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**Children's Consumption of Fruits and Vegetables:  
Do School Environment and Policies Affect Choice in School Meals?**

Ariun Ishdorj, Mary Kay Crepinsek and Helen H. Jensen

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Keywords: Food Assistance, Fruits and Vegetables, School Meals, Endogeneity, Censoring

A. Ishdorj is Assistant Professor, Texas A&M University; M.K Crepinsek is Senior Researcher, Mathematica Policy Research, Inc.; H. Jensen is Professor, Iowa State University. This research was supported in part by the Economic Research Service, USDA.

## ABSTRACT

### **Children's Consumption of Fruits and Vegetables:**

#### **Do School Environment and Policies Affect Choice in School Meals?**

Considering most children spend a majority of their weekdays at school and, on average, obtain more than one-third of their daily caloric intake from meals consumed at school during the school year, school is a natural place to implement nutrition policies that would help develop healthy eating habits and improve health and well-being of children. At the same time, local school meal policies may influence what foods are offered and how the foods are prepared. In this regard, the U.S. Department of Agriculture's (USDA) two school meal programs can play an important role in children's diets and food habit formation and thus positively influence children's health. The focus of our research is children's intakes of fruits and vegetables by location of consumption. We include intake of the fruits and vegetables at school and at home and evaluate whether the school meal intake substitutes or supplements intake at home. We use data from the third School Nutrition Dietary Assessment Study (SNDA-III), and estimate jointly the student's latent consumption of target foods (fruits and vegetables) by location of consumption and the student's endogenous decision to participate in the school meal program. We find demographic effects influence consumption, and although school food policies examined had little effect on participation in the school meal program, some school policies do affect fruits and vegetables consumption. There is evidence that increased exposure to fruits and vegetables in school will positively affect home consumption.

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## **INTRODUCTION**

Childhood and adolescence are unique periods of growth and development. In addition to maturing physically, children begin to make independent choices about when, where, and what they eat. Good nutrition during childhood and adolescence plays a key role in assuring adequate growth and development, preventing the long-term risk of chronic disease, and enhancing health and well-being of individuals. Since food habits are still developing during childhood and adolescence it is important to help young people to adopt healthy eating habits in order to improve longer term health outcomes. Although individual factors play an important role in food habit formation, there is an increasing awareness that eating is influenced by environmental factors as well. In addition to differences in the home environment, individual factors, and parental influence, differences in the school environment may contribute to eating habits of children.

Considering most children spend the majority of their weekdays at school and, on average, obtain more than one-third of their daily caloric intake from meals consumed at school during the school year (Briefel et al. 2009), school is a natural place to implement nutrition policies that would help develop healthy eating habits. At the same time, local school meal policies influence what foods are offered and how the foods are prepared. In this regard, the U.S. Department of Agriculture's (USDA) two school meal programs, namely The National School Lunch Program (NSLP) and School Breakfast Program (SBP), can play an important role in children's diets and food habit formation and thus positively influence children's weight status and health.

The NSLP is the second largest government food assistance program with the primary objective to "safeguard the health and well-being of the Nation's children." The program seeks to provide nutritious lunches at low-cost or for free to school children. Children from lower income families are eligible for free or reduced-price lunch, while children from families with higher income can receive a "full-price" lunch, although the full-price is still subsidized<sup>1</sup>. In 2011, 58% of the

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<sup>1</sup> Children are eligible for different levels of lunch subsidies if their family income as a percentage of the federal poverty level adjusted for family size is as follows; for free lunch at most 130% of the federal poverty level or whose families participate in the Food Stamp Program (FSP), Temporary Assistance for Needy Families (TANF) or assistance from the Food Distribution Program on Indian Reservations (FDPIR), reduced lunch between 130% and

lunches served were free, 8% reduced-price, and 34% full price (USDA 2011(b))<sup>2</sup>. All public and non-profit private schools and child care institutions are eligible to participate in the NSLP. The NSLP provides lunches to 31.8 million children each school day, which costs the federal government \$10.1 billion in cash payments and another \$1.1 billion in commodity food costs (USDA 2011(a)). Similar to NSLP, the SBP was designed to promote the health and well-being of children. These programs reach millions of children each day and as a result, making school meals healthier may potentially impact a large number of children across different socioeconomic groups.

Recent national data show students consume only 40% of recommended vegetable intake, and have low levels of intake vitamins A and C, potassium and fiber, and high levels of intake of saturated fat and sodium. Fruits and vegetables are rich in vitamins, minerals and fiber and low in calories. Increased consumption of fruits and vegetables is associated with reduced risk of health conditions such as obesity, diabetes, cancer and cardiovascular disease. Despite the increasing knowledge about the health benefits of diets high in fruits and vegetables, school-aged children's diets are characterized by low intakes of vegetables and fruit (Cole and Fox 2008; Condon et al 2009; Clark and Fox 2009). Therefore, in addition to providing healthier meals schools can provide programs that focus on increasing the intake of fruits and vegetables and decreasing the consumption of competitive foods that are high in fat and sugar. Competitive foods are any foods or beverages which are sold or served outside of the school meal program. Unlike school meals, which must meet specified nutrition standards in order to receive federal funding, the competitive foods are not required to meet USDA nutrition standards. Existing research shows that one or more sources of competitive foods were available in 75% of elementary schools, 97% of middle schools, and 100% of high schools in the 2004-2005 school year (Fox et al. 2009), the school year of our data.

