BREAKFAST BREAKDOWN:

Examining Systematic Differences in Compliance with Nutrient Guidelines in the School Breakfast Program

Undergraduate Honors Thesis

Terry Sanford School of Public Policy

Duke University

Durham, NC

Megan Cheney

December 2010

ACKNOWLEDGEMENTS

I would like to sincerely thank my advisor, Professor Christina Gibson-Davis, who guided me through the data analysis process and answered my frantic questions. Her guidance gave me a new understanding of - and appreciation for - the complexities of the research process.

I would also like to thank Professor Ken Rogerson, who was an excellent cheerleader throughout the thesis process and a great sounding board for my ideas and concerns.

Finally, I would like to thank the Office of Research and Analysis of the United States Department of Agriculture's Food and Nutrition Service for providing me with the data to complete this analysis.

TABLE O F CONTENTS

ABSTRACT

In policy circles and academic publications, discussions of the School Breakfast Program focus on encouraging participation and expansion. The hope is that breakfast provision will improve the diets of low-income children and bolster students' academic achievement. Yet policymakers have done little analysis of the program's implementation. What research there is indicates that the majority of schools do not serve breakfasts that meet federal nutrition requirements.[1] Before a nation-wide effort to increase School Breakfast Program participation is undertaken, factors that indicate successful (or unsuccessful) program implementation must be identified.

This study uses data from the School Nutrition Dietary Assessment Study-III to explore relationships between select school characteristics and the nutritional value of the school's subsidized breakfasts. Key variables include age of the student population, the racial/ethnic composition of the school, district poverty levels, urbanicity, program participation, and the availability of competitive foods. Significant relationships between levels of nutrients provided and age of the student population, racial/ethnic composition of the population, income, urbanicity, and participation rates suggest that systematic differences exist in School Breakfast Program implementation. These disparities have important implications for the future of school nutrition policy.

HISTORY

The School Breakfast Program (SBP) was created in the Child Nutrition Act of 1966. It expanded an effort already underway through the National School Lunch Program (NSLP) to "safeguard the health and well-being of the Nation's children."[2] The Act authorized the Department of Agriculture to reimburse schools for each breakfast that they served. Schools provided breakfasts at three price levels (full-price, reduced-price, and free) based on the student's ability to pay; federal subsidies supplemented student contributions.

To realize the program's stated health goals, all subsidized meals were to comply with dietary standards set by the Secretary of Agriculture based on "tested nutritional research," with specific regulations left to be determined during policy implementation.[3] When the SBP was made permanent in 1975, the program still lacked regulatory thresholds for nutrients served in balanced school meals.[4]

1990s Revisions

In 1994 policymakers passed the Healthy Meals for Healthy Americans Act, which created the first explicit nutrient targets for subsidized meals. While the initial purpose of the Act was to reauthorize the National School Lunch and School Breakfast Programs, members of Congress also used this opportunity to respond to concerns about the quality of school meals. The government-sponsored School Nutrition Dietary Assessment (SNDA) study, released in October 1993, highlighted disparities between existing regulations for school meals and the latest nutrition science. SNDA results showed that NSLP and SBP requirements did not result in consumption of healthful school meals. In the wake of these findings and the release of updates to the evidence-based *Dietary Guidelines for Americans*, the Department of Agriculture was charged with specifying and implementing new nutrient guidelines for school meal programs.

The Department subsequently issued a rule known as the School Meals Initiative (SMI).[5] The SMI used nutrition science to set official guidelines for the quantities of vitamins, minerals, and percentages of calories from fat and saturated fat provided by federally subsidized school meals, including breakfast.[6]

The Healthy Meals for Healthy Americans Act and the School Meals Initiative were the last major updates to school meals' nutrient requirements. Despite constant updates to scientists' understands of nutritional needs, dietary guidelines for school breakfasts have not been revised since 1995.

Program Expansion: A Recent Development

While policymakers have not altered the substance of the SBP since 1994, its scope has expanded dramatically. In 1990 only 44 percent of schools participating in the NSLP served school breakfasts.[7] But, by the 2004-2005 school year, the program was available in over 85 percent of NSLP schools.[8] In fiscal year 2009, the SBP served 11.1 million children at a cost of $2.9 billion, and approximately 80 percent of participants had family incomes less than or equal to 185 percent of the federal poverty line, qualifying them for free or reduced-price meals.[9]

But as more schools and students participate, supplemental feeding programs are coming under increased scrutiny. A 2004-2005 study commissioned by the Department of Agriculture revealed that only 13 percent of schools participating in the subsidized SBP offered breakfasts that met SMI nutrient requirements, and only 20 percent of schools served breakfasts that did so.[10] And at the same time that the SBP is failing to meet its nutrition goals, the health of American children is deteriorating. Childhood obesity rates are rising, particularly among racial and ethnic minorities.[11] Children of lower socioeconomic status, who are more likely to participate in the School Breakfast Program, are also significantly more likely to be overweight or obese.[12] As these increases in overweight show, the health problems facing at-risk children can no longer be solved by simply providing them with more food. Thus, legislators must carefully examine and rework the nation's food supplement policies, including the SBP, to adequately address the needs of their target population.

THE CURRENT SCHOOL FOOD ENVIRONMENT

The School Breakfast Program (SBP) is administered by schools and School Food Authorities.[i] In accordance with the School Meals Initiative of 1995 (SMI), each school aims to provide set amounts of specified nutrients based on Recommended Dietary Allowances (RDAs) from 1989 and the 1995 *Dietary Guidelines for Americans*.[13] A school's compliance with the SMI is determined by the amount of each nutrient that school provides at breakfast, averaged over a one week period.

Regulation: Impact of the School Meals Initiative

In theory, schools must comply with the nutrient guidelines set out in the SMI for their meals to be federally subsidized. Per meal subsidization in the continental United States ranges from $0.26 (for full-price breakfasts) to $1.48 (for free breakfasts).[14] Schools participating in meal programs like the SBP depend on these federal subsidies to fund their operations and are thus heavily influenced by SMI requirements.

The School Meals Initiative states that schools providing subsidized breakfasts must:

1. Provide ¼ of the 1989 Recommended Dietary Allowances for daily calories, protein, calcium, iron, vitamin A, and vitamin C;

[i] School Food Authorities (SFAs) are "the governing bod[ies] which [are] responsible for the administration of one or more schools and which [have] legal authority to operate a breakfast program therein" (School Breakfast Program, 7 CFR §220.2 (2003)). SFAs generally oversee only one district, although they may monitor multiple districts.

2. Follow the 1995 *Dietary Guidelines for Americans'* recommendations to increase food variety, provide meals with less than 30 percent of calories from total fat, provide meals with less than 10 percent of calories from saturated fat, reduce meals' sodium content, reduce meals' cholesterol content, and increase fiber;
3. Use one of three prescribed methods to plan menus; and
4. Assess breakfasts' ability to meet the unique nutrition requirements of each age group they serve.[15]

The current nutrient standards for a qualifying school breakfast are available in Table 1 of Appendix I.

Menu Planning Options

To provide sufficient quantities of nutrients while minimizing program costs, schools must plan menus in advance. Under the SMI, a school may adopt one of three menu planning options.

The first option is Nutrient-Based Menu Planning. In a nutrient-based system schools use computer software to evaluate the nutritional content of all foods served and aggregate the results for each meal. A subset of Nutrient-Based Menu Planning, the Assisted Nutrient-Based Menu Planning system, allows schools without the required software to create menus using meals that have already been evaluated by other schools or state agencies.[16]

The second option is Food-Based Menu Planning. Under a food-based system schools must provide students with four breakfast component options from at least three of four food groupings. Each breakfast must include one serving of milk; one serving of fruits/vegetables; and two servings of meat/meat alternate, two servings of grains/breads, or one serving each of a meat equivalent and grain.[17] Serving sizes are based both on United States Department of Agriculture (USDA) guidelines and student age. There is also a more specialized version of Food-Based

Menu Planning, called Enhanced Food-Based Menu Planning. The enhanced approach imposes different nutrient requirements for grades K through 6 and grades 7 through 12 in recognition of the fact that older students need more of all nutrients.[18]

Finally, schools may select an open-ended option known as Any Reasonable Approach. Under this catch-all provision the School Meals Initiative allows a School Food Authority to create its own menu planning method, subject to state agency approval.[19]

Offer versus Serve

An additional requirement known as “offer versus serve” further complicates implementation of SMI guidelines. Under offer versus serve, students may elect to take only some of the foods offered to them as part of a subsidized breakfast. In a nutrient-based system, there must be at least three meal components and students must choose two; for a food-based system, there must be at least four components and students must choose three.[20] While the decision to implement offer versus serve is left to the discretion of each school district participating in the SBP, the vast majority of schools use this provision.[21] A USDA-commissioned 2004-2005 study (referenced above) found that 81.3 percent of elementary and middle schools sampled used offer versus serve in their SBP, and data showed higher offer versus serve participation for schools serving older students.[22] While this regulation does help decrease food waste, schools that use offer versus serve are likely to observe a discrepancy between the nutritional value of the foods they provide and what students elect to take.[23] Thus, for offer versus serve participants, nutrient intake disparities may derive from two sources: the school’s meal offerings and student choice.

Food Purchasing

While the SMI requires that schools follow the menu planning methods outlined above, it does not regulate food procurement decisions. As a result, the 1998 School Food Purchase Study examining food purchasing decisions for the National School Lunch Program (NSLP) showed that "school districts are highly diverse in the types of foods they offer their students."[24] The authors found that 842 different foods contributed to meals served in the NSLP and, of those foods, 30.9 percent were purchased by 100 schools or less.[25] The authors hypothesize that variety in food purchasing and serving habits was the result of "regional and ethnic tastes," as well as "creativity of school food program staff."[26] Not only did schools purchase a number of different foods, but they purchased those foods from many different sellers. Even within a school, an average of eight different food vendors were used, and more vendors were used by larger school districts.[27]

But schools' food purchasing options are constrained by student preferences and price. Preferences determine which foods will attract student consumers and generate funds from those with the option to purchase a school meal. Because select foods have relatively universal appeal, 46.7 percent of foods purchased by districts surveyed in the School Food Purchase Study came from just 10 food categories[ii] and accounted for only 58 of the 842 food groupings mentioned above.[28] Thus, a relatively small number of meal components place a large burden on school food budgets.

Prices may also limit options. Schools consistently cite price as the number one influence on their decision to purchase foods from a given vendor.[29] In an effort to keep prices down, many schools have begun buying foods through their district or as part of group or state-level purchasing cooperatives. More than half of school districts of all sizes now make food purchasing decisions at the district level.[30] The percentage of districts participating in even larger purchasing cooperatives has also increased drastically. Between the 1983-1984 and 1996-1997

[ii] The ten food categories are milk (a federal requirement), pizza, ground beef, cheese, potatoes, chicken nuggets, oranges, hamburger/hot dog buns, apples, and fruit drinks. (Daft et al., "School Food Purchase Study," V-10.)

school years, district participation in larger purchasing cooperatives increased for all food groups.[31] While lower prices can have positive effects, the benefit of lower per-unit prices may only serve to reduce food service budgets rather than facilitating reallocation of money within the food service to increase quality. Cooperatives may also constrain the variety of foods that schools purchase and the vendors they buy from, limiting the nutrients available in school breakfasts.

Existing School Breakfast Program Evaluations

Nutrient guidelines, menu planning options, offer versus serve, and food purchasing decisions all shape the school food environment. School meal programs' successes and deficiencies can thus be traced back to the same pieces of legislation that authorized nutrient requirements: the Health Meals for Healthy Americans Act of 1994 and the School Meals Initiative of 1995.

There is already a substantial literature analyzing many facets of the National School Lunch Program: who participates, the nutrients in the meals served, and recommended amendments. But the School Breakfast Program (SBP) has received far less attention[iii], despite being equally besought by non-compliance with nutrient guidelines.[32] To improve the SBP, policymakers must explore any relationships between SBP compliance and characteristics of the schools responsible for its implementation. Only then can the program be revised in meaningful ways.

