# Food and Nutrition Service Evaluation of the Fresh Fruit and Vegetable Program (FFVP)

## Interim Evaluation Report

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# Contents

# Executive Summary

This report describes interim findings from the USDA Food and Nutrition Service (FNS) Evaluation of the Fresh Fruit and Vegetable Program (FFVP), a national program which provides funding for the distribution of free fresh fruits and vegetables to students in selected elementary schools with high rates of free- and reduced-price meal enrollment. Abt Associates Inc. and its partner, the Dr. Robert C. and Veronica Atkins Center for Weight and Health at University of California, Berkeley, conducted the evaluation for FNS during the 2010-2011 school year.

## Background

The USDA Fresh Fruit and Vegetable Program is intended to increase fruit and vegetable consumption among students in the nation's poorest elementary schools by providing free fresh fruits and vegetables to students outside of regular school meals. FFVP began as a pilot program in 2002 and was converted into a nationwide program in the Food, Conservation, and Energy Act of 2008 (PL 110-234).[1]

Crucially for the design of the impact analysis, the FFVP authorizing legislation (National School Lunch Act, section 19, 42 U.S.C. 1769a) dictates that FFVP funds are to be allocated "to schools with the highest percentages of low-income students, to the maximum extent practicable" at a level of $50 to $75 per student per school year, or between $1 and $2 per week.[2] Funding levels have risen over time, allowing more schools to participate. Initial funding was $40 million for the 2008–2009 school year, rising to $65 million, $101 million, and $150 million in the following three school years, respectively, and to continue at that level thereafter, indexed for inflation.

## Objectives

Section 4304, 19(h) of the FFVP authorizing legislation required the Secretary of Agriculture to conduct an evaluation of the program. The results presented in this interim report address the key objectives of this Congressionally-mandated evaluation:

> *determination as to whether children experienced, as a result of participating in the program—*
>
> *(A) increased consumption of fruits and vegetables;*
> *(B) other dietary changes, such as decreased consumption of less nutritious foods; and*
> *(C) such other outcomes as are considered appropriate by the Secretary.*

The study estimates the impact of FFVP on two focal outcomes among students in participating schools on days when FFVP fruits and/or vegetables were distributed:

- Total quantity of fruits and vegetables consumed, and

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1 Officially, The Food, Conservation, and Energy Act of 2008 amended the Richard B. Russell National School Lunch Act (NSLA). FFVP is described in Section 19 of the amended NSLA.

2 Spending per week calculated by dividing annual per student spending by 38 weeks (average length of the school year).

- Total energy intake (also referred to as total caloric intake),[3] allowing the assessment of whether any additional fruit and vegetable consumption was in addition to or in place of other foods consumed.

This interim report additionally describes characteristics of students according to students' self-reported frequency of participation in the program.

## Design, Data, and Methods

This evaluation estimates the impact of FFVP using regression discontinuity (RD), which is considered the strongest possible design when random assignment is not feasible.[4] The RD approach leverages the procedure by which schools are assigned to participate in FFVP. Specifically, as noted above, the FFVP legislation and FNS guidance requires that available FFVP funding be allocated in each State to the poorest schools, where poverty is defined by the percent of students eligible for free or reduced price school lunch (FRPSL) in the previous school year. Our RD design estimates impacts by comparing schools immediately above and below the funding cutoffs in each of the sampled States. Those schools differ in whether they received FFVP, but are likely to be otherwise similar.

The final full analytic sample included 5,560 students in 252 schools—2,903 students in FFVP schools just above the funding cutoff, and 2,657 students in schools just below the funding cutoff that did not participate in FFVP (see Appendix C for details). The final preferred analytic specification, for which findings are presented in this report, is a restricted subsample of 4,696 students in 214 schools within two and a half percentage points of the funding cutoff in each State.

We collected information on student food intake using diary-assisted 24-hour recall interviews, which have been widely and successfully used with elementary school aged children. In FFVP schools, the diary was completed on a day on which FFVP fruits and/or vegetables were offered to students, allowing us to estimate the impact of FFVP on intake on FFVP days.

## Findings

Our interim results indicate that FFVP increased average fruit and vegetable consumption among students in participating schools on FFVP days by approximately one-quarter of a cup per day ($p<0.001$). In addition, the results show no significant increase in total energy intake (Exhibits ES-1 and ES-2). This represents an increase of 14.6 percent over fruit and vegetable consumption levels in the absence of FFVP. If we had found an increase in total energy intake, we might have been concerned that FFVP could contribute to weight gain. Instead, increased fruit and vegetable consumption appears to have replaced consumption of other foods.

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3 "Total energy intake" is the preferred terminology among nutrition researchers, consistent with language used in the Dietary Reference Intakes (DRIs), the most recent set of dietary recommendations established by the Food and Nutrition Board of the Institute of Medicine (IOM, 2005).

4 See for example, Cook, 2008; Dinardo and Lee, 2010.

**Exhibit ES-1: Impact of FFVP on Consumption of Fruits and Vegetables, Restricted Near-Cutoff Subsample (N=4,696)**

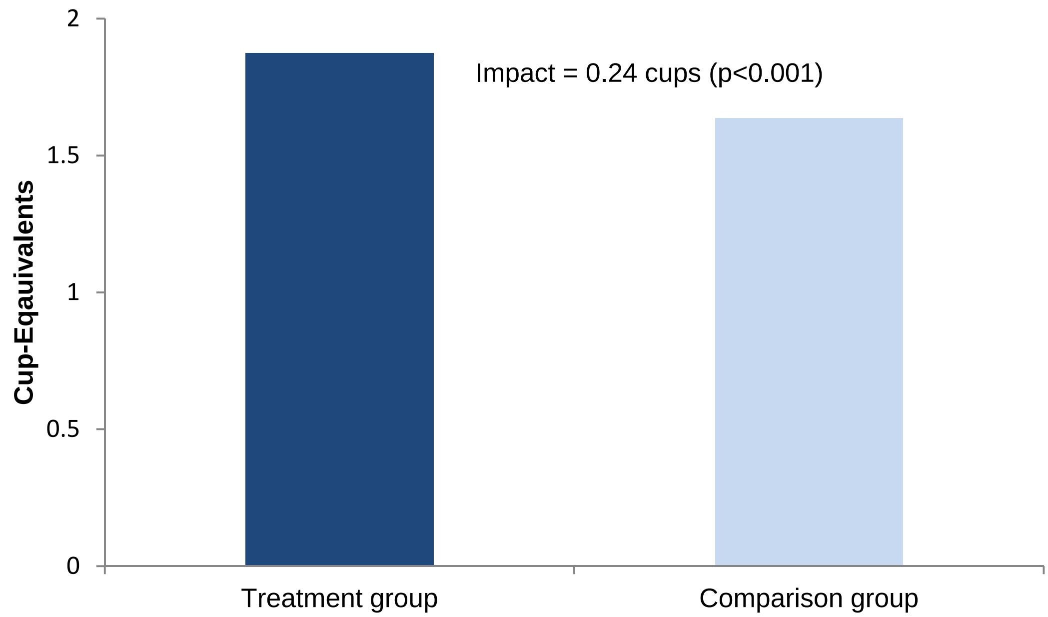
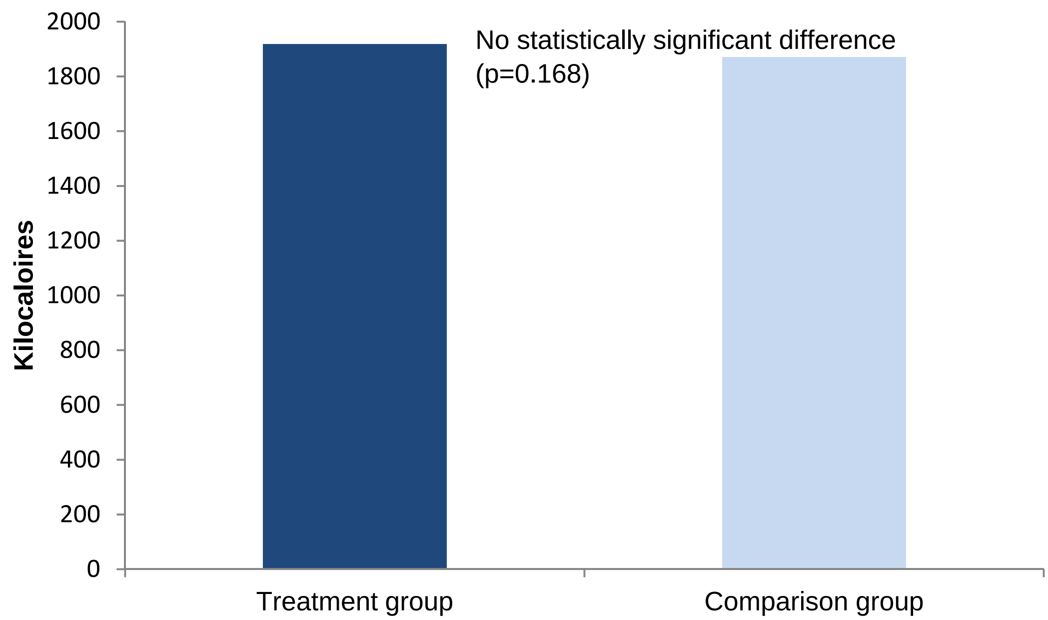



**Exhibit ES-2: Impact of FFVP on Total Energy Intake, Restricted Near-Cutoff Subsample (N=4,696)**



## Conclusions

An increase in fruit and vegetable consumption of one-quarter of a cup per day, or approximately half a serving per day, is within the range observed in various other interventions to increase fruit and vegetable consumption in school children (Knai et al., 2006; Delgado-Noguera et al., 2011), and about twice as large as that previously observed in smaller studies of interventions primarily focusing on provision of free or subsidized fruits and vegetables (Bere et al., 2006; Moore and Tapper, 2008; and Ransley et al., 2007). While there is no consensus as to what constitutes a meaningful change in fruit and vegetable intake, it is generally accepted that children with the lowest intakes are at greatest risk of poor health outcomes , and that the greatest benefit would be conferred by increasing intakes of fruits and vegetables among this group (USDA & DHHS, 2010). Further, children from socioeconomically disadvantaged families tend to have the lowest intakes of fruits and vegetables (Krebs-Smith et al., 1996; Darmon and Drewnowski, 2008; Dubowitz et al., 2008; Lorson et al., 2009); by targeting poorer schools, FFVP specifically targets this at-risk group. Thus, increasing fruit and vegetable intakes in this population even by small amounts is likely to confer a health benefit.

## Next Steps

The final evaluation report will expand on this interim report in two major ways. First, the final report will include impacts for additional outcomes. Second, the final report will include detailed information on how FFVP was implemented in a nationally-representative sample of schools.

# Chapter 1: Introduction

This report describes interim findings from the USDA Food and Nutrition Service (FNS) Evaluation of the Fresh Fruit and Vegetable Program (FFVP), a national program which provides funding for the distribution of free fresh fruits and vegetables to students in selected elementary schools with high rates of free- and reduced-price meal enrollment. Abt Associates Inc. and its partner, the Dr. Robert C. and Veronica Atkins Center for Weight and Health at University of California, Berkeley, conducted the evaluation for FNS during the 2010-2011 school year.

The results presented in this report address the key objectives of this Congressionally-mandated evaluation:

> *determination as to whether children experienced, as a result of participating in the program—*
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> *(A) increased consumption of fruits and vegetables;*
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> *(C) such other outcomes as are considered appropriate by the Secretary.*

The study estimates the impact of FFVP on two focal outcomes among students in participating schools on days when FFVP fruits and/or vegetables were distributed:

- Total quantity of fruits and vegetables consumed, and
- Total energy intake (also referred to as total caloric intake),[5] allowing the assessment of whether any additional fruit and vegetable consumption was in addition to or in place of other foods consumed.

This interim report additionally describes characteristics of students according to their self-reported frequency of participation in the program.

The final evaluation report will expand on this interim report in two major ways. First, the final report will include impacts for additional outcomes. Second, the final report will include detailed information on how FFVP was implemented in a nationally-representative sample of schools.

In the remainder of this chapter, we provide information on the nutritional and statutory context for the study and an overview of the evaluation design and methods. Chapter 2 describes our research design, data collection, and methods. Chapter 3 presents our results. Chapter 4 summarizes the findings, including conclusions, and notes their limitations.

