Incentivizing Children's Fruit and Vegetable Consumption: Results of a United States Pilot Study of the *Food Dudes* Program

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ABSTRACT

Objective: Preliminary evaluation in the United States (US) of a school-based fruit and vegetable (F/V) intervention, known as the *Food Dudes* (FD) program, developed in the United Kingdom.

Methods: Over 16 days (Phase 1), elementary-school children (n = 253) watched short videos featuring heroic peers (the FD) eating F/V and received a reward for eating F/V served at lunchtime. In the 3 months that followed (Phase 2), children received increasingly intermittent rewards for eating F/V. Consumption was measured by photo analysis and assessment of skin carotenoids.

Results: Fruit and vegetable intake increased significantly after Phases 1 and 2 ($P < .001$ for both). This effect was most discriminable among children who consumed no fruit (n = 100) or no vegetables (n = 119) at pre-intervention baseline. Among these children, F/V intake (combined) increased by 0.49 (0.53) cups per day.

Conclusions and Implications: The FD program can increase F/V intake in US elementary schools.

Key Words: children, vegetables, fruit, intervention studies, positive reinforcement (*J Nutr Educ Behav*. 2013;45:54-59.)

INTRODUCTION

The benefits to human health of consuming a diet rich in fruits and vegetables (F/V) are indisputable.[1] Fruit and vegetables are low-energy, nutrient-dense foods that contribute to satiety and may help to displace the consumption of high-sodium and energy-dense foods.[2] Consuming the recommended amounts of F/V may be an effective way to prevent the development and progression of chronic diseases such as cardiovascular disease, and certain cancers, and to maintain an appropriate body weight.[3,4] Despite the health benefits of eating F/V, less than 20% of children between the ages of 4-13 years are consuming the recommended 5 or more daily servings.[5]

Although school-based interventions hold the potential to increase F/V consumption, they have produced inconsistent and moderate increases in F/V intake.[6,7] One school-based intervention that has produced consistent and clinically significant positive results is the *Food Dudes* (FD) program, which has been implemented in over 100 elementary schools in the United Kingdom (UK).[8] The program uses role models, repeated tasting of F/V in the classroom as a midmorning snack, and tangible incentives awarded to students for F/V consumption to encourage and support plentiful F/V consumption.[8-10] In a study of 749 children attending 2 inner-city elementary schools in London, the FD program increased lunchtime fruit and vegetable intake by 50%.[9] Despite these outcomes, the FD program has yet to be tested in United States (US) schools. Thus, it is not known whether the cultural, curricular, and school-scheduling differences separating the US and the UK would render FD ineffective in the US.

This report summarizes the outcomes of a pilot evaluation of the FD intervention adapted for implementation in a US public school.[9,10] The methods were followed as prescribed by the FD developers, with the exception that repeated tasting of F/V was provided to children with lunch in the cafeteria instead of in classrooms as a midmorning snack.

METHODS

Participants and Setting

Participants were 253 first- through fifth-graders (6- to 11-year-olds, though students were not included or excluded based on age) who attended 1 public elementary school in northern Utah during 2010-2011. Of these participants, 58% were female, 87% white (7% Hispanic and 6% other), and they were approximately evenly distributed across grades (48 in first grade, 48 in second grade,

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http://dx.doi.org/10.1016/j.jneb.2012.06.001

and 53 in each of the other grades). On average, 22% of participants received free or reduced-cost lunch and 85% participated in the school lunch program. Thirteen percent of children were overweight or obese at the outset of the study. Ninety-nine percent of parents allowed their child to participate by passive consent. Parents of 78% of students (n = 200) signed a separate active consent allowing assessment of height, weight, and skin carotenoids. The research protocol was reviewed and approved by the Institutional Review Board at Utah State University.

Procedures

Figure 1 shows the sequence of events in the pilot study. These procedures are described in detail below.