SCHOOL DEMOGRAPHICS POTENTIALLY INFLUENCING IMPLEMENTATION: ANALYSIS OF EXISTING STUDIES

Existing studies of eating patterns have examined what their authors consider to be the most

---

[iii] The three USDA-commissioned School Nutrition Dietary Assessment studies are notable exceptions. These studies examine both the NSLP and SBP but offer limited policy analysis. They also fail to explore affects of simultaneous external influences on the quality of NSLP or SBP implementation.

relevant variables for predicting the dietary quality of individuals or demographic groups. While the studies differ in many respects, including the meals and populations they examine and the data they use, each points to characteristics that may influence the nutritional quality of School Breakfast Program (SBP) meals. Where possible, studies that focus on school meal programs are used in this evaluation. Some research outside of the school meal programs is considered, however, to generate a more comprehensive report. Reviewing this broad spectrum of research reveals several variables that may be relevant to school meal nutrition. Each variable is discussed in turn.

Age

Age of the student population is among the most consistent predictors of nutritional value for school meals. Mathematica Policy Research, Inc.'s analysis of its own School Nutrition Dietary Assessment Study-III data found disparities in the nutritional value of SBP meals served in elementary, middle, and high schools.[33] Younger students were more likely to have adequate intakes of key nutrients and were also more likely to consume milk.

As the study's authors hypothesized in their analysis of the National School Lunch Program, much of this age disparity likely comes from different student preferences, which manifest to a greater degree among older students, who are often allowed more choice in their meal contents.[34] While schools may allow students of all ages to reject some meal items, older students are more likely to be given this privilege.[35] Thus, Mathematica found that the meals offered to older students were more likely to comply with nutrient standards than the meals they were actually served, and the disparity between the nutritional value of meals offered and meals served was greater for older students than younger students.[36] Based on this evidence, student age is likely a significant predictor of the nutritional value of subsidized school meals served.

Race

Food is a reflection of societal and lifestyle factors. Goyan Kittler, Sucher, and Kumanyika hypothesize that diet is heavily influenced by the past and by cultural understandings, making food a component of identity.[37] Parents and surrounding communities sway children's food preferences and may encourage School Food Authorities to serve different meals in areas with high concentrations of racial and ethnic minorities. Racial and ethnic disparities could, therefore, influence dietary quality in school breakfasts, both as offered and as served.[38]

A few important trends in racial and ethnic communities may influence SBP contents. These trends include high meat consumption among Latinos and African Americans; a general preference for seafood and fruit drinks (including fruit-flavored beverages) among African Americans; distaste for dairy among all minorities, who tend to experience high levels of lactose intolerance; and a propensity towards the non-perishable commodities available on reservations among Native Americans.[39]

Existing Studies of Race and Children's Diets

Many researchers have examined the relationship between children's racial/ethnic background and nutrition, but findings have been inconsistent. (For a summary of studies that measure the relationship between nutrient consumption and race/ethnicity, see Table 2 of Appendix I.)

In their study of National Evaluation of School Nutrition Programs data from 1980-1981 Devaney and Fraker found that breakfasts consumed by Black and Hispanic participants contained significantly lower amounts of essential vitamins and significantly higher amounts of cholesterol than those consumed by Whites.[40] A second study by Johnson et al. using data from children ages one to ten from the 1987-1988 Nationwide Food Consumption Survey found that race was a meaningful predictor of the vitamin A, total fat, saturated fat, cholesterol, and sodium in children's diets.[41] In this study, minority status again seemed to be negatively related to a healthful diet: Black children consumed the lowest levels of vitamin A and the highest levels of sodium, fat, and saturated fat.[42]

While these studies do not strictly measure the interaction between race and school meals, they do speak to dietary deficiencies that may plague minority children, particularly African Americans. This pattern is in keeping with community-wide research showing lower access to quality food sources, like well-stocked grocery stores, and greater access to nutrient-deficient fast food in communities with high minority concentrations.[43]

When recent data from the School Health Policies and Programs study (SHPPS) was analyzed, however, the results were exactly contradictory to the two studies cited above.[44] Food environments and policies were given lower ratings in schools with higher proportions of White students when ratings assessed the nutrition of food offerings, the training of food service administrators, and the amount of time students were given to eat. While the relationship between race and school food environments was small, it was statistically significant.[iv]

Further support for this final study is found in a 2009 school food program evaluation from California.[45] Like the SHPPS study cited above, this analysis created only two racial groups: "minority" and White, non-Hispanic. The authors then examined the relationship between high schools' compliance with new, stricter school food policies and the proportions of schools' populations that were classified as "minorities." In direct contrast with the Devaney and

[iv] One weakness in this study is the lack of an income variable. As a result, the race variable may reflect nutrient differences that arise as a result of racial/ethnic differences and income disparities, which are highly correlated with race.

Fraker and Johnson et al. studies, the authors found that schools with higher proportions of non-White students were more compliant with nutrition requirements for beverages and food.[46]

One key difference between the first two studies and the final two studies is the number of racial/ethnic categories. While the Devaney and Fraker and Johnson et al. studies employ three racial/ethnic categories (Black, Hispanic, and White), the latter two studies use only two categories (White, non-Hispanic and minority). The latter two studies use a definition that allows for more variety in self-identification and removes potential overlap of racial/ethnic categories, but different definitions complicate comparisons between the four studies.

Separating Race from Socioeconomic Status

The relationship between race, ethnicity, and food habits is also shaped by socioeconomic status, as discussed below. Children's food preferences are functions of available and affordable foods, and the relationship between race and socioeconomic status, because of historical and current practices, is highly predictable.[47] Yet race and socioeconomic status, while correlated, are still independent predictors of health and diet.[48] Thus, it is important to consider a community's racial makeup, not just its economic characteristics, as a potential predictor of dietary quality.

Measuring and Explaining the Impact of Race and Ethnicity

These studies show that evidence on the relationship between race and ethnicity of children and the nutrients they consume is mixed. Inconsistent classifications of "minority," limited knowledge of the health of school meals consumed by minority groups, and varied definitions of nutritionally sound school meals further complicate interpretation. Yet nutritional disparities between meals served in schools with high and low minority concentrations demonstrate the potentially significant relationship between race/ethnicity and school breakfast quality.

Income

Analyses that attempt to draw conclusions about the quality of districts' food programs based on income distribution also produce contradictory results. Larson and Story's 2009 study of the influence of environment on personal nutrition reveals inequities in children's diets based on socioeconomic status (SES) that lead to significantly higher weight and more health complications for children in lower income households.[49] Larson and Story hypothesize that these health and dietary disparities are related to differences in food availability.[50]

But, while their analysis found that overall diet quality was poorer for low SES children and young adults, difficulties arose when disaggregating school and home nutrient intakes. Larson and Story also found that low-income and high-income school districts did not serve significantly different amounts of what the authors called unhealthy foods.[51] Thus, the relationship between income and nutrient intake in this study is only relevant to analyses of children's overall diets. The same relationship cannot be shown for nutrition derived strictly from school meals.

In another analysis using SNDA-III data, the only measure of school meal nutrition that was significantly related to income was the amount of fresh produce offered.[52] Fresh produce was directly related to students' family income, suggesting that there are economic or structural barriers to students in low-income areas consuming certain nutritious foods.[53]

In contrast to the studies above, which found that wealthier students had more nutritious food environments, stricter nutrition policies introduced in high schools throughout California were followed more precisely by districts with large numbers of low-income students.[54] The authors posit a promising explanation: low-income schools benefit from private and government funding programs, many unique to California, that help subsidize nutrition programs when revenue from popular but unhealthy foods is lost.[55] This makes it easier for low-income districts to adhere to nutrition policies. Thus, if food services in districts with particularly large numbers of low-income students are given supplemental resources, there may be an inverse relationship between district wealth and school nutrition.

Based on the above literature, household income has proven to be an informative predictor of overall dietary quality for an individual and may be significantly related to the nutritional quality of federally-regulated meals in a school district. The direction and magnitude of this effect, however, remains unclear.

Urbanicity

The urban, suburban, and rural divide is also instrumental in local dietary preferences. Urbanicity, a multifaceted measure of the differences between urban and rural areas, may be especially meaningful for explaining disparities in nutrient provision in the School Breakfast Program, as participants tend to be highly concentrated in very urban and very rural areas.[56] The literature shows qualitative and quantitative differences in meal programs by district urbanicity. Qualitatively, a case study of four rural Appalachian schools found that “biscuits, sausage, 2% milk, orange juice, and gravy” were among the foods most commonly served in district SBPs, leading to breakfasts that were higher in fat than the regulations set by the USDA.[57] These foods might be more popular for the region, the rural setting, or both; regardless, the school’s surrounding environment profoundly influenced the foods served to participants.

Quantitatively, a study relating urbanicity to the total diets of children ages one to ten found that children residing in non-metropolitan (rural) areas consumed more calories, fat, saturated fat, sodium, and cholesterol, and that urbanicity had an impact on more nutrients than any other independent variable in their study.[58] While this study did not exclusively examine foods consumed through school meal programs, the significance of urbanicity in children's diets, separate from the impact of race, age, region, household size, household income, education, and employment status of parents, suggests that urbanicity may also be related to the health of school meals.

Geographic Location

Diet is also a regional phenomenon. A cluster analysis of dietary choices constructed from the Bureau of Labor Statistics' Consumer Expenditure Survey classified individuals by the region in which they live and examined how they allocate their food budget.[59] A few significant characteristics emerged.

First, in the urban South, households are more likely to devote large portions of their budget to meat. In the urban Midwest, however, households tend to devote more of their budgets to "miscellaneous foods," including prepackaged foods and snacks. And, in addition to their food expenditures, rural households and households in the urban West are more likely to spend large portions of their budgets on non-alcoholic beverages (which could include soda and other high-calorie beverages in addition to coffee, tea, and milk). Households in the urban Northeast are the only demographic likely to have "balanced" diets (those in keeping with federal nutrition recommendations).[60]

These regional differences, which are measured across all ages, may in turn influence the dietary habits of children and School Food Authorities. A qualitative statement of this geographic effect is again exemplified in the study of four rural Appalachian schools. Observers found that regional dietary preferences for what the study called "traditional Appalachian foods" influenced the types of foods served as part of a federally-subsidized school breakfast.[61] The propensity towards meat consumption in Southern environments, noted in the Bureau of Labor

Statistics data, was evident in Appalachian school meal programs, which favored "ham, sausage, [and] bacon."[62]

Regional variation is also present in schools' food preparation and serving methods. A study by Pannell, for example, noted that schools in the Southeast tended to prepare vegetables in "pork fat and lots of salt," and that those in the South consistently serve grain products with butter.[63] Small differences like these, as well as regional preferences for ethnic foods, have been qualitatively observed over long periods and could influence foods available in federal meal programs.

Regional variation was also quantified by Devaney and Fraker, who examined the nutritional content of children's breakfasts in four separate regions as part of a multi-factor analysis. Devaney and Fraker found that young children (those up to age 11) in the three regions classified (North-central, South, and West) consumed significantly more calories at breakfast than the omitted Northeastern region.[64] Young children in the North-central and Western regions also ate breakfasts with significantly higher levels of all vitamins and minerals than children in the Northeast, while no significant difference in vitamin or mineral levels was evident between breakfasts served in the Northeast and those served in the South.[65] Data does not point to many significant differences in dietary quality for the older age cohort, however. Breakfasts consumed by individuals ages 11 to 21 show little variation in the nutritional value, although older students in the South still consume significantly more calories and less vitamin B_6 and iron than their counterparts.[66]

Devaney and Fraker's evidence suggests that together region and age could explain significant amounts of variation in the nutritional quality of federally-subsidized school breakfasts. This study's conclusions have a limited applicability to the SBP, however, because

Devaney and Fraker examined children consuming breakfasts both at school and elsewhere. The data are also dated (coming from a 1980-1981 study, prior to more stringent nutritional guidelines for the SBP, issued in 1995). So, while there is evidence of overall regional variation in food consumption, the relationship between region and school nutrition is by no means certain.

