with the demonstration program. In the case of the food stamp cashout demonstrations, the evaluations estimated the effects of receiving benefits in the form of checks rather than as food stamps (coupons) but did not estimate the overall impact of the FSP itself.

Virtually all of the research that has examined the impact of FANPs on nutrition- and health-related outcomes has used nonrandomized or quasi-experimental designs. In quasi-experiments, nonparticipants are identified through some means other than random assignment. Most quasi-experimental designs are subject to problems of selection bias. The underlying problem is that identified nonparticipants may not be sufficiently comparable to participants.

Selection bias often occurs because participants are more highly motivated to achieve the program-relevant outcomes than nonparticipants. Suppose, for example, that the women who seek WIC benefits for themselves or their children tend to be very concerned about the effect of diet on their children's health. Such women may well take other actions with the same objective, such as following dietary guidelines in brochures they pick up in the doctor's office—or getting to a doctor's office at all. If this were true, one would expect the children of mothers who seek WIC benefits to have better nutrition and health outcomes, even in the absence of the program, than children of mothers who are less motivated and do not seek WIC benefits. A simple comparison of WIC and non-WIC children would, therefore, reveal that the WIC children had more positive outcomes even if the program had no effect at all.

Sometimes selection bias operates in the opposite direction. Mothers of children with nutrition-related problems might be especially motivated to seek WIC benefits, for example, whereas mothers of healthy children might be less inclined to participate. WIC might improve the

[6] Studies of the Team Nutrition Initiative and Nutrition Education and Training Program have used random assignments of volunteer schools or classrooms to assess impacts on nutrition-related knowledge, attitudes, and self-reported behaviors.

participating children's condition, but the children might not catch up with their nonparticipating, healthier counterparts. In this example the simple comparison would find WIC children to have less positive outcomes even though the program had a positive effect. The fact that WIC specifically targets individuals who are at nutritional risk increases the likelihood of this type of bias.

Participant motivation toward the program outcome is one of the most common sources of potential bias and one of the most difficult to counteract. Other common sources of selection bias include need (often proxied by income), potential for gain (often proxied by the dollar value of the benefit), and the individual's desire not to depend on public assistance.

Selection bias may also result from program rules or procedures. In nonentitlement programs, local staff often decide which applicants will be approved for participation based on a combination of program policies and individual judgment. In all programs, outreach practices, referral networks, office locations and hours, and community customs may make some people more likely to participate than others.

Finally, some selection bias occurs when program participation is based on transitory characteristics. For example, some people who qualify for means-tested programs are permanently poor, or nearly so, and would be income-eligible for program participation for periods of many years. Other people who qualify are not permanently poor, but are at a temporary low point in a fluctuating income pattern. In an earlier period, their income was high enough that they did not qualify for the program, and at some point, they will regain that level of income. These two types of people might have similar incomes at the time they enter the program, but their subsequent outcomes, in the absence of the program, might not be at all similar.

Researchers have used a variety of approaches to try to counteract selection bias (see Hamilton and Rossi, 2002, or Fox, Hamilton, and Lin, 2004, chapter 2, for a detailed description of these techniques and their relative strengths and weaknesses). All of these techniques have the basic objective of making the participant and nonparticipant groups "alike" on certain specified dimensions, thereby minimizing the potential influence of selection bias on study results. However, none of the techniques can guarantee that selection bias has been eliminated.

Well-conceived approaches to controlling for selection bias in FANP research have yielded both plausible and implausible results. The situations that produce implausible results cannot be identified a priori, and none of the customary approaches has consistently yielded plausible results. Moreover, a plausible selection bias adjustment has not necessarily accomplished its purpose just because it is plausible. After decades of research and debate, the statistical community has not yet reached a consensus that any particular approach will consistently remove selection bias.

In addition, data limitations hamper nearly all attempts to counter selection bias. Careful theorizing about the determinants of participation usually suggests many factors that are not measured in existing datasets. Even with special data collection, many of the factors pertain to the period before the individual began participating (or not participating) and cannot be measured reliably on a retrospective basis.

Although the extent of remaining bias cannot be known for sure, testing the robustness of the results is usually informative. A program impact estimate that remains stable under various alternative specifications is somewhat more credible than one that varies dramatically. Of course, if several specifications fail equally to remove the bias, the results will be consistent with one another but inaccurate.

Relative Age of the Available Research

Another limitation affecting much of the existing research is the relative age of the data. Many of the datasets used date back to the 1980s and even the 1970s. Application of findings from these studies to today's FANPs must be done with some caution. Although this general caution applies to all research, a compelling argument can be made that impacts on nutrition- and health-related outcomes are more sensitive to temporal considerations than impacts on food expenditures. For example, the American food supply has changed dramatically in the past 20-30 years, with important implications for both nutrient availability at the household level and individual dietary intakes. Americans are eating substantially more grains than they were two decades ago, particularly refined grains, as well as record-high amounts of caloric sweeteners and some dairy products and near-record amounts of added fats (Putnam and Gerrior, 1999).

In addition to myriad new products on the market and changes in food enrichment policies and standards, a number of sociodemographic trends may have influenced food purchasing behaviors. These trends include, for example, an increase in the amount of food eaten away from home, smaller households, more two-earner and single-parent households, an aging population, and increased ethnic and racial diversity (Putnam and Gerrior, 1999).

Finally, the design and implementation of some FANPs has changed substantially over the past 30 years. Studies based on data from 30, 20, or even 10 years ago cannot be assumed to represent current program operations or participants. As discussed later, this point is particularly true for the NSLP and SBP.

Standards Used To Assess Dietary Intake

Most studies that examined the impact of FANPs on dietary intake focused on nutrient intake—most often food energy (kilocalories) and vitamins and minerals—rather than on food intake, and were interested in the adequacy of the diets being consumed rather than the quality. Most studies assessed nutrient intakes as a percentage of age-and-gender-appropriate Recommended Dietary Allowances (RDAs) rather than as raw intakes in kilocalories, milligrams (mg) or grams (gm) (National Research Council (NRC), 1989a). Most FANP researchers compared mean intakes of participants with intakes of nonparticipants, although some researchers compared the proportion of individuals in each group who had intakes below a defined cutoff, generally between 70 and 100 percent of the RDA. The latter approach is less common, perhaps because an expert panel convened by USDA in the early 1980s specifically recommended against the use of fixed cutoffs relative to the RDAs as a means of assessing the prevalence of inadequate intakes (NRC, 1986).

In assessing program impacts, researchers generally deemed a significantly greater mean intake among participants or a significantly greater percentage of participants with intakes above a specified cutoff as evidence of a positive program effect. Effects were characterized as program participation leading to "increased intake(s)." Although these interpretations are common in the available literature, information on differences in the mean percentage of the RDA consumed or in the proportion of individuals consuming some percentage of the RDA does not provide information on the underlying question: Are FANP participants more likely than nonparticipants to consume an adequate diet? Even when the mean nutrient intake of a group approximates or exceeds the RDA, a significant share of the population may have inadequate intakes. On the other hand, use of RDA-based cutoffs seriously overestimates the proportion of a group at risk of inadequate intake because, by definition, the RDA exceeds the needs of nearly all (97-98 percent) healthy individuals in the group (Institute of Medicine (IOM), 2001).

Thus, the available research provides an imperfect picture of both the prevalence of inadequate intakes and the substantive significance of differences in intakes of FANP participants and nonparticipants. That is, the available data provide information on whether FANP participants have "increased intakes" of food energy or key nutrients relative to nonparticipants but do not provide information on whether these differences affect the likelihood that FANP participants consume adequate amounts of food energy or nutrients.

This imperfect picture of the risk of inadequacy reflects a limitation in the reference standards and dietary assessment methods available when most of the existing FANP research was conducted rather than shortcomings in the research per se. This limitation has been addressed in the Dietary Reference Intakes (DRIs), a revised set of nutrient intake standards that has replaced the RDAs (IOM, 2002a, 2002b, 2000a, 2000b, 1999).

The development of the DRIs has led to statistically based guidance on estimating the prevalence of inadequate intakes of population groups (IOM, 2001). The recommended approach, referred to as the "EAR cutpoint method," differs in two important ways from the approach used in previous research. First, assessment of adequacy is based on the Estimated Average Requirement (EAR) rather than the RDA. The EAR is the level of intake estimated to meet the requirements of half of the healthy individuals in a given gender and life-stage group.[7] It was developed specifically to provide a better standard for assessing the adequacy of nutrient intakes than is possible with the RDA.

Second, assessment is based on estimates of usual rather than observed intakes. Estimation of usual intakes requires 2 nonconsecutive or 3 consecutive days of intake data for a subgroup of the population(s) under study. These data are used to adjust the distribution of intakes to remove within-person variation and better represent usual intake patterns.

[7]For some nutrients, most notably calcium, available data were insufficient to establish an EAR. In these instances, a different DRI—an Adequate Intake, or AI—was established. The AI is a level of intake that is assumed to be adequate, based on observed or experimentally determined intake estimates. The DRIs also define Tolerable Upper Intake Levels (ULs) for selected nutrients. The UL is the highest intake likely to pose no risk of adverse health effects. The DRI applications report provides guidance on appropriate uses of AIs and ULs in assessing nutrient intakes of groups (IOM, 2001).

Compared with estimates from previous research, the recommended approach is likely to yield lower estimates of the prevalence of inadequacy because, as noted, using the RDA as a reference point for assessing adequacy always leads to an overestimation of the problem.[8] Similarly, using observed intakes rather than usual intakes tends to overestimate the percentage of individuals falling below a given cutoff because the distribution of observed intakes is usually wider than the distribution of usual intakes. These improved dietary assessment methods are just beginning to appear in FANP research (Cole and Fox, 2004a; Ponza et al., 2004; and McLaughlin et al., 2002).

Relatively few studies have looked the impact of FANP participation on the quality of dietary intakes, for example, in comparison with recommendations made in the *Dietary Guidelines for Americans* (USDA and the U.S. Department of Health and Human Services (HHS), 2000) and the Food Guide Pyramid (USDA, Center for Nutrition Policy and Promotion (CNPP), 1996) or with the Healthy Eating Index (HEI), a summary measure of overall diet quality developed by CNPP (Kennedy et al., 1995). Many of the studies completed since the mid-1990s have examined dietary quality at some level, but few of the earlier studies did.

Overview of the Findings

The sections that follow summarize key findings from the research available for each FANP. Basic background information on the subject research can be found in detailed tables provided in appendix A. These tables summarize important characteristics of each study, including the year published (or written, for nonpublished reports), data sources, population studied, sample size, research design, measure of program participation, and analysis methods. Tables are provided for all FANPs that had at least one impact study. All identified research that described differences between participants and nonparticipants is included in these tables. Although some of the studies had relatively weak designs or used rudimentary or, in some cases, no statistical analysis, they are included in the interest of completeness.

In interpreting findings from the complete body of research for a given program, greater weight was given to findings from studies that had the strongest research design and analysis methods and that used the most recent data. This report does not comment at length about the strengths and limitations of various studies. These detailed discussions are included in Volume 3 (Fox, Hamilton, and Lin, 2004).

Appendix B includes the reference lists from each program-specific chapter in Volume 3. The lists can be used to obtain full citations for studies cited in the appendix A tables. They can also be used to identify related and background literature used in preparing the comprehensive reviews. Because of space constraints, the tables in appendix A cite only the first author's name for papers or reports that have more than two authors.

Food Stamp Program

The FSP stands at the intersection of two sets of Federal programs: those with the primary goal of improving access to adequate diets and those with the primary goal of maintaining income. The FSP is particularly important because of its universality. It is an entitlement program with eligibility requirements based almost solely on financial need, while the other major FANPs are targeted toward certain types of individuals or households.

FSP benefits can be used only to purchase food for home consumption or seeds and plants used to produce food. Benefits are distributed as electronic transfers, which can be redeemed only at participating retail outlets. The Personal Responsibility and Work Opportunity Reconciliation Act of 1996 (PRWORA) mandated that all FSP benefits be distributed via electronic transfers. Nationwide changeover from coupons to electronic transfers was completed in June 2004 (USDA, 2004).

The FSP is the cornerstone of the Nation's nutrition safety net. In FY 2002, the total Federal expenditure for the FSP was $20.7 billion, which accounted for about 54 percent of the $38 billion Federal expenditure for all FANPs. The program served more than 19 million participants per month (table 1). In FY 2003, the maximum monthly food stamp allotment for a family of four was $471 per month.

The FSP has been extensively researched, with much of the research based on secondary analysis of data from large national surveys, such as the Continuing Survey of Food Intakes by Individuals (CSFII). The bulk of the existing research concerns impacts on household food expenditures, household nutrient availability, and individual dietary intakes (app. tables 1-3, pp. 46-56). These three outcomes are logically sequential. The

[8]For some nutrients, the estimated prevalence of inadequate intakes would be lower even if the old approach was replicated using the latest RDAs because the new RDAs for some nutrients differ substantially from previous RDAs. For example, for children ages 1-3, the 1989 RDAs for zinc and vitamin C were, respectively, 10 mg and 40 mg. The new RDAs for these nutrients are substantially lower, at 3 mg (zinc) and 15 mg (vitamin C).

hypothesis is that the FSP benefit leads to increased food spending, which leads to increased household nutrient availability, which, leads to increased intakes by individual household members. However, there are several reasons why these seemingly obvious effects may not occur, particularly for nutrients that are in short supply. For example, participating households may increase expenditures on food in ways that actually reduce the availability of some nutrients—for example, by choosing foods that are convenient or especially palatable but lower in nutrients. Participants may also purchase more expensive forms of the same food, resulting in no net gain in nutrients. In addition, nonparticipants may get more of their food from nonpaid sources, such as friends, relatives, soup kitchens, and food pantries (Gleason et al., 2000).

Similarly, the relationship between nutrient availability at the household level and nutrient intake at the individual level may be weakened by several considerations:

- Household members may unequally consume nutrients from the food supplies, relative to their needs, depending on their tastes and appetites.
- Some household food supplies are consumed by guests or are wasted.
- Some household members may consume food from other sources, including restaurants, school cafeterias, and other nonhome sources.

Moreover, greater nutrient availability is not necessarily a positive outcome. For example, increased expenditures may lead to greater availability of nutrients and food components that Americans consume to excess, including fats, cholesterol, sodium, and added sugars. Increased availability of food energy and selected nutrients at the household level does not necessarily translate into more adequate diets at the individual level or into healthier patterns of food intake (for example, eating more fruits and vegetables or whole grains).

Most studies that examined nutrition-related impacts of the FSP, especially the more recent ones, focused on impacts on the dietary intakes of individuals residing in FSP households. A smaller number of studies examined nutrient availability at the household level.

Food Expenditures

Existing research has consistently shown that the FSP increases household food expenditures, and that the increase is greater than what would occur if the same dollar value of benefits were provided as an unrestricted cash grant. Estimates of the size of the effect vary, depending on the research approach used. The most reliable estimates come from studies that looked at the marginal propensity to spend on food (MPS_F), or the increase in food expenditures per dollar increase in income. These studies indicate that the MPS_F for food stamps is in the range of 0.17-0.47, which translates into additional food expenditures of between $0.17 and $0.47 for every dollar of FSP benefits.

Household Nutrient Availability

The available research suggests that the FSP increases household availability of food energy and protein. It may also increase the availability of a number of vitamins and minerals. The evidence in this area is weaker, however. The strongest study that reported significant effects on household availability of vitamins and minerals used data that were collected in the 1970s, prior to elimination of the purchase requirement.[9]

Individual Dietary Intake

Existing research has provided little evidence that the FSP consistently affects participants' dietary intakes. Several studies found that FSP participation increased vitamin and mineral intakes of young children, but these findings were not replicated in the most recent and well-conducted study (Gleason et al., 2000). Moreover, limitations in measurement techniques and nutrient standards used in existing research make it impossible to adequately address the critical research question of whether the prevalence of inadequate nutrient intakes differs for FSP participants and nonparticipants.

Only a few studies looked at the impact of FSP participation on the intake of carbohydrates, fat, saturated fat, cholesterol, sodium, or fiber or on patterns of food intake. For the most part, these studies found little evidence of an FSP impact. Gleason et al. (2000) found that preschool FSP participants consumed significantly fewer servings of grains and grain products than comparably aged nonparticipants and were significantly less likely to meet the *Dietary Guidelines* recommendation of less than 10 percent of total energy from saturated fat. This study also found that FSP adults consumed significantly fewer servings of vegetables and less dietary fiber than nonparticipating adults.

[9]Before 1979, all households of a given size received the same FSP benefit in the form of coupons, but they had to pay a certain amount of cash to purchase the coupons. Households with more income paid a greater amount.

Other Nutrition and Health Outcomes

A substantially smaller body of research has examined impacts of the FSP on other nutrition- and health-related outcomes (app. table 4, pp. 57-59). More than a dozen identified studies examined the impact of the FSP on food security. Some found that FSP households were more likely than other low-income households to experience food insecurity. Others reported an inverse relationship. These conflicting results underscore the complexity of the relationship between FANP participation and food security. Food insecurity is likely to lead households to seek food assistance, and receiving food assistance benefits may subsequently improve the household's food security. This situation makes estimates of FANP impacts on food security particularly vulnerable to selection bias and reverse causality.

Two recent studies that used sophisticated techniques to control for selection bias help clarify the relationship between FSP participation and food security. Both found that, once one controlled for selection bias, there was no evidence of significantly greater levels of food insecurity (or insufficiency) among FSP participants. The analysis completed by Gundersen and Oliveira (2001) assessed reported levels of food insufficiency using the so-called "USDA food insufficiency question" that preceded the 18-item Federal food security module, the currently accepted standard for measuring household and individual food security (Price et al., 1997; Bickel et al., 2000). Huffman and Jensen (2003) expanded on the work done by Gundersen and Oliveira, incorporating information on labor force participation decisions and using the more severe outcome of food insecurity with hunger based on the 18-item Federal food security module. These authors also simulated the effects of changes in FSP benefits, unemployment rate, and nonlabor income and found that FSP benefits were more effective in reducing levels of food insecurity with hunger than pure cash transfers.

A limited number of studies have considered FSP impacts on other nutrition- and health-related outcomes, including birthweight (two studies), height and/or weight (six studies, but only one or two for any population subgroup—children, adolescents, adults, elderly), nutritional biochemistries (three studies), and general measures of health status (two studies). Because of the limited number of studies available for any given outcome and population subgroup, as well as design limitations of the available research, it is not possible to draw conclusions about FSP impacts in these areas.

WIC Program

The Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) was established to provide "supplemental nutritious food as an adjunct to good health care during critical times of growth and development in order to prevent the occurrence of health problems and improve health status..." (P.L. 95-627). WIC targets five specific groups: pregnant women, infants, children up their fifth birthday, breastfeeding women (up to 1 year after an infant's birth), and nonbreastfeeding postpartum women (up to 6 months after an infant's birth). In April 2002, 50 percent of all WIC participants were children and 26 percent were infants. The remainder were women—11 percent pregnant women, 8 percent postpartum nonbreastfeeding women, and 6 percent breastfeeding women (Bartlett et al., 2003; Kresge, 2003).

Although WIC is a means-tested program (as of April 2000, all WIC State agencies used an income-eligibility cutoff of 185 percent of poverty (Bartlett et al., 2002)), being low-income is not sufficient to qualify for WIC participation. In addition to being in one of the program's target groups, WIC participants must have one or more documented nutritional risks. Individual States define the specific criteria used to determine nutritional risk, but the criteria must be selected from a standardized list defined by FNS.

WIC is not an entitlement program, so the number of participants served each year depends on available funding and the cost of running the program. To deal with the possibility that local programs may not be able to serve all eligible people, WIC uses a priority system to allocate available caseload slots to eligible applicants. The priority system is designed to ensure that available services go to those most in need. In general, pregnant women, breastfeeding women, and infants are given higher priority than children and nonbreastfeeding postpartum women. In addition, applicants with nutritional risks that are based on hematologic measures, anthropometric measures, or medical conditions are given higher priority than applicants with nutritional risks based on dietary patterns or other characteristics.

The relative importance of the priority system has declined over time as increasing funds have allowed the program to serve many lower priority individuals. Today, the WIC program serves almost half of all infants in the U.S. and about a quarter of the children ages 1-4 (Hirschman, 2004). In FY 2002, the Federal

Government spent approximately $4.3 billion on the WIC program, which served 7.5 million participants each month (table 1).[10]

WIC was designed to counteract the negative effects of poverty on prenatal and pediatric health (Kresge, 2003). To achieve this goal, the program offers a combination of services, including supplemental foods (selected specifically to supply nutrients that may be lacking in the diets of low-income pregnant women and children), nutrition education, and referrals to health care and social services. WIC services do not fluctuate by household income. All participants have access to the same basic benefits. The types and amounts of supplemental food provided to each participant are determined based on participant category, age (for infants), and individual needs and preferences.

An extensive amount of research has investigated the impact of WIC on health- and nutrition-related outcomes. Given the program's integral focus on ameliorating nutritional risks, it is not surprising that, compared with research on other FANPs, research on WIC includes many more studies that have looked at outcomes beyond dietary intake. Coverage of the five different participant groups is very uneven in the existing research. The participant group that has been studied most often is prenatal participants, with a particular focus on program impacts on birthweight and related outcomes, including health care costs. Overall, less research has focused on WIC's impacts on participating children, but much of the most recent research has addressed this information gap. Research on the impact of the program on women (beyond the impact of prenatal participation on birth outcomes) is lacking, particularly for breastfeeding women and nonbreastfeeding postpartum women.

Birth Outcomes

The impact of prenatal WIC participation has been estimated by comparing birth outcomes of women who participated in WIC during pregnancy and those who did not (app. table 5, pp. 62-70). Because of potential selection bias and other technical limitations, the existing body of research does not provide a definitive conclusion about WIC's impact on birth outcomes. However, the evidence is quite compelling and strongly suggests that WIC increases mean birthweight, reduces the incidence of low birthweight, and decreases birth-related Medicaid costs.

Because of design characteristics that contribute to inherent underestimation or overestimation of WIC impacts and the wide range of impact estimates reported in the literature, characterizing the relative size of WIC's impact with any confidence is difficult (for example, the estimated reduction in the prevalence of low birthweight infants). Moreover, subgroup analyses completed by some researchers suggest that WIC impacts are likely to be greatest among Blacks and among the lowest income women—groups with the highest prevalence of low birthweight.

In addition, many important changes have taken place since most of the available research was conducted. These changes may influence the extent to which findings from previous research apply to the WIC program as it operates today. Some of the most noteworthy changes include: a substantially higher level of program penetration in most areas of the United States than was present in the mid- to late 1980s when most of the research was completed (most eligible prenatal applicants are able to enroll in the program); more generous Medicaid income-eligibility criteria for pregnant women (including some that exceed the WIC cutoff of 185 percent of poverty), which infers automatic income-eligibility for WIC; and the use of standardized nutritional risk criteria. Furthermore, welfare reform legislation, which did not affect WIC directly, may have affected the circumstances of both WIC participants and nonparticipants. Any of these changes may influence both the presence and size of WIC impacts as well as variations in impacts across subgroups.

Breastfeeding

Relatively little research has examined the impact of WIC on breastfeeding (app. table 6, pp. 71-73). The literature search identified many studies that have assessed the impact of specific breastfeeding promotion programs on breastfeeding behaviors of *WIC participants*. While such studies provide information on the effectiveness of particular breastfeeding interventions (among WIC participants), they provide no information on the impact of WIC per se.

The literature also includes many descriptive studies that examined predictors of breastfeeding behaviors. These studies have demonstrated that women who are African American, less educated, low-income, and younger are less likely to breastfeed than other women. These demographic characteristics are also associated with higher rates of WIC participation, so it is not surprising that studies that included WIC participation among the list of potential breastfeeding predictors have almost

[10]Excludes the estimated cost of the WIC Farmers' Market Nutrition Program.

invariably found a negative association or no association between WIC participation and breastfeeding.

These negative statistics have prompted substantial commentary and questions over the years, particularly: Does the formula provided by WIC act as a disincentive to breastfeeding? Does the WIC program devote adequate resources to breastfeeding promotion? Obtaining reliable answers to these questions is complicated by substantial selection bias that makes it more likely that researchers will find a negative association between WIC participation and breastfeeding. As just noted, the demographic characteristics of women who are least likely to breastfeed closely parallel the characteristics of women who are most likely to participate in WIC. In addition, it is reasonable to assume that women who have decided to formula feed may be more likely to participate in WIC than women who have elected to breastfeed in order to obtain the free formula. The incentive to participate may be substantially reduced for women who have decided to breastfeed.

The available research on WIC's impact on the breastfeeding behaviors of WIC participants provides no firm basis for conclusions. Moreover, breastfeeding promotion efforts in the WIC program have expanded substantially since the time most of these studies were conducted.

Nutrition and Health Characteristics of Pregnant Women

Dietary Intakes. With the exception of two recent descriptive studies that compared dietary intakes of WIC participants and nonparticipants without accounting for measured differences between the two groups or for selection bias (Mardis and Anand, 2000; Kramer-LeBlanc et al., 1999), all of the studies that have assessed the impact of WIC participation on the dietary intakes of pregnant women are quite old (app. table 7, pp. 74-76). Indeed, the most recent estimate of WIC impacts in this area comes from the National WIC Evaluation (NWE) (Rush et al., 1988b), which used data collected in 1983-84.

Evidence from the NWE and other contemporaneous studies paints a reasonably consistent picture of potential WIC impacts on women's dietary intakes, suggesting that WIC participation increases intakes of food energy and most of the nutrients examined, including four of the five nutrients traditionally targeted by the program—protein, vitamin C, iron, and calcium. Evidence for vitamin A, the fifth WIC nutrient, is less consistent. Vitamin A intake, however, is especially difficult to estimate because the distribution is so skewed (vitamin A is concentrated in large amounts in relatively few foods). The early evidence also suggests that WIC may increase intakes of vitamin B_6, which the program has targeted in recent years.[11]

NWE authors (Rush et al., 1988b) pointed out that the relative magnitude of the incremental intakes observed among pregnant WIC participants were plausible in that they were comparable to the levels of supplementation achieved in smaller, intensively controlled clinical trials. Moreover, a thorough analysis of the sources of nutrients in women's diets completed for the NWE confirmed that differences in the diets of WIC participants and nonparticipants were attributable to consumption of WIC foods. Other authors also found similar relationships between observed nutrient intakes and the types of food provided in WIC food packages (Endres et al., 1981; Bailey et al., 1983).

In addition to the potential for selection bias, which was not addressed in any of this research, findings from such dated studies are subject to concerns about changes in the program and its participant groups over time, as discussed in the preceding section on birth outcomes. And, as noted previously, a compelling argument can be made that impacts on diet-related outcomes are more sensitive to temporal considerations than impacts on other outcomes. Finally, limitations in the measurement techniques and nutrient standards used in this research make it impossible to determine whether the reported increases in nutrient intake led to a greater prevalence of adequate intakes among WIC participants.