Prior to evaluating F/V consumption, trained research assistants measured children's height, weight, and skin carotenoids. Height was measured using a portable stadiometer after children removed their shoes. Weight was measured to the nearest 0.5 kg using a digital scale (TBF551, Tanita, Tokyo, Japan, 2002) as children wore light clothing. Skin carotenoids were assessed using the Pharmanex Biophotonic scanner (S2 Everest Edition, Pharmanex, Provo, UT, 2007), which uses resonance Raman spectroscopy technology to measure the concentration of carotenoids in the skin at a point of the palm of the right hand. Total dermal carotenoids assessed by Raman spectroscopy have been previously correlated with total dermal carotenoids assessed by high performance liquid chromatography of dermal biopsies (r = 0.66; $P < .001$) and to total carotenoid intake and total intake of F/V as self-reported by adults using a food frequency questionnaire (r = 0.52, $P <$ .001; r = 0.39, P = .008, respectively).[11]

Fruit and vegetable intake was assessed using digital photographs, which were taken of children's trays as they exited the school cafeteria line and before they discarded their food waste. Stickers with identification numbers were placed on each tray so that before and after photos could be matched and coded for consumption of F/V. During a 4-day naturalistic baseline, these procedures were followed with no intervention. During a 4-day default-provision baseline, photographs were taken on days on which children were provided with full portions of 1 of 4 pairs of FD F/V (50 g of each for first- and second-graders, 60 g of each for third- through fifth-graders). The 4 FD F/V pairs were blueberries and carrots, grapes and red peppers, apples and cherry tomatoes, and cucumbers and cantaloupe.

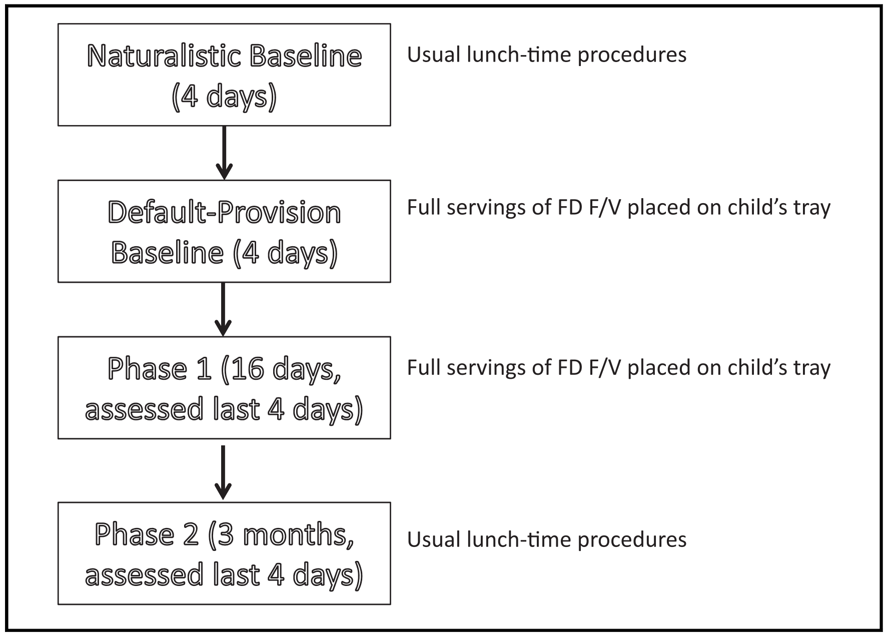

Figure 1. Sequence of *Food Dudes* (FD) programmed events where fruit and vegetable (F/V) consumption was measured by pre-post lunch tray photos.

During the next 16 days (Phase 1), children periodically watched FD videos in the classroom. The 6 videos were 6 minutes each and featured the heroic FD; a group of four 12- or 13-year-olds, 2 boys and 2 girls. In each episode, the FD battle the evil "Junk Punks," who plan to overtake the world by depriving people of their life-giving F/V. To arm themselves for their impending struggle, the FD enjoy eating a variety of F/V and encourage other children to do the same. A series of letters, purportedly from the FD, was read periodically by the teachers; the letters further encouraged F/V consumption.

In the cafeteria, children were provided by default the same F/V served during the default-provision baseline. For 4 days, children were instructed that they could earn tangible incentives for tasting (and swallowing) a single bite of both the FD fruit and vegetable. Research assistants observed children doing so and stamped their hands to indicate success; separate red and green stamps indicated that the child had tasted the FD fruit and vegetable, respectively. Observers discouraged children from sharing, trading, or otherwise discarding food from their trays. Children later showed their hands to their teacher, who distributed tangible rewards (eg, pencil, eraser, pedometer) to those with both hand stamps. On days 5 through 15, children earned hand stamps and subsequent rewards by consuming larger portions of F/V (up to a full age-appropriate portion) each day. Before-after digital photographs were taken on the final 4 days of Phase 1. Skin carotenoids were again measured during the final 4 days of Phase 1.

