The Impact of the Updated National School Lunch Program Meal Standards on Fruit and Vegetable Consumption Among Elementary School Students in Cache County Utah

Jillian C. Fox
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THE IMPACT OF THE UPDATED NATIONAL SCHOOL LUNCH PROGRAM MEAL STANDARDS
ON FRUIT AND VEGETABLE CONSUMPTION AMONG ELEMENTARY SCHOOL
STUDENTS IN CACHE COUNTY UTAH

by

Jillian C. Fox

A thesis submitted in partial fulfillment of the requirements for the degree
of
MASTER OF SCIENCE
in
Nutrition and Food Sciences

Approved:

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Heidi Wengreen, PhD          Gregory Madden, PhD
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                               Dean of the School of Graduate Studies

UTAH STATE UNIVERSITY
Logan, Utah
2015
ABSTRACT

The Impact of the Updated National School Lunch Program Meal Standards on Fruit and Vegetable Consumption Among Elementary School Students in Cache County Utah

by

Jillian C. Fox, Master of Science
Utah State University, 2015

Major Professor: Dr. Heidi J. Wengreen
Department: Nutrition, Dietetics, and Food Science

Due to a mandate from the Healthy, Hunger-Free Kids Act of 2010, the US Department of Agriculture updated and implemented the National School Lunch Program meal standards beginning school year 2012-2013. The new guidelines require schools to offer students a larger quantity and variety of fruits and vegetables (F/V) to improve F/V consumption and support the reduction of childhood obesity rates in the United States. The objective of the current study was to determine the effectiveness of these program updates on F/V consumption in an elementary school population.

Data from this secondary analysis were from a follow-up randomized trial of the Food Dudes program, an incentives-based program aiming to increase F/V consumption among elementary students. The follow-up trial spanned the final year of the old standards (fall 2011 to spring 2013) and the implementation of the new standards (fall...
2012 to spring 2013). Participants for the study included 1st through 5th graders (n=1551) from four schools in Cache County, UT. Schools were randomized to receive one of three treatments: control, praise, or incentives. F/V consumption was measured via digital photo analysis in cups per day. GLM repeated measures analyses were conducted to determine change in consumption over four time points and the interaction effects of gender, grade, and condition.

Results indicated combined F/V consumption decreasing initially over time with the implementation of the updated standards among nearly all grade and condition groups (P<.001 and P=.002, respectively). However, consumption increased significantly (P=.02) from spring 2012 to spring 2013, indicating that participants were actually consuming more in the spring after than the spring before the new standards. Additionally, vegetable consumption increased by 30% from fall 2012 to spring 2013 (P=.007). F/V consumption among the incentives group increased significantly at each time point, while consumption decreased for both the praise and control groups.

Despite initial decreases in F/V consumption in most groups, promising trends were observed over time which indicate that students are adjusting to the updated standards. Also, participation in the incentives group of the Food Dudes program negated the decrease in consumption that was observed among other conditions.
PUBLIC ABSTRACT

The Impact of the Updated National School Lunch Program Meal Standards on Fruit and Vegetable Consumption Among Elementary School Students in Cache County Utah

Jillian C. Fox

Due to the short time the updated National School Lunch Program standards have been in place since fall of 2012, few research studies have explored what effect these new standards have had on fruit and vegetable (F/V) consumption, particularly among elementary school students. Because the new standards require schools to offer students more F/V than before, researchers are interested to know if F/V consumption has indeed increased.

The participants in the study were enrolled in a program to motivate students to eat more F/V – the Food Dudes program. The results of the data analysis found that most students, regardless of grade, were eating less F/V initially after the new standards were in place. However, the group of students receiving prizes from the Food Dudes program actually ate more F/V over time instead of less. Also, F/V consumption for the first spring under the new standards did not decrease as much as it had during the spring under the old standards.

These results indicate that, despite initial declines in F/V consumption, students could be adjusting to the updated standards. Also, students who have participated in the incentives group of the Food Dudes program did not show a drop in F/V
consumption, even during the first semester the new standards were in place. Future studies should look at the current F/V intake of students under the updated guidelines now that they have been in place for several school years, as well as at additional intervention programs to increase F/V consumption among this population.
ACKNOWLEDGMENTS

First, I would like to give a huge ‘Thank You’ to Dr. Heidi Wengreen, who was willing to take me on as her graduate student, especially under my unique circumstances. She provided excellent support in helping me navigate the new worlds of graduate school and research writing. I am also thankful to the other members of my committee, Dr. Greg Madden and Sheryl Aguilar, for providing me with the necessary feedback and advice that made this end product a success. Finally, I would like to thank my understanding and encouraging husband, who never complained about the late nights, crappy dinners, or non-stop talk about “school lunch.” You’re next, love!

Jillian C. Fox
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CHAPTER 1

INTRODUCTION AND BACKGROUND

Abstract

The updated meal standards for the National School Lunch Program (NSLP) by the United States Department of Agriculture aim to address the alarming rate of childhood obesity in America, in part by providing program participants with an increased quantity and variety of fruits and vegetables (F/V), as these are two food groups students are lacking adequate consumption of. A follow-up study implementing The Food Dudes program, an incentives-based program designed to increase F/V consumption among elementary students, was conducted among six elementary schools in Cache County, UT. The study followed participants throughout the school years prior to and just after the new meal standard implementation. This secondary analysis examined the impact that the updated NSLP standards had on F/V consumption among Food Dude program participants, specifically investigating the main effect of consumption over four specific time points and the interaction effect of gender, grade, and treatment condition (control, praise, incentives) within the study.

Introduction

On January 26, 2012, the United States Department of Agriculture (USDA) finalized the updated standards for the National School Lunch (NSLP) and School Breakfast Programs, complete with restructured meal patterns and updated nutrition standards to be implemented in schools across the nation beginning July 1, 2012.¹
Mandated by the Healthy, Hungry-Free Kids Act of 2010, the standards were revised to address the increase of childhood obesity as well as more closely align with the current Dietary Guidelines for Americans (DGAs).²

Fruit and vegetable (F/V) consumption prior to the implementation of the new standards was well below recommended levels among school-aged children. According to a 2008 report, 64% and 70% of students did not consume any vegetable or fruit at lunch, respectively, with improved intake needed of vitamins A, C, and E, magnesium, phosphorus, potassium, and dietary fiber, which are commonly found in F/V.³ Another report found inadequacies among school-aged children in consumption of vegetables (including greens), beans, whole grains, seafood and plant proteins, and beneficial fatty acids when compared to DGAs.⁴ In response to these reports, the updated NSLP standards require more F/V be offered and served to students.

As the updated nutrition standards have only been in use for two complete school years, few observational research studies have been published on the effect these new standards have on consumption, specifically of F/V, though participation numbers in the program have been published. A report from the Government Accountability Office published in January 2014 indicated that participation in the NSLP had dropped by 3.7% since new standard implementation,⁵ with subsequent reports documenting a continued decrease in participation.⁵ The purpose of this study is to expand the current literature base concerning the effectiveness of the updated NSLP standards, specifically on consumption of F/V among elementary school students.
Background and Literature Review

**Program standards and updates.** The NSLP is a federally funded, state-run program whose aim is to provide per-meal reimbursements to schools that serve students lunches that meet specific nutrient requirements. First authorized under the National School Lunch Act of 1946, the NSLP was established to protect the health of children by helping schools provide a nutritious lunch partly through the use of agricultural commodities. Under this act, the Secretary of Agriculture was to decide upon the nutritional requirements that meals would need to meet based on current nutrition research with a focus on preventing malnourishment. Subsequent legislation further expanded the NSLP to include breakfast and special milk programs.\(^7\)

The NSLP was updated in 1994 via the Healthy Meals for Healthy Americans Act, which required the reimbursable meals served to conform to the DGAs.\(^8\) The program was again updated in the Healthy, Hunger-Free Kids Act of 2010 that mandated the meal patterns and nutrient standards of reimbursable meals be updated per recommendations from the Food and Nutrition Board, which were also based on current DGAs.\(^2\) As current nutritional challenges have shifted from potential malnutrition to the challenge of increasing overweight and obesity rates, the aim of this act was to help ameliorate childhood obesity through more nutritious school lunches.\(^2\)

Prior to the mandate of the Healthy, Hunger-Free Kids Act of 2010, the school lunch meal patterns and nutrient requirements were to account for one-third of the dietary needs of school-aged children over a five day average based on the dietary reference intakes (DRIs) and recommended dietary allowances (RDAs).\(^9\) Specific nutrient
recommendations were later established based on the 1995 DGAs. Meals were to meet a minimum level for calories and five specific nutrients (protein, vitamin A, vitamin C, calcium, and iron), all deemed necessary for proper growth and development.\textsuperscript{10} A maximum value was also set for saturated fat based on age-grade groups. Recommendations were made concerning cholesterol, sodium, and fiber, though these standards were not required to be implemented.\textsuperscript{10} A fruit or vegetable was to be offered to all students, though no requirement existed to mandate whether students must actually be served either a fruit or vegetable.\textsuperscript{11}

Despite the update of the NSLP guidelines to more closely align with the current DGAs, several studies indicated that school-aged children were not meeting these guidelines. The following studies were highly influential in effecting proposed legislation to reformulate the guidelines.\textsuperscript{12} A 2007 report titled \textit{School Nutrition Dietary Assessment Study} – III (SNDA-III), conducted by the Office of Research, Nutrition and Analysis of the U.S. Department of Agriculture (USDA), was to “provide up-to-date information on the school meal programs, the school environments that affect the food programs, the nutrient content of school meals, and the contributions of school meals to children’s diets”.\textsuperscript{13} Carried out over the course of SY 2004-05 among elementary, middle, and high schools, this nationally representative study used a series of surveys for school food authorities and individual school food service managers to gather information about foods offered and served and daily meal counts. Consumption was not examined in this study. On the student level, two 24-hour dietary recalls were administered, height and weight were measured, and a parent interview was conducted. Fruits and vegetables
were offered on 96% and 94% of the daily menus, respectively. Starchy vegetables and side green salads were the most commonly served vegetables, while canned sweetened peaches and fresh apples were most common in the fruit category. The average elementary school lunch served consisted of 676 calories, 25 grams of total fat (8 grams saturated fat), and 28 grams of protein. In general, lunches served met the recommendation for protein, vitamins A and C, calcium, and iron. However, only 10.7% of elementary school lunches served met all nutrient requirements due to most schools having lunches with energy from fat and saturated fat content exceeding recommended levels.

A 2008 report from the Food and Nutrition Service of the USDA examined overall quality and variety of school-aged children’s diets. Using 24-hour recall data from the National Health and Nutrition Examination Survey (NHANES), the report compared participants in the NSLP to non-participants in the categories of micro- and macronutrient intake and intakes from specific food groups. When applicable, intake was compared to the DRIs, Estimated Average Requirements (EARs), and DGAs to check for adequacy. Among students ages 9-18, the study found a need for improved intake of vitamins A, C, and E, magnesium, phosphorus, calcium, potassium, and dietary fiber. Among adolescent girls (ages 14-18) specifically, vitamin B₆, iron, folate, zinc, and protein were below desired levels. Major gaps were seen in consumption at lunch when compared to recommendations. Only 3% of the population consumed whole grains, and 64% and 70% of students reported consuming no vegetable or fruit at lunch, respectively, with dark green and orange vegetables among the least consumed.
subgroups. Also, 85% of students had energy intake from saturated fat greater than the DGA recommendation.  