A recent descriptive analysis of the nutrient intakes of pregnant WIC participants and nonparticipants also raises questions about whether previously observed impacts persist today. Kramer-LeBlanc and her colleagues (1999) used data from the third National Health and Nutrition Examination (NHANES-III) to compare nutrient intakes of pregnant WIC participants and income-eligible nonparticipants. In their analysis, the only nutrient for which a significant difference was detected in median intakes was selenium. A comparison of the nutrient intakes of WIC participants and the maximum nutrient contribution of the WIC food package for pregnant women suggested that pregnant WIC participants may

[11]Results from early research do not permit an assessment of the potential impact of WIC on intake of folic acid. All of the available studies were completed before the recent widespread fortification of cereals and grain products with folic acid and before the increased attention to folic acid supplementation during pregnancy. (Inadequate intake of folic acid has been associated with neural tube defects (Centers for Disease Control and Prevention, 1992)).

not have redeemed all of their vouchers or consumed all the food provided. Results of this analysis do not constitute a valid assessment of WIC impacts, and the analysis may have been hampered by small sample sizes (only 71 WIC participants). Nonetheless, the fact that the analysis showed virtually no overlap with findings from earlier studies raises questions about whether positive findings from earlier studies still apply to today's prenatal WIC participants.

To date, only one study (Mardis and Anand, 2000) assessed intakes of prenatal WIC participants and nonparticipants in relation to consumption patterns recommended in the *Dietary Guidelines for Americans*.[12] This analysis, which used bivariate t-tests to assess differences between groups, found no significant differences in intakes of total fat, saturated fat, cholesterol, or sodium. Moreover, with the exception of cholesterol, intakes of both participants and nonparticipants exceeded recommended levels. With regard to food intake, no significant differences were detected between WIC participants and nonparticipants in consumption of grains, vegetables, fruits, milk, or meats and beans.

Given the increasing prevalence of pregnancy-associated obesity (Lederman et al., 2002) and the potential role the WIC program may be able to play in curtailing this problem, it is important to obtain valid estimates of WIC's impact on women's dietary intakes based on more up-to-date information.

Other Nutrition and Health Outcomes. A handful of studies has examined the impact of WIC participation during pregnancy on other measures of nutritional status (app. table 7, pp. 74-76). However, the relative paucity of research on any given measure, as well as design and analytic limitations of existing studies, makes drawing firm conclusions about impacts in this area impossible. Moreover, such impacts may be difficult to elucidate among pregnant women. For example, assessment of hemoglobin concentration, arguably the most straightforward and widely used measure of nutritional status among other population groups, is complicated during pregnancy by numerous physiologic processes that are not completely understood (Rush et al., 1988b). Adequate assessment of iron status during pregnancy requires the collection of several more complex hematologic indices that are not readily available in most WIC or medical records.

[12]Kramer-LeBlanc et al. (1999) also report data for intake of total fat, saturated fat, cholesterol, and sodium, but it is the same data reported in Mardis and Anand (2000).

Nutrition and Health Characteristics of Infants and Children

Although infants and children make up more than three-quarters of the total WIC population, very little research has been done on these participant groups until recently. Of 41 identified studies (app. table 8, pp. 77-86), 10 are based on data collected primarily or exclusively in the early to mid-1990s, 10 are based on data collected in the mid- to late 1990s, and 3 used data that were collected exclusively in 2000 or later or had data collection periods that started late in the 1990s and extended beyond 2000. The relative recency of these studies is particularly important because of the increase in child participation experienced during the early 1990s (Oliveira et al., 2002). Studies based on data collected after this time are more likely to be generalizable to the current population of WIC children and are less subject to bias associated with restricted program access.

Some studies have included both infants (younger than 12 months) and children (1-4 years), but the available research is heavily slanted toward children. Given that children make up 50 percent of the WIC population overall, this emphasis is not inappropriate.

Dietary Intakes of Children. Several studies have suggested that WIC participation increases children's intakes of selected nutrients. The most convincing evidence comes from a study by Oliveira and Gundersen (2000). The authors used data from the 1994-96 CSFII and employed a unique strategy to control for selection bias. They limited their analysis sample to WIC participants and income-eligible nonparticipants who lived in households where at least one other member was on the WIC program. The rationale for this restriction was that it effectively controlled for key sources of selection bias, including lack of awareness of the WIC program and resistance to participation because of stigma or other reasons. The authors acknowledge that two important sources of potential bias remain, both of which are associated with rationing rather than self-selection. The income-eligible nonparticipant group may have included (1) children who were not actually eligible for WIC because they did not have a certified nutritional risk and (2) children who were fully eligible but could not participate because the local WIC program had no available slots. Both of these sources of bias would tend to underestimate program impacts.

Findings from the Oliveira and Gundersen study indicate that WIC participation significantly increases children's intakes of iron, vitamin B_6, and folate. Other studies suggest that WIC participation may lead to reduced intake of added sugar and, among the lowest income children, to increased intakes of protein, carbohydrate, zinc, vitamin E, thiamin, niacin, riboflavin, and magnesium and reduced intake of fat (Rose, Habicht, and Devaney, 1998; Siega-Riz et al., 2004; Kranz and Siega-Riz, 2002). These suggestive findings would be more convincing if they were replicated in the restricted sample analyzed by Oliveira and Gundersen (Oliveira and Gundersen did not assess intakes of vitamin E, thiamin, niacin, riboflavin, magnesium, carbohydrate, or fat).

As noted in previous discussions of available data on dietary intake, evidence that WIC participants consumed greater amounts of selected nutrients does not necessarily mean that WIC participants were more likely than nonparticipants to have adequate diets. Recent data on the *usual* nutrient intakes of age-eligible children, estimated using state-of-the-art techniques recommended by the IOM (2001), indicate that the vast majority of both WIC and non-WIC children have nutritionally adequate diets. Cole and Fox (2004a) found that virtually all children ages 1-4, regardless of WIC participation status, had adequate usual intakes of iron and zinc. Ponza et al. (2004) reported similar findings for iron for children ages 1 and 2. As discussed in a subsequent section, the adequacy of children's usual iron intakes is consistent with declining levels of anemia in this population and may reflect an indirect effect of the WIC program on the availability and use of iron-fortified breakfast cereals.

Neither Cole and Fox (2004a) nor Ponza et al. (2004) assessed intakes of vitamin B_6 or folate (the other two nutrients found to be significant in Oliveira's and Gundersen's analysis) or vitamin E, niacin, riboflavin, thiamin, or magnesium (the other nutrients for which Rose, Habicht, and Devaney (1998) reported a significant WIC impact). However, in the nationally representative Feeding Infants and Toddlers Study, Devaney and her colleagues (2004b) found that less than 1 percent of all 1 and 2 year olds had inadequate usual intakes of vitamin B_6, riboflavin, thiamin, or magnesium, and only 2 percent had inadequate usual intakes of folate.[13] Three percent had inadequate usual intakes of niacin, and 58 percent had inadequate usual intakes of vitamin E. (The authors urged caution in interpreting the finding for vitamin E, given that clinical data from NHANES-III do not indicate problems with vitamin E status. They suggested that the high prevalence of apparently inadequate vitamin E intakes may be associated with the difficulty of assessing the types and amounts of fats and oils used in cooking and/or with variability in food composition databases.)

Data from Devaney et al. (2004b), Cole and Fox (2004a), and Ponza et al. (2004) suggest that the prevalence of inadequate nutrient intakes among very young children is low and that today's WIC children are doing as well nutritionally as their nonparticipating counterparts. However, the fact that the descriptive analyses completed by Cole and Fox (2004a) and Ponza et al. (2004) did not reveal meaningful differences in the prevalence of nutrient inadequacy among WIC and non-WIC children does not necessarily mean that the WIC program has no impact on children's diets. For example, WIC may be responsible for bringing intakes of participating children up to the level of other children. The question of WIC impacts cannot be assessed even at a basic level without multivariate analysis techniques that, at a minimum, control for measured differences between the two groups.

Information about the potential impact of WIC on children's intakes of cholesterol, sodium, and fiber or on food intake relative to recommendations made in the Food Guide Pyramid is very limited. The study by Oliveira and Gundersen did not examine children's diets along these lines, and the majority of studies that did were descriptive studies that assessed differences between groups with bivariate t-tests or did not assess statistical significance.

Dietary Intakes of Infants. Two relatively dated WIC studies (Rush et al., 1988a; Burstein et al., 1991) provided convincing evidence that WIC participation had a significant impact on the dietary intakes of infants. Both studies found that WIC infants had significantly higher intakes of iron than non-WIC infants. More recent data from the Feeding Infants and Toddlers Study (Ponza et al., 2004) showed that WIC infants ages 7-11 months had greater mean *usual* intakes of iron than did nonparticipant infants and, more importantly, that the prevalence of adequate usual iron intakes was greater for WIC infants than for non-WIC infants (99 percent vs. 90 percent). The statistical significance of these differences was not tested.

Rush et al. also found that WIC infants consumed significantly less calcium, magnesium, and phosphorus than non-WIC infants. Burstein and her colleagues reported no impact on calcium intake in their main analysis, which assessed the percentage of infants consuming less

[13]Compared with national distributions, the sample used in this study had slightly higher incomes and had a smaller percentage of Hispanics (Devaney et al., 2004a).

than 77 percent of the RDA. However, supplementary analyses that used mean intakes found, like Rush et al., that WIC infants consumed significantly less calcium than non-WIC infants.

For the NWE, Rush and his colleagues completed a detailed analysis of the sources of nutrients in infants' diets and found that the greater iron intakes and lower calcium, magnesium, and phosphorus intakes noted for WIC infants were related. All of these findings were associated with an increased use of cow's milk among non-WIC infants. Because the American Academy of Pediatrics recommends that cow's milk not be fed to infants less than 12 months of age, the lower intakes of calcium, magnesium, and phosphorus among WIC infants were not interpreted as negative impacts. Burstein and her colleagues (1991) found a similar pattern. Specifically, they found that, among non-breastfed infants, WIC infants were more likely to receive formula and non-WIC infants were more likely to receive cow's milk. Moreover, among formula-fed infants, WIC infants were more likely to receive iron-fortified formula and non-WIC infants were more likely to receive formula that was not fortified with iron.

Recent descriptive studies provide some evidence that differences between WIC infants and non-WIC infants in the use of cow's milk may persist today. For example, Kramer-LeBlanc and her colleagues (1999) found that, among infants ages 4-11 months, WIC participants consumed significantly less protein, calcium, magnesium, riboflavin, vitamin B_{12}, and sodium. All of these nutrients occur in greater concentrations in cow's milk than in iron-fortified infant formula. In addition, Cole and Fox (2004a) analyzed the infant feeding inventory used in NHANES-III and found that WIC participants were significantly less likely than nonparticipants to be fed cow's milk before 12 months of age.

In contrast, in an analysis of 24-hour intakes, Ponza et al. (2004) found no significant difference between WIC infants and non-WIC infants in the percentage consuming cow's milk. In addition, findings from an inventory of feeding practices that assessed whether an infant had ever been fed cow's milk found no difference between WIC and non-WIC infants ages 7-11 months. Reported feeding of cow's milk was rare among younger infants (4-6 months). In this age group, however, significantly more WIC infants than non-WIC infants had been fed cow's milk at some point. These results should be interpreted with caution because the comparison group used in the Ponza et al. analysis included all income levels. This may obscure differences between WIC participants and income-eligible nonparticipants, who constitute a more appropriate comparison group.

Burstein and her colleagues (1991) also found that WIC participation was associated with more appropriate introduction of solid foods. WIC infant feeding guidelines, which are based on recommendations of the American Academy of Pediatrics and other expert groups, recommend that no solids be introduced until infants are at least 4 months of age. Indeed, the WIC food package for infants younger than 4 months is limited to iron-fortified formula. Burstein and her colleagues found that nonparticipant infants were significantly more likely than WIC infants to be fed solid foods before 4 months of age.

It is not clear whether this finding still holds for today's WIC infants. Based on the infant-feeding inventory in NHANES-III, Cole and Fox (2004a) found no difference between WIC participants and nonparticipants in the percentage of infants or children who were fed solid foods before 4 months of age. Similarly, Ponza and his colleagues (2004) found no differences between WIC participants and nonparticipants in the mean ages at which infant cereal and pureed baby foods were introduced. These data may be less reliable than the data from the Burstein et al. study, however, because they are based on a more extended recall period.[14] In addition, as noted previously, the all-income comparison group used by Ponza and his colleagues may obscure differences between WIC participants and income-eligible nonparticipants.

Kramer-LeBlanc et al. (1999) found that carbohydrates and fiber intakes among infants ages 4-11 months were significantly lower for WIC participants than for income-eligible nonparticipants and suggested that this pattern may be associated with earlier introduction and greater consumption of cereal among non-WIC infants. Data from Ponza et al. (2004) suggest that the difference in cereal consumption may be concentrated among older infants and, therefore, not associated with better adherence to infant feeding guidelines per se. Ponza and his colleagues found no difference between WIC participants and nonparticipants in consumption of either infant cereal or ready-to-eat cereal among infants ages 4-6 months. Among infants ages 7-11 months, however, the percentage consuming ready-to-eat cereal was 77 percent lower for WIC participants than for nonparticipants.

[14]The Burstein et al. (1991) study was limited to 6-month-old infants, so caregivers reported on relatively recent feeding practices. The NHANES-III infant feeding histories analyzed by Cole and Fox (2004a) included infants up to 12 months old, and the Ponza et al. (2004) analysis included only toddlers ages 12-24 months.

Growth. Many of the earliest efforts to assess WIC impacts on children's growth were hampered by technical difficulties, such as missing or inaccurate data in medical records or WIC files and problems with equipment calibration. Self-selection issues have also affected this research. In the NWE, Rush and his colleagues (1988a) reported differential recruitment of children with abnormal growth (overweight, underweight, or stunted) into WIC, in keeping with the program's focus on individuals with identifiable nutritional risks. This pattern of self selection is likely the reason for the significantly greater prevalence of underweight and growth retardation among WIC children reported by Cole and Fox (2004a) and Burstein et al. (2000) in their more recent descriptive analyses of NHANES-III data.

Two recent studies that did not suffer from the methodological and technical limitations that affected earlier studies provide evidence to suggest that WIC participation may affect infants' growth (Black et al., 2004) and reduce the prevalence of failure to thrive (Lee et al., 2000). (Failure to thrive is a general diagnosis that can have many causes, but the sentinal finding is a failure to gain weight and to grow as expected.)

In recent years, increasing attention has been paid to problems at the opposite end of the growth spectrum—the problem of overweight among children, including very young children. Research that has examined this issue is sparse. The studies that have been conducted have not found a significant association between WIC participation and the prevalence of overweight.

All of the research in this area is subject to concerns about selection bias. Moreover, it is doubtful that studies like these can provide definitive answers to questions about WIC's impact on the growth of infants and children. Researchers involved in designing and implementing a field test of a study to measure WIC's impact on children concluded that the only way WIC's impacts on child growth can be reliably assessed is through a longitudinal study that includes serial measurements repeated at regular intervals for both WIC participants and nonparticipants (Puma et al., 1991).

Anemia/Iron Status. The majority of studies that examined the relationship between WIC participation and iron status/anemia found that WIC participation was associated with an increase in mean levels of hemoglobin or hematocrit and/or a decrease in the prevalence of anemia. In most cases, these differences were statistically significant. Although each of the studies reviewed had weaknesses, the consistency of findings across studies is compelling.

The most convincing evidence comes from analyses done by Yip and his colleagues at the CDC using data from the Pediatric Nutrition Surveillance System (PedNSS) (Yip et al., 1987). The CDC researchers looked at the prevalence of anemia in infants and children ages 6-60 months between 1975 and 1985, a period of substantial growth in the WIC program. They documented a steady decline in the prevalence of anemia, from 7.8 percent in 1975 to 2.9 percent in 1985. Using detailed data from one State, the authors demonstrated that the socioeconomic status of the population had remained stable over this period. The authors also compared initial and followup measures of hemoglobin or hematocrit (taken roughly 6 months apart) for approximately 73,000 WIC children. The analysis revealed decreased levels of anemia at followup.

Another CDC analysis reported on trends between 1980 and 1991 (Yip et al., 1992). During this period, the prevalence of anemia decreased by more than 5 percent for most age- and race/ethnicity-specific subgroups. Other measures of childhood health monitored in PedNSS, including the prevalence of low birthweight, low height-for-age, low weight-for-height, and high weight-for-height (overweight), generally remained stable.

The CDC analyses suggest that WIC has a direct effect on the prevalence of anemia, as well as a probable indirect effect. WIC requires use of iron-fortified infant formulas and includes iron-fortified breakfast cereals in its food packages. Because more than half of all formula sold in the United States, as well as a large share of breakfast cereals, are purchased with WIC vouchers, manufacturers have consciously focused on bringing to market iron-fortified products that are allowed in WIC food packages (Batten et al., 1990). These foods have assumed a leading position in their respective markets and have, therefore, been increasingly fed to both WIC and non-WIC children. As a result, the WIC program may have contributed to the observed improvement in the prevalence of anemia in the general population of low-income U.S. children.

General Health Status. Although subject to concerns about selection bias, two recent studies suggest that WIC may improve children's general health status (Black et al., 2004; Carlson and Senauer, 2003).

Findings from the Carlson and Senauer study are based on physician ratings assigned after completion of physical exams in NHANES-III. The authors found that children who resided in households where at least one person participated in WIC were significantly more likely than children who resided in non-WIC households to be rated as having excellent health. This association was strongest for the lowest income children.

Immunization Status. Findings from the limited number of studies that have assessed the impacts of WIC on immunization status, including two recent cross-sectional studies that analyzed data from the National Immunization Survey (NIS) for 1999 (Shefer et al., 2001) and 2000 (Luman et al., 2003), generally suggest that WIC participation had a positive impact on the likelihood that children will have up-to-date immunizations. Results from all of these studies are highly vulnerable to selection bias, however. Mothers who are motivated to enroll their child in WIC may be more motivated to keep the child's immunizations up to date.

The positive WIC impact suggested by this research, if real, may be influenced by an ongoing collaboration between USDA and the CDC to use the WIC program as a means to improve immunization rates among the Nation's low-income children. Since the early 1990s, a variety of strategies has been used to promote timely and complete immunizations among WIC participants (Shefer et al., 2001). Randomized trials have demonstrated that some of these strategies can dramatically increase immunization coverage (Birkhead et al., 1995; Hutchins et al., 1999). In addition, Shefer et al. (2001) used data from the 1999 NIS and data from an annual survey of WIC directors and State immunization program directors to model the relationship between WIC immunization activities and immunization rates among WIC children. They found that WIC children in States with high-intensity immunization activities (50 percent or more of WIC children enrolled at sites that implemented an immunization intervention at every WIC visit) had significantly higher rates of up-to-date immunization at 24 months than did WIC children in States with low-intensity immunization activities (less than 50 percent of WIC children enrolled at sites that implemented an immunization intervention and the intervention was implemented at only recertification visits). Finally, Dietz et al. (2000) found that a WIC voucher incentive program was one of eight factors that had a positive, significant effect on immunization rates in Georgia's public health clinics.

Use and Costs of Health Care Services. Three recent studies have examined the relationship between children's WIC participation and the use of health care services (Lee et al, 2000; Buescher et al., 2003) and dental care services (Lee et al., 2004a). All three studies reported that WIC participation had a significant, positive effect on the use of health care/dental care services, and the two studies that examined health care/dental care costs (Buescher et al., 2003; Lee et al., 2004b) reported an associated increase in costs for WIC participants. Only the study that looked at the use of dental care services controlled for selection bias (Lee et al., 2004a).[15] Thus, findings from the other two studies are vulnerable to potential selection bias—it is possible that children who have health problems or who use more health care services may be more likely to be referred to WIC.

Cognitive Development and Behavior. There is little evidence that WIC affects children's cognitive development or behavior. Few studies have examined outcomes in this area, however, and most suffer from selection bias, as well as small sample sizes and/or noncomparability of WIC and non-WIC groups. The strongest and most recent study in this area was completed by Kowaleski-Jones and Duncan (2000). The authors examined the impact of prenatal WIC participation on temperament and the development of motor and social skills using a fixed-effects model (based on sibling pairs) to control for selection bias. The authors reported that WIC participation decreased the likelihood that a child would have a difficult temperament; however, the result was significant only at the $p < 0.10$ level.

Food Security. Only one identified study examined the impact of WIC participation on household food security (Black et al., 2004). The study found that WIC infants had significantly higher rates of food insecurity than low-income infants in households that did not participate in WIC because caregivers did not perceive a need for WIC services. The difference between WIC infants and low-income infants who did not participate in WIC because of access problems was not significant. As noted previously, assessment of the impact of FANP participation on food security is particularly vulnerable to problems of selection bias and reverse causality.

[15]Lee and her colleagues completed separate analyses of dental care use (Lee et al., 2004a) and costs (Lee et al., 2004b). The former analysis controlled for selection bias, but the latter did not.

Nutrition and Health Characteristics of Nonbreastfeeding Postpartum Women and Breastfeeding Women

Very little is known about the impact of WIC on either group of postpartum WIC participants. Other than the previously described study by Kramer-LeBlanc et al. (1999), which assessed nutrient intakes of WIC participants and nonparticipants, the literature search identified only two studies that assessed WIC impacts on nonbreastfeeding postpartum WIC participants and only one study that looked at the impact of WIC participation on breastfeeding participants (app. table 9, pp. 87-88). The latter study provides little insight because it is a dated local study that used a very small sample of breastfeeding WIC participants and an even smaller comparison sample of middle-class women who were nonbreastfeeding (Argeanas and Harrill, 1979).

The two studies that focused on nonbreastfeeding postpartum women provide evidence to suggest that WIC participation during the postpartum period may have positive impacts on the women themselves, as well as on the outcomes of subsequent pregnancies. Caan et al. (1987) assessed women's weight status at the start of a subsequent pregnancy and the birth outcomes of that pregnancy. The authors found that extended postpartum WIC participation (5-7 months) increased both weight and length of the second infant at birth. The odds ratio of having a low birthweight infant approached significance, but, because low birthweight is rare, small sample sizes hampered the analysis. In addition, women who had been obese at the start of the previous pregnancy and had 5-7 months of postpartum WIC participation were 50 percent less likely than comparable women with 0-2 months of postpartum participation to be obese at the start of the subsequent pregnancy.

Pehrsson et al. (2001) found that nonbreastfeeding postpartum WIC participants who experienced 6 uninterrupted months of participation were significantly less likely to become anemic than comparable women who did not participate in WIC during the postpartum period.

Neither of these studies provides definitive information about the impact of WIC participation during the postpartum period. Exploration of impacts on this lowest priority participant group is needed. If postpartum WIC participation is associated with improved birth outcomes in the subsequent pregnancy and with improved nutrition, health, and/or weight status for the women, there may be reason to rethink the lower priority assigned to this group. In view of the ongoing obesity epidemic, the potential for WIC to play a role in addressing pregnancy-related weight retention, which is especially prevalent among minority women (Gore et al., 2003; Abrams et al., 2000), seems particularly important.

National School Lunch Program

The NSLP, established in 1946, is the oldest and second largest FANP. The NSLP is the cornerstone of the largely school-based child nutrition programs. Schools that participate in the NSLP receive Federal reimbursement for each program meal served to students, with higher reimbursements for lunches served free of charge or at a reduced price to children certified to receive NSLP meal benefits.[16] Since 1998, the program has also covered snacks served to children in after-school programs (USDA/FNS, 2003b). Any child in a participating school is eligible to participate in the NSLP.

In FY 2002, more than 28 million children participated in the NSLP on an average school day. The program served more than 4.7 billion lunches and 123 million after-school snacks. The total cost for the NSLP was $6.9 billion, about 18 percent of the total Federal expenditure for FANPs (table 1). Almost 99 percent of public schools and 83 percent of all public and private schools combined participate in the NSLP.

On an average school day, about 60 percent of children in schools that offer the NSLP participate in the program (Fox et al., 2001). Participation varies with household income, age, and gender. For example, studies have shown that students certified to receive free or reduced-price lunches are more likely to participate than students who are not certified for meal benefits, elementary school students are more likely to participate than secondary school students, and males are more likely to participate than females (Fox et al., 2001; Gleason, 1996; Maurer, 1984; Akin et al., 1983).

The literature on the impacts of the NSLP is anchored by two national evaluations: the National Evaluation of School Nutrition Programs (NESNP), conducted in 1980-81 (Wellisch et al., 1983), and the first School Nutrition Dietary Assessment Study (SNDA-I), conducted in 1991-92 (Burghardt et al., 1993; Devaney et al., 1993). A third national evaluation, the second School Nutrition Dietary Assessment Study (SNDA-II), was conducted in 1998-99 (Fox et al., 2001), but this study did not assess student-level impacts. In addition to these national evaluations, a few studies have used

[16]USDA does not reimburse schools for adult meals, second meals, or a la carte items, including extra servings of components of program meals.

national survey data to assess NSLP impacts, and a number of studies have examined program impacts in smaller, local samples.

The existing literature on NSLP impacts needs to be considered cautiously because program operations changed substantially after most of the available research was completed. In 1995, USDA launched the School Meals Initiative for Healthy Children (SMI). The SMI was designed specifically to address nutritional shortcomings identified in SNDA-I. SNDA-I found that, compared with the *Dietary Guidelines* (USDA/HHS, 1990) and NRC *Diet and Health* recommendations (NRC, 1989b), NSLP meals were high in fat, saturated fat, and sodium and low in carbohydrates (Burghardt et al., 1993). At the time, schools were not required to offer meals that were consistent with these guidelines.

The SMI provides schools with educational and technical resources that can be used to assist foodservice personnel in preparing nutritious and appealing meals and to encourage children to eat more healthful meals. Key components of the SMI include revised nutrition standards, such as goals for fat and saturated fat content that are consistent with *Dietary Guidelines* recommendations, a major restructuring of menu planning requirements, and a broad-based nutrition education program known as the Team Nutrition Initiative.[17]

The Healthy Meals for Healthy Americans Act (P.L. 103-448) formally required that school meals be consistent with the *Dietary Guidelines* and that schools begin complying with SMI nutrition standards in the 1996-97 school year unless a waiver was granted by the cognizant State agency. The regulatory requirement that school meals be consistent with the *Dietary Guidelines* has been incorporated into the FNS strategic plan. The current goal is for all schools to satisfy these standards by 2005 (USDA/FNS, 2000a).

The SMI has been supported by several parallel initiatives. For example, considerable efforts have been devoted to improving the nutrient profile of commodity foods provided to NSLP schools (Buzby and Guthrie, 2002). In addition, under the Nutrition Title of the 2002 Farm Act, USDA received $6 million for a pilot program to provide fresh and dried fruits and fresh vegetables to children in elementary and secondary schools. The pilot program, which was implemented in the 2002-03 school year, was very well received (Buzby et al., 2003) and was expanded under the Child Nutrition and WIC Reauthorization Act of 2004 (P.L. 108-265).

