Children's Food Security and Intakes from School Meals

Final Report

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Abstract

Using 2005 data from the U.S. Department of Agriculture's Third School Nutrition Dietary Assessment survey, this study examines the contribution of school meals to the food and nutrient intake of children in food-secure, marginally secure, and food-insecure households. The study finds that children from food-insecure and marginally secure households receive a larger proportion of their food and nutrient intakes at school than do children from highly secure households. This difference is partially explained by the higher participation rates of the insecure and marginally secure in school meal programs. The average amount of foods and nutrients consumed were similar across food security levels, except that children from marginally secure households consumed fewer calories (and thus nutrients) than both other groups. Breakfast skipping was significantly more common among the food-insecure and marginally secure children. Even at schools with breakfast programs, 20 percent of children from food-insecure and marginally secure households did not eat breakfast, for reasons that will require further study to explore.

Keywords: School nutrition, food insecurity, 24-hour intakes, marginal food security, NSLP, SBP, MPEs, breakfast skipping

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We gratefully acknowledge these contributions and accept full responsibility for any errors that remain.

CONTENTS

Contents (continued)

TABLES

Tables (continued)

FIGURES

EXECUTIVE SUMMARY

The National School Lunch Program (NSLP) and the School Breakfast Program (SBP) seek to provide nutritious meals to low-income children for free or at a reduced price and are important parts of the nation's safety net. In 2007, 16 percent of households with children experienced food insecurity (Nord 2009). Given President Obama's goal of ending childhood hunger by 2015 and the upcoming reauthorization of the NSLP and the SBP, understanding the role of school meals in the diets of disadvantaged children is crucial.

What Is the Issue?

School nutrition policies are faced with balancing the needs of children from food insecure households and concerns about childhood obesity. Although there is recent work on the relationship of school meals and obesity, less is known about the dietary intakes of children from less-food-secure households and the contribution of school meals to their diets. This report, therefore, focuses on the diets of children from food-insecure and marginally food-secure households and the school meals they consume.

Using data from the third School Nutrition Dietary Assessment Study (SNDA-III), this study examines the school-day diets of a national sample of children who attended public schools in 2005. Children from food-insecure households are compared with children from marginally food-secure households and highly food-secure households in five areas: (1) background characteristics; (2) intakes of calories, nutrients, and foods; (3) the contribution of school meals to their daily intakes; (4) percentage of school lunch portions consumed; and (5) rate of meal skipping.

What Did the Study Find?

Children from food-insecure or marginally food-secure households were more disadvantaged than highly food-secure children in household income, family structure, and parent education. For example, 90 percent and 85 percent of the food-insecure and marginally secure households, respectively, reported incomes below 185 percent of the federal poverty level (and hence were eligible for free or reduced-price meals) compared with 27 percent of the highly food-secure households. Correspondingly large majorities of children from food-insecure and marginally food-secure households participated in NSLP. However, far fewer participated in SBP: 37 percent of those from food-insecure households and 26 percent of those from marginally secure households.

Daily calories consumed were similar for children from food-insecure and highly secure households. Furthermore, very few significant differences emerged from the analysis of diet quality in terms of either nutrients or types of foods eaten when comparing the insecure with the highly secure. Both groups consumed similarly low amounts of fruits and vegetables relative to U.S. Department of Agriculture (USDA) recommendations (less than one and one-quarter cups of each food group). However, children from marginally secure households consumed significantly fewer calories than those in either of the other two groups (and, accordingly, smaller amounts of many other nutrients).

School meals represented a larger proportion of the school-day caloric and nutrient intakes of children from food-insecure and marginally secure households relative to children from highly secure households. On average, children from highly secure households obtained 16 percent of their daily calories from school meals while children from insecure and marginally secure households

obtained 26 and 24 percent, respectively. This difference is only partially explained by the lower participation rates of the highly secure in the school meal programs. Participants from highly secure households obtained 27 percent of their daily calories from school meals while participants from insecure households obtained 32 percent. The same pattern was observed for many nutrients and foods. One large significant difference was for calcium intakes; participants from insecure households obtained 47 percent of their daily calcium from school meals compared with 38 percent for participants from highly secure households.

This study also examined whether food-insecure lunch participants were more or less likely to consume all of the items they selected. Exploratory analysis of this topic, also known as "plate waste," took advantage of the SNDA-III menu survey to construct a measure of the percentage consumed by NSLP participants among foods selected as part of school lunches. The values for this variable ranged widely and sometimes exceeded 100 percent, indicating some possible food trading or sharing. The median amount consumed was approximately 100 percent for all major food groups, except for vegetables, for which the median percentage consumed was 68 percent. No significant differences were found in percentages consumed across the food security groups. Limitations of this approach were small sample sizes and lack of data on foods selected but not even tasted.

Lastly, breakfast skipping was significantly more common among food-insecure and marginally secure children. Even at schools with breakfast programs, 20 percent of children from food-insecure and marginally secure households did not eat any breakfast. Regardless of food-security status, breakfast skippers, on average, did not make up calories missed later in the day. Furthermore, breakfast skippers tended to be from households with lower incomes than consumers, to be obese more often, and were less likely to be reported as in excellent health.

This analysis raises two areas for future research.

1. Why did children from insecure and marginally secure households skip breakfast at a higher rate than other children when the SBP was available to them? What policies could increase SBP participation?
2. Is the finding that children from marginally secure households consume less corroborated by other databases and, if so, what might explain this surprising finding?

How Was the Study Conducted?

SNDA-III data are from a nationally representative sample of public school students in grades 1 to 12 in 2005. Data collected include 24-hour dietary recalls of students and parent surveys on background characteristics and the USDA food-security module. In addition, the study collected detailed data on foods offered on school menus. Using the publicly available data from SNDA-III, this report compares average food and nutrient intakes on a single school-day across the three food security groups. Intakes were assessed over the full day and for breakfast and lunch separately. Mean intakes are presented both with and without adjusting for other background characteristics.

I. INTRODUCTION

The National School Lunch Program (NSLP) and the School Breakfast Program (SBP) are intended to promote children's health and well-being by providing nutritious meals to low-income children for free or at a reduced price (and to higher-income children at a subsidized price) and are important parts of the nation's safety net. Established in 1946, the NSLP in fiscal year (FY) 2008 served more than 30.5 million children per school day, of whom 60 percent received lunches free or at a reduced price (USDA FNS 2009a). The SBP was piloted starting in 1966 and became a permanent program in 1975 (USDA FNS 2009b). Although targeted to districts serving low-income children and children who traveled a long way to school, the program is now offered in 85 percent of public schools that offer the NSLP (Gordon et al. 2007a). It still predominantly serves children from low-income families—81 percent of SBP breakfasts were served free or at a reduced price in FY 2008. Both programs are federally funded and are administered at the federal level by the U.S. Department of Agriculture (USDA), Food and Nutrition Service (FNS); FY2008 expenditures were more than $9.3 billion for the NSLP and more than $2.4 billion for the SBP (USDA FNS 2009a, 2009b).

One part of USDA's mission (as outlined in its 2005-2010 strategic plan) is "improvements in access to federal nutrition assistance programs as the centerpiece of the federal strategy to reduce and prevent hunger among low-income people" (USDA 2006). USDA developed and uses food security measures to monitor the extent of food insecurity in the population and to identify those groups most in need of nutrition assistance. It defines food insecurity as "the lack of access to adequate food because of insufficient money or other resources for food" (Nord 2007).

The NSLP and SBP are up for reauthorization in 2010, so it is an opportune time to consider how well the programs are meeting their goals. In the past decade, the goals of school nutrition policy have broadened from ensuring that children receive adequate nutrition to include addressing

childhood obesity. In considering changes to the school meal programs, policymakers face the challenge of making changes sufficiently flexible that the school meal programs remain a safety net for children from food-insecure households, while also promoting healthy diets. For example, some observers (such as Besharov [2002]) have recommended reducing portion sizes in school meals to help prevent excessive energy intakes. This report may indirectly inform the debate about potential tradeoffs between providing less food-secure children with a high-quality diet and preventing them from consuming too much.[1] However, the focus of this study is not to examine links between food security and obesity[2] (or school meals and obesity[3]).

Given the large number of families with children who use emergency food sources (Mabli et al. 2010) and the higher levels of food insecurity during summer months (Nord and Romig 2006), it seems likely that some students (and parents) from food-insecure households rely on school meals to meet students' daily energy needs. Therefore our aim is to provide descriptive evidence on the relationship between household food security, school meals, and children's diets using a rich data source, the third School Nutrition Dietary Assessment Study (SNDA-III).

A. Study Goals

School meal issues are currently under the spotlight of reauthorization debates, the economic recession, and continuing concerns about childhood obesity. Nonetheless, the role of school meals in the diets of children in families with some degree of food insecurity has not been extensively

[1] This report presents descriptive information on the weight status of children by their level of food security (see Chapter III) but does not otherwise address the relationship between food insecurity and obesity.

[2] The relationship between food security and obesity in children is still an open question. See Appendix B of Nord (2009) for a summary of this literature (such as Alaimo et al. [2001], Bhargava et al. [2008], Bronte-Tinkew et al. [2007], Jyoti et al. [2005], and Winicki and Jemison [2003]).

[3] There is some recent work on the relationship between school meals and obesity. Gleason et al. (2009) finds that lunch participation is not associated with higher BMI, while Millimet et al. (forthoming) and Schanzenbach (2009) argue that, after controlling for selection, participation in NSLP may contribute to childhood obesity. Gleason et al. (2009) and Millimet et al. (forthcoming) both find that participation in SBP may protect against it.

studied. Because food insecurity may affect or be affected by school meal participation, it is hard to establish the direction of causality, particularly using cross-sectional data. The goal of this project is to use data from SNDA-III, based on a 2005 national sample of U.S. public school students in grades 1 through 12, to examine the degree to which the USDA school meal programs provide a safety net for schoolchildren from food-insecure and marginally secure households.[4] This study addresses the following descriptive research questions:

- How do the ***nutrients*** consumed by children from food-insecure and marginally food-secure households compare to consumption by highly secure children at breakfast, lunch, and over 24 hours? Do food-insecure and marginally secure children obtain a larger proportion of their nutrients and energy on school days from school meals than highly food-secure children?

- How do the ***foods*** consumed by children from food-insecure and marginally food-secure households compare to consumption by highly secure children at breakfast, lunch, and over 24 hours? Do food-insecure and marginally secure children consume a larger proportion of their daily servings of key food groups (such as milk, fruits, vegetables, and meats) from school meals than highly food-secure children?

- Do food-insecure and marginally secure children who participate in the NSLP consume larger portions of lunch menu items (relative to the portions offered) than other participants? In other words, do they waste less food?

- Are food-insecure and marginally secure children more likely to skip meals than highly secure children?

The USDA food security scales classify households on a gradient from "highly secure" to "insecure," with "marginally food secure" in between. The research questions mention both food-insecure and marginally food-secure children because we also sought to assess whether children "on the margin" eat differently or have characteristics different from children in households that are classified as insecure or highly secure. To address these questions, this study uses SNDA-III data on

[4] In the rest of this report, at times, for the sake of brevity, we refer to children as "food insecure" (or "marginally secure") to mean that they are part of a household that is food insecure (or marginally secure). However it is possible that only the adults in these households experience food insecurity (or marginal food security). Our measures of food insecurity will be discussed in more detail in Chapter II.

both foods and nutrients offered in the meal programs at public schools, as well as data from 24-hour dietary recalls on students' consumption on a typical school day. By matching these two sources of data, we can gain insight into the role of school meals in children's diets for children from households with different levels of food security, and assess the extent to which differences reflect such factors as greater participation among less-food-secure students, as well as differences in food choices among participants at various levels of food security.[5]

B. Previous Research

To provide context for our analyses, this section reviews previous literature that examined relationships between food security and children's dietary intakes and other developmental outcomes, as well as research on food security and school meal participation.

1. Relationships Among Food Security, Dietary Intake, and Developmental Outcomes

Previous studies indicate that the relationship between food security and dietary and developmental outcomes is complex. Some studies indicate that food insecurity is associated with lower dietary intakes, but some point in the opposite direction. At the same time, food insecurity may have little relation to schoolchildren's diets because, in most food-insecure households with children, the younger children are shielded from effects of the family's food insecurity (Nord and Hopwood 2007). Rose (1999), in an analysis of the 1989-1991 Continuing Survey of Food Intake by Individuals (CSFII), reported that preschoolers from food-insufficient households did not have significantly lower nutrient intakes than those from food-sufficient households, but that the rest of the household members did have lower intakes. Using the 1994-1996 CSFII, Casey et al. (2001) found that children from low-income households had similar intakes, whether they were food sufficient or food insufficient. However, Olson (1999) and Kleinman et al. (1998) reported that

[5] We use the term "less-food-secure" to refer to students from food-insecure and marginally food-secure households as one group—all who are not from highly food secure households.

hunger in children (as measured by the Community Childhood Hunger Identification Project) was associated with negative psychosocial outcomes, as measured by the parent-completed Pediatric Symptom Checklist. In addition, Jyoti et al. (2005), using longitudinal data on elementary school children from the Early Childhood Longitudinal Survey, Kindergarten Cohort (ECLS-K), concluded that food insecurity was linked to undesired developmental consequences.

2. Relationship of Food Security and NSLP and SBP Participation

Only a few studies have looked at food insecurity and school meals. In a series of papers funded under USDA Small Grants, Dunifon and Kowaleski-Jones (2003, 2004) examined factors associated with NSLP participation (including food security) and the effect of both food security and NSLP participation on health and developmental outcomes. An interesting feature of their model was the use of sibling fixed effects to look at the effect of participation. However, their use of sibling fixed effects was not a strong identification strategy: it relied on one sibling participating and the other not participating, which reduced their sample sizes and may have led to a biased sample. Outcomes they examined included math and reading test scores, parental reports of the child's health limitations, and measures from the Behavioral Problems Index. They found that the probability of a student having a health limitation was positively correlated with both food insecurity and NSLP participation. However, after controlling for self-selection into the NSLP program (also known as "selection bias") by sibling comparison, they concluded that the association between NSLP participation and child heath limitations was due to unmeasured family-specific factors.[6] Although they did not find a positive effect of NSLP participation after adjusting for selection bias, their findings suggested that the seemingly negative effect was likely to be due to selection into the program.

[6] In general, in estimating the effects of program participation on an outcome, "selection bias" occurs when the outcome is affected by unmeasured factors correlated with program participation and with the outcome of interest.

Bartfeld et al. (2009) included a section on the relationship between food security and the availability of school breakfasts among low-income third grade students. Using the ECLS-K, they found that, unconditionally, there is a strong inverse relationship between a student's access to SBP and food insecurity, measured using both the standard USDA definition of food insecurity and a less restrictive definition that included the marginally secure. After controlling for many household and geographical characteristics, they found that access to SBP is not significantly related to the likelihood of being food insecure (USDA definition), but that it does significantly decrease the likelihood of being marginally secure or insecure. As they note, only a small minority of low-income children do not have access to the SBP, which makes it more difficult to measure the possible effect of SBP availability. Furthermore, while studying the effect of access to SBP (instead of the effect of SBP participation) addresses the issues of individual selection, there may still be selection bias because schools select into the SBP. To address this concern, they used variation in state-level mandates about whether SBP must be offered.[7] Using this technique, they did not find any significant relationship between access to SBP and either measure of food insecurity.

Bhattacharya et al. (2004a) compared the nutritional status of school-aged children during the summer to their nutritional status during the school year, using the National Health and Nutrition Examination Survey (NHANES) III, 1988-1994, and concluded that the SBP improved children's diets.[8] This may explain their finding in a related study that neither poverty nor food insecurity was related to nutritional outcomes among school-aged children (2004b).

[7] Since these mandates are highly predictive of whether schools offer SBP, this variation can be used to identify the impact of access to SBP on food insecurity as long as these mandates are not related to food insecurity except through its association with SBP. The possibility that such mandates could be a response to higher levels of food security is not discussed in the report.

[8] Furthermore, they found some evidence of spillover effects to adults in the household.

Nord and Romig (2006) took a similar approach to assessing the impact of the NSLP. They first described the differences in seasonal rates of food insecurity for households with school-aged children and for households without them. They found greater seasonal changes for households with school-aged children; specifically, such households had more food insecurity in the summer, which may be associated with school meals not being available. Next, they looked at differences across states in the size of their Summer Food Service Program (SFSP)—a much smaller federal child nutrition program that serves school-aged children during the summer-- and reported that the seasonal changes in food security were greater in states that served fewer SFSP meals relative to their NSLP meals served during the school year. This macro (state-level) approach is another way to address the self-selection issues that affect estimates of the impact of food assistance programs using individual-level data.[9]

C. Overview of Report

Chapter II provides additional background on the SNDA-III data and sample and the food security measures used in this report. Chapter III describes the background characteristics of schoolchildren at various levels of food security for both the overall sample and the subsample of NSLP participants, as context for interpreting the results regarding their diets. Chapters IV to VI present the core results of the study. Chapter IV addresses the first two sets of research questions by examining mean intakes of nutrients and MyPyramid food groups by food security status at breakfast, lunch, and over 24 hours, as well as the proportion of daily intakes contributed by school meals. Chapter V presents analysis of a measure of "percentage consumed" by school lunch participants for items from school lunch menus, by food group (at the whole food level), and by children's food security status. Chapter VI describes the relationship between food security and

[9] There is a much larger literature on the impact of food stamps on participants' food security and dietary status. See Wilde et al. (2008) for a recent survey.

skipping breakfast among children in public school. Chapter VII summarizes key findings and reflects on remaining puzzles.

II. DATA AND METHODS

This chapter contains an overview of the SNDA-III data used in this report; a discussion of dietary measures, measures of school meal program participation, and food security measures used to classify students; and some notes on the analysis methods used.

A. Overview of SNDA-III Data

SNDA-III provides data that are nationally representative of public school districts, the schools in them, and the students who attended those schools in school year (SY) 2004-2005. School- and district-level survey data provide a wide range of characteristics of the meal programs, basic school characteristics such as enrollment, and demographic and socioeconomic characteristics of the students. Detailed data on the foods and nutrients provided in reimbursable school meals are also available.

Student-level data, of most interest for this study, were derived from a student interview about opinions of school meals and, for older students, questions about eating habits and other activities related to health. In addition, students participated in a 24-hour dietary recall interview (with parent help for elementary school students), which, when coded using a nutrient database, provided detailed data on foods and nutrients consumed over a typical school day. Students' heights and weights were also measured. Finally, parents completed an interview that included collection of family background characteristics; child characteristics; socioeconomic variables such as parents' education and employment, household income, and participation in public assistance programs; and last, the full USDA food security scale (discussed in Section C).

1. Sample Design

The SNDA-III three-stage sample design is representative of all public School Food Authorities (SFAs) participating in the NSLP in SY 2004-2005, schools in those SFAs, and students in grades 1-12 in those schools. Sample sizes were chosen based on the ability to detect statistically significant

differences in nutrient intakes between school meal participants and nonparticipants. To achieve the desired level of precision for student estimates, we selected sampled SFAs and schools with probability proportional to size, that is, we assigned SFAs and schools a higher probability of selection if they had a higher student enrollment. In general, within each SFA, we selected one elementary school, one middle school, and one high school. (In districts without all three levels, we selected three schools from the levels available.) Students were randomly sampled within schools. SFAs, schools, or students who declined to participate in the data collection were replaced by randomly chosen substitutes.

In the end, 130 SFAs participated in the study, and we collected school-level data from 398 schools in these SFAs. Student-level data were collected on site in a random subset of 287 schools in 94 SFAs. About 8 students per school both completed a 24-hour dietary recall themselves and had a parent complete an interview on child and family background characteristics; 2,314 students were included in the SNDA-III analysis sample.

2. Data Collection on School Breakfast and Lunch Menus

School foodservice managers completed surveys of their menus for one school week—generally five days. Most schools provided both breakfast and lunch menus, but schools that did not offer the SBP provided only lunch menus; one school provided only breakfast menus; 397 schools completed the menu survey for lunch, 331 for breakfast. The menu survey included a set of forms for each meal (if applicable) for each day of the school week. The main forms asked foodservice managers to write down every food offered for lunch (or breakfast) on the specific weekday, described in as much detail as possible. To make this task easier, the forms pre-listed many common foods. Manufacturers' and product codes were requested when available. The foodservice managers were also asked to provide the portion size for each food, as well as the number of servings selected as part of a reimbursable meal. Special forms were used to record recipes for foods prepared on site, as

well as to list the offerings on self-serve salad bars or other food bars. In addition, foodservice managers provided information on the numbers of reimbursable breakfasts and lunches served each day, as well as the types of milk offered. To assist with the large number of forms and reduce burden, each school foodservice manager received regular calls from specially trained technical assistants who could answer questions and provide encouragement. These assistants also called the respondents back if key information was missing or unclear.

3. Data Collection from Students and Parents

The focal point of the student interview was an in-person 24-hour dietary recall. Interviewers used the Automated Multiple Pass Method (AMPM) software (Version 2.3, 2003, Agricultural Research Service, Food Surveys Research Group, Beltsville, MD) on laptop computers. Elementary school children were interviewed in school about foods eaten since they woke up on the interview day, and were interviewed with a parent assisting on the next day (or within 48 hours) about what they ate over the rest of the target day. Older children were interviewed about what they had eaten from midnight to midnight on the day before the interview. All recalls covered school days (and thus weekdays). Details on intakes of dietary supplements were not collected, but parents were asked whether their child, and older children were asked whether they themselves, took any supplements. Interviewers used the USDA two-dimensional food models booklet to help children and parents describe portion sizes. After the dietary recall interview, field interviewers measured each child's height and weight using standardized equipment and procedures. Measures were taken in school, in a location selected to keep the process private.

Parents of elementary school students were interviewed in person after they helped their child complete the dietary recall; parents of older students were interviewed by telephone. About a week after their initial interview, a randomly selected 29 percent of students who completed a recall also

completed a second 24-hour recall, which was used to estimate the distribution of usual nutrient intakes.

Field interviewers were generally experienced in working with children and/or in collecting dietary intake data. The interviewers received extensive training over an 8- to 11-day period in a central location, including about 5 days of training in the use of AMPM to conduct dietary recalls with children.

B. Dietary and Participation Measures

The key outcomes for this study are (1) school-day intakes of nutrients and other dietary components; and (2) intakes of serving equivalents of the MyPyramid food groups at breakfast, at lunch, and over 24 hours. As described in Chapter IV, the mean differences in these dietary outcomes across food security groups, for both the full sample and school meal participants, are the focus of this report.[1] This section explains (1) how nutrient intakes and MyPyramid Equivalents (MPEs) were estimated for each food in the dietary recall file, (2) how foods were classified as breakfast or lunch foods and how foods were designated as "on menu," and (3) how students were classified as SBP or NSLP participants or nonparticipants. These classifications and estimations are all based on Gordon et al. (2007a, 2007b) except for the MPEs, which are from the work of Fox et al. (forthcoming).

1. Food and Nutrient Coding

Analysts with strong nutrition backgrounds food- and nutrient-coded dietary recall interviews with the USDA Agricultural Research Service (ARS) SurveyNet software, which draws on USDA's Food and Nutrient Database for Dietary Studies (FNDDS). They also used SurveyNet to do food and nutrient coding of the five days of school menu data collected from foodservice directors. ARS

[1] Chapter V is an exception: to address the third research question, it looks exclusively at "on menu" foods eaten by NSLP participants.

staff developed nutrient profiles for 100 common commercially prepared foods that were developed specifically for school meals (and thus were not in the FNDDS). SNDA-III staff used data for these 100 foods to impute nutrients for less-common but similar commercially prepared foods that did not match to FNDDS. These extra steps ensured that schools received credit for serving pre-prepared foods that were modified to help schools meet nutrition guidelines (Gordon et al 2007c).

In addition, each food included in the 24-hour dietary recall file was linked to the MyPyramid Equivalents Database (MPED) (Version 1.0 for USDA Survey Food Codes, 2006), also developed by ARS. The MPED provides, for all foods in the USDA nutrient database, the number of equivalents (cups, ounces, grams, teaspoons) in 100 grams of a food for 32 MyPyramid food groups and subgroups (listed in table below). Foods were also linked to the CNPP 01-02 Fruit Database (USDA Center for Nutrition and Policy Promotion 2007), which includes values for whole fruit and fruit juice for all MPED foods that contain any amount of fruit or juice.[2] MPEs were not coded for foods in the school menu data, because many more menu data foods did not match to the MPED, and imputing MPEs for such foods would have required more resources than were available.

2. Definitions of Breakfast, Lunch, and On-Menu Foods

The definitions of lunch and breakfast foods were the same as those used in the SNDA-III reports (Gordon et al. 2007a, 2007b, 2007c), which in turn were adapted from the time-of-day and meal-type definitions used by Gleason and Suitor (2001). All foods reported between 5 a.m. and 9:30 a.m. and foods reported between 9:30 a.m. and 10:30 a.m. and called "breakfast" by the student were counted as breakfast foods. A small number of breakfasts from earlier in the day (before 5 a.m.) and later in the day (after 10:30 a.m.) were clearly the first meals consumed after waking up

[2] Detailed documentation on these databases is available at [www.ars.usda.gov/Services/docs.htm?docid=17562] and [www.cnpp.usda.gov/HealthyEatingIndex-2005report.htm].