Competitive Food Policies

Competitive foods are any food items sold on school grounds that fall outside the domain of the USDA-regulated and subsidized National School Lunch or School Breakfast Programs.[67] This includes vending machine sales, school store purchases, and supplemental foods sold during the school day or outside of school hours. These foods are nearly unregulated at the federal level, and there are substantial variations in competitive food restrictions among states and localities.

Competitive foods are a relatively recent phenomenon, which makes it particularly difficult to assess their influence on the school meal environment. The Government Accountability Office (GAO) has attempted to quantify the impact of emerging competitive food policies because schools are often permitted to use competitive food revenues to subsidize underfunded school meal programs or other school activities.[68] Subsidization is especially relevant to the School Breakfast Program. SBP revenues and federal subsidies do not cover the costs of 42 percent of breakfasts served.[69] If competitive food revenues prove instrumental in subsidizing breakfast programs, variance in competitive food policies and revenues could play an important if under-researched role in the quality of SBP meals.

Menu-Planning Systems

In their analysis Mathematica evaluated the impact of a school’s menu-planning system on the nutrients it provides in SBP meals. They found “no major differences” in the percentage of schools using each of the menu-planning systems that met SMI guidelines for the SBP.[70] Because Mathematica has already shown that the menu-planning system a school selects does not have a significant relationship with the nutrients in its school breakfasts, this variable can be omitted from further analyses.

Commodities Programs

Commodities programs, which provide schools with bulk quantities of specific foods for use in federally-subsidized meal programs, are essential in financing the National School Lunch Program (NSLP), particularly for schools with a large number of reduced price or fully subsidized participants. But commodities are not directly available to supplement the School Breakfast Program; only commodities that have been donated to a school as part of the NSLP may be served as part of the SBP.[71] Thus commodities programs, while vital to school meals in general, are unlikely to directly impact SBP quality.

Anticipated Findings

Based on the above literature, age, race, income, urbanicity, region, and competitive food policies are expected to show strong relationships with the compliance of SBP meals. Given past research on the influence of age, it seems likely that breakfasts offered to and consumed by older students will be less compliant with the SMI. Results from existing studies that, like the SMI, focus on nutrient values rather than program structure, indicate that minority status is also likely to have an indirect relationship with the compliance of breakfasts served, while district income is expected to have a direct relationship.

Unlike the above variables, which show some discrepancy in the literature, urbanicity seems to have a clear influence on nutrient provision and consumption. As districts become more rural, compliance rates are projected to drop, particularly for fat, saturated fat, cholesterol, and sodium, in keeping with the analyses outlined above. And while geographic region is multifaceted and complex, Southern and Midwestern areas are generally expected to show lower levels of compliance for the nutrients assessed. Finally, competitive food policies, while poorly understood, are expected to have a strong association with SBP quality. Revenue from competitive foods, measured in this study by additional offerings of a la carte items, is expected to boost school food service budgets and have a positive relationship with overall compliance.

The following analysis examines these variables' associations with provision of individual nutrients and with overall SMI compliance. Statistical measures are used to evaluate these hypotheses and to assess each demographic variable's relationship to SBP nutrition.

MEASURING VARIATIONS IN SCHOOL BREAKFAST PROGRAM IMPLEMENTATION

Data

Data comes from the School Nutrition Dietary Assessment Study-III (SNDA-III), conducted by Mathematica Policy Research, Inc. for the United States Department of Agriculture. SNDA-III data, collected from 2004 to 2005, is among the most recent and comprehensive information on the School Breakfast Program.[72] Several elements make this data set particularly strong for school-level breakfast analyses.

Multistage Sampling Design Emphasizes School Diversity and Equal Representation for All Age Cohorts

Mathematica randomly selected 270 School Food Authorities (SFAs) from an existing sample of 2,500 after weighting each SFA to create an equal opportunity to select each student.[73] Conducting random selection at the SFA rather than the school level allowed for randomization in key characteristics, including region, urbanicity, and district size, while drawing equally from each student age bracket to compare differences across grades.

The resulting sample of SFAs was divided into 135 matched pairs, with each pair containing one “main” and one “alternate” SFA. SFAs from the main set were asked to participate in the study and, if they refused, the alternate SFA was contacted. In the end, a total of 130 SFAs and their 398 subsidiary schools contributed to SNDA-III. This analysis draws on the 251 schools where all relevant school-level data were collected.[74]

School-Based Data Collected

Surveys of School Food Authorities, principals, and food service managers, as well as menu analyses, were conducted for each school. Mathematica survey administrators also completed food source and a la carte food checklists on site at select schools. Each of these data sources measures foods provided as part of the School Breakfast Program or in the surrounding school food environment.

Constructing a Useful Model

This study uses multiple linear regression to measure the association between a number of school characteristics and the nutritional quality of breakfasts served to students through the School Breakfast Program (SBP). Linear regressions allow all independent variables of interest to be explored simultaneously and offer insight into the direction and magnitude of influence of each factor accounted for in this study.

Potential Correlates with Nutritional Quality

Possible predictors of School Breakfast Program quality are taken from existing literature examining the nutritional value of school meals, explored in detail above.[v]

[v] Geographic region was a significant predictor of dietary quality in past literature and was originally intended to be a part of this study. As data were analyzed, however, region, defined by the seven geographic regions employed by

School type reflects the age of the student population. All schools are classified as elementary (schools not exceeding the 8th grade) or secondary (schools with grades after elementary through 12th). Schools serving all grades are classified as elementary, and schools that do not clearly fall into one category are included in the category in which they have more grades, with an elementary cutoff at the 6th grade.[vi] (For example, a school containing grades 6 through 9 would be classified as secondary; a school containing grades 4 through 8 would be classified as elementary.)

The school type variable was created from grade data provided by school food administrators. It is divided into only two categories to reflect age specifications under one menu planning method, the Enhanced Food-Based system, detailed in SBP legislation. When administering the SBP, schools may choose to provide nutrients at one level for all grades or they may administer an optional, "enhanced" version of the meal program. The enhanced version divides students into two age cohorts: kindergarten through 6th grade and 7th grade on, with distinct nutrition recommendations for the two groups.[75] While this study will only examine the differences in nutrients provided relative to the single, lower benchmark set for all grade levels,

---

the United States Department of Agriculture's Food and Nutrition Service in administering the School Breakfast Program, proved to be highly correlated with both urbanicity and poverty levels. (Food and Nutrition Service, USDA, "Contact Us.") Despite attempts to redefine region as in Devaney and Fraker's study, "The Dietary Impacts of the School Breakfast Program," and redefining urbanicity and poverty into one variable, termed "environment," including geographic region, urbanicity, and poverty in the same regression equations always resulted in multicollinearity when assessed using Pearson's χ^2 test for independence. Because regional significance was either from data not specific to the school meal programs or from literature written long before the School Meals Initiative set higher nutritional standards for the School Breakfast Program in 1995, it was determined that region showed less potential significance than the urbanicity and income variables and the region variable was subsequently dropped.

[vi] This definition is formatted based the U.S. Department of Education's National Center for Education Statistics' "Documentation to the NCES Common Core of Data Public Elementary/ Secondary School Universe Survey: School Year 2007–08," authored by Sable and Plotts. Use of this survey for definitions of elementary and secondary schools is suggested in Buzby, Guthrie, and Kantor's "Evaluation of the USDA Fruit and Vegetable Pilot Program: Report to Congress."

The binary elementary/secondary distinction is used, rather than more specific measures, to reflect the subdivision applicable to nutrition requirements for the School Breakfast Program. Nutrition requirements are set by age group, divided into preschool, K-12, and/or 7-12 groupings (this last division is optional). A division of grade levels based on these requirements addresses difficulties in measuring nutrient standards that vary by age/grade. The elementary school cutoff used here is lower than in the Common Core of Data definition (it is 6th grade rather than 8th) to reflect federal nutrition guidelines.

creating subgroups based on enhanced menu planning allows the reader to compare average nutrient levels for older students to these optional, higher requirements.

Percent of non-white students is used to reflect a school's ethic composition. Non-White includes students who identify as Black non-Hispanic, Hispanic, and all other races. Percentages are based on the 2004-2005 National Center for Education Statistics' Common Core of Data for each school.[vii]

Environment measures the influence of both population density and income. Because urbanicity and income are highly correlated (p = 0.00 using Pearson's χ^2 test for independence), both of these three-category factor variables are combined into one variable with nine factor levels.

Urbanicity measures the influence of population density on meal quality. All participating schools were categorized by the data collection agency into three urbanicity levels: urban, suburban, and rural. These categories are used to measure differences in school breakfast quality that are related to the local environment.

Income, another estimate of sociodemographic characteristics, is measured by the percentage of a school's population that lives below the poverty line. Because the federal poverty line is used to set subsidy eligibility in the School Breakfast Program, income is best defined in relation to this legal benchmark. To protect schools' identities, Mathematica created a categorical variable measuring the percentage of the school population at or below the federal poverty line based on income data from the 2000 Census. The variable contains three categories: schools where less than 20 percent of the population is below the federal poverty line (low-poverty),

---

[vii] If Common Core of Data information was unavailable for a given school in the 2004-2005 school year, Mathematica used No Child Left Behind data to supply this information. For more information, see Gordon et al., "School Nutrition Dietary Assessment Study-III: Public-Use File Documentation, Version 2."

schools where 20 to less than 30 percent is below the federal poverty line (mid-poverty), and schools where 30 percent or more of the population lives below the poverty line (high-poverty).

School Food Authority (SFA) a la carte percentages reflect subsidies to the school food program from competitive food sales. School food programs often use competitive food sales to supplement food service revenues. While competitive foods may be sold in many venues throughout the school, only revenues from a la carte foods[viii] are likely to be allocated to the school food service in full.[76] Thus, only a la carte sales are used in this proxy for external food service revenue.

The SFA a la carte percentage is the total number of items available a la carte in a district relative to the maximum number of a la carte items available in any school district included in this study. Totals are computed by district because school meal funding is generally provided at the district level.

The weekly School Breakfast Program participation rate is the final predictor of SMI compliance. To protect schools' privacy, Mathematica uses participation rates rather than number of meals served to portray the scope of a school's meal programs. To calculate participation rates, the following formula was used:

Weekly Participation Rate= (number of breakfasts served during target week/number of menu days in the week) / (number of students * average daily attendance rate)[77]

It is important to note that school populations and the number of breakfasts served were not reported at the same point in the school year, so participation rates may be slightly skewed.

Assessing Nutritional Quality

Policy analysts use SMI guidelines to assess the quality of school meals' nutritional

[viii] A la carte items are "[p]urchases of individual food items that are not taken as part of a reimbursable meal." (Bartlett et al., "School Lunch and Breakfast Cost Study - II: Final Report," E-1.)

content. While these standards are under heavy debate and may soon be altered,[ix] updated requirements have not been put in place. Therefore, to assess a school's ability to comply with current regulations, only nutrients directly referenced in the SMI are assessed.

Applicable Measures of Dietary Quality

Individual nutrients monitored by the SMI are used as dependent variables and regressed against the independent variables outlined above to judge a school's ability to comply with each SBP guideline given its demographic characteristics. Nutrients tracked by the SMI are: calories, calcium, iron, vitamin A, vitamin C, protein, percentage of calories from saturated fat, percentage of calories from total fat, cholesterol, dietary fiber, and sodium.[78] All nutrient values have been standardized to allow comparisons of coefficients across nutrients.

Using Unweighted and Weighted Nutrient Measures

Both unweighted and weighted measures of nutrients are assessed to distinguish systematic failures in school-level implementation of the SBP from inadequate nutrient consumption due to students' preferences. Unweighted nutrient values describe nutrient levels for the average meal that a school offered to students on a given day. These can be quite different from weighted

---

[ix] Current regulations require that school meal programs subsidized by the federal government comply with School Meals Initiative guidelines. Yet School Meals Initiative requirements are based on dietary values from Recommended Dietary Allowances set in 1989 and the *Dietary Guidelines for Americans* from 1995. When schools set menus that comply with USDA guidelines they are meeting less updated versions of nutritional recommendations.

