Impact of Farm to School Programs on Students' Consumption of Healthful Foods: An Empirical Analysis in Georgia

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INTRODUCTION

Background and Motivation

Over one third of America's adults and 17% of children are considered obese (Ogden, et al. 2014). Research shows that children who are obese are much more likely to grow up to become obese as adults (Ogden, et al. 2014). A major concern is the increasing trend in obesity rates over the past three to four decades. While obesity as a health problem has been studied extensively and theories have been posited as to how the ever-growing epidemic can be stopped, the rates of obesity in the U.S. continue to rise (Taubes 2008).

One major contributor to the obesity epidemic in the U.S. is "empty calories", which are calories from added sugar and solid fat that don't contribute nutritionally to the diet when consumed (U.S. Department of Agriculture 2012). A 2008 study by an Institute of Medicine committee comprised of child-nutrition experts found that children were eating over 500 excess calories from solid fat and added sugar, and nearly 80% of kids were consuming more saturated fat than recommended (Woo Baidal and Taveras 2014). A more recent study showed that approximately 33% of calories consumed by children ages 2-18 came from empty calories, and that school meals accounted for approximately 32% of the empty calories consumed came from school lunches (Poti, Slining and Popkin 2014).

To address the dietary quality of children in school, several initiatives have been implemented, including the Healthy, Hunger-Free Kids Act (HHFKA) in 2010, Michelle Obama's "Let's Move!" program and President Barack Obama's development of the Task Force on Childhood Obesity (U.S. Department of Agriculture 2014; Let's Move!, 2015). The HHFKA,

which expanded upon other policies regarding childhood nutrition, was a call for new school nutrition standards that met the Dietary Guidelines for Americans released in 2010 (Echon 2014; Woo Baidal and Taveras 2014). It aimed to increase student consumption of fruits, vegetables, and whole grains and limited trans fats and sodium in school lunches, while also establishing calorie ranges for school children (Woo Baidal and Taveras 2014). Prior to the HHFKA, a study surveying over 600,000 lunches found that 84% of school lunches did not meet the recommended daily minimum servings for vegetables, and 61% did not meet the recommended minimum for grain (Echon 2014).

Michelle Obama's "Let's Move!" program was geared more towards activities in school and getting children to lead active lives rather than simply looking at the nutrition aspect of the childhood obesity issue (Let's Move! 2015). As part of this initiative taken on by Mrs. Obama, it encourages communities to take part in building healthy children, asking families, teachers, health care professionals, and others involved in the lives of children to come together to encourage kids to get active. However, while the aim of the program is primarily to encourage activity, it recognizes that nutrition also plays a major role in the health of children, and promotes healthy eating habits as well as activity as a way to maintain a healthy lifestyle (Let's Move! 2015). Finally, the Task Force on Childhood Obesity has worked to develop and implement an inter-agency plan that to work towards reducing the levels of childhood obesity back down to five percent by 2030, which is the same rate it was in the late 1970s before it first began rising in the U.S. (Let's Move!, 2015).

In response, the US Department of Agriculture (USDA) made changes to the Nutrition Standard in the National School Lunch Program (NSLP) and National School Breakfast Program (NSBP), requiring schools to increase servings of fruits, vegetables, whole grains, and dairy in

school lunches (Cohen, et al. 2014). Studies have found that there are lower odds of overweight and obesity when fruits and vegetables were sold along with other foods in schools (Terry-McElrath, O'Malley and Johnston 2014). The Centers for Disease Control and Prevention (CDC) adds that consumption of "more fruits and vegetables adds under consumed nutrients to diets, reduces the risks for leading causes of illness and death, and helps manage body weight" (Kim, et al. 2014).

One way schools are working to reach these new standards for the NSLP is by implementing farm-to-school programs (FTSPs)[1]. FTSPs are generally defined as programs that seek to improve student nutrition and aid local economies by procuring healthy, local food and produce from small and medium-sized local or regional farms, and engaging students in food and nutrition learning opportunities (Joshi, Azuma and Feenstra 2008). Beginning in the mid-1990s, the first FTSPs were developed, and by the early 2000s, many school districts nationwide were using FTSPs to improve the quality of school lunches, educate their students on food and nutrition, and support their local economies (Benson 2014). Federal programs as well as non-profit organizations like the National Farm to School Network (NFSN) have worked with local school districts to help promote healthier food offerings to students.

It is not entirely clear whether the FTSPs result in better dietary habits for school children. One way that FTSPs may have a positive impact on student consumption and perceptions of food is through its multifaceted approach, exposing students to new foods not just in the cafeteria, but also in the classroom and on field trips. Students eat what they like and they like what they know. The more exposure children have to new foods, to the more likely they are

[1] Throughout this study we use the acronym FTSP to refer to "farm to school program" and FTS to refer to "farm to school," except in the case of the USDA's Farm to School Census, which is referred to by the USDA as the F2S Census.

to eat them (Birch and Fisher 1998; Cooke 2007). The CDC points out that children's taste preferences, how often they are exposed to certain produce, and their social experiences may all impact the amount of fruits and vegetables they consume (Kim, et al. 2014). Birch and Fisher point out, "Because children eat what they like and leave the rest, food preferences are especially important determinants of the food intake of young children" (1998). Furthermore, it can often take between five and fifteen exposures to merely increase the willingness to try a new food, meaning that children may never get the chance at home to eat new vegetables if their parents give up trying to get them to eat it after the second or third exposure (Cooke 2007). Because FTSPs expose students to different foods through an educational component as well as serving more produce in the cafeteria, they might also lead to an increase in student consumption of healthful foods (Feenstra and Ohmart 2012).