MyPyramid Equivalents Database 1.0: Major Food Groups and Subgroups

Total grain (oz. equivalents)	Meat, poultry, fish (oz. equivalents)
Whole grain	Meat (beef, pork, lamb, game)
Non-whole grain/refined grain	Organ meat
Total vegetables (cup equivalents)	Frankfurters, sausages, luncheon meats
Dark-green vegetables	Poultry
Orange vegetables	Fish and shellfish high in omega-3 fatty acids
White potatoes	Fish and shellfish low in omega-3 fatty acids
Other starchy vegetables	Eggs (oz. equivalents)
Tomatoes	Cooked dry beans and peas (oz. equivalents)
Other vegetables	Soybean products (tofu, meat analogs) (oz. equivalents)
Total fruits (cup equivalents)	Nuts and seeds (oz. equivalents)
Citrus fruits, melons, and berries	Discretionary oil (grams)
Other fruits	Discretionary solid fat (grams)
Whole fruit[a]	Added sugars (teaspoon equivalents)
Fruit juice[a]	Alcohol (drinks)
Total milk (cup equivalents)	
Milk	
Yogurt	
Cheese	

[a] From CNPP 01-02 Fruit Database.

and these were also counted as breakfast. The following were counted as lunch: (1) all foods reported between 10 A.M. and 2 P.M. unless reported as breakfast; (2) all foods reported between 9:30 A.M. and 10 A.M. that were reported as lunch, supper, or dinner; and (3) all foods reported between 2 P.M. and 3:30 P.M. that were reported as lunch.

To help determine whether students ate school breakfasts and lunches, we matched foods reported by students to the breakfast and lunch menu foods offered in their schools on or around the recall day. For example, if a child reported having a donut obtained in school for breakfast, and the school breakfast menu offered donuts as an option, that was one piece of evidence that the child had eaten a school meal. However, the process of matching recall data and menu data was challenging. Foods were defined to be "on menu" if the reported food (or a similar food) was found to be on the menu (1) on the day of the recall, the day before, or the day after; or (2) in the rare situations where recall and menu survey dates did not overlap, the reported food was on the menu

two or more times during the week of the menu survey or there was evidence of a comparable meal (for example, cold cereals offered every day).[3]

3. Student Participation in the NSLP and SBP

Students were counted as NSLP participants on the target day if they reported consuming either (1) a school lunch and at least one item counting toward a reimbursable meal; or (2) food items from all the food groups required for a reimbursable meal and also found on the school lunch menu. The SBP participation measure used for the analyses was based on whether the student reported having consumed at least one breakfast item that was obtained at school and was on the school breakfast menu. More detail on how these measures were constructed and why they were selected over possible alternatives, such as self-reports, can be found in Gordon et al. (2007b), Appendix A.

C. Food Security Measures

The USDA food security scales are household measures of access to food over the course of the past year. The three related scales are meant to measure the degree to which financial constraints affected the diets of children in the household (the children's scale), adults in the household (the adult scale), and the entire household (the household, or full, scale). All three scales are household-level measures of food security during the past 12 months. None of them is meant to measure the food security status of a particular individual.[4] For reasons explained below, this report uses the adult scale to identify food-insecure and marginally secure households.

The 18 items on the full scale are (1) yes/no questions such as "In the last 12 months, did you ever eat less than you felt you should because there wasn't enough money for food?"; (2) a follow-

[3] Items from other days were accepted as matches because many schools served certain items every day, and because they sometimes served leftovers or ran out of food and served items that had been planned for later in the week.

[4] The NHANES has collected an individual-level measure of food security for several years (Nord and Hopwood 2007), but this was not used in SNDA-III.

up question about how many months a year such a thing happened[5]; or (3) statements such as "We couldn't afford to eat balanced meals," to which respondents are asked to say whether it was often, sometimes, or never true in the past 12 months. Every item on the scale specifies a lack of money as the reason for the condition reported. Responses of yes, more than two months a year, "often," or "sometimes" are coded as affirmative answers.[6] Table II.1 lists (in abbreviated form) the 18 items and the percentage of parents responding affirmatively to each item (see the "Total" column in Table II.1), as estimated using weighted SNDA-III data.

The household scale is based on all 18 items if there are children 18 and under in the household. For households without children, the household scale is the same as the adult scale (the 8 child-focused questions are omitted). The adult scale is based on 10 questions, including those that ask about the household overall (3 questions), the experiences of the adult respondent (3 questions), and the experiences of all adults in the household (4 questions). The child scale is based on the 8 questions that ask the respondent about the experiences of all children 18 and under in the household, as shown in Table II.1.

Both the household scale and the child scale are known to be sensitive to the age of the oldest child in the household (Nord and Bickel 2002). Typically, younger children are shielded from household food shortages, while teenagers have experiences more similar to those of adults. Hence, household food shortages are more likely to be reported as having affected a child in the household

[5] Three of the yes/no questions were followed up on (in the event of a "yes" response) with questions about how many months a year something happened: (1) Did you or other adults in the household ever cut the size of your meals or skip meals because there wasn't enough money for food? (2) Did you or other adults in your household ever not eat for a whole day because there wasn't enough money for food? (3) Did any of the children ever skip a meal because there wasn't enough money for food?

[6] Therefore, households may have experienced these conditions (such as worrying whether their food would run out, not being able to eat balanced meals, or skipping meals) at only some points during the past year.

Table II.1 Percentage Responding Affirmatively to Each Food Security Item, by the Number of Affirmative Answers on the Adult Scale

	Number of Affirmative Responses on Adult Scale							
	High	Marginal		Low		Very low		
Food Security Items	0	1	2	3	4-5	6-7	8-10	Total
HOUSEHOLD								
Worried food would run out	0.0	59.6	93.8	94.3	95.1	100.0	100.0	20.6
Food bought just didn't last	0.0	10.6	69.0	86.6	87.9	95.1	96.0	15.6
Couldn't afford balanced meals	0.0	29.3	28.1	89.0	79.9	90.3	98.9	14.7
ADULTS								
Cut size of meals or skipped	0.0	0.5	4.6	8.3	54.9	94.1	100.0	6.8
3 or more months a year	0.0	0.0	0.7	2.3	19.7	54.8	88.6	3.7
Ate less because not enough $	0.0	0.0	3.8	18.0	69.1	100.0	100.0	7.9
Hungry because not enough $	0.0	0.0	0.0	0.8	18.2	73.6	95.6	4.2
Lost weight because not enough $	0.0	0.0	0.0	0.8	2.9	25.2	86.7	2.2
Didn't eat for whole day	0.0	0.0	0.0	0.0	3.0	13.0	65.3	1.5
3 or more months a year	0.0	0.0	0.0	0.0	0.0	3.6	47.2	0.9
CHILDREN (aged 0-18)[a]								
Relied on few kinds of low-cost food	1.5	24.8	61.8	74.0	81.1	90.1	85.5	16.1
Couldn't eat balanced meals	0.5	14.0	26.4	62.2	64.2	79.0	88.0	11.5
Not eating enough because not enough $	0.2	0.3	9.7	27.4	40.1	47.1	76.7	6.0
Cut size of meals because not enough $	0.0	0.0	0.0	4.5	14.9	34.2	35.5	2.2
Hungry because not enough $	0.0	0.0	0.0	0.3	7.4	20.8	31.5	1.3
Skipped meal because not enough $	0.0	0.0	0.0	0.9	5.8	9.0	20.1	0.8
3 or more months a year	0.0	0.0	0.0	0.0	3.6	5.3	14.4	0.5
Didn't eat for a whole day	0.0	0.0	0.0	1.8	0.4	4.3	2.3	0.3
Sample Size	**1,638**	**163**	**121**	**123**	**110**	**70**	**45**	**2,270**
Percentage of Total Sample (Row %)	76.12	6.12	4.58	5.10	3.98	2.45	1.66	100.0

Source: SNDA-III Parent Interviews, school year 2004-2005. Tabulations are weighted to be nationally representative of students in public NSLP schools. The Adult Food Security Scale is based on the three household items and the seven adult items.

[a] Sample size is 2,202 for households with children 0 to 18.

if at least one child is a teenager. Therefore, in any analysis using the household food security scale, it is important to control for the age of the oldest child. Since the SNDA-III parent survey did not include a full household roster and specifically did not ask the age of each member, the age of the oldest child in the household is not known (except in households with only one child).[7] Lacking this information, we cannot distinguish households with lower levels of food security than average for children of a given age from households that have lower levels of food security because they include older children. Therefore, we conduct our analysis using the adult scale so that we have a consistent measure across different types of households.

The adult scale is grouped into four categories: (1) high food security for those with zero affirmative answers, (2) marginal food security for those with 1 or 2 affirmative answers, (3) low food security for those with 3 to 5 affirmative answers, and (4) very low food security for those with 6 or more affirmative answers. On the USDA adult and household food security scales, marginally and highly food-secure households are both classified as food secure. In this study, we report on each group separately because of research suggesting that marginal food security is associated with lower academic performance and worse health outcomes, and that families with this status are more similar to low- than to high-food-security families (Children's HealthWatch 2009; Jyoti et al. 2005; Winicki and Jemison 2003). Furthermore, less is known about the marginally secure group, as they are typically pooled with the much larger group of children from high-food-security households.

In light of these issues, this report presents results—using the adult scale throughout—for both students from food-insecure households (low or very low food security) and students from marginally secure households. The food-insecure group combines the low and very low groups because of the small sample size for the very low group when taken separately—115 students in the

[7] The number of children in the household is asked, but not their ages. Only the age of the sampled child is known.

SNDA-III sample (versus 348 combining the low and very low groups). The marginally food-secure group includes 284 students. The comparison group is 1,638 students from households with a high level of food security, whom we refer to as highly food-secure students. The total sample size of students with a known food security status is 2,270.

Table II.2 shows the relationships between our indicator variables for food insecurity and marginal food security—both based on the adult scale—and the detailed adult, household, and child scales.[8] In general, the different food security measures tend to classify households similarly. There is a lot of overlap across the three scales (as expected given the overlap in questions included on each scale). Nevertheless, there are some important differences. For example, 28 percent of households with children that were food insecure on the adult scale would have been classified as having food security among children (Table II.2, column 1) which is consistent with earlier research findings[9] that adults usually shield children from the effects of the household's food insecurity if possible.[10]

Other differences across the scales highlight the desirability of looking at the marginally food-secure group separately from the highly secure one. Thirty-four percent of the marginally secure households on the adult scale would have been classified as having low food security on the

[8] The response patterns for the SNDA-III data were assessed by Dr. Mark Nord of the USDA Economic Research Service, a leading authority on the measurement of food security, using conditional maximum likelihood estimation based on the Rasch Model. Since Dr. Nord recommended that we use the adult scale, we report on his assessment of that scale in particular. The overall model fit and the item discrimination were good, which means that respondents appeared to be giving thoughtful responses in general. Item severities, the likelihood of a positive response given responses to other food security questions, were very similar to the CPS, with the exception of the items about adults cutting and skipping meals, which were less likely to be reported in the SNDA-III data (given answers to the other food security items). The differences were not large and, according to Dr. Nord, result in only a slight downward bias in the prevalence of very low food security in the data. His conclusion was that we should "use the adult food security classification with confidence" (email from Mark Nord to Liz Potamites on January 2, 2009).

[9] Nord and Bickel (2002), Nord (2003), and Nord (2009).

[10] Note, however, that the child scale does not include a separate category for marginal food security among children; households with one affirmative response to any of the eight children questions are classified as secure. Table II.1 shows that many of the households in the low-food-security group on the adult scale did answer at least one question on the child scale positively.

Table II.2 Adult Food Security Is Closely Related to Other Food Security Measures

	Adult Food Insecurity	Adult Marginal	Adult High Security	Total
Food Security Status, Adult				
High Security (0)[a]	0.0	0.0	100	76.1
Marginal Security (1-2)	0.0	100	0.0	10.7
Low Security (3-5)	68.9	0.0	0.0	9.1
Very Low Security (6-10)	31.1	0.0	0.0	4.1
Food Security Status, Household[b]				
High Security (0)	0.0	0.0	98.3	74.8
Marginal Security (1-2)	0.0	66.2	1.6	8.3
Low Security (3-7)	63.2	33.8	0.1	12.0
Very Low Security (8-18)	36.8	0.0	0.0	4.9
Food Security Status, Child (n=2202, households with children)				
Secure (0-1)	28.0	83.9	99.5	88.4
Low Security (2-4)	63.9	16.1	0.5	10.6
Very Low Security (5-8)	8.1	0.0	0.0	1.1
Sample Size	**348**	**284**	**1,638**	**2,270**

Source: SNDA-III Parent Interviews, school year 2004-2005. Tabulations are weighted to be nationally representative of students in public NSLP schools.

[a] Numbers in parentheses refer to the number of affirmative responses for each level on the food security scale.
[b] The household measure for households with no children is the same as for the adult scale. The number of affirmative answers given in the parentheses is for households with children.

household scale (Table II.2, column 2),[11] whereas 98 percent of the highly food secure on the adult scale also had high security on the household scale. If the child scale had been used, all but 0.5 percent of the highly food secure with children would have been secure on the child scale as well (Table II.2, column 3), whereas 16 percent of adult marginally secure households with children would have been classified as insecure. These statistics further support the decision to look at the marginally secure group separately from the highly secure one, as the former appears to be more disadvantaged.

[11] This is because, as Table II.1 shows, many of the marginally secure households answered two questions affirmatively on the adult scale, and many of those also answered at least one of the child questions affirmatively. Therefore, they would have had at least three affirmative answers total and thus would have been considered to have low security on the household scale.

D. Analysis Methods and Issues

As noted, SFAs and schools were not selected with equal probability. Thus, to make statements about SFAs, schools, or students nationally, we reweighted the sample so that all SFAs, schools, or students in the population, as applicable, were equally represented. (The basic sampling weight at each level is the inverse of the probability of selection, as this makes the weighted probability of selection for each SFA, school, or student equal to one.) In addition, SFA-, school-, and student-level data were all weighted to adjust for nonresponse. Full details on the sampling and weighting procedures are in Gordon et al. (2007c).

Much of the analysis involves tabulations of means and frequency distributions. Taylor series linearization methods available in SUDAAN (Release 10, 2008, Research Triangle Institute, Research Triangle Park, NC) were used to estimate standard errors adjusted for the complex sample design. In addition, SUDAAN was used to conduct chi-squared tests for differences in categorical variables by food security status as well as t-tests for differences in mean. SUDAAN was also used to adjust the standard errors of coefficient estimates from regression analyses for clustering at the level of the primary sampling unit, which in most cases was the local SFA. Analyses used a minimum 95 percent level of confidence for statistical significance ($P<0.05$).

Both weighted unadjusted means and regression-adjusted means were calculated for all dietary outcomes presented in Chapter IV. The unadjusted means give a representative picture of the average experiences of students from families with various levels of food security. The regression-adjusted estimates allow us to examine the extent to which controlling for other differences between food security groups reduces the raw differences observed. Thus, the adjustment allows us to isolate the relationship between food security and dietary intakes, since there are many observable differences in factors such as age, gender, and household income across the three food security groups. Differences in the regression-adjusted means represent differences among students with

other characteristics held constant. Since there may still be important unobserved differences between less-food-secure and highly food-secure students not accounted for in the regression adjustment, differences between the two groups still do not represent causal effects of food security status. Nonetheless, the regression adjustment accounts for some of the differences between the three groups. Details on the regression adjustment are in Appendix A.

Dietary outcomes, whether regression adjusted or not, have to be interpreted with particular care because, unlike outcomes in many program evaluations, desired changes in foods and nutrients consumed are not in the same direction for each child. For some children, consuming more calories than average could be a positive finding, while for many others, it would be cause for concern. Furthermore, differences in mean amounts of nutrients are not always substantively meaningful (even if statistically significant), as the levels of many nutrients are "acceptable" over a wide range. Policy concerns in the nutrition area generally focus on the tails of nutrient intake distributions—that is, on avoiding both inadequate and excessive intakes.

Since we are focusing on children from families with adult food insecurity, the prevalence of inadequate intakes among the children is naturally of interest. However, more than one day of intakes is needed to identify inadequacies in usual intakes, since people's intakes during one day are quite variable.[12] Since the focus of this study is on the role of school meals in the diets of children from less-food-secure households, comparisons of mean outcomes are relevant, as they provide a

[12] For most nutrients, methods have been developed to use a second 24-hour intake from a random subsample of the population to estimate the distribution of usual intakes, to separate within- (day-to-day) and between-person variability in intake (Nusser et al. 1996). To take advantage of these methods, SNDA-III collected a second-day dietary recall data on a subsample. Usual nutrient intake distributions can thus be estimated for the full sample and large subgroups. Since 94 food-insecure students and 92 marginally secure students have a second day of dietary intake data, the Nusser et al. approach could potentially be used to assess usual *nutrient* intakes for these populations. However, usual *food* intakes cannot be estimated because there are many more zero observations for foods consumed compared to nutrients. Furthermore, the usual intakes are estimates for populations, not for individuals, so the regression approach cannot be used to control for observable differences between the food-secure and food-insecure groups.

general sense of whether these children consume different amounts of key nutrients, energy, and other dietary components such as fiber and cholesterol, as well as different amounts of underconsumed foods such as fruits and vegetables. Even more, examining intakes from school meals as a percentage of daily intakes provides a measure of the importance of the school meals in the diets of less-food-secure children.

III. CHARACTERISTICS OF FOOD-INSECURE AND MARGINALLY SECURE STUDENTS

To provide context for the analysis of the main research questions, this chapter presents descriptive background information on food-insecure and marginally secure students and their families, and contrasts them to highly food-secure students and families. Before we consider the dietary outcomes, which are the focus of our research questions, we describe how similar or different the food-insecure, the marginally secure, and the highly secure students were. Our description of the various food security groups is of interest in its own right, especially for the marginally food-secure students, who have been studied less often. There are six comparisons that the tables in this chapter detail. The first three comparisons are between the highly food-secure students, the food-insecure students, and the marginally secure students. The next three examine the same three groups but use a subsample restricted to NSLP participants in each group. Participants are those most directly affected by the program, and the dietary intakes of NSLP participants will be presented separately in Chapter IV to provide in-depth answers to our research questions.

To assess these comparisons, we ran six independent chi-squared tests per categorical row variable for tables III.1 through III.4. These are not to be interpreted as tests for causal relationships; they are simply a measure of whether there were, between each pair of groups, differences not likely to have occurred by chance.

A. Student and Household Characteristics

As expected, students lived in households whose food security status (on the adult scale) was closely related to their income and program participation. Household income (relative to the poverty line) was highly correlated with food security: 72 percent of food-insecure students (and 60 percent of marginally secure students) were from households with incomes below 130 percent of the poverty line, compared to 19 percent of highly food-secure students (Table III.1). Participation in the school

Table III.1 Household Income and Program Participation, by Food Security Status

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Household Income as a % of Poverty		β	γ			β	γ	
0-130	71.8	60.3	18.5	30.0	70.5	60.6	23.5	36.2
131-185	18.0	24.5	8.6	11.6	20.0	24.5	10.9	14.2
186-300	4.8	10.2	21.5	18.1	3.8	10.6	21.3	17.0
301-400	1.5	2.2	19.2	15.0	0.7	1.1	16.9	12.1
Greater than 400	3.9	2.8	32.3	25.4	5.1	3.2	27.4	20.5
Applied for Free/Reduced Price Lunch	92.6α	83.6β	32.5γ	45.9	94.4α	87.1β	41.4γ	56.3
Eats School Lunch 1+ times/week [a]	93.4	90.3β	84.5γ	86.3	99.6	97.6	99.3	99.1
Eats School Lunch 3+ times/week [a]	85.5	80.1β	68.3γ	71.9	96.3	91.9	91.7γ	92.5
NSLP Participant (on recall day)	75.8	78.3β	56.7γ	61.5	100.0	100.0	100.0	100.0
Usually Eats Breakfast								
Sometimes	14.5	16.2	11.4	12.4	10.4	13.7	9.1	10.0
Yes	74.3	73.9	80.2	78.6	78.5	77.3	83.1	81.4
No	11.2	9.9	8.4	9.0	11.1	9.0	7.8	8.6
Eats School Breakfast 1+ times/week [a, b]	80.4α	67.9β	44.9γ	52.8	84.8α	74.8β	57.2γ	64.7
Eats School Breakfast 3+ times/week [a, b]	48.9α	40.2β	25.2γ	30.5	57.9α	46.5β	36.2γ	41.6
SBP Participant (on recall day)[b]	36.7α	25.9β	17.1γ	21.0	43.2α	31.0	25.4γ	29.4
Sample Size	**348**	**284**	**1,638**	**2,270**	**249**	**197**	**914**	**1,360**
Households with Income to Poverty Line Ratios 185% or below								
Family Receives Food Stamps	46.0α	32.3	24.1γ	32.2	46.6	32.5	26.2γ	33.6
Any Emergency Food Past 30 Days[c]	18.7α	2.1	3.4γ	7.5	20.6α	2.4	4.1γ	8.5
Family Receives WIC Benefits[d]	22.4	16.3	14.6γ	17.2	23.2	16.9	16.5	18.5
Receives TANF/Other Cash Welfare	17.7	12.1	10.1γ	12.7	17.8	12.1	12.0	13.7
Receives Medicaid or SCHIP	58.8	53.4	47.1γ	51.8	62.3	55.9	50.5γ	55.1
Sample Size	**308**	**229**	**444**	**981**	**218**	**160**	**310**	**688**

Table III.1 (continued)

Source: SNDA-III Parent Interviews, school year 2004-2005. Tabulations are weighted to be nationally representative of students in public NSLP schools.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale. NSLP participation refers to participation on the recall day.

α, β, and γ represent the results from individual χ^2 tests for categorical variables:
$^{\alpha}$ Difference between the insecure and the marginal group is significant at the .05 level.
$^{\beta}$ Difference between the marginal and the high security group is significant at the .05 level.
$^{\gamma}$ Difference between the high security and the insecure group is significant at the .05 level.

[a]Based on child's response if available about usual breakfast or lunch participation. If not available, then filled in with parent's response.
[b]Restricted to students at schools that serve breakfast, n=1970.
[c]From a food pantry, soup kitchen, or shelter.
[d]WIC is the Special Supplemental Nutrition Program for Women, Infants, and Children.
[e]SCHIP is the State Children's Health Insurance Program. Because in some states it is part of Medicaid, the interview asked about them jointly. The income cutoffs for SCHIP are higher than for Medicaid, and exceed 185 percent of poverty in some states.

meal programs and food insecurity were also closely related. Insecure and marginally secure students were much more likely than highly secure ones to have applied for free or reduced-price lunches (93 percent and 84 percent, respectively, compared to 33 percent of the highly secure). In addition, larger proportions of the insecure and marginally secure groups than of the highly secure group reported eating a school lunch one or more times a week. The contrast is also evident when we look at proportions that reported usually eating school meals three or more times a week (86 percent of the insecure, 80 percent of the marginally secure, and 68 percent of the highly secure).

Reports by students on whether they usually eat breakfast were not significantly different among the food security groups, but it is worth noting that the percentages that said they do not eat breakfast or sometimes eat breakfast increased as food security decreased (see Chapter VI for more discussion of breakfast skipping). However, less food secure students were significantly more likely to report eating breakfast *at school* (both at least once a week and at least three times a week).

The primary measure of participation for either the NSLP or the SBP refers to participation on the day covered by the child's 24-hour recall interview, not the self-reported measures of usual participation, because it covers the same day as the dietary recalls. Food-insecure students and marginally secure students were more likely to participate in the NSLP (76 percent and 78 percent, respectively) on the recall day than highly food-secure students (57 percent).[1] The food-insecure students were also more likely than the marginally and highly food-secure students to have eaten a school breakfast. Nonetheless, only 37 percent of the food-insecure students in schools that served breakfast participated in the SBP on the recall day.

[1] If it seems somewhat surprising that 24 percent of children from food-insecure households did not participate in the NSLP, recall that food security is a measure of household access to food over the past 12 months, while our measure of participation is for one particular day.

Among students from households at or below 185 percent of the poverty level, the households of food-insecure students were more likely than those of marginally and highly food-secure students to be receiving food stamps or emergency food (from a food pantry, soup kitchen, or shelter). Again looking only at lower-income households, food-insecure households were more likely than highly food-secure ones to be receiving WIC benefits (see lower panel of Table III.1).[2,3] Other researchers have also found that food-insecure households are more likely than low-income families who are food secure to participate in food assistance programs (Briefel et al. 2003).

The food-insecure and marginally secure students differed from the highly secure in terms not only of income and program participation, but also of basic demographic characteristics, and on the whole tended to be more disadvantaged. They were on average slightly, but not significantly, older than the highly secure students (Table III.2). The marginally secure students were disproportionately female (the insecure, disproportionately male). Both the marginally secure and the insecure were less likely to be non-Hispanic white and more likely to be non-Hispanic black or Hispanic. They were also more likely than the highly food secure to speak Spanish at home. Both insecure and marginally secure students were more likely than highly secure students to be from households with only one adult. Their parents were less educated and worked fewer hours. Lower levels of food security were also associated with more children under 18 in the household.

[2] WIC is the Special Supplemental Nutrition Program for Women, Infants, and Children. It is available only to pregnant and postpartum women and children less than five years old, so the differences in participation can reflect differences in household composition as well as overall interest in or need for assistance.