The Healthy Eating Index-2010, which is a report of overall diet quality, also used NHANES data from 2003-2008 to assess children’s diets in the United States. The report found inadequacies in consumption of vegetables (including greens), beans, whole grains, seafood and plant proteins, and beneficial fatty acids. Levels of refined grains, sodium, and empty calories were also above levels recommended in the 2010 DGAs.  

After the Healthy, Hunger-Free Kids Act of 2010 was passed, the NSLP standards were reviewed and revised to reflect current nutrition research, which was published in “School Meals: Building Blocks for Healthy Children,” a comprehensive report written by the Institute of Medicine to “establish criteria for nutrient targets and meal standards” for the NSLP. The report also outlines recommended new meal patterns for the program. “School Meals” was based on the 2005 DGAs, however, the 2010 DGAs were released just after the first draft of “School Meals” was released, and they were considered in the final draft. Committee members reviewed SNDA-III and NHANES Diet Quality of School-Age Children to establish which nutrients were failing to meet established benchmarks. The revised guidelines were to address these inadequacies as well as concerns of overconsumption of other nutrients.  

The revised standards were finalized on January 26, 2012, after allowing the public to comment for 90 days on the proposed new rules. The revised guidelines became effective March 26, 2012, with compliance to begin July 1, 2012. Overarching themes of the guidelines are to increase the availability of specific food groups (fruits,
vegetables, whole grains, fat-free and low-fat milk) in school meals while reducing levels of others (sodium, saturated fat, and trans fat) all within a specified calorie limit with an established minimum and maximum. “These improvements to the school meal programs . . . are expected to enhance the diet and health of school children, and help mitigate the childhood obesity trend.”

The revised meal patterns are food-based, as opposed to previous nutrient-based guidelines. Specific nutrient requirements that are to be met include calories, saturated fat as a percentage of total energy, trans fat, and sodium (see Table 1-1). An ounce equivalent system is used for the rest of the nutrients based on pre-determined nutrient levels found in common items served for school lunch published in the “Food Buying Guide for Child Nutrition Programs.”

Significant changes were made to the fruit and vegetable meal components in the new standards. Fruits and vegetables are considered separate meal components. Qualifying fruit can be canned in fruit juice, water, light syrup, frozen without added sugar, dried, or 100% fruit juice, though juice can only account for half of the total weekly cup requirements. Vegetable sub-groups are now required (dark green, red/orange, beans and peas (legumes), starchy, and other), which mirror the subgroups found in the DGAs. Minimum cup requirements are set for each subgroup to be met throughout the week. Specific age-grade cup requirements include: K-5 = 2 ½ cups minimum fruit per week (1/2 cup per day), 3 ¾ cups minimum vegetables per week (3/4 cup per day). Under offer v. serve (OVS), students are only required to take ½ cup of
either a fruit or vegetable component, though the full daily portion minimum amounts must still be offered.¹

### Table 1-1 – Comparison of the Previous and Current National School Lunch Program Meal Standards

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Previous requirements K-5</th>
<th>Current requirements K-5</th>
</tr>
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<tbody>
<tr>
<td>Fruits</td>
<td>½ to ¾ cup <strong>combined</strong> fruit and vegetable per dayᵇ</td>
<td>½ to 1 cup per day</td>
</tr>
<tr>
<td>Vegetables</td>
<td>No specifications of sub-groups</td>
<td>¾ to 1 cup per day, requirements in sub-group categoriesᶜ</td>
</tr>
<tr>
<td>Whole Grains</td>
<td>No requirement</td>
<td>As of July 1, 2014, all grains served must be whole grain rich</td>
</tr>
<tr>
<td>Fluid Milk</td>
<td>1 cup per day, variety of fat contents allowed with no restriction on flavor</td>
<td>1 cup per day, must be fat-free (unflavored or flavored), or low-fat 1% (unflavored)</td>
</tr>
</tbody>
</table>

**Specific Nutrient Standards (based on 5-day weekly average)**

<table>
<thead>
<tr>
<th></th>
<th>Minimum only (grade-based)</th>
<th>550-650 kcals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories</td>
<td>&lt;10% total calories</td>
<td>&lt;10% total calories</td>
</tr>
<tr>
<td>Saturated fat</td>
<td>≤1,230 mg as of July 1, 2014, final target of ≤640 mg to be met by July 1, 2022</td>
<td></td>
</tr>
<tr>
<td>Sodium</td>
<td>No requirement</td>
<td>0 g per servingᵈ</td>
</tr>
</tbody>
</table>

ªAdapted from “Nutrition Standards in the National School Lunch and School Breakfast Programs” and “Impact of the New U.S. Department of Agriculture School Meal Standards on Food Selection, Consumption, and Waste.”¹¹⁷

ᵇUnder OVS, students must be offered ½ to 1 cup of fruits and ¾ to 1 cup of vegetables per day, though must only select ½ cup of fruits or vegetables.

ᶜVegetable sub-groups include dark green, red/orange, beans/peas (legumes), starchy, and other.

ᵈProducts with less than 0.5 grams per serving count as 0

Initial reports of the effectiveness of the new meal standards demonstrated discouraging results. According to a Government Accountability Office report to Congress, participation in the NSLP dropped by 3.7 percent (1.2 million students).

Though this change was seen between three individual school years (2010-11, 2011-12, and 2012-13), participation dropped by 3.2% during SY 2012-13 alone. This participation drop was seen as a major concern, as, prior to this point, participation had steadily been
increasing for over ten years. According to survey data sent to school food authorities (authorities for administrating the NSLP) across the nation, students were less accepting of school lunches compliant with the new guidelines, including the change to whole-grain rich products, vegetable subgroups, and legume requirement.\(^5\)

Furthermore, according to the Food and Nutrition Service branch of the USDA, participation continued to fall by 1.46% in SY 2013-14 from the previous year. The majority of decreased participation was among students paying full price for their lunches, though slight increases in participation rates were seen among those receiving free lunches.\(^6\)

Currently, few published studies have detailed the effect the updated standards have had on consumption. One such study conducted in a low-income, urban area in Massachusetts examined the effect that the new guidelines had on consumption of individual meal components among students (n=1030) grades 1-8 in four elementary/K-8 schools. The study was a secondary analysis conducted on data collected via Project Modifying Eating and Lifestyles at Schools (MEALS), a kitchen-based school dietary intervention study. Two days of consumption in fall 2011 (before new guideline implementation) were compared to two days of consumption in fall 2012 (after implementation). Methods of the study included weighing each studied food item at the end of the meal and comparing this weight against an average pre-weight of each item to determine overall consumption. Only data from control schools were used to try to control for potential bias of a sample from an intervention school. Results showed 23% more students choosing fruit after updated standard implementation, though selection
of vegetables remained unchanged. Vegetable consumption increased from 0.13 cups/day to 0.31 cups/day. No significant change was found for fruit consumption from fall 2011 to fall 2012. Several other studies have examined the effect that the updated standards have had on plate waste, with findings of plate waste increasing after new standard implementation, especially for vegetables.

A survey study was conducted in the second half of SY 2012-13 (first year of implementation) to better understand perceptions of elementary school administrators and food service managers concerning the updated standards. A nationally representative sample of elementary schools (n=586) was selected to participate in the mail-in survey study. The survey asked questions concerning specific foods offered in lunch lines as well as questions specifically related to perceived responses to the updated standards. These questions included topics such as if more or less students are purchasing school lunch (includes free/reduced lunches), if amount of food students were consuming had changed, with other specific questions asked on a Likert scale including “Students generally seem to like the new school lunch,” “At first, students complained about the new lunches,” “Few students complain about the new lunches,” and “Most students don’t seem concerned about the changes in the school lunches.”

Most schools surveyed reported a minimal change in participation in the NSLP (4.3% reported perceptions that “a lot fewer” students purchased lunch) as well as minimal change in the percentage of food students were consuming. However, perceptions among rural schools revealed complaints from students about the new meals, as well as a lower number of students purchasing meals and lessened consumption of those
meals. Among schools with a higher degree of lower socioeconomic status, reported perceptions included more students purchasing and consuming school meals.\textsuperscript{20}

**A program to increase F/V consumption.** The Food Dudes Program (FD) is designed to increase fruit and vegetable consumption among school-aged children through repeated exposure, modeling, and rewards.\textsuperscript{21} The program was initiated and further tested in the United Kingdom,\textsuperscript{22} and has been expanded to the United States, specifically among elementary school students in Cache County, Utah. In a pilot study conducted by Wengreen et al., 253 students were repeatedly exposed to F/V and provided tangible prizes for tasting the foods. In order to qualify for a reward on subsequent days, students were required to gradually consume larger portions of F/V. Participants would also watch videos in the classroom about the “Food Dudes”, who were animated role-model characters that fought the vile “Junk Punks” by eating F/V, while motivating participants to do the same. Letters from the Food Dudes were also read to provide additional encouragement. Overall, F/V intake increased during the study, with the most notable increase seen among students that had no F/V consumption at baseline (0.49 cup per day increase).\textsuperscript{23}

Data for the current study is taken from a six school follow-up study of the initial FD pilot study in Cache Valley. The purpose of this follow-up study was to evaluate the sustainability of the FD program in maintaining elevated levels of fruit and vegetable (F/V) consumption above baseline levels. The six schools were separated into three categories: praise (n=668), incentives (n=913), and control (n=839), with two schools in each category.\textsuperscript{24}
Two baseline collections were taken during fall of SY 2011-12, with the intervention phase conducted during the spring of the same school year. Additional follow-up data was collected during SY 2012-13, the first year the new NSLP guidelines were in place. Digital photo data was used to document F/V consumption. A photo was taken just as the student exited the lunch line as well as after they had finished eating, just prior to clearing their tray. To ensure that pre- and post photos could be matched, each tray was tagged with the student’s ID number on a sticker. Among the control schools, consumption data was collected with no intervention to influence F/V intake. Students at the prize schools were rewarded for consuming prescribed amounts of targeted fruits and vegetables with a small tangible prize such as a bouncy ball or pencil. Research assistants observed children consuming F/V in the cafeteria and gave students a stamp on their hand to indicate if they had consumed the goal amount of F/V for the day. Teachers then gave students their reward in their classrooms. Among the praise schools, students were given praise by their teacher once back in the classroom if the student ate the required amount of F/V for that day.24

At least two trained observers, blinded to the condition and estimates of other observers, estimated F/V intake based on the pre- and post photos. Observers estimated intake to the nearest 0.13 cup (1/8 cup), which was determined to equal “2 child bite-sized pieces of fruit or vegetable.”24 The estimated intake was then averaged. If the number was off by more than 0.13 cup, a third observer examined the photos. If the number was still inconsistent, a trained Registered Dietitian (Sheryl Aguilar, MS, RD)
examined the photos and made a final decision on what to document for intake. Approximately 5% of the data required estimation by the RD.\textsuperscript{24}

**Dietary assessment methods.** In order to determine accurate estimates of dietary intake among school-aged children, an accurate assessment method is necessary. Several methods dominate among the current literature. The visual estimation method requires highly trained observers to record in real time the various components on each participant’s tray, as well as the amount uneaten (waste), usually reported as a percentage.\textsuperscript{25} Another method, weighed inventory, requires the weighing of a random selection of each item before service (pre-weight) and then weighing what’s unconsumed (post-weight) on each individual tray. This method is often considered time consuming, costly, and disruptive, though can be highly accurate.\textsuperscript{26} A third more-recent option for researchers includes taking digital photographs of each individual tray just as the student leaves the lunch line as well as after they have completed their lunch.