However, we posit that there are several reasons why FTSPs may not have any effect on students' perceptions or consumption of healthful foods. First, it is possible that FTSPs are doing an exceptional job at teaching students about nutrition and where their food comes from, to the point where students are finely attuned to what foods are considered "healthy" and what foods they should be eating. It is possible that their demand for these healthful foods cannot be kept up with by the school's nutrition programs, and therefore they may perceive that school lunches are not as healthy as they should be, so their responses change little, or may even reverse in this situation. Secondly, the opposite may be true, where the programs may be improving the overall quality of lunches in the schools, but is not effectively teaching students about nutrition, and therefore they are not changing their consumption habits because they do not see a need to change what they are eating. Finally, it is possible that FTSPs simply do not have any effect, or

that not enough time has passed for us to see an effect given the data to which we currently have access.

The motivation behind this study is to empirically examine the link between FTSPs and student consumption of healthful foods. We look at student responses to the nutrition questions from Georgia Student Health Survey II (GSHS) as well as district responses to the F2S Census to look at how student responses change after implementation of a FTSP within a school district. We used a panel dataset and ran a series of regression models to look at the potential effects of FTSPs on the students' responses to the GSHS. We also used a Probit model approach to look at the different characteristics of districts choosing to adopt FTSPs. We find that the types of districts in Georgia that are most likely to adopt a FTSP are those with higher overall agricultural sales (both crop and animal sales) and that those with lower median incomes are slightly more likely to adopt. Overall, we found no statistically significant effect of FTSPs on either consumption or perception of availability of healthful foods in school. This does not, however, indicate that there is no effect from FTSPs on students' diets or health merely that the data we were able to obtain does not indicate an effect given the time period we examined.

Literature Review

A large amount of the literature currently available regarding school lunches has more to do with the NSLP than on FTSPs specifically. Because the NSLP was developed in 1945, there is a great deal of research regarding the standards set forth and how and whether schools are meeting these standards (Woo Baidal and Taveras 2014). As mentioned previously, FTSPs were not really developed until the mid-1990s, and did not become popular nationwide until the USDA's formation of their FTS Team in 2013 (Benson 2014). Therefore, much of the research on NSLP is crucial in looking into FTSPs. How the NSLP affects school lunches and student

health sets a baseline for the results we would like to see from FTSPs and helps to determine whether FTSPs are effectively helping schools to meet the guidelines for NSLP and HHFKA. Gundersen, Kreider and Pepper (2012) did research on the impact of the NSLP child health using a nonparametric bounds approach, specifically looking at how the NSLP affected students who received free lunches. Their estimates indicated "the program has reduced the rate of poor health by at least 29%...and the rate of obesity by at least 17%" (Gundersen, Kreider and Pepper 2012). Another study focuses on the effect of parental perceptions of healthful school food on whether students eat lunch at school or not (Ohri-Vachaspati 2014). The study looked at parental perceptions of the nutrition quality of school meals in low-income communities with large minority populations, and concluded that "parental perception of school meals was a significant predictor of the odds of a student eating lunch served at school" (Ohri-Vachaspati 2014).

Additionally, we see several articles that focus on the amount of waste produced in schools by the new NSLP standards implemented by the HHFKA in 2010. They stress the backlash and concern that the new federal mandates increase the amount of waste produced by school lunches given students may not be receptive to the new menu offerings (Byker, et al. 2014; Cohen, Richardson and Austin, et al. 2013; Cohen, Richardson and Parker, et al. 2014; Gase, et al. 2014). These studies tend to focus on specific cities or school districts, and, for the most part, conclude that measures need to be taken to improve school lunches to help decrease student waste. Cohen, Richardson and Austin, et al., focused on middle schoolers in Boston, using a controlled study over two years to measure food waste and concluded, "Students might benefit if additional focus were given to the quality and palatability of school meals" (2013). Additionally, in Los Angeles in 2014, Gase, et al. also concluded that the amount of produce wasted was significant, and that "additional work may be needed to increase student selection

and consumption of fruit and vegetable offerings." It is possible that FTSPs could provide the key link between nutrition education and improvement in school lunches that helps schools to reduce the overall waste produced by school lunches.

Previous FTSP studies have looked at the effect of FTSP on student knowledge local foods, nutrition, and health, or the effect on consumption at specific schools (Joshi, Azuma and Feenstra 2008). Additionally, Michigan has distributed a survey on FTSPs in 2004 and 2009, putting out a brief report on the survey's findings each time (Colasanti, Matts and Hamm 2012). Finally, there have also been policy and law reviews that have looked at the impact of FTSPs in specific states (Winston 2011; Thompson, et al. 2014). To our knowledge, no research has examined the effect of FTSPs on student preferences or consumption at a statewide level (Joshi, Azuma and Feenstra 2008). Therefore, we attempt to fill a gap in the literature by looking at the effect of FTSPs on student consumption and perceptions of availability of healthful foods in schools.