[3] Results regarding participation in public assistance and emergency food programs are based on a sample restricted to households with incomes at or below 185 percent of the poverty line, in order to compare participation rates across households that are likely to be eligible. Furthermore, families with incomes above 200 percent of the poverty level were not supposed to be asked the questions about food stamps, WIC benefits, TANF or other cash welfare, or Medicaid/SCHIP. Compliance with this was not perfect, and some families above 200 percent did respond, but because the sample was limited to those under 185 percent of the poverty level, the statistics reported in Table III.1 are unaffected by this inconsistency.

Table III.2 Demographics by Food Security and NSLP Participation

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Age (years)								
5-8	18.6	21.5	24.4	23.3	23.1	24.9	29.2	27.6
9-10	15.5	15.8	18.9	18.1	17.8	19.9	21.5	20.7
11-13	26.3	26.5	22.7	23.6	27.6	26.0	25.0	25.5
14-19	39.6	36.2	34.0	35.0	31.4	29.2	24.4	26.2
Average Age	12.2	11.9	11.6	11.7	11.6	11.3	10.9$^{\gamma}$	11.1
Sex	α					β		
Male	54.1	42.5	50.0	49.8	55.5	43.7	54.0	52.9
Female	45.9	57.5	50.0	50.2	44.5	56.3	46.0	47.1
Race/Ethnicity		β	γ			β	γ	
Hispanic	42.5	34.3	17.2	22.4	41.9	35.3	18.6	24.7
White, non-Hispanic	28.3	38.4	61.3	54.5	30.7	37.6	57.5	50.5
Black, non-Hispanic	22.3	24.0	14.4	16.5	20.5	24.4	17.2	18.7
Other	6.9	3.2	7.0	6.6	6.9	2.7	6.6	6.1
Language Spoken at Home		β	γ			β	γ	
Spanish	27.2	15.6	6.4	10.1	28.0	16.4	7.9	12.3
Other than Spanish or English	5.1	5.9	2.9	3.5	4.5	5.0	2.7	3.3
Number of Adults in Household		β	γ			β	γ	
1	30.9	24.1	13.1	16.6	31.5	24.0	15.7	19.4
2	46.4	53.8	65.0	61.3	47.0	54.8	63.5	59.6
3	15.7	16.5	17.3	17.0	16.3	15.7	15.8	15.9
4 or more	7.0	5.7	4.7	5.1	5.2	5.5	4.9	5.1
Number of Children Under 18 in Household		β	γ			β	γ	
0	2.0	1.7	2.6	2.4	1.6	1.7	1.7	1.7
1	15.5	14.7	26.5	23.8	13.6	13.7	26.6	22.8
2	26.1	33.6	40.6	38.0	25.3	30.2	38.8	35.4
3	31.4	28.1	18.7	21.4	32.3	30.6	19.8	23.3
4 or more	25.0	21.9	11.7	14.5	27.1	23.8	13.1	16.9

Table III.2 *(continued)*

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Parent's Highest Education Level	α	β	γ		α	β	γ	
Less than HS	32.0	18.4	6.4	11.1	33.5	17.0	8.1	13.5
High School/GED	30.1	40.7	20.8	24.1	31.4	40.1	24.5	27.8
Some postsecondary	31.6	28.3	37.3	35.5	31.3	30.6	38.6	36.3
College Grad	6.4	12.7	35.6	29.3	3.7	12.3	28.7	22.4
Parent's Hours Worked per Week		β	γ				γ	
0	30.1	31.1	23.0	24.8	31.4	30.8	22.4	25.0
1-20	18.8	16.3	11.5	13.0	18.3	15.6	10.9	12.7
21-35	10.4	10.7	15.3	14.2	11.7	10.6	14.6	13.6
36-40	26.0	28.0	29.2	28.6	23.8	29.0	29.2	28.3
More than 40	14.6	13.8	21.0	19.4	14.8	13.9	22.9	20.3
Sample Size	**348**	**284**	**1,638**	**2,270**	**249**	**197**	**914**	**1,360**

Source: SNDA-III Parent Interviews, school year 2004-2005. Tabulations are weighted to be nationally representative of students in public NSLP schools.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale. NSLP participation refers to participation on the recall day.

α, β, and γ represent the results from individual χ^2 tests for categorical variables:
[α] Difference between the insecure and the marginal group is significant at the .05 level.
[β] Difference between the marginal and the high security group is significant at the .05 level.
[γ] Difference between the high security and the insecure group is significant at the .05 level.
Differences in the average age were tested using independent two-tailed t-tests.

B. Student Health, Physical Activity, and Eating Habits

Marginally food-secure and food-insecure students were more likely than highly food-secure students to be overweight or obese (at or above the 95th percentile for Body Mass Index), less likely to participate in community sports, and less likely to be reported as in excellent health by their parents (Table III.3). There was also a significant difference between the insecure and the highly secure in the nights per week that their families eat together (measured only among students aged 12 or older). While 34 percent of both groups reported eating together 7 nights a week, 16 percent of the highly secure reported eating dinner with their families 5 to 6 nights a week, compared to 8 percent of the insecure. On the other end of the scale, 26 percent of the highly secure reported eating 0 to 2 dinners a week with their families, compared to 36 percent of the insecure.

Food-insecure students were more likely than highly secure ones to be considered very or somewhat picky eaters by their parents, but both groups had similar eating habits related to fat consumption (Table III.3). The marginally secure were more likely than the highly secure to be very picky, but their overall pickiness (the total of very and somewhat picky) was similar to that of the highly secure. Reported eating habits of students at all food security levels, as measured by parent reports of whether they drink skim milk, eat fried chicken, add fat to potatoes, or have a lot of fat spread on their bread, were similar across the groups in the sense that the distribution of habits within each group was very similar, in general. One exception was that highly food-secure students were more likely than food-insecure students to be served low-fat milk all the time.

C. School Characteristics

Marginally secure and insecure students were disproportionately in secondary schools (versus elementary schools), because families with older children were more likely than families with younger children to report adult food insecurity or marginal security (Table III.4). Consistent with their higher household incomes, highly food-secure students were more likely to attend a school

Table III.3 Health, Physical Activity, and Eating Habits, by Food Security and NSLP Participation

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Body Mass Index (BMI)		β	γ			β	γ	
< 5th percentile	3.3	5.8	6.4	5.9	3.6	6.7	5.0	5.0
≥5th percentile & <85th percentile	52.3	49.6	58.1	56.4	51.3	49.6	59.4	56.8
≥85th percentile & <95th percentile	13.8	15.7	16.4	16.0	12.9	15.4	14.8	14.6
≥95th percentile	30.6	28.9	19.1	21.7	32.1	28.3	20.8	23.7
Physical Activities								
(Child report, multiple yes's possible[a])								
Taking physical education in school	72.9	76.7	79.5γ	78.3	76.0	80.5	84.1γ	82.3
On a school sports team	20.4	13.4β	25.4	23.4	20.0	12.3β	23.5	21.4
Participate in community sports	37.9	39.2β	54.0γ	50.3	38.7	40.1β	54.1γ	49.6
Walks or bikes to school	22.9	23.4	19.1	20.1	22.1	23.2	17.8	19.2
Physically active outside of school	91.2	92.4	94.6	93.8	96.4	94.1	94.7	95.0
Child's General Health		β	γ			β	γ	
Excellent	37.6	40.4	53.4	49.9	37.9	41.5	52.0	48.3
Very good	32.1	29.9	33.1	32.6	33.8	32.5	33.2	33.2
Good	20.0	21.2	10.9	13.2	18.5	16.4	11.9	13.6
Fair	9.3	8.2	2.1	3.7	8.6	9.4	2.3	4.3
Poor	0.9	0.2	0.5	0.6	1.2	0.2	0.7	0.7
Nights per Week Family Eats Dinner Together			γ					
(Child report, age 12 & up only, n=1,544)								
Every Night	34.4	38.2	34.1	34.7	34.7	38.5	35.6	35.8
5 or 6	7.5	9.5	15.6	13.7	7.8	6.3	14.7	12.1
3 or 4	22.0	24.9	24.6	24.2	24.0	23.8	26.0	25.3
1 or 2	19.7	14.9	16.8	17.0	20.3	17.2	13.9	15.6
None	16.4	12.5	8.9	10.5	13.2	14.3	9.9	11.2
Amount Child Eats Compared with Other Children the Same Age								
Larger Amount	26.4	24.8	22.1	22.9	23.5	24.2	22.7	23.0
Same Amount	56.2	54.5	63.4	61.5	57.5	54.4	63.0	61.0
Smaller Amount	17.4	20.6	14.6	15.6	19.1	21.4	14.3	16.0
Pickiness	α	β	γ		α	β	γ	
Very picky eater	28.2	29.8	19.0	21.4	29.5	27.5	18.8	21.7
Somewhat picky eater	47.4	35.0	45.7	44.8	47.1	33.8	45.5	44.1
Not a picky eater	24.4	35.2	35.3	33.8	23.4	38.8	35.8	34.2

Table III.3 *(continued)*

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
In past 30 days, ate less or chose foods low in fat or carbs to lose weight (Child report, age 12 & up, n=1,533)	35.7	35.0	27.9	29.9	36.8	37.5	25.7	29.6
Uses Skim or 1% Milk			γ					
Always	31.0	33.9	39.1	37.5	30.4	34.7	36.2	35.1
Sometimes	16.3	16.2	9.4	11.0	13.6	16.6	9.6	11.2
Rarely	7.2	7.5	8.6	8.3	8.0	6.7	9.6	8.9
Never	44.7	40.0	41.7	41.9	47.6	39.3	43.5	43.6
Doesn't drink milk	0.7	2.4	1.2	1.3	0.4	2.8	1.1	1.2
Serves Chicken That is Fried			γ					
Always	13.6	10.7	7.4	8.6	13.9	10.3	9.5	10.3
Sometimes	44.2	41.2	33.8	36.0	44.0	40.7	37.7	39.1
Rarely	29.6	30.3	38.3	36.3	29.3	29.8	36.0	34.0
Never	11.1	17.4	19.0	17.8	11.1	19.1	15.8	15.5
Doesn't eat chicken	1.6	0.5	1.4	1.4	1.7	0.1	1.1	1.1
Adds Fat to Potatoes, Baked or Mashed	α		γ		α		γ	
Always	50.2	52.1	58.7	56.8	50.2	55.5	58.7	56.9
Sometimes	30.7	20.9	17.6	19.6	28.8	17.4	18.0	19.6
Rarely	11.0	10.6	10.3	10.4	12.7	9.4	10.1	10.5
Never	7.8	13.2	9.8	9.9	7.7	14.6	10.7	10.7
Doesn't eat this	0.4	3.2	3.7	3.2	0.5	3.0	2.5	2.3
Amount of Fat Spread on Bread								
None	20.1	17.4	17.5	17.8	20.2	15.3	16.7	17.1
Light	41.3	46.2	45.6	45.1	43.9	46.7	46.5	46.1
Moderate	32.7	28.6	32.5	32.1	31.3	30.0	32.5	32.0
Generous	6.0	7.8	4.3	4.9	4.6	8.1	4.3	4.9
Sample Size	**348**	**284**	**1,638**	**2,270**	**249**	**197**	**914**	**1,360**

Table III.3 *(continued)*

Source: SNDA-III Parent and Child Interviews, school year 2004-2005. Tabulations are weighted to be nationally representative of students in public NSLP schools. Body Mass Index was calculated by Mathematica based on direct measurement of student's height and weight. Other data are from Parent Interview unless otherwise noted.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale. NSLP participation refers to participation on the recall day.

α,β, and γ represent the results from individual χ^2 tests for categorical variables:
[α] Difference between the insecure and the marginal group is significant at the .05 level.
[β] Difference between the marginal and the high security group is significant at the .05 level.
[γ] Difference between the high security and the insecure group is significant at the .05 level.

[a] Since multiple yes's are allowed with respect to a child's physical activities, chi-squared tests were performed individually for each activity.

Table III.4 Characteristics of Schools Attended, by Food Security and NSLP Participation Status

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
School Type		β	γ					
Elementary	43.7	44.6	52.4	50.4	52.8	53.0	62.0	59.3
Middle	25.2	26.3	18.3	20.0	22.9	24.2	18.2	19.7
High	31.2	29.2	29.3	29.6	24.4	22.9	19.8	21.0
Percentage of Students Certified for Free or Reduced Lunch[a]		β	γ				γ	
Low (< 20%)	23.0	30.7	41.8	38.2	21.2	31.7	34.6	32.0
Medium (20-60%)	39.8	41.2	41.2	41.0	38.2	41.8	42.0	41.3
High (60%more)	37.2	28.1	16.9	20.8	40.6	26.5	23.4	26.6
School Participates in SBP	93.3	90.7[β]	80.6[γ]	83.4	95.4	91.3	83.1[γ]	86.2
School Size (enrollment)		β	γ				γ	
Small	25.4	25.4	28.3	27.6	18.4	20.9	20.9	20.5
Medium	56.5	50.7	39.6	43.0	61.6	51.1	44.1	47.9
Large	18.1	23.9	32.2	29.4	20.0	28.1	35.0	31.6
Metropolitan Status			γ					
Urban	50.1	42.5	34.8	37.6	46.8	40.5	32.9	36.2
Suburban	28.9	38.9	45.2	42.4	29.9	39.6	42.7	40.2
Rural	20.9	18.5	20.1	20.0	23.3	19.9	24.4	23.6
FNS Region		β	γ			β	γ	
Mid-Atlantic	7.6	10.8	11.0	10.5	7.4	8.0	11.5	10.4
Midwest	11.3	10.5	18.4	16.6	11.2	10.4	18.6	16.3
Mountain/Plains	2.4	7.4	8.9	7.9	1.6	8.8	8.7	7.6
Northeast	5.4	6.5	9.6	8.7	5.6	5.5	7.7	7.1
Southeast	24.4	25.2	21.8	22.5	26.1	27.9	26.0	26.3
Southwest	25.0	15.0	14.1	15.6	25.4	14.4	14.7	16.4
Western	23.8	24.6	16.2	18.1	22.7	25.0	12.7	16.0
Sample Size	**348**	**284**	**1,638**	**2,270**	**249**	**197**	**914**	**1,360**

Table III.4 *(continued)*

Source: SNDA-III Initial Contact Survey, school year 2004-2005. Tabulations are weighted to be nationally representative of students in public NSLP schools.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale. NSLP participation refers to participation on the recall day.

α, β, and γ represent the results from individual χ^2 tests for categorical variables:
[α] Difference between the insecure and the marginal group is significant at the .05 level.
[β] Difference between the marginal and the high security group is significant at the .05 level.
[γ] Difference between the high security and the insecure group is significant at the .05 level.

[a] Based on 2003-04 U.S. Department of Education Common Core of Data.

with a low percentage of students (less than 20 percent) certified for free or reduced-price lunch (42 percent for the highly secure compared to 31 percent for the marginally secure and 23 percent for the insecure). Highly food-secure students were modestly (but significantly) less likely to attend schools that participate in the SBP. Overall, 83 percent of students attended schools that serve breakfasts, but 93 percent of insecure and 91 percent of marginally secure students attended such schools, compared to 81 percent of the highly food secure.

Only 18 percent of food-insecure students attended large schools (more than 1,000 enrolled) compared to 24 percent of the marginally food-secure and 32 percent of the highly food-secure students. The latter result is surprising, since food insecurity was reported more frequently by parents of secondary school students, and secondary schools tend to be larger. From 19 to 21 percent of each group attended schools in rural areas, but 50 percent of the food-insecure students attended urban schools, compared to 43 percent of the marginally secure and 35 percent of the highly secure.[4] The insecure and marginally secure were more likely than the highly secure to live in the West and less likely to live in the Midwest. The insecure were also more likely than the marginally secure and highly secure to live in the Southwest and less likely to live in either the Mountain/Plains or the Mid-Atlantic region.

[4] Geographic region and metropolitan status for each student in SNDA-III is based upon the school's location.

IV. COMPARISONS OF DIETARY INTAKES BY FOOD SECURITY STATUS

This chapter examines the key outcomes for this study: intakes on school days of (1) food energy, nutrients, and other dietary components such as fiber, and (2) MyPyramid Equivalents (MPEs) of key food groups. It also examines the proportions of children' daily intakes of nutrients and specific food groups from on-menu school foods (that is, foods offered as part of reimbursable school meals).

1. Research Questions

This chapter addresses two sets of research questions:

1. How do the ***energy and nutrients*** consumed by children from food-insecure and marginally food-secure households compare to consumption by highly secure children at breakfast, lunch, and over 24 hours? Do food-insecure and marginally secure children obtain a larger proportion of their nutrients and energy on school days from school meals than highly food-secure children?
2. How do the ***foods*** consumed by children from food-insecure and marginally food-secure households compare to consumption by highly secure children at breakfast, lunch, and over 24 hours? Do food-insecure and marginally secure children consume a larger percentage of servings of key food groups (such as milk, fruits, vegetables, and meats) from school meals than highly food-secure children?

A. Approach to Food and Nutrient Analyses

There are three ways in which less-food-secure children could consume (proportionately) more foods and nutrients from school breakfasts and lunches than highly food-secure children: (1) they could be more likely to participate in the school meal programs; (2) when they do participate, they could eat more calories than highly secure participants, since the marginal cost of additional school meal items is often zero (and, in fact, schools require that children take a certain number of items); and (3) they could eat less outside school meals than highly secure participants, either in school or outside school. To help sort out the drivers of any differences, we also compared less-food-secure *school meal participants* to highly food-secure *participants* in each of the data tables. As discussed in the next two sections, compared to highly secure children, insecure and marginally secure children

obtained a higher proportion of their school-day intakes of energy, nutrients, and key food groups from on-menu foods.

Intakes from key food groups such as milk, fruits, vegetables, and meats are measured by MPEs, as described in Chapter II. Nutrient intakes are presented in Tables IV.1a through IV.4b, and MPEs in Tables IV.5a through IV.8b.[1] For each set of tables, the discussion examines (1) mean 24-hour dietary intakes, (2) mean intakes at breakfast, (3) mean intakes at lunch, and (4) proportions contributed by on-menu school foods to 24-hour intakes.[2]

For all these outcomes, we compared food-insecure and marginally secure children to highly food-secure children and present results showing both the unadjusted mean values (Tables IV.1a to IV.8a) and regression-adjusted means from a multivariate analysis that adjusts for observable differences between the food security groups, such as age, gender, household income, and participation in school meals (Tables IV.1b to IV.8b).[3] To isolate the relationship between food security and dietary intakes, the regressions control for differences among the groups other than food security. Details on the regression adjustments are in Appendix A; they are based on the regression adjustments used in the SNDA-III study (Gordon et al. 2007b).

The adjusted results are very similar to the unadjusted results for the tables that look at the mean intakes consumed (compare Tables IV.1a to IV.3a and IV.5a to IV.7a to the b versions of these tables). However, when considering the proportion of intakes from on-menu school foods, the results differ (compare Table IV.4a to IV.4b and IV.8a to IV.8b.) Whether or not we control for school meal participation matters for these results, because participation rates are so much higher

[1] Table presentation begins in Section B.

[2] Since this report is descriptive, we have not in any way restricted the number of outcome variables, and our reporting on the individual significant differences at the 5 percent level for each comparison is strictly for descriptive purposes.

[3] The full list of covariates is shown in Table A.1 in Appendix A.

for the insecure and the marginally secure than for the highly secure, and because participants consume more on-menu school foods than nonparticipants.[4]

The tables describing breakfast and lunch intakes include only children who reported eating something during breakfast or lunch. (See Chapter II, Section B.2 for definitions of breakfast and lunch foods). Thus, the sample sizes are larger for the 24-hour intake tables (IV.1a, b and IV.5 a, b), since everyone ate something during the 24-hour recall period. An alternative would have been to include zeros for those children who skipped each meal, but then any differences would be harder to interpret. Thus, the meal-specific tables focus only on children that ate something at that meal. Meal skipping and, in particular, breakfast skipping (which is much more prevalent than lunch skipping) are discussed in Chapter VI.

B. Mean Nutrient Intakes by Food Security Status

1. Intakes over 24 Hours

Over the 24-hour recall period, there were only a few significant differences in nutrient intakes between highly food-secure and insecure children (Tables IV.1a and IV.1b). Significant differences at the 5 percent level between these groups are indicated by a γ in the *high* column (column 4 in the tables). Significant differences between the insecure and the marginally secure are shown by an α in the *insecure* column, and significant differences between the marginally secure and the highly secure are shown by a β in the *marginal* column. The entry in the *food energy* row and *high* column shows that the average highly food-secure student consumed 2,121 calories over the course of 24 hours (Table IV.1a, unadjusted) and that this was not significantly different from what the average insecure

[4] As a sensitivity test, we also ran the regression controlling for just a few basic observable characteristics (age, gender, and height) and not participation. These (unreported) results were very similar to the unadjusted results.

Table IV.1a 24-Hour Nutrient Intakes

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Food Energy (kcal)	2,166$^{\alpha}$	1,945$^{\beta}$	2,121	2,108	2,195$^{\alpha}$	1,933$^{\beta}$	2,150	2,129
Macronutrients: Total Amount (g)								
Total fat	80.4$^{\alpha}$	69.7$^{\beta}$	76.3	76.2	81.0$^{\alpha}$	69.0$^{\beta}$	77.2	76.8
Saturated fat	27.5$^{\alpha}$	23.7$^{\beta}$	26.5	26.3	27.9$^{\alpha}$	23.5$^{\beta}$	26.9	26.6
Monounsaturated	30.9$^{\alpha}$	26.8$^{\beta}$	29.4	29.3	30.8$^{\alpha}$	26.5$^{\beta}$	29.7	29.4
Polyunsaturated	16.0$^{\alpha}$	14.0	15.0	15.0	16.3$^{\alpha}$	13.9	15.0	15.1
Carbohydrate	285.2$^{\alpha}$	263.1$^{\beta}$	289.2	285.8	289.5$^{\alpha}$	261.8$^{\beta}$	292.6	287.8
Protein	81.6$^{\alpha}$	70.7$^{\beta}$	75.4$^{\gamma}$	75.8	83.3$^{\alpha}$	70.9$^{\beta}$	77.3	77.5
Macronutrients: Percentage of Food Energy from								
Total fat	32.2	32.1	31.8	31.9	32.2	32.1	31.8	31.9
Saturated fat	11.1	10.9	11.0	11.0	11.2	11.0	11.1	11.1
Monounsaturated	12.4	12.4	12.3	12.3	12.3	12.4	12.2	12.3
Polyunsaturated	6.3	6.4	6.3	6.3	6.4	6.4	6.2	6.2
Carbohydrate	53.6	54.1	55.0	54.7	53.5	54.0	54.8	54.4
Protein	15.2	14.7	14.4$^{\gamma}$	14.6	15.4	14.8	14.5$^{\gamma}$	14.7
Vitamins and Minerals								
Vitamin A (mcg RAE)	591.3	544.4$^{\beta}$	635.3	621.2	625.8	548.8$^{\beta}$	665.4	644.2
Vitamin C (mg)	91.9	94.5	90.8	91.5	91.4	95.6	89.5	90.9
Vitamin E (mg)	6.7$^{\alpha}$	5.5$^{\beta}$	6.3	6.2	6.7	5.3$^{\beta}$	6.0	6.0
Vitamin B_6 (mg)	1.9$^{\alpha}$	1.6$^{\beta}$	1.8	1.8	1.9$^{\alpha}$	1.6$^{\beta}$	1.8	1.7
Vitamin B_{12} (mcg)	5.5$^{\alpha}$	4.8	5.3	5.3	5.7$^{\alpha}$	4.7$^{\beta}$	5.3	5.3
Folate (mg DFE)	565.0	528.9$^{\beta}$	599.5	586.9	553.6	529.6	585.0	572.0
Calcium (mg)	1,116$^{\alpha}$	973.6$^{\beta}$	1,101	1,090	1,176$^{\alpha}$	1,006$^{\beta}$	1,174	1,151
Iron (mg)	15.9	14.1$^{\beta}$	15.6	15.4	15.7	14.1	15.3	15.2
Magnesium (mg)	261.0$^{\alpha}$	229.2$^{\beta}$	254.0	252.2	269.5$^{\alpha}$	230.5$^{\beta}$	257.0	255.2
Phosphorus (mg)	1,434$^{\alpha}$	1,258$^{\beta}$	1,368	1,366	1,497$^{\alpha}$	1,275$^{\beta}$	1,417	1,411
Potassium (mg)	2,597$^{\alpha}$	2,352$^{\beta}$	2,498	2,498	2,696$^{\alpha}$	2,357$^{\beta}$	2,600	2,584
Sodium (mg)	3,499$^{\alpha}$	3,136$^{\beta}$	3,419	3,400	3,578$^{\alpha}$	3,124$^{\beta}$	3,492	3,458
Zinc (mg)	12.2$^{\alpha}$	10.6$^{\beta}$	11.6	11.6	12.3$^{\alpha}$	10.6$^{\beta}$	11.6	11.6
Other Dietary Components								
Fiber (g)	14.6$^{\alpha}$	12.9$^{\beta}$	14.1	14.0	15.1$^{\alpha}$	13.2$^{\beta}$	14.3	14.3
Cholesterol (mg)	231.6$^{\alpha}$	202.9	210.7	213.1	233.5$^{\alpha}$	197.0	207.4	211.2
Number of Students	**348**	**284**	**1,638**	**2,270**	**249**	**197**	**914**	**1,360**

Table IV.1a *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Intakes of both NSLP participants and nonparticipants include all foods and beverages eaten over 24 hours. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP participation refers to participation on the recall day.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