The nutrition guidelines regulating the National School Lunch and School Breakfast Programs have thus come under scrutiny from the Institute of Medicine (IOM), part of the National Academies of the United States which seeks to monitor and influence health policy. In their *Nutrition Standards and Meal Requirements for National School Lunch and Breakfast Programs*, published in 2008, the IOM finds the SMI dietary standards outdated given the rise in obesity among American students and the latest scientific research. Their report, completed at the request of the United States Department of Agriculture, suggests establishing nutrient reference values based on new Dietary Reference Intakes (DRIs). DRIs include more nutrients, have more metrics for assessing the appropriate levels of nutrients, and include recommended nutrient values for more specific subpopulations, including gender-specific groups and more age cohorts (Institute of Medicine, Food and Nutrition Board, *Nutrient Standards*, 72-73).

Because DRIs are considered a better measure of nutritional value and are frequently more stringent, schools would be required to improve their nutritional standards if the USDA chose to adopt the IOM's recommended guidelines. Currently, no such improvements have been made, however.

values, which measure nutrients based on what foods were actually served. Weighted values assume that each student consumed equal amounts of all foods that were dispensed during a meal. While these values may not reflect an individual's consumption, they are more accurate measures of nutrient intake than unweighted values. Taking into account both unweighted and weighted measures will show the effect of student preferences on a school's SBP nutrition.

Combining Relevant School Variables to Predict Dietary Measures

After determining which school characteristics are related to each nutrient's provision and consumption, two additional linear regressions will be created to measure a school's compliance with SMI guidelines for all nutrients simultaneously. Two scores, one representing the number of nutrients a school provides at levels complying with SMI guidelines and one showing the number of nutrients that students consume at levels complying with SMI guidelines, are used to assess aggregate SMI compliance. Each SMI compliance score has a maximum value of eight (full compliance) and a minimum value of zero.[x]

The relationship between each of the independent demographic variables listed above and each SMI compliance score (unweighted, or as offered, and weighted, or as served) is again assessed using multiple linear regression.

Conducting Data Analysis

All statistical analysis is conducted using Stata 11. Data are treated as survey data to reflect the multistage cluster sample design of SNDA-III and are weighted to be nationally representative at the school level.

[x] The SMI recommends that schools reduce cholesterol and sodium levels and increase dietary fiber levels. These nutrients are assessed as individual unweighted and weighted dependent variables, but because they have no benchmark level under the SMI, they will not be included in compliance scores. Nutrients included in compliance scores are: calcium, energy, iron, percentage of calories from saturated fat, percentage of calories from total fat, protein, vitamin A, and vitamin C.

Stepwise backward elimination is used to remove variables from predictive equations if their t-score significance levels did not meet a cutoff of $p < 0.10$ for continuous variables or an F-score cutoff of $p < 0.10$ for categorical variables. Coefficients, standard errors, and R^2 values are interpreted for models after all variables with significance levels outside of these bounds have been removed.

Potential Data Concerns

Many of the independent variables are likely to be highly correlated: urbanicity and percentage of the population below the poverty line, for example. To avoid multicollinearity problems, Pearson's χ^2 test for independence was used to measure collinearity of categorical variables and variance inflation factors were used to measure relationships of continuous variables to all other variables. Multicollinearity resulted in the removal of one variable (geographic region) and the combination of two categorical variables (urbanicity and poverty level) into one variable (environment).

SNDA-III data also contain outliers in most nutrient categories. All regressions were run two ways: using unaltered data and imputing outliers (those values more than four standard deviations from the mean) back to the closest non-outlier value. In most cases the R^2 values and standard errors were not substantially different for original and imputed data and the original values were kept. In a few cases, however, the differences between imputed and unimputed data were substantial and the imputed values were used to provide a more representative result.[xi]

[xi] Weighted energy, weighted iron, weighted sodium, and weighted vitamin A levels all showed large changes in R^2 values or in the significance of independent variables when imputed values were used for nutrient levels that were more than four standard deviations above the mean. Imputed values were used to conduct analyses for these nutrients.

REGRESSION RESULTS

A few explanatory variables were consistently significantly associated with quantities of nutrients provided through the School Breakfast Program, suggesting that specific demographic characteristics are systematically related to a school's ability to serve healthy meals as part of the School Breakfast Program (SBP). This was true for both unweighted meals (meals that were offered to students) and weighted meals (meals that were consumed by students, assessed by weighting the total amounts of all foods dispensed as though each student had eaten an equal share of each food). Demographic differences, therefore, appear to be associated both with what districts serve and what student participants select.

Predictor Variables in Individual Nutrient Regressions

School Type

Age of the student population was significantly related to unweighted and weighted values of most nutrients. Unweighted values of vitamins A and C and weighted values of calcium, dietary fiber, iron, and vitamins A and C were the only nutrient values not significantly related to student age. Where disparities exist, older students are provided with significantly greater amounts of nutrients. For example, secondary schools are expected to offer meals where the calcium levels are 0.265 standard deviations from the mean (SDs) greater than meals offered in elementary schools ($p<0.1$). But secondary students often choose to consume a selection of foods that does not include higher amounts of beneficial nutrients. Thus, weighted calcium for secondary school students is not significantly different from weighted calcium for elementary school students, all other variables being equal.

Older students were also offered and consumed significantly greater amounts of nutrients to minimize, including cholesterol, sodium, and percentage of calories from fat and saturated fat.

Higher nutrient values are, therefore, not uniformly positive findings. For the full effects of school type, see Tables 1 and 2 in Appendix II.

Student age was an especially large and significant predictor of energy and percentage of calories from total fat in school breakfasts offered and served. Disparities in energy and total fat between elementary and secondary schools were so large (and compliance rates were sufficiently low) that rates of compliance with the School Meals Initiative (SMI) for these two nutrients were significantly different for the two age groups. Secondary schools offered energy at levels 0.577 SDs above elementary schools' offerings, making them significantly more likely to meet energy compliance standards ($p < 0.01$). They were also significantly more likely to be compliant in weighted levels of energy ($p < 0.01$) and served meals containing energy 0.659 SDs ($p < 0.001$) above the energy provided in elementary schools' meals.

In addition, secondary schools were significantly less likely to comply with SMI guidelines for the percentage of calories from fat in both weighted ($p < 0.01$) and unweighted ($p < 0.05$) measures of meals. Elementary schools offered breakfasts 0.509 SDs ($p < 0.001$) lower in percentage of calories from total fat, and students consumed breakfasts 0.636 SDs (0.001) lower in percentage of calories from total fat than students in similar secondary schools.

Percent Non-White

Percentage of the student body that is non-White has minimal influence on nutrient offerings. The amount of a nutrient offered to an all-White student body was 0.7 SDs higher than the amount provided to a completely non-White student body. These results were moderately significant (all p-values < 0.05).

But, for the evaluated nutrients where the percentage of non-White students was significant, this variable had a consistent effect. Larger percentages of non-White students were associated with lower availability of key vitamins and minerals (calcium, iron, and vitamins A and C) based on the data. Schools with higher percentages of non-White students were also significantly less likely to comply with SMI requirements for calcium offered.[xii] The percentage of the student body that was non-White was not significantly related to any weighted nutrient values.

Environment

No single school environment (encompassing both income and urbanicity) is consistently associated with the supply of nutrients. A few environmental trends in nutrient provision emerge, however, in both unweighted and weighted categories.

Unweighted (As Offered) Nutrient Level Trends

Cities and suburbs tend to offer breakfasts with greater amounts of vitamins A and C. Disparities are especially evident in mid and high-poverty areas. When vitamin A provision is compared for rural and urban schools in the same income bracket, mid-poverty rural schools offer vitamin A at levels 0.953 SDs ($p < 0.05$) below their urban counterparts. High-poverty rural schools are likewise 1.251 SDs ($p < 0.01$) behind comparable urban districts in measures of vitamin A. Results for vitamin C are similar. Mid-poverty suburban schools offer meals 1.093 SDs ($p < 0.05$) higher in vitamin C than rural districts from the same income bracket, and high-poverty cities offer vitamin C in quantities 1.017 SDs ($p < 0.001$) above comparable suburban schools and 0.570 SDs ($p < 0.10$) above comparable rural schools. Vitamin C levels also tend to be substantially lower in low-poverty urban and suburban areas. In urban areas, for example, low-poverty districts provide vitamin C in amounts 0.911 SDs ($p < 0.05$) below mid-poverty districts and 0.684 SDs ($p < 0.05$) below high-poverty districts.

[xii] It is important to note, however, that most schools comply with calcium requirements. This is partially the result of a requirement that fluid milk be served as part of all school meals.

While low-poverty suburban schools, like their urban counterparts, provide significantly lower amounts of vitamin C, they also tend to provide higher levels of energy, the most frequently underserved element of the School Breakfast Program. Energy provision in high-poverty cities is up to 0.633 SDs ($p < 0.01$) below low and mid-poverty suburbs. Similarly, energy provided in high-poverty rural areas is up to 0.534 SDs ($p < 0.01$) below these low and mid-poverty suburban areas. Even high-poverty suburbs provide energy at levels up to 0.998 SDs ($p < 0.001$) below their lower poverty counterparts. But, while they provide lower levels of energy, these high-poverty suburbs are also the most likely to offer meals with lower percentages of calories from fat and saturated fat.

Like suburbs, rural areas show distinct trends. Mid-poverty rural areas offer meals that are significantly higher in sodium (more than 0.700 SDs higher than high-poverty cities). But rural areas' strengths are fiber and cholesterol. High-poverty rural areas offer dietary fiber at levels more than one standard deviation above urban and suburban high-poverty schools. And, unlike cities and suburbs, rural schools in all income brackets show no propensity toward offering meals that are particularly high in cholesterol.

Weighted (As Served) Nutrient Level Trends

When meals are weighted (or measured as served), differences between urbanicities again emerge. Rural schools are associated with higher provision of select nutrients. High-poverty rural areas are especially likely to serve greater amounts of vitamin A and fiber than other environments. Vitamin A served in high-poverty rural areas is up to 0.595 SDs ($p < 0.01$) above quantities of vitamin A served in lower-poverty city and suburban schools. Disparities in fiber consumption are even greater. High-poverty rural areas serve dietary fiber at levels up to 1.378 SDs ($p < 0.001$) above other environments.

Low and high poverty suburban and rural areas also serve the most calories, and rural areas have significantly higher compliance rates for weighted energy than other urbanicities. Compared to low-poverty urban schools, energy served is more than 0.500 SDs ($p < 0.05$) higher in low-poverty suburban schools and more than 0.700 SDs ($p < 0.001$) higher in low-poverty rural schools. Rural areas also serve meals with the most protein, and the differences in protein consumption between urban and rural schools are particularly stark. But, while students in rural areas benefit from the greater amounts of calories and protein served, low-poverty rural students also consume sodium at levels 0.426 SDs ($p < 0.05$) above their urban counterparts while high-poverty rural students consume sodium at levels 0.937 SDs ($p < 0.01$) above levels for students in similar urban schools. Within the highest income bracket, in addition to serving elevated levels of sodium, rural schools also serve a higher percentage of calories from fat (0.608 SDs, $p < 0.1$) than other urbanicities.

To see the effects of each environmental variable relative to low-income cities, see Tables 1 and 2 in Appendix II.[xiii]

School Food Authority (SFA) A La Carte

The number of items sold a la carte by a School Food Authority, which serves as a proxy for competitive food revenues, was not a consistent or meaningful predictor of the nutrients provided in school breakfasts. SFA a la carte percentage was only significantly related to three weighted nutrient values, and significance levels were moderate at most ($p < 0.05$). Coefficients for the a la carte predictor were also somewhat small, so any significant relationship had a limited effect on nutrients served. No coefficient for SFA a la carte percentages exceeded 0.630 SDs from the mean value of any given nutrient.

[xiii] Analyses were completed by switching the omitted category for all regressions so that each of the nine environment categories was omitted in turn. These results tables are not included in the appendices but are available upon request.

SFA a la carte percentages did have a consistent impact, however. Larger volumes of a la carte items were associated with less desirable student choices. This includes iron intakes up to 0.418 SDs ($p < 0.1$) lower, vitamin A intakes up to 0.545 SDs ($p < 0.05$) lower, and percentage of calories from saturated fat 0.629 SDs ($p < 0.1$) higher in schools with maximum a la carte offerings relative to schools with no a la carte offerings. The association between a la carte availability and vitamin A consumption is sufficient to create a measurable difference in compliance for weighted breakfasts.

