Pairing Vegetables with a Liked Food and Visually Appealing Presentation: Promising Strategies for Increasing Vegetable Consumption among Preschoolers

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Abstract

Background: Vegetable consumption among preschool children is below recommended levels. New evidence-based approaches to increase preschoolers’ vegetable intake, particularly in the child care setting, are needed. This study tests the effectiveness of two community-based randomized interventions to increase vegetable consumption and willingness to try vegetables: (1) the pairing of a vegetable with a familiar, well-liked food and (2) enhancing the visual appeal of a vegetable.

Methods: Fifty-seven preschoolers enrolled in a Child and Adult Care Food Program–participating child care center participated in the study; complete lunch and snack data were collected from 43 and 42 children, respectively. A within-subjects, randomized design was used, with order of condition counterbalanced. For lunch, steamed broccoli was served either on the side of or on top of cheese pizza. For a snack, raw cucumber was served either as semicircles with chive and an olive garnish or arranged in a visually appealing manner (in the shape of a caterpillar). Paired t-tests were used to determine differences in consumption of meal components, and McNemar’s test was performed to compare willingness to taste.

Results: Neither visual appeal enhancement nor pairing with a liked food increased vegetable consumption. Pairing increased willingness to try the vegetable from 79% to 95% of children (p = 0.07). Greater vegetable intake occurred at snack than at lunch.

Conclusions: Further research should explore the strategy of pairing vegetables with liked foods. Greater consumption at snack underscores snack time as a critical opportunity for increasing preschool children’s vegetable intake.

Introduction

Preschool-aged children in the United States fail to meet recommended dietary guidelines. Specifically, children are consuming more added sugar and fat than is recommended and not enough nutrient-rich whole fruits, vegetables, whole grains, and low-fat dairy.1,2 The preschool years are a crucial time for fostering healthy eating habits, because development of attitudes toward food and overall taste preferences during early childhood persist throughout life3 and track well with later dietary patterns and BMI.4

Improving the diet of preschool-aged children is particularly important in the context of the present obesity epidemic, because consumption of nutritionally optimal diets high in fruits and vegetables may decrease the likelihood of child overweight and obesity.5 Currently, 21.2% of children ages 2–5 are overweight or obese (have a BMI for age ≥85th percentile).6 High BMI in childhood tracks well with high adult BMI and obesity-associated chronic diseases.7,8 The Institute of Medicine (IOM) and a recent systematic literature review emphasize a need for overweight and obesity prevention interventions that begin in early childhood.5,9

Primary obesity prevention in the child care setting has the potential to affect children’s health, because 82% of children 3–5 years of age are enrolled at least half-time at a preschool center.10 Those enrolled in full-day care (≥8 hours daily) potentially consume between 50 and 66% of their calories at the center. The USDA Child and Adult

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Care Food Program (CACFP) provides federal reimbursements for meals that meet minimum nutritional criteria at child care centers where at least 25% of families served are low income. Today, 3.2 million US children receive meals through the CACFP.

The Healthy, Hunger-Free Kids Act of 2010 has charged the USDA with revising the CACFP’s nutrition standards and requirements, which are currently based on 1989 dietary guidelines. The IOM has recommended that the CACFP require increased servings and variety of vegetables and whole grains, with smaller servings of meat or meat alternates, milk, solid fats, and added sugars; the USDA is expected to base revised standards on these recommendations. However, it is still seeking guidance on behavioral interventions to promote increased uptake of the proposed healthier meal components.

Some interventions to improve consumption of fruits and vegetables among preschoolers have met with success. Jansen and colleagues demonstrated that children ages 4–7 consumed more fruit when it was presented in a visually appealing manner; however, this study took place in a lab setting, where children engaged one-on-one with researchers. Recent work by Fisher demonstrated that preschool children had greater intake of broccoli when it was served with a salad dressing; however, CACFP-participating centers are not able to receive reimbursement for the condiment, and adding dip is likely to increase the overall caloric and saturated fat intake of the meal. Healthful, cost-effective, feasible strategies are needed to improve consumption of nutrient-rich foods in young children in community-based settings.

The primary aim of this study was to test the feasibility of two strategies to increase preschoolers’ vegetable consumption and willingness to try vegetables: (1) the pairing of a vegetable with a familiar, well-liked food and (2) enhancing the visual appeal of a vegetable.