The objective of this study is to determine whether implementation of FTSPs in school districts impacts students' perception of healthful foods and their reported consumption of specific healthful food items. In addition, we examine key socio-demographic characteristics that embody districts that adopt FTSPs. Our primary objective was to determine whether the implementation of FTSPs has an effect on student consumption of fruits, vegetables, and whole grains, and whether or not the programs impact students' opinions on availability of healthful foods in their schools. Secondarily, we wanted to look at the socio-demographic characteristics that contribute to a school district's choice to adopt a FTSP.

Through examining the effect of FTSPs on students in Georgia, we gain a better understanding as to how well the programs are working. The findings of this study could be

beneficial to policymakers interested in encouraging a focus towards FTSPs. The alignment of FTSPs with the slow and local food movements that are currently popular in American society also make this study relevant to the general public.

METHODS AND DATA ANALYSIS

Data Collection and Sources

In 2009, the USDA established a Farm-to-School Team, which sent out its first Farm-to-School Census (F2S Census) to public schools nationwide in 2013 (Benson 2014). The goal of the F2S Census is to collect national data on school districts' participation in FTSPs. This was the first of any such data collected at a national level. The USDA worked with the NFSN to develop questions targeted to public school districts across the nation, looking primarily at their farm to school activities during the 2011-12 school year (U.S. Department of Agriculture 2014). The survey was distributed to food service directors using an email message, which contained a hyperlink to the online questionnaire, from the agency in each state responsible for administering school nutrition programs (U.S. Department of Agriculture 2014). The respondents who stated that their district had not participated in farm to school activities within the past school year were given a shortened version of the questionnaire, while those who had participated or planned to participate answered a separate set of questions (U.S. Department of Agriculture 2014). An example of the questionnaire for the F2S Census can be found in Appendix 1. Within Georgia, 155 of the 180 school districts responded to the census.

While the primary question for the F2S Census was whether a district participated or began FTS activities during the 2011-12 school year, the census also included questions about whether the district served local food, held taste tests of foods cooked from school gardens, promoted local foods, and also questions regarding the district's definition of local, the total reported cost of food for the district, and the estimated amount spent on local foods (U.S.

Department of Agriculture 2014). Overall, the USDA send the census out to 13,331 public school districts in all fifty states as well as DC, and received responses from 9,887 of the districts.

One question that was not asked of the schools who responded that they were already participating in FTSPs as of the 2011-12 school year was what year the district began FTS activities. In the state of Georgia, 60 districts reported having farm to school activities in 2011-12. To determine whether they had begun FTS activities prior to that school year, we called the nutrition directors of these 60 districts to see when the districts began their FTS activities. We found that some had begun prior to that school year, many began during that school year, and two had never even had farm to school and believed the survey response was in error. Table 2.1.1 shows the breakdown of the responses of Georgia school districts.

Table 2.1.1 Number of School Districts Enrolled in Farm to School Programs by Year

Year	# of Districts with FTSPs
2003	1
2007	7
2008	1
2009	3
2010	6
2011	34
2011, cancelled in 2013	1
2012	14
2013	2
Don't Know	2
Future	33
No plans	46
No response	30
Total	**180**

An issue we ran into with this was a number of districts had turnover in their nutrition department, and therefore the current nutrition director was unsure how long the district had

participated in the program. Approximately seven of the 61 districts originally claiming to have had FTSPs implemented since at least the 2011-12 school year were unsure whether the program had started that year or if it had begun earlier. Because of the uncertainty, we wanted to account for this in our models. We took our completed dataset and manipulated it into three different datasets, for which the uncertain districts were coded differently. For the first setup, we dropped all of the uncertain observations entirely. For the second setup, we coded the uncertain districts as having implemented the FTSP in the 2011-12 school year. Finally, for the third setup, we coded these uncertain districts as having had the FTSP for all years (i.e. implemented in 2008).

The second data source used for our study was the Georgia Student Health Survey II (GSHS). The Georgia Department of Education (GADOE) conducts the GSHS annually, which includes questions regarding students' consumption of alcohol and drugs, their environments, as well as school nutrition. An example of the GSHS can be found in Appendix 2. We obtained all individual responses to the GSHS from 2008 to 2013, although all identifying information was removed from the data for privacy reasons, so the responses did not include any indicators such as gender or race. The responses we were interested in were those for the nutrition related questions, which are phrased as statements with response scales from one to four, one being strongly agree and four being strongly disagree. A list of each of the nine nutrition related statements can be found in Table 2.1.2.

Table 2.1.2 Georgia Student Health Survey Nutrition Statements

#	Statement
Nutrition 1	I eat at least three servings of dairy products each day (dairy includes cheese, yogurt, and milk).
Nutrition 2	I eat at least five servings of fruits or vegetables each day.
Nutrition 3	School meals in my school cafeteria are healthy.
Nutrition 4	Facts about nutrition are available in my school cafeteria.
Nutrition 5	I eat school lunch three of more times per week.
Nutrition 6	I make healthy food choices in my school cafeteria.
Nutrition 7	There are whole wheat and multigrain breads and cereals available in my school cafeteria.
Nutrition 8	If only healthy snacks and beverages were available in the vending machines during the school day, I would purchase them.
Nutrition 9	If breakfasts were available at school, but outside the cafeteria, I would eat breakfast at school more often.