Table IV.1b Regression-Adjusted 24-Hour Nutrient Intakes

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Food Energy (kcal)	2176.4$^{\alpha}$	1980.1$^{\beta}$	2114.6	2107.9	2,184.6$^{\alpha}$	1,938.6$^{\beta}$	2,151.9	2,128.8
Macronutrients: Total Amount (g)								
Total fat	80.1$^{\alpha}$	70.1$^{\beta}$	76.3	76.2	79.9$^{\alpha}$	68.6$^{\beta}$	77.5	76.7
Saturated fat	27.4$^{\alpha}$	24.1$^{\beta}$	26.4	26.3	27.6$^{\alpha}$	23.7$^{\beta}$	26.9	26.6
Monounsaturated	30.8$^{\alpha}$	27.1	29.4	29.3	30.5$^{\alpha}$	26.4$^{\beta}$	29.8	29.4
Polyunsaturated	16.0$^{\alpha}$	13.8	15.0	15.0	16.1$^{\alpha}$	13.5$^{\beta}$	15.1	15.1
Carbohydrate	288.5	270.6$^{\beta}$	287.7	285.9	291.3$^{\alpha}$	264.7$^{\beta}$	291.7	287.9
Protein	81.7$^{\alpha}$	71.5	75.3$^{\gamma}$	75.7	81.4$^{\alpha}$	70.3$^{\beta}$	77.8	77.4
Macronutrients: Percentage of Food Energy from								
Total fat	32.1	31.7	31.9	31.9	32.0	31.9	31.9	31.9
Saturated fat	11.2	10.9	11.0	11.0	11.3	11.0	11.1	11.1
Monounsaturated	12.3	12.3	12.3	12.3	12.2	12.3	12.3	12.2
Polyunsaturated	6.3	6.2	6.3	6.3	6.3	6.2	6.2	6.2
Carbohydrate	54.0	54.7	54.8	54.7	54.1	54.4	54.6	54.5
Protein	15.1	14.6	14.4$^{\gamma}$	14.5	15.1	14.7	14.6	14.7
Vitamins and Minerals								
Vitamin A (mcg RAE)	651.0	592.7	618.8	619.8	675.0	589.5	646.8	643.1
Vitamin C (mg)	94.1	97.6	89.9	91.3	91.5	98.2	88.8	90.6
Vitamin E (mg)	7.0$^{\alpha}$	5.7	6.2	6.2	6.6	5.3$^{\beta}$	6.0	6.0
Vitamin B_6 (mg)	1.9$^{\alpha}$	1.7	1.8	1.8	1.8$^{\alpha}$	1.6$^{\beta}$	1.8	1.7
Vitamin B_{12} (mcg)	5.7$^{\alpha}$	5.0	5.2	5.2	5.7$^{\alpha}$	4.7$^{\beta}$	5.3	5.3
Folate (mg DFE)	626.9	581.1	581.0	587.4	582.1	544.7	576.7	572.4
Calcium (mg)	1147.0$^{\alpha}$	1017.5	1089.8	1089.4	1,209.3$^{\alpha}$	1,046.0$^{\beta}$	1,158.0	1,151.2
Iron (mg)	16.8$^{\alpha}$	14.9	15.3	15.4	16.0	14.2	15.3	15.2
Magnesium (mg)	265.6$^{\alpha}$	236.4	252.1	252.2	270.1$^{\alpha}$	233.3$^{\beta}$	256.3	255.4
Phosphorus (mg)	1454.0$^{\alpha}$	1297.1	1359.4	1365.0	1,508.1$^{\alpha}$	1,297.0$^{\beta}$	1,410.3	1,410.8
Potassium (mg)	2589.7$^{\alpha}$	2396.1	2492.8	2495.4	2,696.2$^{\alpha}$	2,389.4$^{\beta}$	2,592.7	2,582.2
Sodium (mg)	3525.1$^{\alpha}$	3182.6$^{\beta}$	3409.3	3399.2	3,540.8$^{\alpha}$	3,125.5$^{\beta}$	3,504.4	3,456.0
Zinc (mg)	12.4$^{\alpha}$	10.9	11.5	11.5	12.2$^{\alpha}$	10.6$^{\beta}$	11.6	11.6
Other Dietary Components								
Fiber (g)	14.6$^{\alpha}$	13.2	14.1	14.0	15.1$^{\alpha}$	13.4	14.3	14.3
Cholesterol (mg)	244.7$^{\alpha}$	212.7	206.9$^{\gamma}$	212.6	230.0$^{\alpha}$	192.8	209.4	210.2
Number of Students	**348**	**284**	**1,638**	**2,270**	**249**	**197**	**914**	**1,360**

Table IV.1b *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Intakes of both NSLP participants and nonparticipants include all foods and beverages eaten over 24 hours. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP participation refers to participation on the recall day. All mean estimates have been regression-adjusted for differences in personal, family, and school characteristics between food security groups including age, sex, household income relative to poverty, ethnicity, height, region and several other characteristics listed in Appendix B.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

student consumed (2,166 calories, Table IV.1a). Of the 21 distinct outcome variables,[5] there are only two significant differences between the insecure and highly secure children: the latter consumed less protein and obtained a lower percentage of food energy from protein.[6] As noted in Section D in Chapter II, given the wide range of acceptable nutrient levels, not all statistically significant differences are substantively important.

However, the marginally secure children consistently consumed significantly less than both other groups, whether we look at all children or NSLP participants. When compared to the insecure, the marginally secure consumed significantly fewer calories, and less of most macronutrients, vitamins, minerals, and other dietary components.[7] The differences in the macronutrients (fat, carbohydrates, and protein) are due to more calories being consumed by the insecure group, because there are no differences in the percentage of food energy from each macronutrient. This pattern occurs in both the unadjusted and the regression-adjusted results.[8] Therefore, the fact that more of the marginally secure were female, compared to the insecure, for example, does not explain their lower intakes of calories and key nutrients.[9]

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[5] While all the dietary intakes in the table are related to the total food energy consumed throughout the day and are thus not completely independent from one another, there are seven rows that are strictly dependent on the other rows in the table and are hence excluded from this count of outcomes. Total fat is the sum of saturated fat, monounsaturated fat, and polyunsaturated fat, and the rows that give the percentage of food energy from fats, carbohydrates, and protein are derived directly from these variables and total food energy. So if the 21 outcomes were independent, at least one significant difference at the 5 percent level would be expected just by chance.

[6] For the adjusted results, there are three significant differences; highly secure students also consumed significantly less cholesterol (Table IV.1b).

[7] Over 24 hours, marginally secure students consumed 221 fewer calories than the insecure and 176 fewer than the highly secure (Table IV.1a, unadjusted).

[8] If we compare the marginally secure group to the highly secure group, we find some differences between the unadjusted and adjusted results. In the adjusted results, there are fewer significant differences in the vitamins and minerals consumed. The sign of the difference is the always the same (and usually the marginally secure students consumed less than the highly secure), but the regression adjustment tends to reduce the size of the differences because part of the differences are due to other observable differences besides food security.

[9] The regression-adjusted intakes are the average predicted values from the regression, assuming that the entire sample is either insecure or marginal but otherwise holding their characteristics constant. The effects of food security status are assumed to be the same for all sample members, regardless of their other characteristics. The regression-

One possible explanation would be that the marginally secure children were less likely to qualify for free or reduced-price meals or other food programs, as they are more likely to have incomes above 130 percent of poverty than the insecure and they were significantly less likely to apply (refer back to Table III.1). Among children from food insecure households, receiving free or reduced-price meads may have also freed up some resources at home. Even among NSLP participants, however, the 24-hour intakes of the marginally secure participants were significantly and substantially lower than those of insecure participants. The next two subsections consider intakes at breakfast and lunch to gauge how much these meals contribute to 24-hour intakes.

2. Breakfast Intakes

Food-insecure children consumed more calories at breakfast than marginally secure children, both among all children that ate breakfast and among SBP participants, but this difference was statistically significant only for the full sample, and only after adjusting for other characteristics (Tables IV.2a and IV.2b). Among those who ate breakfast, marginally secure children consumed 67 fewer calories than the insecure group at breakfast and 20 fewer than the highly secure (Table IV.2a, unadjusted). Comparing the sample sizes at the bottom of Table IV.2a to those in Table IV.1a shows that 74 marginally secure children skipped breakfast completely, but so did 74 insecure children and 201 highly secure ones. Breakfast-skipping behavior is discussed further in Chapter VI.

In general, there were very few significant differences between the insecure and the marginally secure SBP participants in their nutrient intakes at breakfast. One caution is that the sample of SBP participants had only 372 children (103 insecure, 61 marginally secure, and 208 highly food secure), so the ability to detect statistically significant differences was limited.

(continued)
adjusted means shown in the *participant* columns are from a separate regression that was run using only the participant sample.

Table IV.2a Breakfast Nutrient Intakes

	All Students				SBP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Food Energy (kcal)	463.5	396.0	416.1	420.3	462.7	391.6[β]	485.8	464.4
Macronutrients: Total Amount (g)								
Total fat	14.1	11.8	11.4[γ]	11.8	12.5	12.1	14.8	13.8
Saturated fat	5.3	4.4	4.2	4.4	4.6[α]	4.1[β]	5.1	4.8
Monounsaturated	5.2	4.3	4.1[γ]	4.3	4.9	4.7	5.5	5.2
Polyunsaturated	2.4	2.2	2.2	2.2	2.3	2.5	3.0[γ]	2.7
Carbohydrate	71.1	62.1	67.9	67.8	74.8	60.0[β]	74.8	72.3
Protein	14.7[α]	11.6	12.1[γ]	12.4	14.2	11.9[β]	14.8	14.2
Macronutrients: Percentage of Food Energy from								
Total fat	24.7	23.1	23.1	23.4	22.9	25.5	25.7	25.0
Saturated fat	9.6	9.2	8.1[γ]	9.0	8.8	8.9	9.0	9.0
Monounsaturated	9.0	8.4	8.2	8.4	8.9	9.7	9.6	9.4
Polyunsaturated	4.3	4.2	4.3	4.3	4.1	5.1	5.2[γ]	4.9
Carbohydrate	63.8	67.0	67.0[γ]	66.6	64.9	63.6	63.3	63.7
Protein	12.9[α]	11.1	11.6[γ]	11.7	13.2	12.1	12.1	12.4
Vitamins and Minerals								
Vitamin A (mcg RAE)	214.7	201.1	231.2	225.8	208.4[α]	162.4	208.3	201.2
Vitamin C (mg)	28.7	21.6	28.5	27.9	35.7	23.2	30.2	30.9
Vitamin E (mg)	1.0	0.9	1.1	1.1	0.8	0.9	1.1[γ]	1.0
Vitamin B_6 (mg)	0.6	0.5[β]	0.6	0.6	0.5	0.4	0.4	0.4
Vitamin B_{12} (mcg)	1.9	1.6	1.8	1.8	1.7[α]	1.3	1.5	1.5
Folate (mg DFE)	211.6	203.1	238.0	230.9	170.4	151.3	178.3	172.8
Calcium (mg)	324.3	288.6	313.2	311.6	343.6[α]	301.3	344.5	338.2
Iron (mg)	5.2	4.6	5.3	5.2	4.7	4.2	4.3	4.4
Magnesium (mg)	58.1	49.3	55.9	55.4	57.3	47.6[β]	59.2	56.8
Phosphorus (mg)	356.5	308.1	315.5	319.4	370.6[α]	311.4	364.1	356.0
Potassium (mg)	606.2[α]	500.2	539.4	543.2	646.5	521.5[β]	631.9	619.5
Sodium (mg)	633.2[α]	495.1	546.5	552.9	640.6	516.3[β]	679.6	643.5
Zinc (mg)	3.1	2.6[β]	3.1	3.0	3.0[α]	2.3	2.8	2.8
Other Dietary Components								
Fiber (g)	2.7	2.1[β]	2.7	2.6	2.6	2.1[β]	2.7	2.6
Cholesterol (mg)	60.8[α]	36.5	39.7[γ]	42.3	39.3	24.8[β]	36.9	35.6
Number of Students	**274**	**210**	**1,437**	**1,921**	**103**	**61**	**208**	**372**

Table IV.2a *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample excludes students who did not consume a breakfast. Intakes of both SBP participants and nonparticipants include all foods and beverages eaten at breakfast. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. SBP participation refers to participation on the recall day.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

Table IV.2b Regression-Adjusted Breakfast Nutrient Intakes

	All Students				SBP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Food Energy (kcal)	476.5[α]	405.9	412.5[γ]	420.0	463.0	412.8	475.2	466.3
Macronutrients: Total Amount (g)								
Total fat	13.9	11.4	11.5[γ]	11.8	11.1	12.1	14.1[γ]	13.8
Saturated fat	5.1	4.2	4.3	4.4	4.0	4.3	4.9	4.8
Monounsaturated	5.2	4.1	4.1[γ]	4.3	4.4	4.8	5.3	5.3
Polyunsaturated	2.6	2.2	2.1	2.2	2.1	2.3	2.8[γ]	2.8
Carbohydrate	75.2	65.7	66.7[γ]	67.7	79.1[α]	65.1	73.9	72.7
Protein	14.4[α]	11.4	12.1[γ]	12.4	13.0	12.1	14.6	14.2
Macronutrients: Percentage of Food Energy from								
Total fat	24.1	22.3	23.3	23.3	20.1	24.7	25.0[γ]	25.0
Saturated fat	9.2	8.8	8.9	9.0	7.7	9.0	8.9[γ]	9.0
Monounsaturated	8.8	8.2	8.3	8.3	7.9	9.6	9.4[γ]	9.4
Polyunsaturated	4.4	4.2	4.3	4.3	3.9	4.6	4.9[γ]	4.9
Carbohydrate	65.2	68.1	66.7	66.6	68.4	64.2	63.7[γ]	63.8
Protein	12.3	10.9	11.7	11.7	12.3	12.2	12.4	12.4
Vitamins and Minerals								
Vitamin A (mcg RAE)	244.3	226.0	223.4	226.2	217.0	195.6	202.7	201.7
Vitamin C (mg)	33.7	24.8	27.2	27.9	40.3[α]	24.1	31.7	30.6
Vitamin E (mg)	1.3	1.1	1.0	1.1	0.9	0.9	1.1	1.0
Vitamin B_6 (mg)	0.7	0.6	0.6	0.6	0.5	0.4	0.4	0.4
Vitamin B_{12} (mcg)	2.1	1.8	1.8	1.8	1.7	1.6	1.5	1.5
Folate (mg DFE)	272.3	242.8	223.4	231.3	203.3	173.1	172.2	172.4
Calcium (mg)	347.9	316.8	305.2	312.2	336.0	338.3	338.0	338.1
Iron (mg)	6.4	5.4	5.1[γ]	5.3	5.2	4.7	4.3[γ]	4.4
Magnesium (mg)	63.3	52.1	54.6	55.5	57.4	48.8[β]	58.5	57.1
Phosphorus (mg)	366.7	320.7	311.8[γ]	319.8	345.8	340.5	361.2	358.2
Potassium (mg)	628.4[α]	517.7	532.8[γ]	543.8	649.1	555.9	630.5	619.8
Sodium (mg)	635.8[α]	498.3	545.9[γ]	552.2	582.2	538.3	664.2	646.1
Zinc (mg)	3.5[α]	2.8	3.0	3.0	3.1	2.7	2.8	2.8
Other Dietary Components								
Fiber (g)	3.1[α]	2.3	2.6	2.6	2.4	2.2	2.7	2.6
Cholesterol (mg)	62.8[α]	34.1	39.7[γ]	42.0	37.3	28.9	37.0	35.8
Number of Students	**274**	**210**	**1,437**	**1,921**	**103**	**61**	**208**	**372**

Table IV.2b *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample excludes students who did not consume a breakfast. Intakes of both SBP participants and nonparticipants include all foods and beverages eaten at breakfast. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. SBP participation refers to participation on the recall day. All mean estimates have been regression-adjusted for differences in personal, family, and school characteristics between food security groups including age, sex, household income relative to poverty, ethnicity, height, region and several other characteristics listed in Appendix B.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

There were just a few significant differences between insecure and highly secure children in nutrient intakes at breakfast. The highly secure consumed less in total fat, monounsaturated fat, protein, and cholesterol (Table IV.2a, unadjusted). However, among SBP participants, none of these differences were significant.[10]

3. Lunch Intakes

There are four significant differences between the insecure and highly secure in their mean nutrient intakes at lunch; the insecure consumed more energy from protein, vitamin B_{12}, calcium, and potassium (Table IV.3a).[11] Among NSLP participants, there are no significant differences between the insecure and highly secure.

Table IV.3a shows that the marginally secure consumed 48 fewer calories than the insecure and 56 fewer than the highly secure at lunch, but only the latter difference was significant.[12] A back-of-the-envelope calculation, assuming that everyone eats breakfast and lunch, suggests that these two meals could account for at most 115 of the 221 calories that the insecure consumed relative to the marginally secure over the course of 24 hours and 76 of the 176 additional calories that the highly secure consumed.[13] Among participants, a similar rough calculation suggests that if everyone ate both the school breakfast and the school lunch, these two meals could account for 100 of the 262 calories that the insecure ate relative to the marginally secure and 137 of the 217 additional calories

[10] Though, highly secure participants consumed significantly more polyunsaturated fat and vitamin E than insecure participants (Table IV.2a, unadjusted).

[11] Within the regression-adjusted results (Table IV.3b), none of these differences are significant.

[12] Again, lunch differences are only for students who ate something for lunch, but only a few students skipped lunch completely.

[13] This calculation uses columns 2 though 4 of tables IV.1a through IV.3a and ignores the fact that students who did not eat breakfast and/or lunch are included in Table IV.1 and excluded from Table IV.2a and/or Table IV.3a respectively. Calculations done with the adjusted tables (IV.1b, IV.2b, and IV.3b) yielded similar results.

Table IV.3a Lunch Nutrient Intakes

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Food Energy (kcal)	629.2	581.3[β]	637.6	631.1	617.9	589.1	632.3	625.4
Macronutrients: Total Amount (g)								
Total fat	24.1	22.1[β]	24.6	24.3	23.5	21.8	23.9	23.7
Saturated fat	8.2[α]	7.1[β]	8.0	8.0	8.2[α]	7.1[β]	8.1	8.0
Monounsaturated	9.5	8.8[β]	9.9	9.7	9.1	8.6	9.4	9.3
Polyunsaturated	4.9	4.7	5.1	5.0	4.7	4.7	4.9	4.8
Carbohydrate	79.9	74.6[β]	82.2	81.0	77.4	76.3	80.7	79.5
Protein	24.9	22.7	23.9	24.0	25.7	23.7[β]	25.5	25.5
Macronutrients: Percentage of Food Energy from								
Total fat	33.0	33.5	33.0	33.1	33.2	32.9	33.0	33.1
Saturated fat	11.5	11.0	10.9	11.0	11.8	10.9	11.3	11.3
Monounsaturated	12.9	13.4	13.1	13.1	12.8	12.8	12.9	12.9
Polyunsaturated	6.4	6.9	6.8	6.8	6.5	7.0	6.7	6.7
Carbohydrate	51.9	51.5	53.3	52.9	50.8	51.6	51.7	51.4
Protein	16.1	16.1[β]	15.0[γ]	15.3	17.1	16.8	16.4	16.6
Vitamins and Minerals								
Vitamin A (mcg RAE)	170.3	151.2	155.2	157.8	193.8[α]	170.2[β]	197.0	194.1
Vitamin C (mg)	23.6	25.5	20.4	21.3	21.6	27.3	19.6	20.9
Vitamin E (mg)	1.9	1.8	2.0	2.0	1.8	1.8	1.8	1.8
Vitamin B_6 (mg)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Vitamin B_{12} (mcg)	1.4	1.2	1.2[γ]	1.3	1.5[α]	1.3[β]	1.5	1.5
Folate (mg DFE)	118.7	109.6[β]	122.8	121.1	119.1	113.7	122.2	120.9
Calcium (mg)	387.5[α]	337.1	339.8[γ]	347.1	420.0[α]	368.0[β]	407.6	405.5
Iron (mg)	3.7	3.4[β]	3.7	3.7	3.7	3.5[β]	3.8	3.8
Magnesium (mg)	79.3	71.7[β]	78.1	77.6	82.1	75.4	80.7	80.2
Phosphorus (mg)	453.1[α]	409.5	424.0	427.5	480.6[α]	430.8[β]	468.4	466.9
Potassium (mg)	841.6	772.4	774.0[γ]	783.6	893.9	808.2	864.1	862.4
Sodium (mg)	1,080	1,014[β]	1,096	1,088	1,098	1,039[β]	1,134	1,119
Zinc (mg)	3.31[α]	2.8	3.0	3.1	3.4[α]	2.9[β]	3.2	3.3
Other Dietary Components								
Fiber (g)	4.7[α]	4.1[β]	4.5	4.5	4.8	4.3	4.7	4.7
Cholesterol (mg)	54.1	57.9	60.2	59.4	54.9	59.2	58.7	58.7
Number of Students	**333**	**273**	**1,582**	**2,188**	**249**	**197**	**913**	**1,359**

Table IV.3a *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample excludes students who did not consume a lunch. Intakes of both NSLP participants and nonparticipants include all foods and beverages eaten at lunch. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP participation refers to participation on the recall day.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

Table IV.3b Regression-Adjusted Lunch Nutrient Intakes

	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Food Energy (kcal)	645.2	611.8	630.4	630.5	618.1	604.9	630.4	624.1
Macronutrients: Total Amount (g)								
Total fat	24.7	23.4	24.3	24.3	23.2	22.4	23.9	23.5
Saturated fat	8.3	7.5	7.9	7.9	8.1	7.3[β]	8.1	7.9
Monounsaturated	9.7	9.4	9.7	9.7	8.9	8.9	9.4	9.2
Polyunsaturated	5.1	4.9	5.0	5.0	4.7	4.8	4.9	4.8
Carbohydrate	82.6	79.2	81.1	81.1	78.7	78.7	80	79.5
Protein	25.1	23.1	23.8	23.9	25.4	23.9	25.6	25.3
Macronutrients: Percentage of Food Energy from								
Total fat	33.1	33.6	33.0	33.0	32.9	33.2	33.1	33.0
Saturated fat	11.5	11.0	10.9	11.0	11.7	10.9	11.3	11.3
Monounsaturated	12.9	13.4	13.1	13.1	12.7	13.0	12.9	12.9
Polyunsaturated	6.6	6.9	6.8	6.8	6.4	7.0	6.7	6.7
Carbohydrate	52.2	52.1	53.2	53.0	51.3	51.6	51.5	51.5
Protein	15.8	15.5	15.1	15.3	16.9	16.5	16.5	16.6
Vitamins and Minerals								
Vitamin A (mcg RAE)	160.0[α]	135.3β	159.9	156.7	197.2[α]	166.4[β]	197.6	192.8
Vitamin C (mg)	22.6	25.2	20.7	21.4	18.5	26.7	20.5	21.0
Vitamin E (mg)	2.0	1.8	2.0	2.0	1.7	1.8	1.9	1.8
Vitamin B_6 (mg)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Vitamin B_{12} (mcg)	1.3	1.1	1.3	1.2	1.5[α]	1.3[β]	1.5	1.4
Folate (mg DFE)	119.9	112.7	122.1	120.8	118.2	115.1	122.1	120.6
Calcium (mg)	371.5[α]	321.0	345.5	345.8	421.5[α]	366.4[β]	408.0	404.2
Iron (mg)	3.7	3.5	3.7	3.7	3.7	3.6	3.8	3.8
Magnesium (mg)	79.5[α]	72.9	77.9	77.6	80.2	75.8	81.1	80.2
Phosphorus (mg)	446.3[α]	405.0	426.2	426.2	478.6[α]	431.8[β]	469.5	465.2
Potassium (mg)	806.1	752.2	783.5	782.7	874.9	810.6	869.6	861.4
Sodium (mg)	1104.1	1056.8	1086.1	1085.1	1103.1	1065.4	1129.9	1114.8
Zinc (mg)	3.1[α]	2.8	3.1	3.0	3.3[α]	2.9[β]	3.3	3.2
Other Dietary Components								
Fiber (g)	4.6	4.2	4.5	4.5	4.8	4.4	4.7	4.7
Cholesterol (mg)	62.4	65.8	57.3	59.1	51.5	58.8	59.9	58.1
Number of Students	**333**	**273**	**1,582**	**2,188**	**249**	**197**	**913**	**1,359**

Table IV.3b *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Intakes of both NSLP participants and nonparticipants include all foods and beverages eaten over 24 hours. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP participation refers to participation on the recall day. All mean estimates have been regression-adjusted for differences in personal, family, and school characteristics between food security groups including age, sex, household income relative to poverty, ethnicity, height, region and several other characteristics listed in Appendix B.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

that the highly secure ate.[14] Therefore, the lower level of 24-hour energy consumption by the marginally secure is partially explained by breakfast and lunch, but about half the difference must come from dinner or snacks. Overall, the fact that the marginally secure ate less than both other groups remains puzzling. Chapter VII discusses possible implications of this puzzle for future research.