The visual estimation method has been validated by several studies. A study conducted in Nepal examined the efficacy of using visual estimation v. a weighed inventory of the items consumed. Eight trained observers estimated the weighed portion consumed of individual food items and compared these estimates against pre- and post-weights of each of the items throughout seventeen different testing situations. A strong relationship was seen among observed v. actual food weights (r=0.89), with observers tending to overestimate consumption rather than underestimate. The study also noted that smaller portions were more difficult to accurately visually estimate.\textsuperscript{25}
A study conducted by Williamson et al. explored the differences between digital photography, visual estimation, and weighed inventory as a means to estimate dietary intake in a cafeteria setting. Three researchers were trained on direct visual estimation, while three researchers analyzed pre- and post-photos to estimate intake to the nearest 10%. Both visual estimation and digital photography were highly correlated to weighed inventory \((r = 0.89-0.97)\). Though correlation coefficients were significantly higher among the direct visual estimation group compared to the digital photography group, the groups both yielded fairly accurate, not significantly different reports of total grams for food selection, plate waste, and intake.\(^{26}\)

Swanson has also published further evidence that digital photography is a viable option as a means for collecting dietary intake information in a school setting, especially in addressing the issue of strict schedules in school cafeterias.\(^{27}\) One disadvantage of the digital photography method includes the possibility of some items on the tray obscuring others from view, which is very difficult to correct as the photos are analyzed at a later time. It also may be difficult to determine accurate portion sizes if a reference photo is not provided. However, the digital photography method allows for researchers to gather intake data and analyze it at a later date, which helps to eliminate the difficulty of gathering accurate estimations in the rushed setting of a school cafeteria. The photos can also be saved and referred back to if a discrepancy needs to be further explored.

**Objective**

The objective of the proposed project is to determine the effect the National
School Lunch Program standards have on F/V consumption among elementary school children.

**Specific Aims**

SA1. Examine differences in F/V intake prior to the new NSLP guideline implementation (SY 2011-12) compared to F/V consumption post-implementation (SY 2012-13).

- Examine differences in F/V intake at B1 and P3 for the two control schools (Birch Creek and Millville) of the Food Dudes Intervention (n=839).
- Examine differences in F/V intake at B1, P2, P3, and P4 for one control school (Birch Creek, n=487). Comparisons between B1 to P3 (fall 2011 to fall 2012), P2 to P4 (spring 2012 to spring 2013), and P3 to P4 (fall 2012 to spring 2013) are all of interest to assess the effect of the new standards.

SA2. Determine the effect the school condition (control, FD praise, FD incentives) had on F/V intake post-implementation of the new standards.

- Examine differences in F/V intake at B1 and P3, P2 to P4, and P3 to P4 for one school from each condition with complete data (Birch Creek, Park, Canyon), assessing the condition-factor effect on F/V intake at these specific time points.

**Methods**

Participants are 1st through 5th grade students from six elementary schools in the Cache County School District and were recruited for a follow-up study of the FD program (SYs 2011-12 and 2012-13). Participants had the option to opt-out via parent consent.
form, though 92% participation was achieved (Table 1-2). Study included students participating in the NSLP as well as those eating home lunch. Three condition groups were randomly assigned, with two schools per group: praise, incentive, and control. Students in the praise group received verbal acknowledgement for consumption of F/V, while students in the incentive groups received small toy prizes as reinforcement.

<table>
<thead>
<tr>
<th>School</th>
<th>Condition</th>
<th>Total (n)</th>
<th>Baseline 1&lt;sup&gt;a&lt;/sup&gt; (n)</th>
<th>Baseline 2 (n)</th>
<th>Phase 1 (n)</th>
<th>Phase 2 (n)</th>
<th>Phase 3 (n)</th>
<th>Phase 4 (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunrise</td>
<td>Praise</td>
<td>412</td>
<td>384</td>
<td>387</td>
<td>360</td>
<td>333</td>
<td>333</td>
<td>NA</td>
</tr>
<tr>
<td>Providence</td>
<td>Incentive</td>
<td>457</td>
<td>422</td>
<td>422</td>
<td>425</td>
<td>402</td>
<td>336</td>
<td>NA</td>
</tr>
<tr>
<td>Birch Creek</td>
<td>Control</td>
<td>487</td>
<td>456</td>
<td>448</td>
<td>444</td>
<td>471</td>
<td>421</td>
<td>286</td>
</tr>
<tr>
<td>Millville</td>
<td>Control</td>
<td>352</td>
<td>315</td>
<td>306</td>
<td>299</td>
<td>321</td>
<td>285</td>
<td>NA</td>
</tr>
<tr>
<td>Park</td>
<td>Praise</td>
<td>256</td>
<td>251</td>
<td>250</td>
<td>240</td>
<td>208</td>
<td>238</td>
<td>121</td>
</tr>
<tr>
<td>Canyon</td>
<td>Incentive</td>
<td>456</td>
<td>431</td>
<td>427</td>
<td>427</td>
<td>419</td>
<td>355</td>
<td>269</td>
</tr>
</tbody>
</table>


The procedures and timeline for the FD study are as follows:

- **Baseline 1 (Fall 2011):** Participants received regularly scheduled F/V from the lunch menu. The same meals served during Baseline 1 were also served again during Phase 2. (4 days)
- **Baseline 2 (Fall 2011):** Participants received 60 mg of fruit and vegetable in addition to regularly served F/V from the lunch menu. Students who brought
home lunch were also served the additional F/V. F/V served during Baseline 2 were also served during Phase 1. (4 days)

- **Phase 1 (Fall 2011):** Participants were shown a video and/or read a letter of the FD prior to lunch. Additional F/V beyond the regularly scheduled lunch menu were served to all participants and were the same as those served during Baseline 2. Participants received hand stamps before exiting the lunchroom for consuming both fruits and vegetables at the goal level. Once back in the classroom, students with a hand stamp received praise or a prize from their teacher, depending on their school condition. Participants in the control schools received the same additional F/V as intervention schools, though were not provided with any letters, videos, hand stamps, or incentives. (16 days)

- **Phase 2 (Spring 2012):** Additional F/V were no longer provided, and participants were required to consume full portions of regularly-served F/V more frequently in order to receive a prize. Baseline 1 conditions were resumed after 3 months, and digital photos for intake estimation were taken the last three days of the phase. (remainder of SY 2011-12)

- **Follow-Up 1 (Fall 2012):** Baseline 1 conditions were followed. All participants during the previous school year were included in follow-up. 5th grade participants that matriculated to middle school were also included in follow-up. (3 days)

- **Follow-Up 2 (Spring 2013):** Identical methods to Follow-Up 1. (3 days)
To determine lunchtime dietary intake of F/V, digital photographs were taken of participants’ lunch trays as the student exited the lunch line and prior to clearing their tray and were analyzed according to the previously-stated method to determine consumption.

F/V intake will be quantified and compared in cups per day consumed. The distribution of the variables of interest will be examined for outliers and normalcy. Data with non-normal distributions will be altered to achieve normalcy, while outliers will be Winsorized to the highest value within three standard deviations of the mean. Analysis of variance (ANOVA) will be used to test associations between gender, grade, and condition (FD praise, incentive, control), and F/V consumption at Baseline 1 (fall 2011, prior to the implementation of the new standards) and Phase 3 (fall 2012, first semester of new guidelines). A repeated measures function in SPSS will be used to run mixed-design ANOVA and to examine links between condition and lunchtime F/V consumption over three specific times: fall 2011 to fall 2012, spring 2012 to spring 2013, and fall 2012 to spring 2013. Condition, grade, and gender will be identified as the between-subject factors. The interaction term for condition and F/V consumption at different time points will be included in the model. Statistical significance will be determined as p<0.05 and partial $\eta^2$ will be reported following Cohen’s convention for interpreting effect size with .01 = small, .06 = medium, and .14 = large.

References

1. Nutrition Standards in the National School Lunch and School Breakfast Programs;


4. United States Department of Agriculture, Center for Nutrition Policy and Promotion. Diet quality of children age 2-17 years as measured by the Healthy Eating Index-2010.


foodservice, school food environment, and meals offered and served.


19. Smith SL, Cunningham-Sabo L. Food choice, plate waste and nutrient intake of elementary- and middle-school students participating in the US National School


CHAPTER 2
THE EFFECT OF THE UPDATED NATIONAL SCHOOL LUNCH PROGRAM MEAL
STANDARDS ON FRUIT AND VEGETABLE CONSUMPTION IN AN ELEMENTARY SCHOOL POPULATION

Abstract

Objective: The purpose of this secondary analysis was to determine the effect of the updated National School Lunch Program meal standards on fruit and vegetable (F/V) consumption among an elementary school population.

Design: In this randomized trial, consumption data were gathered during school years 2011-2012 and 2012-2013 and were measured through digital photo analysis.

Participants: 1st through 5th grade students from two schools in Cache County, UT (n=808)

Main Outcome Measure: F/V consumption in cups per day

Analysis: GLM repeated measures was used to determine change in consumption over time and assess any interaction effects, with the significance threshold set at P<.05.

Results: From fall 2011 to fall 2012, consumption of F/V decreased significantly among both schools (P<.001), with consumption decreasing most dramatically among 5th grade participants (.45 to .22 cups per day, 51% decrease). From spring 2012 to spring 2013, F/V consumption increased significantly (P=.02), indicating that the previously observed decline in consumption from fall 2011 to spring 2012 by 26%
(P<.001) was less under the new standards. Also, vegetable consumption increased from fall 2012 to spring 2013 by 30% (P=.007).

Conclusions and Implications: Future research to understand current F/V consumption trends among similar populations and potential intervention programs to increase F/V consumption could be beneficial.

Introduction

In January of 2012, the National School Lunch (NSLP) and Breakfast Program (NSLP) nutrition standards with restructured meal patterns were finalized by the United States Department of Agriculture, with implementation of the new standards to begin July of 2012. The standards were required to be updated by the Healthy, Hungry-Free Kids Act of 2010 in an effort to address the increase of obesity observed among American children, as well as more closely match the current Dietary Guidelines for Americans.

Under the new standards, all food groups were adjusted to some extent. Some of the most dramatic changes were among the fruits and vegetables groups, as these were foods that children in America were not consuming in recommended amounts. One 2008 report based on the National Health and Nutrition Examination Survey noted that 64% and 70% of students surveyed did not consume any vegetable or fruit at lunch, respectively. Under the updated NSLP standards, program participants are being offered a larger quantity and variety of fruits and vegetables with the hope that consumption of these foods would increase.
As the revised standards have only been in place for two full school years (2012-2013, 2013-2014), the effect they have had, particularly on F/V consumption, has not been detailed extensively. A highly-publicized study by Cohen et al. conducted in a low-income urban area in Massachusetts found that 23% more students chose fruit post-implementation of the updated guidelines, though students’ selection of vegetables did not change. Fruit consumption did not significantly change between pre and post implementation, though a significant increase in vegetable consumption was found, from 0.13 cups/day to 0.31 cups/day. The current study will examine the same time frame that was used by Cohen et al. (fall 2011 compared to fall 2012) and will additionally explore the trend of F/V consumption into spring semester of 2013.