Most recently, policymakers have begun to focus on the "school nutrition environment" (Ralston et al., 2003; American School Food Service Association (ASFSA), 2003; USDA/FNS, 2000b). A school's nutrition environment includes the nutritional quality of reimbursable school meals, the availability and nutritional quality of competitive (non-NSLP) foods, meal scheduling, physical characteristics of the cafeteria, nutrition education and marketing activities, and the school's commitment to nutrition and physical activity.

The SNDA-II study, completed in the early stages of SMI implementation (the 1998-99 school year), provides some evidence that the nutritional profile of school meals is improving. Although, on average, lunches offered to students in 1998-99 continued to exceed *Dietary Guidelines* and NRC recommendations, they were significantly lower in total fat, saturated fat, and sodium than lunches offered in 1991-92 (as reported in SNDA-I) (Fox et al., 2001). Moreover, schools were able to reduce fat and saturated fat content without diminishing the relative contribution of school meals to children's daily nutrient needs. Since the SNDA-II data were collected, efforts to implement the SMI nutrition standards have continued at the Federal, State, and local levels. Consequently, even this relatively recent data may not provide an accurate picture of the nutrient content of meals currently offered in the NSLP.

Given the nature and extent of the changes associated with the SMI—changes that specifically targeted the nutrient content of school lunches and students' consumption of healthful lunches—the available research on program impacts is significantly limited. Although the existing research provides information on past and potential impacts of the NSLP, one cannot assume that findings from this research apply to today's NSLP. New research is essential to understanding the impact of the NSLP as it operates today (Guthrie, 2003).

Students' Dietary Intakes

Existing NSLP research has focused mainly on impacts on students' dietary intakes at lunch and/or over 24 hours (app. table 10, pp. 90-93). The strongest evidence comes from the SNDA-I study (Devaney et al., 1993) and from a recent analysis of data from the 1994-96 CSFII completed by Gleason and Suitor (2003). SNDA-I researchers controlled for selection bias using an instrumental variables approach and confirmed the

[17]Goals for sodium and cholesterol content are not included in SMI nutrition standards; however, schools are encouraged to monitor levels of these dietary components.

robustness of their results using a variety of specifications. Gleason and Suitor improved upon the techniques used in SNDA-I to control for selection bias by using a fixed-effects model. SNDA-I completed subgroup analyses that suggest that some program impacts may vary by students' age and household income. The findings summarized here apply to students overall.

The evidence is strong that, before the SMI, the NSLP increased children's lunchtime intakes of selected vitamins and minerals (riboflavin, vitamin B_{12}, calcium, phosphorus, magnesium, and zinc). Evidence for riboflavin, calcium, and phosphorus is particularly strong. Every study that examined intakes of these nutrients found that NSLP participants had significantly higher intakes at lunch than nonparticipants. It is generally accepted that this pattern is caused by increased consumption of milk, which is a concentrated source of all of these nutrients, among NSLP participants (Lin and Ralston, 2003; Devaney et al., 1993; Radzikowski and Gale, 1984).

Analyses completed by both SNDA-I (Devaney et al., 1993) and NESNP (Wellisch et al., 1983) researchers suggest that differences in the vitamin and mineral intakes of NSLP participants and nonparticipants at lunch are due to the *types* of food eaten rather than to the *quantities*. Both SNDA-I and NESNP examined the nutrient density of lunches and found that lunches eaten by NSLP participants were higher in nutrient density than lunches eaten by nonparticipants. Although only the NESNP results were tested for statistical significance, both groups of investigators concluded that the NSLP increased intakes of selected nutrients by providing lunches that were more dense in those nutrients, rather than by simply providing more food.

The strongest available study (Gleason and Suitor, 2003) suggests that NSLP effects on students' intakes of vitamins and minerals persisted over 24 hours. Because of limitations in the dietary assessment methodologies used, however, it is not possible to determine whether NSLP participants were more likely than nonparticipants to have adequate intakes of these vitamins and minerals.

The evidence is also strong that, before the SMI, NSLP participants consumed less carbohydrate and more fat and saturated fat (as percentages of total food energy) than nonparticipants, both at lunch and over 24 hours. Available evidence suggests that the difference in carbohydrate intake was due to decreased consumption of added sugars among NSLP participants (Gleason and Suitor, 2003).

Finally, the available evidence indicates that, before the SMI, NSLP participation had no significant effect on students' energy intakes or on sodium or cholesterol intakes. NSLP participation was associated, however, with a significantly greater intake of dietary fiber, both at lunch and over 24 hours.

A few researchers have looked at food consumption patterns of NSLP participants and nonparticipants. The quality of measures used in these studies varied and none of these analyses controlled for potential selection bias. Thus, conclusions about impacts on food consumption patterns are more tentative than conclusions about impacts on intake of energy and nutrients. Results of the available studies are largely consistent, however, and fit reasonably well with the conclusions about pre-SMI impacts on energy and nutrient intake.

The available data suggest that NSLP participants consumed *more* milk and vegetables at lunch and *fewer* sweets and snack foods than nonparticipants. Findings for other food groups are equivocal. SNDA-I found that a significantly greater proportion of NSLP participants than nonparticipants consumed grain products at lunch.

In contrast, Gleason and Suitor (2001) found that, on average, NSLP participants consumed significantly fewer servings of grains at lunch than nonparticipants. In both cases, between-group differences were relatively small.

The Gleason and Suitor (2001) finding deserves more weight than the SNDA-I finding because the former analysis looked at the actual number of servings consumed (rather than the percentage of children eating at least one item within the food group) and adjusted for differences in observed characteristics of students. Rainville (2001) reported results similar to Gleason and Suitor (2001) and found that the increase in the number of grain items consumed by nonparticipants was attributable to a high prevalence of sandwiches in lunches from home.

Gleason and Suitor (2001) found no difference between NSLP participants and nonparticipants in consumption of fruits and juices at lunch. However, all of the other studies reported that NSLP participants consumed more fruit and juices than nonparticipants.

Data on food consumption patterns of NSLP participants and nonparticipants over 24 hours are more limited. The available data suggest that some NSLP impacts on food consumption at lunch were maintained over 24 hours, while others faded.

Other Nutrition and Health Outcomes

A small number of studies have examined NSLP impacts on other nutrition- and health-related outcomes, such as height and/or weight (six studies), iron status (three studies), cholesterol levels (two studies), and cognitive functioning (one study) (app. table 11, pp. 94-95). None of these studies support firm conclusions about NSLP effects.

School Breakfast Program

The School Breakfast Program (SBP) began as a pilot program in 1966 and was permanently authorized in 1975. The intent of the program was to provide breakfast at school to children from poor areas who may not have eaten breakfast at home and to children in rural areas who ate an early breakfast, did chores, and then arrived at school hungry after traveling long distances (Devaney and Stuart, 1998). The program was modeled after the NSLP, which had been in existence for some 20 years when the SBP was established. The combination of the NSLP and SBP was intended to provide "a coordinated and comprehensive child food service [program] in schools" (P.L. 89-842).

The SBP operates in essentially the same manner as the NSLP. Schools that participate in the SBP provide breakfasts to children, regardless of household income. Federal reimbursement is provided for each breakfast served, with higher reimbursements for breakfasts served free of charge or at a reduced price to children certified to receive NSLP and SBP meal benefits. Any child in a participating school is eligible to participate in the SBP. In FY 2002, more than 8 million children participated in the SBP on an average school day. Approximately 1.4 billion meals were served, at a total Federal cost of $1.6 billion (table 1).

Compared with the NSLP, the SBP is available to fewer children and student participation rates are lower. The SBP is offered in about 78 percent of the schools and institutions that offer the NSLP (USDA/FNS, 2003c; USDA/FNS, 2003d). Using data from SNDA-I, Rossi (1998) found that, in schools where the SBP was available, only 78 percent of children who were eligible for free or reduced-price breakfasts were certified to receive meal subsidies. And of those certified, only 37 percent participated in the breakfast program. The combined effect was that, at the time the SNDA-I data were collected (the 1991-92 school year), only 29 percent of children eligible for free and reduced-price meals were eating school breakfasts. More recent studies have reported similar findings (Fox et al., 2001).

A major factor affecting application and participation decisions related to the NSLP and SBP is the perceived stigma of receiving free or reduced-price meals (Glantz et al., 1994). Stigma appears to be more of an issue for the SBP and for secondary school students than for the NSLP and elementary school students. Although program regulations require school districts to ensure that children approved for free and reduced-price meals are not overtly identified, many students and parents believe that simply eating a school breakfast carries a stigma. Other factors that have been identified as potential barriers to SBP participation include scheduling (when breakfast is served relative to the official start of the school day), meal prices, competing a la carte offerings, bus/transportation issues, lack of time to eat, lack of space, and student preferences for other foods (Reddan et al., 2002; Rosales and Jankowski, 2002; and Project Bread, 2000).

Some States require that all schools, or schools with a specific proportion of low-income students, participate in the SBP. Offering a free breakfast to all children regardless of family income—or a "universal-free" breakfast program—has become a popular vehicle for increasing participation in the SBP. In the 1990s, several States and school districts implemented demonstrations to test the feasibility and impact of such programs. Early results indicated that universal-free breakfasts substantially increased participation. Program evaluators also reported positive effects on tardiness, absentee rates, academic achievement, and related outcomes. However, most of the demonstrations were small in size, used nonexperimental designs, and had other design and/or data limitations (McLaughlin et al., 2002).

To obtain a more scientifically sound assessment of the potential impacts of universal-free school breakfast, Congress established the School Breakfast Program Pilot Project (SBPP) in 1998 (P.L. 105-336). The project, which began in the 2000-01 school year and ended at the end of the 2002-03 school year, included a comprehensive evaluation of both the implementation and impact of universal-free school breakfast. Results from the first year of implementation, including information on impacts on a variety of student outcomes, were published in late 2002 (McLaughlin et al., 2002). A final report covering all 3 years of the pilot is expected in 2004.

The existing literature on SBP impacts needs to be considered cautiously because program operations changed substantially after most of the available research was completed. The SMI and related initiatives (see discussion in preceding section on the NSLP) may have affected the meals offered to students and students' consumption of those meals. In addition, concerted efforts have been made in recent years to increase participation in the SBP. Increased participation may lead to changes in the characteristics of the children being served by the program, which, in turn, may lead to changes in program impacts. For these reasons, new research is essential to understanding the nutrition- and health-related impacts of the SBP as it operates today (Guthrie, 2003).

SBP research has studied the impacts of the program on two categories of student outcomes: (1) dietary intake and (2) academic performance and related outcomes such as attendance, tardiness, and behavior. The evaluation of the SBPP is the only study to look at all of these outcomes concurrently.

Students' Dietary Intakes

A total of 14 of the identified studies tried to estimate SBP impacts on children's dietary intakes (app. table 12, pp. 98-100). The best data in this area come from the SNDA-I study (Gordon et al., 1995; Devaney and Stuart, 1998) and the first-year report of the evaluation of the SBPP (McLaughlin, 2002). Both of these studies have limitations, however. SNDA-I provides the most recent nationally representative data and includes statistical controls for selection bias, but the study was completed prior to both the SMI and recent initiatives to increase SBP participation. Data from the SBPP evaluation are more recent—collected in spring 2001—but are not nationally representative and are based on data from six school districts that volunteered to participate in a universal-free breakfast demonstration. The SBPP evaluation used a randomized experimental design; however, the evaluation was designed to assess the impact of universal-free breakfast rather than the impact of the SBP per se.

The main analyses completed for the first-year SBPP report compared the *entire* treatment group (students in schools where universal-free breakfast was available) with the *entire* control group (students in schools where the standard SBP was available). Results of these analyses provide no information on the question that is central to understanding the impact of the SBP: Do the dietary intakes (or other outcomes) of students who participate in the SBP differ from those of students who do not participate in the program?

However, SBPP researchers completed a separate analysis that does provide some insight on this issue. A statistical procedure (based on Bloom, 1984) was used to estimate impacts on students who actually participated in the universal-free breakfast program. Results of this adjustment provide unbiased estimates of the impact of participating in universal-free school breakfast.[18] These findings are *suggestive* of the impact of participating in the regular SBP some 6 years after the SMI was launched.[19]

The overarching goal of the SBP is to provide breakfast to children who might otherwise not eat before starting the school day. The extent to which the SBP influences the likelihood that a child will eat breakfast has been addressed most thoroughly in a reanalysis of the SNDA-I data (Devaney and Stuart, 1998).[20] The analysis considered three different definitions of "breakfast." Each definition was based on foods consumed between waking and 45 minutes after the start of school and included foods consumed at home and at school. The three definitions were as follows:

(1) Consumption of any food or beverage (except water).

(2) Consumption of food or beverages that contributed more than 10 percent of the Recommended Energy Allowance (REA).

(3) Consumption of food or beverages from at least two of five major food groups PLUS more than 10 percent of the REA.

Overall, the availability of the SBP had no significant impact on the likelihood of breakfast consumption, regardless of the definition used. For students from low-income households, however, availability of the SBP significantly increased the likelihood that students would eat a more substantial breakfast (a breakfast that satisfied either definition 2 or 3). At the same time, availability of the SBP significantly reduced the likelihood of

[18]For more information, see McLaughlin et al. (2002), chapter 4 and appendixes C and F.

[19]The characteristics of meals provided in universal-free breakfast programs are likely to be comparable to those provided in the regular SBP (see McLaughlin et al., 2002). However, the characteristics and consumption behaviors of students who choose to participate in universal-free school breakfast and students who choose to participate in the regular SBP may not be comparable.

[20]The Evaluation of the SBPP (McLaughlin et al., 2002) assessed the impact of a universal-free breakfast program on the likelihood that students would eat breakfast. These data are not included in this review because they have limited applicability to the regular SBP, where free breakfasts are available only to students who are certified to receive that benefit.

low-income students eating a nominal breakfast (a breakfast that provided 10 percent or less of the REA).[21]

SBP impact studies completed before implementation of the SMI are virtually unanimous that the program increased students' intakes of three minerals—calcium, phosphorous, and magnesium—both at breakfast, and, when examined, over 24 hours. There is also a consistent finding that the SBP increased riboflavin intake at breakfast but this effect generally did not persist over the full day. All of these nutrients (calcium, phosphorus, magnesium, and riboflavin) occur in concentrated amounts in milk.

Findings from pre-SMI studies are less consistent for food energy and other nutrients and dietary components. SNDA-I, which provides the strongest evidence, found that SBP participants consumed significantly more food energy and protein and less carbohydrate (as a percentage of food energy) at breakfast than nonparticipants (Gordon et al., 1995). In addition, although differences were not statistically significant, mean intakes of fat and saturated fat, as a percentage of total energy intake, and intakes of cholesterol and sodium were greater for SBP participants than nonparticipants. All of these differences persisted over 24 hours.

The evaluation of the SBPP, the only post-SMI study identified, found few significant differences between energy and nutrient intakes of universal-free breakfast participants, either at breakfast or over 24 hours. Universal-free breakfast participants consumed significantly more calcium and phosphorus at breakfast than nonparticipants, but neither of these differences persisted over 24 hours. Differences for magnesium and riboflavin were not statistically significant for either time point. In addition, the SBPP evaluation estimated *usual* daily (24-hour) intakes and assessed the impact of universal-free breakfast on the likelihood that students had adequate intakes, using the approach recently recommended by the IOM (2001). No significant differences were found in the prevalence of inadequate nutrient intakes among students who participated in universal-free breakfast and those who did not.

The evaluation of the SBPP found no significant differences in energy and macronutrient intakes of universal-free breakfast participants and nonparticipants, either at breakfast or over 24 hours. Moreover, the general trend was the reverse of the trend observed in SNDA-I. That is, on average, point estimates for the percentage of calories from fat and saturated fat were lower for universal-free breakfast participants than nonparticipants. And the SBPP evaluation found that universal-free breakfast participants consumed significantly less cholesterol than nonparticipants, both at breakfast and over 24 hours. No significant between-group differences were noted for sodium intake.

While results of the SNDA-I and SBPP studies cannot be compared directly, the SBPP data suggest a shift in SBP impacts over time that is largely consistent with changes observed in the nutrient profiles of SBP meals. For example, the SNDA-II study found that breakfasts offered in 1998-99 provided 5-6 percent less calcium than breakfasts offered at the time SNDA-I data were collected (1991-92 school year) (Fox et al., 2001).[22] Likewise, breakfasts offered in 1998-99 were significantly lower in energy, protein, total fat, saturated fat, cholesterol, and sodium than breakfasts offered in 1991-92.

A few studies have examined SBP impacts on students' food consumption patterns. Findings from McLaughlin et al. (2002) provide the strongest suggestive evidence of current SBP impacts. These data indicate that universal-free breakfast participants consumed significantly more servings of fruit and dairy products at breakfast than nonparticipants, and significantly fewer servings of meats and meat substitutes. However, data on 24-hour intakes indicate that all of these effects dissipated over the course of the day.

School Performance and Cognitive/Behavioral Outcomes

Eight of the identified studies attempted to measure the impact of eating a school breakfast on an array of school performance, cognitive, and behavioral outcomes (app. table 13, pp. 101-102). With one exception (Meyers, 1989), these studies evaluated universal-free breakfast programs rather than the actual SBP. Consequently, findings from these studies provide, at best, suggestive evidence of potential SBP impacts. Because the SBP does not offer breakfasts free of charge to all students, impacts observed in demonstrations of universal-free breakfast cannot be assumed to apply to the regular SBP.

[21]The results differed slightly for elementary and secondary school students. Among secondary school students, a significantly greater likelihood of breakfast consumption was observed only for the most stringent definition (two food groups and more than 10 percent of the REA).

[22]The average calcium content of breakfasts offered at both points in time more than satisfied the program standard of providing one-fourth of children's daily calcium needs. SNDA-II did not assess magnesium, phosphorus, or riboflavin content.

In this research, impacts on school performance and related outcomes were often measured based on group membership rather than on individual behavior. That is, analyses generally compared the *entire* treatment group (students in schools where universal-free breakfast was available) with the *entire* comparison/control group (students in schools where the standard SBP was available). This is a fairly imprecise definition of program participation because it does not take into consideration the actual behavior of students in the two groups of schools—students in either type of school may or may not have eaten the breakfasts that were offered to them.

The previously described supplementary analysis completed for the evaluation of the SBPP compared universal-free breakfast participants with nonparticipants based on actual participation in the universal-free breakfast program. Participation was defined based on same-day participation for short-term outcomes and on cumulative participation over the implementation year for longer term outcomes. This more precise definition of universal-free breakfast participation, combined with the randomized design, dictates that considerably more credence be given to results of the SBPP study than to the other studies. Other factors that minimize the credibility of findings from other studies are limitation to one geographic area (one city or State), small sample sizes, and inadequate statistical control for clustering (Ponza et al., 1999).

The SBPP evaluation found that universal-free breakfast participation had no significant effect on a broad array of measures, including attendance, tardiness, academic achievement, cognitive functioning, behavior, health status, food security, and Body Mass Index. The study found a small but significant and negative effect on teacher-rated behavioral opposition among long-term participants in universal-free breakfast.[23]

Child and Adult Care Food Program

The CACFP began in 1968 as a pilot program known as the Special Food Service Program for Children (SFSPFC). Participation was initially limited to center-based child care in areas with poor economic conditions. Beginning in 1976, family child care homes were also eligible to participate, provided that they met State licensing requirements, where these were imposed, or obtained approval from a State or local agency. Homes had to be sponsored by a nonprofit organization that assumed responsibility for ensuring compliance with Federal and State regulations and that acted as a conduit for meal reimbursements.

The CACFP was authorized as a permanent program in 1978. At the time, the program was focused exclusively on children and was called the Child Care Food Program (CCFP). In 1987, as a means of increasing support for elderly feeding programs, P.L. 100-175 amended the Older Americans Act to mandate that the CCFP be expanded to allow eligible adult day care centers to participate. The program was renamed the Child and *Adult* Care Food Program and institutional participation was expanded to include centers that provide day care services to people age 60 and older or to functionally impaired people age 18 and older. Eligible adult care centers have the option of participating in the CACFP or in the HHS-sponsored Elderly Nutrition Program (discussed later in this report) but cannot receive reimbursement under both programs for the same meal. The child and adult care components of the program are governed by the same rules and regulations. However, at the State level, the two components may be administered by separate agencies, at the discretion of the governor.

In 1998, the Child Nutrition Reauthorization Act (P.L. 105-336) expanded institutional eligibility for the child care component of the CACFP to include after-school care programs not participating in the NSLP and homeless shelters that serve children. Participation of after-school programs is limited to those in geographic areas where 50 percent or more of the children enrolled in school are eligible for free or reduced-price meals in the NSLP. Programs must provide regular, structured activities for children, including educational and enrichment activities (USDA/FNS, 2003e).

Although the adult component of the CACFP has increased steadily over time, the child care component of the program is substantially larger. In September 2002, the program served an average of 2.9 million children and 86,000 adults per day (USDA/FNS, 2003e). The $1.9 billion Federal expenditure for FY 2002 supported the provision of 1.7 billion meals and snacks to children and 44.6 million meals and snacks to adults (table 1).

Child and adult care providers who participate in the CACFP are reimbursed at fixed rates for each meal and snack served. Under current program regulations, child and adult care centers and child care homes may be

[23]This result is based on the first year of a 3-year demonstration and may not hold across all 3 years.

reimbursed for a maximum of two meals and one snack or two snacks and one meal per eligible participant per day. Homeless shelters may be reimbursed for up to three meals per child per day and after-school programs may be reimbursed for one snack per child per day. After-school programs in some States are also eligible to receive reimbursement for suppers.

To date, no research has examined the impact of the CACFP on participants' dietary intakes or other nutrition- and health-related outcomes. The limited amount of research on the CACFP is almost entirely descriptive, focusing on the characteristics of participating institutions, providers, and the children or adults they serve. An early study of the child care component of the program compared the nutrient content of meals offered in child care centers that did and did not participate in the program (then known as the CCFP) (Glantz and O'Neill-Fox, 1982). The study found that meals offered in CCFP centers were higher in calories and provided greater quantities of a number of different nutrients. The study design is potentially vulnerable to selection bias. Moreover, the study's results are of questionable importance today because over time so much has changed in the CACFP program and in the child care industry in general. Other available research on the child care component of the program is less outdated but provides no information on program impacts because the research did not include non-CACFP institutions.

The one study that has been completed on the adult component of the program (Ponza et al., 1993) was also descriptive and did not compare outcomes for program participants and nonparticipants.

The most recent study of the CACFP was a congressionally mandated study that examined the effects of a new reimbursement structure designed to increase the number of low-income children served in family child care homes. Under the new reimbursement structure, family child care homes that are (1) located in low-income areas or (2) operated by low-income providers have reimbursement rates similar to the rates that existed before the change. (A low-income area is defined as either an area where at least half of the children live in families with incomes below 185 percent of the poverty level or an area served by an elementary school in which at least half of the enrolled children are eligible for free or reduced-price school meals.) All other homes are reimbursed at substantially lower rates than those that were in existence before the change.

The change in reimbursement structure has been referred to as "tiering." Tier I homes are those that receive the greater reimbursement associated with operating in a low-income area or being run by a low-income provider. Homes that receive the lower reimbursement are referred to as Tier II homes.

The mandated evaluation of the effects of tiering found that the legislative change achieved the desired objectives: The number of low-income children served in family child care homes grew by 80 percent between 1995 and 1999, and the number of meal reimbursements going to low-income children doubled (Hamilton et al., 2001). Moreover, tiering had no adverse effect on either the number or nutritional characteristics of meals offered by Tier II providers (Crepinsek et al., 2002).

Summer Food Service Program

The SFSP was created to ensure that low-income children would have access to nutritionally balanced meals when school is not in session. The program was created in 1968 as a 3-year pilot project and was permanently authorized as an entitlement program in FY 1975.

The SFSP provides funds to eligible organizations to serve nutritious meals and snacks, free of charge, to children at approved feeding sites. Organizations eligible to sponsor feeding sites include public or private nonprofit schools; local government agencies; nonprofit community organizations, such as YMCAs and Boys and Girls Clubs; churches; National Youth Sports Programs (NYSP);[24] and residential camps. In FY 2002, the SFSP cost $263 million and served about 122 million meals and snacks (table 1). In July 2002, during peak participation, the program served about 1.9 million children per day.[25]

In recent years, concerns have escalated about the number of low-income children who go without Federal meal benefits during the summer. In describing the problem, Under Secretary of Agriculture Eric M. Bost pointed out that the 2 million SFSP meals served per day in FY 2000 represented only about 12 percent of the free and reduced-price meals served each day during the regular school year through the

[24]NYSPs are federally funded sports camps for low-income children. Programs are administered by colleges and universities.

[25]An additional 1.6 million children per day received summer meals through the NSLP as part of summer school programs or year-round schools (based on reported NSLP participation for July 2002 (USDA/FNS, 2003f)).

NSLP (Bost, 2000). Bost deemed this level of SFSP participation, which reached “only a fraction of eligible children,” to be “unreasonably low.”[26]

Several initiatives have been implemented to increase penetration of the SFSP by attracting more program sponsors, particularly school districts. In late 2000, P.L. 106-554 (the Consolidated Appropriations Act), authorized a special pilot project to increase the number of children participating in the SFSP in Puerto Rico and 13 States with low SFSP participation rates (Garnett, 2001; Food Research and Action Center (FRAC), 2001).[27] The pilot project was initially authorized to operate from FY 2001 through FY 2003 and was extended by Congress through March 2004. It simplified recordkeeping and reporting requirements and provided sites with the maximum per meal reimbursement for both operating (foodservice) cost reimbursements and administrative cost reimbursements. Moreover, pilot sites were allowed greater flexibility in using funds from two different reimbursement streams. Analyses completed by FRAC (FRAC, 2003) and FNS (Singh and Endahl, 2004) indicate that States participating in the pilot successfully increased SFSP participation. FNS found that, in all 14 States combined (considering Puerto Rico a State), the number of SFSP sponsors increased by 18 percent between July 2000 and July 2003, and average daily participation increased by 43 percent. Impacts varied substantially across States, however, and based on July 2003 data, many pilot States continued to have low SFSP participation relative to other States. Assessment of the pilot’s impacts was complicated by other SFSP initiatives that were implemented during the same period.

For example, before the start of SFSP activities for summer 2002, USDA implemented “seamless summer waivers” for school districts that operate the NSLP (USDA/FNS, 2002a). The waivers, which ran through FY 2004, allowed school districts to offer the SFSP without having to deal with paperwork and other administrative tasks that were previously required. Tasse and Ohls (2003) studied early reaction to and effects of seamless waivers. Although school district response to the waivers was generally positive, early evidence indicated that the waivers had a limited impact on the number of children receiving summer meals. On a typical day in summer 2002, an estimated 50,000 children received meals who would not have done so without seamless waivers. Determining the ultimate success of seamless waivers will require information about impacts during summer 2003 and 2004.