While SFA a la carte percentage was related to the consumption of some nutrients, there was no visible relationship between the number of a la carte items and the health of meals that a district offered to students. Thus, any additional revenue from a la carte sales that was captured by the SFA a la carte variable was not associated with an improvement or worsening in school implementation of the SBP.

Weekly Participation Rates

Generally, weekly participation rates for the School Breakfast Program were not significantly related to nutrient levels. When participation rates were significant, however, they consistently had a negative relationship with the health of meals. Higher participation rates were associated with higher values of nutrients that should be minimized and lower values of nutrients that should be emphasized in seven cases across unweighted and weighted measures.

Weekly participation rates did not signal a difference in compliance with SMI requirements for any nutrients other than unweighted energy. There was a sufficient negative relationship between weekly participation rates and the amount of energy (calories) offered to show a significant difference in mean participation rates of energy compliant and non-compliant schools (Pearson's χ^2 test for independence, $p = 0$).

Overall School Breakfast Program Compliance

Unweighted (As Offered) Meals

The number of SMI nutrients that a school provides in adequate amounts is significantly related to its surrounding environment and weekly SBP participation rate. There is a large negative relationship between weekly SBP participation rates and the number of nutrients that a school provides at levels in accordance with the SMI. Full student participation in the SBP is associated with a 1.817 point decrease in their compliance score (out of a maximum of 8). Thus, schools with full SBP participation provide about two fewer nutrients at SMI-compliant levels than schools with near-zero participation.

Environmental variables had smaller coefficients and thus smaller associations with overall SMI compliance of offered meals. Only select income and urbanicity combinations complied with significantly different numbers of nutrients than the omitted category (low-poverty urban school districts). High-poverty suburban schools, which have compliance scores 0.800 ($p < 0.001$) points higher than low-poverty urban schools, are by far the most compliant environments. Middle-income urban schools are also slightly more compliant than low-poverty urban schools. Being part of this demographic increases compliance scores by 0.477 points ($p < 0.1$).

For full regression outputs, see Table 3 of Appendix II.

Weighted (As Served) Meals

Nutrient compliance for breakfasts served was still significantly related to environment, but was also significantly related to the percentage of a la carte items offered and the percentage of the student population that was non-White. Weekly participation rates were no longer significant when predicting weighted compliance scores.

The constant for the regression equation predicting compliance scores for weighted nutrients was 6.180, 0.762 points lower than the constant for unweighted compliance scores. This indicates slightly larger relationships between independent variables and compliance scores when students' preferences are taken into account. The environments that were more likely to comply with SMI standards using unweighted measures were again more likely to comply when assessments were done using weighted nutrient values, and the size of each environment's impact was augmented. High-poverty suburban schools complied with 1.716 ($p < 0.001$) more nutrient categories than low-poverty urban schools, and mid-poverty urban schools complied with 0.967 ($p < 0.05$) more nutrient categories than their low-poverty counterparts. These environmental variables' effects on weighted compliance are more than double the magnitude of their effects on unweighted compliance.

In addition to environmental effects, School Food Authorities offering the maximum number of a la carte items among schools in this study would expect a decrease in compliance score of 0.790 ($p < 0.1$), or compliance with about one less nutrient, in the meals it serves. The percentage of the student body that is non-White also has a significant, negative relationship with the weighted compliance score. A fully non-White student body would see a 0.900 ($p < 0.1$) decrease in compliance score relative to an all-White student body. For full regression results, see Table 4 of Appendix II.

Comparing Unweighted and Weighted Results

Differences between unweighted and weighted results suggest trends in student behavior that both reinforce and counteract systematic differences in the nutritional value of school food offerings. Environment is important across both unweighted and weighted assessments and gains magnitude when student preferences are taken into account (through weighted nutrient values).

Thus environment (a measure of urbanicity and income) appears to be related not just to school implementation of the SBP but also to student preferences.

But the SBP participation rate, while significantly related to compliance scores in the unweighted equation, was no longer significant in the weighted equation. This suggests that participation is related to the selection of foods an SFA includes in its SBP, but that participation rates are not related to the nutritional value (and thus the SMI compliance) of the foods students ultimately choose. The percentage of non-White students, in contrast, is only significantly related to weighted nutrient compliance scores. This indicates that the racial/ethnic makeup of the student body is not related to a school's overall ability to comply with the many components of the SBP. Racial/ethnic background may, however, be related to the food selections that students make, and thus the aggregate compliance of the breakfasts a school serves.

SFA a la carte percentage is also related to weighted but not unweighted compliance scores. This suggests that SFA food purchases for the SBP are not related to a la carte provision (or, presumably, to a la carte revenues), but that these additional, unregulated offerings may be related to student choices.

IMPLICATIONS OF THE DATA FOR SCHOOL BREAKFAST PROGRAM POLICY

These results indicate that there are significant disparities in nutrient provision and School Meals Initiative (SMI) compliance in the School Breakfast Program (SBP) based on student age, percentage of the population that is non-White, income, urbanicity, and SBP participation rates. School demographics are, therefore, associated with nutrient provision and consumption in the School Breakfast Program. The systematic differences outlined above can be used to target non-compliant groups and improve policy implementation.

Higher Nutrient Levels among Older Students Suggest Implementation Adjustments

In keeping with the SNDA-III analysis conducted by Mathematica, secondary schools offered and served significantly greater amounts of most nutrients. Student preference plays a large role in age-related disparities in nutrient consumption. While secondary school students were offered more of nine of the eleven nutrients assessed, they were only served more of six of these nutrients (and only two of the nutrients served in greater quantities were beneficial; four were nutrients to be minimized). Evidence from this study reaffirms the conclusion that age-related disparities in nutrient provision are significant and suggests that closing this gap requires change at school food service and student levels.

Improving Compliance in Elementary and Secondary Schools

To improve compliance with the SBP elementary schools, in particular, must give more attention to the amount of energy provided in their school breakfasts. Energy is the main nutrient for which their compliance rates lag behind secondary schools, and sufficient energy provision is an essential part of the program. Likewise secondary schools, which have been shown to provide higher amounts of all nutrients, including nutrients to be minimized, must focus on reducing the quantities of sodium, cholesterol, fat, and saturated fat that they provide.

Secondary schools face an additional implementation challenge: student preference. As seen in the disparities between nutrients offered and nutrients served, older students are provided greater quantities of nutrients than their elementary school counterparts, but they do not consume larger amounts of vital nutrients like calcium and iron. Instead, secondary school students opt for food combinations that augment levels of fat, cholesterol, and sodium that are already offered at levels significantly above those for comparable elementary schools. To realize the benefits of greater nutrient provision in secondary schools and to mitigate the harms, nutrition education for middle and high school students is essential.

Education for secondary school students should be integrated into the school food environment to achieve maximum results. By drawing students' attention to offered foods with high levels of desirable nutrients and low levels of undesirable nutrients, School Food Authorities (SFAs) would bring the innovations of behavioral scientists from restaurants to school food service. Increases in student knowledge have the potential to alter student choice and improve overall SBP implementation.

Minority Status is Related to Differences in Individual Choices

Findings in this study directly contradict literature suggesting that school nutrition improves as the percentage of non-White students increases.[79] Instead, these results follow from prior studies suggesting that overall diet quality is lower among minority populations.[80] This suggests that racial/ethnic disparities in diet quality that have been observed within the home environment may extend to school meals.

The race/ethnicity variable has two distinct effects: this variable has a negative relationship with specific unweighted nutrients and a negative relationship with weighted compliance scores. The effect on unweighted values suggests that specific nutrients (calcium, iron, vitamin A, and vitamin C) are offered at lower levels in schools with higher minority populations, but these disparities generally do not lead to lower compliance. When weighted values of nutrients are considered, race/ethnicity no longer has a discernable, systematic association with consumption of any specific nutrient. Thus, schools with higher minority populations tend to provide lower levels of four key nutrients, but they are still, on average, within the boundaries of compliance for the SMI. Students' selections make consumption of all individual nutrients relatively uniform across schools, regardless of the proportion of minority students in the population.

While schools with larger minority populations do not underperform on weighted values of any specific nutrient, overall compliance is lower for breakfasts served in schools with larger percentages of minority studies. This suggests that SMI compliance for breakfasts served does not suffer uniformly for specific nutrients but generally for the breakfasts selected by high-minority populations. Thus, while there are systematic differences in school offerings that are related to race/ethnicity, they do not alter compliance. Differences in overall compliance may instead stem from general preferences for less healthy foods among racial/ethnic groups, though the nutritional deficits in their selections are not confined to specific nutrients.

Increasing Student Education to Reduce Disparities

These disparities in weighted compliance levels suggest a need to focus nutrition education in particularly high-minority districts to better inform students' food selections. Because minority status is more relevant to weighted than unweighted compliance scores (and thus overall meal quality), emphasis on student choices rather than program administration is essential to removing disparities in the program's ability to meet dietary needs.

Environment

Findings from this study suggest that income is related to nutrient provision within school meal programs, contrary to the conclusions of some elements of the existing literature.[81] The direction of this relationship is not uniform across all nutrients, however. For example, while greater amounts of vitamin A were offered in high-poverty areas, unweighted energy levels fell as poverty increased.

Nutrient disparities by urbanicity are also significant but inconsistent. Rural schools, for instance, serve breakfasts containing more sodium than urban or suburban schools, but also serve significantly higher levels of dietary fiber than other urbanicities. These results show strengths and weaknesses in the health of meals served within urban, suburban, and rural schools. While some of this study's findings on the supply of individual nutrients support qualitative and quantitative accounts in the existing literature, others, like the finding on dietary fiber cited above, add new complexities to current understandings.[82]

Inconsistent relationships between environments and nutrient provision make systematic recommendations difficult. Nonetheless, a focus on a few environmental differences related to individual nutrients' provision may improve policy implementation. Because students in rural areas tend to consume more vitamin A and fiber, cities and suburbs might look to these districts for ideas about increasing desirable offerings of these key nutrients. Likewise, rural areas should look to cities and suburbs for methods of reducing fat, saturated fat, and sodium in the foods they provide and the cooking methods they use to limit students' ability to select particularly high sodium, high fat meals.

More research is also needed to examine the causal link for greater nutrient provision in high-poverty districts. Differences in administration style, federal funding, or state or local grants are all plausible explanations for strong nutrition environments in low-income areas. Unearthing the cause of this disparity could suggest national policy changes to improve overall breakfast quality.

Participation Rates

The negative relationship between SBP participation and unweighted nutrient values, as well as unweighted compliance scores, is likely another manifestation of the relationship between nutrient provision and income. Most SBP participants are low-income or live in low-income areas.[83] Very high participation rates would be expected for schools operating under Provisions 2 and 3 of the SBP, in which schools provide meals to all participants at no charge, and under Provision 1, in which at least 80 percent of students are eligible for free or reduced price meals.[84] This results in very high participation rates in very low income areas, where a district's resources might be more strained and low federal subsidies are the only substantial funding source for meal programs.

The relationship between high participation rates and lower SMI compliance has concerning implications. Those districts being encouraged to increase participation levels or where students are most in need of nutritious meals may be the least able to provide them. This suggests the need for increased SBP funding and monitoring in districts with higher participation rates to correct the levels of nutrients offered. While participation does not seem to be associated with overall nutrient consumption, improving levels of nutrients offered may, in fact, benefit student consumption patterns and bolster SMI compliance in the neediest areas.

Limitations and Areas for Future Research

This broad study highlights systemic disparities within the SBP, but new, more specific questions are also raised. Data could be better defined and causal relationships explored in the following areas.

Race/Ethnicity

It is likely that substantial nutritional disparities among minority groups exist. In this study, due to limited race/ethnicity information and a constrained number of observations, the most effective measure available from SNDA-III data that allowed for robust results is a single, continuous variable measuring Whites relative to non-Whites. Because of this limited measure of minority status, conclusions cannot be drawn about nutritional disparities between different minority populations. Future studies using larger data sets and minority variables that distinguish between Asian, Black, Hispanic, and Native American program participants could show more complex relationships between race/ethnicity and nutrient provision.