The purpose of the study was to determine the effectiveness of the updated NSLP standards in relation to the consumption of F/V among elementary school students. The new standards require schools to offer more fruits and vegetables to students than previously required; however, it is not known whether this change has increased F/V consumption. Thus, it is increasingly important to realize consumption trends post-implementation of the new standards in order to help nutrition educators understand where, and if, additional efforts are needed to continue improving children’s diet quality.

**Methods**

Original data for this secondary analysis is from a randomized trial of the Food Dudes program, an incentive-based intervention implemented among school-aged children with the aim to increase fruit and vegetable consumption through rewards,
modeling, and repeated exposure.\textsuperscript{8,9} Specifications and methods of the program have been detailed previously.\textsuperscript{10} Six schools with varying socioeconomic status were included in the Food Dudes study; two schools were randomized to the control condition, and four received one of the two variations of the Food Dudes program. Data used for this analysis are from the control schools.

Researchers met with school administrators during spring 2011, and schools with interest in the program were then randomly assigned to control or intervention groups. Passive, opt-out consent was obtained from a total of at least 92\% of the population at each school. The Institutional Review Board at Utah State University reviewed and approved the research protocol and passive consent procedure. All students in 1st through 5th grades were encouraged to participate in the study, including those who brought a lunch from home during any point of the study. The first year of the study (fall 2011 – spring 2012) was the final year of the old guidelines, with the follow-up year of the study (fall 2012 – spring 2013) occurring during the first year the updated guidelines were implemented.

Digital photography was used to assess intake of F/V.\textsuperscript{11,12} Participants’ student ID numbers were printed on small stickers attached to their tray to allow for correct grouping of before and after photos. A photograph using a handheld digital camera (Cannon Power Shot SD 1300 IS with 10.1-megapixel resolution) was then taken of each participant’s tray, with all food items in clear view, as they exited the lunch line as well as just before discarding their tray. Participants that brought a lunch from home placed all their lunch items on a labeled tray to be photographed as well.
The pre- and post-consumption photos were then analyzed by at least two trained observers to determine F/V intake. The observers were blinded to the estimates of other observers as well as the treatment level of the participant. Intake was estimated to the nearest 0.13 cup (1/8 cup) or piece of fruit or vegetable (baby carrot), which has been found to equal “2 child bite-sized pieces of fruit or vegetable.” An average of the intake was then found, and a third observer assessed the photos if the individual averages were off by more than 0.13 cup. A trained Registered Dietitian (Sheryl Aguilar, MS, RD) made the final decision on estimated F/V intake if additional inconsistencies arose, which was the case in approximately 5% of the data.

All F/V intake estimates were compared in cups per day consumed. Statistical analysis was performed using SPSS Statistics software (SPSS version 22.0, IBM). The variables of interest were first examined for normal distribution and constant variance. Any outliers outside three standard deviations of the mean will be Winsorized to improve possible skewness. The main effect of change in F/V consumption over time will be assessed using GLM repeated measures. Average change in F/V consumption from fall 2011 to fall 2012 among two control schools will first be examined. A second analysis will detail changes in consumption in one control school among four time points: fall 2011 to fall 2012, fall 2011 to spring 2012, spring 2012 to spring 2013, and fall 2012 to spring 2013. Only one school is used in the second analysis due to incomplete data across all time points in the second control school. Interaction effects for between-subject factors (gender, grade, and school) will be determined using between-within subjects ANOVA. The statistical significance threshold will be set as
p<0.05. Effect size will be reported via partial eta squared following Cohen’s convention, with .01 = small, .06 = medium, and .14 = large.14

Additionally, the participants that were in 5th grade during the first school year of the study (2011-2012) matriculated to middle school the following school year. Many of these participants were lost due to this change in school, and complete consumption data is not available for these participants for the 2012-2013 school year. The 5th grade participants will be included in all the analyses of interest that involve school year 2011-2012 only. However, because of the possible confounding issue that this change in school may involve, analyses will also be conducted excluding the 5th grade participants entirely from all time points examined.

Due to the nature of the consumption data in all three food groups (i.e. many participants had zero consumption of F/V at baseline, which is not abnormal for this population), the data set is highly skewed to the right. Because of this abnormal configuration, the data set does not comply with the assumption of normality and also violates the assumption of constant variance (verified with Levene’s Test of Equality of Error Variances). A transformation to adjust for the non-normality and heterogeneity of variance was not possible for the data set because of the amount of zeros in the set. A non-parametric test that does not require these assumptions to be valid (Wilcoxon rank sum test) was conducted on the data set with very similar levels of significance observed. However, using this non-parametric test would have greatly limited the strength and possible conclusions to be drawn from of the data set. Therefore, the repeated measures test was decided upon based on these constraints.
Results

Participants (n=808) were 1st through 5th grade students. The grade designation used to identify participants was the participants’ 2011-2012 school year grade regardless of students’ matriculation to the next grade during the follow-up school year (2012-2013). See Table 2-1 for participant demographics at baseline (fall 2011). Eighty-one cases were missing gender designation, though were still included in the analysis. One case was missing a grade designation and was excluded from the analysis and table below.

Table 2-1 – Fall 2011 Participant Demographics

<table>
<thead>
<tr>
<th>Grade (n)</th>
<th>Total n</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Male (n)</th>
<th>Female (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control 1</td>
<td>470</td>
<td>114 (24%)</td>
<td>84 (18%)</td>
<td>91 (19%)</td>
<td>90 (19%)</td>
<td>91 (19%)</td>
<td>224 (52%)</td>
<td>205 (48%)</td>
</tr>
<tr>
<td>Control 2</td>
<td>338</td>
<td>66 (20%)</td>
<td>84 (25%)</td>
<td>55 (%16)</td>
<td>67 (20%)</td>
<td>66 (19%)</td>
<td>146 (49%)</td>
<td>153 (51%)</td>
</tr>
</tbody>
</table>

Fall 2011 to fall 2012 for control 1 and control 2. From fall 2011 to fall 2012, a significant three-way interaction effect for the between-subject factors of grade* school was found after running a repeated measures analysis, which demonstrated a decrease in consumption among fruit (P=.003), vegetable (P=.01), and combined F/V (P<.001) groups (see Table 2-2), with a small to moderate effect size at all groups (partial η² = .020-.032). Overall, fruit consumption decreased by 13%, vegetable consumption by 42%, and combined F/V consumption by 27%. Figure 2-1 showcases the effect grade had
on combined F/V consumption. Fifth grade participants demonstrated the greatest change in average consumption over all three food groups, with combined F/V consumption dropping from .45 to .22 cups per day, a 51% decline. Consumption also varied by school, with a 51% (.37 to .18 cups per day) decline in consumption for combined F/V at school 2 compared to a 13% (.38 to .33 cups per day) decrease in consumption for combined F/V at school 1.

Table 2-2 – Average F/V Consumption from Fall 2011 to Fall 2012 for Two Control Schools (n=668)

<table>
<thead>
<tr>
<th></th>
<th>Fall 2011 Mean_{ab} (SD)</th>
<th>Fall 2012 Mean_{ab} (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect size_{c}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.24 (.26)</td>
<td>.21 (.22)</td>
<td>-13%</td>
<td>.003</td>
<td>.024</td>
</tr>
<tr>
<td>Vegetable</td>
<td>.12 (.20)</td>
<td>.07 (.12)</td>
<td>-42%</td>
<td>.01</td>
<td>.020</td>
</tr>
<tr>
<td>Combined</td>
<td>.37 (.34)</td>
<td>.27 (.28)</td>
<td>-27%</td>
<td>&lt;.001</td>
<td>.032</td>
</tr>
</tbody>
</table>

*a* In cups consumed per day

*b* The overall means are from the GLM repeated measures analysis of variance model that included gender, grade, and school.

*c* .01 = small, .06 = medium, and .14 = large

![Figure 2-1](image-url)
Conducting the same analysis excluding the 5th grade group yielded similar results. Consumption decreased significantly for all three food groups with the following significant interactions: time*school for the fruit group, time*grade and time*school independently for the vegetable group, and time*school for the combined F/V group (see Table 2-3). The interaction effects of grade for the fruit and combined F/V groups were lost with the exclusion of the 5th graders, though the effect sizes for these two groups were strengthened in exchange. Figure 2-2 showcases the time*grade interaction effect for the vegetable group, with the most dramatic decrease found for the 3rd graders (.16 to .06 cups per day, 63%).

Table 2-3 – Average F/V Consumption from Fall 2011 to Fall 2012 for Two Control Schools Without 5th Graders (n=550)

<table>
<thead>
<tr>
<th>Group</th>
<th>Fall 2011 Mean_{ab} (SD)</th>
<th>Fall 2012 Mean_{ab} (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect size_{c}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.23 (.25)</td>
<td>.22 (.23)</td>
<td>-4%</td>
<td>&lt;.001</td>
<td>.044</td>
</tr>
<tr>
<td>Vegetable</td>
<td>.12 (.19)</td>
<td>.06 (.11)</td>
<td>-50%</td>
<td>.002</td>
<td>.027</td>
</tr>
<tr>
<td>Combined</td>
<td>.36 (.33)</td>
<td>.29 (.27)</td>
<td>-19%</td>
<td>&lt;.001</td>
<td>.084</td>
</tr>
</tbody>
</table>

*a In cups consumed per day

*b The overall means are from the GLM repeated measures analysis of variance model that included gender, grade, and school.

c .01 = small, .06 = medium, and .14 = large
Fall 2011 to fall 2012 for control 1. For control school 1 from fall 2011 to fall 2012, F/V consumption decreased for each food group (see Table 2-4). A significant interaction effect for time*grade was found among all three food groups (fruit $P < .001$, vegetable $P = .01$, combined F/V $P < .001$). Small to medium effect sizes were found for this comparison, with the largest effect size at the fruit group (partial $\eta^2 = .109$). 5th grade participants continued to demonstrate the largest decrease in consumption (.34 to .13 cups per day, 62% decrease), which appeared to drive the effect size. All other grades showed increased fruit consumption, with 3rd graders demonstrating increased consumption from .23 to .31 cups per day, a 26% increase (see Figure 2-3). From fall 2011 to fall 2012, vegetable consumption decreased in all grades except 1st, and combined F/V consumption showed a mixed effect, with consumption increasing for 1st, 2nd, and 3rd graders and decreasing for 4th and 5th graders.
Table 2-4 – Average F/V Consumption from Fall 2011 to Fall 2012 for One Control School (n=407)

<table>
<thead>
<tr>
<th></th>
<th>Fall 2011 Meanab (SD)</th>
<th>Fall 2012 Meanab (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect sizec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.27 (.27)</td>
<td>.26 (.24)</td>
<td>-4%</td>
<td>&lt;.001</td>
<td>.109</td>
</tr>
<tr>
<td>Vegetable</td>
<td>.11 (.19)</td>
<td>.08 (.14)</td>
<td>-27%</td>
<td>.01</td>
<td>.030</td>
</tr>
<tr>
<td>Combined</td>
<td>.38 (.33)</td>
<td>.34 (.29)</td>
<td>-11%</td>
<td>&lt;.001</td>
<td>.098</td>
</tr>
</tbody>
</table>

aIn cups consumed per day
bThe overall means are from the GLM repeated measures analysis of variance model that included gender and grade.
c.01 = small, .06 = medium, and .14 = large

Without the 5th grade students, fruit and combined F/V consumption increased, while the consumption of vegetables was similar among both analyses, though the change in consumption for combined F/V was not significant (see Table 2-5). A significant time*grade interaction effect was found for the vegetable group, with 3rd
and 4th grade students’ consumption decreasing, while participants in 1st and 2nd grades had stable or slightly increased consumption (see Figure 2-4).