Other actions taken by USDA to increase SFSP sponsorship include providing State agencies with the flexibility to approve deviations in the length of time between meal services and/or the duration of meal service, when existing requirements pose a barrier to participation, and to consider closed, enrolled sites that provide services exclusively to the “Upward Bound” program as categorically eligible for the SFSP. (Income-eligibility thresholds used for “Upward Bound” are identical to those used in the SFSP.) Finally, USDA developed a Web-based geographic information tool to help State agencies and other interested organizations identify areas that are underserved by the SFSP (Gordon and Briefel, 2003).[28]

To date, no research has examined the impact of the SFSP on nutrition or health outcomes of participating children. The research that does exist has been descriptive, much of it focusing on program operations and the characteristics of sponsoring organizations. The most recent such study was completed in March 2003 (Gordon and Briefel, 2003). In addition to looking at program operations and characteristics, the study looked at factors that affect participation, the nutritional quality of the meals served, and the extent of plate waste. FNS is currently undertaking a qualitative study to examine what low-income children not participating in the SFSP do during the summer.

The Emergency Food Assistance Program

The Emergency Food Assistance Program (TEFAP) provides commodity foods to emergency kitchens (often referred to as soup kitchens), homeless shelters, and similar organizations that serve meals to homeless and other needy individuals. Through food banks and food pantries, the program also provides basic commodities to low-income households for preparation and consumption at home. USDA purchases commodity foods and processes, packages, and distributes them to designated State agencies, which, in turn, distribute the foods to approved local charitable organizations.

TEFAP evolved from the Federal Surplus Relief Corporation, which was established under the Agricultural

[26]There are several reasons that SFSP participation is lower than NSLP participation. One is that open SFSP sites must be located in low-income neighborhoods, whereas the NSLP is available everywhere; another is that attendance at SFSP sites is voluntary, while children must attend school during the year (Gordon and Briefel, 2003). In addition, systems that transport students to schools during the normal school year are generally not operational during the summer months.

[27]The 13 States are Alaska, Arkansas, Idaho, Indiana, Iowa, Kansas, Kentucky, Nebraska, New Hampshire, North Dakota, Oklahoma, Texas, and Wyoming.

[28]Available at www.ers.usda.gov/data/SFSP/.

Adjustment Act of 1933 to encourage consumption of surplus domestic farm commodities, while providing nutritious foods to needy individuals. The current program was first authorized as the Temporary Emergency Food Assistance Program in 1981. The name associated with the acronym TEFAP was changed to The Emergency Food Assistance Program under the 1990 Farm Act. In 1996, PRWORA combined TEFAP with the previously separate Commodity Distribution Programs for Charitable Institutions, Soup Kitchens, and Food Banks.

TEFAP foods are distributed free of charge, but individuals who receive TEFAP foods for home use must meet eligibility criteria defined by each State. The types of commodities available through TEFAP vary from year to year, depending on agricultural conditions as well as State preferences. In FY 2001, more than 40 products were available, including canned and dried fruits; canned vegetables; fruit juice; meat, poultry, and fish; dried egg mix; peanut butter; nonfat dry milk; rice; pasta; and cereal (USDA/FNS, 2003g).

A recently completed study of providers in the U.S. Emergency Food Assistance System (EFAS) found that TEFAP commodities account for about 14 percent of all food distributed through the EFAS (Ohls and Saleem-Ismail, 2002). Nationally, 55 percent of emergency kitchens, 52 percent of food pantries, and 84 percent of food banks distribute TEFAP foods. In FY 2002, 611 million pounds of food were distributed through TEFAP at a Federal cost of $435 million (table 1).

The literature search identified no direct evaluations of TEFAP's effects on nutrition or health outcomes. A small number of studies have examined nutrition and health characteristics of people who use programs that commonly receive and distribute TEFAP foods, but TEFAP provides only part of the food that these programs distribute and the studies do not specifically measure TEFAP's role.

The recent survey of providers in the EFAS (Ohls and Saleem-Ismail, 2002) offers a detailed and up-to-date picture of the organizational system and programs that distribute TEFAP foods. An associated survey of EFAS clients in food pantries and emergency kitchens describes the characteristics and experiences of likely recipients of TEFAP food (Briefel et al., 2003).

Nutrition Services Incentive Program

The Nutrition Services Incentive Program (NSIP), formerly known as the Nutrition Program for the Elderly (NPE), provides cash and/or commodities to agencies or organizations that sponsor Elderly Nutrition Program (ENP) sites. The ENP, which is administered by HHS's Administration on Aging (AoA), is the primary vehicle for the organization and delivery of nutrition and support services to the Nation's elderly. The ENP provides meals in both group (congregate feeding sites) and home settings (the "Meals on Wheels" program). People ages 60 and older, their spouses, and certain others are eligible to participate in the ENP. The ENP has no income eligibility requirement, although the administering programs typically target lower income persons. Recipients are encouraged, not required, to contribute toward the cost of the meals they receive.

USDA's involvement in the ENP began in 1975 when Congress authorized USDA to donate commodities to the program. The USDA program, known as the Nutrition Program for the Elderly (NPE), provided commodities to States and Indian Tribal Organizations (ITOs) which, in turn, distributed them to local ENP sites. In 1977, P.L. 95-65 allowed States and ITOs to elect to receive their NPE entitlement in the form of cash or commodities. Over time, the predominant type of support provided by the NPE shifted from commodities to cash. In FY 1999, only 2 percent of the $140 million NPE appropriation was distributed to ENP meal providers as commodities (HHS/AoA, 2002).

When the ENP was reauthorized in FY 2000, the name for the USDA program was changed to the NSIP. In addition, the model for administering the program was changed from a simple reimbursement model to an allocation model. Rather than reimbursing States and ITOs per meal based on the number of meals served the previous fiscal year, NSIP funds are now distributed to States and ITOs based on the number of meals served *relative to the total number of meals served by all States and ITOs*. The reason for this change was a desire to reward States and ITOs for efficient use of cash and/or commodities in providing meals to older adults (USDA/FNS, 2002b).

In FY 2003, responsibility for the administration of the NSIP was transferred from USDA to HHS, although USDA continues to provide financial support and donated commodities. In FY 2002, USDA's contribution to the ENP was $152 million (table 1).

No studies have examined the effectiveness of the NSIP (or the former NPE) per se. To understand the impact of the NSIP, one has to look to research on the larger program, the ENP. Since the inception of the

ENP, two national evaluations and a number of smaller local studies have assessed the program's effectiveness. All of these studies used quasi-experimental designs, with nonparticipants identified in a variety of ways. Selection bias is an issue in all of this research, but only the most recent national study addressed the problem systematically (although inconclusively) (Ponza et al., 1996).

Most of the studies that have looked at the health and nutrition impacts of the ENP have focused on dietary intake or nutritional status, although food security has also received some attention (app. table 14, pp. 104-107). Some research has also examined the impact of the ENP on socialization. While many of the available studies are dated—approaching or exceeding 20 years old—a comprehensive national evaluation published in 1996 provides a reasonably up-to-date perspective on the nutrition- and health-related impacts of the ENP (Ponza et al., 1996).

Dietary Intakes

The strongest available evidence on the ENP's impact on dietary intake comes from the National Evaluation of the Elderly Nutrition Program, 1993-95 (Ponza et al., 1996). This study found that both congregate and home-delivered meal participants had significantly greater intakes of energy and protein than nonparticipants. In addition, ENP participants who received congregate meals had significantly greater intakes of a wide variety of vitamins and minerals than nonparticipants. ENP participants who received home-delivered meals also had higher mean intakes than did nonparticipants, but some of these differences did not reach statistical significance. Because of limitations in the dietary assessment methodologies used, determining whether ENP participants were more likely than nonparticipants to have adequate intakes of these vitamins and minerals is not possible.

No significant differences between ENP participants and nonparticipants were detected in intakes of total fat, saturated fat, cholesterol, or sodium. Mean cholesterol intakes of both groups were well within the recommended range. However, excessive intake of total fat, saturated fat, and sodium, relative to accepted recommendations, was a problem for some ENP participants.

Other Outcomes

While all studies of the impact of the ENP are subject to selection bias, studies that looked at measures other than dietary intake are especially prone to this problem because the program specifically targets individuals who are at nutritional or social risk. The impact of the ENP on more direct measures of nutritional status—including nutritional biochemistries, weight status, and a comprehensive measure of nutritional risk—has been examined only in small, local studies. The limited information available suggests that ENP participation is not associated with obesity and that, in fact, thinner, more frail elderly may self-select into the program. With the possible exception of serum vitamin A, which was positively associated with participation in the ENP, drawing firm conclusions about the impact of the ENP on nutritional biochemistries is not possible.

Evidence is mixed about the impact of the ENP on reducing social isolation and promoting quality of life among the elderly. While the perceived benefit of social and support services is high, two national evaluations that attempted to systematically measure social outcomes of ENP participants, relative to a group of eligible nonparticipants, employed different measures of socialization and reported divergent results.

The issue of food security among ENP participants has not been well researched, and the relationship is a complicated one. The 1993-95 evaluation assessed food security among ENP participants but did not collect comparable data for nonparticipants (Ponza et al., 1996). Instead, the authors compared data for ENP participants with data for the U.S. elderly population overall. Results indicated that, although most ENP participants reported having enough food to eat, they were much more likely to experience food insecurity than elderly people overall. This pattern presumably does not reflect an impact of ENP participation but indicates that individuals who choose to participate in the ENP are more food insecure than the general elderly population.

Only one of the identified studies estimated the impact of ENP participation on food security by comparing ENP participants with comparable nonparticipants (Edwards et al., 1993). The study included a sample of elderly diabetics who were either receiving home-delivered meals or on a waiting list for home-delivered meals. The ENP was found to have a positive effect on food security. Elderly diabetics who were receiving home-delivered meals were less likely than their counterparts on the waiting list to be food insecure or to go 1 or more days per month without food.

Nutrition Assistance Program in Puerto Rico, American Samoa, and the Northern Marianas

The NAP provides food and nutrition assistance to low-income individuals in Puerto Rico, American Samoa, and the Northern Marianas through block grants to territory administrative agencies. The territories provide cash or checks to eligible participants. The NAP replaced the FSP, which operated in the territories from 1975 through 1982. The 1981 Omnibus Budget Reconciliation Act (OBRA) abolished the FSP in the territories and replaced it with a block grant. Puerto Rican authorities designed the NAP to administer the block grant beginning in July 1982. The switch from the coupon-based FSP to the cash-based NAP was permanently authorized in September 1985.

The objectives of the NAP and the FSP are identical: to provide low-income households with access to a nutritious diet through increased food purchasing power. Both programs have monthly benefits that vary by household size and net income, and both programs are available to all applicants who meet specified eligibility criteria. Major differences between the programs include the following:

- ***Form of benefit.*** Electronic benefits for the FSP; cash or check for the NAP.[29]

- ***Benefit restrictions.*** FSP benefits are restricted to purchase of food for home consumption. NAP benefits are not restricted.

- ***Size of benefit.*** NAP benefits are constrained by the size of the block grant so eligibility requirements are stricter and benefits are generally smaller.

In FY 2002, the NAP block grants were $1.35 billion for Puerto Rico, $5.3 million for American Samoa, and $6.1 million for the Northern Marianas (table 1).

Very little research has been done on the impacts of the NAP (app. table 15, p. 110). The three studies identified in the literature search all focused on Puerto Rico. All three studies are considerably dated, having used data from the 1977 Puerto Rico Supplement to the Nationwide Food Consumption Survey (NFCS) and/or the 1984 Puerto Rico Household Food Consumption Survey (HFCS). The former survey was conducted while the FSP was still in place. The latter survey was conducted during the second full year of NAP operations.

The strongest analysis of food expenditures found a positive impact, as would be expected from a program that supplements the household's purchasing power (Beebout et al., 1985). Contradictory findings from the only other analysis of this outcome probably stem from weaknesses in the analytic approach (Hama, 1993).

Available evidence on the impact of the NAP on household nutrient availability is limited but suggests small, positive effects. All three of the identified studies looked at this outcome, using the same database but different analytic approaches. All found small increases in household availability of food energy as well as several vitamins and minerals considered to be potentially problematic in the Puerto Rican diet. However, only one study reported on the statistical significance of observed differences (Bishop et al., 1996). This study found that some nutrient intake distributions improved significantly after the NAP (iron, vitamin A, and niacin), some worsened significantly (calcium and riboflavin), and some remained the same (magnesium and vitamin B_6). In examining impacts by income quintiles, the authors noted that the improvements reached the lowest income quintile while the negative changes did not.

Bishop and his colleagues also compared energy and nutrient availability among NAP participants and nonparticipants, using only the 1984 HFCS data. In these analyses, the sample was restricted to households in the lowest quintile of the nutrient distribution under consideration. Among these high-risk households, NAP participation was associated with greater availability of food energy and six of the seven nutrients examined (all but calcium). Differences were statistically significant for iron, magnesium, and vitamin B_6.

Commodity Supplemental Food Program

The CSFP was established in 1968, largely in response to concerns about hunger and malnutrition among vulnerable low-income populations. The Supplemental Food Program, as it was initially known, was developed as a joint effort between USDA and the U.S. Department of Health, Education, and Welfare (the forerunner of the current HHS). The program provided food packages, including evaporated milk, corn syrup, and "reinforced" cereals, to low-income women, infants, and preschool children. Food packages were distributed to participants—upon "determination [of need] by a competent medical authority"—through health clinics, visiting nurses,

[29]PRWORA mandated that all FSP benefits be distributed as electronic transfers rather than as coupons. Nationwide changeover from coupons to electronic transfers was completed in June 2004 (USDA, 2004).

and health centers that served low-income populations (Mahoney Monrad et al., 1982).

Over time, other types of social service organizations have come to serve as local CSFP agencies. In the current configuration, not all local agencies that provide commodity foods also provide direct health services, but all are encouraged to provide health information and linkages. In addition, with the inception and growth of the WIC program and growing interest in issues related to aging, the CSFP has shifted emphasis toward the low-income elderly. Elderly participation in the CSFP began with a pilot project in FY 1982. The program continues to serve pregnant and breastfeeding women, new mothers up to 1 year postpartum, infants, and children under age 6. The nonelderly population is similar to the population served by WIC, but eligible individuals cannot participate in both programs at the same time.

The CSFP does not operate in all 50 States. In FY 2003, 32 States, the District of Columbia, and 2 Indian reservations were authorized to operate the program (USDA/FNS, 2003h). In FY 2002, 427,000 individuals, the majority of whom were elderly, participated in the CSFP each month. The total Federal expenditure for the program was $110 million (table 1).

The only identified study to examine CSFP impacts dates back to 1982 (app. table 16, p. 112). The study included only pregnant women and preschool children. For pregnant women, the study found favorable impacts on birth outcomes such as gestational age, birthweight, and length of hospital stay after birth (Mahony Monrad et al., 1982). The study found some evidence of positive effects for children but generally had inconclusive results. Study authors provided little information on the procedures used to identify nonparticipants; however, the study likely suffers from selection bias. The relevance of the study to today's CSFP is also limited by the fact that it is more than 20 years old and provides no information on the current majority participant group (the elderly).

Food Distribution Program on Indian Reservations and the Trust Territories

The FDPIR was authorized under the Food Stamp Act of 1977.[30] In establishing the FDPIR, Congress cited concerns that the FSP might not adequately meet the food assistance needs of low-income American Indian households living on or near reservations (Usher et al., 1990). The primary concern was that the remote location of many reservations made it difficult for American Indian households to participate in the FSP. In many instances, the distance between the reservation and the local FSP offices was substantial and/or food stores where FSP coupons could be redeemed were scarce or far away. Thus, the FDPIR was designed to provide an alternative to the FSP for low-income American Indian households living on or near reservations.

The FDPIR provides monthly supplemental food packages to low-income households living on Indian reservations and to eligible American Indian households living in approved areas near reservations. Income eligibility for the FDPIR is based on federally defined income eligibility requirements used in the FSP. However, the FDPIR does not impose FSP requirements related to employment and training or time limits for able-bodied adults without dependents (ABAWDs). All households residing on Indian reservations are eligible to participate in the program if they meet income and resource standards. Households living in approved areas near reservations or in Oklahoma are eligible to participate if at least one member of the household is a member of a federally recognized tribe (USDA/FNS, 2003j).

Eligible households may choose to participate in either the FDPIR or the FSP but not both. Participating households receive a monthly food package weighing between 50 and 75 pounds. In FY 2003, more than 70 different food items were offered, including canned meats, poultry, and fish; canned fruits, vegetables, and juices; dried fruits; dehydrated potatoes; canned soups; canned spaghetti sauce; packaged macaroni and cheese and other types of pasta; cereals; rice and other grains; cheese; egg mix; peanuts; peanut butter; low-fat refried beans; and nonfat dry and evaporated milks (USDA/FNS, 2003j). Staples, such as flour, cornmeal, bakery mix, corn syrup, vegetable oil, and shortening, are also offered. Frozen ground beef and chicken and/or fresh produce are also available to most programs that have facilities to store and handle these foods.[31]

In addition to providing food, the FDPIR makes available to participants printed materials, including guidance on how to use FDPIR foods as part of a healthy diet, commodity fact sheets that provide storage and preparation tips, nutrition information and recipes, and

[30] The FDPIR was actually the precursor to today's FSP. After FY 1975, when the FSP was available nationwide, the program served U.S. territories in the Pacific Islands as well as Indian reservations. Most of the Pacific Island sites were phased out during the 1980s and 1990s, as the islands converted from U.S. territories to commonwealths (USDA/FNS, 2003i).

[31] Even when offered, some families are not able to use fresh or frozen foods because they do not have refrigerators (Ballew et al., 1997).

a “Nutrition Facts” booklet that lists the ingredients and nutrient composition of available commodities (USDA/FNS, 2003j). Sponsoring agencies can also apply for additional Federal funding to be used specifically for nutrition education.

In FY 2003, the FDPIR was administered by 98 Indian Tribal Organizations and five States and provided benefits to approximately 243 American Indian tribes (USDA/FNS, 2003j). In FY 2002, the program served approximately 110,000 individuals each month at an annual cost of $69 million (table 1).

Very little research has been done on the FDPIR. The only program-specific study identified was a nationally representative study completed by Usher et al. (1990). The study was descriptive in nature, with the primary objectives of describing program operations, sociodemographic characteristics of FDPIR households, the dietary needs and preferences of low-income American Indians, and how the FDPIR addresses those needs. The study also compared availability and acceptability of the FDPIR vs. the FSP in providing food assistance. The only other potentially relevant literature documents nutrition and health concerns among American Indians, suggesting a need for the program’s benefits. However, no scientific research has assessed the extent to which the FDPIR meets these needs.

WIC and Senior Farmers’ Market Nutrition Programs

The Farmers’ Market Nutrition Programs provide low-income individuals with coupons that can be used to buy fresh fruits, vegetables, and herbs from authorized farmers and farmers’ markets. The WIC Farmers’ Market Nutrition Program (FMNP) is affiliated with the WIC program and serves certified WIC participants and eligible nonparticipants who are on waiting lists. FMNP participants can receive farmers’ market coupons totaling $10-$20 per year, usually at the beginning of the fruit- and vegetable-growing season. Not all WIC programs participate in the FMNP. In FY 2003, the FMNP operated in 36 States, the District of Columbia, Guam, Puerto Rico, and 5 Indian Tribal Organizations (USDA/FNS, 2003k). The Federal appropriation for the FMNP was $25 million for FY 2003, and the program served more than 2 million participants in FY 2002 (table 1).

The Senior Farmers’ Market Nutrition Program (SFMNP) is a new FANP, just started in 2002. The SFMNP is essentially the same as the WIC version of the program but is targeted toward low-income elderly. Total costs for the program were about $13 million in its first year of operation (table 1). In FY 2003, the SFMNP operated in 35 States, the District of Columbia, Puerto Rico, and 3 Indian Tribal Organizations (USDA/FNS, 2003l). A total of $17 million in funding was available, including the FY 2003 appropriation ($15 million) and unspent funds from FY 2002 (approximately $2 million) (USDA, FNS, 2003l).

The literature search identified two studies that assessed nutrition-related impacts of the FMNP by comparing participants and nonparticipants (app. table 17, p. 114).[32] Both studies used research designs that were quite vulnerable to selection bias, reported on a very early period in the program’s operation, and based impact assessments on self-reported consumption of fresh fruits and vegetables. One study found that participants ate more fresh fruits and vegetables (Galfond et al., 1991), while the other found no effect (Anliker et al., 1992).

The limited and scientifically flawed research that is available on the FMNP does not support a firm conclusion about the program’s impact. The small dollar value of the FMNP benefit—no more than $20 per year—suggests that the program’s impact, if any, is likely to be so small that it would be extremely costly to measure.

Special Milk Program

The Special Milk Program (SMP) operates in schools and child care institutions that do not participate in other federally sponsored child nutrition programs (the NSLP, the SBP, or the CACFP). Schools that do participate in these other programs may also participate in the SMP to provide milk to children enrolled in preschool or kindergarten programs that do not provide meals.

Institutions participating in the SMP provide milk to children and receive a Federal subsidy for each half pint served. Children from households with incomes at or below 130 percent of the Federal poverty level may receive milk free of charge. In FY 2002, the program provided approximately 113 million half pints of milk to low-income children at a Federal cost of $16 million (table 1).

Research on the SMP is extremely limited. Only two studies that assessed program impact were identified (app. table 18, p. 116). Both of these studies are based

[32]The SFMNP was not considered in the literature review because it was not established until 2002.

on data that are more than 20 years old, reflecting a time when the program was 10-15 times as large as it is today.

The strongest available evidence on the potential impact of the SMP, although subject to selection bias, comes from the National Evaluation of School Nutrition Programs (NESNP), which collected data in the 1980-82 school year (Wellisch et al., 1983). Results of this study indicated that SMP participants consumed significantly more food energy and protein than nonparticipants, as well as more calcium, riboflavin, magnesium, and vitamin B_6. These results are consistent with the nutrient content of milk.

Team Nutrition Initiative and Nutrition Education and Training Program

The Team Nutrition (TN) Initiative and the Nutrition Education and Training (NET) Program differ from other FANPs in three important ways.[33] First, the primary focus of each program is educational in nature—to promote healthful eating patterns. Neither program provides food or enhances food purchasing power. Second, neither program targets benefits based on household income. That is, both programs, which are implemented primarily in schools, are intended to serve all children rather than offering greater benefits to low-income children (as the NSLP and SBP do) or being limited to children with specific nutritional risks (as WIC is).[34] Finally, target audiences for both TN and NET services extend beyond children to include teachers, school foodservice workers, parents, and community members, all of whom may influence children's food choices.

After the Senior Farmers' Market Nutrition Program, which began in 2002, TN is the youngest FANP. It was created in 1995 as part of the comprehensive School Meals Initiative (see preceding discussion on the NSLP). The FY 2002 appropriation for TN was $10 million (table 1). NET has been authorized for more than 25 years but has not received funding since FY 1998. Relatively little research has been done on either TN or NET (app. table 19, p. 118).

Team Nutrition Initiative

The best available information about potential impacts of TN comes from an evaluation of a pilot project that was implemented shortly after the program was established (USDA/FNS, 1998). The evaluation assessed the impact of TN in three key areas: skill-based nutrition knowledge, nutrition-related motivation and attitude, and food consumption behaviors. The TN pilot was designed to test optimal implementation of the initiative. School districts selected to participate in the pilot demonstrated capacity to meet the requirements of TN implementation, as well as the associated evaluation. Four districts were selected to participate in an indepth outcome evaluation. Three other districts participated in a limited process study.

Results of the pilot evaluation, although preliminary and certainly not generalizable, were promising. For skill-based knowledge, significant and positive impacts were noted for students' ability to (1) identify healthier choices and (2) apply knowledge of the Food Guide Pyramid. Students' ability to apply a "balanced diet" concept also increased, relative to pretest scores, but differences were not statistically significant. Small but positive and significant effects were noted for three different attitude measures. Followup data showed that significant TN effects were maintained over time, although the size of the impact decreased for three of the five measures that were significant initially. Estimated impacts at followup were equivalent to or greater than initial impacts only for the general attitudes measure and for perceived consequences of increased consumption of fruits, vegetables, and grains. The fact that the relative size of the impacts was small (generally one more correct answer) did not seem to be attributable to a ceiling effect. The authors suggested that the results reflected the short implementation period used for the evaluation and speculated that impacts could be larger with a more protracted period of intervention.

Effects on observed food selection and consumption behaviors in the cafeteria were modest. The only effects that were noted in an analysis that combined results for all pilot districts were a slight increase in the number of grain foods selected, an associated increase in the amount of grain foods eaten, and a small increase in the diversity of foods eaten (the number of different food groups tasted per day and total number of items). No significant differences were noted for selection or consumption of fruits, vegetables, or low-fat milk.

Analysis of three different measures of self-reported eating behaviors showed that TN had small but statistically significant effects on self-reported behaviors. The specific behaviors examined were use of low-fat foods, consumption of fruits and vegetables, and dietary variety (the number of food groups included in meals and

[33]FNS considers the TN to be part of the NSLP and SBP rather than a separate FANP.

[34]The TN also provides nutrition education materials to other FANP programs, such as WIC and the FSP.

snacks eaten the previous day). TN was found to have a small but positive and statistically significant impact on all three measures, but none of the impacts persisted over time.

Nutrition Education and Training Program

The only national study of NET was completed during the very early stages of the program, between 1979 and 1980 (St. Pierre and Rezmovic, 1982). At that point, it was plausible to expect program impacts in only a few States that had been able to begin implementation almost immediately after funds became available. Moreover, because of the diversity of States' goals, only State-specific impact evaluations were deemed appropriate.

Consequently, impact assessment was limited to two States in which NET was firmly established: Georgia and Nebraska (St. Pierre and Rezmovic, 1982). In Nebraska, a pre-/post-test design showed significant, positive impacts on children's nutrition-related knowledge (St. Pierre et al., 1981). In addition, some groups of students were more willing to try new or previously rejected foods in the school cafeteria or more likely to have improved their food preferences (based on self-report). Effects on nutrition-related attitudes, self-reported eating behaviors, or plate waste were not consistent. In the Georgia study, NET had strong positive effects on nutrition knowledge but limited effects on attitudes and self-reported eating behaviors (St. Pierre and Glotzer, 1981).

The literature search identified three small local studies that examined the impact of NET interventions on children's nutrition-related knowledge, attitudes, and/or eating behaviors.[35] Some of these studies, like the national evaluation, yielded convincing evidence that NET nutrition education activities produced at least short-term improvements in children's nutrition knowledge and attitudes, but little evidence that they affected children's eating habits.

[35]The literature search included only studies where NET was specifically identified and did not include studies that examined impacts on teachers or foodservice workers. The latter research is sumarized elsewhere (Olson, 1994).