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185% and "full-price" lunch above 185%. Local school food authorities determine their own prices for full price lunch, but must operate their meal services as non-profit programs.

<sup>2</sup> In 2011-2012 school year the federal government reimbursed schools as follows: \$2.77 for a free lunch, \$2.37 for a reduced-price lunch and \$0.26 for a full-price lunch.

To date, many studies have examined the effect of NSLP and SBP on children's food and nutrient intake and health outcomes. However, not all the studies account for the potential endogeneity of participation in NSLP and SBP. Available research on consumption of food does find that NSLP participants consume more fruits and vegetables and milk and less snacks and beverages compared to nonparticipants (Gordon et al. 2007, Gleason and Suitor, 2003). However these studies did not adjust for the potential endogeneity of program participation. Recent studies that look at the effect of school meal programs on health outcomes of children and address the potential endogeneity of program participation include Schanzenbach (2009), Bhattacharya et al.(2006), Gundersen et al.( 2012), and Millimet et al. (2010). Existing research also shows that for school age children the school environment plays an important role (Briefel, et al. 2009; Finkelstein, et al. 2008; Fox, et al. 2009; and Lytle and Kubik, 2003). However, relatively little research has been done on the influence of school meal program participation and school environment on children and adolescents' food habits, and other food choices outside of school.

The focus of our research is children's intakes of fruits and vegetables. In addition to intake at school, we include intake of the fruits and vegetables away from school as well and evaluate whether the school meal intake substitutes for or supplements intake at home. The school food environment can greatly influence children's intake of fruit and vegetable – through what foods are offered and aspects of school meal environment that raise the “cost” (specifically, time cost) and hassle of participation. School policies dictate whether desserts or French fries are offered, for example. The availability of competitive foods through vending machines, school stores, and snack bars may reduce participation in the school meals program and can lead to reduced intake of healthier foods. On the other hand availability of salad bars can have a positive effect on student's fruit and vegetable intake. Therefore, controlling for the school environment (what food policies are practiced, and the “costs” to the student participating in the program, here measured as crowding in the lunch lines) in the analysis is important.

We use data from the 2004-05 School Nutrition Dietary Assessment III (SNDA-III) survey to examine the association between school meal program participation and children's dietary patterns and address the potential endogeneity of school meal program participation in the estimation. The data used for analysis include information on 2,096 school-age children and data

from 256 schools. We estimate a system of two equations specified jointly that includes (i) one of the latent consumption of target foods (fruits and vegetables) by location of consumption and (ii) the student decision to participate in the school meal program. School policies have little effect on participation in the school lunch program. We find demographic effects influence intake, and some school policies affect the fruit and vegetable consumption, both at school and outside of school. Increased attention to improving foods served at school highlights the potential role that school planning and policies can play in influencing dietary choices of school children. Evidence from this study identifies some policies and practices that are more effective than others at promoting healthy food choices for children.

This paper is organized as follows. First, an econometrics model and an estimation approach are described. These sections are followed by a detailed description of the data used in the analysis, the description of results and the conclusions.

## ECONOMETRIC MODEL

Our outcome variables of interest are the amount of fruits consumed at school, fruits consumed away from school, vegetables consumed at school and vegetables consumed away from school. There is a censoring problem associated with our outcome variables of interest. Specifically, 66%, 58%, 27% and 12% of respective observations are zero. To address the censoring we work with latent consumption,  $c_{mi}^*$ , and specify our model for students' consumption of fruits and vegetables at school and away from school as follows:

$$c_{mi}^* = x_{mi}\alpha + \gamma p_i + \varepsilon_{mi} \quad (1)$$

$$c_{mi} = \max\{0, c_{mi}^*\} \quad (2)$$

where  $c_{mi}$  is a consumption of student  $i$  of good  $m$  ( $m=1, \dots, 4$ ),  $p_i$  is a student's participation decision and  $x_{mi}$  is a vector of student, household and school level controls, and policies on à la carte foods, and other school environment related controls.

Participation in the school lunch program can be endogenous and we account for this endogeneity by using an instrumental variables approach.

$$p_i^* = z_i\beta + \mu_i \quad (3)$$

Where

$$p_i^* = \begin{cases} 1 & \text{if } p_i^* > 0 \\ 0 & \text{if } p_i^* \leq 0 \end{cases}$$

and  $z_i$  is a vector of instruments and individual, household, and school-specific characteristics.