## Nutritional Context

Reducing the prevalence of obesity among children and adolescents in the U.S. by 10 percent is a key national health objective in Healthy People 2020 (DHHS, 2011). However, data from the ongoing National Health and Nutrition Examination Surveys (NHANES) show no improvement in obesity rates

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5 "Total energy intake" is the preferred terminology among nutrition researchers, consistent with language used in the Dietary Reference Intakes (DRIs), the most recent set of dietary recommendations established by the Food and Nutrition Board of the Institute of Medicine (IOM, 2005).

among US children and adolescents from 1999-2000 through the most recent time period for which data are available (2007-2008), with 16.9 percent of children and adolescents obese in 2007–2008. Obesity and overweight are more prevalent among children and adolescents of lower socioeconomic status (Gordon-Larsen et al., 2003; Wang & Zhang, 2006; Ogden et al., 2010).

Epidemiologic studies have shown that increased consumption of fruits and vegetables is associated with a reduction in long-term obesity risk (He et al., 2004). Because fruits and vegetables are relatively high in water and fiber, their increased consumption is thought to contribute to lower overall dietary energy density and total energy intake. Consistent with this hypothesis, experimental interventions involving the addition of fruits and vegetables to the diet have demonstrated short-term effectiveness in reducing body weight in some cases, particularly when paired with advice to reduce dietary fat and/or overall energy intake (Rolls et al., 2004; Jebb, 2005; Carlton-Tohill, 2007). Additionally, epidemiologic and cohort studies have consistently found a relationship between increased fruit and vegetable consumption and reduced risk of heart disease and some cancers (Steinmetz & Potter, 1996; Riboli & Norat, 2003; Dauchet et al., 2006).

Despite this evidence of the health benefits of consumption of fruits and vegetables, relatively few children and adolescents consume five or more servings a day, and under-consumption is particularly pronounced among younger children (Guenther et al., 2006; see Exhibit 1).

***The Role of Schools.*** Children spend a substantial proportion of their time in school, and meals and snacks consumed at school are a major contributor to total daily consumption of food and nutrients for many students (DHHS, 2007; Lin et al., 1999). School is thus a promising context in which to deliver interventions to increase children's consumption of fresh fruits and vegetables (Wechsler et al., 2000; Kubik et al., 2003; French, 2005).

**Exhibit 1: Percent of U.S. Children Consuming at Least Five Daily Servings of Fruits and Vegetables, by Age and Gender**

| | Age | | |
|---|---|---|---|
| | **4–8** | **9–13** | **14–18** |
| Boys | 14% | 18% | 37% |
| Girls | 10% | 20% | 28% |

Source: Guenther et al. (2006) calculations from NHANES 1999-2000.

Through the School Breakfast Program and the National School Lunch Program, the federal government has long had a major role in school nutrition policy and child food consumption.[6] The Healthy, Hunger-Free Kids Act of 2010 (P.L. 111-296) seeks to improve the nutritional content of school meals through performance-based reimbursement rates and simplified eligibility criteria, as well as by providing additional funding for Farm to School and school garden programs.

## Statutory Context

As a complement to these programs, the USDA Fresh Fruit and Vegetable Program (FFVP) provides free fresh fruits and vegetables *outside* of regular school mealtimes. FFVP has its origins in the Fresh Fruit and Vegetable Pilot Program, which was authorized as part of the 2002 Farm Bill (the Farm Security and Rural Investment Act of 2002; P.L. 107-171). The pilot was intended "to identify best practices for increasing fresh fruit and vegetable consumption among students, and to determine the feasibility and

6 For more information on the National School Lunch Program and the School Breakfast Program see the FNS school meals programs website at http://www.fns.usda.gov/cnd/.

students' interest."[7] By the 2005-2006 school year, the pilot program was operating in 14 States and several Indian Tribal Organizations.

The 2008 Farm Bill (the Food, Conservation, and Energy Act of 2008; PL 110-234) converted that pilot program into the nationwide Fresh Fruit and Vegetable Program.[8] USDA FNS administers the program through States. States are required to solicit applications from individual elementary schools, to select specific elementary schools for funding, and to provide oversight of school implementation. Schools are to use FFVP funds to make fresh fruits and vegetables available to students other than at meal service periods and at no cost to students. In addition, schools are encouraged to provide appropriate nutrition education in conjunction with the distribution of fresh fruits and vegetables.[9]

FFVP's approach complements existing efforts to improve the nutritional content of school meals. Its approach of offering *free* fruits and vegetables is consistent with evidence that students' food choices are price sensitive (French et al., 2004) and the plausible conjecture that price is particularly salient for children from lower income families (Drewnowski & Darmon, 2005). FFVP provision of fresh fruits and vegetables to students in low-income schools free of charge may therefore be an effective tactic for inducing their consumption in place of less healthful foods available for purchase in schools.

Beyond any immediate impact on food intake, the FFVP legislation implicitly assumes that by introducing students to fresh fruits and vegetables in the school context, FFVP can encourage both short-term and long-term shifts towards increased fruit and vegetable consumption. Such shifts in ongoing food choices would be expected to reduce childhood obesity, leading to better health outcomes. Indeed, the *FFVP Handbook* (USDA FNS, 2010) describes FFVP's goals as:

- Create healthier school environments by providing healthier food choices.
- Expand the variety of fruits and vegetables children experience.
- Increase children's fruit and vegetable consumption.
- Make a difference in children's diets to impact their present and future health.

Crucially for our evaluation design, FFVP funds are to be allocated "to schools with the highest percentages of low-income students, to the maximum extent practicable" (National School Lunch Act, section 19, 42 U.S.C. 1769a) at a level of $50 to $75 per student per school year, or between $1 and $2 per week.[10] Funding levels have risen over time, allowing more schools to participate. Initial funding was $40 million for the 2008–2009 school year, rising to $65 million, $101 million, and $150 million in the following three school years, respectively, and to continue at that level thereafter, indexed for inflation.

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7 Language is from the USDA FFVP Fact Sheet. http://www.fns.usda.gov/cnd/FFVP/Resources/FFVPfactsheet.pdf.

8 Officially, The Food, Conservation, and Energy Act of 2008 amended the Richard B. Russell National School Lunch Act (NSLA). FFVP is described in Section 19 of the amended NSLA.

9 Analyses in the final report, based on web surveys of school principals, will provide information on the extent to which schools incorporate nutritional education into the FFVP.

10 Spending per week calculated by dividing annual per student spending by 38 weeks (average length of the school year).

Section 4304, 19(h) of the FFVP authorizing legislation required the Secretary of Agriculture to conduct an evaluation of the program. After an open and competitive bidding process, in June 2009 FNS awarded the evaluation contract to Abt Associates Inc. and its partner, the Dr. Robert C. and Veronica Atkins Center for Weight and Health at University of California, Berkeley. This document reports interim findings from that evaluation.

# Chapter 2: Design, Data, and Methods

This chapter discusses the design, data, and methods used in this interim report. The final report will provide additional information on these topics, as well as further information on the design, data, and methods for additional analyses not presented here.

## Overview of Design

The Congressional research questions are explicitly causal in nature. For various student- and school-level outcomes, we wish to compare outcomes under FFVP to what outcomes would have been without FFVP—for the same students in the same schools and time period. In practice, we can never observe outcomes with and without FFVP for the same child in the same time period. Instead, while we observe outcomes for children in FFVP schools, we need to estimate what outcomes would have been in the absence of the program for these students.

While random assignment is universally considered ideal for estimating causal impacts, random assignment was not possible in this evaluation due to the legislative requirement that FFVP funds be allocated in each State to the poorest schools. Recent developments in methods research suggest that regression discontinuity (RD) designs are the strongest possible alternatives when random assignment is not feasible.[11]

The RD approach used in this evaluation leverages the procedure by which schools are assigned to participate in FFVP. Specifically, the FFVP legislation and FNS guidance requires that available FFVP funds be allocated in each State to the poorest schools, where poverty is defined by the percent of students eligible for free or reduced price school lunch (FRPSL) in the previous school year. Our RD design estimates impacts by comparing students in schools immediately above and below the funding cutoffs in each of the sampled States. The last few schools to get FFVP and the first few schools not to get FFVP differ only very slightly in percent of students eligible for FRPSL. Within this narrow FRPSL window, it is implausible that the trivial differences in FRPSL eligibility percentages between the groups could explain any differences in nutritional outcomes. Therefore, when appropriate statistical tests allow us to conclude that the difference is not merely due to chance, any differences in outcomes between schools with and without FFVP can reasonably be attributed to FFVP.

***Estimating Program Impacts.*** A simple comparison of mean outcomes for students in participating schools just above the FRPSL cutoff ("treatment schools") and non-participating schools just below the FRPSL cutoff ("comparison schools") would yield consistent estimates of the impact of FFVP. However, to increase precision and to account for several technical issues, we use a linear multivariate regression approach. Our analytic approach accounts for several aspects of the design:

- *Variations in Outcomes Associated with Student Characteristics*: Including student characteristics as regressors in the models can improve the precision of impact estimates by controlling for some portion of the variation in observed outcomes. We therefore incorporated covariates for student gender, grade level, race/ethnicity, and FRPSL eligibility, as well as indicator variables for each

[11] See for example, Cook, 2008; Dinardo and Lee, 2010.

State. Estimated coefficients were then combined with observed covariate means to compute regression-adjusted means.

- *School Effects*: Students are clustered within schools, and it seems likely that there are unobservable school-level effects. To adjust for this, we report robust standard errors that account for school-level clustering (Moulton, 1986, 1990).
- *Varying Distance of Schools from the Cutoff*: Inclusion of schools that are far from the FRPSL cutoff may threaten the validity of the RD approach and therefore of the impact estimates. To address this concern, our preferred specification excludes schools that are more than two and a half percentage points from the cutoff. Students in the included schools comprise 84 percent of students in the full analytic sample.[12]

See Appendix A for technical details of our approach.

## Selection of States, Schools, Classrooms, and Students

In support of the RD method, we drew the sample of schools for this impact analysis from schools near each State's FRPSL cutoff. We arrayed all schools that applied for FFVP from highest to lowest along the selection criterion dimension (i.e., percent of students eligible for free/reduced price lunches). The RD sample includes schools as close as possible to the State funding cutoff; schools just above the funding cutoff participated in FFVP during the 2010–2011 school year, and schools just below the cutoff, while eligible for the program, did not participate due to funding limitations.

Here we provide an overview of our four stage sampling strategy. Appendix B provides more detail on the strategy and specific implementation issues at each stage, including response rates. Appendix Exhibit B-1 provides a graphical depiction of the sampling plan and unit counts at each level.

- ***Stage 1: Selection of States.*** In the first stage of sampling, we randomly selected 16 States from the 48 contiguous States and Washington, DC, using probability proportional to size (PPS) sampling.[13]
- ***Stage 2: Selection of Schools.*** In the second stage, we drew a total of 256 schools. These schools were not selected randomly. Instead, we chose applicant schools closest to each State-specific cutoff:  128 participating schools directly above State-specific cutoffs and 128 non-participating schools directly below State-specific cutoffs. We sampled more schools in larger States and fewer schools in smaller States.
- ***Stage 3: Selection of Classrooms.*** In the third stage, we randomly selected three classrooms in each school from grade levels eligible for the evaluation (grades 4, 5, and 6).

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12 Study results for the full sample of schools and for alternative multivariate regression specifications (some of which include a regressor for school FRPSL percentage) are presented in Appendix C.

13 In order to ensure adequate representation of geographical and racial/ethnic subgroups in the treatment and comparison samples, we selected States within strata defined by Census region and percent of children who are non-Hispanic white. (Note that students of all races/ethnicities were included in the analysis). See Appendix B for further details.

- ***Stage 4: Selection of Students.*** In the final stage, we randomly selected ten students from each of these classrooms, and attempted to complete interviews with at least eight of these students.

This four-stage sampling plan yielded an initial target sample size of 24 students per school, and a total of 6,144 students (3,072 participating and 3,072 nonparticipating) from the 256 schools.