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Appendix A

Summary of Impact Studies Identified in the Literature Review

Note: As discussed in the text, all identified research that described differences between participants and nonparticipants is included in these tables. Although some of these studies had weak designs or used rudimentary or, in some cases, no statistical analysis, they are included in the interest of completeness. The tables include information about both design and analysis methods. In interpreting findings from the complete body of research for a given program, greater weight was given to findings from studies that had the strongest design and analysis methods and that used the most recent data.

Food Stamp Program

Appendix table 1—Studies that examined the impact of the Food Stamp Program on household food expenditures

Study	Data source[1]	Measure of expenditures[2]	Population (sample size)	Design	Measure of participation	Analysis method
Group IA: Participant vs. nonparticipant comparisons—Secondary analysis of national surveys						
Hama and Chern (1988)	1977-78 NFCS elderly supplement	At-home Nonpurchased food included Per person per week	FSP-eligible households with elderly members (n=1,454)	Participant vs. nonparticipant	Participation dummy	Simultaneous food expenditure/nutrient availability equation[3]
Kisker and Devaney (1988)	1979-80 NFCS-LI	At-home Nonpurchased food included Per ENU per week	FSP-eligible households (n~2,900)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Basiotis et al. (1983)	1977-78 NFCS-LI	At-home Nonpurchased food included Per household per week	FSP-eligible households (n=3,562)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Price (1983)	1973-74 BLS-CES	At-home Purchased food only Per equivalent adult per week	All households (n=10,359)	Participant vs. nonparticipant; also dose-response	Participation dummy; benefit amount	Multivariate regression
Salathe (1980)	1973-74 BLS-CES	At-home, away, total Purchased food only Per person per week	FSP-eligible households (n=2,254)	Participant vs. nonparticipant; also dose-response	Participation dummy; benefit amount	Multivariate regression
Group IB: Participant vs. nonparticipant comparisons—State and local studies						
Lane (1978)	Kern County, CA (1972-73)	At-home Nonpurchased food included Per person per month	FSP-eligible households (n=329)	Participant vs. nonparticipant	Participation dummy	Bivariate comparisons based on proportion of income spent on food
West et al. (1978)	Washington State (1972-73)	At-home Nonpurchased food included Per equivalent adult per month	FSP-eligible households with child age 8-12 (n=332)	Participant vs. nonparticipant; also dose-response[4]	Participation dummy; bonus amount	Weighted multivariate regression

See notes at end of table.

Continued—

Appendix table 1—Studies that examined the impact of the Food Stamp Program on household food expenditures—Continued

Study	Data source[1]	Measure of expenditures[2]	Population (sample size)	Design	Measure of participation	Analysis method
Group II A: Dose-response estimates—Secondary analysis of national surveys						
Kramer-LeBlanc et al. (1997)	1989-91 CSFII	At-home, total Purchased food only Per household per week	FSP participant households (n=790)	Dose-response	Benefit amount	Multivariate regression
Levedahl (1991)	1979-80 NFCS-LI	At-home, total Purchased food only	FSP participants who used all their food stamps (n=1,210)	Dose-response	Bonus value	Multivariate regression
Fraker et al. (1990)	1985 CSFII	Expenditures on food during previous 2 months	FSP- and WIC-eligible households (n=515)	Dose-response	Participation dummy; benefit amount	Multivariate regression
Devaney and Fraker (1989)	1977-78 NFCS-LI	Aided recall of food used in last 7 days	FSP-eligible households (n=4,473)	Dose-response	Participation dummy; bonus value	Multivariate regression
Basiotis et al. (1987)	1977-78 NFCS-LI	At-home Nonpurchased food included Per household per week	FSP-eligible households (n~3,000)	Dose-response	Participation dummy; bonus value	Simultaneous equations for food cost/nutrient availability/nutrient intake relationship
Senauer and Young (1986)	1978 PSID	At-home Purchased food only Per household per month	FSP participant households (n=573)	Dose-response	Bonus value	Multivariate regression
Smallwood and Blaylock (1985)	1977-78 NFSC-LI	At-home Purchased food only Per person per week	FSP-eligible households (n=3,582)	Dose-response	Participation dummy; expected weekly bonus value	2-equation selection-bias model
West (1984)	1973-74 BLS-CES	At-home, away, total Purchased food only Per equivalent adult per week	FSP-eligible households (n=2,407)	Dose-response	Participation dummy; bonus value	Multivariate regression
Allen and Gadson (1983)	1977-78 NFCS-LI	At home, away, total Purchased food only Per household per week	FSP-eligible households (n=3,850)	Dose-response	Bonus value	Multivariate regression
Chen (1983)	1977-78 NFCS-LI	Aided recall of food used in last 7 days	FSP participant households (n=1,809)	Dose-response	Participation dummy; bonus value	Multivariate regression

See notes at end of table.

Continued—

Appendix table 1—Studies that examined the impact of the Food Stamp Program on household food expenditures—Continued

Study	Data source[1]	Measure of expenditures[2]	Population (sample size)	Design	Measure of participation	Analysis method
Brown et al. (1982)	1977-78 NFCS-LI	Aided recall of food used in last 7 days	FSP participant households (n=911)	Dose-response	Bonus value	Multivariate regression
Chavas and Yeung (1982)	1972-73 BLS-CES	At-home Purchased food only Per household per week	FSP-eligible households, southern region (n=659)	Dose-response	Bonus value	Seemingly unrelated regression model, interactions between bonus value and demographic variables[5]
Johnson et al. (1981)	1977-78 NFCS-LI	At-home Nonpurchased food included Per household per week	Low-income households (n=4,535)	Dose-response	Participation dummy; bonus value	Multivariate regression
Benus et al. (1976)	1968-72 PSID	Annual expenditures for food used at home	All households (n~3,300)	Dose-response	Participation dummy; bonus value	Dynamic adjustment model
Hymans and Shapiro (1976)	1968-72 PSID	Annual expenditures for food used at home	All households (n~3,300)	Dose-response	Participation dummy; bonus value	Multivariate regression
Group IIB: Dose-response estimates—State and local studies						
Breunig et al. (2001)	San Diego cashout demonstration (1990)	At-home Purchased food only Per person per month	FSP participant households receiving coupons (n=487)	Dose-response	Benefit amount	Multivariate regression
Levedahl (1995)	San Diego cashout demonstration (1990)	At-home Purchased food only Per person per month	FSP participant households receiving coupons (n=494)	Dose-response	Benefit amount	Multivariate regression
Ranney and Kushman (1987)	Counties and county groups in California, Indiana, Ohio, Virginia (1979-89)	At-home Nonpurchased food included	FSP-eligible households (n=896)	Dose-response	Participation dummy; bonus value	Multivariate regression
Neenan and Davis (1977)	Polk County, FL (1976)	At-home Purchased food only Per household per month	FSP participant households (n=123)	Dose-response	Participation dummy	Multivariate regression

See notes at end of table.

Continued—

Appendix table 1—Studies that examined the impact of the Food Stamp Program on household food expenditures—Continued

Study	Data source[1]	Measure of expenditures[2]	Population (sample size)	Design	Measure of participation	Analysis method
West and Price (1976)	Washington State (1972-73)	At-home Nonpurchased food included Per equivalent adult per month	Households with children ages 8-12[6] (n=995)	Dose-response	Bonus value	Multivariate regression
Group IIIA: Cashout demonstrations—Experimental design						
Fraker et al. (1992)	Alabama cashout demonstration (1990)	At-home, away, total Purchased food only and nonpurchased food included Per household, ENU, and AME per month	FSP participants (n=2,386)	Random assignment of participants to check or coupon	Group membership dummy; benefit amount	Multivariate regression
Ohls et al. (1992)	San Diego cashout demonstration (1990)	At-home, away, total Purchased food only and nonpurchased food included Per household, ENU, and AME per month	FSP participants (n=1,143)	Random assignment of participants to check or coupon	Group membership dummy; benefit amount	Multivariate regression
Group IIIB: Cashout demonstrations—Nonexperimental design						
Cohen and Young (1993)	Washington State cashout demonstration (1990)	At-home, away, total Purchased food only and nonpurchased food included Per household, ENU, and AME per month	Households participating in AFDC and who applied after FIP[7] implementation (n=780)	Comparison of treatment and matched comparison counties	Group membership dummy; benefit amount	Multivariate regression
Davis and Werner (1993)	Alabama ASSETS demonstration (1990)	At-home, away, total Purchased food only Per household and AME per month	ASSETS and FSP participants (n=1,371)	Comparison of treatment and matched comparison counties	Group membership dummy; benefit amount	Multivariate regression

See notes at end of table.

Continued—

Appendix table 1—Studies that examined the impact of the Food Stamp Program on household food expenditures—Continued

Study	Data source[1]	Measure of expenditures[2]	Population (sample size)	Design	Measure of participation	Analysis method
Beebout et al. (1985)	1977 Puerto Rico supplement to the NFCS and 1984 Puerto Rico HFCS	At-home, total Nonpurchased food included Per household and AME per week	Participant and FSP-eligible nonparticipant households using 1977 eligibility criteria (n= 3,995)	Pre-cashout compared with cashout (1977 vs. 1984)	Group membership dummy; participation dummy; benefit amount	2-equation selection-bias models

[1] Data sources:

ASSETS = Avenues to Self-Sufficiency through Employment and Training Services.
BLS-CES = Bureau of Labor Statistics' Consumer Expenditure Survey.
CSFII = Continuing Survey of Food Intakes by Individuals.
HFCS = Household Food Consumption Survey.
NFCS = Nationwide Food Consumption Survey.
NFCS-LI = Nationwide Food Consumption Survey - Low Income Supplement.
PSID = Panel Study of Income Dynamics.

[2] Includes indications of whether the dependent variable corresponds to food consumed at home, food consumed away from home, or all food; whether measure(s) represent only food purchased with cash, credit, or food stamp coupons or include the estimated dollar value of home-grown food, gifts, etc.; whether expenditures are measured per person, per household, per adult male equivalent (AME), per equivalent adult, or per equivalent nutrition unit (ENU); and the time unit for expenditures.

[3] Does not treat FSP as endogenous.

[4] Eligible participants were isolated in the nonparticipant group.

[5] Main effects were not reported.

[6] Eligible participants not isolated in the nonparticipant group.

[7] FIP = Family Independence Program.

Appendix table 2—Studies that examined the impact of the Food Stamp Program on household availability of food energy and nutrients

Study	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Group IA: Participant vs. nonparticipant comparisons—Secondary analysis of national surveys						
Hama and Chern (1988)	1977-78 NFCS elderly supplement	Aided recall for food use from household supply (7 days)	FSP-eligible households with elderly members (n=1,454)	Participant vs. nonparticipant	Participation dummy	Simultaneous food expenditure/nutrient availability equation[2]
Kisker and Devaney (1988)	1979-80 NFCS-LI	Record of household food use (7 days)	FSP-eligible households (n~2,900)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Allen and Gadson (1983)	1977-78 NFCS-LI	Aided recall for food use from household supply (7 days)	FSP-eligible households (n=3,850)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Basiotis et al. (1983)	1977-78 NFCS-LI	Aided recall for food use from household supply (7 days)	FSP-eligible households (n=3,562)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Scearce and Jensen (1979)	1972-73 BLS-CES	Food category amount and expenditure diary	FSP-eligible, southern region (n=1,360)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Group IB: Participant vs. nonparticipant comparisons—Local studies						
Lane (1978)	Kern County, CA (1972-73)	24-hour recall of food consumed at home	FSP-eligible households (n=329)	Participant vs. nonparticipant	Participation dummy	Bivariate comparisons
Group II: Dose-response estimates—Secondary analysis of national surveys						
Devaney and Moffitt (1991)	1979-80 NFCS-LI	Record of household food use (7 days)	FSP-eligible households (n=2,925)	Dose-response	Benefit amount	Multivariate regression; selection-bias models
Basiotis et al. (1987)	1977-78 NFCS-LI	Aided recall for food use from household supply (7 days)	FSP-eligible households (n~3,000)	Dose-response	Participation dummy; bonus value	Simultaneous equations for food cost/nutrient availability/nutrient intake relationship
Johnson et al. (1981)	1977-78 NFCS-LI	Aided recall for food use from household supply (7 days)	Low-income households (n=4,535)	Dose-response	Participation dummy; bonus value	Multivariate regression

See notes at end of table.

Continued—

Appendix table 2—Studies that examined the impact of the Food Stamp Program on household availability of food energy and nutrients—Continued

Study	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Group IIIA: Cashout demonstrations—Experimental design						
Bishop et al. (2000)	Alabama cashout demonstration (1990) and San Diego cashout demonstration (1990)	7-day food use from records and recall	Alabama FSP participants (n=2,184) San Diego FSP participants (n=935)	Random assignment of participants to check or coupon	Group membership dummy	Stochastic dominance methods
Fraker et al. (1992)	Alabama cashout demonstration (1990)	7-day food use from records and recall	FSP participants (n=2,386)	Random assignment of participants to check or coupon	Group membership dummy; benefit amount	Multivariate regression
Ohls et al. (1992)	San Diego cashout demonstration (1990)	7-day food use from records and recall	FSP participants (n=1,143)	Random assignment of participants to check or coupon	Group membership dummy; benefit amount	Multivariate regression
Group IIIB: Cashout demonstrations—Nonexperimental design						
Cohen and Young (1993)	Washington State cashout demonstration (1990)	7-day food use from records and recall	Households participating in AFDC and who applied after FIP[3] implementation (n=780)	Comparison of treatment and matched comparison counties	Group membership dummy; benefit amount	Multivariate regression
Beebout et al. (1985)	1977 Puerto Rico supplement to the NFCS and 1984 Puerto Rico HFCS	7-day food use from records and recall	Participant and FSP-eligible nonparticipant households using 1977 eligibility criteria (n= 3,995)	Pre-cashout compared with cashout (1977 vs. 1984)	Group membership dummy; participation dummy; benefit amount	2-equation selection-bias models

[1]Data sources:
BLS-CES = Bureau of Labor Statistics' Consumer Expenditure Study.
HFCS = Household Food Consumption Survey.
NFCS = Nationwide Food Consumption Survey.
NFCS-LI = Nationwide Food Consumption Survey - Low Income Supplement.
[2]Does not treat FSP as endogenous.
[3]FIP = Family Independence Program.

Appendix table 3—Studies that examined the impact of the Food Stamp Program on dietary intakes of individuals

Study	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Group IA: Participant vs. nonparticipant comparisons—Secondary analysis of national surveys						
Dixon (2002)	1988-94 NHANES-III	24-hour recall	Adults ages 20 and older (n=10,545)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Bhattacharya and Currie (2000)	1988-94 NHANES-III	24-hour recall and nonquantified food frequency	Youth ages 12-16 (n=1,358)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Wilde et al. (1999)	1994-96 CSFII	2 nonconsecutive 24-hour recalls	Low-income individuals (n=1,901)	Participant vs. nonparticipant	Participation dummy	Maximum likelihood estimation
Weimer (1998)	1989-91 CSFII	24-hour recall followed by 2 days of food records	Elderly individuals (n=1,566)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Cook et al. (1995)	1986 CSFII-LI	24-hour recall followed by 2 days of food records	Children ages 1-5 in households under 125% of poverty[2]	Participant vs. nonparticipant	Participation dummy	Bivariate chi-squared tests
Rose et al. (1995)	1989-91 CSFII	24-hour recall followed by 2 days of food records	Children ages 1-5 (n=800)	Participant vs. nonparticipant	Participation dummy	Multivariate regression (weights not used)
Bishop et al. (1992)	1977-78 NFCS-LI	24-hour recall followed by 2 days of food records	FSP-eligible individuals (n=2,590)	Participant vs. nonparticipant	Participation dummy	Stochastic dominance methods
Fraker et al. (1990)	1985 CSFII	4 nonconsecutive 24-hour recalls	WIC-eligible women ages 19-50 (n=381) and their children ages 1-5 (n=818)	Participant vs. nonparticipant	Participation dummy	Multivariate regression and bivariate selection model
Gregorio and Marshall (1984)	1971-73 NHANES-I	24-hour recall	Preschool children (n=2,774), School-aged children (n=3,509)	Participant vs. nonparticipant	Participation dummy; participation interacted with poverty index ratio	Bivariate and multivariate regression
Lopez and Habicht (1987a, 1987b)	1971-73 NHANES-I and 1976-80 NHANES-II	24-hour recall	Low-income elderly (n=1,684 and n=1,388)	Participant vs. nonparticipant	Participation dummy	Multivariate analysis of variance

See notes at end of table.

Continued—

Appendix table 3—Studies that examined the impact of the Food Stamp Program on dietary intakes of individuals—Continued

Study	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Group IB: Participant vs. nonparticipant comparisons—State and local studies						
Fey-Yensan et al. (2003)	Low-income areas in Connecticut (1996-97)	Food frequency questionnaire	Low-income elderly living in subsidized housing (82% female) (n=200)	Participant vs. nonparticipant	Participation dummy	Chi-square tests and analysis of variance
Perez-Escamilla et al. (2000)	2 pediatric clinics in low-income areas of Hartford, CT (1999)	24-hour recall and 2 food frequency questionnaires	Children ages 8 months to 5 years who were participating in WIC or who had participated in past year (n=99)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Perkin et al. (1988)	1 urban family practice center in Florida (dates for data collection not reported)	24-hour recall	Women ages 18-45 (n=102)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Posner et al. (1987)	1980-81 FNS SSI/ECD	24-hour recall via telephone	Elderly (n=1,900)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Butler et al. (1985)	1980-81 FNS SSI/ECD	24-hour recall via telephone	Low-income elderly individuals (n=1,684)	Participant vs. nonparticipant	Participation dummy	Multivariate regression with selection-bias technique
Futrell et al. (1975)	1 county in Mississippi (1971)	4-day record	Black children ages 4-5 (n=96)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Group IIA: Dose-response estimates—Secondary analysis of national surveys						
Gleason et al. (2000)	1994-96 CSFII/DHKS	2 nonconsecutive 24-hour recalls	Low-income individuals (n=3,935)	Dose-response	Benefit amount	Comparison of regression-adjusted means
Basiotis et al. (1998)	1989-91 CSFII	24-hour recall followed by 2 days of food records	Low-income households (n=1,379)	Dose-response	Participation dummy; benefit amount	Multivariate regression

See notes at end of table.

Continued—

Appendix table 3—Studies that examined the impact of the Food Stamp Program on dietary intakes of individuals—Continued

Study	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Rose et al. (1998a)	1989-91 CSFII	24-hour recall followed by 2 days of food records	Nonbreastfeeding preschoolers (n=499)	Dose-response	Benefit amount	Multivariate regression; investigated selection bias
Kramer-LeBlanc et al. (1997)	1989-91 CSFII	24-hour recall followed by 2 days of food records	FSP-eligible individuals (n=793)	Dose-response	Benefit amount	Multivariate regression
Akin et al. (1987)	1977-78 NFCS elderly supplement	24-hour recall followed by 2 days of food records	Elderly individuals (n=5,615)	Dose-response	Participation dummy; bonus value; participation interacted with social security income	Multivariate regression
Basiotis et al. (1987)	1977-78 NFCS-LI	24-hour recall followed by 2 days of food records	FSP-eligible individuals (n=3,000)	Dose-response	Participation dummy; bonus value	Simultaneous equations for food cost/nutrient availability/ nutrient intake relationship
Akin et al. (1985)	1977-78 NFCS elderly supplement	24-hour recall followed by 2 days of food records	Elderly individuals (n=1,315)	Dose-response	Participation dummy; bonus value	Multivariate switching regression model
Group IIB: Dose-response estimates—State and local studies						
Butler and Raymond (1996)	1980-81 FNS SSI/ECD and 1969-73 RIME	24-hour recall via telephone and in-person	Low-income elderly individuals (n=1,542) Low-income individuals in rural areas (n=1,093)	Dose-response	Participation dummy; bonus value	Multivariate endogenous switching model with selection-bias adjustment

See notes at end of table.

Continued—

Appendix table 3—Studies that examined the impact of the Food Stamp Program on dietary intakes of individuals—Continued

Study	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Whitfield (1982)	Tulsa, OK (1978)	24-hour recall	FSP-eligible individuals (n=195)	Dose-response	Participation dummy; bonus value	Multivariate regression
West et al. (1978)	Washington State (1972-73)	Unspecified	Children ages 8-12 (n=728)	Dose-response	Bonus value	Multivariate regression

[1]Data sources:
CSFII = Continuing Survey of Food Intakes by Individuals.
DHKS = Diet and Health Knowledge Survey.
FNS SSI/ECD = Food and Nutrition Service Supplementary Security Income/Elderly Cashout Demonstration.
NFCS = Nationwide Food Consumption Survey.
NFCS-LI = Nationwide Food Consumption Survey - Low Income Supplement.
NHANES = National Health and Nutrition Examination Survey.
RIME = Rural Income Maintenance Experiment.
[2]Sample size not stated.

Appendix table 4—Studies that examined the impact of the Food Stamp Program on other nutrition and health outcomes

Study	Data source[1]	Population sample (sample size)	Design	Measure of participation	Analysis method
Food security: Participant vs. nonparticipant comparisons					
Huffman and Jensen (2003)	1997 longitudinal SPD and 1998 experimental SPD	Low-income households (n=3,733)	Participant vs. nonparticipant	Participation dummy	Simultaneous equation model with 3 probits
Jensen (2002)	2000 April FSS-CPS	FSP and FSP-eligible households (n=6,300)	Participant vs. nonparticipant	Participation dummy	Bivariate ordered probit model
Gunderson and Oliveria (2001)	1991 and 1992 SIPP	Low-income households (n=3,452)	Participant vs. nonparticipant	Participation dummy	Simultaneous equation model with 2 probits
Bhattacharya and Currie (2000)	1988-94 NHANES-III	Youth ages 12-16 (n=1,358)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Perez-Escamilla et al. (2000)	2 pediatric clinics in low-income areas of Hartford, CT (1999)	Children ages 8 months to 5 years who were participating in WIC or had participated in past year (n=99)	Participant vs. nonparticipant	Participation dummy	Chi-square analysis
Cohen et al. (1999)	1996-97 NFSPS	Low-income households (n=3,228)	Participant vs. nonparticipant	Participation dummy	Comparisons of proportions
Alaimo et al. (1998)	1988-94 NHANES-III	Low-income households (n=5,285)	Participant vs. nonparticipant	Participation dummy	Logistic regression (survey weights)
Hamilton et al. (1997)	1995 CPS	Low-income households (n=21,810)	Participant vs. nonparticipant	Participation dummy	Comparison of proportions
Cristofar and Basiotis (1992)	1985-86 CSFII-LI	Low-income women (n=3,398) and low-income children ages 1-5 years (n=1,930)	Participants vs. nonparticipant	Participation dummy; benefit amount	Multivariate regression
Kisker and Devaney (1988)	1979-80 NFCS-LI	Low-income (n~2,900)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests

See notes at end of table.

Continued—

Appendix table 4—Studies that examined the impact of the Food Stamp Program on other nutrition and health outcomes—Continued

Study	Data source[1]	Population sample (sample size)	Design	Measure of participation	Analysis method
Food security: Dose-response estimates					
Rose et al. (1998b)	1989-91 CSFII and 1992 SIPP	All households (n=6,620 and n=30,303)	Dose-response	Annual dollar amount of food stamps	Logistic regression
Food security: Cashout demonstrations					
Fraker et al. (1992)	Alabama cashout demonstration (1990)	FSP participants (n=2,386)	Random assignment of participants to check or coupon	Group membership dummy and benefit amount	Multivariate regression
Ohls et al. (1992)	San Diego cashout demonstration (1990)	FSP participants (n=1,143)	Random assignment of participants to check or coupon	Group membership dummy and benefit amount	Multivariate regression
Davis and Werner (1993)	Alabama ASSETS demonstration (1990)	ASSETS and FSP participants (n=1,371)	Comparison of treatment and matched comparison counties	Group membership dummy and benefit amount	Multivariate regression
Birthweight: Participant vs. nonparticipant comparisons					
Korenman and Miller (1992)	1979-88 NLSY	Infants born to poor women with 2 births between 1979 and 1988 (n~2,568)	Participant vs. nonparticipant	Participation dummy	Multivariate regression; fixed-effects models
Currie and Cole (1991)	1979-87 NLSY	Infants born to poor, young women (n~4,900)	Participant vs. nonparticipant	Participation dummy	Multivariate 2-stage least squares and fixed-effects model
Weight and/or height: Participant vs. nonparticipant comparisons					
Fey-Yensan et al. (2003)	Low-income areas in Connecticut (1996-97)	Low-income elderly living in subsidized housing (82% female) (n=200)	Participant vs. nonparticipant	Participation dummy	Chi-square tests and analysis of variance
Gibson (2003)	1985-96 NLSY	Low-income women, ages 20-40 (n=13,390)[2]	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Jones et al. (2003)	1997 PSID-CDS	Children ages 5-12 from households with incomes <185% of poverty	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Gibson (2001)	1997 NLSY-child supplement	Youth ages 12-17 (n=7,920)	Participant vs. nonparticipant	Participation dummy	Multivariate regression

See notes at end of table.

Continued—

Appendix table 4—Studies that examined the impact of the Food Stamp Program on other nutrition and health outcomes—Continued

Study	Data source[1]	Population sample (sample size)	Design	Measure of participation	Analysis method
Bhattacharya and Currie (2000)	1988-94 NHANES-III	Youth ages 12-16 (n=1,358)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Korenman and Miller (1992)	1986 and 1988 NLSY-child supplement	Children ages 0-7 (n=6,598)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Nutritional biochemistries: Participant vs. nonparticipant comparisons					
Dixon (2002)	1988-94 NHANES-III	Adults ages 20 and older (n=10,545)	Participant vs. nonparticipant (albumin, hemoglobin, serum iron, vitamin C, vitamin E, carotenoids)	Participation dummy	Multivariate regression
Bhattacharya and Currie (2000)	1988-94 NHANES-III	Youth ages 12-16 (n=1,358)	Participant vs. nonparticipant (iron, cholesterol, vitamin A, vitamin C, vitamin E)	Participation dummy	Multivariate regression
Lopez and Habicht (1987b)	1971-73 NHANES-I and 1976-80 NHANES-II	Low-income elderly (n=1,684, NHANES-I) and (n=1,388, NHANES-II)	Participant vs. nonparticipant (iron)	Participation dummy	Multivariate ANOVA
General measures of nutrition or health status: Participant vs. nonparticipant comparisons					
Fey-Yensan et al. (2003)	Low-income areas in Connecticut (1996-97)	Low-income elderly living in subsidized housing (82% female) (n=200)	Participant vs. nonparticipant	Participation dummy	Chi-square tests and analysis of variance
Gibson (2001)	1997 NLSY	Youth ages 12-17 (n=7,920)	Participant vs. nonparticipant	Participation dummy	Multivariate regression

[1]Data sources:
ASSETS = Avenues to Self-Sufficiency through Employment and Training Services.
FSS-CPS = Food Security Supplement of the Current Population Survey.
CPS = Current Population Survey.
CSFII = Continuing Survey of Food Intakes by Individuals.
CSFII-LI = Continuing Survey of Food Intakes by Individuals - Low-Income Samples.
NFCS-LI = Nationwide Food Consumption Survey - Low Income Supplement.
NFSPS = National Food Stamp Program Survey.
NHANES = National Health and Nutrition Examination Survey.
NLSY = National Longitudinal Survey of Youth.
PSID-CDS = Panel Study of Income Dynamics - Child Development Supplement.
SIPP = Survey of Income and Program Participation.
SPD = Survey of Program Dynamics.