Environment

The data set used had very small sample sizes for some district types. High-poverty suburban and rural areas were particularly under-sampled (only two districts fell under the former classification and six districts under the latter), so the results for these categories are suggestive but not definitive. A similar environmental analysis that samples districts from all environments equally and subsequently weights districts for a nationally representative sample would provide a more conclusive reading of nutritional disparities between environments.

Participation

This study only measured overall participation rates. Participation by level of breakfast subsidization (free, reduced price, and full price) was not explored due to sample size limitations but could play a substantial role in program funding and thus nutrient provision. Separate studies of SMI compliance by schools operating under Provisions 1, 2, and 3 of the SBP would also be an interesting topic, highlighting concerns specific to very low-income, high-provision schools.

Alternative Food Revenues

The measure of a la carte foods provided within a district was very limited in this study. School populations were not available, so revenues from a la carte foods could not be determined on a per-student basis. The amount of a la carte revenue that was used to subsidize school meal programs within a district was also unknown.

Further study of the impact of competitive foods on school nutrition is essential. Future analyses should examine the places and times that competitive foods/beverages are available throughout the school day, types of foods/beverages available, and the revenue stream from these alternative food sources. It will be particularly important to note how much revenue accrues from these alternative food sources and who benefits from that revenue. When food services benefit from alternative food revenues, the impact of the additional revenue on operations and SMI compliance should be assessed.

The Government Accountability Office has attempted to study these issues in the past, but data was limited and school food administrators were still uncertain about the impact that changes in the foods and beverages provided would have on revenue.[85] By examining schools with diverse alternative food policies future studies can offer insights on the best way to improve the school food environment in the presence of competitive foods. As states and districts continue to adopt their own regulations for competitive foods, case studies for a range of policies are developing for researchers to better explore the nuances of this complex funding issue.

Financial Viability of the School Meal Program

Conclusions on the relationship between a school food program's financial sustainability and the health of the meals it serves have been contradictory yet significant, and further analysis could be informative.[xiv] Yet SNDA-III has no metric for costs and revenues for the general

---

[xiv] Pannell's 1995 article in the American Journal of Clinical Nutrition, "Why school meals are high in fat and some suggested solutions," cited an inverse relationship between a school meal's fat content and its cost. Both because the initial cost is lower and labor is less intensive for processed foods, which tend to have higher fat content, the article suggests that schools that do not earn sufficient revenue in their meal programs will increase their meals' fat content. Factors that are expected to decrease meal program revenues include low program participation and increasing food costs, both of which plague the School Breakfast Program. (Evidence of School Breakfast Program revenue shortfalls and low participation rates can be found in Bartlett et al.'s *School Lunch and Breakfast Cost Study – II: Final Report*, issued in 2008.)

March and Gould's study of meal programs in Kansas, "Compliance with the School Meals Initiative: Effect on meal programs' financial success," recognizes that percentages of fat and saturated fat are inversely related to food cost, yet asserts that financially successful programs in their state actually served less fat and saturated fat than those school food service budget, and all schools are kept anonymous to protect their privacy, prohibiting access to further information on the schools sampled. Thus, it was not feasible to provide an analysis that captured the impact of a school food program's financial viability, nor was it possible, given diverging conclusions in previous studies, to assert in which direction this omission could bias results. Future large-scale studies should, if possible, collect and include a program's net cost so as to assess the impact of financial constraints on food programs' implementation.

Omitted Variables

While this study explored many factors that the literature suggested to be significantly related to nutrient provision and consumption, these variables are far from a comprehensive list. Bias may result from omitted variables or from variables that were not well-defined. Some of the recognized limitations have been noted above, but others likely exist and have an unknown effect on results.

Correlations Do Not Allow Conclusions Regarding Causation

Finally, all results strictly measure correlations between the listed variables and nutrient provision or SMI compliance. Based on the data presented here, no conclusions can be drawn regarding the causal mechanism for these associations. While background knowledge, prior studies, and qualitative accounts can be used to make speculative statements, the data do no reveal the causes of these relationships. Additional study is needed to draw further conclusions.

POTENTIAL EFFECTS OF PENDING POLICY CHANGES

The Healthy, Hunger-Free Kids Act, a law updating many provisions of the existing

---

that could not cover their costs. While no nutrients were consistently divergent between financially stable and unstable meal programs, stable programs met nutrient requirements while unstable programs had substantial fluctuation. When these analyses are combined with the high insolvency rates of schools participating in the School Breakfast Program, financial success might prove to be an indicator of health of SBP meals.

Child Nutrition Programs, including the School Breakfast Program (SBP), was signed by President Barack Obama on December 13, 2010. This new legislation calls on the Secretary of Agriculture to update nutrient requirements to reflect the latest version of the Dietary Guidelines and recommendations from the Food and Nutrition Board of the National Academy of Sciences National Research Council.[86]

Generally, the nutrition policy community, including the American Clinical Board of Nutrition, the American Dietetic Association, and the Center for Science in the Public Interest, sees the Act as a welcome revision.[87] Nutrient levels have not been updated since 1995, and substantial changes have been made to the Dietary Guidelines since that time. The third installment of the *Dietary Guidelines for Americans* issued since the School Meals Initiative went into effect will be published in the coming months. It is likely to continue to recommend increases in fiber and whole grains, neither of which have fixed targets under the School Meals Initiative, as well as further reductions in sodium.

Added Oversight to Improve Compliance

The new legislation also requires additional oversight of the SBP to ensure compliance with new nutrient requirements.[88] But, as shown above, school-level nutrient provision needs substantial improvement and many schools are likely to fail compliance tests. If the new nutrient recommendations that the Secretary sets out are more stringent, in keeping with changes in the Dietary Guidelines, compliance will only fall. Improving the SBP is a matter of both policy change and correction of the systemic school-level issues described above.

Past cost studies of the SBP suggest that schools face substantial concerns about the price of serving a healthy breakfast. Additional funding could be an integral part of improving breakfasts. Also, differences between unweighted and weighted nutrient levels show that student choice has a substantial impact on nutrient intake. Thus, education is vital to providing children with adequate nutrition. By improving nutrition education and the amount of nutrition information available to students as they make food selections, schools could begin to address nutrition issues that affect both breakfast and lunch programs.

Though it is not referenced in the new law's text, schools might also consider reducing the options available through the offer versus serve provision of the SBP. The original intent of offer versus serve was to prevent food waste, but offer versus serve also allows students to reject healthier meal components. If properly implemented, added constraints on students' meal choices could improve the dietary quality of meals served.

Another area that has yet to be discussed by policymakers and is again overlooked in the latest legislation is the systemic underperformance of some school meal programs. National and state regulators need a contingency option should a district repeatedly fail to meet nutrient targets. A uniform, state-designed menu plan that has been analyzed using nutrient software from the Nutrient-Based Menu Planning system could be used as a replacement for deficient School Food Authorities. Only by having a backup to the district-designed school meal program can state and federal regulators truly enforce nutrient requirements in schools where students depend on supplemental meals.

Legislating Competitive Food Requirements

The legislation further requires the Secretary to set national nutrient requirements for competitive foods for the first time and requires that all revenues from competitive food sales accrue to the school food service.[89] This new policy will certainly add to the work of the school food service, but it will also, presumably, facilitate study of the impact of competitive foods and improve the health of the overall school food environment. Additionally, this requirement may alter the relationship between competitive food revenues, school meal budgets, and nutrition.

Increasing SBP Participation

The new Act also calls for increasing SBP participation, particularly in schools where more than 40 percent of the student body is eligible for free or reduced-price meals.[90] Given this study's findings on the link between nutrition and participation rates, this provision could be problematic. While the Act also requires additional nutrition education and grant funding for the districts that choose to expand or implement a new SBP, further study of the relationship between participation rates and program quality should be completed before haphazardly expanding the program to areas that may be predisposed to struggle to adhere to policy guidelines.

Policy changes required by the Healthy, Hunger-Free Kids Act are an exciting prospect. The School Breakfast Program is long overdue for restructuring and nutrition guidelines are far outdated. But it is important to bear in mind the implementation challenges that will come from improving SBP standards. Raising nutrient requirements does not improve implementation, and this new act does not address systematic disparities in the nutritional value of school breakfasts served. Raising requirements may only result in lower compliance rates unless the systemic challenges highlighted above are explored and addressed to improve schools' and students' food selections. Additional training, funding, and education will be essential. Many schools already fall short of compliance with the School Breakfast Program, and federal regulators must keep in mind the difficulties in facilitating a healthier version of this program.

Bibliography

Abbott et al., To The Hon. George Miller, The Hon. John Kline, President Obama, and Members of Congress. November 29, 2010.

Bartlett, Susan, Frederic Glantz, and Christopher Logan. “School Lunch and Breakfast Cost Study - II: Final Report.” In *Special Nutrition Programs*. Alexandria, VA: United States Department of Agriculture, Food and Nutrition Service, 2008.

Brener, Nancy D., Sherry Everett Jones, Laura Kann, and Tim McManus. “Variation in School Health Policies and Programs by Demographic Characteristics of U.S. Schools.” *Journal of School Health* 73, no. 4 (2003): 143-49.

Buzby, Jean C., Joanne F. Guthrie, and Linda S. Kantor. “Evaluation of the USDA Fruit and Vegetable Pilot Program: Report to Congress.” Washington, D.C.: Economic Research Service, USDA, 2003.

“Child Nutrition Act of 1966.” United States Congress, 1966.

“Child Nutrition Programs: School Meal Initiatives for Healthy Children; Final Rule.” In 7 CFR Parts 210 and 220, United States Department of Agriculture, Food and Consumer Service, 31187-222. Federal Register, 1995.

Daft, Lynn, Alyssa Arcos, Ann Hallawell, Cherie Root, and Donald W. Westfall. “School Food Purchase Study: Final Report.” Alexandria, VA: Office of Analysis and Evaluation, USDA Food and Nutrition Service, 1998.

Devaney, B., and T. Fraker. “The Dietary Impacts of the School Breakfast Program.” *American Journal of Agricultural Economics* 71, no. 4 (1989): 932-48.

Fan, J. X., B. B. Brown, L. Kowaleski-Jones, and K. R. Smith. “Household Food Expenditure Patterns: A Cluster Analysis.” *Monthly Lab. Rev.* 130 (2007): 38.

Finkelstein, D. M., E. L. Hill, and R. C. Whitaker. “School Food Environments and Policies in Us Public Schools.” *Pediatrics* 122, no. 1 (2008): e251.

Gordon, Anne, Mary Kay Crepinsek, Renee Nogales, and Elizabeth Condon. “School Nutrition Dietary Assessment Study-III: Volume I: School Foodservice, School Food Environment, and Meals Offered and Served.” In *Nutrition Assistance Program Report Series*: U. S. Department of Agriculture, Food and Nutrition Service, 2007.

Gordon, Anne, Mary Kay Fox, Melissa Clark, Renee Nogales, Elizabeth Condon, Philip Gleason, and Ankur Sarin. “School Nutrition Dietary Assessment Study-III: Volume II: Participation and Dietary Intakes.” In *Nutrition Assistance Program Report Series*: United States Department of Agriculture Food and Nutrition Service, 2007.

Gordon, Anne, John Hall, Eric Zeidman, Mary Kay Crepinsek, Melissa Clark, and Elizabeth Condon. “School Nutrition Dietary Assessment Study-III: Volume III: Sampling and Data Collection.” Princeton, NJ: Mathematica Policy Research, Inc., 2007.

Gordon, Anne, Elizabeth Condon, Melissa Clark, Karin Zeller, Elaine Hill, Ander Wilson, and Ronette Briefel. “School Nutrition Dietary Assessment Study-III: Public-Use File Documentation, Version 2.” Princeton, NJ: Mathematica Policy Research, Inc., 2009.