4. Contributions of On-Menu School Foods to Nutrient Intake

To supplement this descriptive look at the overall diets of insecure and marginally secure children with information about the role that school meals play, we also calculated the proportion of 24-hour nutrient intakes that was contributed by on-menu school foods (Tables IV.4a and IV.4b). In columns 2 through 4 of both tables, we see that, as expected from their lower participation rates, the highly secure obtained, on average, a lower proportion of many of their daily nutrients from on-menu school foods than the insecure and the marginally secure, with or without adjusting for observable differences. The highly secure obtained between 15 and 20 percent of their nutrient intakes of most nutrients from on-menu foods. For the insecure and the marginally secure, the percentages ranged from about 26 to 33 percent (Table IV.4a, unadjusted). After adjusting for participation and other observable differences (columns 2 through 4 in Table IV.4b), the average differences between the highly secure and less secure groups are smaller, although they remain statistically significant in many cases. The same pattern can be seen in columns 6 through 8 of Table IV.4a; there are still significant differences between the highly secure and less secure groups among school meal participants, but they are much smaller than the differences among all children

[14] This calculation uses columns 6 though 8 of tables IV.1a through IV.3a and ignores the fact that students who did not eat breakfast and/or lunch are included in Table IV.1a and excluded from Table IV.2a and/or Table IV.3a respectively. Calculations done with the adjusted tables (IV.1b, IV.2b, and IV.3b) yielded similar results.

Table IV.4a Proportion of 24-hour Nutrient Intakes Contributed by On-Menu School Foods

	All Students				NSLP or SBP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Food Energy (kcal)	0.26	0.24$^{\beta}$	0.16$^{\gamma}$	0.18	0.32	0.30$^{\beta}$	0.27$^{\gamma}$	0.28
Macronutrients								
Total fat	0.26	0.26$^{\beta}$	0.17$^{\gamma}$	0.19	0.33	0.31$^{\beta}$	0.28$^{\gamma}$	0.29
Saturated fat	0.28	0.26$^{\beta}$	0.17$^{\gamma}$	0.19	0.34	0.31$^{\beta}$	0.28$^{\gamma}$	0.30
Monounsaturated	0.27	0.26$^{\beta}$	0.17$^{\gamma}$	0.19	0.33	0.32$^{\beta}$	0.29$^{\gamma}$	0.30
Polyunsaturated	0.26	0.27$^{\beta}$	0.18$^{\gamma}$	0.20	0.33	0.33$^{\beta}$	0.29	0.30
Carbohydrate	0.25	0.23$^{\beta}$	0.15$^{\gamma}$	0.17	0.31	0.28$^{\beta}$	0.25$^{\gamma}$	0.26
Protein	0.31	0.29$^{\beta}$	0.20$^{\gamma}$	0.22	0.38	0.36$^{\beta}$	0.32$^{\gamma}$	0.34
Vitamins and Minerals								
Vitamin A	0.37	0.33$^{\beta}$	0.22$^{\gamma}$	0.25	0.46	0.41	0.35$^{\gamma}$	0.38
Vitamin C	0.26	0.23$^{\beta}$	0.15$^{\gamma}$	0.17	0.32	0.29	0.24$^{\gamma}$	0.26
Vitamin E	0.23	0.25$^{\beta}$	0.16$^{\gamma}$	0.18	0.29	0.30$^{\beta}$	0.26	0.27
Vitamin B_6	0.28	0.26$^{\beta}$	0.16$^{\gamma}$	0.19	0.34	0.31$^{\beta}$	0.27$^{\gamma}$	0.29
Vitamin B_{12}	0.36	0.31$^{\beta}$	0.21$^{\gamma}$	0.24	0.45	0.38	0.34$^{\gamma}$	0.36
Folate	0.26	0.23$^{\beta}$	0.16$^{\gamma}$	0.18	0.32	0.29	0.26$^{\gamma}$	0.27
Calcium	0.38	0.35$^{\beta}$	0.23$^{\gamma}$	0.26	0.47	0.42	0.38$^{\gamma}$	0.40
Iron	0.27	0.25$^{\beta}$	0.16$^{\gamma}$	0.19	0.33	0.31$^{\beta}$	0.27$^{\gamma}$	0.28
Magnesium	0.29	0.28$^{\beta}$	0.18$^{\gamma}$	0.21	0.36	0.34$^{\beta}$	0.30$^{\gamma}$	0.31
Phosphorus	0.33	0.30$^{\beta}$	0.21$^{\gamma}$	0.23	0.41	0.37	0.34$^{\gamma}$	0.35
Potassium	0.31	0.3.0$^{\beta}$	0.20$^{\gamma}$	0.22	0.39	0.36$^{\beta}$	0.32$^{\gamma}$	0.34
Sodium	0.27	0.25$^{\beta}$	0.17$^{\gamma}$	0.19	0.33	0.31	0.28$^{\gamma}$	0.29
Zinc	0.31	0.27$^{\beta}$	0.18$^{\gamma}$	0.20	0.38$^{\alpha}$	0.33$^{\beta}$	0.29$^{\gamma}$	0.31
Other Dietary Components								
Fiber	0.27	0.27$^{\beta}$	0.18$^{\gamma}$	0.20	0.34	0.33	0.29$^{\gamma}$	0.31
Cholesterol	0.29	0.27$^{\beta}$	0.18$^{\gamma}$	0.20	0.35	0.33	0.30$^{\gamma}$	0.31
Number of Students	**348**	**284**	**1,638**	**2,270**	**262**	**203**	**951**	**1,416**

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample for NSLP or SBP participants includes all students who participated in one or more of the school meal programs (1,044 students participated only in NSLP, 316 in both, and 56 only in SBP).

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP or SBP participation refers to participation on the recall day.

$^{\alpha}$Difference between the insecure and the marginal group is significant at the .05 level.
$^{\beta}$Difference between the marginal and the high security group is significant at the .05 level.
$^{\gamma}$Difference between the high security and the insecure group is significant at the .05 level.

Table IV.4b Proportion of 24-Hour Nutrient Intakes Contributed by On-Menu School Foods, Regression-Adjusted Means

	All Students				NSLP or SBP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Food Energy (kcal)	0.20	0.22[β]	0.18[γ]	0.18	0.27	0.28	0.26	0.26
Macronutrients: Total Amount (g)								
Total fat	0.21	0.23[β]	0.18	0.19	0.29	0.30	0.27	0.28
Saturated fat	0.22	0.23[β]	0.19	0.19	0.30	0.29	0.27	0.28
Monounsaturated	0.21	0.24[β]	0.19	0.19	0.30	0.31	0.28	0.28
Polyunsaturated	0.22	0.25[β]	0.19	0.20	0.30	0.32[β]	0.28	0.29
Carbohydrate	0.19	0.20[β]	0.17[γ]	0.17	0.25	0.26	0.24	0.24
Protein	0.25	0.26[β]	0.21[γ]	0.22	0.34	0.34	0.32	0.32
Vitamins and Minerals								
Vitamin A	0.29	0.27	0.24[γ]	0.25	0.37	0.34	0.34	0.35
Vitamin C	0.19	0.19	0.16	0.17	0.25	0.24	0.23	0.23
Vitamin E	0.19	0.23[β]	0.16	0.17	0.27	0.29[β]	0.25	0.25
Vitamin B_6	0.22	0.23[β]	0.18[γ]	0.19	0.29	0.29	0.26	0.26
Vitamin B_{12}	0.28	0.26	0.23[γ]	0.24	0.37	0.33	0.33	0.34
Folate	0.19	0.20	0.17	0.18	0.25	0.25	0.25	0.25
Calcium	0.30	0.29	0.25[γ]	0.26	0.39	0.36	0.37	0.37
Iron	0.20	0.22[β]	0.18	0.18	0.27	0.28	0.26	0.26
Magnesium	0.23	0.24[β]	0.20[γ]	0.20	0.30	0.31	0.29	0.29
Phosphorus	0.26	0.26[β]	0.22[γ]	0.23	0.34	0.33	0.33	0.33
Potassium	0.25	0.26[β]	0.21[γ]	0.22	0.33	0.33	0.31	0.31
Sodium	0.21	0.23[β]	0.18[γ]	0.19	0.29	0.29	0.28	0.28
Zinc	0.24	0.23[β]	0.19[γ]	0.20	0.32	0.30	0.28[γ]	0.29
Other Dietary Components								
Fiber	0.22	0.24[β]	0.19	0.20	0.30	0.31	0.29	0.29
Cholesterol	0.23	0.24[β]	0.19[γ]	0.20	0.31	0.32	0.30	0.30
Number of Students	**348**	**284**	**1,638**	**2,270**	**262**	**203**	**951**	**1,416**

Table IV.4b *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample for NSLP or SBP participants includes all students who participated in one or more of the school meal programs (1,044 students participated only in NSLP, 316 in both, and 56 only in SBP).

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP or SBP participation refers to participation on the recall day. All mean estimates have been regression-adjusted for differences in personal, family, and school characteristics between food security groups including age, sex, household income relative to poverty, ethnicity, height, region and several other characteristics listed in Appendix B.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

(columns 2 through 4 of Table IV.4a). Participation accounts for roughly half the original difference across the food security groups for all children. Among participants, adjusting for observable differences in columns 6 through 8 of Table IV.4b, the differences are even smaller and are generally not significant.

C. Food Group Servings (MyPyramid Equivalents)

1. Intakes of MPEs over 24 Hours

Over the course of 24 hours, the average MPEs that children consumed from key food groups were similar across the three food security groups (Tables IV.5a and IV.5b). Although the mean servings for all five major food groups (milk products, fruits and juices, vegetables, meat and beans, and grains) were higher for the food insecure than for the marginally secure, the difference was statistically significant only for the meat-and-beans category (with or without regression adjustment). The food insecure also ate significantly more of the soy products, nuts, and seeds category and more cheese than the marginally secure. The highly secure ate more milk products and grains than the marginally secure. The only significant differences between the insecure and the highly secure were that the insecure ate less yogurt, more legumes, and more meat and beans (Table IV.5a, unadjusted).[15]

Policymakers and public health and nutrition experts are concerned about the low number of servings of fruits and vegetables consumed by American schoolchildren (and adults). These data show that at least the school-day diets of children from food-insecure households contain roughly the same number of servings of fruit and vegetables as those of children from highly food-secure households-between two and two-and-a-half MPEs per day. Both groups of children, however, need to eat more fruits and vegetables.

[15] The regression adjustment changes this slightly. The magnitude of the differences between the highly secure and the insecure is smaller, so the differences are no longer significant. Within the adjusted results (Table IV.5b), the only significant difference between the insecure and the highly secure was that the insecure ate more dark-green vegetables (but both groups consumed very small amounts).

Table IV.5a MyPyramid Equivalents Eaten Over 24 Hours by Food Security Status and NSLP Participation

	Mean Cup or Oz. Equivalents of the MyPyramid Food Groups							
	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Total Milk Products (cup equivalents)	2.48	2.18[β]	2.46	2.44	2.69[α]	2.28[β]	2.70	2.64
Milk	1.68	1.57	1.70	1.69	1.86	1.63[β]	1.90	1.86
Yogurt	0.02	0.05	0.06[γ]	0.05	0.01	0.06	0.04	0.03
Cheese	0.78[α]	0.55[β]	0.70	0.69	0.81[α]	0.58[β]	0.75	0.74
Total Fruits & Juices (cup equivalents)	1.27	1.14	1.27	1.25	1.30	1.12	1.26	1.25
Whole fruit[a]	0.60	0.50	0.61	0.60	0.67[α]	0.48	0.59	0.59
Fruit juice[a]	0.67	0.64	0.66	0.66	0.63	0.64	0.67	0.66
Total Vegetables (cup equivalents)	1.16	1.13	1.11	1.12	1.19	1.11	1.15	1.15
Dark-green vegetables	0.05	0.04	0.05	0.05	0.05	0.04	0.05	0.05
Orange vegetables	0.04	0.04	0.05	0.05	0.04	0.04	0.05	0.05
Potatoes & other starchy vegetables	0.41	0.44	0.42	0.42	0.41	0.42	0.44	0.43
Other vegetables	0.67	0.62	0.58	0.60	0.70	0.61	0.61	0.63
Legumes (cup equivalents)	0.09	0.09	0.06[γ]	0.07	0.10	0.10	0.06	0.07
Total Meat & Beans (oz. equivalents)	5.03[α]	4.11	4.39[γ]	4.45	4.92	4.01	4.21	4.32
Meat [b]	2.41	2.11	2.14	2.19	2.38[α]	2.07	2.14	2.19
Poultry	1.48	1.23	1.22	1.26	1.48	1.20	1.18	1.24
Fish & Shellfish	0.33	0.31	0.21	0.24	0.29	0.29	0.22	0.24
Eggs	0.22	0.17	0.16	0.17	0.22	0.16	0.15	0.17
Soy products, nuts, & seeds	0.59[α]	0.29[β]	0.65	0.6	0.54	0.30[β]	0.51	0.49
Total Grains (oz. equivalents)	7.34	6.67[β]	7.44	7.34	7.52	6.82[β]	7.72	7.55
Whole grains	0.55	0.44[β]	0.61	0.58	0.57	0.45	0.56	0.55
Non-whole grains/ refined grains	6.80	6.23[β]	6.82	6.75	6.95	6.36[β]	7.16	7.01
Number of Students	**348**	**284**	**1,638**	**2,270**	**249**	**197**	**914**	**1,360**

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Intakes of both NSLP participants and nonparticipants include all foods and beverages eaten over 24 hours. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP participation refers to participation on the recall day.

[a]Fruit juice and whole fruit were defined using the Center for Nutrition and Policy Promotion 01-02 Database.
[b]The meat category includes all beef, pork, lamb, organ meat, frankfurters, sausages, and luncheon meats consumed.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

Table IV.5b Regression-Adjusted MyPyramid Equivalents Eaten Over 24 Hours

	Mean Cup or Oz. Equivalents of the MyPyramid Food Groups							
	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Total Milk Products (cup equivalents)	2.51	2.26	2.44	2.43	2.73[α]	2.37[β]	2.67	2.64
Milk	1.70	1.65	1.69	1.68	1.92	1.76	1.87	1.86
Yogurt	0.04	0.07	0.05	0.05	0.02	0.05	0.04	0.04
Cheese	0.76[α]	0.53[β]	0.70	0.69	0.79[α]	0.56[β]	0.76	0.74
Total Fruits & Juices (cup equivalents)	1.28	1.17	1.26	1.25	1.28	1.09	1.27	1.25
Whole fruit[a]	0.61	0.53	0.60	0.60	0.66[α]	0.45[β]	0.60	0.59
Fruit juice[a]	0.67	0.64	0.65	0.66	0.62	0.64	0.67	0.66
Total Vegetables (cup equivalents)	1.17	1.14	1.10	1.12	1.21	1.14	1.14	1.15
Dark-green vegetables	0.07	0.05	0.04[γ]	0.05	0.08	0.05	0.04[γ]	0.05
Orange vegetables	0.05	0.04	0.05	0.05	0.04	0.04	0.05	0.05
Potatoes & other starchy vegetables	0.41	0.44	0.42	0.42	0.44	0.44	0.43	0.43
Other vegetables	0.64	0.61	0.59	0.60	0.65	0.60	0.63	0.63
Legumes (cup equivalents)	0.07	0.08	0.06	0.07	0.08	0.09	0.06	0.07
Total Meat & Beans (oz. equivalents)	4.98[α]	4.08	4.40	4.44	4.57	3.8	4.33	4.30
Meat[b]	2.25	2.02	2.18	2.17	2.11	1.89	2.24	2.17
Poultry	1.43	1.20	1.23	1.26	1.38	1.16	1.21	1.23
Fish & Shellfish	0.38	0.30	0.21	0.24	0.33	0.26	0.22	0.24
Eggs	0.24	0.18	0.16	0.17	0.23	0.15	0.15	0.17
Soy products, nuts, & seeds	0.69[α]	0.38[β]	0.62	0.60	0.53	0.35	0.51	0.49
Total Grains (oz. equivalents)	7.46	6.81	7.40	7.34	7.62	6.94[β]	7.67	7.57
Whole grains	0.62	0.48	0.59	0.59	0.64	0.48	0.54	0.55
Non-whole grains/ refined grains	6.84	6.33	6.80	6.76	6.98	6.46[β]	7.13	7.02
Number of Students	**348**	**284**	**1,638**	**2,270**	**249**	**197**	**914**	**1,360**

Table IV.5b *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Intakes of both NSLP participants and nonparticipants include all foods and beverages eaten over 24 hours. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP participation refers to participation on the recall day. All mean estimates have been regression-adjusted for differences in personal, family, and school characteristics between food security groups including age, sex, household income relative to poverty, ethnicity, height, region and several other characteristics listed in Appendix B.

[a]Fruit juice and whole fruit were defined using the Center for Nutrition and Policy Promotion 01-02 Database.
[b]The meat category includes all beef, pork, lamb, organ meat, frankfurters, sausages, and luncheon meats consumed.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

2. Breakfast Intakes

Tables IV.6a and IV.6b show that children from all food security groups who ate breakfast obtained, on average, roughly the same number of MPEs of key food groups at breakfast; MPEs consumed at breakfast were also similar among SBP participants from all three food security groups. The food insecure consumed significantly more MPEs of meat and beans than either the marginally secure or the highly secure and significantly more MPEs of fruit than the marginally secure, but neither difference was significant among SBP participants (Table IV.6a).

3. Lunch Intakes

There are also relatively few differences across the food security groups in consumption of key food groups at lunch (Tables IV.7a and IV.7b). The insecure and marginally secure ate significantly fewer MPEs of grain-based foods at lunch than the highly secure overall and among NSLP participants (Table IV.7a, unadjusted).[16] The insecure consumed significantly more milk at lunch than the marginally secure among all children and participants, with or without regression adjustment.

4. Contributions of On-Menu School Foods

As might be expected from lower rates of school meal participation, the highly food secure obtained smaller proportions of MPEs of their key food groups from on-menu school foods than the insecure and the marginally secure (columns 2 to 4 in Table IV.8a). Compared to the insecure and the marginally secure, they consumed a lower proportion of MPEs of all five major food groups from school foods. When the sample was limited to children who participated in at least one school meal (columns 6 through 8 of Table IV.8a, unadjusted), the differences between the marginally

[16] This is another example of a difference that the regression adjustment reduces and renders nonsignificant (Table V.7b).

Table IV.6a MyPyramid Equivalents Eaten at Breakfast, by Food Security Status and SBP Participation

	Mean Cup or Oz. Equivalents of the MyPyramid Food Groups							
	All Students				SBP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Total Milk Products (cup equivalents)	0.76	0.72	0.68	0.69	0.85	0.79	0.86	0.84
Milk	0.71	0.67	0.63	0.64	0.81	0.73	0.74	0.75
Yogurt	0.00	0.01	0.01[γ]	0.01	0.00	0.00[β]	0.01	0.01
Cheese	0.05	0.04	0.04	0.04	0.04	0.06	0.11[γ]	0.08
Total Fruits & Juices (cup equivalents)	0.46[α]	0.30	0.40	0.40	0.52	0.39	0.47	0.47
Whole fruit[a]	0.13	0.06[β]	0.11	0.11	0.09	0.09	0.07	0.07
Fruit juice[a]	0.34	0.23	0.29	0.29	0.44	0.30	0.40	0.40
Total Vegetables (cup equivalents)	0.02	0.06	0.03	0.03	0.02	0.02	0.07	0.05
Dark-green vegetables	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Orange vegetables	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Potatoes & other starchy vegetables	0.01	0.02	0.01	0.01	0.01	0.00	0.02	0.01
Other vegetables	0.01	0.02	0.02	0.02	0.01	0.02	0.04	0.03
Legumes (cup equivalents)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Meat & Beans (oz. equivalents)	0.52[α]	0.27	0.28[γ]	0.31	0.36	0.29	0.40	0.38
Meat, Poultry & Fish[b]	0.30[α]	0.13	0.13[γ]	0.15	0.24	0.15	0.23	0.23
Eggs	0.17	0.07	0.08[γ]	0.09	0.09	0.02	0.04	0.05
Soy products, nuts, & seeds	0.05	0.07	0.07	0.07	0.03	0.12	0.12	0.10
Total Grains (oz. equivalents)	1.72	1.52	1.72	1.70	1.91	1.65	1.99	1.92
Whole grains	0.24	0.24	0.32	0.30	0.23	0.16	0.24	0.22
Non-whole grains/ refined grains	1.48	1.28	1.40	1.40	1.69	1.48	1.75	1.70
Number of Students	**274**	**210**	**1,437**	**1,921**	**103**	**61**	**208**	**372**

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample excludes students who did not consume a breakfast. Intakes of both SBP participants and nonparticipants include all foods and beverages eaten at breakfast. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. SBP participation refers to participation on the recall day.

[a]Fruit juice and whole fruit were defined using the Center for Nutrition and Policy Promotion 01-02 Database.
[b]The meat, poultry, and fish category includes all beef, pork, lamb, organ meat, frankfurters, sausages, luncheon meats, poultry, fish, and shellfish consumed.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

Table IV.6b Regression-Adjusted MyPyramid Equivalents Eaten at Breakfast

	Mean Cup or Oz. Equivalents of the MyPyramid Food Groups							
	All Students				SBP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Total Milk Products (cup equivalents)	0.71	0.72	0.69	0.69	0.81	0.89	0.87	0.85
Milk	0.68	0.69	0.63	0.64	0.79	0.82	0.74	0.76
Yogurt	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01
Cheese	0.03	0.02	0.05	0.04	0.02	0.06	0.11$^{\gamma}$	0.08
Total Fruits & Juices (cup equivalents)	0.53$^{\alpha}$	0.33	0.39$^{\gamma}$	0.40	0.58$^{\alpha}$	0.35	0.46	0.47
Whole fruit[a]	0.15	0.09	0.10	0.11	0.09	0.07	0.07	0.08
Fruit juice[a]	0.37$^{\alpha}$	0.24	0.28	0.29	0.49$^{\alpha}$	0.28	0.38	0.39
Total Vegetables (cup equivalents)	0.03	0.06	0.03	0.03	0.02	0.04	0.06$^{\gamma}$	0.05
Dark-green vegetables	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Orange vegetables	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potatoes & other starchy vegetables	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Other vegetables	0.01	0.03	0.02	0.02	0.01	0.02	0.05$^{\gamma}$	0.03
Legumes (cup equivalents)	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Meat & Beans (oz. equivalents)	0.47$^{\alpha}$	0.19	0.30	0.31	0.27	0.26	0.44	0.37
Meat, Poultry, & Fish[b]	0.23$^{\alpha}$	0.06	0.15	0.15	0.15	0.14	0.27$^{\gamma}$	0.22
Eggs	0.18$^{\alpha}$	0.06	0.08$^{\gamma}$	0.09	0.07	0.04	0.04	0.05
Soy products, nuts, & seeds	0.06	0.06	0.07	0.07	0.05	0.08	0.12	0.10
Total Grains (oz. equivalents)	1.89	1.65	1.68	1.70	2.00	1.59	1.95	1.92
Whole grains	0.31	0.27	0.30	0.30	0.21	0.24	0.23	0.22
Non-whole grains/ refined grains	1.58	1.38	1.37	1.40	1.79	1.35	1.72	1.70
Number of Students	**274**	**210**	**1,437**	**1,921**	**103**	**61**	**208**	**372**

Table IV.6b *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample excludes students who did not consume a breakfast. Intakes of both SBP participants and nonparticipants include all foods and beverages eaten at breakfast. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. SBP participation refers to participation on the recall day.

[a]Fruit juice and whole fruit were defined using the Center for Nutrition and Policy Promotion 01-02 Database.
[b]The meat, poultry, and fish category includes all beef, pork, lamb, organ meat, frankfurters, sausages, luncheon meats, poultry, fish, and shellfish consumed.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

Table IV.7a MyPyramid Equivalents Eaten at Lunch, by Food Security Status and NSLP Participation

	Mean Cup or Oz. Equivalents of the MyPyramid Food Groups							
	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Total Milk Products (cup equivalents)	0.96[α]	0.84	0.82	0.84	1.10[α]	0.93[β]	1.05	1.05
Milk	0.61	0.54	0.51	0.53	0.74[α]	0.62[β]	0.73	0.72
Cheese	0.34	0.28	0.28	0.29	0.36	0.30	0.31	0.32
Total Fruits & Juices (cup equivalents)	0.35	0.34	0.33	0.33	0.33	0.37	0.32	0.32
Whole fruit[a]	0.20	0.19	0.23	0.22	0.21	0.21	0.23	0.22
Fruit juice[a]	0.15	0.15	0.10	0.11	0.12	0.16	0.09	0.10
Total Vegetables (cup equivalents)	0.38	0.39	0.36	0.37	0.42	0.40	0.42	0.41
Dark-green vegetables	0.02	0.01	0.01[γ]	0.01	0.02	0.01	0.01	0.01
Orange vegetables	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02
Potatoes & other starchy vegetables	0.14	0.16	0.16	0.16	0.14	0.15	0.17	0.16
Other vegetables	0.22	0.21	0.18	0.19	0.24	0.23	0.21	0.22
Legumes (cup equivalents)	0.03	0.01	0.02	0.02	0.02	0.01	0.01	0.02
Total Meat & Beans (oz. equivalents)	1.42	1.30	1.54	1.50	1.33	1.30	1.37	1.37
Meat[b]	0.70	0.57	0.73	0.71	0.70	0.55	0.64	0.65
Poultry	0.45	0.44	0.38	0.40	0.41	0.41	0.45	0.44
Fish & Shellfish	0.05	0.11	0.07	0.07	0.06	0.13	0.07	0.07
Eggs	0.01	0.03	0.02[γ]	0.02	0.01	0.03	0.02[γ]	0.02
Soy products, nuts, & seeds	0.20	0.15[β]	0.33	0.29	0.14	0.18	0.20	0.19
Total Grains (oz. equivalents)	2.04	1.96[β]	2.29[γ]	2.22	2.04	1.99[β]	2.31[γ]	2.23
Whole grains	0.11	0.09[β]	0.13	0.12	0.11	0.08	0.11	0.10
Non-whole grains/ refined grains	1.93	1.87[β]	2.16	2.10	1.92	1.91[β]	2.21[γ]	2.12
Number of Students	**333**	**273**	**1,582**	**2,188**	**249**	**197**	**913**	**1,359**

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample excludes students who did not consume a lunch. Intakes of both NSLP participants and nonparticipants include all foods and beverages eaten at lunch. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP participation refers to participation on the recall day.