[2]Multiple observations for each person, collected annually between 1979 and 1994 and biannually thereafter. Sample size represents person-years.

WIC Program

Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Group I: National evaluations						
Rush et al. (1988a) (NWE)	Birthweight, gestational age, likelihood of low birthweight, very low birthweight, and premature birth, and neonatal and infant mortality rates	Vital statistics records for 1,392 counties in 19 States and DC (1972-80)	N/A (Aggregate data analysis)	Trends analysis relating WIC program penetration over time to birth outcomes	WIC penetration index	Multivariate regression
Rush et al. (1988d) (NWE)	Birthweight, gestational age, likelihood of premature birth, and fetal mortality rate	Record abstractions in 174 WIC sites and 55 prenatal clinics(1983-84)	Nationally representative sample of pregnant WIC participants and income-eligible nonparticipants receiving prenatal care in surrounding public health clinics or hospitals (n=3,935)[3]	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Edozien et al. (1979)	Birthweight, gestational age	Primary data collection in 19 WIC sites in 14 States. Data were collected at time of WIC enrollment, approximately every 3 months until delivery, and once after delivery (1973-76)	Postpartum WIC participants who participated prenatally (n~1,000)	Participants, before vs. after, separate groups	Newly enrolling participants vs. participants with varying lengths of participation	Multivariate regression
Group II: Secondary analysis of national surveys						
Finch (2003)	Likelihood of low birthweight	1988 NMIHS	WIC and non-WIC women who were White, Black, or Hispanic with live singleton births that were at least 22 weeks gestation (n=12,814)	Participant vs. nonparticipant	Participation dummy with short- (<6 months) and long-term (6+ months) WIC participation	Multivariate regression

See notes at end of table.

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Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Kowaleski-Jones and Duncan (2002)	Birthweight	1990-96 NLSY	(1) NLSY children born between 1990 and 1996 (n=1,984) (2) NLSY children born between 1990 and 1996, with at least 1 other sibling born during the same period (n=453 sibling pairs)	Participant vs. nonparticipant	Participation dummy	(1) Multivariate regression (2) Fixed-effects model
Hogan and Park (2000)	Likelihood of low birthweight and very low birthweight	1988 NMIHS	WIC and non-WIC women (n=8,145)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Brien and Swann (1999)	Birthweight, likelihood of low birthweight and premature birth, and neonatal and infant mortality rates	1988 NMIHS	(1) WIC and income-eligible non-Hispanic women who were at nutritional risk (n=7,778) (2) WIC and income-eligible non-Hispanic women with at least 1 live birth prior to 1988 (n=6,254 pairs of births)	Participant vs. nonparticipant	(1) Participation dummies: 1 for ever participated and 1 for participated during first trimester (2) Participation status for each pregnancy	(1) Multivariate regression, including attempt to control for simultaneity and several selection-bias-adjustment models (2) Fixed-effects model; separate models estimated for Blacks and Whites
Moss and Carver (1998)	Neonatal mortality rate	1988 NMIHS	WIC and income-eligible non-Hispanic women (n=7,796)	Participant vs. nonparticipant	Participation dummy with and without Medicaid	Logit analysis
Frisbie et al. (1997)	Likelihood of intrauterine growth retardation, premature birth, and heavy preemie[4]	1988 NMIHS	WIC and non-WIC women (n=8,424)	Participant vs. nonparticipants	Participation dummy	Multivariate regression analysis to identify determinants of birth outcomes

See notes at end of table.

Continued—

Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Covington (1995)	Likelihood of low birthweight and very low birthweight	1988 NMIHS	WIC and non-WIC African American women who received some prenatal care (n=3,905)	Participant vs. nonparticipant	Participation dummy	Multivariate regression. Separate models for LBW vs. normal weight and VLBW vs. normal weight for each of 4 subgroups based on combinations of income and receipt of Medicaid and/or AFDC
Gordon and Nelson (1995)	Birthweight, gestational age, likelihood of low birthweight, very low birthweight, and premature birth, and neonatal and infant mortality rates	1988 NMIHS	WIC and income-eligible women (n=6,170)	Participant vs. nonparticipant	Participation dummy	Multivariate regression and logit analysis. Birthweight analysis included separate models for Blacks and Whites, as well as several alternative models to control for simultaneity.[5, 6] Attempted, but rejected, selection-bias adjustment.
Joyce et al. (1988)	Neonatal mortality rate	1977 Census data for large counties in the U.S.	Data for 677 counties with 50,000+ residents for White analysis and 357 counties with 5,000+ Blacks for Black analysis	Cost-effectiveness study using aggregate data	State-specific number of pregnant women enrolled in WIC per 1,000 State-specific eligible women	Multivariate regression, including selection-bias adjustment. Separate models for Blacks and Whites.
Group III: State-level studies using WIC participation files matched with Medicaid and/or birth record files						
Roth et al. (2004)	Likelihood of low birthweight, very low birthweight, neonatal mortality, postneonatal mortality, infant mortality[7]	Linked WIC, Medicaid, and vital statistics records for births in Florida between January 1996 and the end of December 2000	WIC and non-WIC Medicaid recipients who did not participate in high-risk obstetrical program (n=295,599)	Participant vs. nonparticipant	Participation dummy	Multivariate regression

See notes at end of table.

Continued—

Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Gregory and deJesus (2003)	Likelihood of low birthweight, very low birthweight, neonatal mortality, and infant mortality, length of infants' hospital stay, Medicaid costs	Linked WIC, Medicaid, birth and death record, and hospital discharge files for births in New Jersey between May 1992 and December 1993	WIC and non-WIC Medicaid recipients with live singleton births (n=19,614)	Participant vs. nonparticipant	Participation dummy	Multivariate regression. Separate models for Blacks and non-Blacks
Buescher and Horton (2000)	Birthweight, likelihood of low birthweight and very low birthweight, Medicaid costs	Linked WIC, Medicaid, and birth record files for 1997 births in North Carolina	WIC and non-WIC Medicaid recipients who were enrolled in prenatal care and had live singleton births (n=42,965)	Participant vs. nonparticipant	Participation dummy	Multivariate regression, including several alternative models to control for simultaneity[8]
Ahluwalia et al. (1998)	Likelihood of low birthweight	Linked WIC and birth record files for 1992 births in Michigan	WIC and non-WIC women with full-term births (n=53,782)	Participant vs. nonparticipant	Dose response: Length of prenatal WIC "exposure"[9]	Multivariate regression
Buescher et al. (1993)	Likelihood of low birthweight and very low birthweight, Medicaid costs	Linked WIC, Medicaid, and birth record files for 1988 births in North Carolina	WIC and non-WIC Medicaid recipients who were enrolled in prenatal care (n=21,900)	Participant vs. nonparticipant	Participation dummy and dose-response: Percentage of gestation on WIC	Multivariate regression, including attempt to control for simultaneity[10]
Devaney and Schirm (1993)	Likelihood of neonatal and infant mortality	FNS WIC/Medicaid (1987-88)	WIC and non-WIC Medicaid recipients (n=111,958)	Participant vs. nonparticipant	Participation dummy: Enrolled by 30 weeks gestation	Probit analysis
Devaney (1992)	Likelihood of very low birthweight	FNS WIC/Medicaid (1987-88)	WIC and non-WIC Medicaid recipients (n=111,958)	Participant vs. nonparticipant	Participation dummy	Probit analysis, including attempts to control for simultaneity[11]
Devaney et al. (1990/91)	Birthweight, gestational age, likelihood of premature birth, and Medicaid costs	FNS WIC/Medicaid (1987-88)	WIC and non-WIC Medicaid recipients (n=111,958)	Participant vs. nonparticipant	Participation dummy	Multivariate regression and probit analysis, including attempt to control for simultaneity.[12] Attempted but rejected selection-bias adjustment.

See notes at end of table.

Continued—

Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
New York State (1990)	Birthweight, gestational age, likelihood of low birthweight, very low birthweight, and premature birth, and Medicaid costs	Linked WIC, birth record, and hospital discharge files for births in New York State in the last 6 months of 1988	Singleton births to WIC and non-WIC women (n=132,994)	Participant vs. nonparticipant within 3 groups defined on the basis of insurance coverage (Medicaid, private, none)	Participation dummy	Multivariate regression
Simpson (1988)	Likelihood of low birthweight	Aggregate county-level data for North Carolina, including vital statistics, demographic and service infrastructure characteristics, and program penetration and expenditures (1980-85)	Data for 75 (of 100) counties, all of which provided WIC and other prenatal care services for all county residents (rather than sharing responsibility with another county)	Trends analysis relating WIC penetration over time to birth outcomes	Program "intensity" variable based on county-level WIC expenditures	Multivariate regression
Stockbauer (1987)	Birthweight, gestational age, likelihood of low birthweight, very low birthweight, premature birth, small-for-gestational-age, and neonatal mortality	Linked WIC, birth and death record files for 1982 births in Missouri	Matched WIC and non-WIC women with singleton births (n=9,411 pairs)[13]	Participant vs. matched control	Participation dummy and dose response: Dollar value of redeemed vouchers	Analysis of covariance
Schramm (1986)	Birthweight, likelihood of low birthweight, neonatal mortality rate, and Medicaid costs	Linked WIC, Medicaid, birth record, hospital care, and death record files for 1982 births in Missouri	WIC and non-WIC Medicaid recipients (n=8,546)	Participant vs. nonparticipant	Participation dummy and dose response: WIC food costs adjusted for length of pregnancy	Multivariate regression

See notes at end of table.

Continued—

Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Stockbauer (1986)	Birthweight, gestational age, likelihood of low birthweight, and neonatal mortality rate	Linked WIC, birth, and death record files for 1980 births in Missouri	WIC and non-WIC Missouri residents with singleton births (n=6,732 WIC; sample for non-WIC not reported)	Participants vs. 3 different nonparticipant groups: (1) all non-WIC births; (2) random sample of non-WIC births; (3) matched group of non-WIC births[14]	Participation dummy and dose-response: Duration of participation and dollar value of redeemed WIC coupons	Analysis of covariance. Separate analyses for White, non-White, and total group.
Schramm (1985)	Birthweight, likelihood of low birthweight, Medicaid costs	Linked WIC, Medicaid, birth, and hospital care records for 1980 births in Missouri	WIC and non-WIC Medicaid recipients (n=7,628)	Participant vs. nonparticipant	Participation dummy and dose response: WIC food costs adjusted for length of pregnancy	Analysis of covariance
Kotelchuck, et al. (1984)	Birthweight, gestational age, likelihood of low birthweight, premature birth, small-for-gestational-age birth, and neonatal mortality rate	Linked WIC, birth, and death records for 1978 births in Massachusetts	Matched WIC and non-WIC women with singleton births (n=4,126 pairs)[15]	Participant vs. matched control	Participation dummy and dose response: Months on WIC and percent of pregnancy on WIC	Bivariate comparisons
Group IV: Other State and local studies						
Reichman and Teitler (2003)	Birthweight, likelihood of low birthweight	Standardized data collected for women enrolled in New Jersey's HealthStart program for pregnant Medicaid recipients between 1988 and 1996	All WIC and non-WIC HealthStart participants who had a live singleton birth (n=90,117)	Participant vs. nonparticipant	Participation dummy	Multivariate regression, including attempt to control for simultaneity[16]
Brown et al. (1996)	Birthweight, likelihood of low birthweight, and infant mortality rate	Medical records, birth, and death certificates for births in 1 Indiana hospital between January 1988 and June 1989	Non-Hispanic women who delivered at the area's primary hospital for the "underserved" (n=4,707)	Participant vs. nonparticipant	Participation dummy	Multivariate regression

See notes at end of table.

Continued—

Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Mays-Scott (1991)	Birthweight	WIC records in 1 county health department in Texas (1987-89)	Prenatal WIC participants who were ≤17 years and had at least 1 previous pregnancy (n=217)	Participants, before vs. after	Dose response: Number of months enrolled, nutrition education contacts, and voucher pickups	Analysis of variance
Collins et al. (1985)	Birthweight	Primary data collection in public health department clinics in 6 Alabama counties (1980-81)	WIC and non-WIC pregnant women (n=519)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Metcoff et al. (1985)	Birthweight	Primary data collection at a prenatal clinic in 1 hospital in Oklahoma (1983-84)	Income-eligible pregnant women selected at mid-pregnancy based on predicted birthweight; roughly equivalent numbers were predicted to have average-size babies vs. small or large babies (n=410)	Randomized experiment	Participation dummy	Multivariate regression
Heimendinger et al. (1984)	Birthweight	WIC and medical records in 3 WIC clinics and 4 non-WIC clinics in the same Boston neighborhoods (1979-81)	WIC and Medicaid-eligible infants and toddlers up to 20 months of age with at least 2 height and weight measurements[17] (n=1,907)	Participant vs. nonparticipant	Participation dummy based on mother's participation in WIC during pregnancy	Multivariate regression

See notes at end of table.

Continued—

Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Kennedy and Kotelchuck (1984)	Birthweight, gestational age, likelihood of low birthweight and small-for-gestational-age birth, and fetal death rate	WIC and medical records in WIC sites and non-WIC health facilities in 4 geographic areas of Massachusetts (1973-78) (Reanalysis of data from Kennedy et al., 1982)	Matched WIC and non-WIC pairs of pregnant women (n=418 pairs)[18, 19]	Participant vs. matched control	Participation dummy and dose response: Number of months vouchers received	Bivariate comparisons
Bailey et al. (1983)	Birthweight	Primary data collection at 1 WIC site and 1 non-WIC site in Florida (Dates not reported)	WIC and income-eligible nonparticipants who were 30 weeks pregnant at time of recruitment and receiving identical prenatal care (n=101)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Paige (1983)	Medicaid costs, health care utilization	Medicaid records in 4 counties in Maryland, 2 in which WIC was available and 2 in which WIC was not available (1979-80)	WIC and income-eligible non-WIC women who were on Medicaid for at least 16 weeks during pregnancy (n=114)	Participant vs. nonparticipant	N/A	Comparisons of means and proportions (no statistical tests reported)
Kennedy, et al. (1982)	Birthweight, likelihood of low birthweight	WIC and medical records in WIC sites and non-WIC health facilities in 4 geographic areas of Massachusetts (1973-78)	WIC and WIC-eligible women (n=1,297)[18]	Participant vs. nonparticipant	Participation dummy and dose response: Number of vouchers received, months on WIC	Multivariate regression

See notes at end of table.

Continued—

Appendix table 5—Studies that examined the impact of prenatal WIC participation on birth outcomes, including associated health care costs—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Silverman (1982)	Birthweight, likelihood of low birthweight	Medical records for random sample of women enrolled in Maternity and Infant Care Project (MIC) in Allegheny County, PA, before (1971-74) and after (1974-77) initiation of WIC	WIC and income-eligible nonparticipants (n=2,514)	Participants, before vs. after, separate groups	Participation dummy	Multivariate regression

Notes: N/A = Not applicable.

[1]Data sources:

FNS WIC/Medicaid = FNS' WIC/Medicaid database.

NLSY = National Longitudinal Survey of Youth.

NMIHS = National Maternal and Infant Health Survey.

[2]Unless the description of the study sample indicates that a comparison group was limited to nonparticipants who were income-eligible for WIC or known to be Medicaid participants, all income levels were included in the comparison group. Income was generally controlled for in the analysis if the information was available.

[3]Maximum analysis sample; sample varies by outcome. Birth outcome data were available for only about 75 percent of women in the study.

[4]Intrauterine growth retardation defined as fetal growth ratio of less than 85 percent (observed birthweight at gestational age by mean for gestational age of sex-specific fetal growth distribution). Heavy preemie defined as birthweight of 2,500 gm or more and gestation of less than 37 weeks. (Authors report that mortality rate for heavy preemies may be twice that of normal birthweight infants).

[5]Used three alternative definitions of WIC participation to control for simultaneity in analyses of impacts on birthweight and gestational age: (1) during first 8 months; (2) during first 7 months; (3) during first 6 months. Also estimated model for birthweight that controlled for gestational age.

[6]For all outcomes, estimated basic model as well as separate models for four different cohorts defined by length of gestation thresholds: 28 weeks, 32 weeks, 36 weeks, and 40 weeks.

[7]Authors also examined impacts on birth defects, C-section, and complications during pregnancy and delivery. No significant differences were noted for birth defects or complications during pregnancy and delivery. The rate of C-section was significantly greater for WIC participants.

[8]Alternative models included (1) women who enrolled in WIC after 33 weeks gestation included in the nonparticipant group, (2) three separate cohorts, based on gestational age (29, 33, and 37 weeks), and (3) gestational age as a control variable.

[9]Exposure for women who did participate in WIC was considered high = enrolled before 12 weeks gestation, medium = enrolled at 12-20 weeks gestation, and low = enrolled at 21-37 weeks gestation.

[10]In addition to basic model, estimated alternative model that included women who enrolled in WIC at 36 weeks gestation or later in the nonparticipant group.

[11]Alternative models defined WIC participants as those who enrolled in WIC (1) before 32 weeks gestation and (2) by 30 weeks gestation.

[12]Estimated two alternative models: (1) basic model with addition of control for first-trimester WIC participation and gestational age, (2) basic model with WIC participants who enrolled after 36 weeks considered nonparticipants.

[13]Pairs matched on age, race, education, gravidity, number of births this pregnancy, and marital status.

[14]Pairs matched on age, race, education, number births this pregnancy, smoking during pregnancy, and pre-pregnancy weight.

[15]Pairs matched within catchment area on age, race, parity, education, and marital status.

[16]Included separate model to control for gestational-age bias, but sample was restricted based on initiation of prenatal care (1st or 2nd trimester) rather than timing of WIC enrollment.

[17]The main focus of study was impact of WIC on children's growth; however, the authors compared birthweights of subjects whose mothers were and were not in WIC.

[18]WIC-eligible women included in the nonparticipant group were wait-listed for WIC during their pregnancy, enrolled in WIC postpartum, or women who received prenatal care at non-WIC health care facilities in same neighborhood but never enrolled in WIC.

[19]Approximately 80 percent of women were matched on race, age, parity, marital status, and income. The remainder were matched on four of the five variables.

Appendix table 6—Studies that examined the impact of the WIC program on breastfeeding

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Group I: National evaluations						
Rush et al. (1988c) (NWE)	Breastfeeding initiation and duration	Primary data collection in 174 WIC sites and 55 prenatal clinics (1983-84)	Random sample of infants and children of women included in the longitudinal study of women (see Rush et al., 1988d below) (n=2,370)	Participant vs. nonparticipant	Participation dummy based on age of inception into WIC, including prenatally	Multivariate regression
Rush et al. (1988d) (NWE)	Breastfeeding intention and initiation	Primary data collection in 174 WIC sites and 55 prenatal clinics (1983-84)	Nationally representative sample of pregnant WIC participants and comparison group receiving prenatal care in surrounding public health clinics or hospitals (n=3,935)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Group II: Secondary analysis of national surveys						
Chatterji et al. (2002)	Breastfeeding initiation and duration	1989-95 NLSY	(1) NLSY children born between 1990 and 1995 (n=1,282) (2) Low-income NLSY children born between 1991 and 1995 (n=517) (3) NLSY children born between 1989 and 1995, with at least one other sibling born during the same period (n=970)	Participant vs. nonparticipant	Participation dummy	(1) (2) Multivariate regression, including attempt to control for selection bias (3) Fixed-effects model

See notes at end of table.

Continued—

Appendix table 6—Studies that examined the impact of the WIC program on breastfeeding—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Balcazar et al. (1995)	Breastfeeding intention	1988 NMIHS live births	Mexican-American and non-Hispanic White women who were not undecided about infant feeding plans prior to the infant's birth (n=4,089)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
GAO (1993)	Breastfeeding initiation	1989-92 RLMS	Nationally representative sample of mothers of 6-month-old babies. Analysis included all respondents with complete data for questions of interest (n=79,428)[3]	Prenatal participants vs. nonparticipants and postpartum-only participants	Participation dummy	Multivariate regression
Schwartz et al. (1992)	Breastfeeding initiation and duration	1988 NMIHS	WIC participants and income-eligible nonparticipants (n=6,170)	Participants who received advice to breastfeed compared with participants who did not receive advice and to income-eligible nonparticipants	Participation dummy and advice dummy	3-stage regression with selection-bias adjustment
Ryan et al. (1991)	Breastfeeding initiation and duration	1984 and 1989 RLMS	Respondents in 1984 and 1989 (n=120,334)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Group III: State and local studies						
Tuttle and Dewey (1994)	Breastfeeding initiation	Primary data collection in WIC clinics and neighborhoods in 1 northern California community	Hmong and Vietnamese WIC participants whose youngest child was less than 1 year (n=122)	Participant vs. nonparticipant	Dose response: Number of times previously participated in WIC	Multivariate regression

See notes at end of table.

Continued—

Appendix table 6—Studies that examined the impact of the WIC program on breastfeeding—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Burstein et al. (1991)	Breastfeeding initiation and duration	Primary data collection in Florida and North Carolina (1990-91)	Random sample of WIC and income-eligible infants (6 months old) stratified by birthweight (n=807)	Participant vs. nonparticipant	Participation dummy	Multivariate regression, including attempt to control for selection bias

[1]Data sources:

NLSY = National Longitudinal Survey of Youth.

NMIHS = National Maternal and Infant Health Survey.

RLMS = Ross Laboratories Mother's Survey.

[2]Unless the description of the study sample indicates that a comparison group was limited to nonparticipants who were income eligible for WIC or known to be Medicaid participants, all income levels were included in the comparison group.

[3]Overall response rate for survey was approximately 50 percent. After excluding cases with incomplete data, analysis sample comprised only 34 percent of the initial survey sample.

Appendix table 7—Studies that examined the impact of the WIC program on nutrition and health outcomes of pregnant women

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Group I: National evaluations						
Rush et al. (1988d) (NWE)	Dietary intake, prevalence of anemia, pregnancy weight gain	Primary data collection and record abstractions in 174 WIC sites and 55 prenatal clinics (1983-84). Data were collected at time of enrollment into WIC or prenatal care and again at about 8 months gestation	Nationally representative sample of pregnant WIC participants and comparison group receiving prenatal care in surrounding public health clinics or hospitals (n=3,473)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Edozien et al. (1979)	Dietary intake, hemoglobin, prevalence of anemia, pregnancy weight gain	Primary data collection in 19 sites in 14 States (1973-76). Data were collected at time of WIC enrollment, approximately every 3 months until delivery, and once after delivery	Pregnant women who enrolled in WIC (n~2,885)[3]	(1) Nutritional biochemistries: Participants, before vs. after, separate groups (2) Dietary intake: Participants, before vs. after, same women	Dose response: Newly enrolling participants vs. participants with varying length of participation	Multivariate regression
Group II: Secondary analysis of national survey data						
Mardis and Anand (2000)	Dietary intake	1988-94 NHANES-III	WIC and income-eligible women (n=242)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Kramer-LeBlanc et al. (1999)	Dietary intake	1988-94 NHANES-III	WIC and income-eligible women (n=242)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests

See notes at end of table.

Continued—

Appendix table 7—Studies that examined the impact of the WIC program on nutrition and health outcomes of pregnant women—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Group III: State-level studies using WIC participation files matched with Medicaid and/or birth record files						
Roth et al. (2004)	Pregnancy weight gain	Linked WIC, Medicaid, and vital statistics records for births in Florida between January 1996 and the end of December 2000	WIC and non-WIC Medicaid recipients who did not participate in high-risk obstetrical program (n=295,599)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Group IV: Other State and local studies						
Collins et al. (1985)	Pregnancy weight gain	Primary data collection in public health department clinics in 6 Alabama counties (1980-81)	WIC and non-WIC pregnant women (n=519)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Metcoff et al. (1985)	Variety of nutritional biochemistries	Primary data collection at a prenatal clinic in 1 hospital in Oklahoma (1983-84)	Income-eligible pregnant women selected at mid-pregnancy based on predicted birthweight; roughly equivalent numbers were predicted to have average-size babies vs. small or large babies (n=410)	Randomized experiment	Participation dummy	Multivariate regression
Bailey et al. (1983)	Dietary intake, nutritional biochemistries	Primary data collection at 1 WIC site and 1 non-WIC site in Florida (Dates not reported)	WIC and income-eligible nonparticipants were 30 weeks pregnant at time of recruitment and receiving identical prenatal care (n=101)	Participant vs. nonparticipant	Participation dummy	Analysis of variance

See notes at end of table.

Continued—

Appendix table 7—Studies that examined the impact of the WIC program on nutrition and health outcomes of pregnant women—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Kennedy and Gershoff (1982)	Hemoglobin and hematocrit levels	WIC and medical records in WIC sites and non-WIC health facilities in 4 geographic areas of Massachusetts (1973-78)	WIC and WIC-eligible women[4] (n=232)	Participants vs. nonparticipants, before and after	Dose response: Number of WIC vouchers received	Multivariate regression
Endres et al. (1981)	Dietary intake	Dietary recalls for sample of pregnant WIC participants in 22 counties in Illinois (1978-79)	Newly enrolling pregnant WIC participants and participants who were on the program for 6 months or more (n=766)	Participants, before vs. after, separate groups	Participation dummy	Bivariate t-tests

[1] Data source: NHANES = National Health and Nutrition Examination Survey.

[2] Unless the description of the study sample indicates that a comparison group was limited to nonparticipants who were income eligible for WIC or known to be Medicaid participants, all income levels were included in the comparison group.

[3] Approximate maximum; sample size varied for each measure and analysis approach.

[4] Subset of participants in larger study focusing on impact of WIC on birthweight (see table 5). WIC-eligible women included in the nonparticipant group were wait-listed for WIC during their pregnancy, enrolled in WIC postpartum, or were women who received prenatal care at non-WIC health care facilities in same neighborhood but never enrolled in WIC.