To account for the potential endogeneity of NSLP participation, we allow the errors of (1) and (3) to be correlated. That is, unobservables that make a student more likely to participate in school meal program may also make that student more likely to consume more fruits and vegetables at school and away from school. We choose to accommodate this type of correlation by including a individual-specific error term in (1) and allowing this error to be correlated with error term in (3). Thus, unobservable factors affecting NSLP participation will likely spill over and correlate with the fruit and vegetable intakes of students at different consumption locations. To this end, we consider the following model:

$$c_{mi}^* = x_{mi}\alpha + \mathcal{P}_i + u_{mi} + \varepsilon_{mi} \quad (5)$$

$$p_i^* = z_i\beta + \mu_i \quad (6)$$

Where

$$\begin{bmatrix} u_{mi} \\ \mu_i \end{bmatrix} \Big| x, z \stackrel{iid}{\sim} N \left[ \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_u^2 & \sigma_{uv} \\ \sigma_{uv} & 1 \end{pmatrix} \right], \quad (7)$$

and

$$\varepsilon_{mi} \Big| x, z \stackrel{iid}{\sim} N(0, \sigma_\varepsilon^2) \quad (8)$$



Equations (5) and (6) now represent a standard two-equation treatment-response model using only observed rather than potential outcomes. We estimate this model using Bayesian methods. For more on related posterior simulators for such models, see Koop and Poirier (1997), Chib and Hamilton (2000, 2002), Poirier and Tobias (2003) and Chib (2007). Ishdorj et al. (2008) used a similar model specification in evaluating the effectiveness of the WIC program.

## **DATA**

Our analysis makes use of the data from the third School Nutrition Dietary Assessment Study (SNDA-III) conducted for the Food and Nutrition Service (FNS) by Mathematica Policy Research, Inc. The SNDA-III is a nationally representative, cross-sectional study of the National School Lunch Program (NSLP) and School Breakfast Program (SBP) in 2005. As part of its ongoing assessment of program performance, the FNS sponsored SNDA-III to provide comprehensive and up-to-date information on the characteristics of the school meal programs, the school food policies and environments that affect the programs, the foods and nutrients in school lunches and breakfasts, and the role of school meals in students' diets (Gordon et al. 2007(a)). The study used a multistage sampling approach to sample public school food authorities (SFAs)<sup>3</sup>, schools in a random subset of those SFAs, and students attending those schools. Approximately three schools were selected per district—one elementary, one middle, and one high school. Students in grades 1 through 12 were randomly sampled within schools.

Data for SNDA-III were collected from SFA directors; school food service managers and principals; students and their parents or guardians; and by direct observation of school food venues. Most important for our purposes, students completed an in-person 24-hour dietary recall interview. Specially trained field interviewers used the USDA Automated Multiple-Pass Method (AMPM) software (version 2.3, 2003, Agricultural Research Service, Beltsville, MD) to collect information on the types and quantities of food and beverages consumed on a typical school day (weekdays), and whether or not the food was eaten at school. Parents were interviewed in person

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<sup>3</sup> A school food authority is the local administrative unit for the federal school meal programs and may represent one or more school districts.

or by telephone about child and family background characteristics. During the same week, school food service managers completed a self-administered food service operations survey and a menu survey. The menu survey captured detailed information on the foods and portion sizes in federally-reimbursable school breakfasts (if available) and lunches over a typical five-day period. Surveys of SFA directors and principals provided additional information on the school food environment and food policies as well as school demographic characteristics.

The final sample sizes for SNDA-III were 130 SFAs; 397 schools with complete menu data for school lunches; and 2,314 students (aged 6 to 18 years) from 287 schools in 94 SFAs with data from both the 24-hour dietary recall and parent interview. Observations with non-missing or imputed values for the individual- and school-level control variables used in our analysis were 96% of the full sample. Thus, our final sample consists of 2,096 students attending 256 schools.

With respect to participation in NSLP and SBP programs SNDA-III data include measures of both “usual” and “target day” participation. Because the analysis described in this article examines a short-term outcome—consumption of fruit and vegetables—we used the short-term measure of school meal program participation on a single day. It can be difficult for students to tell whether their food selections comprise a full reimbursable meal, and the tendency is to over report participation in the meal programs. Therefore, students were classified as NSLP participants if they: (1) self-reported lunch participation on the recall day, *and* (2) their 24-hour recall included a minimum number of food items offered in the reimbursable lunch as reported in the menu survey (Gordon et al. 2008, Vol. II). The approach was the same for identifying SBP participants. However, in our estimation we decided to drop SBP participation from the list of explanatory variables since about 90% of SBP participants in our final sample were also participating in NSLP. Table 1 provides information on number of students participating in NSLP and SBP and those receiving free/reduced price meals. The rates of NSLP and SBP participation in our sample (Table 1) were nearly identical to the full SNDA-III sample for breakfasts and high school lunches (Gordon et al. 2008), and only slightly higher for lunch participation in elementary schools (74.6% vs. 72.6%) and middle schools (62% vs. 60.2%).