For the next 3 months (Phase 2), the F/V served during lunch returned to the naturalistic condition. Research assistants continued to monitor lunchtime consumption, and separate hand stamps were provided daily for consumption of full portions of fruit or vegetable, but tangible incentives were awarded intermittently. To this end, teachers displayed a wall chart in their classroom. The wall chart outlined F/V consumption goals and rewards. The number of days of F/V consumption required between incentives changed according to the following sequence: 2, 4, 6, 8, 5, 7, 8, 8, 12, as previously determined and successfully used by Horne et al.[8] This reward schedule was known to children at the outset of Phase 2. At the conclusion of Phase 2, skin carotenoids were reassessed and before-after digital photographs were collected for 4 days on which the same food items were served as during the naturalistic baseline.

Two trained research assistants used the digital photographs to independently estimate the amount of F/V consumed (intraclass correlation = 0.61, $P \leq .001$). When estimates of the 2 observers disagreed, a third expert observer provided a third estimate of consumption. In all cases, the third estimate agreed with 1 of the 2 previous estimates and was considered truth.

The school food service manager provided records of the amount of F/V served daily. Additional food was served on an on-demand basis, and the manager kept these records as part of her usual budgeting procedures. In addition, parents, teachers, and foodservice staff were asked to complete a 15-question online survey (SurveyMonkey, Palo Alto, CA, 2009) regarding their perception of their child's experience during the FD program.

Data Analysis

Means and SD were calculated for all continuous variables, and distributions were examined for normality. Because the distribution of observed F/V intake contained many zeroes, the investigators conducted exact statistical tests to examine differences in mean intake across time points of interest (naturalistic baseline vs end of Phase 2; default-provision baseline vs end of Phase 1) using StatExact 5 (Cytel, Inc, Cambridge, MA, 2002). Exact statistical tests are useful when assumptions of traditional methods are violated. Skin carotenoid scanner scores followed a normal distribution. General linear model repeated measures procedure in Predictive Analytics software (version 18.0, PASW, Inc, Chicago, IL, 2007) were used to assess change in skin carotenoid scanner scores over time while controlling for the effects of between-subject factors including grade, teacher, and sex. Children who did not consume lunch on 2 or more data-collection days within a phase were excluded from the dataset summarizing that phase. Two-tailed significance was set *a priori* at $P \leq .05$.

RESULTS

Default–Provision Baseline vs End of Phase 1

As shown in the upper-left panel of Figure 2, during the default-provision baseline, participants consumed an average of 0.29 cups of FD fruit and 0.14 cups of FD vegetable. Fourteen participants (6%) consumed no fruit, and 57 (23%) consumed no vegetable, excluding potatoes. Fifth-graders consumed more F/V than did children in first through fourth grades ($P < .01$); no other between-grade or between-teacher differences were significant in either fruit or vegetable consumption. Likewise, there was no difference in the amount of F/V consumed by females and males ($P = .30$).

Consumption of FD F/V increased significantly following Phase 1 ($P < .001$ for both). *Food Dudes* fruit intake increased by 31% (to 0.38 cup) and FD vegetable intake increased by 93% (to 0.27 cup). Only 3% and 10% of children consumed no fruit or no vegetable, respectively, across the assessment days of Phase 1, a significant decrease from the default-provision baseline ($P < .001$). As shown in the lower-left panel of Figure 2, skin carotenoid scores increased modestly, but significantly, above baseline levels in Phase 1 ($P = .001$).