Within these nine different nutrition statements, we see that there statements regarding students' dietary habits, including Nutrition 1, 2, and 5, as well as statements regarding how students perceive the availability of healthful food and nutrition information (Nutrition 3, 4, and 7). Finally, there are statements about the choices students make or would make, given the availability of healthful foods, such as Nutrition 6, 8, and 9. For our study, we were most interested in Nutrition 2, the amount of fruits and vegetables students claim to be consuming, as well as Nutrition 3, the students' perception of how healthy school meals are. We anticipated that FTSPs should have a positive impact on both of these statements, where students whose districts had implemented a FTSP were more likely to strongly agree that they consume five servings of fruits and vegetables per day, and that they believed their school meals to be healthier. We were also somewhat interested in Nutrition 1, the number of servings of dairy consumed per day, and Nutrition 6, whether FTSPs impacted the meal choices students make. Similarly to the first two nutrition statements of interest, we anticipated that FTSPs should have a

positive impact on the responses to Nutrition 6, where students participating in FTSPs make healthier choices in their meals than those in districts without the program.

We were not as interested in the remaining statements, although we were interested in examining how Nutrition 5, if the student consumed three or more meals per week at school, affected their responses to the questions. Table 2.1.3 shows the summary statistics for each of these responses across our panel data.

Table 2.1.3 Georgia Student Health Survey Nutrition Summary Statistics

Variables	N[2]	Mean	SD	Min	Max
Nutrition 1	5,566	2.95	0.29	1	4
Nutrition 2	5,566	2.63	0.31	1	4
Nutrition 3	5,566	2.39	0.41	1	4
Nutrition 4	5,566	2.67	0.41	1	4
Nutrition 5	5,566	2.99	0.39	1	4
Nutrition 6	5,566	2.71	0.37	1	4
Nutrition 7	5,566	2.84	0.39	1	4
Nutrition 8	5,566	2.71	0.37	1	4
Nutrition 9	5,566	2.83	0.30	1	4

It is important to note that with these responses, the GSHS is originally set up where a one is a positive response ("strongly agree") while a four is a negative response ("strongly disagree". This distinction is necessary because in the analysis a negative correlation between our FTS variables and the responses to the questions would actually signify an improvement. In order to account for this, we subtracted all of the average responses across grade levels and districts from five, resulting in a one being "strongly disagree" and a four being "strongly agree" so that our corresponding parameter estimates would be positive for an improvement and negative for a decrease in the students' nutrition responses. Therefore in the table above, we see

[2] N here represents the number of grades responding from all school districts across all years.

that the average nutrition response is positive for all nutrition questions, leaning more towards "agree", which would be a 3 with the way our data is coded, than to 2, which would be "disagree". There is not a great deal of change across any of the statements; they all have similar means, and their standard deviations are also close in value.

We are concerned with the fact that we are missing responses for the F2S Census from 25 districts in Georgia, which represents approximately 14% of the districts and means that we have to eliminate data on all responses to the GSHS from those districts in our analysis. Additionally, given that the survey was sent out by the NFSN and thus they likely involved Georgia Organics (the organization the NFSN works with in Georgia to coordinate FTSPs on a state level), districts that are actively participating were more likely to respond to the survey than districts who were not involved. This was clearly evident from the phone calls we made to districts who responded positively to the question about whether they had FTSPs in the 2011-12 school year, where many of the districts who were highly involved in FTSPs were eager to speak with us. Another concern about the data is that the definition of FTSPs within the survey may be interpreted differently by school districts. The survey set up the question regarding FTSPs which included a definition for FTSPs. Table 2.1.4 shows the USDA's definition as well as the response scale for the question.

Table 2.1.4 USDA F2S Census Farm to School Program Definition and Question

Farm to School Definition	Farm to School activities generally center around procurement of local or regional foods and food, agriculture or nutrition-based educational activities such as but not limited to: • Serving local food products in school meals and snacks • Serving local food products in classrooms (snacks, taste tests, educational tools) Conducting educational activities related to local foods such as farmers in the classroom and culinary education focused on local foods; field trips to farms, farmers' markets, or food processing facilities; and educational sessions for parents and community members • Creating and tending school gardens (growing edible fruits and vegetables)
Census Question	Based on the definition above, did your district or any schools in your district participate in Farm to School activities during the 2011/2012 school year?
Response Choices	1= Yes 2= No, but started activities in 2012/2013 school year 3= No, but plan to start activities in the future 4= No activities currently and no plans 5= I don't know

Given this set up, districts who responded to the question may not have fully understood the definition. There were some districts who we spoke with that made it seem like the extent of their "program" was just procuring and serving one type of local fruit (strawberries or apples, for instance) during just one growing season per year, but that they did not have any of the educational or curriculum aspects typically associated with FTSPs.

Importantly, each district may have defined FTSPs differently, despite the definition being given in the question.

Within the GSHS we encountered a number of issues as well. First, not every student is required to respond each year, so the number and frequency of responses changed from year to year. Table 2.1.5 shows a count of the responses across grades for each year we have data. Furthermore, as you can see in Table 2.1.5, not all grade levels were surveyed every year.