The main outcome variables, fruit and vegetable consumption at school and away from school, were derived from the students’ dietary intake data. The 24-hour recall and school menu data were coded by trained nutritionists using version 1.0 of the USDA Food and Nutrient Database

for Dietary Studies (FNDDS). In addition to energy and nutrient values from the FNDDS, the SNDA-III recall data include cup equivalent<sup>4</sup> measures of fruit and vegetable intake. These measures were estimated by matching the 24-hour recall data to the Pyramid Servings Database for USDA Survey Food Codes (version 1.0) for (a) each discrete fruit and vegetable reported, such as raw apple, cooked broccoli, tossed salad, and orange juice, and (b) mixed dishes comprised mostly of vegetables, such as Chef’s salad, stir fry chicken and vegetables, chili with kidney beans, and vegetable soup. Using the food-level Pyramid servings data and an indicator of whether the food was consumed at school, we were able to compute the total cup equivalents consumed by each student, separately for solid fruit at school, solid fruit away from school, vegetables except French fries at school, and vegetables except French fries away from school.

It is important to note that fruits and vegetables consumed “at school” may have been obtained from reimbursable school meals, “competitive” school food venues, or from sources outside the school (such as, a store, restaurant, or the student’s home). However, fruits and vegetables consumed “away from school” rarely included those obtained at school (Briefel et al. 2009). Because most of the fruits and vegetables consumed away from school were consumed “at home”, we refer to “at home” consumption which covers all consumption away from school.

Reported fruit and vegetable intakes were examined separately for consistency with the current MyPyramid recommendations and new standards for school menu planning (IOM 2010; Federal Register, 2012). Fruit juice and French fries were excluded from the measures of fruit and vegetable intake for two reasons: (a) our intent was to model fruit and vegetable intakes as more healthful eating behaviors, and (b) a previous study using SNDA-III data (Briefel et al. 2009) found very little evidence of a relationship between school food environment and practices and fruit and vegetable intake at school when juice and French fries were included.

Table 2 provides a summary of the independent and dependent variables used in the analysis. The student and household-level control variables used in both the participation and consumption

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<sup>4</sup> One cup of fruit, ½ cup dried fruit, 1 cup 100% fruit juice, and 1 cup raw or cooked vegetables count as 1 cup equivalent of fruit or vegetables (Dietary Guidelines for Americans, 2010).

equations include gender, race/ethnicity, household size, and an indicator of the number of parents in the household and their employment status. An indicator denoting if the student currently (last 30 days) receives free or reduced price school lunches, based on parent report, is included in both consumption and participation equations. The consumption model includes indicators for students' target day participation in the NSLP.

As reported in Table 2, students' mean intakes of vegetables in school with French fries excluded were 0.39 and 0.96 for at school and away from school, respectively, compared to 0.46 and 1.05 cups equivalent of total vegetables for at school and away from school, respectively. The mean intakes of fruits with fruit juices excluded at school and away from school, 0.26 and 0.43, respectively, were also lower than mean intakes of total fruits at school and away from school, 0.48 and 0.98 cups equivalent, respectively. French fries and fruit juices represent a relatively large portion of total vegetables and fruits consumed at school and away from school.

The school-level controls include region<sup>5</sup>, urbanicity, and size (student enrollment). We also make use of eleven school food policy and practice variables that may affect school meal participation and students' dietary behaviors. Two of those are based on information from school principals: whether or not nutrition education was provided in every grade in the school and whether information was available on the nutrient content of USDA-reimbursable meals to parents. The next five variables characterize availability of competitive foods and beverages, based on the school principals' survey. The remaining four variables characterize healthful aspects of the reimbursable school lunch offered, based on the menu survey: (a) no whole or 2% fat milk, (b) fresh fruit or raw vegetables offered daily, (c) no French fries or similar potato products, and (d) no desserts. Finally, because dietary patterns and school food practices vary across school levels (Briefel et al. 2009), we include an indicator for elementary, middle and high school in both participation and consumption equations.

To address the potential endogeneity of NSLP participation in the consumption model, we use an instrumental variable. An appropriate instrument should have the potential to influence the students' NSLP participation decision but not their consumption of fruit or vegetables. We chose

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<sup>5</sup> These are the seven regions through which FNS administers the school meal programs: Northeast, Mid-Atlantic, Southeast, Midwest, Mountain, Southwest, and Western.

an instrument that measures a child's opinion about the length of lunch lines in the cafeteria. In schools where the number of lines is inadequate (i.e., longer waiting time), students may choose to bring lunch from home or purchase items from a vending machine or snack bar as an alternative to the reimbursable meal. In contrast, if the number of lines is felt to be adequate (less waiting); student participation in the NSLP is likely to be higher because of the lower (time) costs of eating a school provided meal. An adequate number of lunch lines, however, should not affect students' consumption of fruit or vegetables at or away from school, conditional on NSLP participation. We also use a second instrument, which is an indicator of whether the child likes school lunch. This variable was created using two questions from the child/youth interview questionnaire regarding children's opinion of school lunch and the taste of the food served at lunch. We argue that children who like school lunches and the taste of the food served during lunch are more likely to participation in school meal programs.