Due to issues that arose during data collection and cleaning (described in Appendix B), we completed 5,890 student interviews in 252 schools (an average of approximately 23 per school, slightly below the target sample size of 24). Our analytic sample additionally excludes 330 students for whom data on gender, grade level, race/ethnicity, or FRPSL eligibility were not reported by either students or parents. The final full analytic sample size was therefore 5,560 students in 252 schools. The sample size for the preferred analytic sample, which includes the 214 schools within two and a half percentage points of each State's funding cutoff, is 4,696 students.

## Student Interviews, 24-Hour Recalls, and Post-Processing

The key outcomes for the impact study are student dietary and nutritional outcomes. For this report, we consider impacts during FFVP days on:

(i) fruit and vegetable consumption, defined as total cup-equivalents of fruits and vegetables consumed per day; and
(ii) total energy intake, defined as total number of kilocalories consumed per day.

We collected information on student food intake using diary-assisted 24-hour recall interviews. The 24-hour recall method has been widely and successfully used with elementary school aged children. We augmented the 24-hour recall interview with a food diary completed by students in advance of the interview in order to improve recall accuracy. In FFVP schools, the diary was completed on a day on which FFVP fruits and/or vegetables were offered to students, allowing us to estimate the impact of FFVP on intake on FFVP days.

Completed recalls were coded using a coding system developed specifically for this study. The coding system is based on the USDA Food and Nutrient Database for Dietary Studies (FNDDS) version 3.0. We developed coding manuals similar to those used in other dietary data collection studies in order to standardize data entry. Trained staff coded the data as soon as possible after completion of each interview; a 10 percent subsample of recalls was double-entered as a consistency check. Extreme and/or questionable values for selected foods, food groups, food energy, and selected nutrients were checked and verified on the electronic file to identify possible data entry errors.

Finally, nutrient values from the FNDDS version 3.0 and food group equivalents from the MyPyramid Equivalents Database (MPED) version 2.0 were used to generate student-level intake amounts from individual reported foods.[14]

[14] Where necessary, new FNDDS 3.0 foods were matched by our team of expert nutritionists to similar existing foods in the MPED 2.0 database to derive approximate food group equivalent amounts for these foods. If the MPED 3.0 database is released sufficiently far in advance of the final evaluation report, we will update our estimates to incorporate the new MPED equivalent amounts.

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# Chapter 3: Interim Report Results

In this chapter, we present results of our analyses examining the impact of FFVP on students' fruit and vegetable consumption and on their total energy intake. As noted in Chapter 2, we present results for our preferred specification—including only those schools that are within two and one-half percentage points of each State's funding cutoff. See Appendices C and D for sensitivity analyses of the findings.[15, 16]

In the first section of this chapter, we present student characteristics. The following section then reports on characteristics of students in FFVP schools only, disaggregated by their self-reported frequency of participation in the program (always, mostly, occasionally, or never participating). Finally, we present our impact results: regression discontinuity estimates of the impact of FFVP on consumption of our two focal nutritional outcomes, consumption of fruits and vegetables and total energy intake.

## Sample Student Characteristics

Exhibit 2 presents descriptive statistics for students in schools within two and a half percentage points of the appropriate State-specific FRPSL percentage cutoff. To test for differences in student characteristics across the treatment and comparison group, we computed chi-square statistics adjusted to account for the complex sampling design. P-values for each comparison are reported in the table; p-values less than 0.05 indicate statistically significant differences.

The treatment and comparison groups were similar in gender composition with a substantially higher proportion of female students represented. The treatment and comparison groups were also similar in terms of distribution across grade levels, race/ethnicity, and FRPSL eligibility status. The RD model in this interim report included gender, grade level, race/ethnicity, and FRPSL status indicator variables as covariates to adjust for any potential differences and to increase the precision of our impact estimates.

## Student Characteristics by Program Participation Level

Exhibit 3 presents descriptive student characteristics in the FFVP subsample by self-reported frequency of program participation. For fruits and for vegetables, students were asked, "When they are offered, how

15 Seven California schools initially selected as comparison group schools were re-classified as treatment schools due to a re-allocation of FFVP funding late in the school year. Each of these schools was awarded FFVP funding when additional funds became available, and had implemented FFVP by the time of our scheduled visits. Appendix B provides additional details on the FFVP selection process in California.

16 Appendix C presents sensitivity analyses that vary (i) whether we include schools that are relatively far from the cutoff, and (ii) which regression controls we include. Appendix D presents results of sensitivity analyses that drop the California schools. The results of these sensitivity analyses are qualitatively similar to the main results presented in the body of the report. We therefore do not explicitly discuss any of the sensitivity results in the body of the report.

We note that in some of the sensitivity analyses, some tests that are clearly statistically insignificant ($p>0.10$) in the main analysis are borderline statistically significant ($0.05<p<0.10$) in some of the sensitivity analyses. Many of the borderline significant results can be attributed to the large number of tests and the lack of correction for "multiple comparisons", as is appropriate for exploratory results (only the fruit and vegetable intake test was specified as confirmatory; on these technical issues, see Schochet 2009).

often do you usually take the free fresh [FRUIT/VEGETABLE] snack?” We report p-values for a chi-square test, adjusted appropriately to account for the complex sampling design; p-values lower than 0.05 indicate statistically significant differences.[17]

**Exhibit 2: Student Characteristics, Treatment vs. Comparison Group, Restricted Near-Cutoff Subsample (N=4,696)**

| | Treatment Group | Comparison Group | P-Value for T-C Difference |
|---|---|---|---|
| **Gender** | | | |
| Male | 43.9% | 43.0% | (0.589) |
| Female | 56.1% | 57.0% | |
| **Grade Level** | | | |
| 4th grade | 44.5% | 42.5% | (0.804) |
| 5th grade | 44.5% | 45.3% | |
| 6th grade | 11.0% | 12.2% | |
| **Race/Ethnicity** | | | |
| Hispanic | 45.2% | 38.6% | (0.111) |
| Non-Hispanic Black | 25.7% | 22.7% | |
| Non-Hispanic White | 21.0% | 29.8% | |
| Other Race/Ethnicity | 8.0% | 8.9% | |
| **FRPSL Status** | | | |
| Eligible for Free Lunch | 74.7% | 69.7% | (0.236) |
| Eligible for Reduced-Price Lunch | 7.9% | 8.9% | |
| Not FRPSL Eligible | 17.4% | 21.4% | |
| Sample size | 2,471 | 2,225 | |

Note: There were no statistically significant differences in characteristics across treatment and comparison groups at the 95% confidence level. (Chi-square test, adjusting for clustering of students within schools.)

Students reported that they were substantially more likely to participate in FFVP when fruits were offered than when vegetables were offered (chi-squared test; $p<0.001$). For fruits, 48 percent of students reported that they took the snacks every time, and 38 percent that they took them most times, as compared to 30 percent of students who reported that they took vegetable offerings every time and 33 percent who reported that they took vegetable offerings most times.

Exhibit 3 also shows that in FFVP schools we found no statistically significant differences in the frequency with which students took FFVP fruits and vegetables by student demographic characteristics grade level, race/ethnicity, or FRPSL status.

[17] Note that in support of the RD design for the impact analysis, this sample was purposively drawn from schools near the FRPSL cutoff, rather than from a nationally representative sample of FFVP-participating schools. These participation frequency results are, therefore, not necessarily generalizable to all students participating in FFVP.

**Exhibit 3: Descriptive Statistics, FFVP Students by Self-Reported Frequency of Participation, Fresh Fruits and Fresh Vegetables, Restricted Near-Cutoff Subsample**

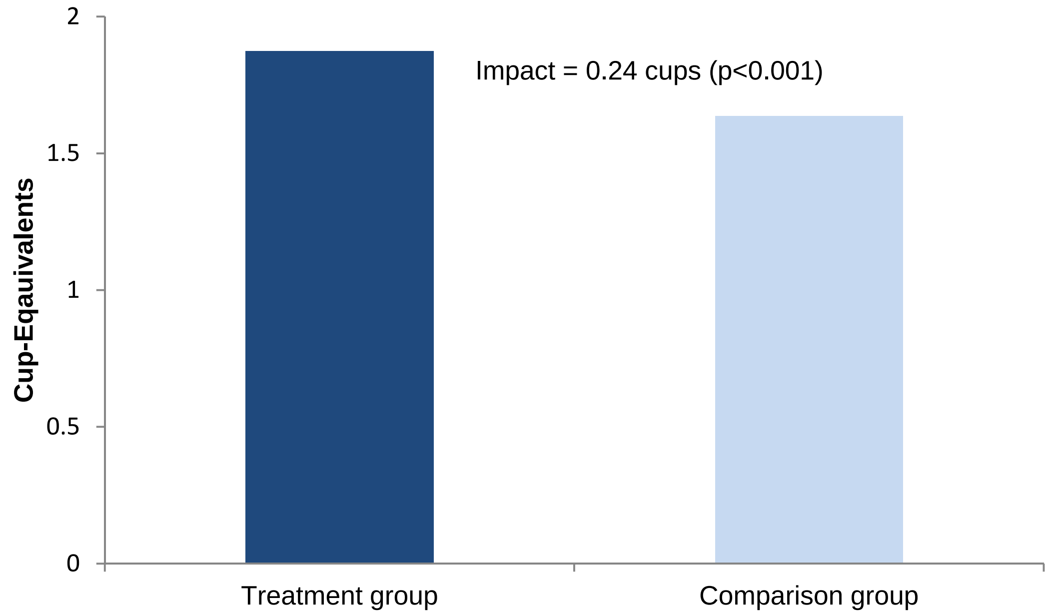
| | Fresh Fruits (N=2,308) | | | | | | Fresh Vegetables (N=2,305) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Takes Every Time | Takes Most Times | Takes Occasionally | Never Takes | Hasn't Seen Offered | P-Value for Difference | Takes Every Time | Takes Most Times | Takes Occasionally | Never Takes | Hasn't Seen Offered | P-Value for Difference |
| **All Students** | 47.7% | 37.5% | 10.7% | 2.5% | 1.6% | N/A | 29.9% | 33.3% | 21.5% | 10.8% | 4.4% | N/A |
| **Gender** | | | | | | | | | | | | |
| Male | 47.3% | 34.9% | 13.0% | 3.3% | 1.6% | (0.070) | 30.3% | 31.1% | 23.0% | 11.8% | 3.9% | (0.642) |
| Female | 48.1% | 39.5% | 9.0% | 1.8% | 1.5% | | 29.7% | 35.0% | 20.4% | 10.0% | 4.8% | |
| **Grade Level** | | | | | | | | | | | | |
| 4th grade | 49.7% | 35.7% | 10.3% | 2.9% | 1.5% | (0.515) | 32.5% | 33.2% | 19.6% | 10.8% | 3.9% | (0.779) |
| 5th grade | 47.7% | 37.9% | 10.4% | 2.4% | 1.7% | | 28.9% | 33.4% | 22.0% | 10.7% | 5.1% | |
| 6th grade | 40.4% | 43.1% | 14.1% | 0.8% | 1.6% | | 23.8% | 33.6% | 27.3% | 11.3% | 3.9% | |
| **Race/Ethnicity** | | | | | | | | | | | | |
| Hispanic | 47.7% | 37.3% | 11.8% | 2.5% | 0.7% | (0.324) | 26.9% | 34.6% | 23.7% | 10.7% | 4.1% | (0.715) |
| Non-Hispanic Black | 51.9% | 33.2% | 10.5% | 2.2% | 2.2% | | 35.4% | 32.0% | 17.7% | 10.6% | 4.4% | |
| Non-Hispanic White | 43.0% | 41.1% | 10.5% | 2.7% | 2.7% | | 29.0% | 31.9% | 21.6% | 11.3% | 6.2% | |
| Other Race/ Ethnicity | 47.5% | 42.1% | 6.6% | 2.7% | 1.1% | | 31.7% | 34.4% | 21.9% | 10.9% | 1.1% | |
| **FRPSL Status** | | | | | | | | | | | | |
| Eligible for Free Lunch | 50.2% | 36.3% | 10.1% | 2.2% | 1.2% | (0.193) | 31.9% | 33.5% | 20.2% | 10.4% | 4.0% | (0.559) |
| Eligible for Reduced-Price Lunch | 42.5% | 42.5% | 10.2% | 2.7% | 2.2% | | 24.3% | 31.4% | 27.6% | 12.4% | 4.3% | |
| Not FRPSL Eligible | 40.3% | 40.0% | 13.7% | 3.3% | 2.6% | | 24.3% | 33.6% | 24.3% | 11.6% | 6.1% | |

Note: There were no statistically significant differences in characteristics across participation levels at the 95% confidence level. (Chi-square test, adjusting for clustering of students within schools.)