Gordon, A. R., R. Cohen, M. K. Crepinsek, M. K. Fox, J. Hall, and E. Zeidman. “The Third School Nutrition Dietary Assessment Study: Background and Study Design.” *Journal of the American Dietetic Association* 109, no. 2S (2009): 20-30.

Government Accountability Office. “Competitive Foods Are Widely Available and Generate Substantial Revenues for Schools.” In *School Meal Programs*, edited by David D. Bellis. Washington, D.C.: United States Government Accountability Office, 2005.

Government Accountability Office. “School Meal Programs: Experiences of the States and Districts That Eliminated Reduced-Price Fees.” In *School Meal Programs*. Washington, D.C.: United States Government Accountability Office, 2009.
Goyan Kittler, Pamela and Kathryn P. Sucher. *Food and Culture in America*: New York: Van Nostrand Reinhold, 1989.
Goyan Kittler, Pamela and Kathryn P. Sucher. *Food and Culture*. 5th Edition ed. Belmont, CA: Thomson Wadsworth, 2008.
Graves, Andrea, Betsy Haughton, Lisa Jahns, Eugene Fitzhugh, and Sonya Jones. “Biscuits, Sausage, Gravy, Milk, and Orange Juice: School Breakfast Environment in 4 Rural Appalachian Schools.” *Journal of School Health* 78, no. 4 (2008): 197-202.
Healthy, Hunger-Free Kids Act of 2010, S. 3307, 111th Congress. (2010).
Improving Nutrition for America’s Children Act, H.R. 5504, 111th Congress. (2010).
Institute of Medicine, Food and Nutrition Board. *Nutrition Standards and Meal Requirements for National School Lunch and Breakfast Programs : Phase I. Proposed Approach for Recommending Revisions*. Washington, D.C.: National Academies Press, 2008.
Johnson, R. K., H. Guthrie, H. Smiciklas-Wright, and M. Q. Wang. “Characterizing Nutrient Intakes of Children by Sociodemographic Factors.” *Public Health Reports* 109, no. 3 (1994).
Kumanyika, S. "Nutrition and Chronic Disease Prevention: Priorities for Us Minority Groups." *Nutrition reviews* 64, no. Supplement 1 (2006): 9-14.
Larson, N., and M. Story. “A Review of Environmental Influences on Food Choices.” *Annals of Behavioral Medicine*: S56-S73.
LaVeist, T. A. “Disentangling Race and Socioeconomic Status: A Key to Understanding Health Inequalities.” *Journal of Urban Health* 82 (2005).
March, Lynda and Rebecca Gould. “Compliance with the School Meals Initiative: Effect on Meal Programs' Financial Success.” *Journal of the American Dietetic Association* 101, no. 10 (2001): 1199-201.
Pannell, D. V. “Why School Meals Are High in Fat and Some Suggested Solutions.” *American Journal of Clinical Nutrition* 61 (1995): 245S-6S.
“Provisions 1, 2, & 3 Fact Sheet.” United States Department of Agriculture, Food and Nutrition Service, http://www.fns.usda.gov/cnd/Governance/prov-1-2-3/Prov1_2_3_FactSheet.htm.
Sable, Jennifer and Christopher Plotts. “Documentation to the NCES Common Core of Data Public Elementary/ Secondary School Universe Survey: School Year 2007–08.” Washington, D.C.: National Center for Education Statistics, U.S. Department of Education, 2009.
Samuels, S. E., S. Lawrence Bullock, G. Woodward-Lopez, S. E. Clark, J. Kao, L. Craypo, J. Barry, and P. B. Crawford. “To What Extent Have High Schools in California Been Able to Implement State-Mandated Nutrition Standards?” *Journal of Adolescent Health* 45, no. 3S (2009): S38-S44.
School Breakfast Program, 7 CFR §220.2 (2003).
Singh, Gopal K., Ph.D., Michael D. Kogan, Ph.D., Peter C. Van Dyck, MD, MPH, and Mohammad Siahpush, Ph.D. “Racial/Ethnic, Socioeconomic, and Behavioral Determinants of Childhood and Adolescent Obesity in the United States: Analyzing Independent and Joint Associations.” *Annals of Epidemiology* 18, no. 9 (2008): 682-95.

Strauss, Richard S., M.D., and Harold A Pollack, Ph.D. “Epidemic Increase in Childhood Overweight, 1986-1998.” *Journal of the American Medical Association* 286, no. 22 (2001): 2845-48.

Team Nutrition, USDA. “Offer Versus Serve in the School Nutrition Programs.” 2004.

United States Department of Agriculture, Food and Nutrition Service. *Menu Planner for Healthy School Meals*: United States Department of Agriculture, 1998, Rev. 2008.

United States Department of Agriculture, Food and Nutrition Service. “Nutrient Analysis Protocols: How to Analyze Menus for USDA's School Meals Programs.” Alexandria, VA: United States Department of Agriculture, 2007.

United States Department of Agriculture, Food and Nutrition Service. “Schools/Child Nutrition Commodity Programs.” Washington, D.C.: United States Department of Agriculture, Food and Nutrition Service, 2009.

Zenk, S. N., A. J. Schulz, B. A. Israel, S. A. James, S. Bao, and M. L. Wilson. “Fruit and Vegetable Access Differs by Community Racial Composition and Socioeconomic Position in Detroit, Michigan.” *Ethnicity & Disease* 16, no. 1 (2006): 275-80.

APPENDIX I: BACKGROUND TABLES

TABLE 1: Current School Meals Initiative Guidelines, by Grade[xv]

	Preschool	K-12	Grades 7-12 (Optional)
Calories	388	554	618
Protein (g)	5	10	12
Calcium (mg)	200	257	300
Vitamin A (RE)	113	197	225
Vitamin C (mg)	11	13	14
Iron (mg)	2.5	3.0	3.4
% Calories from Fat	≤ 30	≤ 30	≤ 30
% Calories from Saturated Fat	< 10	< 10	< 10

[xv] United States Department of Agriculture, Food and Nutrition Service (2007). *Nutrient Analysis Protocols: How to Analyze Menus for USDA's School Meals Programs*. Alexandria, VA: United States Department of Agriculture.

TABLE 2: Summary: Studies Relating Race/Ethnicity and Nutrition

Study	Year	Data Source	Racial/Ethnic Categories	Findings
The dietary impacts of the school breakfast program	1980-1981	National Evaluation of School Nutrition Programs	White, Black, Hispanic	Black students of all ages consume less vitamin B_6 and more cholesterol than white and Hispanic students; younger black students consumed more calories at breakfast than whites or Hispanics; older black students consumed less vitamin A, calcium, and magnesium than whites and Hispanics; totals all breakfasts consumed (not specifically the School Breakfast Program)
Characterizing nutrient intakes of children by sociodemographic factors	1987-1988	Nationwide Food Consumption Survey	White, Black, Other	Race significantly related to vitamin A, fat, saturated fat, cholesterol, and sodium intakes; black children had highest levels for all except vitamin A; other children had the lowest; measures intakes in overall nutrient intake, not just breakfast
Variation in School Health Policies and Programs by Demographic Characteristics of US Schools	2000, published 2003	School Health Policies and Programs	White and Non-White	More food options and higher education requirements for food service administrators in schools with larger percentages of non-White students
To What Extent Have High Schools in California Been Able to Implement State-Mandated Nutrition Standards?	2006-2008, published 2008	Sample of 56 California High Schools	White and Non-White	Higher percentages of nonwhite students positively associated with better adherence to new food and beverage nutrition policies

APPENDIX II: REGRESSION RESULTS

Table 1A. Unweighted Nutrient Regression Results

	UW Calcium	UW Cholesterol	UW Dietary Fiber	UW Energy	UW Iron	UW Percent Saturated Fat
City, low poverty	--	--	--	--	--	--
Suburb, low poverty	**0.166** (0.314)	**0.395*** (0.162)	**0.175** (0.222)	**0.724***** (0.141)	**0.179** (0.237)	**0.229** (0.304)
Rural, low poverty	**-0.218** (0.317)	**0.136** (0.189)	**-0.281** (0.230)	**0.310** (0.216)	**-0.521*** (0.261)	**0.454+** (0.273)
City, mid poverty	**0.514** (0.314)	**0.493*** (0.233)	**0.558** (0.383)	**0.627+** (0.334)	**0.654+** (0.335)	**0.283** (0.377)
Suburb, mid poverty	**1.123*** (0.542)	**-0.130** (0.148)	**-0.273** (0.196)	**0.631***** (0.168)	**0.558**** (0.209)	**0.618** (0.520)
Rural, mid poverty	**-0.293** (0.334)	**0.048** (0.199)	**-0.082** (0.265)	**0.275** (0.181)	**-0.103** (0.403)	**0.638** (0.451)
City, high poverty	**0.215** (0.291)	**-0.081** (0.170)	**-0.501**** (0.187)	**0.091** (0.174)	**0.567** (0.362)	**0.670*** (0.261)
Suburb, high poverty	**-0.086** (0.311)	**0.488***** (0.124)	**-0.439*** (0.198)	**-0.274*** (0.109)	**-0.322** (0.276)	**-0.341** (0.227)
Rural, high poverty	**0.120** (0.482)	**-0.088** (0.266)	**0.582** (0.469)	**0.097** (0.138)	**0.382** (0.734)	**-0.043** (0.844)
Percent Non-White	**-0.007+** (0.004)				**-0.007+** (0.003)	
Elementary School	--	--	--	--	--	--
Secondary School	**0.265+** (0.152)	**0.330**** (0.114)	**0.332*** (0.141)	**0.577***** (0.135)	**0.344*** (0.156)	**0.295*** (0.144)
Weekly Participation			**-1.624***** (0.332)	**-0.947*** (0.398)		
SFA A La Carte						
Constant	**-0.067** (0.288)	**-0.632***** (0.133)	**2.961***** (0.196)	**-0.644***** (0.159)	**0.084** (0.255)	**-0.496*** (0.247)
R^2	**0.110**	**0.122**	**0.242**	**0.258**	**0.133**	**0.076**
Number of Schools	**251**	**251**	**241**	**241**	**251**	**251**

+ p< 0.10 * p<0.05 ** p<0.01 ***p<0.001

UW designates unweighted values

-- designates omitted category in categorical variables

Table 1B. Unweighted Nutrient Regression Results, continued

	UW Total Fat	UW Protein	UW Sodium	UW Vitamin A	UW Vitamin C
City, low poverty	--		--	--	--
Suburb, low poverty	**0.299** (0.280)		**0.455**** (0.170)	**0.140** (0.355)	**0.110** (0.238)
Rural, low poverty	**0.664+** (0.339)		**0.308+** (0.177)	**-0.273** (0.300)	**0.139** (0.282)
City, mid poverty	**0.339** (0.327)		**0.545+** (0.321)	**0.436** (0.395)	**0.911*** (0.411)
Suburb, mid poverty	**0.768** (0.487)		**0.344** (0.260)	**-0.014** (0.337)	**1.297**** (0.442)
Rural, mid poverty	**0.829+** (0.420)		**0.601*** (0.232)	**-0.517** (0.313)	**0.204** (0.348)
City, high poverty	**0.423** (0.403)		**-0.145** (0.422)	**0.727** (0.466)	**0.684*** (0.271)
Suburb, high poverty	**-0.070** (0.220)		**-0.016** (0.137)	**-0.081** (0.316)	**-0.332** (0.254)
Rural, high poverty	**0.026** (0.942)		**0.177** (0.160)	**-0.524*** (0.236)	**0.114** (0.247)
Percent Non-White				**-0.007+** (0.004)	**-0.007*** (0.003)
Elementary School	--	--	--		
Secondary School	**0.509***** (0.144)	**0.427***** (0.106)	**0.665***** (0.113)		
Weekly Participation				**-1.470**** (0.474)	
SFA A La Carte					
Constant	**-0.741**** (0.224)	**-0.493***** (0.073)	**-0.876***** (0.147)	**0.706*** (0.282)	**-0.091** (0.246)
R^2	**0.137**	**0.067**	**0.218**	**0.182**	**0.123**
Number of Schools	**251**	**252**	**251**	**241**	**251**