## **RESULTS**

In total we estimated four systems of two equations: one system for each of the four food choice outcomes (fruits and vegetables at or away from school) and including the participation equation. We estimated the two-equation system of participation in NSLP and latent consumption using Bayesian methods. We ran the Gibbs sampler for 50,000 iterations and discarded the first 5,000 observations as the burn-in.

### ***NSLP Participation***

Table 4 reports the parameter posterior means, standard deviation and probabilities of being positive of NSLP participation equation. Our instruments appear to play an important role in NSLP participation decision and the signs are consistent with our expectations. That is, students who generally like school lunches and/or like the taste of school lunches are associated with higher probabilities of NSLP participation, with positive parameter posterior mean and probability of being positive equals to one. Students who think that lunch lines are generally long are less likely to participate in NSLP, since the parameter posterior mean is negative with very low probability of being positive, 0.05.

As expected, characteristics of the students and their families influence participation in the NSLP. Students who live in larger households, living in southeast, attending schools with

enrollment less than 1,000 students are more likely to participate in NSLP. Also children with parents with no high school or high school degree are more likely to participate in NSLP compared to those whose parents have a college degree or above. Being Hispanic or black is associated with higher probability of school lunch participation. Children attending middle and high schools are less likely to participate in school meal program compared to children attending elementary school.

Participation varies among groups with different household structure and parental employment. Compared to students with two employed parents students living in household with two parent present one employed, or one parent present not employed are less likely to participate in school meal program, reflecting the time constraint that employed parents may face in preparing their children's lunches. With regard to free/reduced price meals, children were more likely to participate in school meal program if they were receiving free or reduced price meals. An important finding is that none of the school food environment and policy variables that were included had any effect on student's decision to participate in NSLP.

### ***Socio-economic Factors***

With respect to the consumption equations, after controlling for the endogeneity of NSLP participation we find that students participating in NSLP tend to consume more fruits and vegetables at school compared to those who choose not to participate. This result suggests that the NSLP is effective in increasing fruits and vegetables intake of program participants. However, these findings are location specific, i.e. students who eat school lunches tend to consume fewer vegetables away from school, indicating that there might be some substitution effect present.

Students in larger households with more educated parents tend to consume more fruits at school, while higher education of parents leads to less intake of vegetables at school. We observe some regional variation in students' intakes of fruits and vegetables by location of consumption. Receipt of free or reduced price meals had no effect on our intake variables of interest. Students attending smaller schools are more likely to consume more of fruits and vegetables at school and at home. Compared to white students, Hispanics and other race students tend to consume more fruits away from school.

### *School Food Environment and Policy*

Tables 5 and 6 present parameter posterior means, standard deviations and probabilities of being positive from estimating the censored regressions for four variables of interest: solid fruit at school, solid fruit away from school, vegetables except French fries at school, and vegetables except French fries away from school. As noted earlier, fruits and vegetables consumed “at school” may have been obtained from reimbursable school meals, “competitive” school food venues, or from sources outside the school (such as, a store, restaurant, or the student’s home). However, fruits and vegetables consumed “away from school” rarely included those obtained at school.

With respect to availability of competitive foods and beverages in schools we found that putting restrictions on sales of à la carte foods and beverages and having no stores or snack bars selling foods and beverages have a positive effect on students’ intake of fruits at school. However, restrictions imposed on à la carte foods and beverages in schools reduce the amount of fruits consumed at home, indicating that this policy may lead to some substitution effect: the increase in fruit intake at school is associated with less fruit intake at home.

As reported in Table 3 more about 85 percent of students in our sample had access to competitive foods and beverage through à la carte services, compared to only 27 percent of students through school stores and snack bars. A policy of no store or snack bar leads to increased consumption of fruit in school. At the same time, there is some indication this policy is associated with less fruit and vegetable intake at home. No à la carte services are associated with less fruit at home.

A no dessert policy is associated with increased vegetable consumption in school (but not fruit), and lower intakes of vegetables away from school. In fact, somewhat surprisingly, a no dessert policy had little effect on fruit consumption at any location.

Over 60 percent of students in our data attend schools in our data offer fresh fruits or raw vegetables daily. We found that a fresh fruit and vegetables policy at school leads to increased intake of fruits at home, but had no effect on children’s fruit intake in school. Having daily fresh fruit and vegetables led to lower intake of vegetables in school. It may be that the selection of fresh vegetables has less appeal to students in general. Only 20 percent of students in our sample

attended schools that did not offer French fries one or more days per week. This policy is associated with increased vegetable consumption at home but reduced fruit consumption, both at school and away from school.