## Impact Estimates

Exhibits 4, 5 and 6 show our main impact results: regression discontinuity (RD) estimates of the impact of FFVP on total fruit and vegetable consumption and total energy intake on FFVP days using our preferred specification.

**Exhibit 4: Impact of FFVP on Consumption of Fruits and Vegetables, Restricted Near-Cutoff Subsample (N=4,696)**




**We find that students in FFVP schools consumed approximately one-quarter (0.24) of a cup more fruits and vegetables per day on FFVP days than students in comparable non-FFVP schools** (Exhibit 6). This represents an increase of 14.6 percent over fruit and vegetable consumption levels in the absence of FFVP. Furthermore, in our preferred specification, we can decisively reject the null hypothesis of no impact ($p<0.001$; much smaller than the conventional 0.05 cutoff).

**With respect to total energy intake, we do not find a statistically significant difference across FFVP and non-FFVP students.** If we had found an increase in total energy intake, we might have been concerned that FFVP participation could contribute to weight gain. Instead, increased fruit and vegetable consumption appears to have replaced consumption of other foods.

**Exhibit 5: Impact of FFVP on Total Energy Intake, Restricted Near-Cutoff Subsample (N=4,696)**

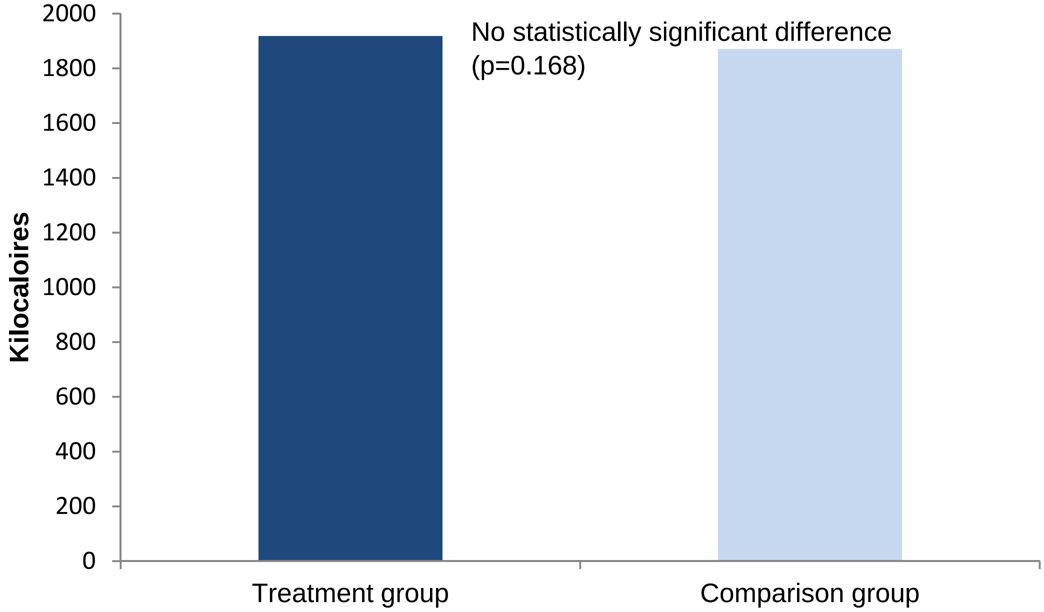



**Exhibit 6: Impact of FFVP on Consumption of Fruits and Vegetables and Total Energy Intake, Restricted Near-Cutoff Subsample (N=4,696)**

| | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) |
|---|---|---|
| Regression-adjusted mean, treatment group | 1.87 | 1918 |
| (S.E.) | (0.05) | ( 24) |
| Regression-adjusted mean, comparison group | 1.64 | 1871 |
| (S.E.) | (0.04) | ( 22) |
| Estimated impact (T-C) | 0.24 | 47 |
| {t-statistic} | {3.43} | {1.38} |
| (P-value) | (0.000)*** | (0.168) |

Notes: Regression adjustment using student characteristics.

Asterisks indicate statistical significance for regression coefficients: *p<0.10, **p<0.05, ***p<0.01. (One-sided test for increase in fruit and vegetable consumption; two-sided test for total energy intake.)

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# Chapter 4: Discussion

This final chapter summarizes our findings, presents conclusions, and notes some limitations of the study.

## Summary of Findings

The USDA Fresh Fruit and Vegetable Program (FFVP) was created to increase children's consumption of fresh fruits and vegetables. Specifically, the program distributes fresh fruits and vegetables outside of school meals at no cost to students in the nation's poorest elementary schools, at a funding level of about $1 to $2 per week per student.

This document provides interim findings from USDA FNS's evaluation of FFVP. The evaluation uses regression discontinuity (RD) methods to estimate the causal impact of FFVP, i.e. to estimate outcomes in FFVP-participating schools compared to what they would have been in the absence of FFVP. RD generates causal estimates by leveraging the sharp discontinuity in the proportion of free- and reduced-price school lunch (FRPSL) induced by the FFVP assignment rule which provides program funding to applicant schools with FRPSL above the cutoff. Applicant schools with FRPSL below the cutoff do not get FFVP funds. RD compares outcomes in applicant schools on either side of the cutoff. For these schools, the difference in FRPSL is small, so impacts can plausibly be attributed to FFVP.

Our interim results indicate that FFVP increased fruit and vegetable consumption among students in participating schools by approximately one-quarter of a cup per day ($p<0.001$), or about 14.6 percent. In addition, the results show no statistically significant increase in total energy intake. If we had found a statistically significant increase in total energy intake, we might have been concerned that FFVP participation could contribute to weight gain. Instead, increased fruit and vegetable consumption appears to have replaced consumption of other foods.

## Conclusions

An increase in fruit and vegetable consumption of one-quarter of a cup per day, or approximately half a serving per day, is within the range observed in several other interventions to increase fruit and vegetable consumption in school children.

Previous evidence on school-based interventions is largely limited to relatively small random-assignment studies and controlled clinical trials, mostly focused on local or regional interventions with relatively small sample sizes. Knai et al. (2006) found positive effects on fruit and vegetable intake of 0.3 to 0.9 servings per day in ten of the fifteen studies included in their review. A recent systematic review of interventions to promote fruit and vegetable consumption among elementary school children also reported several effect sizes between 0.2 and 0.35 servings per day (Delgado-Noguera et al., 2011). The interventions reviewed in these studies were primarily school-based, extended over months or years, and included one or more of the following components: integration of nutrition education on fruits and vegetables into the school curriculum; computer-based programs for child learning and goal-setting related to fruits and vegetables; school meal and other food service changes; free or subsidized fruits and vegetables offered at school; promotional campaigns such as posters and videos; teacher training; and parent involvement.

Further, Knai et al. concluded that evidence of effectiveness was strongest in multi-component programs. While FFVP included some promotional and educational elements, because its primary focus is provision of free fruits and vegetables at school, it is essentially a single-component intervention. The three papers cited by Delgado-Noguera et al. that tested programs primarily focusing on provision of free or subsidized fruits and vegetables (Bere et al., 2006; Moore and Tapper, 2008; and Ransley et al., 2007) found effects on fruit and vegetable consumption of approximately 0.2 servings (0.1 cups), about half of the impact estimated for FFVP.

The increase in fruit and vegetable consumption observed in the FFVP evaluation is important because population dietary changes are generally small and incremental. While there is no consensus as to what constitutes a meaningful change in fruit and vegetable intake, it is generally accepted that children with the lowest intakes are at greatest risk of poor health outcomes, and that the greatest benefit would be conferred by increasing intakes of fruits and vegetables among this group (USDA & DHHS, 2010).

Further, children from socioeconomically disadvantaged families tend to have the lowest intakes of fruits and vegetables (Krebs-Smith et al., 1996; Darmon and Drewnowski, 2008; Dubowitz et al., 2008; Lorson et al., 2009); by targeting poorer schools, FFVP specifically targets this at-risk group. Thus, increasing fruit and vegetable intakes in this population even by small amounts is likely to confer a health benefit.

## Limitations

Some limitations of the impact estimates presented in this report are inherent both in the evaluation design and in features of FFVP, as legislatively mandated and implemented in participating schools. We discuss these considerations below.

***Regression Discontinuity Design.*** Our results rely on the RD method. RD has internal validity comparable to that of random assignment (RA), which is the gold standard, provided that school selection adhered to the FRPSL eligibility cutoff rule. If there are features of school selection of which we are unaware and which deviate from the FRPSL eligibility criterion, the RD estimates might be biased. Differences in student characteristics across treatment and comparison schools would be evidence of such deviation; we find no evidence of such differences.

RD deviates from RA when sampled schools are not very close to the cutoff. We were able to choose schools for our full analysis sample relatively close to the cutoff, and we identified a large subsample of schools that were even closer. This restricted subsample is more homogeneous than samples in most other RD studies. We take the results in the “near-cutoff sample” as our preferred estimate. Appendix C reports results for the unrestricted analytic sample and for other specifications that have been suggested in the RD literature. While there is some variation in the impact estimates, the overall conclusions—statistically significant impacts of about a quarter of a cup on fruit and vegetable consumption, and no statistically significant impact on total energy intake—are robust across alternative specifications considered. This gives us additional confidence in the results presented in the body of the report.

Even so, it is conceivable that there is strong variation of food consumption with small changes in school FRPSL, or that variation is highly nonlinear. Either of these phenomena would pose a threat to the validity of our findings. On a priori grounds, such strong variation seems unlikely and there is no evidence of it in our data. In particular, we note that models that include FRPSL or include schools farther from the cutoff yield similar results (see Appendix C).

Finally, if the impact of FFVP varies strongly with FRPSL, our estimates are only applicable at the cutoff. If the policy choice was an incremental expansion (or shrinkage) of the program, estimates near the cutoff would be preferred for guiding this decision (Angrist, Imbens, and Rubin, 1996; Imbens and Angrist, 1994; Imbens and Rubin, 1997). On the other hand, if there was strong variation in impact with FRPSL, our estimates could not be generalized to predict the likely effects of a large-scale expansion of the program to include schools well above the current FRPSL cutoff. There is no reason to think that such strong variation in the impact of FFVP with FRPSL is present as a rule (see Grogger, Karoly, and Klerman, 2002; Klerman, 2010). We therefore believe that it is reasonable to use these estimates for policy decisions about the program as a whole.

***Measuring food intake***. Measuring food intake is challenging in general, and especially so for elementary school age children. Measurement error would decrease the precision of our results. This study has used state of the art methods for measuring child intake. The high precision of our impact estimates suggests that measurement error is not a serious problem.

***Identifying short-term versus long-term impacts***. Because of the schedule for the Congressionally mandated report, this evaluation could only measure short-term outcomes, or those occurring while the program was underway. During that period, fruits and vegetables were distributed to children during the school day. Children received nutrition education messages about fruit and vegetable consumption indirectly as a result of the distribution itself. They also received nutrition education messages directly to the extent that they were incorporated in classroom lessons. Over the longer-term, after students leave the program, the effects of both acclimation to fruits and vegetables and nutrition education may remain. The relative size of short-term and long-term impacts is unclear. It is possible that acclimation and nutritional education impacts will grow as children age and gain more control over their food consumption. Alternatively, impacts might shrink, both because of the elimination of any direct impact of fruit and vegetable distribution and because of the attenuation of nutritional education messages.

***Program maturity and dosage***. The evaluation estimates impacts for the program as currently designed and implemented. FFVP has been operating nationwide for only three years, with funding increasing approximately 50 percent each year over the previous year. Many schools and students participating in the impact evaluation were in their first year of FFVP participation. It is possible that longer exposure would lead to larger student impacts. Also, schools may improve their programs as their experience increases. An additional consideration is that FFVP authorizing legislation mandates per student fruit and vegetable expenditures of between $50 and $75 per year, only $1-2 per student per week in school.