[a]Fruit juice and whole fruit were defined using the Center for Nutrition and Policy Promotion 01-02 Database.
[b]The meat category includes all beef, pork, lamb, organ meat, frankfurters, sausages, and luncheon meats consumed.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

Table IV.7b Regression-Adjusted MyPyramid Equivalents Eaten at Lunch

	Mean Cup or Oz. Equivalents of the MyPyramid Food Groups							
	All Students				NSLP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Total Milk Products (cup equivalents)	0.91[α]	0.77	0.84	0.84	1.12[α]	0.92[β]	1.05	1.04
Milk	0.56	0.48	0.53	0.53	0.76[α]	0.63	0.72	0.71
Cheese	0.31	0.26	0.29	0.29	0.35	0.27	0.32	0.32
Total Fruits & Juices (cup equivalents)	0.34	0.34	0.33	0.33	0.31	0.34	0.33	0.33
Whole fruit[a]	0.20	0.19	0.23	0.22	0.21	0.19	0.23	0.22
Fruit juice[a]	0.14	0.15	0.10	0.11	0.11	0.15	0.09	0.10
Total Vegetables (cup equivalents)	0.36	0.38	0.37	0.37	0.42	0.42	0.41	0.41
Dark-green vegetables	0.02	0.01	0.01[γ]	0.01	0.02	0.01	0.01[γ]	0.01
Orange vegetables	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.02
Potatoes & other starchy vegetables	0.14	0.17	0.16	0.16	0.15	0.17	0.17	0.16
Other vegetables	0.19	0.19	0.19	0.19	0.23	0.22	0.22	0.22
Legumes (cup equivalents)	0.03[α]	0.01	0.02[γ]	0.02	0.02	0.01	0.02	0.02
Total Meat & Beans (oz. equivalents)	1.58	1.47	1.48	1.50	1.27	1.34	1.38	1.36
Meat[b]	0.71	0.65	0.71	0.71	0.61	0.56	0.66	0.64
Poultry	0.48	0.45	0.38	0.40	0.46	0.44	0.43	0.44
Fish & Shellfish	0.07	0.10	0.07	0.07	0.06	0.11	0.07	0.08
Eggs	0.00	0.02	0.03[γ]	0.02	0.00[α]	0.03	0.03[γ]	0.02
Soy products, nuts, & seeds	0.31	0.25	0.30	0.30	0.14	0.20	0.19	0.19
Total Grains (oz. equivalents)	2.10	2.02[β]	2.27	2.22	2.10	2.06	2.28	2.23
Whole grains	0.12	0.10	0.13	0.12	0.11	0.07	0.11	0.10
Non-whole grains/ refined grains	1.98	1.92[β]	2.14	2.10	1.99	1.98	2.18	2.12
Number of Students	**333**	**273**	**1,582**	**2,188**	**249**	**197**	**913**	**1,359**

Table IV.7b *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample excludes students who did not consume a lunch. Intakes of both NSLP participants and nonparticipants include all foods and beverages eaten at lunch. For participants, this may include, in addition to foods/beverages obtained as part of the reimbursable meal, foods/beverages that were obtained in school from non-reimbursable sources and foods/beverages brought from home or consumed at home.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP participation refers to participation on the recall day. All mean estimates have been regression-adjusted for differences in personal, family, and school characteristics between food security groups including age, sex, household income relative to poverty, ethnicity, height, region and several other characteristics listed in Appendix B.

[a]Fruit juice and whole fruit were defined using the Center for Nutrition and Policy Promotion 01-02 Database.
[b]The meat category includes all beef, pork, lamb, organ meat, frankfurters, sausages, and luncheon meats consumed.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

secure and the highly secure are not significant (except in the cheese and soy-nuts-seeds categories). The differences between the insecure and the highly secure are still significant for all major food groups, except vegetables.

Table IV.8b shows that the results that are regression-adjusted for school meal participation and many other characteristics differ from the unadjusted results (Table IV.8a). Since participation is highly correlated with lower food security, the unadjusted results are more informative for the question of the role of school meals in the diets of less-food-secure children overall. The results that are limited to participants only (columns 6 through 8 of Table IV.8a) and the results that control for participation and other characteristics (Table IV.8b) are relevant to the question of whether there are differences across the food security groups beyond the differences in participation rates. Columns 6 through 8 of Table IV.8a show that the higher proportion of on-menu foods in the diets of the food insecure relative to the highly secure is not due solely to the higher participation rates of the insecure.

D. Conclusions

The goal of this chapter was to describe the school-day diets of less-food-secure children relative to highly secure children. In general, there were few differences between the insecure and the highly secure in terms of the nutrients and foods consumed at breakfast, lunch, and over 24 hours. The marginally secure consumed less than both the insecure and the highly secure over 24 hours. This is a result partially of differences at lunch and breakfast, but roughly 50 percent is due to differences during the rest of the day.

The contribution of school foods was higher for the marginally secure and the insecure than for the highly secure. Lower school meal participation among the highly secure explains part of this difference, but even among participants, the insecure and marginally secure obtained a higher proportion of their nutrients and major food groups from school meals.

Table IV.8a Proportion of 24 Hour MyPyramid Equivalents Contributed by On-Menu School Foods, by Food Security Status and NSLP or SBP Participation

	Proportion of Mean Cup or Oz. Equivalents of the MyPyramid Food Groups							
	All Students				NSLP or SBP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Total Milk Products	0.46	0.40$^{\beta}$	0.28$^{\gamma}$	0.32	0.56	0.49	0.45$^{\gamma}$	0.47
Milk	0.52	0.42$^{\beta}$	0.32$^{\gamma}$	0.36	0.63$^{\alpha}$	0.51	0.50$^{\gamma}$	0.52
Cheese	0.38	0.39$^{\beta}$	0.23$^{\gamma}$	0.27	0.46	0.47$^{\beta}$	0.38	0.40
Total Fruits & Juices	0.29	0.26$^{\beta}$	0.17$^{\gamma}$	0.19	0.36	0.32	0.28$^{\gamma}$	0.30
Whole fruit[a]	0.33	0.34$^{\beta}$	0.22$^{\gamma}$	0.24	0.39	0.41	0.35	0.37
Fruit juice[a]	0.25	0.21$^{\beta}$	0.13$^{\gamma}$	0.15	0.32	0.25	0.21$^{\gamma}$	0.23
Total Vegetables	0.26	0.28$^{\beta}$	0.18$^{\gamma}$	0.20	0.32	0.34	0.28	0.30
Dark-green vegetables	0.36	0.25	0.13$^{\gamma}$	0.18	0.43	0.33	0.25$^{\gamma}$	0.29
Orange vegetables	0.43	0.25	0.19$^{\gamma}$	0.23	0.49	0.30	0.31	0.34
Potatoes & other starchy vegetables	0.26	0.29	0.20	0.22	0.30	0.34	0.31	0.32
Other vegetables	0.27	0.26$^{\beta}$	0.16$^{\gamma}$	0.19	0.33	0.30	0.26	0.28
Legumes	0.29	0.18	0.16	0.18	0.33	0.20	0.22	0.23
Total Meat & Beans	0.37	0.31$^{\beta}$	0.20$^{\gamma}$	0.24	0.45	0.37	0.31$^{\gamma}$	0.35
Meat[b]	0.44	0.42$^{\beta}$	0.30$^{\gamma}$	0.34	0.53	0.52	0.46	0.49
Poultry	0.33	0.38$^{\beta}$	0.27	0.29	0.37	0.46	0.44	0.43
Fish & Shellfish	0.20	0.29	0.15	0.17	0.29	0.38	0.22	0.25
Eggs	0.27	0.28	0.18	0.20	0.33	0.34	0.28	0.29
Soy products, nuts, & seeds	0.44	0.49$^{\beta}$	0.29$^{\gamma}$	0.33	0.54	0.59$^{\beta}$	0.46	0.48
Total Grains	0.28	0.26$^{\beta}$	0.18$^{\gamma}$	0.20	0.35	0.32	0.30$^{\gamma}$	0.31
Whole grains	0.35	0.33$^{\beta}$	0.20$^{\gamma}$	0.23	0.41	0.39	0.32	0.34
Non-whole grains/ refined grains	0.29	0.26$^{\beta}$	0.19$^{\gamma}$	0.21	0.36	0.32	0.31$^{\gamma}$	0.32
Number of Students	**348**	**284**	**1,638**	**2,270**	**262**	**203**	**951**	**1,416**

Table IV.8a *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample for NSLP or SBP participants includes all students who participated in one or more of the school meal programs (1,044 students participated only in NSLP, 316 in both, and 56 only in SBP).

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP or SBP participation refers to participation on the recall day.

[a]Fruit juice and whole fruit were defined using the Center for Nutrition and Policy Promotion 01-02 Database.
[b]The meat category includes all beef, pork, lamb, organ meat, frankfurters, sausages, and luncheon meats consumed.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

Table IV.8b Regression-Adjusted Proportion of 24-Hour MyPyramid Equivalents Contributed by On-Menu School Foods

	Proportion of Mean Cup or Oz. Equivalents of the MyPyramid Food Groups							
	All Students				NSLP or SBP Participants			
	Insecure	Marginal	High	Total	Insecure	Marginal	High	Total
Total Milk Products	0.36	0.34	0.30[γ]	0.31	0.47	0.42	0.44	0.44
Milk	0.42	0.36	0.34[γ]	0.35	0.54[α]	0.43	0.48	0.48
Cheese	0.30	0.32	0.25	0.26	0.41	0.40	0.38	0.39
Total Fruits & Juices	0.21	0.23	0.18	0.19	0.28	0.28	0.25	0.26
Whole fruit[a]	0.24	0.31	0.23	0.24	0.32	0.38	0.32	0.32
Fruit juice[a]	0.15	0.17	0.14	0.14	0.18	0.19	0.17	0.17
Total Vegetables	0.23[α]	0.27[β]	0.18	0.20	0.32	0.34	0.28	0.29
Dark-green vegetables	0.32	0.15	0.09[γ]	0.13	0.40[α]	0.08	0.15[γ]	0.18
Orange vegetables	0.42[α]	0.22	0.19[γ]	0.23	0.51[α]	0.32	0.28[γ]	0.32
Potatoes & other starchy vegetables	0.23	0.27[β]	0.19	0.20	0.31	0.35	0.29	0.30
Other vegetables	0.24	0.22	0.17[γ]	0.18	0.32	0.28	0.26	0.27
Legumes	0.37[α]	0.18	0.16[γ]	0.19	0.40[α]	0.19	0.20[γ]	0.22
Total Meat & Beans	0.25	0.29[β]	0.21	0.22	0.34	0.39[β]	0.31	0.33
Meat[b]	0.27	0.27	0.21	0.22	0.37	0.35	0.31	0.32
Poultry	0.30[α]	0.41[β]	0.26	0.28	0.39	0.50	0.41	0.42
Fish & Shellfish	0.08	0.20	0.17	0.16	0.15	0.27	0.22	0.22
Eggs	0.17	0.21	0.17	0.17	0.22	0.24	0.27	0.26
Soy products, nuts, & seeds	0.34[α]	0.44[β]	0.31	0.33	0.46[α]	0.57[β]	0.43	0.45
Total Grains	0.22	0.22	0.20	0.20	0.30	0.29	0.30	0.30
Whole grains	0.20	0.24	0.21	0.22	0.25	0.29	0.30	0.29
Non-whole grains/ refined grains	0.23	0.22	0.20	0.21	0.31	0.29	0.31	0.31
Number of Students	**348**	**284**	**1,638**	**2,270**	**262**	**203**	**951**	**1,416**

Table IV.8b *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Sample for NSLP or SBP participants includes all students who participated in one or more of the school meal programs (1,044 students participated only in NSLP, 316 in both, and 56 only in SBP).

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured on the adult scale. NSLP or SBP participation refers to participation on the recall day. All mean estimates have been regression-adjusted for differences in personal, family, and school characteristics between food security groups including age, sex, household income relative to poverty, ethnicity, height, region and several other characteristics listed in Appendix B.

[a]Fruit juice and whole fruit were defined using the Center for Nutrition and Policy Promotion 01-02 Database.
[b]The meat category includes all beef, pork, lamb, organ meat, frankfurters, sausages, and luncheon meats consumed.

[α]Difference between the insecure and the marginal group is significant at the .05 level.
[β]Difference between the marginal and the high security group is significant at the .05 level.
[γ]Difference between the high security and the insecure group is significant at the .05 level.

V. PERCENTAGE OF SCHOOL LUNCH FOODS CONSUMED

This chapter addresses our third research question, which asked whether food-insecure and marginally food-secure children who participate in the school lunch program consume larger fractions of school menu items (relative to the portions served) and waste less than other participants. We did not find evidence to support this hypothesis—proportions wasted were generally similar across food security groups. However, these data provide interesting information on plate waste in school meals in general. A limitation of this work is that we cannot observe school meal items that were selected or served but not consumed at all. They are not counted as wasted, as they were not reported in dietary recalls. In addition, students can purchase school meal items à la carte or share or trade them with friends and thus consume more than one serving. However, these limitations apply to students at all levels of food security. This work is a first attempt to compare recall and menu survey portion sizes in order to estimate plate waste in school meals, which may be useful in future research.

A. Method for Estimating Percentage Consumed/Plate Waste in School Meals

Previous research on nutrition programs has generally measured plate waste out of concern about whether resources are used efficiently, so as to minimize costs. The focus here is to assess differences between children with varying levels of food security in how much they consumed (and, implicitly, how much they left on their plates) relative to the portion size offered, as an indicator of their potential need for school meals. Regardless of the reason for studying plate waste, previous studies have generally measured it in one of three ways: (1) direct measurement of participants' plates before and after they eat (weighing or otherwise measuring amounts); (2) visual assessment of plate waste by trained observers; or (3) dietary recall interviews in which participants are asked to report all foods selected and portion sizes served, as well as the amount consumed (Buzby and Guthrie 2002). None of these approaches was used in SNDA-III.

Given the data available, this study focused on foods consumed as part of school meals, and assessed the "percentage of portion consumed" by matching foods reported in dietary recalls to the school menu foods, for which the data included the typical amount offered. To construct the percentage-consumed variable, we needed to know the portion size offered on the school lunch menu and the portion size the child reported consuming.[1] However, the typical portion size of the school lunch menu item was not always available.[2] The "percentage of portion consumed" is thus defined only for school lunch participants and only for foods consumed that were on the school lunch menu (coded as "on menu").[3] As noted, this measure can be constructed only for foods that students reported eating. Foods served to or selected by students as part of the school lunch that were not eaten are not reported in the SNDA-III recall data. Hence, the percentage-consumed variable is always greater than zero.[4] Thus, the proportion *not* consumed is a measure of plate waste for items selected from the school menu that were at least tasted.

In construction of the percentage-consumed variable, the first step was to match the foods in the recall data to the SNDA-III school lunch menu data. Each food reported by SNDA-III sample members during the dietary recall interview (during which interviewers enter detailed food descriptions and amounts consumed) was assigned a USDA food code and associated nutrient amounts. As discussed in Chapter II, the SNDA-III study team developed a variable that designated which foods in the recall data were "on the menu" for the school lunch or breakfast on the target day. To construct the variable, they matched foods in the dietary recall data that students said were

[1] Portion sizes were measured in grams.

[2] The portion sizes of individual items offered as part of a self-serve food bar (e.g., salad bar) or prepackaged lunch were not available in the school lunch menu data. This will be discussed in detail later in this chapter.

[3] This measure could also have been created for on-menu breakfast items, but given the small sample of SBP participants and the exploratory nature of this analysis, we focused on items served at lunch.

[4] Some students reported eating just a small taste of certain foods (consuming less than 1 percent of the portion).

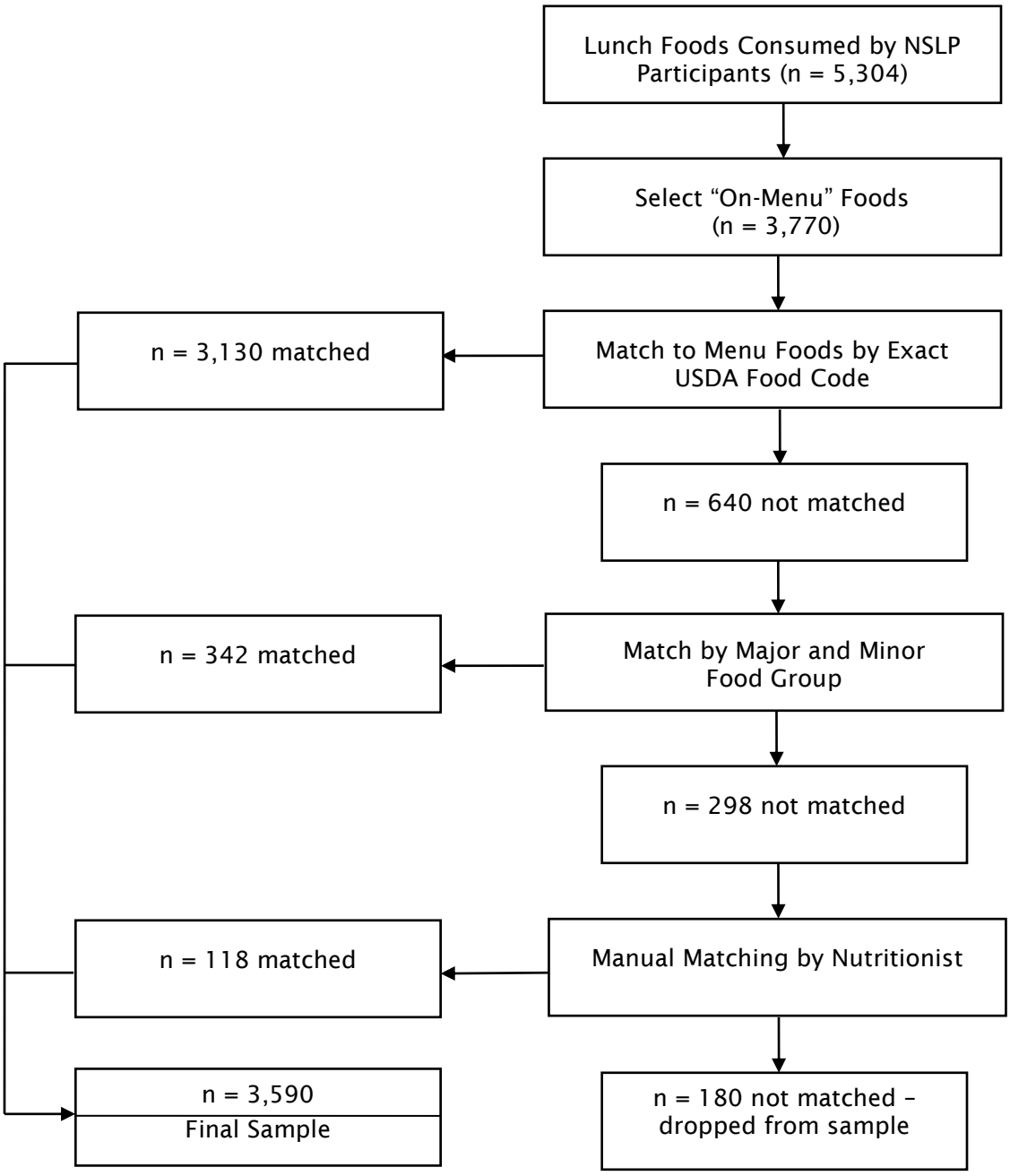
obtained in school during lunch to the corresponding school menu data on foods offered at lunch. When they found a match, they coded the recall food as "on menu."

To improve the accuracy of the data, the SNDA-III team often replaced the food code and nutrients of the on-menu recall food with those of the matched menu survey food as well as well as marking the "on-menu" indicator.. For these foods, we could easily determine the menu food they were matched with (because the detailed food code was the same) and extract information on the portion size offered from the menu data file. However, a challenge in creating the percentage-consumed variable was that nearly half the on-menu recall foods did not have their nutrients replaced, so the recall food record did not have an ithe food code for the specific menu food matched to it. We used multiple strategies sequentially in matching the recall foods and the menu foods, as shown in Figure V.1 and described in detail in Appendix B. The first major step, restricting the sample to on-menu foods, involved using the variable constructed as part of the SNDA-III study to select foods that had previously been matched to the menu data. The remaining steps involved reconstructing that match as part of this study. In the end, we matched fully 95 percent of on-menu foods to a menu record that indicated the "portion size offered." Most of the remaining five percent did not have a specific portion in the menu data (for example, some self-serve items).

We analyzed the data on percentage consumed separately for each menu food group used in NSLP food-based menu planning (milk, entrees or meat/meat alternates, vegetables, fruits, and grains) and each food security group.[5] Table V.1 first shows a categorical breakdown of the percentage consumed among NSLP participants who consumed that food group at lunch on the

[5] Note that the menu food groups used in this chapter are different from the MPE groups used in Chapter IV. To assess vegetable MPEs, we summed the number of servings of vegetables consumed by each student across all foods eaten at the meal that contained any vegetables, whereas in this chapter we calculated the percentage of vegetables consumed only for foods that were reported as discrete vegetable items. For example, the vegetables in a serving of lasagna are not included in the percentage of vegetables consumed, because the lasagna would be classified as an entrée and the percentage of the entire entrée consumed is what is identifiable from the data.

Figure V.1 Matching Process to Obtain Portion Offered for Dietary Recall Foods from SNDA-III Menu Survey Data



Note: See Appendix B for additional details. Major and minor food groups are whole food categories used in SNDA-III (Gordon et al. 2007b, Appendix D).

Table V.1 Percentage of School Lunch Portions Consumed by NSLP Participants, by Food Security Status

Food Group	Food Insecure Participants	Marginally Secure Participants	Highly Secure Participants	All Participants[a]
Milk				*
(0, 45%)[b]	4.3	3.7	4.6	4.4
[45, 90)[c]	18.3	27.2	17.7	19.0
[90, 110)	76.1	68.6	74.0	73.7
[110, 190)	0.5	0.0	0.3	0.3
[190, 210)	0.8	0.6	3.3	2.5
210% or more	0.0	0.0	0.1	0.1
Mean	90.1	86.0	91.9	90.9
(Standard Error)	(2.6)	(2.9)	(1.6)	(1.3)
Median	99.1	99.8	100.0	100.0
Sample Size	175	117	635	927
Weighted %[d]	76.9	66.7	73.1	72.8
Vegetables				
(0, 45%)[b]	25.5	25.6	25.4	25.4
[45, 90)[c]	33.6	36.5	31.8	32.7
[90, 110)	17.2	19.1	17.5	17.7
[110, 190)	11.9	14.2	16.3	15.3
[190, 210)	4.1	1.0	4.1	3.7
210% or more	7.7	3.7	4.9	5.2
Mean	93.2	79.2	90.8	89.8
(Std. Error)	(15.8)	(7.8)	(6.2)	(5.8)
Median	66.2	57.2	70.8	68.2
Sample Size	98	74	363	535
Weighted %[d]	42.2	38.6	41.8	41.4
Fruits				
(0, 45%)[b]	4.7	13.1	8.9	8.7
[45, 90)[c]	34.1	25.8	24.4	26.4
[90, 110)	35.6	28.1	40.7	38.0
[110, 190)	10.3	23.9	18.1	17.5
[190, 210)	10.7	5.4	5.0	6.1
210% or more	4.5	3.8	3.0	3.4
Mean	110.8	104.9	100.9	103.3
(Standard Error)	(11.2)	(11.0)	(4.1)	(4.5)
Median	99.8	98.3	99.7	99.8
Sample Size	80	59	246	385
Weighted %[d]	36.9	33.2	31.7	32.7

Food Group	Food Insecure Participants	Marginally Secure Participants	Highly Secure Participants	All Participants[a]
Entrée or Meat/Meat Alternative				
(0, 45%)[b]	12.6	13.0	12.9	12.8
[45, 90)[c]	18.5	25.4	16.4	18.1
[90, 110)	56.2	45.1	53.1	52.5
[110, 190)	9.4	11.2	11.0	10.8
[190, 210)	1.5	2.5	3.4	2.9
210% or more	1.8	2.8	3.3	3.0
Mean	91.6	94.2	98.4	96.6
(Standard Error)	(4.2)	(5.2)	(3.3)	(2.8)
Median	98.0	96.2	100.0	100.0
Sample Size	208	162	696	1,066
Weighted % [d]	85.8	85.3	78.5	80.6*
Grains				
(0, 45%)[b]	15.1	--	14.5	14.1
[45, 90)[c]	17.9	--	27.0	26.7
[90, 110)	48.1	--	47.1	46.7
[110, 190)	11.0	--	6.2	7.0
[190, 210)	5.6	--	3.9	3.8
210% or more	2.3	--	1.4	1.7
Mean	95.1	--	86.3	87.4
(Standard Error)	(8.1)	--	(5.3)	(4.6)
Median	99.4	--	100.0	100.0
Sample Size	51	23	191	265
Weighted % [d]	18.7	12.7	24.0	22.6*

Source: School Nutrition Dietary Assessment-III, 24-hour Dietary Recalls, school year 2004-2005. Weighted tabulations based on first 24-hour recall, prepared by Mathematica Policy Research.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale. NSLP participation refers to participation on the recall day.
-- Statistics not reported due to small sample size of marginally secure NSLP participants who reported eating grains at lunch.