Table 2-5 – Average F/V Consumption from Fall 2011 to Fall 2012 for One Control School Without 5th Graders (n=331)

<table>
<thead>
<tr>
<th></th>
<th>Fall 2011 Mean(ab) (SD)</th>
<th>Fall 2012 Mean(ab) (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect size(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.25 (.25)</td>
<td>.29 (.24)</td>
<td>+14%</td>
<td>.02</td>
<td>.018</td>
</tr>
<tr>
<td>Vegetable</td>
<td>.10 (.17)</td>
<td>.07 (.13)</td>
<td>-30%</td>
<td>.008</td>
<td>.035</td>
</tr>
<tr>
<td>Combined</td>
<td>.35 (.31)</td>
<td>.36 (.28)</td>
<td>+3%</td>
<td>.57</td>
<td>.001</td>
</tr>
</tbody>
</table>

\(a\) In cups consumed per day  
\(b\) The overall means are from the GLM repeated measures analysis of variance model that included gender and grade.  
\(c\) .01 = small, .06 = medium, and .14 = large

Fall 2011 to spring 2012 for control 1. For control school 1 from fall 2011 to spring 2012, F/V consumption decreased significantly for all three food groups (see Table 2-6). The significant interaction effect of time*grade was only found for the
vegetable group, though a significant decrease in consumption over time was found for the fruit and combined F/V groups. Moderate effect sizes were noted for fruit and combined F/V groups (partial $\eta^2 = .060$ and .066, respectively). For the vegetable group, consumption decreased for 5th, 4th, and 3rd graders by 21%, 65%, and 40%, respectively. However, vegetable consumption increased slightly for 1st graders by 16% and for 2nd graders by 21% (see Figure 2-5). Nonetheless, the effect of these increases in consumption was negated for combined F/V with overall consumption on a steady decline.

Table 2-6 – Average F/V Consumption from Fall 2011 to Spring 2012 for One Control School (n=449)

<table>
<thead>
<tr>
<th></th>
<th>Fall 2011 Meanab (SD)</th>
<th>Spring 2012 Meanab (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect sizec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.27 (.26)</td>
<td>.19 (.24)</td>
<td>-30%</td>
<td>&lt;.001</td>
<td>.060</td>
</tr>
<tr>
<td>Vegetable</td>
<td>.11 (.19)</td>
<td>.08 (.17)</td>
<td>-27%</td>
<td>.008</td>
<td>.031</td>
</tr>
<tr>
<td>Combined</td>
<td>.38 (.33)</td>
<td>.28 (.30)</td>
<td>-26%</td>
<td>&lt;.001</td>
<td>.066</td>
</tr>
</tbody>
</table>

a In cups consumed per day
b The overall means are from the GLM repeated measures analysis of variance model that included gender and grade.
c .01 = small, .06 = medium, and .14 = large
Excluding the 5th grade participants at this time point yielded very similar results to the previous analysis. Consumption of all food groups decreased significantly across the two time points, and a significant time*grade interaction effect was observed for the vegetable and combined F/V groups (see Table 2-7). Figure 2-6 demonstrates the interaction plot for the time*grade effect for the vegetable group, and, while all grade groups had decreased consumption, the most dramatic drop (48%) was observed for the 4th grade participants.

Figure 2-5 – Average Vegetable Consumption from Time 1 (Fall 2011) to Time 2 (Spring 2012) by Grade for One Control School (n=449)
Spring 2012 to spring 2013 for control 1. From spring 2012 to spring 2013, consumption increased significantly among all three food groups, though with only small effect sizes (see Table 2-8). A significant interaction effect for time*grade (P=.04) was only found for the vegetable group, though the main effect of consumption increasing over time was still significant for the fruit and combined F/V groups (P=.04)
Vegetable consumption increased most dramatically for 4th graders, from .04 to .12 cups per day (67% increase), with 1st graders following with a 33% increase. 2nd graders vegetable consumption dropped by 14% at this time point (see Figure 2-7). 5th graders were excluded from this analysis due to high levels of missing data for spring 2013.

**Table 2-8 – Average F/V Consumption from Spring 2012 to Spring 2013 for One Control School**

<table>
<thead>
<tr>
<th></th>
<th>Spring 2012 Meanab (SD)</th>
<th>Spring 2013 Meanab (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect sizec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit (n=284)</td>
<td>.18 (.23)</td>
<td>.21 (.20)</td>
<td>+14%</td>
<td>.04</td>
<td>.015</td>
</tr>
<tr>
<td>Vegetable (n=292)</td>
<td>.07 (.15)</td>
<td>.10 (.16)</td>
<td>+30%</td>
<td>.04</td>
<td>.028</td>
</tr>
<tr>
<td>Combined (n=294)</td>
<td>.26 (.28)</td>
<td>.31 (.28)</td>
<td>+16%</td>
<td>.02</td>
<td>.019</td>
</tr>
</tbody>
</table>

\(a\) In cups consumed per day  
\(b\) The overall means are from the GLM repeated measures analysis of variance model that included gender and grade.  
\(c\) .01 = small, .06 = medium, and .14 = large

---

**Figure 2-7 – Average Vegetable Consumption from Time 1 (Spring 2012) to Time 2 (Spring 2013) by Grade for One Control School**
**Fall 2012 to spring 2013 for control 1.** From fall 2011 to spring 2013, an interaction effect for time*grade was only found to be significant for the combined F/V group (P= .03), though a significant main effect of consumption over time was observed for the fruit and vegetable groups (P <.001 and .007, respectively), with a large effect size noted for the fruit group (partial η²= .159) (see Table 2-9). Consumption of fruit and combined F/V decreased over time, while consumption of vegetables increased significantly by 30% (P=.007). For the combined F/V group, consumption decreased for 1st, 2nd, and 3rd graders by 27%, 27%, and 21%, respectively. Fourth graders combined F/V consumption increased slightly by 5% (see Figure 2-8). Fifth graders were also excluded from this analysis due to high levels of missing data for spring 2013.

**Table 2-9 – Average F/V Consumption from Fall 2012 to Spring 2013 for One Control School**

<table>
<thead>
<tr>
<th></th>
<th>Fall 2012 Meanab (SD)</th>
<th>Spring 2013 Meanab (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect sizec</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fruit</strong> n=286</td>
<td>.31 (.24)</td>
<td>.21 (.20)</td>
<td>-32%</td>
<td>&lt;.001</td>
<td>.159</td>
</tr>
<tr>
<td><strong>Vegetable</strong> n=295</td>
<td>.07 (.13)</td>
<td>.10 (.16)</td>
<td>+30%</td>
<td>.007</td>
<td>.025</td>
</tr>
<tr>
<td><strong>Combined</strong> n=297</td>
<td>.38 (.27)</td>
<td>.31 (.28)</td>
<td>-18%</td>
<td>.03</td>
<td>.030</td>
</tr>
</tbody>
</table>

a: In cups consumed per day  

b: The overall means are from the GLM repeated measures analysis of variance model that included gender and grade.  

c: .01 = small, .06 = medium, and .14 = large
Discussion

Contrary to previous research, fruit, vegetable, and combined F/V consumption decreased among the studied population after the implementation of the updated NSLP nutrition guidelines. Though this decrease in consumption only produced a small effect size, the significant drop in overall vegetable consumption of 42% from fall 2011 to fall 2012 warrants some concern. The significant interaction effect of time*grade found for the analysis appears to be driven by the 5th grade group, which demonstrated the most dramatic decrease in consumption of 52%. Consumption did drop among other grade groups, though this remarkable decline among the 5th grade group may be interesting to explore in future studies.

Figure 2-8 – Average Combined F/V Consumption from Time 1 (Fall 2012) to Time 2 (Spring 2013) by Grade for One Control School
The comparison of the analyses that include versus exclude 5th grade participants is interesting to note. First, of the three separate analyses that examines this comparison, only one is considerably different (fall 2011 to fall 2012). In this comparison, a significant increase in fruit consumption was observed in the analysis without the 5th grade participants, though the increase was small, while a decrease in fruit consumption was observed in the analysis with the 5th graders. Additionally, several time*grade interaction effects were no longer significant without the 5th grade participants, though several effect sizes were larger and more clinically significant also without this group. The difference in including versus excluding the 5th grade group doesn’t appear to change the overall results dramatically, and, as they are a group of interest with viable consumption data, this discussion section will focus on the results observed with the inclusion of the 5th grade participants at the time points of interest for the 2011-2012 school year.

For the second analysis that was conducted using data from control school 1 only, a similar initial decrease in F/V consumption was also noted. Again, the 5th grade group continued to demonstrate a drastic decrease in consumption from fall 2011 to fall 2012. However, despite this large decrease, other grade groups’ consumption actually increased during this time point. Because this increase was not evident during the analysis with both control schools, it may be possible that students at different schools with differing socioeconomic status, despite being in the same geographic area, responded differently to the updated NSLP standards. For the combined F/V group, both control schools had very similar average intakes in fall 2011, yet control school 2
experienced a much sharper decline in consumption than control school 1 for fall 2012. Many possible other unknown confounding factors other than socioeconomic status could be the reason for this relationship, such as differing cultures of the two schools and quality of foods provided and were not explored for this analysis.

Another interesting point to note at control school 1 is the change in overall consumption from fall to spring semester. During the school year prior to the implementation of the updated guidelines, consumption declined in all three food groups by an average of 26%. However, in the comparison of spring 2012 to spring 2013, consumption increased significantly for all three food groups, indicating that participants were actually eating more F/V the spring semester after the implementation of the new guidelines than they were the year prior. This trend can be further explored by examining the data from the first complete year that the updated guidelines were implemented (fall 2012 to spring 2013). Though fruit and F/V combined consumption decreased similarly to the previous year, vegetable consumption actually increased by 28%. Due to this increase in vegetable consumption, the drop in combined F/V consumption from fall 2012 to spring 2013 was less dramatic than the previous year (19% v. 27%, respectively).

It is unclear why this seasonal decrease in F/V consumption was observed. Despite being served a variety of F/V in a variety of preparation methods, participants could have grown tired of eating school lunch by spring semester and began to eat less overall. Also, the three days that consumption was measured during each spring semester were fairly late in the semester, particularly during spring 2013. At this point in
the school year, students may likely grow disinterested in school lunch, as they have been eating similar foods for quite a few months. Additionally, students could be more interested in eminent summer vacations and school field trips than in eating F/V at lunch, especially if they do not normally consume these foods on a regular basis.