***Impacts on non-FFVP days***. We restricted data collection in FFVP schools to days on which fruits and vegetables were scheduled to be offered to students. Our analysis cannot therefore be extrapolated to describe impacts on intake on days on which FFVP is not offered. Understanding the extent to which intake on non-FFVP days is influenced by spillover or substitution effects of the program is an important direction for future research.

***Sample size limitations***. The size of the school/student sample affects the precision with which impacts can be estimated. The sample size was designed to allow us to detect differences in mean fruit and vegetable intake of approximately one quarter cup or larger between FFVP participants and non-participants; our prospective assumptions on the likely variance of the fruit and vegetable consumption outcome measure appear to have been relatively conservative, allowing us to detect slightly smaller impacts in our main analyses. However, the study sample size does not allow us to reliably detect smaller differences. In addition, the study sample size only allows us to detect relatively large impacts within and across subgroups of the population.

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# Appendix A: Estimation Using Regression Discontinuity

Chapter 2 provided general motivation for the Regression Discontinuity (RD) approach.[18] There, we noted that to improve precision and to address some technical issues, we estimate impacts via multivariate regression. This appendix provides a formal discussion of our estimation approach.

## Overview

We begin with a standard regression expression:

(1) $$Y_{s,i} = \alpha + d_s \pi + \varepsilon_{s,i}$$

where $s$ indexes schools, $i$ indexes students within schools, $Y$ is some nutritional outcome, $d$ is a dummy variable (=1 if treatment school; =0 if control school), $\varepsilon$ is a random error term, and $\alpha$ and $\pi$ are parameters to be estimated—the latter being the impact of FFVP.

As with random assignment studies, power is increased and standard errors decreased by modeling how the outcome varies with observed covariates at the school level, $Z$, and at the student level, $X$:

(2) $$Y_{s,i} = \alpha + d_s \pi + X_{s,i} \beta + Z_s \gamma + \varepsilon_{s,i}$$

The observed student-level covariates include student gender, grade, race/ethnicity, and school meals eligibility status; in the interim analyses, the only included school-level covariates are a series of State indicators.

## Weighting

Because our sampling plan (see Appendix B for further details) yields a roughly self-weighting sample of students, we present unweighted results for the RD analysis. We expect that impacts are approximately homogeneous within the narrow band of FRPSL eligibility status represented in our sample, so we do not anticipate that introduction of sampling weights would materially influence results.

## Ranking Variable

Our preferred estimates differ from the standard approach in the RD literature in that they exclude the ranking variable, percent of students in the school eligible for free and reduced price school lunch (FRPSL), from the regression models. The literature has much wider ranges of the ranking variable such that it is plausible that over that range there is large variation in an outcome merely due to the ranking

[18] On the history of RD, see Thistlethwaite and Campbell (1960) and the survey in Cook (2008). The basic theoretical reference is Hahn, Todd and van der Klaauw (2001). On current thinking of best practices in implementing RD, see Imbens and Lemieux (2008), Lee and Lemieux (2010), and DiNardo and Lee (2010).

variable itself. This concern is typically addressed by including two linear (and sometimes quadratic) terms in the ranking variable—one from the left (labeled with a "+") and the other from the right (labeled with a "-").

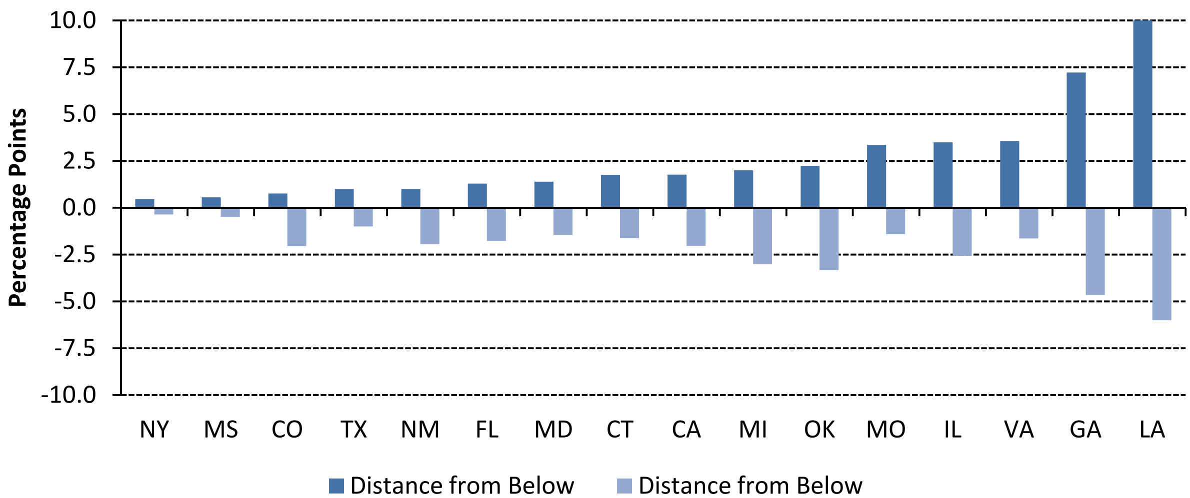
(3) $$Y_{s,i} = \alpha + d_s \pi + \overline{R}_s^- \rho_- + \overline{R}_s^+ \rho_+ + X_{s,i}\beta + Z_s \gamma + \varepsilon_{s,i}$$

Often, the coefficients of the two linear terms are assumed identical.

In our situation, we would need to parameterize *R* as values of the ranking variable relative to the State-specific cutoff (see Black, et al., 2007, for a similar approach). In our models with a ranking variable, we do so as percentage points from the cutoff. However, including the ranking variable as a regressor typically imposes a large cost in statistical power: such RD designs require sample sizes 2.75 to 4.00 times that of conventional random assignment designs (Goldberger, 1972; Cook, 2008).

It is our conjecture, however, that given the way we have selected the schools, it is not necessary to include *R* at all. Because we drew our samples from entire States, most selected schools are within a few percentage points FRPSL from the corresponding State cutoff. Only 38 of 256 initially-selected schools for which we collected dietary recall data were more than two and a half percentage points away from the cutoff. Exhibit A-1 below shows the maximum distance to the cutoff from above and below for schools within each State.

**Exhibit A-1: Maximum Distance to the Percentage FRPSL Cutoff by State, From Above and Below**




When schools are very close to the cutoff, it is not necessary to include the ranking variable as a regressor. This is because, over a small enough range of the ranking variable, the change in the outcome with the ranking variable is not likely to be anywhere near as large as any impact of interest.

More formally, our argument is as follows. For simplicity, consider the case when $\beta$=0, $\gamma$=0, and $R$ is scaled such that it is equal to zero at the discontinuity. Finally, assume that the treatment is to the "right"; i.e., higher values of the ranking value. This is the case for FFVP, where schools with higher FRPSL fractions receive the treatment.

Then the expected value of the outcome to the left ("-") and right ("+") of the cutoff are respectively:

(4) $$E[Y_-] = \alpha \text{ and } E[Y_+] = \alpha + \pi$$

Thus, the difference of those two expected values gives the impact of FFVP:

(5) $$E[Y_+] - E[Y_-] = (\alpha + \pi) - \alpha = \pi$$

Now, add the assumption that near the cutoff the observations are uniformly distributed with respect to $R$. Denote the range of the observations on the left ("-") and right ("+") of the cutoff as $w_-$ and $w_+$, respectively. Then, the expected values of the outcome on the left and right of the cutoff are, respectively,

(6) $$E[-] = \alpha - \tfrac{1}{2} w_- \rho_- \text{ and } E[+] = \alpha + \pi + \tfrac{1}{2} w_+ \rho_+$$

We propose to estimate the impact of FFVP as the difference between these two:

(7) $$\begin{aligned} E[+] - E[-] &= (\alpha + \pi + \tfrac{1}{2} w_+ \rho_+) - (\alpha - \tfrac{1}{2} w_- \rho_-) \\ &= \pi + \tfrac{1}{2}(w_+ \rho_+ + w_- \rho_-) \end{aligned}$$

The first term, $\pi$, is the true, unbiased impact of FFVP, our key parameter of interest. The second term, in parentheses, is undesired bias. Omitting the two $\rho$ terms from our model will thus clearly increase the bias of our estimate of the impact term $\pi$. The question, however, is whether the magnitude of this omission bias is sufficiently small so as to be outweighed by the associated gain in the precision of our impact estimate.

The answer to that question will depend on the (true) magnitude of the $w$ and $\rho$ terms, and the precision with which we can estimate the two $\rho$ terms. We have no reason to believe that $\rho$ is large, i.e., that the relation of child fresh fruit and vegetable consumption to school FRPSL is strong near the cutoff. Furthermore, we have intentionally chosen the schools in our impact study sample to be "close to" the cutoff (in practice, usually two to three percentage points of FRPSL on either side), so that $w$ is small. Finally, given the narrow range of FRPSL values (i.e., $w$) and our relatively small sample sizes, it seems unlikely that we will be able to estimate the $\rho$ parameters with any precision.

For these reasons, we conjectured that inclusion of the ranking variable in our model would ultimately decrease the precision of our impact estimates. We test this conjecture following Lee and Lemieux (2010) by estimating Equation (3) (constraining $\rho_-$ to be equal to $\rho_+$) and performing a significance test for the resulting slope parameter $\rho$. This test fails to reject at the 95% confidence level the null hypothesis that this parameter is equal to zero, both in our full analytic sample and in our restricted subsample of schools within two and a half percentage points of the cutoff (See Appendix C, Exhibit C-5).

## Preferred and Alternative Specifications

***Our preferred specification therefore includes only schools within two and a half percentage points from the cutoff, and excludes the ranking variable as a covariate***. Only the results from this preferred specification are presented in the body of this report. However, in Appendix C we present results both including and excluding the ranking variable, and both for the full analytic sample and the restricted near-cutoff subsample.

# Appendix B:  Sampling

This appendix provides additional detail on our sampling plan. In particular, it describes our plan, several challenges encountered in implementing the plan, and how we addressed those challenges. An appendix to the final evaluation report will provide the complete set of considerations leading from the schools closest to the cutoff to the sample actually used in estimating student impacts.

As was discussed in the body of this report, the sample used to estimate student impacts is specifically drawn from schools as close as possible to the FRPSL cutoff. To examine program implementation, the FFVP evaluation also includes data from a random sample of all schools, including those far from the cutoff. The final evaluation report will discuss our approach to combining the two samples.

This appendix discusses in turn the four stages of sampling: (i) States, (ii) schools, (iii) grades, and (iv) students. Figure B-1 summarizes the sampling strategy graphically (including the implementation study sample that we do not discuss here).

## First Stage—Select States

The first stage of sampling drew a random sample of 16 States from the 48 contiguous States and Washington, DC. Sampling was probability proportional to size (PPS) within strata defined by Census region and percent of children who are non-Hispanic white; the measure of size was the number of public elementary school students in schools where at least 50 percent of students receive free or reduced price school lunches (FRPSL), as reported in the 2006 Common Core of Data (CCD) (http://nces.ed.gov/ccd/). These 16 States served as the first stage sample.