Methods

Participants

One large, racially diverse child care center in Connecticut was recruited for participation in the study in 2011. The center participated in the USDA’s CACFP. All children consumed meals and snacks provided on-site; no food from home was permitted. Preschool children enrolled full time were eligible for participation in the study. A sample size of 27 children was calculated to detect a medium effect size ($d=0.4$; G-Power, version 3.1.2, 2009; Heinrich Heine University, Düsseldorf, Germany). Parental consent and verbal child assent was provided for 57 of 72 children (79% participation rate). One child left the child care center before data collection began. Of the 57 participants, 43 (29 boys and 14 girls) and 42 (27 boys and 15 girls) were present for both days (baseline and intervention) of lunch and/or snack data collection, respectively. The mean age of children was 4.4±0.6 years. The mean sex-specific BMI-for-age percentile was 57.3±28.1. Approximately 16.4% of children were overweight or obese ($\geq 85$th sex-specific BMI-for-age percentile). Among the children’s racial and ethnic backgrounds, 41.1% were non-Hispanic black, 37.5% were non-Hispanic white, 14.3% were Hispanic, and 7.1% were Asian. The median total family income was $33,600 (interquartile range, $19,337–$57,000).

Design

A one-factor, two-level (experimental, control) within-subjects experimental design, with order of condition counterbalanced, was used to study the children’s vegetable consumption. Classrooms were randomly assigned to first participate in either the intervention or control condition for lunch and snack. The children participated in the second condition 1 week after the first condition for each meal. Although all children received control and/or intervention meals, data were only collected from those for whom written parental consent had been obtained. All procedures were approved by the Yale University Institutional Review Board (New Haven, CT).

Measures and Procedures

The two primary outcome measures were willingness to taste (defined as consumption of 3 g or more of a given food item) and total consumption of the test vegetable (in grams). Willingness to try the food garnishes at snack was defined as any consumption of either the olive or the chive.

For both meals and conditions, researchers weighed and plated the children’s meals in the center’s cafeteria in accordance with the CACFP-recommended preschool serving sizes for all meal components before delivering them to the classrooms. All weights were recorded to the nearest 0.1 g on a digital electronic balance (Acculab VIC-5101; Data Weighing Systems, Inc., Elk Grove, IL). For the lunch-pairing intervention, children were offered $\frac{1}{2}$ cup of milk, $\frac{1}{2}$ cup of fresh diced pears and apples, $\frac{1}{4}$ small (80–90 g) pizza with marinara sauce and cheese, and $\frac{1}{4}$ cup (19.1–20.1 g) steamed broccoli either on the side (control) or on top of the pizza (intervention). Broccoli was chosen for the intervention because it was not typically served in this context in the center, but was not a completely unfamiliar food. For the snack visual appeal intervention, children were offered $\frac{1}{2}$ cup of milk and $\frac{1}{2}$ cup (49.7–52.7 g) raw cucumbers either as semicircular half-slices with chive and an olive on the side (control) or arranged as a caterpillar with chive antennae and an olive eye (intervention). Cucumbers were chosen for the snack intervention because they lend themselves to attractive appearance modifications and can be served raw, with limited preparation time, so they may be considered a reasonable addition to snack menus. Children were free to request additional servings of any meal component.

Teachers were instructed to interact as usual with the children during meals, engaging them in conversation, consuming the same food items as children, and helping...
them with additional servings. Teachers did not engage in conversation about the intervention. Researchers remained in the classroom to make observations during mealtimes and to weigh additional servings if requested by the children. After the meal was completed, researchers weighed the plate waste of meal components in the cafeteria.

Researchers recorded the weight and height of participating children using a digital scale (Seca Clara 803; Seca Medical Measurement Systems and Scales, Hanover, MD) and a stadiometer (Seca Road Rod 214 Portable Stadiometer; Seca Medical Measurement Systems and Scales). Other demographic information (birthday, race, ethnicity, and total family income) were obtained from center records. Sex-specific BMI-for-age percentile was calculated using 2000 CDC growth charts.16

**Statistical Analysis**

All analyses were conducted using SAS statistical software (version 9.2, 2008; SAS Institute Inc., Cary, NC). McNemar’s test for paired proportions was performed to compare willingness to taste between study conditions. Paired *t*-tests were used to determine differences between intervention and control conditions in consumption of meal components. For all inferential statistics, critical alpha was set at *p* < 0.05.