Table 2.1.5 Count of Georgia Student Health Survey Responses by Grade and Year

Grade	Year	Districts[3]	Avg. # Respondents	Response SD	Min[4]	Max
6	2008	162	434.2	693.6	4	5352
	2009	163	444.5	627.6	8	4309
	2010	168	418.7	589.4	1	3981
	2011	154	441.6	704.9	1	5380
	2012	172	568.0	1127.4	1	10711
7	2008	94	46.6	115.3	1	833
	2009	98	60.4	167.9	1	1528
	2010	79	61.2	122.5	1	595
	2011	-	-	-	-	-
	2012	175	523.5	1069.4	1	9823
8	2008	166	430.7	665.9	1	4556
	2009	162	466.6	656.6	15	4475
	2010	168	421.1	604.5	9	4271
	2011	157	412.8	693.3	1	5472
	2012	173	540.2	1090.7	1	10300
9	2008	-	-	-	-	-
	2009	-	-	-	-	-
	2010	-	-	-	-	-
	2011	141	317.8	574.7	1	5166
	2012	169	489.8	926.6	1	8593
10	2008	160	340.3	555.2	4	4289
	2009	161	339.0	501.1	1	3484
	2010	164	325.7	427.9	1	2259
	2011	146	285.1	430.2	1	3319
	2012	167	438.6	809.1	1	7000
11	2008	-	-	-	-	-
	2009	-	-	-	-	-
	2010	-	-	-	-	-
	2011	145	240.8	407.7	1	3326
	2012	168	391.6	728.4	3	6033
12	2008	156	276.5	430.6	1	3172
	2009	161	275.5	398.6	1	2813
	2010	164	264.7	348.0	1	2066
	2011	145	250.7	394.8	1	2896
	2012	169	339.0	611.1	1	4792

[3] Districts represents the total number of school districts that responded to the survey for the specified grade level and year

[4] The minimum represents the minimum number of students responding from an individual school district

From Table 2.1.5, we see that the average number of respondents varies greatly across each grade level and year, although the trend is upwards, where by 2012 we are seeing the greatest number of responses in all grade levels for that year for both the average as well as the maximum. Another important item to note from this table is that the minimum in any grade level in most years is 1, meaning that for some school districts only one student responded to the GSHS for that grade level for the given year, therefore that one response represents the entire district for that grade level in that year.

Another potential concern with the GSHS is using survey data from middle and high school students is that their responses are self-reported. Aged at about 11-18, these students may or may not have a good grasp of how the survey works or have confidence in its anonymity, so their answers may be unrealistic, either because they are actively choosing to be mischievous, or simply because they are unsure or unaware of their own habits. The students who choose to misrepresent are called "mischievous responders" and it is an issue with most data collected using self-administered questionnaires; data rife with mischievous responses can cause researchers to make inaccurate conclusions and negatively affect the policy recommendations made through their inaccurate conclusions (Robinson-Cimpian 2014). However, we are less concerned with mischievous responders in our data due to the fact that we believe this problem to be widespread enough that we have no reason to believe there would be a larger percentage of students providing mischievous responses from one county to the next.

To account for yearly variation between the school districts, we also collected U.S. Census data on demographic and business data, as well as data on agricultural sales (for both animals and crops) and road mileage within counties. At the zip code level, the demographic data only go back to 2011 for annual data, and then back to 2000 for aggregated data from that year's

census. We use the difference between the 2011 and 2000 data to create a step and extrapolated the annual data back to 2008 so we had the same number of years as our GSHS survey data. This makes an assumption that the growth between the year 2000 and 2011 was a steady trend between the two years. We created a weighted count which divided the count of the store by the total population, in order to prevent a higher store count in a more heavily populated area from throwing off our numbers. Table 2.1.6 shows the summary statistics for the variables.

Table 2.1.6 Summary Statistics of School District Socio-Demographic Variables

F2S[5]		Median Income	Population	Male	Median Age	White	Convenience Stores	Fruit and Vegetable Markets	Supermarkets and Grocery Stores	Animal Sales	Crop Sales	State Highway Mileage	Country Road Mileage
0	Mean	46587	51053	24918	40	32075	1.10	0.26	2.41	$35,600,000	$19,700,000	121	552
	SD	14029	90591	43559	5	44564	3.49	0.71	11.15	$53,000,000	$26,500,000	54	372
	Max	104062	778431	380358	63	409192	31.00	4.00	131.00	$347,000,000	$143,000,000	415	2541
	Min	21343	652.36	227	24	121	0.00	0.00	0.00	$28,000	$17,000	30	70
1	Mean	45398	109080	53007	38	62014	2.71	0.62	8.03	$63,400,000	$29,000,000	143	724
	SD	12063	173998	84482	5	89607	7.95	1.19	23.26	$83,300,000	$44,200,000	71	470
	Max	87036	725392	348374	59	417713	45.00	6.00	134.00	$363,000,000	$190,000,000	415	2541
	Min	17483	786	343	27	398	0.00	0.00	0.00	$100,000	$522,000	51	164
Total	Mean	46257	67140	32705	40	40375	1.55	0.36	3.97	$43,200,000	$22,200,000	127	598
	SD	13521	122445	59216	5	61961	5.18	0.89	15.69	$63,800,000	$32,500,000	60	408
	Max	104062	778431	380358	63	417713	45.00	6.00	134.00	$363,000,000	$190,000,000	415	2541
	Min	17483	652	227	24	121	0.00	0.00	0.00	$28,000	$17,000	30	70

[5] In this table F2S represents a dummy variable where 0 indicates the district does not have a FTSP and 1 indicates the district has adopted a FTSP.

