

# Increasing Child Fruit and Vegetable Intake: Findings from the US Department of Agriculture Fresh Fruit and Vegetable Program



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## ABSTRACT

**Background** Fewer than 10% of US children and adolescents consume the recommended amounts of fruits and vegetables (F/V). The US Department of Agriculture's Fresh Fruit and Vegetable Program (FFVP) is intended to increase child F/V consumption by funding low-income schools to distribute free fresh F/V snacks outside of school mealtimes.

**Objective** The evaluation assessed FFVP effects on student F/V consumption and total energy intake in and out of school.

**Design** The evaluation employed a regression discontinuity design; that is, cross-sectional comparisons of a sample of students in schools just above and just below the FFVP funding cutoff for the program, which depended on the proportion of students eligible for free or reduced-price meals. During the 2010–2011 school year within a randomly selected sample of states, we selected schools in closest proximity to each state-specific FFVP funding cutoff. Interviewers conducted 24-hour diary-assisted recall interviews to assess dietary intake among children in selected schools.

**Participants/setting** Participants were 4,696 students (grades 4 to 6) from 214 elementary schools in 16 randomly selected states.

**Statistical analyses performed** Analysis proceeded via multivariate regression, comparing adjusted mean student intake in schools just above and just below the funding cutoff.

**Results** Adjusted mean daily F/V intake was one-third of a cup per day higher in FFVP-participating schools than in nonparticipating schools (0.32 cups per day;  $P < 0.001$ ), a difference of 15.5%. This included one-quarter cup higher daily F/V intake during school hours (0.26 cups;  $P < 0.001$ ) among students attending FFVP-participating schools. Fresh (but not total) F/V consumption also increased outside of school.

**Conclusions** The FFVP increases child fresh and total F/V intake in school, and fresh F/V intake outside of school.

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THE 2010 DIETARY GUIDELINES FOR AMERICANS provide recommendations for fruit and vegetable (F/V) intake depending on age, sex, and activity level.<sup>1</sup> For elementary school–aged children, recommended F/V intake ranges from 2½ cup-equivalents per day (for a sedentary 5-year-old boy or girl taking in 1,200 calories per day) up to 5 cup-equivalents per day (for an active 10- or 11-year-old boy taking in 2,200 calories per day), where 1 cup-equivalent is equal to two servings.<sup>1</sup> With <10% of US children and adolescents consuming recommended amounts of F/V,<sup>2,3</sup> increasing F/V consumption is a potentially important strategy for improving diet quality in this group.<sup>4</sup>

Epidemiologic studies have shown that increased consumption of F/V is associated with a reduction in long-term risk of obesity.<sup>5,6</sup> Because F/V 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 F/V to the diet have demonstrated short-term effectiveness in reducing body weight, particularly when paired with advice to reduce dietary fat and/or overall energy intake.<sup>7–9</sup> In addition, epidemiologic and cohort studies have consistently found a relationship between increased F/V consumption and reduced risk of heart disease and some cancers.<sup>10–12</sup>

For many students, a large share of total daily food and nutrients<sup>13,14</sup> and most F/V<sup>15</sup> are eaten at school. School is, therefore, a promising context in which to intervene to increase child F/V intake.<sup>16–18</sup> The US Department of Agriculture (USDA) funds the Fresh Fruit and Vegetable Program (FFVP) as one component of broader school-based efforts to improve child nutrition. The FFVP is intended to increase student F/V intake while teaching children more healthful eating habits.

FFVP is offered in selected low-income elementary schools with high rates of free and reduced-price meal enrollment. Participating elementary schools are reimbursed for providing fresh F/V to students during the school day, outside of normal school breakfast and lunch meals.

Under the 2008 Farm Bill,<sup>19</sup> the Richard B. Russell National School Lunch Act<sup>20</sup> was amended to authorize the expansion of the existing FFVP pilot to selected schools nationwide. Initial funding for the program was \$40 million during the 2008-2009 school year, increasing to \$65 million in 2009-2010, and then to \$101 million in 2010-2011, the year in which data for this evaluation were collected. Funding increased to \$150 million in the 2011-2012 school year, to continue at that level thereafter, indexed for inflation. Funding is to be allocated “to schools with the highest percentages of low-income students, to the maximum extent practicable” (language is from the legislation). Currently, only elementary schools are eligible for FFVP.