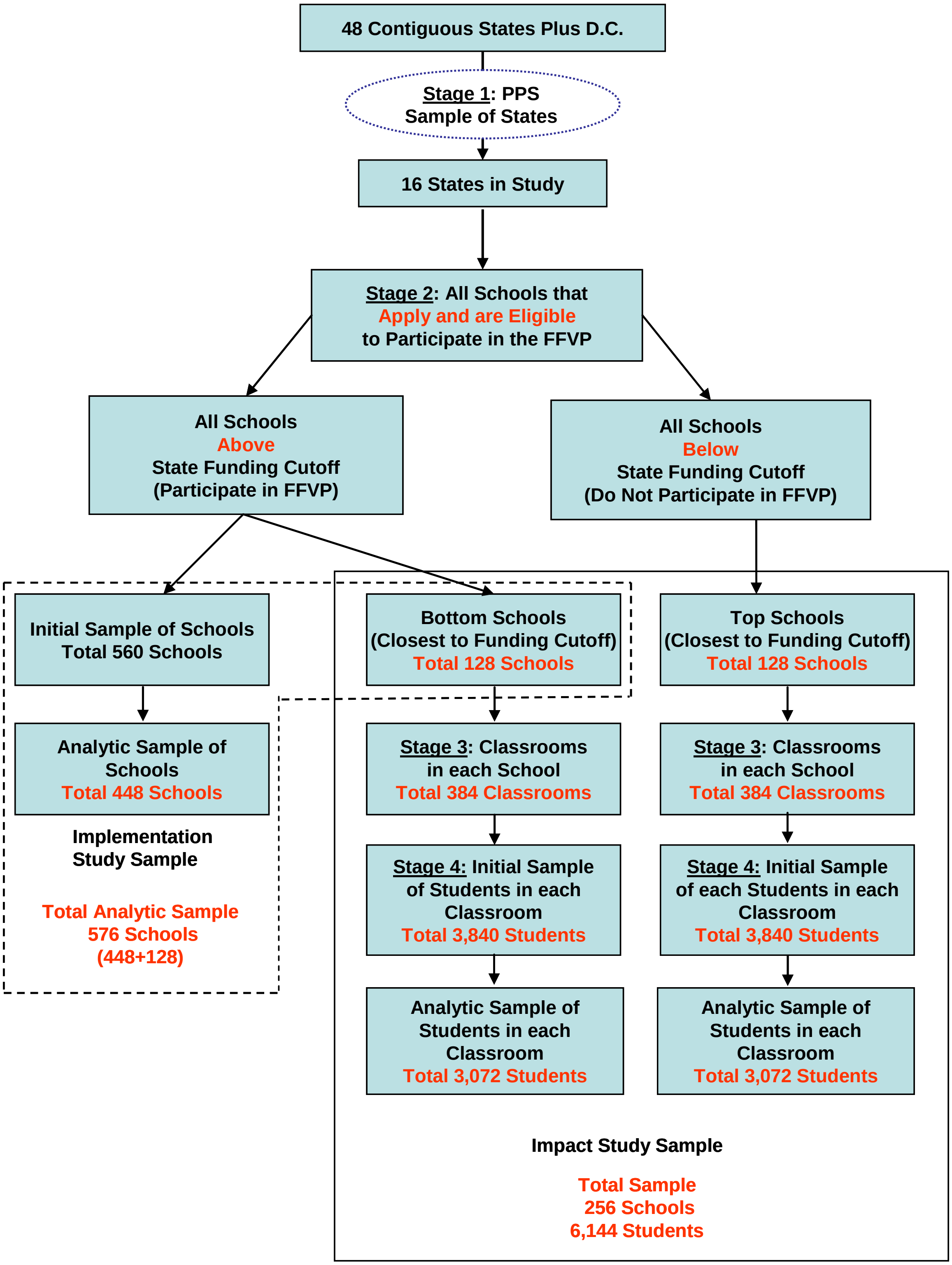
Two initially-selected States were later found to be ineligible to participate in the evaluation because they accepted all or nearly-all applicant schools, and therefore had few or no schools to make up the comparison group for our RD design.

## Second Stage—Select Schools

Within each of the 16 selected States, the second stage sampled applicant elementary schools eligible for inclusion in the study to obtain a total of 256 eligible schools (128 participating in FFVP and 128 not participating in FFVP). We allocated the sample of schools to the States proportional to the measure of size, in this case, the number of public elementary school students in schools where at least 50 percent of students were certified for free or reduced price meals.

Elementary schools in the U.S. have different grade ranges (e.g., K-4, K-5, K-6, etc.) The impact study is targeted to older elementary school children in grades 4-6, in order to focus on the fruit and vegetable consumption of children as they transition into higher grade levels, and because some aspects of the data collection are not suited to younger children. Thus at least one eligible grade must have been present for a school to be eligible for the impact study sample (for example, K-3 elementary schools were not eligible).

**Exhibit B-1: Four-Stage Sample Design—Impact Study and Implementation Study**



In total, we released 316 schools for recruitment. This includes the initial 256 schools and 60 replacement schools. Eighteen (18) schools were ineligible for the evaluation. Reasons for ineligibility varied, and included:

- School or district decided not to participate in FFVP after being granted funding;
- School did not include one or more of grades 4-6. In most cases, we were able to exclude these schools prior to drawing the sample, but in some cases, the information on grade range was either unknown or changed from the time of initial sampling;
- School participated in the FFVP pilot;
- School closed; and
- Students in one school did not speak English.

Forty-two (42) schools refused to participate. Refusals were of three types:

- SFA director refused for all selected schools in the district (15 schools);
- Superintendent refused for all selected schools in the district (16 schools);
- Principal refused (11 schools).

The final sample included 256 schools. The school-level response rate was 86 percent [256/(316-18)].

## Third Stage—Select Classrooms

The third stage of our impact study sampling plan sampled a total of three classrooms from each of the 256 selected schools. For those schools with all three grades present, this included one classroom from each of grades 4, 5, and 6. For K-5 and K-4 schools we sampled from the eligible grades that were present. This yielded a total target sample of 768 classrooms (384 participating and 384 nonparticipating). However, a small number of sampled schools had less than three classrooms in our target grades; in these cases we approached all eligible classrooms in the school. Taking this constraint into consideration, our final target sample size was reduced to 757 classrooms.

In all, we released 769 classrooms for recruitment. Nine classrooms were ineligible (e.g. special education classrooms), and for three classrooms, the school requested that we select a different classroom. The classroom-level response rate was therefore 99.6 percent [757/(769-9)].

## Fourth Stage—Select Students

At the fourth and final stage of sampling for our impact study, we selected a random sample of approximately 10 students per classroom. This resulted in an initial target sample size of 30 students per school, for a total of 7,680 students (3,840 participating and 3,840 nonparticipating) from the 256 schools. We expected that the initial sample of approximately 10 students from each classroom would allow us to obtain completed interviews from approximately 8 students. Thus, the total target sample size for the impact study was approximately 24 students per school, or approximately 6,144 students in all (3,072 participating and 3,072 nonparticipating).

Due to the relatively small size of some classrooms, insufficient parental consents, and the late withdrawal of one school from the study, the student sample included 7,518 students. We completed dietary intake interviews with 6,004 students, yielding a conservative participation rate of 80 percent (6,004/7,518).[19]

## Final Analytic Sample

In practice, one eligible school that initially agreed to participate in the study ultimately declined to schedule a visit during the data collection period, so only 255 school visits were conducted. Additionally, we learned late in the school year after visits had been scheduled that one treatment group school had never been offered FFVP funds, and that two comparison group schools belonged to a district that ultimately declined to participate in the program; though we completed scheduled visits for those schools, we exclude these student interviews from our analysis. Our analytic sample therefore includes data for students in 252 schools. We completed 5,890 student interviews in these 252 schools.

Our analytic sample additionally excludes 330 students for whom data on gender, grade level, race/ethnicity, or FRPSL eligibility were not reported.[20] The final full analytic sample size was therefore 5,560 students in 252 schools (see Appendix C).

## Changes in Treatment Status for California Schools

After the initial sample was selected and school visits had been scheduled, we were informed of some late changes in FFVP participation among California schools that affected their treatment in our final analytic sample. After initially applying to participate in the program earlier in the year, several schools ultimately refused the FFVP funds. This left California with unexpended funds to be reallocated. California therefore offered those funds to the schools immediately below the original FRPSL eligibility cutoff for FFVP funding, i.e. those school originally comprising the comparison group for our study. Of our initially-selected comparison group schools in California, most (14 schools) accepted the FFVP funding, but some of them (5 schools) rejected it, likely because it was already late in the school year.

This reallocation of funds occurred after site recruitment for this evaluation was mostly completed. In seven cases, we were able to visit the schools before they implemented FFVP; in the other seven schools accepting reallocated FFVP funds, we could only visit the school after they had already implemented FFVP.

The results in the body of this report include the California schools, according to their FFVP status as of our visit; in other words, schools that had implemented FFVP at the time of our visit are treated as

[19] The 80 percent participation rate is a conservative estimate in the sense that it does not exclude ineligible students from the denominator. The ineligible students were primarily sampled students that we did not attempt to interview as we had already completed 24 interviews in the school.

[20] As a sensitivity test, we estimated an alternative specification retaining the students with one or more missing covariate, including “missing” status indicators for gender, grade, race/ethnicity, and FRPSL eligibility when covariates were not reported. We found no material difference in the magnitude or statistical significance of our impact estimates in these alternative specifications.

treatment group schools in our analysis, while schools that had not yet implemented FFVP are treated as comparison group schools.

One could argue that this approach potentially threatens the treatment/comparison balance that underlies the RD design:  presumably, some of the initially-selected treatment schools would also have refused funding if it had been offered late in the school year, but we cannot identify those schools—so there is no appropriate comparison group for those schools below the original funding cutoff who refused late funding when offered. Additionally, those schools accepting the late funds began implementing the program in March, just weeks prior to our scheduled visit, unlike other sampled FFVP schools that implemented the program at the start of the school year.

If one accepted this argument, then one approach would be to drop all of the California schools from the sample. However, anecdotal evidence suggests that schools' decisions to accept late-school-year funding were largely a function of logistical issues, plausibly unrelated to program outcomes. Taking this anecdotal evidence into consideration, and because California represents a large fraction of our sample (812 student interviews in 39 schools, approximately 15 percent of our analytic sample), we have chosen not to drop these schools from the analyses presented in the main text. As a sensitivity check, we present analyses excluding California schools in Appendix D. We found no substantive differences in results either including or excluding California schools.

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# Appendix C: Alternative Samples and Models

As discussed in greater detail in Appendix A, our preferred analytic specification includes only students in schools within two and a half percentage points of the State-specific funding eligibility cutoff, and does not include the distance-from-the-cutoff ranking variable as a covariate. In this appendix, we present additional results for the full available sample, and specifications both including and excluding the ranking variable. In general, results were robust to use of alternative samples and estimation procedures.

## Sample Sizes

Exhibit C-1 presents sample size totals and FRPSL percentage information for the two alternative sample specifications, both restricted and inclusive.

**Exhibit C-1: Sample Sizes, Full Sample and Restricted Near-Cutoff Subsample**

| | Restricted Near-Cutoff Subsample | | | Full Analytic Sample | | |
|---|---|---|---|---|---|---|
| | Treatment | Comparison | All | Treatment | Comparison | All |
| **Schools** | 115 | 99 | 214 | 134 | 118 | 252 |
| **Students** | 2,471 | 2,225 | 4,696 | 2,903 | 2,657 | 5,560 |

## Sample Student Characteristics

Exhibit C-2 presents student demographic characteristics for the treatment and comparison groups for the full and restricted samples. We found no evidence of statistically significant differences in student characteristics across treatment and comparison groups.

**Exhibit C-2: Student Characteristics, Treatment vs. Comparison Group**

| | Restricted Near-Cutoff Subsample (n=4,696) | | | Full Analytic Sample (n=5,560) | | |
|---|---|---|---|---|---|---|
| | Treatment Group | Comparison Group | P-Value for T-C Difference | Treatment Group | Comparison Group | P-Value for T-C Difference |
| **Gender** | | | | | | |
| Male | 43.9% | 43.0% | (0.589) | 43.9% | 44.1% | (0.921) |
| Female | 56.1% | 57.0% | | 56.1% | 55.9% | |
| **Grade Level** | | | | | | |
| 4th grade | 44.5% | 42.5% | (0.804) | 44.1% | 44.7% | (0.897) |
| 5th grade | 44.5% | 45.3% | | 44.9% | 43.5% | |
| 6th grade | 11.0% | 12.2% | | 11.0% | 11.7% | |
| **Race/Ethnicity** | | | | | | |
| Hispanic | 45.2% | 38.6% | (0.111) | 39.4% | 34.0% | (0.144) |
| Non-Hispanic Black | 25.7% | 22.7% | | 25.7% | 22.0% | |
| Non-Hispanic White | 21.0% | 29.8% | | 27.1% | 35.5% | |
| Other Race/Ethnicity | 8.0% | 8.9% | | 7.8% | 8.5% | |
| **FRPSL Status** | | | | | | |
| Eligible for Free Lunch | 74.7% | 69.7% | (0.236) | 72.4% | 66.9% | (0.123) |
| Eligible for Reduced-Price Lunch | 7.9% | 8.9% | | 7.9% | 8.8% | |
| Not FRPSL Eligible | 17.4% | 21.4% | | 19.7% | 24.3% | |
| Sample size | 2,471 | 2,225 | | 2,903 | 2,657 | |

Note: There were no statistically significant differences in characteristics across treatment and comparison groups at the 95% confidence level. (Chi-square test, adjusting for clustering of students within schools.)