One major limitation for the study was the high degree of missing data as the study progressed. The reasons for this limitation are not entirely known. Due to the length of the study, it could be speculated that students began to be unwilling to participate in the study. The support of the teachers and staff also could have decreased due to the time constraint that the study placed on the school’s regular schedule. The degree of missing data was large for the 5th grade group for the spring 2013 semester, which resulted in their data being excluded from any analysis involving this semester. Due to the large interaction effect that the 5th grade group displayed in the analyses in which quality data was available, it would have been interesting to note the continuing F/V consumption trend for this group.

Another limitation of the study is the inherent nature of the data set, which violates the assumptions of normality and constant variance. Because many participants consumed an average of zero cups per day of F/V, the data set is highly right skewed and violates the assumption of normality. In addition, alternative methods to adjust for this violation (transformations and the use of non-parametric tests) were not appropriate for this data set. A subset of the data was explored using a Wilcoxon rank sum test, and similar levels of significance were observed. However, this non-parametric test has limited capabilities, so the parametric test was used in its place.
Implications for Research and Practice

Though F/V consumption did decrease from fall 2011 to fall 2012, consumption did appear to stabilize and return to baseline conditions among some groups. The updated NSLP nutrition guidelines require schools to provide a greater quantity and variety of F/V than ever before, and they do not appear to be detrimental to F/V consumption among elementary school students. In order for these new guidelines to be most beneficial among this population, future research should examine school-based intervention programs designed to increase F/V consumption beyond simply offering a larger variety and quantity of F/V.

References


4. United States Department of Agriculture, Center for Nutrition Policy and Promotion. Diet quality of children age 2-17 years as measured by the Healthy Eating Index-2010.


CHAPTER 3

THE EFFECT OF THE FOOD DUDES INCENTIVE PROGRAM ON FRUIT AND VEGETABLE CONSUMPTION POST-IMPLEMENTATION OF THE UPDATED NATIONAL SCHOOL LUNCH PROGRAM MEAL STANDARDS

Abstract

Objective: The purpose of the study was to determine the effect that the updated National School Lunch Program standards had on fruit and vegetable (F/V) consumption among a population participating in the Food Dudes program.

Design: In this randomized trial, participants’ F/V consumption was measured via digital photography analysis at four time points, including pre- and post-implementation of the updated standards.

Participants: Participants (n=1173) were from three elementary schools in Cache County, UT that were randomly assigned to one of three treatments: control, praise, and incentives.

Intervention: Students received social praise or a tangible prize for consuming goal levels of F/V.

Main Outcome Measure: F/V consumption was measured in cups per day.

Analysis: Data were analyzed using GLM repeated measures to determine change in consumption and interactions with between-subject factors of grade, gender, and condition, with the significance threshold set at P<.05.
Results: Combined F/V consumption increased significantly by 19% in the intervention group from fall 2011 to fall 2012, while consumption decreased by 25% and 11%, respectively, for both the praise and control groups (P = .002).

Conclusions and Implications: Participation in the intervention condition of the Food Dudes program increased F/V consumption over time, even with the implementation of the updated meal standards, while other groups’ consumption decreased over time.

Introduction

The Food Dudes (FD) program is an incentives- and social praise- based program designed to increase the consumption of fruits and vegetables (F/V) in elementary school children. The program was initially piloted and further tested in the United Kingdom, with results demonstrating that the program produces significant increases in F/V consumption at school among this population.\(^1\)\(^2\) The program was recently adapted to be used in the United States and was piloted at a single school in Cache Valley, UT by Wengreen et al.\(^3\) Due to the success of this pilot study, the program was further expanded to a six school follow-up trial to determine if the initial positive impact of the program could be extended over multiple schools and multiple years.\(^4\) The study began in school year 2011-2012 with follow-up data extending into school year 2012-2013.

In 2010, the Healthy, Hunger-Free Kids Act was signed into law in response to the increase of childhood obesity in America.\(^5\) To help address this concern, this act mandated that the United States Department of Agriculture (USDA) restructure the nutrition standards and meal patterns for the National School Lunch (NSLP) and
Breakfast Program. The revised guidelines were to align with the current Dietary Guidelines for Americans, which advise that all Americans consume an increased quantity and variety of F/V in order to maintain a healthful diet. Reports demonstrated that these recommended levels of F/V intake were not being met by school-aged children in America. The updated NSLP standards have incorporated these recommendations by requiring schools to offer students ½ to 1 cup each of fruits and vegetables per day, which is twice as many F/V as the previous guidelines mandated. Additional requirements were also placed on increasing the variety of F/V to be offered.

The USDA released the revised guidelines in January 2012, with implementation of these guidelines to begin school year 2012-2013. Because these guidelines have only been fully implemented for two complete school years, limited data exists to demonstrate the effect that the revisions have had on consumption, particularly of F/V. In a secondary analysis of a kitchen-based intervention program, Cohen et al. found a positive effect of the new guidelines, demonstrating that control study participants consumed 58% more vegetables (from 0.13 to 0.31 cups per day) from the fall semester before implementation to the fall after implementation. Though fruit consumption did not change significantly between these two time points, the study did demonstrate that 23% more students chose fruit in fall 2012 compared to fall 2011.

Because the introduction of the updated standards coincided with the follow-up year of the six-school FD study, changes in consumption between pre- and post-implementation can be assessed. Of particular interest is the possible effect that being
in one of the intervention conditions of the FD study has on F/V consumption compared to other study participants in the control condition. The purpose of the study was to assess these differences.

**Methods**

The six-school follow-up study of the FD program was a randomized controlled trial aimed at increasing F/V intake among elementary school students through the use of incentives and social praise. Six public elementary schools in Cache Valley, UT were paired based on low and high-socioeconomic status, which was measured via percentage of total students that qualify for free-or-reduced lunch. The pairs were then randomly selected to each treatment (FD praise, FD incentive, control). This secondary analysis utilizes data from three of the six schools used in the original follow-up study, with one school from each of the treatment conditions. The other three schools were excluded due to a high degree of missing data for the spring 2013 semester.

Recruitment for participants began in spring 2011, after the research team met with several school administrators, and the first baseline data was collected in fall 2011. At least 92% of the population at each school gave passive, opt-out consent to participate in the study (n=1173). The research protocol and passive consent procedure were reviewed and approved by the Institutional Review Board at Utah State University. All students in 1st through 5th grades were encouraged to participate, including those who brought a lunch from home during any day of the data collection.

During fall 2011, prior to the implementation of the updated meal standards, naturalistic baseline conditions were followed at all three schools. Participants'
consumption during lunch was assessed, though no additional intervention was put in place during this time. Between fall 2011 and spring 2012, the treatment conditions were implemented at each of the schools. At the intervention school, students were provided with a tangible prize for consuming a previously specified goal amount of F/V during lunch on consecutive days. At the praise school, participants were given social praise for consuming the same goal amount of F/V over the same amount of time. Participants at the control school were not provided with any type of incentive or praise based on their F/V consumption. Students at both praise and intervention schools also received additional motivation to consume F/V by watching videos and reading letters from the “Food Dudes,” who were animated role-model characters that successfully fought the “Junk Punks” by eating F/V. After the treatment was carried out for three months, each school returned to baseline conditions and consumption data was collected for three days. During fall 2012 and spring 2013 semesters, the first two semesters that the updated standards were implemented, all three schools continued at baseline conditions, and follow-up data was collected for three days during each semester.

F/V consumption was assessed using digital photography.\textsuperscript{12,13} Participants’ trays were identified by small stickers attached to their trays labeled with their student ID numbers. This allowed the research assistants to correctly group each before and after photo during data analysis. Students with a home lunch placed their food items on a tray to be photographed before eating. As participants eating school lunch exited the lunch line, a photograph was taken of each tray using a handheld digital camera.
(Cannon Power Shot SD 1300 IS with 10.1-megapixel resolution). A second photo was taken just before the students discarded their trays.

Both photographs taken for each participant were then analyzed by at least two trained research assistants to determine overall intake, including F/V consumption. All research assistants were blinded to the estimates of others, in addition to the treatment group designation of each participant. F/V intake was estimated to the nearest 0.13 cup (1/8 cup), or small piece of fruit or vegetable (baby carrot). Once each research assistant had estimated each participant’s intake, an average intake of the estimates was determined. If the estimates were off by more than 0.13 cup, a third observer provided an additional estimate. The final decision on estimated F/V intake was determined by a trained Registered Dietitian (Sheryl Aguilar, MS, RD) for approximately 5% of the data due to additional discrepancies between research assistants.

F/V intake estimates were all converted for comparison to cups per day. SPSS Statistics software (SPSS version 22.0, IBM) was used to perform analysis on the data set. The main effect of change in F/V consumption over time was determined using the GLM repeated measures function. First, the data was examined for normal distribution and constant variance in order to check that valid assumptions were met. Outliers outside three standard deviations of the mean were Winsorized to improve the skewness of the data. The repeated measures analysis was run over four time points to examine change in consumption: fall 2011 to fall 2012, fall 2011 to spring 2012, spring 2012 to spring 2013, and fall 2012 to spring 2013. In addition to the main effect over time, interaction effects for between-subjects factors of gender, grade, and
treatment condition were also assessed for significance. The significance threshold was set at $p<.05$, and partial eta squared was used to report effect size following Cohen’s convention (.01 = small, .06 = medium, and .14 = large).\textsuperscript{15}

After the first year of the study (2011-2012), 5\textsuperscript{th} grade participants moved on to middle school the following year (2012-2013). Though complete consumption data is available for some of these participants, many were lost over the course of the second school year due to this change in school, which could possibly change the representativeness of the sample. Because of this possible concern, separate analyses will be conducted excluding 5\textsuperscript{th} graders at all of the time points examined and including them for the time points where complete data is available.

Many participants within the data set consumed zero F/V at some point during the study. This phenomenon is not unique to this population\textsuperscript{8} and is one of the primary reasons for conducting intervention studies of this nature. However, because of the abnormal amount of zeros, the data set is heavily right skewed and does not comply with the assumption of normality or constant variance (verified with Levene’s Test of Equality of Error Variances). Transforming the data does not improve the skewness, as it is difficult to transform the value of zero. In addition, non-parametric tests that do not require valid assumptions of normality, such as the Wilcoxon rank sum test, greatly limit the complexity of the data set and the conclusions that can be drawn from it because they cannot analyze interactions with multiple factors, which is a critical component of the data set. A sample subset of the data was analyzed using a Wilcoxon rank sum test
and similar significance levels were found compared to the repeated measures. Therefore, the repeated measures test was still used with these limitations in mind.

Results

Study participants included students grades 1st through 5th at three elementary schools in Cache County, UT (n=1173). Table 3-1 demonstrates the demographics of the participants with grade designations available, excluding nine cases, during fall 2011. Of the cases included below, 114 were missing a gender designation (9.6%), but were still included in the analyses in models that did not control for gender. At baseline levels during fall 2011, participants in the incentives, control, and praise groups were consuming .31, .38, and .40 cups per day, respectively, of combined F/V. The table also includes comparative demographic data for the three schools excluded from the study based on missing data for spring 2013. F/V consumption at the control schools were not significantly different from each other (p= .41), though F/V consumption at the selected praise and prize schools was lower than it was at the praise and prize schools from these analyses (P=.001 and P=.01, respectively). Overall, between schools included and schools excluded from the study, a significant difference in consumption was observed (.41 cups per day for schools excluded, .36 cups per day for schools included, p< .0001).