[a]Stars in the "All Participants" column represent the results of chi-squared tests across the food security categories and the percentage consumed categories. The means were also compared (15 independent two-tailed t-tests). No significant differences in the means were found across any of the groups for any of the meal components.
[b]The (0, 45%) row shows the percent of the sample that consumed greater than 0 percent and less than 45 percent.
[c]The [45, 90) row shows the percent of the sample that consumed greater than or equal to 45 percent and less than 90 percent.
[d]The "Weighted %" row shows the weighted percent of the sample that consumed any food in that food group. The denominator is all NSLP participants in that food security group. These were compared using a chi-squared test for each food group. Only entrees and grains reached the level of statistical significance.

*=Significantly different at the .05 level. **=Significantly different at the .01 level.

recall day. Next, the average and the median percentage consumed are listed for each food group. Appendix B provides details on the construction of the variables and the analysis.

B. Results

Results for All Students. Overall, vegetables had the lowest median percentage consumed of any of the food groups, at 68 percent, whereas the median percentage consumed for each of the other four food groups was 100 percent (see Table V.1). Fully 58 percent of participants who had a vegetable at lunch consumed less than 90 percent of it, and 25 percent of participants consumed less than 45 percent. The distribution of the percentage consumed of the other food groups was much more concentrated in the range of 90 to 110 percent.

Some students reported eating more than 100 percent of the portion offered. Such findings may reflect general measurement error in 24-hour recalls and the particular challenge of estimating portion sizes. In addition, some percentages greater than 100 percent may reflect problems in matching data from two different sources. Nonetheless, there are small spikes in the distributions around 200 percent consumed, which suggests that some participants may have consumed two entire portions. Furthermore, 24 percent of participants who reported eating vegetables and 27 percent who reported eating fruits said that they consumed over 110 percent of the portion offered, compared to 17 percent for entrees, 13 percent for grains, and 3 percent for milk. Fruits and vegetables may be the food groups where it is easiest to ask for (or take) a second serving or part of a second serving, because USDA guidance encourages serving additional fruits and vegetables. Additional servings of fruits or vegetables or other foods may also be available à la carte or through trading or sharing with other students.[6]

[6] Looking specifically at vegetables, we found that most of the reported multiple servings were for French fries.

Results by Food Security Status. There are almost no significant differences among the food security groups in the percentages consumed of the major food groups. Using the categorical breakdown of the percentage consumed shown in Table V.1, we applied chi-squared tests across the three groups to test for statistical significance. The only significant finding is for milk, which appears to be driven by the fact that over 30 percent of marginally secure participants consumed less than 90 percent of their milk portions, compared to roughly 22 percent of the food insecure or the highly food secure. We also compared the mean percentages consumed within each food group using two-tailed t-tests of the differences between the food security groups taken two at a time. No significant differences were found.

Percentages consumed for foods in each group, such as for fruits or vegetables, were calculated among those who ate some of a discrete fruit or vegetable at lunch. We were concerned that the results could be distorted if highly food-secure students reported eating fruits or vegetables at lunch more (or less) often than less-secure students. However, the percentage of NSLP participants who had a fruit or vegetable at lunch does not vary much across the three food security groups (see the *Weighted %* rows in Table V.1).

If food-insecure students consistently wasted less, it might indicate that they had unmet need, but these data do not support such concerns. Nonetheless, the small sample sizes of students who ate something from some of the food groups limit the power to detect differences between the food security groups.

VI. FOOD SECURITY AND BREAKFAST SKIPPING

In previous chapters, we examined intakes at breakfast only for students who ate breakfast and intakes at lunch only for students who ate lunch. Therefore, for a full description of the patterns of intakes by food security status, we must also examine meal-skipping behavior. Particularly important is breakfast skipping, which is more common than lunch skipping. This chapter examines the relationship between food security status and meal skipping by children and adolescents.

Meal skipping is defined by the timing and eating-occasion names that the children reported for each food consumed during the 24-hour recall period. In the SNDA-III data, breakfast foods are all foods eaten between 5 A.M. and 9:30 A.M., plus foods that students called breakfast and ate between 9:30 A.M. and 10:30 A.M.[1] If a student did not report consuming any foods classified as breakfast foods, then that student was counted as having skipped breakfast. But consuming even a very small amount of food during these times was counted as having eaten breakfast. Similarly, lunch foods included all foods eaten between 10 A.M. and 2 P.M., unless reported as a breakfast food, and also foods that students called lunch and ate between 2 P.M. and 3:30 P.M.[2] If students did not report consuming any lunch foods, then they were counted as having skipped lunch.

Breakfast skipping was relatively common among students overall (13 percent skipped breakfast) but it was almost twice as common among the marginally secure (21 percent) and insecure (20 percent) students as among the highly food-secure students (11 percent) (Table VI.1). Among students who attended schools that served breakfast, food-insecure and marginally secure students were *still* roughly twice as likely as the highly secure to skip breakfast. Breakfast skipping was most common among secondary school students (18 percent skipped breakfast). At the secondary level,

[1] We classified as breakfast a few reported breakfasts eaten before 5 A.M. or after 10:30 A.M., after checking that no other breakfast was reported and, in the case of the late breakfasts, that late lunches were also reported.

[2] We also counted as lunch food all foods eaten from 9:30 A.M. to 10 A.M. and reported as lunch, supper, or dinner.

Table VI.1 Meal Skipping Behavior and Food Security Status

Percentage of students	Insecure	Marginal	High	Total
All Students				
Consume Both	79.1	75.9$^{\beta}$	88.3$^{\gamma}$	85.7
Skip Lunch	3.3	3.8	2.5	2.7
Skip Breakfast	19.5	20.8$^{\beta}$	10.5$^{\gamma}$	12.8
Skip Breakfast (students at schools w/ breakfast)	19.2	21.5$^{\beta}$	11.3$^{\gamma}$	13.7
Predicted Skip Breakfast[a]	16	19$^{\beta}$	12	
Sample Size	**348**	**284**	**1,638**	**2,270**
Secondary Students				
Consume Both	69.4	65.6$^{\beta}$	83.6$^{\gamma}$	79.3
Skip Lunch	5.8	6.9	3.6	4.3
Skip Breakfast	28.0	28.3$^{\beta}$	14.2$^{\gamma}$	18.0
Skip Breakfast (students at schools w/ breakfast)	27.3	30.4$^{\beta}$	15.3$^{\gamma}$	19.1
Predicted Skip Breakfast[a]	25	25$^{\beta}$	17$^{\gamma}$	
Sample Size	**260**	**209**	**1,083**	**1,552**

Source: SNDA-III 24-hour Dietary Recalls, school year 2004-2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale.

α,β, and γ represent the results from individual χ^2 tests for all rows except the predicted breakfast skipping row:
$^{\alpha}$Difference between the insecure and the marginal group is significant at the .05 level.
$^{\beta}$Difference between the marginal and the high security group is significant at the .05 level.
$^{\gamma}$Difference between the high security and the insecure group is significant at the .05 level.

[a]For predicted row α, β, and γ are from logistic regressions with controls for the food security status of each student and whether they attend a school that serves breakfast as well as age, sex, and other socioeconomic differences that may influence breakfast-skipping behavior.

less-food-secure students were also about twice as likely as highly food-secure students to skip breakfast, even among students who attended schools that served breakfast.[3]

Lunch skipping was much less common overall—only 3 percent of students skipped lunch (Table VI.1). Although marginally secure and insecure students had slightly higher rates of skipping lunch (4 percent and 3 percent of them skipped lunch, respectively, compared to 2 percent for highly food-secure students)— these rates are not significantly different.[4] Very few students skipped both lunch and breakfast. Therefore, we focus on breakfast skipping for the rest of this chapter.

Of course, the relationship between food security status and breakfast skipping may in fact reflect other characteristics of the less-food-secure children. To examine this possibility, we estimated multivariate models of breakfast skipping, including indicator variables for children from food-insecure and marginally secure families, with children from highly food-secure families as the omitted category.[5] The adjusted predicted probability of skipping breakfast for each food security group is shown in the next-to-last row of each panel in Table VI.1.

When controlling for a wide range of characteristics, the difference between marginally food-secure and highly food-secure students in their predicted likelihood of skipping breakfast was similar in magnitude to the unadjusted difference and statistically significant at the $p<.05$ level. However, the difference between insecure and highly secure students in their predicted probability of skipping breakfast was slightly smaller than the unadjusted difference and no longer significant at the $p<.05$

[3] Since breakfast skipping (and lunch skipping) is more common among older students and there is a tendency for insecure and marginally secure students to be older, we wanted to verify that we saw the same pattern when considering secondary-school students only. Among secondary students who attended schools that served breakfast, 27 percent of the insecure, 30 percent of the marginally secure, and 15 percent of the highly secure skipped breakfast.

[4] Among secondary students, 6 percent of the insecure, 7 percent of the marginally secure, and 4 percent of the highly secure skipped lunch (not shown in table). These rates are also not significantly different.

[5] See Appendix B for a detailed discussion of the model and its results.

level (although significant at the $p<.10$ level).[6] The findings that skipping breakfast was more common for older students and less-food-secure students are consistent with previous literature, which also notes that breakfast skipping is more common among adolescents than among younger children, and among children of low versus higher socioeconomic status (Rampersaud et al. 2005; Affenito 2007; Berkey et al. 2003).

Skipping breakfast would be of less concern if skippers made up for needed calories or nutrients later in the day. However, regardless of food security status, breakfast skippers did not make up the calories during the rest of the day by eating more snacks or consuming more at other meals (Table VI.2[7]). This finding is also consistent with previous research (Rampersaud et al. 2005). Average calories consumed over the 24-hour recall period were significantly lower for breakfast skippers than for other students (1,691 compared to 2,173). Furthermore, breakfast skippers consumed significantly fewer calories over the day within each of the three food security groups: insecure, marginally secure, and highly secure. Of more concern, breakfast skippers, overall and within each of the three groups, also had significantly lower 24-hour intakes of key nutrients, including vitamin A, vitamin B_6, vitamin B_{12}, calcium, iron, magnesium, potassium, and dietary fiber.[8] Examining background characteristics of breakfast skippers and consumers provides additional insight into how these groups of children differ (Table VI.3). Among the food insecure and in the overall sample, breakfast skippers were significantly poorer than consumers, which may indicate an unmet need for SBP breakfasts. Within each food security category, skippers and consumers were about as likely to have applied for free or reduced-price meals, although for the full sample, skippers were significantly more likely to have applied than consumers (61 percent versus 51 percent).

[6] In contrast, for secondary school students, even after controlling for other characteristics, food-insecure students are still significantly more likely to skip breakfast than highly secure students at the $p<.05$ level.

[7] This table presents weighted means which have not been regression adjusted.

[8] Breakfast skippers also had less sodium and saturated fat.

Table VI.2 24-Hour Intakes by Food Security Status and Breakfast Skipping Behavior, Among Students at Schools that Serve Breakfast

	Insecure		Marginal		High		All	
	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]
Food Energy (kcal)	1743	2225.5**	1624.6	2025.5**	1695.5	2183.6**	1691.4	2173.4**
Macronutrients: Total Amount (g)								
Total fat	64.1	81.9*	61.3	71.7*	65	78.3**	64.2	78.1**
Saturated fat	21.5	28.1**	19.6	24.6**	22	27.3**	21.5	27.1**
Carbohydrate	232.4	293.7*	217.5	275.4**	221.6	298.9**	222.7	295.7**
Protein (g)	64.2	84.4**	55.2	74.2**	60.8	77.2**	60.7	78**
Macronutrients: Percentage of Food Energy from								
Total fat	31.9	32.1	34.6	31.4**	33.2	31.7	33.2	31.8*
Saturated fat	10.9	11.1	11.2	10.8	11.3	11	11.2	11
Carbohydrate	54.1	53.7	52.5	54.7	53.6	55.1	53.4	54.9
Protein	15.1	15.3	13.9	14.9	14.3	14.3	14.5	14.5
Vitamins and Minerals								
Vitamin A(mcg RAE)	400.7	625.3**	289.4	596.5**	360.2	653.7**	358.3	645**
Vitamin C (mg)	80.3	94.5	78.9	101.2	54.5	96.1**	64.4	96.8**
Vitamin E (mg)	5.2	6.9	5.2	5.5	5.2	6.2**	5.2	6.2**
Vitamin B_6 (mg)	1.3	2**	1.2	1.7**	1.2	1.9**	1.2	1.9**
Vitamin B_{12} (mcg)	3.7	6**	3.3	5.2**	3.4	5.5**	3.5	5.5**
Calcium (mg)	838.4	1171.2**	626.1	1061.4**	726.6	1145.1**	733.3	1139.3**
Iron (mg)	11.8	16.6*	9.6	15.1**	10.4	16.2**	10.6	16.1**
Magnesium (mg)	198.6	272.9**	172.9	240.3**	189	258.6**	188.4	258.5**
Potassium (mg)	1884.4	2744.2**	1807.1	2497.3**	1835.2	2573.5**	1845.7	2590.6**
Sodium (mg)	2784.5	3582.4**	2450.9	3312.4**	2800.5	3496.1**	2744.4	3489**
Other Dietary Components								
Fiber (g)	10.8	15.2**	10.6	13.5**	10.7	14.4**	10.8	14.4**
Cholesterol (mg)	178.3	237.2*	162	210.3**	166.7	219**	168.6	221.2**
Sample Size	**76**	**252**	**73**	**190**	**194**	**1,185**	**348**	**1,663**

Table VI.2 *(continued)*

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004–2005. Weighted tabulations based on first 24-hour recall prepared by Mathematica Policy Research. Means are not regression adjusted.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale.

[a]Consumers are students that reported consuming some breakfast foods on the recall day. Stars in the consumer column represent the results of two tailed t-tests comparing consumers to skippers. *=Significantly different at the .05 level. **=Significantly different at the .01 level.

Table VI.3 Student Characteristics by Food Security Status and Breakfast Skipping Behavior, Among Students at Schools that Serve Breakfast

	Insecure		Marginal		High		All	
	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]
Average Age	13.3	11.8	13.2	11.5	13.0	11.5	13.1	11.6
Sex								
Male	44.3	53.3	43.2	44.3	43.6	50.0	43.7	49.7
Female	55.7	46.7	56.8	55.7	56.4	50.0	56.3	50.3
Race/Ethnicity						*		*
Hispanic	41.5	42.2	24.7	40.2	24.3	17.2	28.1	22.8
White, non-Hispanic	18.6	29.3	43.3	32.3	50.2	60.4	42.6	52.9
Black, non-Hispanic	24.0	23.1	28.6	25.1	21.5	16.3	23.0	18.6
Other	15.9	5.3	3.4	2.3	4.0	6.1	6.3	5.8
Number of Children Under 18 in Household								
0	1.6	2.0	4.3	1.1	1.6	2.3	2.1	2.1
1	8.9	15.8	18.1	14.0	29.0	26.8	22.6	23.8
2	38.2	24.0	34.5	34.8	45.2	39.2	41.2	36.4
3	26.4	33.5	19.3	31.4	13.4	19.1	18.2	22.9
4 or more	25.0	24.7	23.8	18.6	10.9	12.5	16.0	14.7
Number of Adults in Household								
1	38.7	29.0	26.8	24.7	16.8	13.2	22.9	16.6
2	37.3	49.1	55.8	51.3	61.4	63.6	55.9	60.4
3	18.8	14.6	14.5	18.2	17.6	18.2	17.1	17.5
4 or more	5.3	7.3	3.0	5.8	4.1	5.0	4.2	5.5
Household Income as a Percentage of Poverty		**						*
0-130	83.6	71.5	70.4	63.0	23.9	21.2	44.2	31.8
131-185	14.1	17.8	15.6	24.8	9.2	9.4	12.3	12.9
186-300	2.3	3.5	5.0	9.2	21.3	22.0	14.5	18.9
301-400	0.0	2.1	0.0	1.9	17.0	18.9	10.3	14.4
Greater than 400	0.0	5.1	9.1	1.2	28.5	28.5	18.8	21.9
Parent's Highest Education								*
Less than HS	32.9	33.6	18.2	19.4	7.4	7.6	14.6	12.2
High School/GED	35.8	29.5	37.7	42.1	26.6	22.2	30.5	25.1
Some postsecondary	29.7	31.1	39.4	25.8	39.8	36.8	37.5	35.3
College Grad	1.6	5.7	4.8	12.7	26.1	33.4	17.4	27.3

Table VI.3 (continued)

	Insecure		Marginal		High		All	
	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]
Parent's Hours Worked per Week								
0	26.6	29.6	27.8	32.9	23.2	23.2	25.4	24.9
1-20	21.9	18.6	19.8	14.8	9.9	11.8	14.0	13.1
21-35	4.8	11.7	11.5	10.9	12.8	14.1	10.7	13.7
36-40	31.9	25.9	27.4	27.1	29.8	30.3	29.7	29.4
More than 40	14.8	14.1	13.4	14.3	24.3	20.6	20.1	18.9
Applied for Free/Reduced Price Meals	94.2	94.3	91.4	85.3	40.5	37.1	60.7	50.5**
Eats School Lunch at least once a week[b]	93.0	94.2	90.4	91.5	83.9	85.6	87.2	87.6
Eats School Lunch at least three times a week[b]	87.3	85.9	73.1	82.6	63.4	69.8	70.4	73.4
NSLP Participant (on recall day)	69.8	79.3	68.0	81.8	50.6	59.4*	57.9	64.8
Eats School Breakfast at least once a week[b]	66.2	83.8	50.2	72.5	41.5	45.3	48.0	53.7
Eats School Breakfast at least three times a week[b]	19.6	55.9**	16.9	46.6**	13.5	26.7**	15.2	32.8**
SBP Participant (on recall day)	0.0	45.4**	0.0	33.0**	0.0	19.3**	0.0	24.6**
Sample Size	**76**	**252**	**73**	**190**	**194**	**1,185**	**348**	**1,663**

Source: SNDA-III Parent Interviews, school year 2004-2005. Tabulations are weighted to be nationally representative of students in public NSLP schools.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale.

[a] Consumers are students that reported consuming some breakfast foods on the recall day. Stars in the consumer column represent the results of chi-squared tests comparing consumers to skippers. *=Significantly different at the .05 level. **=Significantly different at the .01 level.
[b] Based on child's response if available about usual breakfast or lunch participation. If not available, parent's response was used.

Skippers were as likely as consumers to report eating a school lunch at least once a week (87 percent of both groups) and were not significantly less likely to eat a school lunch on the recall day (except among the highly food secure). Insecure and marginal skippers were not significantly less likely than corresponding consumers to report eating a school breakfast at least once a week (about 66 percent of insecure skippers and 50 percent of marginally secure skippers did). However, they were significantly less likely than consumers to report eating a school breakfast three times per week (about 15 to 20 percent of skippers versus about 50 percent of consumers).

Among adolescents, obesity, inactivity, and poor health all have been associated with skipping breakfast (Rampersaud et al. 2005). All these issues were somewhat more common among less-food-secure students in the SNDA-III data, but highly food-secure breakfast skippers were also more likely than highly food-secure consumers to have some of these characteristics (Table VI.4). In particular, highly food-secure breakfast skippers and skippers overall were significantly more likely to be overweight or obese than the respective groups of breakfast consumers. Insecure breakfast skippers and consumers show the same pattern, but it is not statistically significant. However, marginally secure skippers and consumers have very similar distributions of weight status. Breakfast skippers were generally less likely to participate in school- or community-organized sports—again, the marginal group is the exception. Finally, breakfast skippers in each group were less likely than consumers to be in excellent health and more likely to be in good, fair, or poor health, although the differences between skippers and consumers were significant only for the full sample.

An important caveat concerning these results is that breakfast skippers may be underreporting their consumption or eating less in an attempt to lose weight (although our models controlled for reported dieting, secondary students may not want to have reported dieting, and elementary students were not asked the question). Because breakfast skippers were more likely to be overweight or obese, they must have consumed more calories than they used over time more than breakfast

Table VI.4 Health, Physical Activity, Eating Habits, and School Characteristics by Breakfast Skipping Behavior, Among Students at Schools that Serve Breakfast

	Insecure		Marginal		High		All	
	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]
Body Mass Index (BMI)						*		*
< 5th percentile	4.6	3.3	6.8	4.6	2.4	6.6	3.6	5.9
≥5th percentile & <85th percentile	37.6	53.6	47.2	47.7	52.5	57.6	48.7	56.4
≥85th percentile & <95th percentile	18.6	13.4	16.4	17.6	13.1	15.9	14.7	15.6
≥95th percentile	39.1	29.7	29.6	30.1	32.0	19.9	33.1	22.1
Physical Activities (Child report, multiple yes's possible[b])								
Taking physical education in school	68.7	72.3	74.9	77.6	72.7	78.9	72.6	78.1
On a school sports team	4.8	23.9**	10.4	13.0	19.9	27.6*	14.9	25.9**
Participate in community sports	20.4	40.9**	38.9	38.1	41.9	53.2*	36.7	49.7**
Walks or bikes to school	30.8	21.7	12.4	25.3	13.3	20.1*	16.6	20.9
Physically active outside of school	86.9	92.3	92.9	93.5	91.9	94.5	91.0	93.8
Child's General Health (Parent report)								**
Excellent	29.3	40.7	34.5	41.3	44.3	53.6	39.5	50.5
Very good	29.6	31.3	30.7	30.2	36.9	32.3	34.2	32.0
Good	30.1	18.4	27.2	19.4	14.0	11.2	19.8	13.0
Fair	9.3	9.5	6.4	9.1	3.5	2.3	5.2	4.0
Poor	1.7	0.2	1.1	0.0	1.3	0.6	1.3	0.5
Nights per Week Family Eats Dinner Together (Child report, age 12 & up only, n=1,544)								
Every Night	31.9	34.6	32.2	41.5	34.2	34.7	33.5	35.2
5 or 6	8.6	7.2	10.5	8.4	16.5	15.5	13.3	13.6
3 or 4	14.7	23.7	23.8	25.9	22.6	24.7	20.8	24.8
1 or 2	22.5	20.5	13.3	15.2	14.1	16.9	16.3	17.2
None	22.3	14.0	20.3	8.9	12.6	8.2	16.2	9.2
Amount Child Eats Compared to Other Children the Same Age								
Larger Amount	29.4	25.7	34.4	23.1	21.6	21.8	25.3	22.6
Same Amount	56.1	56.0	43.8	58.5	63.3	63.3	57.9	61.5
Smaller Amount	14.5	18.3	21.8	18.4	15.0	15.0	16.8	15.9

Table VI.4 *(continued)*

	Insecure		Marginal		High		All	
	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]	Skipper	Consumer[a]
Pickiness								
Very picky eater	20.4	30.5	31.3	30.4	24.7	19.1	25.0	21.8
Somewhat picky eater	57.6	45.0	48.7	29.9	43.9	45.0	47.5	43.5
Not a picky eater	22.0	24.5	20.0	39.7	31.4	35.8	27.5	34.7
In past 30 days, ate less or chose foods low in fat or carbohydrates to lose weight (age 12 or above only, n=1,563)	42.7	34.0	41.7	35.7	25.7	28.4	32.4	29.7
Percentage of Students Certified for Free or Reduced Lunch								
Low (< 20%)	13.1	24.0	22.5	32.2	33.6	34.5	27.4	32.6
Medium (20-60%)	48.1	35.9	45.3	37.1	42.2	45.0	43.7	42.7
High (> 60%)	38.9	40.1	32.2	30.7	24.2	20.6	28.9	24.7
School Type		**		**		**		**
Elementary	20.9	49.9	21.4	50.7	33.8	53.1	29.0	52.4
Middle	37.5	23.5	40.6	23.1	28.9	18.6	33.1	19.8
High	41.6	26.6	38.0	26.3	37.4	28.3	37.9	27.7
Sample Size	**76**	**252**	**73**	**190**	**194**	**1,185**	**348**	**1,663**

Source: SNDA-III Parent and Child Interviews, school year 2004-2005. Tabulations are weighted to be nationally representative of students in public NSLP schools. BMI was calculated by Mathematica. Other data are from Parent Interview unless otherwise noted.

Note: The insecure, marginal, and high columns refer to the food security status of a student's household as measured by the adult scale.

[a]Consumers are students that reported consuming some breakfast foods on the recall day. Stars in the consumer column represent the results of chi-squared tests comparing consumers to skippers. *=Significantly different at the .05 level. **=Significantly different at the .01 level.
[b]Since multiple yes's are allowed with respect to a child's physical activities, chi-squared tests were performed individually for each activity.
[c]Based on 2003-04 U.S. Department of Education Common Core of Data.

consumers. In turn, differential underreporting of either eating or dieting may contribute to the differences in reported calorie consumption of skippers and consumers.

VII. CONCLUSION

The descriptive results from this study provide policy-relevant information but also raise questions for future research. While school meals play an important role in the diets of students from food-insecure and marginally secure households, one day of dietary intake provides only a snapshot, which cannot give us a full understanding of this role. In addition, the reasons these students did not take full advantage of school meals are unclear.