Not offering whole and 2% milk at school leads to higher intake of both fruits and vegetables at school and higher intake of vegetables away from school.

It is also useful to note that policies for no fundraising, no vending machines, providing fresh fruit and vegetables daily and a policy of no desserts have little effect on fruit intake in school. Policies of no store or snack bar, no fundraising, no à la carte sales or no vending machines and no fries have little effect on consumption of vegetables in school.

## **CONCLUSION**

Both the federally-supported school lunch program and state and local school policies have an important role to play in encouraging school age children to consume healthier foods, in particular fruits and vegetables. Evidence presented in this analysis of recent data from a nationwide sample of schools supports their contribution to healthier food choices after accounting for potential endogeneity of participation in NSLP.

First, participation in the NSLP leads to increased consumption of both fruit and vegetables in school. Holding all other school policies and characteristics constant, there is evidence that fruits and vegetable consumption increases. At the same time, the results suggest that the increased consumption of vegetables at school may come at the expense of reduced consumption away from school. That is, for NSLP participants, the vegetables at school substitute for vegetable acquired and eaten from away from school sources.

A second important finding is that school policies related to making foods provided in school as healthier choices do not affect NSLP participation. There were no statistically significant effects of the policies on NSLP participation. Thus, policies to improve nutrition in school meals do not discourage participation. This finding has important implications as schools work to adopt new dietary standards for the school meals. The evidence here suggests that the new food standards that include increased offering of fruits and vegetables, limited access to competitive foods and restrictions on milk to lower fat milk will not discourage students from school meals. At the



same time, there are differences observed in program participation and in the food intake behavior of students by grade level. Students in middle and high school are less likely to participate. Targeted improvements in foods to appeal to these students may be needed to encourage their participation.

Third, some policies discourage fruit and vegetable selection in school, although interpreting the reason for this is more difficult to answer. Not offering French fries discourages selection of fruit in school. Also, offering fresh fruit and vegetables daily discourages vegetable consumption in school. In the case of the offering of fresh fruits and vegetables, it may be that schools offer salads or salad bars as the fresh offering. Although they appeal to some students, logistics associated with getting the fresh vegetable may have discouraged this food choice. Or, alternatively, offering fresh fruit may discourage selection of vegetable. Reimbursement for the school meal in this period is based on number of items selected. There is relatively little incentive to select additional fruit or vegetables. Once the new meal standards are in place, more frequent and varied fruits and vegetables will become part of the reimbursable meals and increase the incentive to choose fruits and vegetables as part of the meal. These changes will offer particular challenge for schools to make them appealing to students.

Finally, there is some evidence that policies directed to in school consumption of fruits and vegetables can have an effect on consumption that takes place outside of school. Some food policies that limit competitive foods (e.g., no à la carte services) led to decreased consumption of fruit at home. Offering daily fresh fruit and vegetables in school increased fruit consumption at home; providing no fries in school led to increased vegetable consumption at home (and intake that did not include fries).

Although this paper has provided a number of useful findings, it is clear that there are many questions it cannot answer. Further work must be done on studying the effect of participation in multiply food assistance programs. In addition, offering of some foods may lead to cross product substitution effects that are not fully accounted for in the analysis. Cross-sectional data used in this study limit the ability to assess the long-run effect of NSLP participation and school food environment and practices. However, despite these limitations, new evidence presented here indicates the potential for improving food choices through policies and the school environment.

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**Table 1. Number of Students Participating in NSLP, SBP and Receiving Free/Reduced Price Meals**

	Participation										
				Breakfast				Lunch			
				Total		Free/Reduced		Total		Free/Reduced	
	Total	Free/Reduced		Total	Free/Reduced		Total	Free/Reduced			
N	N	%	N	%	N	%	N	%	N	%	
Elementary	664	335	51	147	22	117	80	488	74	287	59
Middle	717	339	47	114	16	92	81	447	62	246	55
High	715	272	38	80	11	57	71	321	45	173	54
Total	2096	946	45	341		266		1256		706	