Naturalistic Baseline vs End of Phase 2

As shown in the upper-right panel of Figure 2, during the naturalistic baseline, participants consumed an average of 0.26 cups of fruit and 0.21 cups of vegetables. One hundred

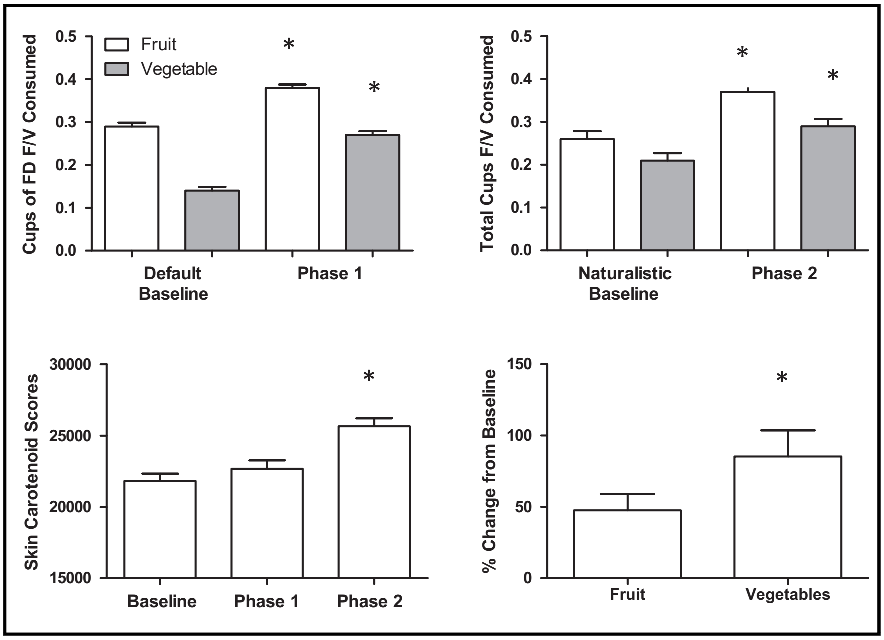

Figure 2. *Upper-left*. *Food Dudes* (FD) fruits and vegetables (F/V) consumption (c) during the Default Provision Baselines compared to the last 4 days of Phase 1. Children received full portions of FD F/V in addition to their regularly planned national school lunch program meal. *Upper-right*. Total F/V consumption (cups) during the Naturalistic Baseline compared to the last 3 days of Phase 2. Children received F/V as part of their regularly planned national school lunch program meal. *Lower-left*. Skin carotenoid scores (counts) assessed during the Naturalistic Baseline, Phase 1, and the last 2 weeks of Phase 2. *Lower-right*. Percentage increase in the amount of F/V served per day in the cafeteria for 2 weeks before the Naturalistic Baselines and during the last 2 weeks of Phase 2. *The mean differences between outcomes were assessed using exact tests; $P \leq .001$ for all noted comparisons.

participants (39%) consumed no fruit on any of the 4 days of naturalistic baseline, and 119 participants (47%) consumed no vegetables, excluding potatoes. Similar grade effects were observed here as were observed at the default-provision baseline; fifth-graders consumed more F/V than did children in first through fourth grades ($P < .05$). There was no difference in the amount of F/V consumed by females and males ($P = .30$). Lunchtime F/V consumption during the naturalistic baseline was correlated with skin carotenoid scanner scores obtained just prior to baseline observations ($r = 0.24$; $P = .001$).

During the final 3 days of Phase 2, the average consumption of F/V had increased by 42% and 38%, respectively, above consumption during the naturalistic baseline (same menu items served; $P = .015$ and .002, respectively). As shown in the Table, this increase was driven entirely by those who consumed no fruit (n = 100) or no vegetables (n = 119) during the naturalistic baseline. At the end of Phase 2, these participants consumed, on average, 0.28 cups of fruit and 0.22 cups of vegetables ($P < .001$ for both). Nonetheless, 53% (n = 53) of those who previously did not eat fruit and 46% (n = 55) of those who did not eat vegetables in the naturalistic baseline continued to not eat these food items at the end of Phase 2. Among participants who were consuming F/V during the naturalistic baseline, there was no change in either vegetable or fruit consumption ($P = .09$ and .96, respectively).