## Student Characteristics by Program Participation Level

Exhibits C-3 and C-4 present descriptive statistics on student characteristics by self-reported frequency of participation in FFVP.

Results in the full analytic sample do not materially differ from results for the restricted near-cutoff subsample as reported in the main text. For vegetables, there are no statistically significant differences in student characteristics in either sample across levels of participation in FFVP (every time, most times, takes occasionally, never takes, never offered). For fruits, boys in the full analytic sample reported that they took FFVP fresh fruit offerings less frequently than girls (p=0.037). This difference was only statistically significant at the 90% confidence level (p=0.070) in the restricted near-cutoff sample.

**Exhibit C-3: Descriptive Statistics, FFVP Students by Self-Reported Frequency of Participation, Fresh Fruits**

| | Restricted Near-Cutoff Sample (n=2,308) | | | | | | Full Analytic Sample (n=2,735) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Takes Every Time | Takes Most Times | Takes Occasionally | Never Takes | Hasn't Seen Offered | P-Value for Difference | Takes Every Time | Takes Most Times | Takes Occasionally | Never Takes | Hasn't Seen Offered | P-Value for Difference |
| **All Students** | 47.7% | 37.5% | 10.7% | 2.5% | 1.6% | N/A | 47.3% | 38.1% | 10.8% | 2.3% | 1.4% | N/A |
| **Gender** | | | | | | | | | | | | |
| Male | 47.3% | 34.9% | 13.0% | 3.3% | 1.6% | (0.070) | 46.7% | 35.7% | 13.1% | 3.1% | 1.3% | (0.037)* |
| Female | 48.1% | 39.5% | 9.0% | 1.8% | 1.5% | | 47.9% | 40.0% | 9.0% | 1.7% | 1.4% | |
| **Grade Level** | | | | | | | | | | | | |
| 4th grade | 49.7% | 35.7% | 10.3% | 2.9% | 1.5% | (0.515) | 49.6% | 36.0% | 10.2% | 2.8% | 1.3% | (0.557) |
| 5th grade | 47.7% | 37.9% | 10.4% | 2.4% | 1.7% | | 46.9% | 38.9% | 10.8% | 2.0% | 1.5% | |
| 6th grade | 40.4% | 43.1% | 14.1% | 0.8% | 1.6% | | 40.3% | 43.6% | 13.2% | 1.7% | 1.3% | |
| **Race/Ethnicity** | | | | | | | | | | | | |
| Hispanic | 47.7% | 37.3% | 11.8% | 2.5% | 0.7% | (0.324) | 47.9% | 37.4% | 11.6% | 2.4% | 0.7% | (0.520) |
| Non-Hispanic Black | 51.9% | 33.2% | 10.5% | 2.2% | 2.2% | | 50.6% | 34.4% | 10.8% | 2.1% | 2.0% | |
| Non-Hispanic White | 43.0% | 41.1% | 10.5% | 2.7% | 2.7% | | 43.5% | 41.6% | 10.7% | 2.3% | 1.9% | |
| Other Race/ Ethnicity | 47.5% | 42.1% | 6.6% | 2.7% | 1.1% | | 47.6% | 41.4% | 7.1% | 2.9% | 1.0% | |
| **FRPSL Status** | | | | | | | | | | | | |
| Eligible for Free Lunch | 50.2% | 36.3% | 10.1% | 2.2% | 1.2% | (0.193) | 50.0% | 36.9% | 9.9% | 2.2% | 1.1% | (0.119) |
| Eligible for Reduced-Price Lunch | 42.5% | 42.5% | 10.2% | 2.7% | 2.2% | | 43.0% | 40.3% | 12.2% | 2.7% | 1.8% | |
| Not FRPSL Eligible | 40.3% | 40.0% | 13.7% | 3.3% | 2.6% | | 39.9% | 41.7% | 13.4% | 2.7% | 2.3% | |

Note:
*Difference across participation levels statistically significant at 95% confidence level. (Chi-square test, adjusting for clustering of students within schools.)

**Exhibit C-4: Descriptive Statistics, FFVP Students by Self-Reported Frequency of Participation, Fresh Vegetables**

| | Restricted Near-Cutoff Sample (n=2,305) | | | | | | Full Analytic Sample (n=2,732) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Takes Every Time | Takes Most Times | Takes Occasionally | Never Takes | Hasn't Seen Offered | P-Value for Difference | Takes Every Time | Takes Most Times | Takes Occasionally | Never Takes | Hasn't Seen Offered | P-Value for Difference |
| **All Students** | 29.9% | 33.3% | 21.5% | 10.8% | 4.4% | N/A | 29.6% | 33.7% | 21.5% | 10.9% | 4.2% | N/A |
| **Gender** | | | | | | | | | | | | |
| Male | 30.3% | 31.1% | 23.0% | 11.8% | 3.9% | (0.642) | 29.4% | 31.7% | 22.7% | 12.4% | 3.8% | (0.524) |
| Female | 29.7% | 35.0% | 20.4% | 10.0% | 4.8% | | 29.7% | 35.3% | 20.6% | 9.8% | 4.6% | |
| **Grade Level** | | | | | | | | | | | | |
| 4th grade | 32.5% | 33.2% | 19.6% | 10.8% | 3.9% | (0.779) | 32.6% | 33.4% | 19.8% | 10.5% | 3.6% | (0.598) |
| 5th grade | 28.9% | 33.4% | 22.0% | 10.7% | 5.1% | | 28.2% | 34.3% | 22.1% | 10.6% | 4.8% | |
| 6th grade | 23.8% | 33.6% | 27.3% | 11.3% | 3.9% | | 23.0% | 32.6% | 26.0% | 13.8% | 4.6% | |
| **Race/Ethnicity** | | | | | | | | | | | | |
| Hispanic | 26.9% | 34.6% | 23.7% | 10.7% | 4.1% | (0.715) | 27.1% | 34.6% | 23.5% | 10.8% | 4.0% | (0.727) |
| Non-Hispanic Black | 35.4% | 32.0% | 17.7% | 10.6% | 4.4% | | 34.7% | 32.9% | 17.6% | 10.7% | 4.1% | |
| Non-Hispanic White | 29.0% | 31.9% | 21.6% | 11.3% | 6.2% | | 28.1% | 32.9% | 22.1% | 11.4% | 5.5% | |
| Other Race/Ethnicity | 31.7% | 34.4% | 21.9% | 10.9% | 1.1% | | 30.0% | 35.2% | 22.9% | 11.0% | 1.0% | |
| **FRPSL Status** | | | | | | | | | | | | |
| Eligible for Free Lunch | 31.9% | 33.5% | 20.2% | 10.4% | 4.0% | (0.559) | 31.3% | 33.9% | 20.3% | 10.7% | 3.8% | (0.542) |
| Eligible for Reduced-Price Lunch | 24.3% | 31.4% | 27.6% | 12.4% | 4.3% | | 26.8% | 29.5% | 26.4% | 13.6% | 3.6% | |
| Not FRPSL Eligible | 24.3% | 33.6% | 24.3% | 11.6% | 6.1% | | 24.6% | 34.7% | 24.0% | 10.9% | 5.9% | |

Notes: There were no statistically significant differences in student characteristics across participation frequency levels at the 95% confidence level. (Chi-square test, adjusting for clustering of students within schools.)

## Regression Discontinuity Estimates

Corresponding to Exhibit 5, Exhibit C-5 provides RD estimates excluding and including the FRPSL ranking variable, for both the full analytic sample and the “near-cutoff” sample of schools within two and a half percentage points of the FRPSL cutoff in each sample State. In the two alternative specifications including the ranking variable as covariates, the test on the coefficient for the ranking variable was not statistically significant at the 95% confidence level. This is as expected given the narrow range of values for FRPSL. Furthermore, this is the case for which the literature suggests not including the ranking variable (Lee and Lemieux, 2010). Our preferred specification therefore excludes the ranking variable, and includes only schools within two and a half percentage points of the FRPSL cutoff.

Further supporting the discussion in the body of the report, the point estimate for the impact of FFVP on total fruit and vegetable consumption per day is robust across all four specifications (range 0.24 to 0.25 cups) and always statistically significant at conventional levels (p-values all <0.001). As expected, the standard errors are larger in the models with a ranking variable, but, as noted, our tests do not support the need for this variable’s inclusion. Although the point estimate for the impact of FFVP on total energy was positive in all four specifications (range 29 to 48 kilocalories), this increase was never statistically significant.

**Exhibit C-5: Impact of FFVP on Consumption of Fruits and Vegetables and Total Energy Intake**

| | Restricted Near-Cutoff Subsample (n=4,696) | | | | Full Analytic Sample (n=5,560) | | | |
|---|---|---|---|---|---|---|---|---|
| | No Ranking Variable | | With Ranking Variable | | No Ranking Variable | | With Ranking Variable | |
| | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) |
| Regression-adjusted mean, treatment group | 1.87 | 1918 | 1.87 | 1918 | 1.88 | 1927 | 1.88 | 1927 |
| (S.E.) | (0.05) | ( 24) | (0.05) | ( 24) | (0.05) | ( 22) | (0.05) | ( 22) |
| Regression-adjusted mean, comparison group | 1.64 | 1871 | 1.64 | 1870 | 1.63 | 1897 | 1.62 | 1898 |
| (S.E.) | (0.04) | ( 22) | (0.04) | ( 23) | (0.04) | ( 21) | (0.04) | ( 21) |
| Estimated impact (T-C) | 0.24 | 47 | 0.24 | 48 | 0.25 | 30 | 0.25 | 29 |
| {t-statistic} | {3.43} | {1.38} | {3.42} | {1.40} | {4.15} | {0.96} | {4.20} | {0.93} |
| (P-value) | (0.000)*** | (0.168) | (0.000)*** | (0.164) | (0.000)*** | (0.338) | (0.000)*** | (0.353) |
| Ranking variable | N/A | N/A | -0.03 | 13 | N/A | N/A | -0.03 | 9 |
| {t-statistic} | N/A | N/A | {-0.56} | {0.43} | N/A | N/A | {-1.41} | {0.67} |
| (P-value) | N/A | N/A | (0.579) | (0.668) | N/A | N/A | (0.159) | (0.506) |

Notes: Regression adjustment using characteristics of Impact Analysis sample.
Asterisks indicate statistical significance for regression coefficients: *p<0.10, **p<0.05, ***p<0.01. (One-sided test for increase in fruit and vegetable consumption; two-sided tests for total energy intake and for ranking variable.)

# Appendix D: Results Excluding California Schools

As discussed in greater detail in Appendix B, a late school-year reallocation of funding to California schools below the original funding cutoff represents a potential threat to the treatment/comparison balance that underlies the RD design. As a sensitivity check, in this appendix we present results excluding student interviews from California schools. In general, our findings appear to be robust when California schools are excluded.

## Sample Sizes

Exhibit D-1 presents sample size totals for near-cutoff subsample and the full analytic sample, excluding California schools.

**Exhibit D-1: Sample Sizes, Full Sample and Restricted Near-Cutoff Subsample, Excluding California Schools**

| | Restricted Near-Cutoff Subsample | | | Full Analytic Sample | | |
|---|---|---|---|---|---|---|
| | Treatment | Comparison | All | Treatment | Comparison | All |
| **Schools** | 88 | 87 | 175 | 107 | 106 | 213 |
| **Students** | 1,923 | 1,961 | 3,884 | 2,355 | 2,393 | 4,748 |

## Sample Student Characteristics

Exhibit D-2 presents student demographic characteristics for the treatment and comparison groups for the full and restricted near-cutoff samples when California schools are excluded. As in our primary sample specifications, we found no evidence of statistically significant differences in student characteristics across treatment and comparison groups.