In practice, elementary schools within each state apply to the State School Food Authority for FFVP funding. The School Food Authority reviews each school's application, rejecting those not meeting secondary criteria (eg, ability to run such a program). Among accepted applications, schools are then ranked by the proportion of children eligible to receive free or reduced-price lunches, with funding ultimately allocated to those schools with the highest proportions of free or reduced-price lunch-eligible students.<sup>21</sup>

The FFVP provides participating schools with \$50 to \$75 per student per year—roughly \$2 per student per week—for the purchase, preparation, and serving of fresh F/V. Schools are granted substantial discretion in implementation, with no target number of F/V servings or specific types of F/V to be provided. Regulations require that the fresh F/V must be served outside of school meals, but there are no rules about how frequently or at what times of day they should be offered.

However, schools are explicitly encouraged to distribute a wide variety of fresh F/V, at least two times per week, including new and unusual F/V to which students might not otherwise be exposed. Evidence from surveys of school staff during the 2010-2011 school year suggested that the variety goal was met. Apples and carrots were the most commonly served items, and grapes, oranges, bananas, melons (cantaloupe or honeydew), strawberries, tomatoes, celery, broccoli, and cucumber were also common.<sup>21</sup>

In addition, FFVP F/V are to be prepared and presented to maximize convenience and appeal whenever possible. This may include pre-slicing or cutting F/V to make them easier for students to eat. In addition, schools are encouraged to provide complementary nutrition education and to establish partnerships with a variety of organizations to aid in program implementation and operation.<sup>22</sup>

The FFVP authorizing legislation mandated an evaluation of the program to determine whether children experienced, as a result of participating in the program, increased consumption of F/V and other dietary changes. One component of the evaluation estimated the effect of FFVP on student dietary intake. By “effect,” we mean outcomes under FFVP relative to what outcomes would have been without FFVP, holding all else equal (sometimes called “impact” or “causal impact”). The FFVP is theorized to increase F/V consumption both directly, through student consumption of the free F/V snacks,

and indirectly, through improvements in student familiarity with and preferences toward F/V as a consequence of increased exposure and related nutritional education.

To provide additional evidence on these two possible mechanisms of action, dietary intake was examined both inside and outside school hours. While an observed increase in F/V intake during school hours might plausibly be attributed to the direct effect of FFVP (ie, the consumption of the FFVP snacks), any increase outside of school hours would be taken as evidence of program effects through indirect mechanisms. In addition, food consumption outside of school might plausibly decrease as a result of the program if FFVP snacks replace other foods in student diets in whole or in part.

## METHODS

This evaluation estimated the effect of FFVP using regression discontinuity, which is widely considered to be the strongest possible design for estimating program effects (ie, “causal impacts”) when random assignment is not feasible.<sup>23-26</sup> In fact, inferences from a properly implemented regression discontinuity design are considered to have internal validity similar to a randomized experiment.

As noted here, the FFVP legislation requires that available FFVP funding be allocated in each state to the schools with the highest proportion of low-income students, as proxied by the proportion of free or reduced-price lunch-eligible students. This requirement simultaneously precluded the possibility of random assignment and facilitated application of regression discontinuity methods. In particular, the regression discontinuity approach leveraged the procedure by which schools are assigned to participate in FFVP by comparing schools immediately above and immediately below the funding cutoffs in each of the sampled states during the 2010-2011 school year. Those schools differed in whether they received FFVP, but were likely to be otherwise similar.

## Sampling

In support of the planned regression discontinuity analyses, the sampling plan purposively sampled the applicant elementary schools that were closest to the state-specific funding cutoff during the 2010-2011 school year. In the first stage of sampling, 16 states were randomly selected from the 48 contiguous states and Washington, DC, using probability proportional to size sampling within strata defined by Census region and percentage of children who are non-Hispanic white. In the second stage, 256 applicant schools closest to each state-specific FFVP funding cutoff were then selected: 128 schools participating in FFVP directly above the cutoff and 128 nonparticipating schools directly below the cutoff. More schools were sampled in larger states and fewer schools in smaller states. In the third stage, three classrooms in each school were randomly selected from grade levels eligible for the evaluation (grades 4, 5, and 6); the evaluation focused on these higher elementary grade levels because children in those older grades are cognitively better able to report on dietary intake compared to younger children.

In the final stage, 10 students were randomly selected from each of these classrooms, and interviewers attempted to complete interviews with at least eight of these students (to allow for student absences, lack of parental consent, and

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