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Group I: National evaluations						
Rush et al. (1988c) (NWE)	Dietary intake, weight, height, head circumference, arm circumference and skinfold thickness, immunization status, use of preventive health care, behavior, vocabulary, and memory	Primary data collection in 174 WIC sites and 55 prenatal clinics (1983)	Random sample of infants and children ages 0-4 of women included in the longitudinal study of women (see Rush et al. (1988d) in table 17) (n=2,370)	Participant vs. nonparticipant	Participation dummy based on age of inception into WIC, including prenatally	Multivariate regression
Edozien et al. (1979)	Dietary intake, blood iron measures, height, weight, and head circumference	Primary data collection in 19 WIC sites in 14 States. Data collected at time of WIC enrollment and again after 6 and 11 months of participation (1973-76)	WIC infants and children ages 6-47 (n=16,000+)[3]	Participants, before vs. after	Participation dummy	Multivariate regression
Group II: Secondary analysis of national surveys						
Cole and Fox (2004)	Dietary intake, infant feeding practices, height, weight, variety of nutritional biochemistries, general health status, and dental health	1988-94 NHANES-III, usual intake	WIC and income-eligible children ages 1-4 (n=3,006)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Ponza et al. (2004)	Dietary intake	2002 FITS, usual intake	WIC and non-WIC infants and children ages 2-24 months (n=3,022)	Participant vs. nonparticipant	N/A	Comparison of means and proportions (no statistical tests reported)

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Siega-Riz et al. (2004)	Dietary intake	1994-96 and 1998 CSFII	WIC- and income-eligible children ages 2-5 who were not enrolled in school, in 2 income groups: <130% of poverty (n=1,772) and 130-185% of poverty (n=689)	Participant vs. nonparticipant	Participation dummy	Multivariate regression; investigated but did not implement correction for selection bias
Luman et al. (2003)	Immunization status	2000-01 NIS	WIC and non-WIC children ages 19-35 months (n=21,212)	Participant vs. nonparticipant	Participation dummy, with non-WIC children divided by income eligibility and prior WIC participation: Ineligible, eligible and participated in the past, and eligible but never participated	Multivariate regression
Shefer et al. (2001)	Immunization status	1999 NIS	WIC and non-WIC children ages 24-35 months (n=15,500)	Participant vs. nonparticipant	Participation dummy, with non-WIC children divided by income and prior WIC participation: previously on WIC, never on WIC and income-eligible, and never on WIC and not income-eligible	Bivariate t-tests[4]
Carlson and Senauer (2003)	Physician-reported general health status	1988-94 NHANES-III	Children ages 24-60 months (1) WIC sample: WIC and income-eligible (2) Full sample: WIC and non-WIC	Participant vs. nonparticipant	Participation dummy	Ordered probit equations

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Kranz and Siega-Riz (2002)	Added sugar intake	1994-96 CSFII	WIC and income-eligible children ages 2-5 (n=5,652)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Variyam (2002)	Dietary intake	1994-96 and 1998 CSFII	WIC and income-eligible children ages 1-4 (n=2,509)	Participant vs. nonparticipant	Participation dummy	Multivariate regression; quantile regressions
Burstein et al. (2000)	Dietary intake, height, weight, nutritional biochemistries, immunization status, general health status, dental health, use of preventive health care, and physical, emotional, and cognitive development	1988-94 NHANES-III 1993-95 SIPP 1995-97 CCDP	WIC and income-eligible children NHANES-III = 2,979 (12-59 months) SIPP = 1,302 (1-4 years) CCDP = 2,067 (2 years)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Kowaleski-Jones and Duncan (2000)	Motor skills, social skills, and temperament	NLSY, 1990-96 waves	(1) WIC and non-WIC infants and children (n=1,984)[5] (2) WIC and non-WIC infants and children with at least 1 other sibling born during the same period (n=453 sibling pairs)[5]	Participant vs. nonparticipant	Participation dummy	(1) Multivariate regression (2) Fixed-effects model

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Oliveira and Gundersen (2000)	Dietary intake	1994-96 CSFII	WIC and income-eligible children ages 1-4 in households where at least 1 other person also participated in WIC (n=180)	Participant vs. nonparticipant	Participation dummy	Multivariate regression[6]
Kramer-LeBlanc et al. (1999)	Dietary intake	1988-94 NHANES-III	WIC and income-eligible infants and children ages 2 months-4 years (n=6,636)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Rose et al. (1998)	Dietary intake	1989-91 CSFII	WIC and non-WIC children ages 1-4 who were not breastfeeding and resided in FSP-eligible households (n=499)	Participant vs. nonparticipant	Dose response: Value of monthly household per capita WIC benefit	Multivariate regression; investigated but did not implement adjustment for selection bias
Centers for Disease Control (1995)	Dietary intake, height, and weight	1988-91 NHANES-III	WIC and income-eligible infants and children ages 2-59 months (n=3,488)	Participant vs. nonparticipant	Participation dummy	Multivariate regression (height and weight) Comparison of means (dietary intake)
Rose et al. (1995)	Iron intake	1989-91 CSFII	WIC and non-WIC children ages 1-4 who were not breastfeeding (n=800)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Fraker et al. (1990)	Dietary intake	1985 CSFII	WIC and income-eligible children ages 1-4 (n=445)	Participant vs. nonparticipant	Dose response: Proportion of 4 recall days on which child was enrolled in WIC; also tested for combined WIC and FSP participation	Multivariate regression with selection-bias adjustment

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Group III: Secondary analysis of State-level files						
Lee et al. (2004a)	Number of dental visits per year and use of dental services (preventive, restorative, and emergency)	Longitudinal linked data base, including birth, Medicaid, WIC, and Area Resource files for children born in North Carolina in 1992 (1993-97)	WIC and non-WIC Medicaid recipients ages 1-4 (n=49,795)	Participant vs. nonparticipant	Dose-response: Number of months any WIC vouchers redeemed	Multivariate regression and ordered probit analysis, including 2-stage modeling to control for selection bias
Lee et al. (2004b)	Dental-care-related Medicaid costs	Longitudinal linked data base, including birth record, Medicaid, WIC, and Area Resource files for children born in North Carolina in 1992 (1992-96)	WIC and non-WIC Medicaid recipients ages 0-3 (n=49,795)	Participant vs. nonparticipant	Participation dummy (any participation per year)	Multivariate regression
Buescher et al. (2003)	Health care utilization and costs	Longitudinal linked data base, including birth, Medicaid, and WIC records for children born in North Carolina in 1992. Data base includes data through the 5th birthday (1992-97)	WIC and non-WIC Medicaid recipients ages 12-59 months (n=16,335-21,277 for 4 age-specific cohorts)	Participant vs. nonparticipant	Dose response: Cumulative WIC participation defined as none, high, medium, and low[7]	Multivariate regression; investigated but did not implement selection-bias-adjustment models
Lee et al. (2000)	Prevalence of anemia, failure to thrive, nutritional deficiencies, and use of preventive health care services	Longitudinal linked data base, including birth record, Medicaid, AFDC/TANF, FSP, and WIC files for all children born in Illinois from 1990 through 1996	WIC and non-WIC infants and children ages 0-59 months who received Medicaid benefits continuously	Participant vs. nonparticipant	Participation dummy	Multivariate regression and proportional hazards models[8]
Partington and Nitzke (1999)	Dietary intake	CSFII data for Midwest region (1994)[9]	WIC and income-eligible children ages 2-5 (n=183)	Participant vs. nonparticipant	Participation dummy	Bivariate z-tests

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Sherry et al. (2001)	Prevalence of anemia	PedNSS data for Colorado, New Mexico, Oklahoma, Utah, and Vermont (early 1980s-mid-1990s) (most data provided by WIC programs)	Infants and children ages 6-59 months (5,500-48,000 records per State per year)	Prevalence estimates for each State in 5-year intervals overall and by age, race/ ethnicity, gender, birthweight, and type of screening visit	N/A	Trends analysis
Sherry et al. (1997)	Prevalence of anemia	PedNSS data for Vermont (1981-94) (most data provided by WIC programs)	Infants and children ages 6-59 months (n=12,000-19,500 records per year)	Prevalence estimates for each year for overall sample by age	N/A	Trends analysis
Yip et al. (1987)	Prevalence of anemia	(1) PedNSS data for Arizona, Kentucky, Louisiana, Montana, Oregon, and Tennessee (1975-85) (Most data provided by WIC programs) (2) Linked PedNSS and birth records for WIC participants in Tennessee PedNSS database (1975-84)	Infants and children ages 6-60 months (1) (n=499,759) (2) (n=72,983)	(1) Overall and age-specific prevalence estimates for each year: Initial measures vs. followup measures (2) Participant vs. nonparticipant	Participation dummy	(1) Linear regression; angular chi-square (2) Multivariate regression
USDA/FNS (1978)	Hemoglobin, hematocrit, height, and weight	WIC records in PedNSS data for Arizona, Kentucky, Tennessee, and Washington (1974-76)	WIC infants and children ages 0-59 months with 3 or more WIC visits at approximately 6-month intervals (n=5,692)[10]	Participants, before vs. after	Participation dummy	Chi-square tests

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Group IV: Other State and local studies						
Black et al. (2004)	Height, weight, caregiver-perceived health status, and household food security	Primary data collection at urban medical centers in Washington, DC, Baltimore, Minneapolis, Boston, Little Rock, and Los Angeles (1998-2001)	WIC and income-eligible infants younger than 12 months (n=5,923)[11]	Participant vs. nonparticipant	Participation dummy, with non-WIC subjects divided into those who did not participate because of access issues and those who did not perceive a need for WIC	Multivariate regression
Kahn et al. (2002)	Prevalence of anemia	Medical records for 3 WIC sites in Chicago (1997-99)	WIC infants and children ages 6-59 months (n=7,053)	Participants, before vs. after	Participation dummy	Not well described
Shaheen et al. (2000)	Immunization status	Primary data collection (interviews and record abstractions) in a predominantly Hispanic low-income area of Los Angeles (dates not reported)	WIC and non-WIC children ages 2-4 (n=270)	Participant vs. nonparticipant	Participation dummy	Age-adjusted odds ratios
James (1998)	Immunization status	Medical records for 1 health care center in Mt. Vernon, NY	Randomly selected sample (matched on age and gender) of children who were up-to-date on immunizations at 12 months of age; equal size groups (n=150)	Participant vs. nonparticipant	Participation dummy	Chi-square tests

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Burstein et al. (1991)	Dietary intake, hemoglobin, hematocrit, height, weight, and head circumference	Primary data collection in Florida and North Carolina (1990-91)	Random sample of WIC and income-eligible infants (6 months old) stratified by birthweight (n=807)	Participant vs. nonparticipant	Participation dummy	Multivariate regression, including attempt to control for selection bias
Brown and Tieman (1986)	Dietary intake, hemoglobin, hematocrit, height, and weight	Primary data collection in low-income areas of 1 county in Minnesota (dates not reported)	WIC and income-eligible children ages 1-5 (n=52)	Participant vs. nonparticipant	Participation dummy	Chi-square test
Smith et al. (1986)	Hemoglobin	Medical records for 1 health center in Los Angeles; initial and 6-month followup measures	Subset of random sample of WIC and non-WIC children ages 1-4 who were diagnosed with anemia; matched on age, gender, and ethnicity (n=25 each group)	Participants vs. nonparticipants, before and after	Participation dummy	Analysis of variance
Miller et al. (1985)	Serum ferritin, hematocrit, and hemoglobin	Medical records for 1 child and youth clinic in Minneapolis (1973-74 and 1977)	WIC and income-eligible children ages 16-23 months (n~2,225)	Participants, before vs. after, separate groups	Participation dummy	Chi-square tests

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Vazquez-Seone et al. (1985)	Hemoglobin	Medical records for children enrolled in an inner-city health center in New Haven, CT, before and after initiation of WIC	WIC and income-eligible infants and children ages 9-36 months (n=583)	Participants, before vs. after, separate groups	Participation dummy	Bivariate t-tests
Hicks and Langham (1985)	IQ scores and school grades	Primary data collection and record abstractions in 3 counties in rural Louisiana (dates not reported)	Sibling WIC pairs ages 8-10; 1 "participated" in WIC prenatally and 1 enrolled after age 1 (n=19 sibling pairs)	Participant vs. sibling control	Participation dummy	Multivariate regression
Heimendinger et al. (1984)	Expected weight gain[12]	Medical records in 3 WIC and 4 non-WIC clinics in the same Boston neighborhoods (1974-79)	WIC- and Medicaid-eligible infants and toddlers up to 20 months with at least 2 height and weight measurements (n=1,907)	Participant vs. nonparticipant, ("value added"or expected growth vs. actual growth)	Participation dummy	Multivariate regression of "value-added" measures by age group (3-month intervals)
Paige (1983)	Medicaid costs and health care utilization	Medicaid records in 4 counties in Maryland, 2 in which WIC was available and 2 in which WIC was not available (1979-80)	WIC and income-eligible infants ages 0-11 months who were on Medicaid for at least 75% of study period (n=138)	Participant vs. nonparticipant	Participation dummy	Comparison of means and proportions (no statistical tests reported)
Hicks et al. (1982)	Hemoglobin, height, weight, and a variety of intellectual and behavioral measures	Primary data collection and record abstractions in 3 rural counties in Louisiana (dates not reported)	Sibling WIC pairs ages 6-8; 1 "participated" in WIC prenatally and 1 enrolled after age 1 (n=21 sibling pairs)	Participant vs. sibling control	Participation dummy	Multivariate regression

See notes at end of table.

Continued—

Appendix table 8—Studies that examined the impact of the WIC program on nutrition and health outcomes of infants and children—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)[2]	Design	Measure of participation	Analysis method
Weiler et al. (1979)	Hemoglobin	WIC records in 1 clinic in Fayette Co, KY (1976-77)	Infants ages 0-6 months initially certified for WIC because of anemia who had followup hemoglobin measure available (n=37)	Participants, before vs. after	Participation dummy	Bivariate t-tests

Note: N/A = Not applicable.

[1] Data sources:

CCDP = Comprehensive Child Development Programs.

CSFII = Continuing Survey of Food Intakes by Individuals.

FITS = Feeding Infants and Toddlers Study.

NHANES-III = Third National Health and Nutrition Examination Survey.

NIS = National Immunization Survey.

NLSY = National Longitudinal Survey of Youth.

PedNSS = Pediatric Nutrition Surveillance System.

SIPP = Survey of Income and Program Participation.

[2] Unless the description of the study sample indicates that a comparison group was limited to nonparticipants who were income-eligible for WIC or known to be Medicaid participants, all income levels were included in the comparison group. Income was generally controlled for in the analysis.

[3] Definition of comparison group varies for different outcomes. Children who never participated in WIC were main comparison group and were compared with former and/or current WIC participants.

[4] Also estimated a multivariate model of the relationship between intensity of WIC immunization activities and immunization coverage rates for WIC participants.

[5] Roughly half of the sample was assessed in the first year of life and half was assessed between their first and second birthdays.

[6] Authors also ran regression for full sample of WIC and income-eligible children. That model resulted in more significant effects.

[7] WIC participation defined based on percentage of months from age 1 through current age in which WIC vouchers had been redeemed. High = more than 66 percent, Medium = 34-66 percent, and Low = 33 percent or less.

[8] To control for the fact that several outcomes under study might be reasons for WIC enrollment, WIC participation was coded as zero if diagnosis of a particular problem preceded the date of WIC enrollment.

[9] CSFII data included two recalls per subject, but authors used only the first recall. Used only data for 1994 because, at the time the study was conducted, only that portion of the 1994-96 data set had been coded for food group consumption.

[10] Maximum sample; sample size varies for each outcome.

[11] Information on income was not collected. Receipt of private health insurance was used as a proxy for income, and the non-WIC sample was limited to infants without private insurance.

[12] A doctoral dissertation completed by Heimendinger in 1981 included data on height and weight-for-height. However, these data were dropped from the peer-reviewed journal article because of substantial problems with missing data.

Appendix table 9—Studies that examined the impact of the WIC program on nutrition and health outcomes of nonbreastfeeding postpartum women, breastfeeding women, all WIC participants, or WIC households

Study	Outcome(s)	Data source[1]	Population (sample size)	Design	Measure of participation	Analysis method
Nonbreastfeeding postpartum women						
Pehrsson et al. (2001)	Dietary iron intake, several biochemical indicators of iron status	WIC sites in Maryland with differing policies for certifying low-risk postpartum women (1994-95)	Low-risk WIC and income-eligible postpartum (nonbreastfeeding) women (n=110)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests, chi-square tests, and analysis of variance
Kramer-LeBlanc et al. (1999)	Dietary intake	1988-94 NHANES-III	WIC and income-eligible postpartum (nonbreastfeeding) women (n=190)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Caan et al. (1987)	Birthweight, birth length, weight status, hemoglobin, prevalence of anemia	47 local WIC agencies in California (1983)	Pregnant WIC participants, some of whom had extended postpartum WIC participation for a previous pregnancy and some of whom had limited or no postpartum WIC participation (n=642)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Breastfeeding women						
Kramer-LeBlanc et al. (1999)	Dietary intake	1988-94 NHANES-III	WIC and income-eligible breastfeeding women (n=56)	Participant vs. nonparticipant	Participation dummy	Bivariate t-tests
Argeanas and Harrill (1979)	Dietary intake	1 local WIC agency in Colorado and 1 unaffiliated prenatal clinic (1978)	WIC and non-WIC breastfeeding women (n=16)	Participant vs. nonparticipant, before and after	Participation dummy	Bivariate t-tests
WIC households or all WIC participants						
Wilde et al. (2000)	Dietary intake	1994-96 CSFII	Low-income households (n=1,901)	Participant vs. nonparticipant	Participation dummy	Maximum likelihood estimation

See notes at end of table.

Continued—

Appendix table 9—Studies that examined the impact of the WIC program on nutrition and health outcomes of nonbreastfeeding postpartum women, breastfeeding women, all WIC participants, or WIC households—Continued

Study	Outcome(s)	Data source[1]	Population (sample size)	Design	Measure of participation	Analysis method
Basiotis et al. (1998)	Dietary intake	1989-91 CSFII	Low-income households (n=1,379)	Dose-response	Participation dummy; benefit amount	Multivariate regression
Arcia et al. (1990)	Food expenditures	NWE (1983-84)	Nationally representative sample of pregnant WIC participants and income-eligible nonparticipants receiving prenatal care in surrounding public health clinics and hospitals (n=3,935)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Taren et al. (1990)	Food intake	Food cooperatives and EFNEP programs in Hillsborough Country, Florida (dates not reported)	Low-income households (n=157)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Rush et al. (1988b)	Food expenditures	Primary data collection (1983-84)	Nationally representative sample of pregnant WIC participants and income-eligible nonparticipants receiving prenatal care in surrounding public health clinics and hospitals (n=3,935)	Participant vs. nonparticipant	Participation dummy	Multivariate regression

[1]Data sources:
CSFII = Continuing Survey of Food Intakes by Individuals.
EFNEP = Expanded Food and Nutrition Education Program.
NWE = National WIC Evaluation.
NHANES-III = Third National Health and Nutrition Examination Survey.

National School Lunch Program

Appendix table 10—Studies that examined the impact of the National School Lunch Program on students' dietary intakes

Study	Outcome(s)	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Group I: National evaluations							
Devaney et al. (1993) (SNDA-I)	Nutrient intake at lunch and over 24 hours Food intake at lunch	Nationally representative sample of students from 329 public and private schools (1991-92)	Single 24-hour recall	Children and adolescents in grades 1-12 (n~3,350)	Participant vs. nonparticipant	Ate NSLP lunch on recall day	Multivariate regression with selection-bias-adjustment (nutrients) Bivariate t-tests (foods)
Wellisch et al. (1983) (NESNP)	Nutrient intake at lunch and over 24 hours	Nationally representative sample of students from 276 public schools (1980-81)	Single 24-hour recall	Children and adolescents in grades 1-12 (n=6,556)	Participant vs. nonparticipant	Ate NSLP lunch on recall day	Multivariate regression
Group II: Secondary analysis of national surveys							
Gleason and Suitor (2003)	Nutrient intake at lunch and over 24 hours	1994-96 CSFII	2 nonconsecutive 24-hour recalls	Children and adolescents ages 6-18 with 2 days of intake data (n=1,614)	Participant vs. nonparticipant	Ate NSLP lunch on recall day	Multivariate regression with fixed-effects model to control for selection bias
Gleason and Suitor (2001)	Nutrient intake at lunch and over 24 hours Food intake at lunch and over 24 hours	1994-96 CSFII	2 nonconsecutive 24-hour recalls	Children and adolescents ages 6-18 with 1 or 2 school days of intake data (n=1,866)	Participant vs. nonparticipant	Ate NSLP lunch on recall day	Comparison of regression-adjusted means
Fraker (1987)	Nutrient intake at lunch and over 24 hours	1980-81 NESNP	Single 24-hour recall	Children and adolescents in grades 1-12 (n=6,556)	Participant vs. nonparticipant	Ate NSLP lunch on recall day	Bivariate t-tests for full sample and low-income sample

See notes at end of table.

Continued—

Appendix table 10—Studies that examined the impact of the National School Lunch Program on students' dietary intakes—Continued

Study	Outcome(s)	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Akin et al. (1983a)	Nutrient intake over 24 hours	1977-78 NFCS	24-hour recall plus 2-day food record	Children and adolescents ages 6-18 (n=1,554)	Participant vs. nonparticipant[2,3]	Ratio of number of days ate school lunch to number of days of dietary data	Multivariate regression
Akin et al. (1983b)	Nutrient intake over 24 hours	1977-78 NFCS	24-hour recall plus 2-day food record	Children and adolescents ages 6-18 (n=1,554)	Participant vs. nonparticipant[4]	Ratio of number of days ate school lunch to number of days ate any lunch	Switching regression; Chow tests
Hoagland (1980)	Nutrient intake over 24 hours	1971-74 NHANES-I	Single 24-hour recall	Children and adolescents ages 6-21 (n=3,155)	Participant vs. nonparticipant[2]	Ate school lunch on recall day	Analysis of variance
Group IIIA: State and local studies with large samples							
Rainville (2001)	Nutrient intake at lunch Food intake at lunch	Students in 10 schools in southeastern Michigan (1998)	Visual observation of food selection and waste	Children in grades 2-4 (n=570)	Participant vs. nonparticipant	Ate school lunch on observation day (vs. sack lunch)	Analysis of variance
Melnick et al. (1998)	Food intake over 24 hours	All students in randomly selected classrooms in 25 sampled public and private schools in New York City (1989-90)	Single 24-hour recall (nonquantitative)	Children in grades 2 and 5 (n=1,397)	Participant vs. nonparticipant[2]	Ate school lunch on recall day	Gender-adjusted anlaysis of covariance
Wolfe and Campbell (1993)	Food intake at lunch	Students in 51 schools in New York State, excluding New York City (1987-88)	Single 24-hour recall (nonquantitative)	Children in grades 2 and 5 (n=1,797)	Participant vs. nonparticipant	Ate school lunch on recall day	Bivariate t-tests and chi-square tests

See notes at end of table.

Continued—

Appendix table 10—Studies that examined the impact of the National School Lunch Program on students' dietary intakes—Continued

Study	Outcome(s)	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Price et al. (1978)	Nutrient intake over 24 hours	Students in schools/districts in 8 regions in Washington State, Blacks and Mexican-Americans were oversampled (1971-73)	3 nonconsecutive 24-hour recalls, including 1 weekend day	Children ages 8-12 (n=728)	Participant vs. nonparticipant	Participation dummies based on usual frequency: 0-1 time per week, 2-3 times per week, 4-5 times per week	Multivariate regression
Emmons et al. (1972)	Nutrient intake at lunch and over 24 hours	All students in selected grades in 1 district in rural New York State (1970-71)[5]	Single 24-hour recall	Children in grades 1-4 (n=512)	Participants, before vs. after[6]	Took 70% or more of school meals offered during study period	Comparison of means (type of statistical test not reported)
U.S. Department of Health, Education, and Welfare (HEW) (10-State Nutrition Survey)	Nutrient intake over 24 hours	Sample of children from 10 States, plus volunteers (1972)	Single 24-hour recall	Children and adolescents ages 10-16 (n=8,495)	Participant vs. nonparticipant[2]	Usually ate school lunch at least 3 times/week	Comparison of means (no statistical tests reported)
Group IIIB: State and local studies with small samples							
Cullen et al. (2000)	Food intake at lunch	Students in 1 middle school in Texas (dates not reported)	5 consecutive daily food records	Children in grade 5 (n=282)	Participant vs. nonparticipant	Ate NSLP lunch (vs. home lunch or snack bar lunch) on food record days	Analysis of variance
Ho et al. (1991)	Nutrient intake at lunch	Students in 1 middle school in Salt Lake City (1989)	Visual observation of food selection and waste	Children and adolescents in grades 7 and 8 (n=254)	Participant vs. nonparticipant	Ate NSLP lunch (vs. sack lunch or vending machine lunch) on observation day	Analysis of variance and Student-Newman-Keuls range test
Perry et al. (1984)	Nutrient intake at lunch	All students in selected classrooms in 3 schools in 1 district in Alabama	3-day food record	Children in grades 5 and 6 (n=233)	Participant vs. nonparticipant[7]	Ate NSLP lunch (vs. brown bag lunch) on food record days	Unmatched t-test

See notes at end of table.

Continued—

Appendix table 10—Studies that examined the impact of the National School Lunch Program on students' dietary intakes—Continued

Study	Outcome(s)	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Howe and Vaden (1980)	Nutrient intake at lunch and over 24 hours	Randomly selected students in 1 urban public high school in Kansas	Single 24-hour recall	Adolescents in grades 10 and 11 (n=104)	Participant vs. nonparticipant	Ate NSLP lunch on recall day	2-way analysis of variance
Yperman and Vermeersch (1979)	Food intake over 24 hours	All students in 2 classrooms per grade in 2 schools in California	Food frequency checklist	Children in grades 1-3 (n=307)	Participant vs. nonparticipant	Number of days ate school lunch on 5 days prior to data collection	Multivariate regression

[1]Data sources:

CSFII = Continuing Survey of Food Intakes by Individuals.

NHANES-I = First National Health and Nutrition Examination Survey.

NFCS = Nationwide Food Consumption Survey.

[2]Did not differentiate NLSP and other lunch programs.

[3]Included lunch skippers with nonparticipants.

[4]Accounted for lunch skippers.

[5]Study included a second district where both free lunch and free breakfast were offered. The two districts were considered separately in the analysis, but the analysis of the second district did not separate contributions of breakfast and lunch meals.

[6]Study compared intakes before and after introduction of a free lunch program. Results were reported for four different subgroups based on baseline characteristics: nutritionally adequate, nutritionally needy, low-income (eligible for free lunch), and not low-income.

[7]Unit of analysis was lunches rather than students; 60 percent of students ate NSLP daily.