As shown in the lower-left panel of Figure 2, skin carotenoid scores collected in Phase 2 were significantly higher than those assessed prior to baseline or following Phase 1 ($P < .001$ for both comparisons). This finding suggests that participants as a group were consuming larger amounts of pigmented F/V during Phase 2 than previously. Corroborating evidence of this finding was provided by records of food usage that were collected by the food-service manager throughout the study. The lower-right panel of Figure 2 shows the percentage increase in the amount of F/V served per day on an on-demand basis for the two weeks before the naturalistic baseline and during the final 2 weeks of Phase 2 ($P < .001$). Twelve types of fruit (apples, cantaloupe, dried cherries, fruit cocktail, grapes, kiwi, mandarin oranges, oranges, peaches, pears, pineapple, strawberries, and watermelon) and 9 vegetables (broccoli, carrots, cauliflower, cucumbers, green onions, green peppers, mushrooms, mixed salad greens, and radishes) were included in the analysis because they were served regularly during both periods. Approximately the same number of children were served per day during the naturalistic baseline and during Phase 2 (mean = 227 and 231 respectively; n = 255). Whether this increase in demand for F/V translates to increased consumption is unknown.

Table. Total Mean (SD) Fruit and Vegetable Intake in Cups (n = 253)

	Consumed No Fruit or Vegetable at Baseline[b]		Consumed Some Fruit or Vegetable at Baseline	
	Vegetables (n = 119)	Fruit (n = 100)	Vegetables (n = 134)	Fruit (n = 153)
Naturalistic baseline[a] (n = 255)	0 (0)	0 (0)	0.40 (0.25)	0.43 (0.25)
Default-provision baseline[c] (n = 253)	0.15 (0.15)	0.32 (0.22)	0.22 (0.18)	0.46 (0.19)
Intervention, Phase 1[d] (n = 254)	0.29 (0.19)*	0.44 (0.29)*	0.40 (0.23)*	0.65 (0.28)*
Intervention, Phase 2[e] (n = 255)	0.22 (0.22)**	0.27 (0.35)**	0.36 (0.30)	0.43 (0.39)

*Exact test of the difference between the mean consumption at default baseline and end of Phase 1; $P \leq .001$; **Exact test of the difference between the mean consumption at naturalistic baseline and end of Phase 2; $P < .001$ for both fruit and vegetable consumption among those who consumed no F/V at baseline; [a]Naturalistic baseline, participants received fruit and vegetable as part of their regularly planned national school lunch program meal; [b]Columns correspond to those children who ate no fruit and no vegetables during the 3 days of the naturalistic baseline; [c]Default-provision baseline, participants received full portions of *Food Dudes* (FD) intervention fruit and vegetable in addition to their regularly planned National School Lunch Program meal; [d]Intervention, Phase 1, participants received full portions of FD intervention fruit and vegetable in addition to their regularly planned National School Lunch Program; participants watched FD videos prior to consuming lunch, and consuming full portions of FD intervention fruit and vegetable was incentivized; [e]Intervention, Phase 2, participants received fruit and vegetable as part of regularly planned National School Lunch Program; consuming full portions of fruit and vegetable was intermittently rewarded.

Note: Children are separated into columns by fruit and vegetable consumption status during the naturalistic baseline.

Consumer Satisfaction

The online survey was completed by approximately 42% (n = 108) of parents of participating children. More than 75% of parents either agreed or strongly agreed that their children were consuming more F/V at school (they could judge by the hand stamps with which their child returned from school, or not, each day), and almost 60% agreed or strongly agreed that their children were consuming more F/V at home. Over 60% of parents agreed or strongly agreed that the FD program positively influenced school culture (making the consumption of F/V the social norm) and more than 70% of parents were happy with the results of the program and would recommend it to other schools. Approximately 80% (n = 16) of teachers and school staff completed a similar survey. More than 80% of respondents agreed or strongly agreed that children enjoyed participating in the FD program; the tangible incentives were the most highly rated component. More than 75% of respondents said that they would recommend the program to other elementary schools.

DISCUSSION

Fruit and vegetable consumption significantly increased during and after the pilot implementation of the FD program. Consistent with other reports, this effect was most discriminable among those children who consumed no F/V at baseline.[9] Among these children, F/V intake (combined) increased by an average of 0.49 cups per day. Thus, despite the considerable cultural, curricular, and school scheduling differences separating the US and the UK, the FD program proved successful.

The FD program, developed by psychologists in the UK, is unique in its trans-theoretical approach to encouraging children to consume more F/V. In the FD program, role modeling is combined with a schedule of positive reinforcement for repeatedly tasting F/V.[12-14] In Europe, the program has consistently resulted in significant increases in F/V consumption, even after rewards are withdrawn at the end of Phase 2.[9,10] Little information is available about the longer-term efficacy of the program or how cultural differences between the UK and the US may influence the success of the program.