We see from Table 2.1.6 that the median income in the districts with FTSPs is slightly lower in districts with FTSPs than those without, although not very much lower. Additionally, the average population in school districts adopting FTSPs is nearly twice as large as in school districts without FTSPs. One consideration for this is that it may be cheaper to implement FTSPs on a larger scale, given the economies of scale afforded to a larger school district in ordering their food. We also see that the agricultural sales as well as more road mileage for both county and state highways in districts with FTSPs are higher than in districts without FTSPs. The combination of greater agricultural sales plus more road mileage could indicate greater access to the local food needed to support a FTSP in these districts, also decreasing the cost of the programs.

In Georgia, there are 159 counties, each of which has its own school district. In addition to the 159 county districts, there are also 21 city school districts, which make up the remaining of the 180 total school districts in Georgia. The USDA F2S Census looks at the data on a district level. The GSHS looks at individuals, and therefore accounts for grade, school, and district level. Finally, the U.S. Census data is available at county or at zip code level. To get the most accurate view of each district, we needed to look at the 21 city districts and determine which zip codes fell into the city district and which into the county districts. We used district level maps showing the district area and zip code maps to determine which zip codes fell into which districts. This allowed us to use the zip code level data from the U.S. Census. Then we collapsed the U.S. Census data by district.

Econometric Analysis and Empirical Models

For our analysis, we focused on using two main types of models. We first examine the characteristics of districts adopting FTSPs. We estimated a Probit models to analyze the socio-

demographic and business characteristics of the districts that implemented a FTSP. We used the panel data for the districts across years and ran a Probit model to determine the variables that had the most impact on whether or not a district chose to implement a FTSP. A Probit model uses a standard normal cumulative density function (CDF) to analyze the probability of success of a specific binary dependent variable. Specifically:

$$Pr[y = 1| x_{it}] = G(x_{it}\beta) \quad (2.4.1)$$

where:

$$G(x_{it}\beta) = \Phi(x_{it}\beta) \equiv \int_{-\infty}^{x_{it}\beta} \frac{1}{\sqrt{2\pi}} \exp\left(-\frac{u_{it}^2}{2}\right) du_{it} \quad (2.4.2)$$

Our dependent variable y takes on a value of 1 if the school district has implemented a FTSP, otherwise it will take on a value of 0. The matrix x includes our independent variables and β are our parameters (Wooldridge 2013). Therefore, in this model we are calculating the impact our independent variables (e.g. the district characteristics) have on the probability that the district will implement a FTSP.

We next specify a linear panel model to estimate the effect of FTSPs on student responses to the nutrition questions provided on the GSHS. We used the F2S Census data to determine which districts have implemented FTSPs and compare the impact of the FTSP across school districts, before and after implementation, using students' responses to the nutrition statements on the GSHS. Given that there were multiple grades within the school districts, we had to set up the linear models to run for each grade level individually.

The implementation of FTSPs slowly across a number of years has provided us with a natural experiment in which our treatment areas are the districts that have adopted, while our control areas are the districts that have yet to adopt FTSPs. We begin with a basic model:

$$y_{it} = \beta_0 + \beta_1 F2S_t + \delta_i Year + \gamma_i District + u_i \quad (2.4.3)$$

in which y_{it} is our response to the GSHS survey, represented by the mean response for the grade and school level we are looking at, β_0 represents our intercept, $F2S_t$ is our FTS variable and δ_i and γ_i are estimates of our time and district fixed effects. The term u_i represents our random error term. We focus specifically on the grades for which we had the most complete data, sixth, eighth, tenth, and twelfth grades, as they answered the survey annually, whereas the remaining grades did not. We then added additional demographic variables into the model to see whether any of them had an effect on the nutrition responses, including race (percentage of a district that was white), population, median income, as well as per-capital supermarkets, convenience stores, and fruit and vegetable markets.

In addition to each of the above fixed effects models, we also ran an IV model using the road mileage and the agricultural sales within the county in which each district was located as an instrument for the FTS variable. This allowed us to look at whether there was any issue with endogeneity that might be having an effect on the interaction between the nutrition variables and our FTS variables that might be preventing the model from performing as efficiently as possible, producing the minimum variance for our parameter estimates.

A challenge is that the implementation of the FTSP may be endogenous to both consumption and students' opinions. That is, unobservable characteristics of the school district affect the decision to implement the FTSP and students' perceptions and behaviors. To account

for such endogeneity, we employ a fixed-effects instrumental variables regression approach. Specifically, we estimate:

$$y_{it} = \beta_0 + \beta_1 F2S_t + \delta_i Year + \gamma_i District + u_i \quad (2.4.4)$$

where:

$$F2S_t = x\beta + IV + e \quad (2.4.5)$$

For our instruments, we use a combination of mileage of roads within the district combined with a measure of the sales of agricultural commodities within a district, both crop and animal sales. Road mileage and agricultural sales should impact FTSP adoption as both act as an indicator for how easy it is for the district to procure the foods needed as well as to have access to the resources required for FTSPs. At the same time, neither should impact students directly with respect to their diet. Dunn discusses proximity to interstate exits as an IV for a study on obesity and the availability of fast food, a method also used by Anderson and Matsa, which is why we felt that road mileage could be a useful IV for FTSPs (Dunn, 2008; Anderson and Matsa 2011). Both of these sources are available at the county level. For 159 of the school districts the county is the same as the district, for the remaining 21 city districts we felt that the distance to county lines from the city was not different enough to warrant exclusion from these IV models.