Fall 2011 to fall 2012. Change in mean F/V intake from fall 2011 to fall 2012 was assessed using GLM repeated measures. Consumption of vegetables and F/V combined decreased from fall 2011 to fall 2012 (P= .001, P= .002, respectively), while consumption of fruit did not change over this period of time (P=.012) (see Table 3-2). A significant three-way interaction effect for time*grade*condition was observed for the vegetable
and combined F/V groups. Effect sizes for all three food groups were small. For the combined F/V group, change in F/V consumption over time varied by condition (see Figure 3-1) and grade. The incentives group saw a 19% increase in combined F/V intake, from .30 to .37 cups per day. Conversely, consumption decreased by 25% for both the praise and control groups (.40 to .30 cups per day) and 11% (.38 to .34), respectively. The most notable changes among grade groups was a 19% increase in consumption for 3rd grade participants (.34 to .42 cups per day) and a 58% decrease in consumption for 5th grade participants (.45 to .19 cups per day).

Excluding all 5th graders from this time point analysis yields a significant main effect of consumption over time for only the fruit group, significant time*grade and time*condition interactions were also observed for this group, though the three-way interaction (time*grade*condition) was non-significant. Consumption significantly decreased in the vegetable group (P= .001), with a significant time*condition effect observed. For the combined F/V group, consumption increased slightly, yet significantly, with an observable significant time*grade*condition interaction. Though the directions of change in consumption are different than the analysis above for the fruit and combined F/V groups, the overall means and large trends are highly similar (see Table 3-3).
Table 3-1 – Fall 2011 Demographics for Participants in Six Elementary Schools in the Food Dudes Follow-Up Study

<table>
<thead>
<tr>
<th>Grade</th>
<th>Incentives 1a (n=443)</th>
<th>Incentives 2 (n=453)</th>
<th>Control 1a (n=476)</th>
<th>Control 2 (n=351)</th>
<th>Praise 1a (n=254)</th>
<th>Praise 2 (n=404)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
<td>n %</td>
</tr>
<tr>
<td>1</td>
<td>93 21</td>
<td>95 21</td>
<td>114 24</td>
<td>74 21</td>
<td>49 19</td>
<td>82 20</td>
</tr>
<tr>
<td>2</td>
<td>86 19</td>
<td>98 22</td>
<td>86 18</td>
<td>87 25</td>
<td>62 25</td>
<td>103 25</td>
</tr>
<tr>
<td>3</td>
<td>85 19</td>
<td>87 19</td>
<td>94 20</td>
<td>55 16</td>
<td>46 18</td>
<td>62 15</td>
</tr>
<tr>
<td>4</td>
<td>96 22</td>
<td>90 20</td>
<td>90 19</td>
<td>67 19</td>
<td>54 21</td>
<td>64 16</td>
</tr>
<tr>
<td>5</td>
<td>83 19</td>
<td>83 18</td>
<td>92 19</td>
<td>68 19</td>
<td>43 17</td>
<td>93 23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Incentives 1a (n=443)</th>
<th>Incentives 2 (n=453)</th>
<th>Control 1a (n=476)</th>
<th>Control 2 (n=351)</th>
<th>Praise 1a (n=254)</th>
<th>Praise 2 (n=404)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>198 50</td>
<td>196 48</td>
<td>227 52</td>
<td>147 49</td>
<td>124 52</td>
<td>201 51</td>
</tr>
<tr>
<td>Female</td>
<td>198 50</td>
<td>210 52</td>
<td>206 48</td>
<td>153 51</td>
<td>115 48</td>
<td>197 49</td>
</tr>
</tbody>
</table>

Combined F/V Consumption\textsuperscript{b} \textsuperscript{*} .31* .37* .38 .36 .40* .52*

\textsuperscript{*} Significantly different from counterpart school with same condition
\textsuperscript{a} Schools used in current study
\textsuperscript{b} In cups per day
Table 3-2 – Average F/V Consumption from Fall 2011 to Fall 2012 for Three Elementary Schools (n=987)

<table>
<thead>
<tr>
<th></th>
<th>Fall 2011 Mean(a) (SD)</th>
<th>Fall 2012 Mean(a) (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect size(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.24 (.24)</td>
<td>.23 (.24)</td>
<td>-4%</td>
<td>.012</td>
<td>.020</td>
</tr>
<tr>
<td>Vegetable</td>
<td>.11 (.18)</td>
<td>.09 (.15)</td>
<td>-18%</td>
<td>.001</td>
<td>.028</td>
</tr>
<tr>
<td>Combined</td>
<td>.36 (.31)</td>
<td>.34 (.31)</td>
<td>-6%</td>
<td>.002</td>
<td>.025</td>
</tr>
</tbody>
</table>

\(a\)In cups consumed per day

\(b\)The overall means are from the GLM repeated measures analysis of variance model that included gender, grade, and condition.

\(c\).01 = small, .06 = medium, and .14 = large
Fall 2011 to spring 2012. From fall 2011 to spring 2012, overall consumption decreased (see Table 3-4). Significant interaction effects were found for all three food groups as follows: time*condition for the fruit group, time*grade for the vegetable group, and time*grade and time*condition independently for the combined F/V group (P < .001 for both factors). No three-way interactions (time*grade*condition) were significant. Despite overall decreases among all three food groups, combined F/V consumption varied significantly by condition and grade. Consumption decreased among both control (.38 to .28 cups per day, down 26%) and praise groups (.42 to .36 cups per day, down 14%). However, the incentives group demonstrated a modest increase of 11% (.31 to .35 cups per day) (see Figure 3-2). Participants in 4th and 5th grades demonstrated a decrease in consumption by 24% and 26%, respectively, while participants in other grades maintained consumption over time. Effect sizes for all three food groups were small.

Table 3-3 – Average F/V Consumption from Fall 2011 to Fall 2012 for Three Elementary Schools Without 5th Graders (n=854)

<table>
<thead>
<tr>
<th></th>
<th>Fall 2011 Mean&lt;sub&gt;a&lt;/sub&gt;b (SD)</th>
<th>Fall 2012 Mean&lt;sub&gt;a&lt;/sub&gt;b (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect size&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.24 (.23)</td>
<td>.26 (.24)</td>
<td>+8%</td>
<td>.01, &lt; .001</td>
<td>.013, .030</td>
</tr>
<tr>
<td>Vegetable</td>
<td>.10 (.17)</td>
<td>.09 (.15)</td>
<td>-10%</td>
<td>.001</td>
<td>.018</td>
</tr>
<tr>
<td>Combined</td>
<td>.34 (.30)</td>
<td>.36 (.31)</td>
<td>+6%</td>
<td>.03</td>
<td>.016</td>
</tr>
</tbody>
</table>

<sup>a</sup>In cups consumed per day
<sup>b</sup>The overall means are from the GLM repeated measures analysis of variance model that included gender, grade, and condition.
<sup>c</sup>.01 = small, .06 = medium, and .14 = large
Figure 3-2 – Average Combined F/V Consumption from Time 1 (Fall 2011) to Time 2 (Spring 2012) by Condition for Three Elementary Schools (n=1058)

Excluding the 5th grade participants for the fall 2011 to spring 2012 analysis yields similar results to the same analysis with the 5th grade group included.

Consumption decreased significantly for all three food groups (see Table 3-5). A significant time*condition interaction was observed for the fruit group, while a significant time*grade interaction was found for the vegetable group. Time*grade and
time*condition interactions were independently significant for the combined F/V group, though the higher order interaction was non-significant.

Table 3-5 – Average F/V Consumption from Fall 2011 to Spring 2012 for Three Elementary Schools Without 5th Graders (n=866)

<table>
<thead>
<tr>
<th></th>
<th>Fall 2011 Meana (SD)</th>
<th>Spring 2012 Meana (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect sizec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.24 (.23)</td>
<td>.23 (.26)</td>
<td>-4%</td>
<td>&lt;.001</td>
<td>.050</td>
</tr>
<tr>
<td>Vegetable</td>
<td>.10 (.17)</td>
<td>.08 (.15)</td>
<td>-20%</td>
<td>&lt;.001</td>
<td>.028</td>
</tr>
<tr>
<td>Combined</td>
<td>.34 (.30)</td>
<td>.32 (.32)</td>
<td>-6%</td>
<td>.002, &lt;.001</td>
<td>.017, .044</td>
</tr>
</tbody>
</table>

a In cups consumed per day
b The overall means are from the GLM repeated measures analysis of variance model that included gender, grade, and condition.
c .01 = small, .06 = medium, and .14 = large

Spring 2012 to spring 2013. From spring 2012 to spring 2013, a significant increase in consumption was found for both vegetable and combined F/V groups, with a significant interaction effect observed for time*condition. Effect sizes for both vegetable and combined F/V groups were small (see Table 3-6). The change in consumption for the fruit group was not significant. For the combined F/V group, the control and incentives groups increased consumption from .26 to .31 cups per day (16%) and .37 to .47 cups per day (21%), respectively (see Figure 3-3). Consumption decreased in the praise group by 13% (.33 to .38 cups per day). Data from 5th graders were not included in this analysis due to high levels of missing data for spring 2013.
Table 3-6 – Average F/V Consumption from Spring 2012 to Spring 2013 for Three Elementary Schools

<table>
<thead>
<tr>
<th></th>
<th>Spring 2012 Meanab (SD)</th>
<th>Spring 2013 Meanab (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect sizec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.23 (.25)</td>
<td>.25 (.23)</td>
<td>+8%</td>
<td>.06</td>
<td>.006</td>
</tr>
<tr>
<td>n= 653</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetable</td>
<td>.09 (.15)</td>
<td>.14 (.20)</td>
<td>+36%</td>
<td>.001</td>
<td>.020</td>
</tr>
<tr>
<td>n= 677</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>.32 (.31)</td>
<td>.38 (.33)</td>
<td>+16%</td>
<td>.005</td>
<td>.015</td>
</tr>
<tr>
<td>n= 682</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a In cups consumed per day
b The overall means are from the GLM repeated measures analysis of variance model that included gender, grade, and condition.
c .01 = small, .06 = medium, and .14 = large

Figure 3-3 – Average Combined F/V Consumption from Time 1 (Spring 2012) to Time 2 (Spring 2013) by Condition for Three Elementary Schools
Fall 2012 to spring 2013. From fall 2012 to spring 2013, overall consumption of F/V was varied, with consumption increasing in the vegetable group and decreasing in the fruit and combined F/V groups (see Table 3-7). Significant interaction effects were observed for all three groups, with time*condition ($P< .001$) for the fruit group, time*grade ($P= .002$) for the vegetable group, and time*grade and time*condition independently for the combined F/V group ($P< .001$ for both effects). The time*condition*grade interaction was not significant for any group. Effect sizes varied among groups, the largest for the combined F/V group ($\text{partial } \eta^2 = .081$). The incentives group demonstrated a modest 13% increase in consumption for the combined F/V group, from .41 to .47 cups per day (see Figure 3-4). The control and praise groups experienced decreased consumption, down 17% and 6%, respectively. At this time point for combined F/V, consumption increased slightly for 1st and 2nd graders by 6% and 15%. However, consumption decreased for 3rd and 4th graders by 9% and 16%. 5th graders were not included in this interval analysis due to high levels of missing data for spring 2013.