**Exhibit D-2: Student Characteristics, Treatment vs. Comparison Group, Excluding California Schools**

| | Restricted Near-Cutoff Subsample (n=3,884) | | | Full Analytic Sample (n=4,748) | | |
|---|---|---|---|---|---|---|
| | Treatment Group | Comparison Group | P-Value for T-C Difference | Treatment Group | Comparison Group | P-Value for T-C Difference |
| **Gender** | | | | | | |
| Male | 43.6% | 43.6% | (0.991) | 43.7% | 44.7% | (0.558) |
| Female | 56.4% | 56.4% | | 56.3% | 55.3% | |
| **Grade Level** | | | | | | |
| 4th grade | 45.7% | 43.6% | (0.883) | 44.9% | 45.9% | (0.965) |
| 5th grade | 42.8% | 44.7% | | 43.7% | 42.8% | |
| 6th grade | 11.5% | 11.7% | | 11.4% | 11.3% | |
| **Race/Ethnicity** | | | | | | |
| Hispanic | 37.6% | 34.4% | (0.354) | 31.8% | 30.0% | (0.391) |
| Non-Hispanic Black | 30.3% | 24.9% | | 29.4% | 23.8% | |
| Non-Hispanic White | 25.9% | 33.3% | | 32.6% | 39.0% | |
| Other Race/Ethnicity | 6.2% | 7.4% | | 6.2% | 7.2% | |
| **FRPSL Status** | | | | | | |
| Eligible for Free Lunch | 71.7% | 67.4% | (0.442) | 69.4% | 64.7% | (0.290) |
| Eligible for Reduced-Price Lunch | 7.7% | 9.2% | | 7.8% | 9.1% | |
| Not FRPSL Eligible | 20.6% | 23.4% | | 22.8% | 26.2% | |
| Sample size | 1,923 | 1,961 | | 2,355 | 2,393 | |

Notes: There were no statistically significant differences in characteristics across treatment and comparison groups at the 95% confidence level. (Chi-square test, adjusting for clustering of students within schools.)

## Student Characteristics by Program Participation Level

Exhibits D-3 and D-4 present descriptive statistics on student characteristics by self-reported frequency of participation in FFVP.

Results in the sample excluding California schools do not materially differ from results for the primary sample as reported in Exhibits C-3 and C-4. For fruits, as in the primary sample specification, there is some weak evidence that girls participate more frequently in FFVP when offered than boys (p=0.083 in the restricted near-cutoff subsample excluding California schools; p=0.051 in in the full sample excluding California schools), and that students eligible for free- or reduced-price lunches participated more frequently than students not eligible for free- or reduced-price lunches (p=0.094 in the full analytic sample excluding California schools).

**Exhibit D-3: Descriptive Statistics, FFVP Students by Self-Reported Frequency of Participation, Fresh Fruits, Excluding California Schools**

| | Restricted Near-Cutoff Sample (n=1,875) | | | | | | Full Analytic Sample (n=2,302) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Takes Every Time | Takes Most Times | Takes Occasion ally | Never Takes | Hasn't Seen Offered | P-Value for Difference | Takes Every Time | Takes Most Times | Takes Occasion ally | Never Takes | Hasn't Seen Offered | P-Value for Difference |
| **All Students** | 47.5% | 37.7% | 10.7% | 2.5% | 1.7% | N/A | 47.1% | 38.4% | 10.7% | 2.3% | 1.5% | N/A |
| **Gender** | | | | | | | | | | | | |
| Male | 48.3% | 33.9% | 12.7% | 3.4% | 1.7% | (0.083) | 47.4% | 35.1% | 12.9% | 3.2% | 1.4% | (0.051) |
| Female | 46.9% | 40.5% | 9.1% | 1.7% | 1.7% | | 46.9% | 40.9% | 9.1% | 1.6% | 1.5% | |
| **Grade Level** | | | | | | | | | | | | |
| 4th grade | 50.0% | 35.3% | 10.5% | 2.7% | 1.5% | (0.628) | 49.9% | 35.8% | 10.4% | 2.6% | 1.4% | (0.700) |
| 5th grade | 46.7% | 38.5% | 10.2% | 2.7% | 1.9% | | 45.9% | 39.6% | 10.7% | 2.2% | 1.6% | |
| 6th grade | 40.6% | 43.9% | 13.2% | 0.5% | 1.9% | | 40.4% | 44.2% | 12.3% | 1.5% | 1.5% | |
| **Race/Ethnicity** | | | | | | | | | | | | |
| Hispanic | 47.0% | 37.7% | 11.8% | 2.7% | 0.9% | (0.541) | 47.3% | 37.8% | 11.5% | 2.6% | 0.8% | (0.776) |
| Non-Hispanic Black | 52.8% | 33.1% | 10.4% | 2.0% | 1.8% | | 51.3% | 34.4% | 10.8% | 1.9% | 1.6% | |
| Non-Hispanic White | 42.9% | 41.1% | 10.3% | 2.8% | 2.8% | | 43.5% | 41.6% | 10.5% | 2.4% | 2.0% | |
| Other Race/ Ethnicity | 45.3% | 44.4% | 6.8% | 1.7% | 1.7% | | 45.8% | 43.1% | 7.6% | 2.1% | 1.4% | |
| **FRPSL Status** | | | | | | | | | | | | |
| Eligible for Free Lunch | 50.5% | 36.2% | 9.7% | 2.3% | 1.3% | (0.173) | 50.2% | 36.9% | 9.5% | 2.3% | 1.1% | (0.094) |
| Eligible for Reduced-Price Lunch | 39.9% | 43.9% | 12.2% | 1.4% | 2.7% | | 41.0% | 41.0% | 14.2% | 1.6% | 2.2% | |
| Not FRPSL Eligible | 40.2% | 40.2% | 13.6% | 3.3% | 2.8% | | 39.8% | 41.9% | 13.2% | 2.6% | 2.5% | |

Notes:
*Difference across participation levels statistically significant at 95% confidence level. (Chi-square test, adjusting for clustering of students within schools.)

**Exhibit D-4: Descriptive Statistics, FFVP Students by Self-Reported Frequency of Participation, Fresh Vegetables, Excluding California Schools**

| | Restricted Near-Cutoff Sample (n=1,872) | | | | | | Full Analytic Sample (n=2,299) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Takes Every Time | Takes Most Times | Takes Occasionally | Never Takes | Hasn't Seen Offered | P-Value for Difference | Takes Every Time | Takes Most Times | Takes Occasionally | Never Takes | Hasn't Seen Offered | P-Value for Difference |
| **All Students** | 30.0% | 32.7% | 22.1% | 11.3% | 3.9% | N/A | 29.6% | 33.3% | 22.0% | 11.4% | 3.8% | N/A |
| **Gender** | | | | | | | | | | | | |
| Male | 31.7% | 29.6% | 22.9% | 12.2% | 3.6% | (0.561) | 30.3% | 30.6% | 22.6% | 12.9% | 3.5% | (0.516) |
| Female | 28.7% | 35.1% | 21.5% | 10.6% | 4.1% | | 29.0% | 35.3% | 21.5% | 10.2% | 4.0% | |
| **Grade Level** | | | | | | | | | | | | |
| 4th grade | 33.3% | 31.4% | 20.6% | 11.2% | 3.5% | (0.814) | 33.3% | 32.0% | 20.7% | 10.9% | 3.2% | (0.617) |
| 5th grade | 28.1% | 33.4% | 22.7% | 11.5% | 4.4% | | 27.5% | 34.5% | 22.6% | 11.2% | 4.2% | |
| 6th grade | 23.9% | 35.2% | 26.3% | 10.8% | 3.8% | | 23.0% | 33.7% | 24.9% | 13.8% | 4.6% | |
| **Race/Ethnicity** | | | | | | | | | | | | |
| Hispanic | 26.0% | 34.7% | 24.7% | 12.1% | 2.6% | (0.443) | 26.3% | 34.6% | 24.4% | 12.3% | 2.5% | (0.472) |
| Non-Hispanic Black | 35.5% | 31.1% | 18.6% | 10.4% | 4.5% | | 34.8% | 32.1% | 18.4% | 10.5% | 4.2% | |
| Non-Hispanic White | 29.1% | 32.0% | 21.5% | 11.5% | 5.9% | | 28.2% | 33.0% | 22.0% | 11.6% | 5.3% | |
| Other Race/Ethnicity | 31.6% | 31.6% | 26.5% | 9.4% | 0.9% | | 29.2% | 33.3% | 27.1% | 9.7% | 0.7% | |
| **FRPSL Status** | | | | | | | | | | | | |
| Eligible for Free Lunch | 32.3% | 32.8% | 20.5% | 10.9% | 3.4% | (0.321) | 31.5% | 33.5% | 20.5% | 11.2% | 3.3% | (0.294) |
| Eligible for Reduced-Price Lunch | 23.8% | 30.6% | 29.9% | 13.6% | 2.0% | | 26.9% | 28.6% | 28.0% | 14.8% | 1.6% | |
| Not FRPSL Eligible | 24.6% | 33.0% | 24.8% | 11.5% | 6.1% | | 24.7% | 34.3% | 24.3% | 10.8% | 5.8% | |

Notes: There were no statistically significant differences in student characteristics across participation frequency levels at the 95% confidence level. (Chi-square test, adjusting for clustering of students within schools.)

# Regression Discontinuity Estimates

Exhibit D-5 provides RD estimates excluding and including the ranking variable, for both the full analytic sample and the “near-cutoff” sample of schools within two and a half percentage points of the FRPSL cutoff in each sample State, when California schools are dropped from the analysis.

Results excluding California schools are qualitatively similar to results for the sample including California. The point estimates for impacts on total fruit and vegetable consumption increase slightly (from 0.24 to 0.27 in our preferred near-cutoff specification excluding the ranking variable; range 0.26 to 0.28 across the four alternative specifications), and remain statistically significant ($p<0.001$) in all specifications. Point estimates for impacts on total energy intake range from 37 to 60 kilocalories when California is excluded from the sample; the impact on total energy intake is statistically significant at the 90% confidence level ($p=0.058$) only for the near-cutoff subsample including the ranking variable.

Finally, we note that when California schools are excluded there is some weak evidence in support of the need to include the ranking variable in the specification for total fruit and vegetable consumption in the full analytic sample (but not the restricted near-cutoff subsample, and not for either sample specification for total energy intake). The coefficient on the ranking variable in that specification is statistically significant at the 90% confidence level ($p=0.091$), though it does not meet the conventional 95% confidence level for statistical significance, and including the ranking variable does not materially impact the magnitude of the impact estimates.

**Exhibit D-5: Impact of FFVP on Consumption of Fruits and Vegetables and Total Energy Intake, Excluding California Schools**

| | Restricted Near-Cutoff Subsample (n=3,884) | | | | Full Analytic Sample (n=4,748) | | | |
|---|---|---|---|---|---|---|---|---|
| | No Ranking Variable | | With Ranking Variable | | No Ranking Variable | | With Ranking Variable | |
| | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) | Fruits and vegetables, cup-equivalents per day | Total energy per day (kcal) |
| Regression-adjusted mean, treatment group | 1.90 | 1972 | 1.90 | 1972 | 1.89 | 1973 | 1.90 | 1973 |
| (S.E.) | (0.06) | ( 29) | (0.06) | ( 29) | (0.05) | ( 25) | (0.05) | ( 25) |
| Regression-adjusted mean, comparison group | 1.63 | 1912 | 1.63 | 1913 | 1.62 | 1935 | 1.62 | 1936 |
| (S.E.) | (0.05) | ( 23) | (0.05) | ( 23) | (0.04) | ( 22) | (0.04) | ( 22) |
| Estimated impact (T-C) | 0.27 | 60 | 0.26 | 59 | 0.27 | 37 | 0.28 | 37 |
| {t-statistic} | {3.48} | {1.61} | {3.42} | {1.58} | {4.24} | {1.11} | {4.31} | {1.10} |
| (P-value) | (0.000)*** | (0.110) | (0.000)*** | (0.115) | (0.000)*** | (0.267) | (0.000)*** | (0.274) |
| Ranking variable | N/A | N/A | -0.07 | -12 | N/A | N/A | -0.04 | 5 |
| {t-statistic} | N/A | N/A | {-1.22} | {-0.35} | N/A | N/A | {-1.70} | {0.35} |
| (P-value) | N/A | N/A | (0.226) | (0.729) | N/A | N/A | (0.091)* | (0.728) |

Notes: Regression adjustment using characteristics of Impact Analysis sample.
Asterisks indicate statistical significance for regression coefficients: *p<0.10, **p<0.05, ***p<0.01. (One-sided test for increase in fruit and vegetable consumption; two-sided tests for total energy intake and for ranking variable.)