RESULTS

Farm to School Adoption

Our results from the Probit model are displayed in Table 3.1.1. We compared five different models. The first looks simply at the effect of population and household median income on the probability of FTSP adoption. The second and third look at each of our instrumental variables and the effect they have on the probability of FTSP adoption, where the second is looking at our agricultural sales variables and the third at the county and state road mileage. The fourth model uses the first model as a base and also includes the three food market businesses we felt might have an effect on FTSP adoption—convenience stores, fruit and vegetable markets, and supermarkets and grocery stores within the district. The final model includes all of the aforementioned variables. The results displayed show the marginal effects of each of the variables on the probability that a district adopts a FTSP, so we can interpret each parameter as the percentage increase (or decrease) in the probability that a district will adopt a FTSP when the corresponding variable changes by one unit.

Table 3.1.1: Probit Marginal Effects from Farm to School Indicators

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Population	0.00111***			0.000959***	0.000853***
(in thousands)	(0.000243)			(0.000257)	(0.000310)
Household Median Income	-0.0120***			-0.0144***	-0.0127***
(in thousands of US dollars)	(0.00226)			(0.00240)	(0.00246)
Animal Sales		0.00131***			0.00136***
(in millions of US dollars)		(0.000377)			(0.000406)
Crop Sales		0.00243***			0.00167**
(in millions of US dollars)		(0.000719)			(0.000801)
State Highway Miles			0.000530		-0.000150
			(0.000473)		(0.000547)
County Road Miles			0.000127*		0.000144*
			(6.61e-05)		(8.44e-05)
Convenience Stores				-1,491**	-1,374*
(per capita)				(723.0)	(792.7)
Fruit and Vegetable Markets				1,257	992.6
(per capita)				(1,508)	(1,559)
Supermarkets and Grocery Stores				1,715***	1,035*
(per capita)				(533.8)	(568.4)
Constant					
Observations	682	688	727	682	646
Number of districts	144	148	154	144	139

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Total population is statistically significant across all models, although its marginal effects are minimal. It appears to have a positive effect on the probability that a FTSP will be implemented in a district. Similarly, animal and crop sales have a highly significant, positive effect, although again, the marginal effects on both parameters is very small, but is likely due to scaling. The positive effects here indicate that an increase in population or agricultural sales tends to increase the probability that a district will adopt a FTSP.

Income has a negative effect, where an increase in $1000 leads to about a 1% decrease in the probability that a school district will adopt a FTSP. While this result is not what we had anticipated, we feel that it is likely that there is a correlation between the increase in agricultural sales in a region and the decrease in median income. Because communities with higher agricultural sales might have lower median incomes, this might be a good indication of why median income has a negative effect on FTSPs.

Aside from the negative marginal effect of income on adoption, we feel that the remaining parameters make sense given our information. We are also seeing that districts in areas with a higher number of convenience stores per capita are less likely to adopt FTSPs, which is statistically significant at 95% significance level within the fourth model. This negative correlation between the number of convenience stores per capita and positive correlation between supermarkets per capita and implementation of FTSPs seems to be in line with literature on food deserts, which shows that areas without access to affordable healthy foods tend to be served by convenience stores (Ver Ploeg 2010). Therefore a greater number of convenience stores per capita might indicate the district is in a food dessert, and the families in the district may not have enough knowledge about the healthful foods they should be eating to push for FTSPs within their district.

Farm to School Program Effects on Survey Responses

We estimate several different specifications of our linear regression equation using the nine different nutrition statements as the dependent variable (Table 3.2.1). Specifically, for each of the statements, Nutrition 1 through Nutrition 9, we look at the impact of FTS on the responses at each grade level and then at the middle and high school level. We also looked at the effects of the FTS variable on the change in the nutrition variable. Next we used a FTS variable that gave weight to the number of years since a district had implemented their FTSP (i.e. after one year, the variable on FTS = 1, after three years, the variable on FTS for that year = 3, etc.) in order to see if the number of years changed the impact the program had on the students.

Table 3.2.1 Regression Models Run

	Models Run for Individual Grades (6-12)[6] as well as for School Level[7]																							
	Model 1a	**Model 2a**	**Model 3a**	**Model 4a**	**Model 5a**	**Model 6a**	**Model 1b**	**Model 2b**	**Model 3b**	**Model 4b**	**Model 5b**	**Model 6b**	**Model 1c**	**Model 2c**	**Model 3c**	**Model 4c**	**Model 5c**	**Model 6c**	**Model 1d**	**Model 2d**	**Model 3d**	**Model 4d**	**Model 5d**	**Model 6d**
Dependent Variable																								
Nutrition (1-9)[8]	X	X					X	X					X	X					X	X				
Change in Nutrition (1-9)[9]			X	X					X	X					X	X					X	X		
Weighted Nutrition (1-9)[10]					X	X					X	X					X	X					X	X
Independent Variables																								
FTS[11]	X		X		X		X		X		X		X		X		X		X		X		X	
Years on FTS[12]		X		X		X		X		X		X		X		X		X		X		X		X
Demographics & Business Data													X	X	X	X	X	X	X	X	X	X	X	X
Year Dummy	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Model Characteristics																								
FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IV	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes

[6] One model run for each grade level, then limited to grades 6, 8, 10, and 12 for which dataset was most complete.
[7] One model run for each school level, the data collapsed by year and district into middle school and high school levels.
[8] One model run for each of the average responses to the nine nutrition statements.
[9] One model run for each of the change in the average responses to the nine nutrition statements.
[10] One model run for each of the average responses to the nine nutrition statements divided by the total number of students who responded to the survey in that district for that year.
[11] FTS = 1 if the district has a FTSP in a given year, otherwise = 0.
[12] Years on FTS gives a district a 1 for the first year they have the program, a 2 for the second and so on.