+ p< 0.10 * p<0.05 ** p<0.01 ***p<0.001

UW designates unweighted values

-- designates omitted category in categorical variables

Table 2A. Weighted Nutrient Regression Results

	W Calcium	W Cholesterol	W Dietary Fiber	W Energy	W Iron	W Percent Saturated Fat
City, low poverty	--	--	--	--		--
Suburb, low poverty	**0.264** (0.237)	**0.299*** (0.122)	**0.131** (0.194)	**0.502*** (0.199)		**0.442+** (0.260)
Rural, low poverty	**0.451*** (0.203)	**0.195** (0.158)	**0.455*** (0.181)	**0.733***** (0.209)		**0.436+** (0.252)
City, mid poverty	**0.774+** (0.395)	**0.254+** (0.137)	**0.931** (0.563)	**0.700+** (0.371)		**0.159** (0.348)
Suburb, mid poverty	**0.856** (0.581)	**-0.048** (0.141)	**-0.135** (0.172)	**0.489*** (0.233)		**1.281** (0.832)
Rural, mid poverty	**0.589*** (0.225)	**0.085** (0.141)	**0.712**** (0.211)	**0.862***** (0.172)		**0.445** (0.374)
City, high poverty	**0.410+** (0.246)	**-0.079** (0.142)	**-0.348*** (0.145)	**0.011** (0.282)		**0.879*** (0.346)
Suburb, high poverty	**0.572**** (0.170)	**0.959***** (0.092)	**0.407**** (0.142)	**0.439**** (0.131)		**-0.332** (0.236)
Rural, high poverty	**0.990+** (0.523)	**0.160** (0.164)	**1.031***** (0.262)	**0.643***** (0.135)		**0.361** (0.407)
Percent Non-White						
Elementary School		--		--		--
Secondary School		**0.279**** (0.084)		**0.659***** (0.191)		**0.362*** (0.148)
Weekly Participation			**-1.443**** (0.499)			**0.726+** (0.379)
SFA A La Carte					**-0.418+** (0.223)	**0.629+** (0.365)
Constant	**-0.413*** (0.170)	**-0.562***** (0.104)	**-0.064** (0.193)	**-0.907***** (0.152)	**0.218** (0.169)	**-1.064***** (0.300)
R^2	**0.073**	**0.097**	**0.126**	**0.179**	**0.005**	**0.131**
Number of Schools	**251**	**251**	**241**	**251**	**252**	**241**

+ p< 0.10 * p<0.05 ** p<0.01 ***p<0.001

W designates weighted values

-- designates omitted category in categorical variables

Table 2B. Weighted Nutrient Regression Results, continued

	W Total Fat	W Protein	W Sodium	W Vitamin A	W Vitamin C
City, low poverty	--		--	--	--
Suburb, low poverty	**0.295**	**0.355+**	**0.343+**	**0.104**	**0.097**
	(0.249)	(0.191)	(0.194)	(0.166)	(0.244)
Rural, low poverty	**0.608+**	**0.456***	**0.426***	**0.262+**	**0.320**
	(0.353)	(0.179)	(0.205)	(0.151)	(0.317)
City, mid poverty	**-0.140**	**0.506***	**0.459**	**0.768**	**0.966***
	(0.306)	(0.215)	(0.337)	(0.592)	(0.414)
Suburb, mid poverty	**0.966**	**0.201**	**0.256**	**-0.253**	**1.000***
	(0.642)	(0.246)	(0.228)	(0.245)	(0.381)
Rural, mid poverty	**0.422**	**0.616****	**0.837****	**0.259**	**0.436**
	(0.364)	(0.183)	(0.283)	(0.201)	(0.287)
City, high poverty	**0.045**	**-0.059**	**-0.152**	**0.557**	**0.608***
	(0.606)	(0.248)	(0.364)	(0.469)	(0.272)
Suburb, high poverty	**-0.270**	**0.541*****	**0.321***	**0.387****	**-0.432***
	(0.227)	(0.135)	(0.136)	(0.141)	(0.193)
Rural, high poverty	**0.293**	**0.756*****	**0.785*****	**0.341***	**0.468**
	(0.317)	(0.189)	(0.176)	(0.149)	(0.327)
Percent Non-White					
Elementary School	--	--	--		
Secondary School	**0.636*****	**0.432*****	**0.755*****		
	(0.176)	(0.115)	(0.175)		
Weekly Participation	**0.793+**			**-1.054***	
	(0.447)			(0.495)	
SFA A La Carte				**-0.545***	
				(0.225)	
Constant	**-0.988*****	**-0.707*****	**-0.808*****	**0.348+**	**-0.427***
	(0.283)	(0.150)	(0.154)	(0.209)	(0.193)
R^2	**0.211**	**0.150**	**0.220**	**0.078**	**0.110**
Number of Schools	**241**	**251**	**251**	**241**	**251**

+ p< 0.10 * p<0.05 ** p<0.01 ***p<0.001

W designates unweighted values

-- designates omitted category in categorical variables

Table 3. Regression Coefficients, Unweighted Compliance

Variable	Coefficient (Standard Error)
City, low poverty	**--**
Suburb, low poverty	**0.017** (0.228)
Rural, low poverty	**-0.056** (0.252)
City, mid poverty	**0.477+** (0.259)
Suburb, mid poverty	**-0.077** (0.424)
Rural, mid poverty	**-0.060** (0.444)
City, high poverty	**0.209** (0.554)
Suburb, high poverty	**0.800*** ** (0.212)
Rural, high poverty	**0.304** (0.223)
Weekly Participation	**-1.817*** (0.862)
Constant	**6.942*** ** (0.267)
R^2	**0.139**
Number of Schools	**241**

+ p< 0.10 * p<0.05 ** p<0.01 ***p<0.001

-- designates omitted category in categorical variables

Table 4. Regression Coefficients, Weighted Compliance

Variable	Coefficient (Standard Error)
City, low poverty	**--**
Suburb, low poverty	**0.188** (0.424)
Rural, low poverty	**0.596** (0.418)
City, mid poverty	**0.967*** (0.457)
Suburb, mid poverty	**-0.083** (0.774)
Rural, mid poverty	**0.508** (0.621)
City, high poverty	**0.611** (0.462)
Suburb, high poverty	**1.716***** (0.458)
Rural, high poverty	**0.797** (0.610)
Percent Non-White	**-0.009+** (0.005)
SFA A La Carte	**-0.790+** (0.470)
Constant	**6.180***** (0.421)
R^2	**0.122**
Number of Schools	**251**

+ p< 0.10 * p<0.05 ** p<0.01 ***p<0.001

-- designates omitted category in categorical variables

[1] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 192.
[2] "Child Nutrition Act of 1966," §2.
[3] Ibid., §4(e)(1)(A).
[4] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 3.
[5] "Child Nutrition Programs: School Meal Initiatives for Healthy Children; Final Rule," 31188-31191.
[6] Ibid., 7-9.
[7] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 30.
[8] Ibid.
[9] United States Department of Agriculture, Food and Nutrition Service, "The School Breakfast Program."
[10] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 192.
[11] Strauss and Pollack, "Epidemic Increase in Childhood Overweight," 2845-48.
[12] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume II," 27; Singh et al., "Determinants of Childhood and Adolescent Obesity," 687.
[13] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 9.
[14] United States Department of Agriculture, Food and Nutrition Service, "The School Breakfast Program."
[15] Food and Consumer Service, "Child Nutrition Programs: School Meal Initiatives," 31217-31218.
[16] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 8-9.
[17] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 8.
[18] United States Department of Agriculture, Food and Nutrition Service, *Menu Planner*, 30.
[19] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 9.
[20] Institute of Medicine, Food and Nutrition Board, *Nutrition Standards*, 43.
[21] Team Nutrition, USDA, "Offer Versus Serve;" Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 52.
[22] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 52.
[23] Team Nutrition, USDA, "Offer Versus Serve in the School Nutrition Programs"; Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I."
[24] Daft et al., "School Food Purchase Study," V-12.
[25] Ibid., V-13.
[26] Ibid., V-12.
[27] Ibid., VI-14.
[28] Ibid., V-10.
[29] Ibid., VI-3.
[30] Ibid., VII-6.
[31] Ibid., VI-25.
[32] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 152-152, 192-193.
[33] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 195-209.
[34] Ibid., 171.
[35] Team Nutrition, USDA, "Offer Versus Serve;" Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 52.
[36] Gordon et al., "School Nutrition Dietary Assessment Study-III: Volume I," 192-193.
[37] Goyan Kittler and Sucher, *Food and Culture* (1989); Kumanyika, "Nutrition and Chronic Disease Prevention," 9-14.
[38] Johnson et al., "Characterizing nutrient intakes of children," 418.
[39] Goyan Kittler and Sucher. *Food and Culture* (5th ed.).
[40] Devaney and Fraker, "Dietary Impacts," 938-941.
[41] Johnson et al., "Characterizing nutrient intakes of children," 418.
[42] Ibid.
[43] Zenk et al., "Fruit and Vegetable Access," 275-80.
[44] Brener et al., "Variation in School Health Policies," 143-49.
[45] Samuels et al., "State-Mandated Nutrition Standards," S38-S44.
[46] Ibid., S42.
[47] LaVeist, "Disentangling Race," iii27-iii29.
[48] Ibid., iii30-iii31.

---

[49] Larson and Story, “Environmental Influences on Food Choices,” S64.
[50] Ibid., S64-S65.
[51] Ibid., S60.
[52] Finkelstein et al.. “School food environments,” e255.
[53] Ibid., e255-e257.
[54] Samuels et al., “State-Mandated Nutrition Standards,” S41-S42.
[55] Ibid., S43.
[56] Gordon et al., *School Nutrition Dietary Assessment Study-III: Volume II*, 104.
[57] Graves et al., “Biscuits,” 200.
[58] Johnson et al., “Characterizing nutrient intakes of children,” 414.
[59] Fan et al., “Household Food Expenditure Patterns,” 38-51.
[60] Ibid., 46-47.
[61] Graves et al., “Biscuits,” 201.
[62] Ibid.
[63] Pannell, “Why School Meals Are High in Fat,” 245S.
[64] Devaney and Fraker, “Dietary Impacts,” 938-939.
[65] Ibid.
[66] Ibid., 940-941.
[67] Gordon et al., “School Nutrition Dietary Assessment Study-III: Volume I,” 93.
[68] Government Accountability Office, “Competitive Foods,” 4.
[69] Bartlett et al., “School Lunch and Breakfast Cost Study - II,” v.
[70] Gordon et al., “School Nutrition Dietary Assessment Study-III: Volume I,” 209.
[71] United States Department of Agriculture, Food and Nutrition Service, “Commodity Programs,” 1.
[72] Gordon et al., “Background and Study Design.”
[73] Gordon et al., “School Nutrition Dietary Assessment Study-III: Volume III,” 3-5.
[74] Gordon et al., “Public-Use File Documentation,” 3-9.
[75] United States Department of Agriculture, Food and Nutrition Service, *Menu Planner*, 50.
[76] Government Accountability Office, “Competitive Foods,” 29.
[77] Gordon et al., “Public-Use File Documentation,” 24.
[78] United States Department of Agriculture, Food and Nutrition Service, “Nutrient Analysis Protocols,” 10.
[79] Brener et al, “Variation in School Health Policies,” 143-149; Samuels et al., “State-Mandated Nutrition Standards,” S38-S44.
[80] Devaney and Fraker, “Dietary Impacts,” 938-941; Johnson et al., “Characterizing nutrient intakes of children,” 418.
[81] Larson and Story, “Environmental Influences on Food Choices,” S60.
[82] Graves et al., “Biscuits,” 197; Johnson et al., “Characterizing nutrient intakes of children,” 414.
[83] Gordon et al., “School Nutrition Dietary Assessment Study-III: Volume II,” 37-38, 40.
[84] “Provisions 1, 2, & 3 Fact Sheet.”
[85] Government Accountability Office, “Competitive Foods.”
[86] Healthy, Hunger-Free Kids Act of 2010.
[87] Abbott et al. to The Hon. George Miller.
[88] Healthy, Hunger-Free Kids Act of 2010.
[89] Ibid.
[90] Ibid.