With respect to the tangible-rewards component of FD, Cooke et al examined children's acceptance of a disliked vegetable over repeated tasting exposures with and without a tangible reward.[15] Children who repeatedly tasted the vegetable over a period of 12 days increased consumption of this food by a small amount ($d = 0.26$) relative to a no-tasting control group; but this intervention proved to have no lasting effect. By contrast, repeated-tasting *plus* a tangible reward (a sticker) contingent upon repeatedly tasting the vegetable produced an immediate ($d = 0.93$) and long-term effect ($d = 0.72$ at 3 months). The latter is critical, as behavioral economists and self-determination theorists have frequently warned of possible demotivating effects of tangible incentives, once they are removed.[16,17] Cooke et al suggested that demotivating effects of incentives might not be expected when baseline motivation to consume the food item is low,[15] a conclusion consistent with the meta-analysis of Cameron et al.[18]

In the present study, increases in F/V consumption were driven primarily by children who did not eat these food items during the naturalistic baseline. If baseline F/V consumption may be taken as a proxy of intrinsic motivation, these children began with very low motivation that was positively influenced by FD at the end of Phase 2. The intrinsic motivation of children already consuming F/V at naturalistic baseline was not negatively influenced, as consumption was unchanged at the end of Phase 2. Consistent with the findings of Cooke et al,[15] these findings do not support the contention that tangible incentives erode intrinsic motivation to consume F/V.

The authors also noted a significantly higher F/V intake among fifth-graders compared to younger children, though the percentage increase in F/V intake that occurred over the study was similar across grades. This difference may have been driven by the higher total energy needs, and thus food consumption, of older compared to younger children, though this idea was not formally evaluated.

The authors note 2 important strengths of the present pilot project. First, objective measures of F/V consumption were used. Skin carotenoid scores and digital photographs of lunch trays allowed the investigators to quantify F/V consumption more objectively than if human observers had attempted to score consumption in the cafeteria in real time. However, there are no published studies validating the use of this method as an indicator of total F/V intake among children. In addition, skin carotenoids were only weakly ($r = .24$; $P = .001$) associated with observed lunchtime intake of F/V. Skin carotenoids may be a useful marker of total intake of highly pigmented F/V, but the degree of correlation between lunchtime intake of F/V and total intake of F/V is not known. A second strength of the present study is that multiple observers scored F/V consumption blind to the phase in which the photograph was taken, thereby preventing experimenter expectations from affecting the outcomes.

The authors note important limitations, as well. The pilot project used a weak experimental design, and therefore, the increase in F/V consumption could be attributed to a number of confounding variables including seasonal variability in F/V intake, or drift in intake not attributed to the FD intervention itself. A stronger experimental design that included a control group that received additional F/V but that did not watch the FD videos or receive rewards when consumption goals were met would allow a number of confounds to be evaluated. A second weakness is that this study was conducted in a single elementary school, so questions of external validity remain. Factors such as socioeconomic status or ethnicity in schools with more diversity may have an impact on the magnitude of the observed effect. The authors could not assess the importance of these factors because they had no additional information on socioeconomic status and the students at this school were predominately non-Latino white (87%). The authors' research group is currently undertaking an experimental evaluation of the FD program in a larger number of schools with a more diverse student population.

IMPLICATIONS FOR RESEARCH AND PRACTICE

The results of this study provide preliminary evidence that the FD program, which has been consistently successful at increasing F/V intake among children abroad, can produce similar outcomes in US schools. The present findings also provide evidence that incentivizing F/V consumption does not diminish intrinsic motivation to eat these food items. To the contrary, among children with the lowest intrinsic motivation to consume F/V, consumption remained significantly elevated after all extrinsic rewards had been removed. The FD model that integrates role modeling, repeated tasting experiences, and a schedule of rewards for the desired behavior may provide a successful strategy to help US children develop healthy eating habits early in life.

ACKNOWLEDGMENTS

This research was supported by grants from the United States Department of

Agriculture (59-5000-0-0065) and the Utah State University Agriculture Experiment Station.

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