Across all the model specifications, we did not find that any of the models produced consistently statistically significant results across all grades for all of the nutrition responses. Therefore, we cannot say with certainty that FTSPs have an effect on students' consumption of healthful foods, or their perception of the availability of healthful foods in their schools.

There are many reasons why we may observe no effect of the FTSP on the nutritional response variables. One reason could be the issue of endogeneity. As mentioned previously, we estimated each of these models with our set of IVs using two-stage least squares. However, upon testing the instrumental variables using the Stock-Yogo test, we find that the IVs are weak instruments for the FTS variable, and therefore the results of the IV regressions will not provide us with more efficient estimates than OLS and therefore do not improve our original regression equations.

Another reason we might not see an effect from FTSPs would be if the demand effect is outweighing the supply effect. As mentioned in the introduction, it is possible that the educational component for the FTSPs has changed students' perceptions of healthful foods to the point where, even if school lunches are improving, the lunches served in schools are no longer perceived as healthful by the students. However, if this were the case, we would expect to see a significant change in the response directly related to the consumption statements but not to the statements regarding the food offered in the school cafeterias. Given that we do not see a statistically significant impact for either, we cannot make the assumption that the educational component is outweighing the availability of healthful foods in school at this time.

Second, it is possible, we may not be seeing any results here are that only 18 school districts had even begun FTSPs prior to the 2011-12 school year. This means that given we only used GSHS data through 2012, we only see one year of effects following FTSP for over half of

the districts that implemented, and for the 14 that implemented in 2012-13 school year, we only see the responses for 2012, that first year they had the program. Therefore, it is likely that not enough time had passed for us to see any statistically significant effects.

Finally, it may be the case that FTSPs simply do not have any effect on student consumption or perceptions of healthful foods. However, on the occasions that we did see a statistically significant effect in any of the models, the parameter estimates tended to be positive. For instance, when we look at the effect of the weighted FTS variable on sixth grade responses to the statement about their consumption of fruits and vegetables (Nutrition 2), we get a positive parameter estimate of .0388, meaning each additional year of FTS leads to an increase in the students agreeing with the statement. This example is particularly relevant if school districts are focusing their FTSPs towards elementary school students. If that is the case, if the district began their program in 2011, it would take an additional three years for the effects to be seen across all middle school grades, and seven years to be seen at all grades at the high school level for that district. Given the positive correlation between FTSPs and the GSHS responses in these cases, at the sixth grade level, we might argue that FTSPs do, at least somewhat, positively impact students' responses.

CONCLUSION

Discussion and Policy Implications

The results of this research will be beneficial in shaping the future of FTSP research. Having determined some of the characteristics of districts choosing to adopt FTSPs, and that at present, given our information, the implementation of the program does not have a significant impact on the students, we can see that there is a need for reviewing the overall efficacy of these programs in Georgia. Despite the fact that we account for many issues within our data, we do not see statistically significant results of the effect of FTSPs on students' consumption of healthful foods nor their perceptions about the availability of healthful foods within their schools. In light of these results, we need to evaluate whether FTSPs actually produce the desired effect in schools, and whether there might be better criteria by which to measure the success of these programs.

While we do not believe that our research discredits the theory that implementation of FTSPs could prove a good way to help districts improve school lunches and meet the new USDA standards, we see a disconnect between the programs being implemented and the data being collected. It is important to consider whether students think that they are being offered healthful foods, but this is not the only measure by which these programs should be evaluated. If FTSPs are having no effect on students' perceptions about nutrition, are they truly working?

At present, the policy implications of this study are that further research needs to be done to determine how effective these programs are prior to significant legislation being passed to promote the programs. Although we contend that FTSPs may be a good way for students to learn

about nutrition and to improve their health, we cannot conclude from our study that they are beneficial. Therefore we can say that if policies are to be developed to encourage more FTSPs across the state, further analysis needs to be done first to determine whether the benefits of these programs actually outweigh any potential costs in implementation.

Potential for Further Research

As discussed above, there is a need for further research to be done with regards to FTSPs. It is possible, with time, that these same datasets used in this study could be used again to gain a better understanding of the effect of FTSPs. The USDA is distributing the F2S Census again this fall, and as they gather more years of data on FTSPs in Georgia and nationally, it will be important to look at whether the length of time the FTSP is implemented plays a role in the responses to the nutrition statements in the GSHS. The potential for future research within FTSPs is boundless, as many programs are just getting started and the movement is slowly sweeping the nation. It will be important to consider not just the effect on student consumption, but also on their overall health and educational outcomes as policymakers look at creating legislation regarding FTSPs.

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APPENDIX 1: Survey and Census Resources

The entire survey for the Georgia Student Health Survey II can be downloaded from the Georgia Department of Education at: https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Curriculum-and-Instruction/GSHS-II/Documents/GSHS%202.0_GaDOE%20version.pdf

The entire questionnaire for the Farm to School Census can be downloaded from the USDA's Farm to School website at: http://www.fns.usda.gov/farmtoschool/census#/media