Appendix table 11—Studies that examined the impact of the National School Lunch Program on other nutrition and health outcomes

Study	Data source[1]	Population (sample size)	Design	Measure of participation	Analysis method
Weight and/or height					
Jones et al. (2003)	1997 PSID, Child Development Supplement	Children ages 5-12 with household incomes ≤185% of poverty (n=772)	Participant vs. nonparticipant	Parent report that child "participates"	Multivariate regression
Wolfe et al. (1994)	Students in 51 schools in New York State, excluding New York City (1987-88)	Children in grades 2 and 5 (n=1,797)	Participant vs. nonparticipant	Parent report that "child eats school lunch"	Multivariate regression
Wellisch et al. (1983) (NESNP)	Nationally representative sample of students from 276 public schools (1980-81)	Children and adolescents in grades 1-12 (n=6,556)	Participant vs. nonparticipant	Average long-term weekly participation	Multivariate regression
Gretzen and Vermeersch (1980)[2]	All students in 2 intervention programs and 2 comparison programs in 1 SFA in California	Children and adolescents in grades 1-8 (n=332)	Participant vs. nonparticipant	Began receiving free school lunch in grade 1 and regularly through grade 8	Analysis of variance; bivariate t-tests
Emmons et al. (1972)	All students in selected grades in 1 district in rural New York State[3] (1970-71)	Children in grades 1-4 (n=844)	Participants, before vs. after[4]	Took 70% or more of school meals offered during study period	Comparison of means (type of statistical test not reported)
Paige (1972)	Students in 4 schools in Baltimore, MD	Children in grades 1, 2, and 6 (n=742)	Participant vs. nonparticipant, before and after	Not reported	Comparison of means (type of statistical test not reported)
Nutritional biochemistries					
Kandiah and Peterson (2001)	Students in 1 school in Indiana	Children/adolescents ages 11-15 (n=3,155)	Participants, before vs. after (cholesterol)	Ate school lunch at least 3 times per week	Multivariate regression
Hoagland (1980)	1971-74 NHANES-I	Children and adolescents ages 6-21 (n=3,155)	Participant vs. nonparticipant[5] (iron, cholesterol, protein)	Ate school lunch on recall day	Linear regression

See notes at end of table.

Continued—

Appendix table 11—Studies that examined the impact of the National School Lunch Program on other nutrition and health outcomes—Continued

Study	Data source[1]	Population (sample size)	Design	Measure of participation	Analysis method
Emmons et al. (1972)	All students in 2 selected grades in 1 district in rural New York State (1970-71)[3]	Children in grades 1-4 (n=844)	Participants, before vs. after (iron)	Took 70% or more school meals offered during study period[4]	Comparison of means (type of statistical test not reported)
Paige (1972)	Students in 4 schools in Baltimore, MD	Children in grades 1, 2, and 6 (n=742)	Participants vs. nonparticipants, before and after (iron)	Not reported	Comparison of means (type of statistical test not reported)
Household food expenditures					
Long (1991)	1980-81 NESNP	Children and adolescents in grades 1-12 (n=5,778)	Participant vs. nonparticipant	Any household member participates in NSLP at least once during a typical week	Multivariate regression with selection-bias adjustment[6]
Wellisch et al. (1983) (NESNP)	Nationally representative sample of students in 276 public schools (1980-81)	Children and adolescents in grades 1-12 (n=6,556)	Participant vs. nonparticipant	Current weekly NSLP participation	Multivariate regression
West and Price (1976)	Students in schools/ districts in 8 regions in Washington State; Blacks and Mexican-Americans were oversampled (1972-73)	Children ages 8-12 (n=992)	Participant vs. nonparticipant	Value of free school lunches (dollars per month)	Multivariate regression. Separate models for Blacks, Whites, Mexican-Americans.

[1]Data sources:
NESNP = National Evaluation of School Nutrition Programs.
NHANES-I = First National Health and Nutrition Examination Survey.
PSID = Panel Study of Income Dynamics, Child Development Supplement.
[2]Study also examined physical fitness, school attendance, and academic performance.
[3]Study included a second district where both free lunch and free breakfast were offered. The two districts were considered separately in the analysis, but the analysis of the second district did not separate contributions of breakfast and lunch meals.
[4]Study compared intakes before and after introduction of a free lunch program. Results reported for four different subgroups based on baseline characteristics: nutritionally adequate, nutritionally needy, low-income (eligible for free lunch), and not low-income.
[5]Did not differentiate NLSP and other lunch programs.
[6]Participation measure not same week as expenditure measure; included NSLP and SBP in expenditures.

School Breakfast Program

Appendix table 12—Studies that examined the impact of the School Breakfast Program on students' dietary intakes

Study	Outcome(s)	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Group I: National evaluations							
Devaney and Stuart (1998) (SNDA-I)	Likelihood of eating breakfast	Nationally representative sample of students from 329 public and private schools	Single 24-hour recall	Children and adolescents in grades 1-12 (n=2,966)	Participant vs. nonparticipant	Ate SBP breakfast on recall day	Multivariate regression with selection-bias adjustment
Gordon et al. (1995) (SNDA-I)	Nutrient intake at breakfast and over 24 hours Food intake at breakfast	Nationally representative sample of students from 329 public and private schools	Single 24-hour recall	Children and adolescents in grades 1-12 (n=2,966)	Participant vs. nonparticipant	Ate SBP breakfast on recall day	Multivariate regression with selection-bias adjustment (nutrients) Bivariate t-tests (foods)
Wellisch et al. (1983) (NESNP)	Nutrient intake at breakfast and over 24 hours[2]	Nationally representative sample of students from 276 public schools	Single 24-hour recall	Children and adolescents in grades 1-12 (n=2,180)	Participant vs. nonparticipant	Ate SBP breakfast and NSLP lunch on recall day (nonparticipants ate NSLP lunch only)	Multivariate regression
Group II: Secondary analysis of national surveys							
Gleason and Suitor (2001)	Nutrient intake at breakfast and over 24 hours Food intake at breakfast and over 24 hours	1994-96 CSFII	2 nonconsecutive 24-hour recalls	Children and adolescents in SBP schools ages 6-18 (n=2,693)	Participant vs. nonparticipant	Ate SBP breakfast on recall day	Comparison of regression-adjusted means
Basiotis et al. (1999)	Nutrient intake over 24 hours Food intake over 24 hours	1994-96 CSFII	2 nonconsecutive 24-hour recalls	Low-income children ages 6-18 (sample size not reported)	Participant vs. nonparticipant	Ate SBP breakfast on recall day	Multivariate regression
Devaney and Fraker (1989)	Nutrient intake at breakfast and over 24 hours	1980-81 NESNP	Single 24-hour recall	Children ages 5-10 (n=2,118) and 11-21 (n=2,809)	Participant vs. nonparticipant	Ate SBP breakfast on recall day	Multivariate regression

See notes at end of table.

Continued—

Appendix table 12—Studies that examined the impact of the School Breakfast Program on students' dietary intakes—Continued

Study	Outcome(s)	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Hoagland (1980)	Nutrient intake over 24 hours[2]	1971-74 HANES-I	Single 24-hour recall	Children and adolescents ages 6-21 (n=412)[3]	Participant vs. nonparticipant	Ate school breakfast on recall day	Analysis of variance
Group III: State and local studies							
Nicklas et al. (1993a)	Nutrient intake at breakfast	Bogalusa Heart Study (1984-85 and 1987-88)	Single 24-hour recall	Children age 10 (n=393)	Participant vs. nonparticipant	Ate school breakfast on recall day	Analysis of variance
Nicklas et al. (1993b)	Nutrient intake over 24 hours	Bogalusa Heart Study (1984-85 and 1987-88)	Single 24-hour recall	Children age 10 (n=393)	Participant vs. nonparticipant	Ate school breakfast on recall day	Analysis of variance
Emmons et al. (1972)	Nutrient intake at breakfast and over 24 hours[2]	All students in 2 school districts in rural New York State (1970-71)	Single 24-hour recall	Children in grades 1-4 (n=844)	Participants, before vs. after[4]	Took 70% or more of school meals offered during study period	Comparison of means (type of statistical test not reported)
Hunt et al. (1979)	Nutrient intake over 24 hours	2 schools in Compton, CA (1970-71)	Single 24-hour recall	Children in grades 3-6 (n=555)	Participant vs. nonparticipant[5]	60% participation in SBP on days in school during experimental period	Analysis of variance
Price et al. (1978)	Nutrient intake over 24 hours	Students in schools/districts in 8 regions in Washington State; Blacks and Mexican-Americans were oversampled (1971-73)	3 nonconsecutive 24-hour recalls, including 1 weekend day	Children ages 8-12 (n=728)[6]	Participant vs. nonparticipant	Usually ate school breakfast 4-5 times/week	Multivariate regression

See notes at end of table.

Continued—

Appendix table 12—Studies that examined the impact of the School Breakfast Program on students' dietary intakes—Continued

Study	Outcome(s)	Data source[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Group IV: Studies of universal-free breakfast							
McLaughlin et al. (2002)	Nutrient intake at breakfast and over 24 hours Food intake at breakfast and over 24 hours[2,7]	70 matched pairs of school units in 6 school districts[8]	24-hour recall, with second recall for subsample (usual intake)	Children in grades 2-6 (n=4,290)	Randomized experiment	Ate universal-free breakfast on recall day[9]	Multivariate regression with Bloom correction to assess impact on universal-free breakfast participants (subgroup analyses)
Cook et al. (1996)	Nutrient intake at breakfast	Elementary schools in Central Falls, RI, matched with schools in Providence, RI	Single breakfast recall	Children in grades 3-6 (n=225)	Participant vs. nonparticipant	Ate SBP breakfast on recall day	Not well described.

[1]Data sources:
CSFII = Continuing Survey of Food Intake of Individuals.
NHANES-I = First National Health and Nutrition Examination Survey.
NESNP = National Evaluation of School Nutrition Programs.
[2]Also examined impacts on height and/or weight, but reported no significant findings.
[3]The study compared SBP participants with students who did not have access to the SBP. Only three SBP participants were included in the sample.
[4]Study compared intakes before and after introduction of free lunch (one district) and free lunch and breakfast (one district). Results reported for four different subgroups based on baseline characteristics: nutritionally adequate, nutritionally needy, low-income (eligible for free lunch), not low income.
[5]Study examined the effect of introducing a free breakfast program, comparing students in experimental school to control school that had no breakfast program.
[6]School breakfast was not the main focus of the study. Only 20 children in the sample consumed a school breakfast.
[7]The study also examined impacts on BMI and food security and found no significant effects.
[8]The study focused on students in grades 2-6. For sampling/matching purposes, schools with different grade configurations (e.g., K-2 and 3-5) were considered one unit. There were a total of 73 treatment schools and 70 control schools.
[9]The study's main analysis compared outcomes for the entire treatment group with outcomes for the entire control group. Findings discussed in this report, however, are from a separate analysis that estimated impacts on students who actually participated in universal-free breakfast on the day of the recall.

Appendix table 13—Studies that examined the impact of universal-free breakfast programs on school performance and behavioral/cognitive outcomes

Study	Outcomes	Data source	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Peterson et al. (2003)	Attendance, academic achievement, health, and discipline	455 schools in Minnesota (1998-2002)	School records and standardized test scores	All children for attendance measures; children in grades 3 and 5 for academic measures (n=43,067)	Participant vs. nonparticipant	Enrolled in universal-free SBP school	Logistic regression
McLaughlin et al. (2002)	Cognitive functioning, attendance, tardiness, behavior academic achievement, student health status[1]	70 matched pairs of school units in 6 school districts (1999-2001)[2]	School records and standardized test scores	Children in grades 2-6 (n=4,290)	Randomized experiment	Ate universal-free breakfast on day of measurement (short-term cognitive functioning)[3] Cumulative participation in universal-free breakfast over the year (all other measures)[3]	Multivariate regression with Bloom correction to asses impact on universal-free breakfast participants (subgroup analysis)
Murphy et al. (2001a)	Attendance and academic achievement	48 schools in Baltimore (1995-2000)	School records and standardized test scores	All children in sample schools (n=not stated)	Participants, before vs. after, separate groups, plus participants vs. nonparticipants, before and after	Enrolled in universal-free SBP school	Analysis of variance

See notes at end of table.

Continued—

Appendix table 13—Studies that examined the impact of universal-free breakfast programs on school performance and behavioral/cognitive outcomes—Continued

Study	Outcomes	Data source	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Murphy et al. (2001b)	Attendance, tardiness, academic achievement	55 schools in Maryland (1997-2000)	School records and standardized test scores	Varied by outcome for both schools and students	Participants, before vs. after, separate groups, plus participants vs. nonparticipants, before and after	Enrolled in universal-free SBP school	Analysis of variance; bivariate t-tests
Murphy et al. (2000)	Attendance, tardiness, academic achievement, emotional functioning	30 schools in Boston, MA (1998-2000)	School records, standardized test scores, parent and student interviews	All children in sample schools (n=not stated)	Participants, before vs. after	Frequency of eating breakfast during 1 index week	Analysis of variance
Murphy et al. (1998)	Attendance, psychological measures, academic achievement	1 school in Baltimore; 2 schools in Philadelphia (dates not reported)	School records and parent, teacher, and student interviews	Children in grades 3-8 (n=133)[4]	Participants, before vs. after	Frequency of eating breakfast during 1 index week	Logistic regression
Cook et al. (1996)	Attendance, tardiness	All elementary schools in Central Falls, RI, matched with schools in Providence, RI (1994)	School records	Children in grades Pre-K-6 (n=not reported)	Participant vs. nonparticipant	Enrolled in universal-free SBP school	Not well described
Meyers et al. (1989)[5]	Attendance, tardiness, academic achievement	16 schools in Lawrence, MA (1985-87)	School records and standardized test scores	Children in grades 3-6 (n=1,023)	Participant vs. nonparticipant	Ate SBP on 3 of 5 days during 1 selected week during school year	Multivariate regression

[1]The study also examined impacts of BMI and food security and found no effects.

[2]The study focused on students in grades 2-6. For sampling/matching purposes, schools with different grade configurations (e.g., K-2 and 3-5) were considered as one school unit. There were a total of 73 treatment schools and 70 control schools.

[3]The study's main analysis compared outcomes for the entire treatment group with outcomes from the entire control group. Findings discussed in this report, however, are from a separate analysis that estimated impacts based on students' actual participation in universal-free breakfast. Impacts on short-term outcomes were estimated on the basis of participation on the day of measurement and impacts on longer term outcomes were estimated on the basis of cumulative participation over the year.

[4]For school-recorded data (maximum sample). Sample sizes varied for interview data (n=85) and teacher ratings (n=76).

[5]The Meyers et al. study (1989) was not a study of universal-free breakfast. The study compared outcomes in schools that did and did not implement the SBP.

Nutrition Services Incentive Program (formerly the Nutrition Program for the Elderly

Note: This research actually focused on the Elderly Nutrition Program (ENP), which is sponsored by the U.S. Department of Health and Human Services. USDA's Nutrition Program for the Elderly (NPE), now known as the Nutrition Services Incentive Program, provided supplemental commodities to ENP delivery sites, based on a per meal reimbursement rate.

Appendix table 14—Studies that examined the impact of the Elderly Nutrition Program on nutrition and health outcomes

Study	Outcome(s)	Data sources[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Group I: National evaluations							
Ponza et al. (1996) (National Evaluation of the ENP—1993-95)	Dietary intake and social contacts	Random sample of ENP participants (both congregate and home-delivered) and random sample of nonparticipants selected from HCFA Medicare beneficiary file (1993-95)	24-hour dietary recall and in-person interview	ENP-eligible elderly (n=2,699)	Participant vs. nonparticipant	Received ENP meal on dietary recall day (did not necessarily consume it)	Multivariate regression; attempted to control for selection bias
Kirschner and Associates and Opinion Research Corporation - Wave II (1983)	Dietary intake and socialization	Participants in 70 randomly selected ENP sites (both congregate and home-delivered), random sample of participants' neighbors, and former participants (1976-77)	24-hour dietary recall and isolation index	ENP-eligible elderly (n=3,411)	Participant vs. nonparticipant and comparisons to Wave I participants still enrolled in congregate sites	Ate ENP meal on dietary recall day	Chi-square tests
Kirschner and Associates and Opinion Research Corporation - Wave I (1979)	Dietary intake and socialization	Participants in 91 randomly selected ENP sites (congregate only) and random sample of participants' neighbors (1982)	24-hour dietary recall and isolation index	ENP-eligible elderly (n=4,563)	Participant vs. nonparticipant	Ate ENP meal on dietary recall day	No statistical tests conducted
Group IIA: State and local studies of congregate meals							
Gilbride et al. (1998)	Dietary intake and nutritional risk	Residents in HUD elderly housing facilities in metropolitan New York City; nonparticipants from facilities that did not have ENP (dates not reported	2 24-hour dietary recalls, food frequency, 5-day food records, and level-one screen from Nutrition Screening Initiative checklist	ENP-eligible elderly (n=40)	Participant vs. nonparticipant	Currently receiving ENP meals	No statistical tests conducted

See notes at end of table.

Continued—

Appendix table 14—Studies that examined the impact of the Elderly Nutrition Program on nutrition and health outcomes—Continued

Study	Outcome(s)	Data sources[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Neyman et al. (1996)	Dietary intake, weight status, nutritional biochemsitries	Participants and nonparticipants at 9 ENP sites in 2 northern California counties (dates not reported)	3-day food record, venous blood sample, height and weight	ENP-eligible elderly (n=135)	Participant vs. nonparticipant	Ate ENP meal on at least 1 food record day	Multifactorial analysis of variance
Czajka-Narins et al. (1987)	Dietary intake, weight status, and nutritional biochemistries	Participants in 6 ENP sites in Missouri; nonparticipants from senior center that did not serve meals (dates not reported)	1-day food record, 24-hour recall, food frequency, venous blood sample, height, weight, and tricep skinfolds	ENP-eligible elderly, over 75 years old (n=185)	Participant vs. nonparticipant	Regular participation: Ate at ENP meal site 2-5 times per week Irregular participation: Ate at ENP site less than twice per week, but at least once per week during last 4 months	Chi-square tests and analysis of variance
LeClerc and Thornbury (1983)	Dietary intake	Participants in 1 ENP site in central Maine; nonparticipants from federally-subsidized housing units in same area (dates not reported)	3-day food records	ENP-eligible, low-income elderly (n=53)	Participant vs. nonparticipant	Ate ENP meal 3-5 times per week	Bivariate t-tests and analysis of variance
Nordstrom et al. (1982)	Iron intake and iron status	Participants in 6 ENP sites in Missouri; nonparticipants from senior center that did not serve meals (1975)	1-day food record and venous blood sample	ENP-eligible elderly (n=320)	Participant vs. nonparticipant	Ate ENP meal on food record day	Analysis of variance

See notes at end of table.

Continued—

Appendix table 14—Studies that examined the impact of the Elderly Nutrition Program on nutrition and health outcomes—Continued

Study	Outcome(s)	Data sources[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Kohrs et al. (1980)	Dietary intake, weight status, and nutritional biochemistries	Participants in 6 ENP sites in Missouri; nonparticipants from senior center that did not serve meals (1975)	1-day food record, 24-hour recall, food frequency, venous blood sample, height, weight, and tricep skinfolds	ENP-eligible elderly (n=547)	Participant vs. nonparticipant	Regular participation: Ate at ENP meal site 2-5 times per week Irregular participation: Ate at ENP site less than twice per week, but at least once per week during last 4 months	Chi-square tests and analysis of variance
Singleton et al. (1980)	Dietary intake	Participants in 7 ENP sites in southern Louisiana; nonparticipants from 2 senior centers that did not serve meals (dates not reported)	24-hour dietary recall	ENP-eligible, low-income elderly females (n=97)	Participant vs. nonparticipant	Ate ENP meal on dietary recall day	Analysis of variance
Kohrs et al. (1978)	Dietary intake	Participants in 6 ENP sites in Missouri; nonparticipants from senior center that did not serve meals (1973)	1-day food record	ENP-eligible elderly (n=466)	Participant vs. nonparticipant	Ate ENP meal on food record day	Analysis of variance
Group IIB: State and local studies of home-delivered meals							
Edwards et al. (1998)	Food security, diet diversity, and diabetic control	Random sample of diabetic recipients of home-delivered meals in New York State and random sample of non-participants from a waiting list (1986-87)	In-person interview and mail survey of respondents' physicians	ENP-eligible, homebound diabetic elderly (n=154)	Participant vs. nonparticipant	Currently receiving ENP meals at least 2 times per week	Multivariate regression

See notes at end of table.

Continued—

Appendix table 14—Studies that examined the impact of the Elderly Nutrition Program on nutrition and health outcomes—Continued

Study	Outcome(s)	Data sources[1]	Data collection method	Population (sample size)	Design	Measure of participation	Analysis method
Ho-Sang (1989)	Dietary intake and weight status	Recipients of home-delivered meals in New York State; nonparticipants from waiting lists for other programs (dates not reported)	24-hour dietary recall, height, weight, and tricep skinfolds	ENP-eligible, homebound elderly (n=448)	Participant vs. nonparticipant	Currently receiving ENP meals	Bivariate t-tests and multivariate regression
Steele and Bryan (1986)	Dietary intake	Recipients of home-delivered meals from 1 site in North Carolina; nonparticipants from a waiting list (1982-83)	24-hour dietary recall and diet history	ENP-eligible, homebound elderly (n=54)	Participant vs. nonparticipant	Currently receiving 1 ENP meal per day, 5 days per week	Bivariate t-tests

[1] All studies were primary data collection efforts.

Nutrition Assistance Program in Puerto Rico, American Samoa, and the Northern Marianas

Appendix table 15—Studies that examined the impact of the Nutrition Assistance Program in Puerto Rico on household food expenditures and/or nutrient availability

Study	Outcome(s)	Data source[1]	Population (sample size)	Design	Measure of participation	Analysis method
Bishop al. (1996)	Household nutrient availability	1977 Puerto Rico supplement to the NFCS and 1984 Puerto Rico HFCS	Participant and income-eligible nonparticipant households using 1977 eligibility criteria (n= 3,995)	Pre-cashout compared with cashout (1977 vs. 1984)	Participation dummy	Stochastic dominance
Hama (1993)	Household food expenditures Household nutrient availability	1984 Puerto Rico HFCS	Participant and nonparticipant (including ineligible) households (n=1,559)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Beebout et al. (1985)	Household food expenditures Household nutrient availability	1977 Puerto Rico supplement to the NFCS and 1984 Puerto Rico HFCS	Participant and income-eligible nonparticipant households using 1977 eligibility criteria (n= 3,995)	Pre-cashout compared with cashout (1977 vs. 1984)	Group membership dummy, participation dummy, and benefit amount	Multivariate regression, with 2-equation selection-bias models

[1]Data sources:
NFCS = Nationwide Food Consumption Survey.
HFCS = Household Food Consumption Survey.

Commodity Supplemental Food Program

Appendix table 16—Studies that examined the impact of the Commodity Supplemental Food Program on nutrition and health outcomes of low-income pregnant women and young children

Study	Outcome(s)	Data source	Population (sample size)	Design	Measure of participation	Analysis method
Mahony-Monrad et al. (1982)	Women: hemoglobin, hematocrit, pregnancy weight gain, birthweight, gestational age, APGAR score, length of newborn hospital stay Children: hemoglobin, hematocrit, height, weight, immunization status	2 CSFP sites in Memphis and 1 in Detroit (CSFP participants) and area hospital/health department clinics (nonparticipants) (1978-80)	Matched pairs of pregnant women (n=421 pairs) and children (n=236 pairs)[1]	Participant vs. nonparticipant	Participation dummy: Received food from CSFP during study period Dose-response: Number of pickups, number of prenatal care visits, and percentage of recommended prenatal visits	t-tests, analysis of covariance, correlations

[1]Women were matched on age, race, number of previous pregnancies, smoking status, marital status, and prepregnancy weight. Children were matched on gender, race, and birthweight.

WIC Farmers' Market Nutrition Program

Appendix table 17—Studies that examined the impact of the WIC Farmers' Market Nutrition Program on self-reported fruit and vegetable consumption

Study	Outcome(s)	Data source	Population (sample size)	Design	Measure of participation	Analysis method
Anliker (1992)	Self-reported fruit and vegetable consumption	Randomly selected WIC participants in 6 sites that participated in FMNP and 3 sites that did not (1989)	FMNP participants (n=172) Nonparticipants (n=44)	Participants vs. nonparticipants, before and after	Received coupons	Analysis of covariance
Galfond (1991)	Self-reported fruit and vegetable consumption	Randomly selected WIC participants in 6 States (1990)	FMNP coupon recipient (n=1,503) FMNP nonrecipients (n=1,126) Recipients in prior but not current season (n=96)	Participant vs. nonparticipant	Received coupons in current growing season	Bivariate t-tests

Special Milk Program

Appendix table 18—Studies that examined the impact of the Special Milk Program on children's milk consumption

Study	Outcome(s)	Data source	Population (sample size)	Design	Measure of participation	Analysis method
Wellisch et al. (1983)	Dietary intake	Nationally representative sample of 90 school districts and 276 schools across the country (1980-81)	Children in grades 1-12 (n=6,566)	Participant vs. nonparticipant	Participation dummy	Multivariate regression
Robinson (1975)	Self-reported milk consumption	Nationally representative sample of 768 schools (1975)	School-age children (n=20,000)	Participant vs. nonparticipant	Participation dummy	Comparison of means and proportions (no statistical tests reported)

Team Nutrition Initiative and Nutrition Education and Training Program

Appendix table 19—Studies that examined the impact of the Team Nutrition Initiative or the Nutrition Education and Training Program on school-age children

Study	Outcome(s)	Data source	Population (sample size)	Design	Measure of participation	Analysis method
USDA, 1998	Nutrition-related knowledge, attitudes, self-reported and observed eating behaviors	4 purposefully selected school districts; 24 schools (1996)	Children in 4th grade (n=144)	Participant vs. nonparticipant, before and after	Participation dummy	Multivariate regression
Shannon and Chen (1988)	Nutrition-related knowledge, attitudes, and self-reported eating behaviors	12 school districts and 35 schools across Pennsylvania (dates not reported)	Children in grades 3-5 (n=1,707 3rd graders in initial sample)	Participants, before and after (sequential nutrition education program that spanned 3 school years)	Participation dummy	Analysis of covariance
Banta et al, (1984)	Plate waste, nutrition-related knowledge, attitudes, and self-reported eating behaviors	48 schools across Tennessee (dates not reported)	Plate waste: Children in grades K-6 (n=1,462) All other outcomes: Children in grades K-12 (n=862)	Participant vs. nonparticipant, before and after	Participation dummy	Not described
Gillespie (1984)	Nutrition-related knowledge, attitudes, and snacking behaviors	6 elementary schools in central New York State (1979-80)	Children in grades K-6 (n=1,157)	Participant vs. nonparticipant, before and after	Participation dummy	Bivariate t-tests, chi-square tests, and Wilcoxon signed ranks tests
St. Pierre and Glotzer (1981)	Nutrition-related knowledge, attitudes, preferences, and self-reported eating behaviors	7 school districts across Georgia (1980)	Children in grades 1-8 (n=1,400)	Participant vs. nonparticipant	Participation dummy	Analysis of covariance, using both children and classrooms as the unit of analysis
St. Pierre et al. (1981)	Nutrition-related knowledge, attitudes, preferences, self-reported eating behaviors, and plate waste	20 schools across Nebraska (1980)	Children in grades 1-6 (n=2,351)	Randomized experiment with random assignment at the school level	Participation dummy	Analysis of covariance, using both children and classrooms as the unit of analysis

Appendix B

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