### Table 3-7 – Average F/V Consumption from Fall 2012 to Spring 2013 for Three Elementary Schools

<table>
<thead>
<tr>
<th></th>
<th>Fall 2012 Mean$_{ab}$ (SD)</th>
<th>Spring 2013 Mean$_{ab}$ (SD)</th>
<th>Percent Change</th>
<th>P-value</th>
<th>Effect size$_{c}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit</td>
<td>.28 (.24)</td>
<td>.25 (.23)</td>
<td>-11%</td>
<td>&lt;.001</td>
<td>.047</td>
</tr>
<tr>
<td></td>
<td>n= 678</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetable</td>
<td>.10 (.15)</td>
<td>.13 (.20)</td>
<td>+23%</td>
<td>.002</td>
<td>.021</td>
</tr>
<tr>
<td></td>
<td>n= 704</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combined</td>
<td>.39 (.31)</td>
<td>.38 (.33)</td>
<td>-3%</td>
<td>&lt;.001</td>
<td>.081</td>
</tr>
<tr>
<td></td>
<td>n= 709</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$a$In cups consumed per day  
$b$The overall means are from the GLM repeated measures analysis of variance model that included gender, grade, and condition.  
$c$.01 = small, .06 = medium, and .14 = large
A broader view of the observable trends for each treatment condition can be found by examining F/V consumption over the time points chronologically as opposed to independently of one another (see Figure 3-5). For the incentives school, consumption at fall 2011 was the lowest of the three groups and gradually increased over time at each time point, for an overall increase from .31 to .47 cups per day (34%). Among participants at both the control and praise schools, consumption decreased chronologically over time, despite a slight increase in consumption for the control group. These trends indicate that a meaningful difference exists between students that are participants in the FD program and those that are not, and that the treatment protocol of the FD program could be mediating these differences. Fifth grade participants were excluded from all time points in this specific analysis.
Discussion

Based on the results of this analysis, overall F/V consumption decreased from fall 2011 to fall 2012, after the implementation of the updated USDA meal standards, for control and praise treatment groups. The trend in F/V consumption across the four time points was dependent upon condition. A slight increase was observed at the incentives school, though the effect size was small. In general, these results are contrary to Cohen et al’s findings, even among the control group, despite fall 2011 baseline consumption levels being comparable. A decrease in consumption was observed for the control group at three of the four time points examined, while the praise group demonstrated decreased consumption at all four time points. However, participants in the incentives group demonstrated an increase in consumption at each of the four individual time
points examined. A broader view chronologically over time also demonstrates that the incentives group, despite having the lowest consumption at fall 2011 among all three groups, increased consumption at each individual time point and ended up having the highest consumption overall at spring 2013.

After examining the analyses including and excluding the 5th grade participants, few differences were found between the analyses including versus excluding the 5th grade participants. The consumption trends for fall 2011 to fall 2012 are slightly different in direction, though the overall change in mean consumption cups per day are still very similar. Additionally, for the fall 2011 to spring 2012 comparison, the analysis changed very little with the exclusion of the 5th grade participants, with no differences in the direction of consumption. Because there are minimal small differences between the two separate analyses, the rest of the discussion will focus on the analyses conducted with the inclusion of the 5th grade group, as they provide a more complete idea of what was happening among all grades in the elementary schools during school year 2011-2012.

The overarching principles behind the FD program lie within the science of applied behavior analysis and involve repeated tasting, peer modeling, and contingency-based reward intervention. Because, as previous reports suggest, F/V consumption is not a typical behavior that many elementary school students engage in on a regular basis, the study participants required behavior shaping in order to consume F/V. This was accomplished through a series of approximations with the participants receiving reinforcements (social praise or a tangible prize) after successfully completing each
approximation. The approximations began simply with students receiving reinforcement for taking a small bite of F/V and gradually increased in difficulty until students were required to consume F/V on multiple days in a row in order to receive reinforcement. Students were also provided with peer support from the “Food Dudes” in the form of videos and letters throughout the treatment phase. Even after the delivery of reinforcements stopped, the participants continued to maintain their newly acquired behavior of consuming F/V, indicating that the shaping treatment was successful, and that these participants began to find the consumption of F/V intrinsically motivating.\textsuperscript{16, 17}

Large differences in F/V consumption between the praise and incentive groups may indicate that elementary students do not find the reinforcement of social praise motivating enough to elicit long-term behavior change. However, the upward trend of F/V consumption among the incentives group could indicate that participants found reinforcement via tangible prizes motivating in the short-term, and this is better translated into longer-term behavior such that, even after the delivery of the reinforcer stopped and the NSLP standards changed. The involvement of participants in the incentives group in this behavioral modification program could be an explanation for the differences observed in consumption post-implementation of the updated NSLP standards.

In addition to the notable interaction effects observed for time* treatment condition, the interaction effect of grade is also interesting to examine. Participants in 5\textsuperscript{th} grade demonstrated the most dramatic reaction to the updated NSLP standards, with consumption decreasing from fall 2011 to fall 2012 by 58%, while consumption
among other grade groups remained stable or increased slightly. The trends observed for the 5th grade group could be due to the fact that this group matriculated to a different school with a different environment and school lunch culture. A decrease in consumption was also observed from fall 2011 to spring 2012 for the 4th and 5th grade groups, which spans the time period when the condition treatment phases were in effect and all children remained in the same school. This may indicate that the FD program may not be as effective for older participants who may potentially require larger reinforcers than younger students to provide adequate motivation for F/V consumption.18

Several limitations are present in this study. First, excluding a few moderate effect sizes, the majority of effect sizes found for the study were small (partial $\eta^2 = .01$-.059). This indicates that, even though the main effect for consumption over time was significant in almost all cases, the overall impact of the different treatment conditions at each individual time interval was small. Despite these individual minor changes, the overall trend of consumption chronologically indicates promising possibilities to improve F/V consumption through the implementation of an intervention program that motivates consumption of F/V using rewards. Another limitation is the exclusion of 5th grade participants for the spring 2013 semester due to missing data for this group. Additionally, the exclusion of three of the six schools originally included in the study is also a limitation, particularly because the overall baseline F/V consumption was significantly different between the schools included and excluded. However, the large sample size for the schools included in the study lessens the impact of this limitation
and results were similar when all available data were included, as opposed to the exclusion of groups where missing data appeared more systematic.

Another limitation of the study is the right skew arrangement of the data set due to the large amount of participants consuming zero F/V throughout the study. This abnormal arrangement violates the assumptions of normality and constant variance. Transformations to correct these violations were not appropriate. A portion of the data set was analyzed using a Wilcoxon rank sum test, and similar results and significance levels were observed. This parametric test inadequately addressed the complexity of the data set did not allow for the including of interaction terms. Thus, this avenue was not pursued.

**Implications for Research and Practice**

Due to the strong positive trend in F/V consumption observed among the participants in the intervention group (Food Dudes program), further research into additional rewards-based intervention studies aimed to increase F/V consumption among elementary school populations is warranted. Research should focus on appropriate intervention/reinforcement for older elementary students, as their reaction to interventions appears to differ from younger students. Intervention programs employing rewards should focus on providing tangible prizes initially, as providing social praise did not provide a lasting effect on F/V consumption. Future intervention programs, along with the increase in quantity and variety of F/V provided by the updated NSLP meal standards, may help improve the overall diet quality of school-aged children in America.
References


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   doi: 10.1509/jmkg.74.3.93.
CHAPTER 4
SUMMARY AND CONCLUSIONS

Summary

The United States Department of Agriculture, in an effort to address the rate of childhood obesity in the United States, recently updated the meal and nutrition standards for the National School Lunch Program (NSLP), and implementation of these standards began in school year 2012-2013. The updated standards require schools to provide a larger variety and quantity of fruits and vegetables (F/V) to program participants than ever before because reports have indicated that elementary school students are not consuming recommended levels of these foods.

Due to the recency of the implementation of these new standards, few research studies have examined whether they do improve F/V consumption among school-age children. One recently published study indicates that the guidelines did have a positive effect on consumption, however, more research is warranted to examine the effect of this wide-sweeping policy change that the USDA estimated would cost schools an additional 10 cents per reimbursable meal to cover new food and labor costs. The purpose of this study was to explore the effect the updated NSLP meal standards have had on F/V consumption immediately and throughout the entirety of the school year that followed the initial implementation.

Data for this secondary analysis were from a follow-up study conducted among six elementary schools in Cache County, UT, which examined the effectiveness of a school-based intervention program (the Food Dudes program) over the course of two
school years (2011-2012, 2012-2013). The Food Dudes program successfully utilizes peer modeling, repeated tasting, and incentives to motivate students to consume more F/V in a school setting.\textsuperscript{6,7,8} The population for the follow-up study included 1\textsuperscript{st} through 5\textsuperscript{th} grade students from six elementary schools that were randomized to one of three treatments of the Food Dudes program: control, praise, incentives. The specific aims of this study were to determine the main effect of consumption over time among four of the six schools and also determine if any significant interaction effects could be observed among the between-subject factors of gender, grade, and treatment condition.

Initially, from fall 2011 (old NSLP standards) to fall 2012 (new NSLP standards), F/V consumption decreased significantly for the control and praise groups that were examined, across all grades, though consumption increased for participants in the incentives school. For the control and prize group, consumption from spring 2012 to spring 2013 increased significantly, which indicates that students were consuming more F/V under the new meal standards than they were the year before under the old meal standards. This trend supports the hypothesis that NSLP participants may be adjusting to the updated standards and that consumption may increase above levels observed under the old standards in time. Also, an observable increase in consumption at each examined time point for the incentives school indicates that participation in an intervention program may negate the detrimental trends observed upon the implementation of the updated standards. However, this same trend was not observed...
for participants from the praise condition, which indicates that students may not find social praise motivating enough to improve F/V consumption.9

The limitations of this study are worth noting. First, because many elementary school students often do not consume any F/V, particularly during baseline, the data set is highly right skewed and violates the assumptions of normality and constant variance. However, alternative methods to adjust the data set and mitigate this limitation were explored, and the decision was made to continue with the previously decided upon analysis method in order to try to fully capture the observable trends within the set. Additionally, as the study continued throughout the follow-up school year, less students were willing to participate, and some schools (n= 2) and a grade group (5th grade participants at all schools) were excluded from the spring 2012 to spring 2013 and fall 2012 to spring 2013 analyses due to a high level of missing data. Also, many of the observed effect sizes for the study were small to moderate, despite having a fairly large sample size.

Conclusion

The requirement for schools to provide students with a larger quantity and variety of F/V under the updated NSLP meal standards is a positive first step at improving the overall diet quality of elementary school children. Despite initial decreases in F/V consumption after the implementation of the updated standards, consumption may be improving over time. However, the effectiveness of the new standards alone to increase F/V consumption may not be likely, and other intervention programs, similar to the Food Dudes program, will be needed to motivate students
beyond simply including more F/V on their trays to actually consuming these foods at recommended levels.

References


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