**Table 2. Variables and Sample Mean Values**

<b>Variables</b>	<b>Mean</b>	<b>Std Dev</b>
<b><i>Dependent Variables (cup equivalent)</i></b>		
Fruit at school	0.26	0.52
Fruit at away	0.43	0.91
Veggies at school	0.39	0.50
Veggies at away	0.96	1.05
<b><i>Explanatory Variables</i></b>		
Participation in NSLP	0.60	0.49
Receive free/reduced price	0.45	0.50
Household size	4.48	1.55
Hispanic	0.23	0.42
White	0.19	0.39
Black	0.51	0.50
Other Race	0.06	0.24
Elementary school	0.32	0.47
Middle school	0.34	0.48
High school	0.34	0.47
Female	0.51	0.50
Urban	0.79	0.41
Mid-Atlantic	0.11	0.31
Midwest	0.17	0.38
Mountain-Plains	0.08	0.27
Northeast	0.09	0.28
Southeast	0.20	0.40
Southwest	0.18	0.38
Western	0.18	0.38
Parent: Less than high school	0.45	0.50
Parent: High school or GED	0.33	0.47
Parent: College graduate	0.22	0.42
2 parents, both employed	0.30	0.46
2 parents, one employed	0.33	0.47
Neither parent employed	0.05	0.23
1 parent, employed	0.15	0.36
1 parent, not employed	0.09	0.29
School enrollment<500	0.26	0.44
1000<School enrollment<500	0.40	0.49
School enrollment>1000	0.34	0.47
<b><i>Instruments</i></b>		
Long lunch lines	0.46	0.50
Likes school lunches	0.73	0.44

**Table 3. School Food Environment and Policy Variables (percentage of children)**

<b>Variables</b>	<b>Description</b>	<b>Mean</b>	<b>Std Dev</b>
Nutrition education	Has nutrition education in every grade	0.55	0.50
Nutrient info for parents	Nutrition information is available to parents	0.63	0.48
No store or snack bar	No store or snack bar selling foods or beverages	0.77	0.42
No fundraising	No fundraising activities selling sweet or salty snacks	0.38	0.49
No à la carte	No à la carte food and beverages except skim/1% milk	0.15	0.36
No vending machine	No vending machines	0.28	0.45
Vending, but not in cafeteria	Vending machine, but not in cafeteria	0.34	0.47
No high fat milk	No whole and 2% fat milk	0.41	0.49
Daily fresh fruit/veggies	Fresh fruit or raw vegetables offered daily	0.61	0.49
No fries	French fries not offered 1 or more days per week	0.20	0.40
No dessert	Dessert not offered 1 or more days per week	0.28	0.45

**Table 4. Posterior Means, Standard Deviations, and Probabilities of Being Positive for NSLP Participation**

Variables	NSLP Participation		
	E( $\cdot$  y)	Std( $\cdot$  y)	Pr( $\cdot$ >0 y)
Intercept	-0.38	0.25	0.41
Receive free/reduced price	0.73	0.08	1.00
Household size	0.06	0.02	1.00
Hispanic	0.25	0.10	1.00
Black	0.11	0.10	0.81
Other race	0.11	0.14	0.56
Middle school	-0.38	0.10	0.00
High school	-0.27	0.10	0.00
Female	-0.76	0.12	0.00
Urban	-0.22	0.09	0.02
Midwest	0.03	0.12	0.81
Mountain-Plains	-0.11	0.15	0.47
Northeast	-0.20	0.14	0.17
Southeast	0.35	0.12	1.00
Southwest	-0.07	0.12	0.58
Western	-0.28	0.13	0.03
Parent: Less than high school	0.19	0.09	0.97
Parent: High school or GED	0.24	0.08	1.00
2 parents, one employed	-0.12	0.07	0.09
Neither parent employed	-0.17	0.14	0.23
1 parent, employed	0.05	0.10	0.63
1 parent, not employed	-0.19	0.11	0.08
School enrollment<500	0.18	0.10	0.95
1000<School enrollment<500	0.22	0.08	1.00
Long lunch lines	-0.12	0.07	0.05
Likes school lunches	0.50	0.06	1.00
Nutrition education	0.05	0.07	0.47
Nutrient info for parents	0.09	0.07	0.20
No store or snack bar	0.03	0.08	0.76
No fundraising	0.01	0.07	0.89
No a la carte	-0.10	0.09	0.27
No vending	0.03	0.11	0.78
Vending machine, but not in cafeteria	-0.04	0.08	0.61
No high fat milk	0.02	0.07	0.78
Daily fresh fruit/veggies	0.05	0.07	0.50
No fries	0.02	0.08	0.78
No dessert	0.01	0.07	0.88