A. Key Findings

- Food-insecure children were more disadvantaged than highly food-secure children in many respects, such as income, family structure, and parental education. Marginally food-secure children fell between the other two groups in most cases, but they were generally more similar to food-insecure than to highly food-secure children.
- Although large proportions of less-food-secure children (over 75 percent) ate a school lunch on the recall day, far fewer ate a school breakfast (37 percent of food-insecure and 26 percent of marginally secure students).
- On school days, students from food-insecure households consumed, on average, levels of calories, nutrients, and MPEs from major food groups similar to the levels consumed by students from highly food-secure households.
- Students from marginally food-secure households consumed fewer calories and nutrients on a typical school day than students from insecure or highly secure households.
- Less food-secure students (the insecure or marginally secure) obtained higher proportions of their daily calories, nutrients, and foods from on-menu school foods than highly secure students. This is partially explained by the higher participation rates of the less secure, but even among school meal participants, some differences among the food security groups persist.
- Food security status was not significantly related to the percentage of offered portions eaten by participants at lunch, but samples were small because we could calculate this measure only for NSLP participants who ate an on-menu food from the specific food group being considered.
- Insecure and marginally secure students skipped breakfast at a rate twice as high as that of highly secure students—about 21 percent of the less secure skipped versus 11 percent of the highly food secure, despite the fact that more than 80 percent of the less secure were eligible for free or reduced-price meals. Secondary-school students skipped breakfast much more frequently than elementary students at all levels of food security.
- Regardless of food security status, breakfast skippers, on average, did not make up calories missed later in the day.
- Breakfast skippers tended to be from households with lower incomes than consumers, to be obese more often, and to have lower reported health status. These patterns held

for both insecure and highly secure breakfast skippers, but not for marginally secure skippers.

B. Two Puzzles

These findings leave us with two puzzles for researchers and policymakers.

1. Why Did So Many Less-Secure Children Skip Breakfast, When the SBP Was Available?

Less-food-secure students repeated skipping breakfast at twice the rate of highly food-secure students, even though most insecure and marginally secure students qualified for free or reduced-price breakfasts and attended schools that offered them. These students were more likely to either skip breakfast or to consume an SBP breakfast (see Tables III.1 and VI.1). This suggests that they have more limited access to breakfast at home and that there were barriers or costs to SBP participation for the group that skipped breakfast, even when the meal was free or very low in cost.

Given that about half the less-secure breakfast skippers reported participating in the SBP at least once a week (see Table VI.3), children who skipped breakfast were often aware of the SBP and at least somewhat interested in participating. On the specific day covered by the dietary recall (and, since few participated regularly, on some other days), they may have faced barriers that made participation difficult. Such barriers could be in their family life, in their relationships with peers, in their neighborhoods, or in school policies that affected the convenience or attractiveness of school breakfasts; they could also have reflected unobserved behavioral issues (such as sleeping late or skipping class).

2. Why Did Marginally Food-Insecure Children Eat Less, on Average, than Both Food-Insecure and Highly Food-Secure Children?

A second puzzle is that marginally food-secure children consumed fewer calories on average than both insecure and highly secure children despite skipping breakfast at roughly the same rate as insecure children (unadjusted). However, after adjusting for other factors, marginally secure children were slightly more likely to skip breakfast (refer back to Table VI.1). Marginally secure skippers were less likely than insecure skippers to report eating an SBP breakfast at least once a week (50 percent

versus 66 percent). Marginally secure breakfast consumers were less likely than insecure consumers to participate in the SBP on the recall day (33 percent versus 45 percent)

Overall, parents of marginally food-secure children were less likely than parents of food-insecure children to report having applied for free or reduced-price school meals, even though over 80 percent of both groups had incomes at or below 185 percent of poverty. However, marginally secure children were more likely than insecure children to be eligible only for reduced-price and not free school meals (Table III.1). Having to pay the reduced price may be a barrier to participation for marginally food-secure students, particularly for school breakfasts, which may be less attractive than lunches because of stigma or inconvenience.

Students from insecure and marginally food-secure families may experience more volatility than highly secure students in their family situations and the challenges they face. The results on usual SBP participation among breakfast skippers support this hypothesis. Although caution should be used in generalizing the results from one day and from these relatively small samples, they suggest some interesting areas for future research, including analysis of differences in usual intakes, studies of patterns of breakfast skipping over time, and exploration of barriers to SBP participation and how they may be reduced.

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APPENDIX A

REGRESSION MODELS AND RESULTS

This appendix describes the methodology used for the analysis of the regression-adjusted mean dietary intakes of school meal program participants and nonparticipants. As noted in the report, less-food-secure students differ from highly food-secure students in many ways, both observable and unobservable. Because of these differences between food security groups, it is likely that their dietary intakes would differ even if the school meal programs were not available.

To adjust for some of the underlying differences between the three food security groups, the mean dietary intakes were regression-adjusted for observable factors that may be correlated with a student's food security status, with their decision to participate in the school meal programs and with their dietary intakes.

The process used to generate the regression-adjusted estimates had two steps. First, linear regression models of students' intakes of each nutrient were estimated (both at breakfast or lunch and over 24 hours), with food security status, NSLP and SBP participation status and other relevant observable factors included as covariates (Table A.1).[1] Second, the estimated coefficients from the regression models were used to calculate three different predicted intake levels for each sample member—one assuming they were highly food secure, one assuming marginally secure, and one assuming food insecure. So the regression-adjusted estimate of mean intakes for each group was computed as the weighted mean value of the predicted intake levels assuming all students were members of that group.

The difference between the predicted intakes of the highly food secure and the insecure is equal to the estimated coefficient on the indicator variable for being food insecure (since being highly food secure was the reference category). The difference is statistically significant if the

[1] Regression models for the "all students" columns were estimated on the full sample of students with completed 24-hour dietary recalls and parent interviews. For students with two dietary recalls, only the first was included.

coefficient is. As in the SNDA-III student-level analyses (Gordon et al. 2007b), standard errors were adjusted for clustering at the primary sampling units, which in most cases was the local School Food Authority.

Table A.1 lists the covariates included in the model.[2] The model used essentially the same covariates as those included in the SNDA-III student-level analyses (Gordon et al. 2007b). Table A.2 presents the full results of these regression models for the energy consumed over the course of 24 hours for all students and for the NSLP participants. For participants, the regression-adjusted estimates of mean intakes were computed similarly; however, the weighted mean value of the predicted intake levels were based on separate regressions only including participants.

Table A.2 also shows the results from the logistic models that were run to predict breakfast skipping behavior, as discussed in Chapter VI. These are raw coefficients; selected predicted probabilities from these models are presented in Table VI.1.

[2] When the value for a particular covariate was missing for a particular student, the value for this covariate was imputed. Across the different covariates included in the analysis, the percentage of sample members with missing values ranged from zero to 8 percent. Missing values of continuous school-level variables were imputed as the mean value of that variable by region and grade level (elementary, middle, or high school), and missing values of continuous student-level variables were imputed as the mean value of that variable by region, grade level, and gender. Missing values of school-level binary and categorical variables were imputed as the modal value for that variable by region and grade level, and missing values of student-level binary and categorical variables were imputed as the modal value for that variable by region, grade level, and gender. The models included 16 imputation indicators.

Table A.1 Covariates Included in Regression Models of Mean Dietary Intakes

Covariate	Description
Food Insecure	A binary variable indicating student's household was food insecure on adult scale
Marginally Secure	A binary variable indicating student's household was marginally secure on adult scale.
NSLP Participation	A binary variable indicating the student participated in the NSLP on the recall day
SBP Participation	A binary variable indicating the student participated in the SBP on the recall day
Female	A binary variable indicating the student's gender
Race/Ethnicity	A set of three binary variables indicating the student's race/ethnicity
Age	A set of 12 binary variables indicating the student's age
Hearty Eater	A set of two binary variables indicating how much the student eats relative to others
Picky Eater	A set of two binary variables indicating whether the student is not picky, somewhat picky, or very picky
Height	The student's height in feet
Food Allergies	A binary variable indicating whether the student has food allergies or special dietary needs
Dieting	A binary variable indicating whether the student is on a diet
Dietary Supplement Use	A binary variable indicating whether the student takes dietary supplements
Health Status	A set of three binary variables indicating how healthy the student is, based on parent reports
Physical Activity	A set of three binary variables indicating the student's level of physical activity relative to others
TV Watching	A set of three binary variables indicating the amount of television the student watches per day
Family Income	A set of four binary variables indicating the student's family income relative to poverty
Public Assistance	A binary variable indicating whether the student's family receives public assistance
Number of Children in Household	A set of two binary variables indicating the number of children in the household

Table A.1 *(continued)*

Covariate	Description
Relationship of Respondent to Student	A binary variable indicating whether the respondent was the student's parent or partner of parent (versus guardian or other relative)
Parental Employment	A set of four binary variables indicating the employment status of the student's parent(s)
Primary Language Spoken at Home	A set of two binary variables indicating the primary language spoken in the student's home (Spanish, other non-English)
Parental Education	A binary variable indicating the highest level of education completed by the student's parent(s) was college or more.
Family Dining Habits	A binary variable indicating whether the student's family eats dinner together 5 nights a week or more
School SBP Participation	A binary variable indicating whether the student's school participated in the SBP
Competitive Foods Offered During Mealtimes	A binary variable indicating whether the student's school offers competitive foods during mealtimes
Healthy Foods Offered Competitively	A binary variable indicating whether the student's school offers healthy foods in vending machines, snack bars, or school store
Recess	A binary variable indicating whether the student's school offers recess
Urbanicity	A set of three binary variables indicating whether the student's school serves an urban area, urban fringe, town, or rural area
Region	A set of six binary variables indicating region of the country in which the student lives (based on FNS regions)
School Size	A set of two binary variables indicating school size
School Poverty Rate	A set of two binary variables indicating poverty rate in the school district
Day of Week	A set of four binary variables indicating the day of the week covered by the student's dietary recall
Imputation Indicators	A set of 16 binary variables indicating whether the values of particular covariates were imputed for that student

Table A.2 Sample Regression Results

	Dependent Variable and Sample			
	Food Energy over 24 hours (kcal)		Skip Breakfast	
	All	NSLP Participants	All	Secondary
Food Insecure	61.71	32.76	0.4	0.63*
Marginally Secure	-134.55*	-213.23**	0.66**	0.58*
NSLP Participation	60.33	.	-0.33*	-0.28
SBP Participation	131.37*	157.7*	.	.
Female	-362.16**	-281.25**	0.37*	0.39*
Black, Non-Hispanic	-55.69	-126.77	-0.01	0.22
White, Non-Hispanic	3.33	-67.23	-0.16	-0.11
Other Race, Non-Hispanic	72.9	-20.53	0.01	-0.15
Age 7	-52.08	-7.62	-0.05	.
Age 8	32.28	91.99	-0.42	.
Age 9	50.07	180.6	-0.97	.
Age 10	-47.5	89.46	-1.36	.
Age 11	104.25	219.73	-0.89	1.25
Age 12	-9.48	245.94	-0.76	0.49
Age 13	80.16	444.51*	-0.47	0.96
Age 14	-57.16	405.37*	-0.17	1.32
Age 15	89.02	466.46*	-0.71	1.03
Age 16	167.49	655.34**	-0.99	0.76
Age 17	168.47	547.28*	-0.92	0.83
Age 18+	171.74	674.43*	-0.79	0.9
Student Eats More than Others	170.02**	142.48	-0.08	-0.15
Student Eats the Same as Others	70.21	55.53	-0.16	-0.1
Student Somewhat Picky Eater	-125*	-76.3	0.14	-0.18
Student Not Picky Eater	-27.98	-3.94	-0.27	-0.6**
Student's Height in Feet	202.63	155.75	0.81*	0.7*
Student Has Food Allergies or Special Dietary Needs	-31.97	-47.86	-0.14	-0.01
Student on a Diet (Middle & High School)	-296.68**	-195.27**	0.12	0.15
Student Takes Dietary Supplements	15.92	105.04*	-0.38*	-0.59**
Student in Good Health (Parent Report)	49.27	-147.69	0.08	-0.11
Student in Very Good Health (Parent Report)	78.48	-33.73	-0.1	0.01
Student in Excellent Health (Parent Report)	168.24*	64.7	-0.33	-0.27
Student About as Physically Active as Others	36.52	97.76	-0.04	-0.11
Student More Physically Active than Others	99.11	120.47	-0.08	-0.45
Student Much More Physically Active than Others	172.94*	155.97	-0.32	-0.49

Table A.2 *(continued)*

	Dependent Variable and Sample			
	Food Energy over 24 hours (kcal)		Skip Breakfast	
	All	NSLP Participants	All	Secondary
Student Watches 0.1 to 1 Hours of TV a Day	38.2	-31.51	-0.4	-0.16
Student Watches 1.1 to 2.9 Hours of TV a Day	85.32	0.25	-0.29	-0.15
Student Watches More than 3 Hours of TV a Day	6.82	-129.95	-0.09	0.17
Family Income 130 to 185 Percent of Poverty	-17.68	33.8	-0.32	-0.64*
Family Income 185 to 300 Percent of Poverty	-178.61**	-131.76	0.08	-0.38
Family Income 300 to 400 Percent of Poverty	-91.27	9.98	-0.16	-0.53
Family Income More than 400 Percent of Poverty	-144.35	-166.45	0.33	0
Family Receives Public Assistance	-25.65	17.86	-0.18	-0.21
Two Children in Household	11.01	32.78	0.29	0.28
Three or More Children in Household	2.89	37.7	0.06	0.18
Respondent Was Parent or Partner of Parent	28.66	-148.27	-0.65	-0.48
Two Parents, Both Employed Full Time	91.65	159.99	-0.71*	-0.26
Two Parents, One Employed Full Time	24.28	77.27	-0.52	0.07
Two Parents, Neither Employed Full Time	199.3	415.78**	-0.09	0.32
One Parent, Employed, Full Time	-6.72	120.67	-0.15	0.27
Primary Language Spoken at Home: Spanish	-99.39	-70.64	0.24	-0.04
Primary Language Spoken at Home: Other	-238.86*	-86.95	0.66	0.88*
Highest Level of Parental Education: College or More	10.87	-39.58	-0.48*	-0.28
Family Eats Dinner Together 5+ Nights a Week	27.18	-33.2	-0.08	-0.06
School Participating in SBP	68.44	121.76	0.36	0.91**
Competitive Foods Offered During Mealtimes	-74.95	-107.57	-0.06	-0.16
Healthy Foods Offered in Vending Machines, Snack Bars, or School Store	-25.34	-77.26	0.07	0.24
School Has Recess (Elementary & Middle Schools)	-47.25	76.94	0.18	0.58*
School Serves Urban Fringe of City	-145.49**	-134.69*	0.16	-0.05
School Serves Town	-202	-303.36**	0.68*	-0.3
School Serves Rural Area	-127.56*	-128.9	0.49*	0.59*
Midwest	33.84	75.54	0.2	0.11
Mountain	-39.31	-24.43	0.28	0.04

Table A.2 *(continued)*

	Dependent Variable and Sample			
	Food Energy over 24 hours (kcal)		Skip Breakfast	
	All	NSLP Participants	All	Secondary
Northeast	-147.94	32.63	-0.17	-0.78
Southeast	-40.82	97.46	0.36	-0.29
Southwest	23.6	100.94	0.43	0.29
Western	-162.97	-229.3*	-0.29	-0.48
School Enrollment 500-1,000	-185.79**	-204.19**	1.15**	1.36**
School Enrollment Over 1,000	-60.58	-80.12	1.42**	1.38**
Poverty Rate in District 10-20%	-62.89	-94.08	-0.37	-0.55*
Poverty Rate in District >20%	-133.31*	-164.39*	-0.1	-0.62*
Tuesday	-33.62	-49.88	0.01	-0.24
Wednesday	5.61	6.19	-0.13	-0.34
Thursday	-12.04	46.54	-0.45	-0.54*
Friday	-29.38	129.53	-0.27	-0.2
Student's Race Imputed	-461.6*	-166.38	-0.13	-0.53
Student's Height Imputed	116.67	240.07*	-0.17	-0.94
Student on Diet Imputed	-250.51	-316.42	0.9	0.77
Amount Student Watches TV Imputed	-741.38**	-937.91**	3.49**	24.32**
Student Takes Dietary Supplement Imputed	274.55	-184.41	-10.26**	0**
Amount Student Eats Compared to Others Imputed	-320.44	-301.95	-0.31	-0.67
Student's Pickiness Level Imputed	27.98	-306.17	0.07	0.28
Student's Physical Activity Level Imputed	-122.98	-272.4	-9.05**	-9.79**
Parent's Employment Status Imputed	44.48	-181.55	-0.15	0.36
Number of Children in Household Imputed	684.98	1263.33**	0.23	-0.87
Family Income Level Imputed	-29.17	141.37	0.58	0.65
Family Eats Dinner Together 5+ Nights a Week Imputed	-406.27	750.52*	-9.83**	-9.35**
Competitive Foods Offered Imputed	-111.68	-80.62	0.46	3.13**
School Has Recess Imputed	78.52	43.84	-0.3	-0.09
School Location Imputed	-591.35**	-476.85*	-1.39**	-1.63**
Parent's Highest Level of Education Imputed	-547.97	-590.07	-1.43	-10.73**
Constant	1,327.19	1,446.46	-5.09	-6.36
Number of Observations	**2,270**	**1,360**	**2,270**	**1,552**
R^2	0.17	0.21	0.11	0.14

Source: School Nutrition Dietary Assessment-III, 24-Hour Dietary Recalls, school year 2004-2005.

*Significantly different from zero at the .05 level.
**Significantly different from zero at the .01 level.

APPENDIX B

CONSTRUCTION OF PERCENTAGE CONSUMED FOR ON-MENU SCHOOL LUNCH FOODS

The analysis presented in Chapter V of the "percentage of portion consumed" for specific food groups focused on foods consumed as part of school lunches, because it was only possible to match foods that school lunch participants reported in dietary recalls to amounts offered for school menu foods. The "percentage of portion consumed" is thus the amount consumed (from the recall data) divided by the portion size offered (from the menu data).[1] However, the typical portion size of the school lunch menu item was not always available.[2] The "percentage of portion consumed" is thus defined only for school lunch participants and only for foods consumed that were on the school lunch menu (coded as "on menu") and had a defined portion size.[3]

To construct the percentage consumed variable, the first step was to match the "on menu" foods in the recall data to the SNDA-III school lunch menu data. As discussed in Chapter II, the SNDA-III study team developed a variable that designated which foods in the recall data were "on the menu" for the school lunch or breakfast on the target day, to help identify school lunch and breakfast participants.[4] In order to construct the variable, foods in the dietary recall data that students said were obtained in school during lunch were matched to the corresponding school menu data on foods offered at lunch. When a match was found, the recall food was coded as "on menu."

This linkage also allowed SNDA-III researchers to replace, in many cases, the nutrients in the recall data for a particular food with the nutrients associated with the matched food in the school menu data. The reason for this replacement was that foodservice managers were more likely to provide detailed and accurate food descriptions than the schoolchildren they served. The recall

[1] Portion sizes were measured in grams.

[2] The portion sizes of individual items offered as part of a self-serve food bar (e.g., salad bar) or prepackaged lunch were not available in the school lunch menu data. This will be discussed in further detail later in this appendix.

[3] This measure could also have been created for on-menu breakfast items, but given the small sample of SBP participants and the exploratory nature of this analysis, we focused on items served at lunch.

[4] The on-menu variable from the SNDA-III data set takes on three different values: "not on menu", "on menu", and "similar on-menu item." For the purposes of this study, the latter two categories were both considered on menu and we attempted to determine the portion size for foods in both categories.

foods with nutrients replaced can easily be matched back to the corresponding menu data to retrieve the portion size offered, since the recall food was given the same food code as the matched menu food as part of the linking and nutrient replacement.

Some recall foods did not need to have their nutrients replaced because their food code matched exactly to a menu food (for example, simple foods such as milk). Determining the amount offered for theses foods is not a problem, in general, because the food codes matched and the offered portions for such foods can thus be obtained from the menu data. Besides these foods, there were 1,133 on-menu foods consumed that could not be matched using the exact USDA food codes and the school menus from the same day (plus or minus one day) as the recall day. The linking of the foods that were not exact food code matches to menu foods required additional steps.

First, we broadened our search to school menus that were from days farther away from the recall day. This is because sometimes schools make last-minute changes to their menus or serve leftover items from a previous day. Our second strategy for assessing the likely portion size offered was to attempt to match the recall food to the school menu using SNDA-III major and minor food groups (the most detailed categories defined in the food grouping system developed specifically for the SNDA-III data; see Gordon et al. 2007b, Appendix D). These food groupings characterize the "whole food" as, in the menu data, mixed dishes were generally coded as single items, not as a combination of items (for example, sandwiches). The groups are based on the meal components used in USDA meal patterns (meat/meat alternates, milk, vegetables, fruits, and grain/bread items), but also distinguish desserts, accompaniments (condiments, dressings, sauces that are not integral to the dish, garnishes), and "other" foods. When we were unable to link recall foods either by matching with a school menu item from a different day or by matching major and minor food groups, manual matching was attempted.

Of the 5,304 foods reported consumed at lunch by NSLP participants, 3,770 (71 percent) were "on menu" and hence eligible to be matched with a portion size.[5] Of the 3,770 on-menu foods, 95 percent (3,590) were successfully matched by one of the methods described above (refer back to Figure V.1).[6] The main reason foods could not be matched to a known portion size is because they were obtained from a self-serve food bar, such as a salad bar or sandwich bar, or from a prepackaged lunch. The food-level portion sizes for the items offered on food bars were collected, but were not linked to the final school menu data for the study, and would not have been very useful for this purpose, as students could often select multiple servings. Some of the unmatched foods were multi-component foods, such as sandwiches, where the child reported eating only some components of the food (for example, eating only the hamburger patty and not the bun). These foods could not be matched to corresponding portion sizes from the school menu, since the portion size (in grams) for the menu food did not include separate weights for each component (the patty and the bun).

Lastly, there were cases where a reported recall food could be matched with more than one "on-menu" food and a definite match could not be made (for example, a child reported "lettuce" and the menu included a side salad, an entrée salad, and a salad bar). For these foods, both the smallest and the largest possible portion size offered were recorded in the data set and the corresponding lower and upper bounds on the percentage consumed were constructed. For 98 percent of the matched foods, the lower and upper bounds were the same. For foods where there was a difference between the upper and lower bounds, we used the average percentage consumed

[5] Both of these food counts exclude foods that have been classified as accompaniments.

[6] Among the 3,590 foods matched, 88 percent were matched by food code using the closest matching day in the school menu data (when the recall food did not match to the corresponding menu day, the next closest day was used – 81 percent were from the same week and only 7 percent were from a different week), 10 percent were matched by food group using the closest matching day in the school menu data (9 percent from same week, 1 percent from a different week), and 3 percent were manually matched. Percentages do not add up to 100 percent due to rounding.

for the purposes of the analysis presented in the text, except that we did not include foods where the difference between the lower and upper bounds of the percentage consumed was greater than 30 percent (only 21 foods).[7]

These omissions and the other foods that could not be matched are a non-random set of foods, and thus have the potential to bias the results. However, since 95 percent of "on-menu" food items consumed by NSLP participants in the SNDA-III recall data were matched, possible bias in the statistics reported due to omission of unmatched foods is likely to be small.[8]

Key limitations of the percentage consumed measure are:

- No information on foods taken and completely discarded is available from the dietary recalls.
- Because we only have portion size offered information on school meals, the measure can only reflect foods selected from school meals.
- Only foods that could be matched to the menu data and were not part of self-serve food bars or prepackaged lunches are included.
- Menus provide typical or planned portion sizes, but the extent of variation at the point of service is unknown.
- When measures of percentage consumed are aggregated by food group, as in the current analysis, samples become even smaller, as only students who consumed an on-menu food from a particular food group are included in the tabulations for that group.

Analysis Note. Statistics on the percentage of portions consumed were estimated at the student level. Since it is possible that students might have had more than one fruit or vegetable at lunch, an average for each student of each food group was constructed by calculating the total weight in grams each student consumed of that food group and then dividing by the total weight (of

[7] The percent difference between the percentage consumed variables was constructed as the difference between the bounds divided by the upper bound. The average percent difference between the lower and upper bounds of the 36 foods for which there was a difference in the bounds (and the difference was less than 30 percent) was 7 percent.

[8] The percentage of food items matched does vary slightly by food group. Specifically, 99.8 percent of milk items were matched with a menu portion size compared to 94.3 percent of vegetables, 94.0 percent of fruits, 92.3 percent of the entrees or meat/meat alternatives, and 93.6 percent of grains.

those foods) offered to each student.[9] Because some food groups were consumed by few students, sample sizes for the food group means and distributions presented in Table V.1 are sometimes small. In addition, vegetables and grains were frequently offered as parts of entrees, so some school menus did not offer separate vegetables or bread/grain items, which further limited the available sample consuming these items.

[9] An alternative method would have simply been to take an average of the percentage consumed of all food items in each food group at the food level, ignoring the fact that some students had more than two items within that group. However, that method has a small risk of underestimating the amount of food wasted if a student ate 100 percent of a two smaller foods but only 40 percent of a food with a larger portion size in the same group and overestimating the plate waste in the opposite situation. In practice, the food-level averages were very similar to the student-level averages.

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