**Table 5. Posterior Means, Standard Deviations, and Probabilities of Being Positive for Fruit Consumption**

Variables	Fruit at school			Fruit away		
	E( $\cdot$  y)	Std( $\cdot$  y)	Pr( $\cdot$ >0 y)	E( $\cdot$  y)	Std( $\cdot$  y)	Pr( $\cdot$ >0 y)
Intercept	-0.55	0.22	0.01	-1.37	0.34	0.02
Participation in NSLP	0.16	0.06	0.01	-0.08	0.09	0.40
Receive free/reduced price	-0.03	0.07	0.70	-0.06	0.11	0.57
Household size	0.03	0.02	0.07	0.01	0.03	0.67
Hispanic	0.14	0.1	0.85	0.34	0.15	1.00
Black	0.04	0.09	0.62	0.18	0.14	0.18
Other race	-0.22	0.14	0.08	0.47	0.19	1.00
Middle school	-0.53	0.09	0.00	-0.12	0.14	0.69
High school	-0.47	0.11	0.00	-0.33	0.17	0.95
Female	0.16	0.06	0.01	0.06	0.08	0.48
Urban	-0.08	0.08	0.35	0.20	0.13	0.89
Midwest	0.11	0.12	0.32	0.30	0.17	0.98
Mountain-Plains	0.12	0.14	0.39	0.67	0.21	1.00
Northeast	0.44	0.14	1.00	0.53	0.21	0.97
Southeast	0.08	0.11	0.48	0.12	0.17	0.48
Southwest	0.02	0.12	0.86	0.34	0.18	1.00
Western	0.25	0.13	1.00	0.72	0.19	1.00
Parent: Less than high school	-0.26	0.08	0.00	-0.21	0.12	0.08
Parent: High school or GED	-0.13	0.08	0.09	-0.03	0.11	0.80
School enrollment<500	0.3	0.09	1.00	0.27	0.14	0.98
1000<School enrollment<500	0.2	0.08	0.99	0.08	0.11	0.50
Nutrition education	-0.02	0.06	0.75	0.06	0.10	0.55
Nutrient info for parents	-0.07	0.06	0.28	0.30	0.10	0.00
No store or snack bar	0.01	0.08	0.90	-0.03	0.12	0.81
No fundraising	-0.09	0.06	0.13	-0.05	0.09	0.56
No a la carte	0.13	0.08	0.91	-0.47	0.13	0.00
No vending	0.04	0.1	0.71	0.19	0.15	0.84
Vending, but not in cafeteria	0.03	0.07	0.69	-0.02	0.11	0.87
No high fat milk	0.18	0.07	1.00	-0.02	0.10	0.84
Daily fresh fruit/veggies	0.03	0.06	0.63	0.17	0.09	0.95
No fries	-0.12	0.07	0.05	-0.20	0.11	0.07
No dessert	-0.09	0.07	0.21	0.04	0.10	0.66

**Table 6. Posterior Means, Standard Deviations, and Probabilities of Being Positive for Vegetable Consumption**

Variables	Vegetables at school			Vegetables away		
	E( $\cdot$  y)	Std( $\cdot$  y)	Pr( $\cdot$ >0 y)	E( $\cdot$  y)	Std( $\cdot$  y)	Pr( $\cdot$ >0 y)
Intercept	0.11	0.12	0.36	1.48	0.21	1.00
Participation in NSLP	0.47	0.03	1.00	-0.16	0.06	0.01
Receive free/reduced price	-0.03	0.04	0.38	-0.06	0.07	0.41
Household size	0.01	0.01	0.42	-0.01	0.02	0.67
Hispanic	-0.11	0.05	0.03	-0.08	0.09	0.37
Black	-0.09	0.05	0.05	-0.08	0.08	0.34
Other race	-0.08	0.07	0.26	0.12	0.12	0.35
Middle school	0.05	0.05	0.76	0.02	0.09	0.86
High school	0.09	0.06	0.87	0.21	0.11	0.95
Female	-0.04	0.03	0.20	-0.18	0.05	0.00
Urban	-0.03	0.05	0.44	-0.10	0.08	0.20
Midwest	-0.01	0.06	0.83	0.17	0.11	0.95
Mountain-Plains	0.06	0.08	0.43	-0.12	0.14	0.37
Northeast	-0.26	0.07	0.00	0.12	0.13	0.35
Southeast	0.08	0.06	0.16	0.13	0.10	0.22
Southwest	0.05	0.06	0.44	0.10	0.11	0.37
Western	-0.07	0.07	0.30	0.05	0.12	0.70
Parent: Less than high school	0.00	0.04	1.00	-0.03	0.08	0.73
Parent: High school or GED	-0.01	0.04	0.81	-0.05	0.07	0.54
School enrollment<500	0.09	0.05	0.95	-0.09	0.09	0.28
1000<School enrollment<500	0.06	0.04	0.15	-0.12	0.07	0.05
Nutrition education	-0.02	0.03	0.51	0.01	0.06	0.85
Nutrient info for parents	-0.04	0.03	0.21	-0.04	0.06	0.54
No store or snack bar	-0.02	0.04	0.66	-0.18	0.07	0.01
No fundraising	-0.02	0.03	0.50	-0.01	0.06	0.89
No à la carte	0.02	0.05	0.62	-0.06	0.08	0.45
No vending	0.05	0.05	0.40	-0.01	0.10	0.90
Vending, but not in cafeteria	0.02	0.04	0.62	0.02	0.07	0.81
No high fat milk	0.06	0.03	1.00	0.11	0.06	0.98
Daily fresh fruit/veggies	-0.07	0.03	0.03	-0.02	0.06	0.80
No fries	-0.03	0.04	0.41	0.12	0.07	0.98
No dessert	0.13	0.04	1.00	-0.16	0.06	0.01