**Results**

*Pairing Intervention*

Consumption of the target vegetable (broccoli) at lunch did not differ significantly between the experimental condition (served on top of cheese pizza; mean = 18.1 ± 12.9 g) and the control condition (served on the side; mean = 17.8 ± 14.9 g; *p* = 0.89; see Fig. 1). Consumption of other meal components did not change as a result of this intervention, with the exception of total pizza intake. Children ate 14.3 g less pizza when it was topped with broccoli than they did when broccoli was plated on the side (*p* < 0.0001). A greater percentage of children tried broccoli (*i.e.,* consumed at least 3 g) when it was served on top of the pizza (95.3%) than when it was on the side (79.1%). The increased willingness to try the vegetable in this intervention trended toward statistical significance (*p* = 0.07).

*Visual Appeal Intervention*

Under the control condition, 29.0 ± 25.0 g of cucumber were consumed, whereas under the visual appeal condition, 34.3 ± 37.4 g were consumed. This difference was not statistically significant (*p* = 0.29). A significant increase in milk consumption of 21.3 g (approximately 1/6 cup) was noted in the intervention condition (*p* = 0.007).

In regard to the children’s willingness to try meal components, 83.3% of children tried cucumber when it was presented in the visually appealing manner versus 78.6% in the control condition. This difference was not statistically significant (*p* = 0.72). In the visual appeal enhancement, 48.8% of children were willing to try the chive garnish, whereas 42.9% were willing to try the chive in the control snack.

**Discussion**

The primary aim of this study was to evaluate the effects of pairing and visual appeal interventions on children’s vegetable consumption. Whereas consumption of vegetable (broccoli), fruit (apple and pear mix), and milk did not change as a result of the pairing intervention, intake of pizza was, on average, 14.3 g less when it was topped with broccoli than when broccoli was served on the side. The reason for this is presently unknown and merits future investigation. A possible explanation is that broccoli on top of the pizza made it less appealing than cheese pizza to the preschool children. However, this is unlikely because the children consumed approximately equal amounts of broccoli across intervention conditions. Further, this pairing intervention appears to have increased preschoolers’ willingness to try broccoli.

Previous lab-based research suggests that presenting fruit in a visually appealing manner can increase overall consumption of that item.15 Though this vegetable study showed a slight increase in consumption of cucumber when presented as visually stimulating caterpillars, the difference was not significant. This is most likely the result of large standard deviations in consumption under both conditions and a moderate sample size not powered to detect small effects. Failure to detect a difference in willingness to taste vegetables in the visual appeal intervention was likely the result of the fact that very few children were unwilling to try the cucumbers in the control condition, creating a ceiling effect.

It is noteworthy that the preschoolers displayed high levels of adventurousness in eating overall, because 46% tried the chive garnish that accompanied the cucumbers without verbal prompt from teachers or researchers. In addition, it is unknown why there was significantly greater intake of milk in the intervention condition. Future research should also investigate the mechanism by which visual appeal encourages greater consumption in child
care, whether it is merely the visual cue, additional enthusiasm from caregivers regarding the intervention (anecdotally, we observed great caregiver excitement during the visual appeal condition, despite instruction to behave as usual), or other unmeasured variables.

The high willingness to try and consumption at baseline demonstrate that preschool children are inclined to eat moderate intakes of vegetables, particularly at snack. In fact, as indicated in Figure 1, the children ate much greater absolute amounts of vegetables at snack than at lunch. One possible explanation for this finding is that the snack vegetable was not in competition with numerous meal components. Snack time in child care may present a unique opportunity for encouraging preschoolers’ consumption of vegetables. For the 3.2 million children participating in the CACFP, being served vegetables for a snack could result in increased total daily intake of vegetables and improvement in overall diet, especially when vegetables replace commonly served less-healthful foods, such as those with refined white grains (e.g., non-whole-wheat crackers) and solid fats and added sugars (e.g., muffins).

This study is not without limitations. As noted in the Methods section, power was not sufficient to detect less than a medium effect size. Though weighing of each meal component generally assured accuracy in outcome variables, measurement error resulting from undetected spillage may have occurred. Also, whereas the participating child care site was heterogeneous in terms of socioeconomic status and race and ethnicity, findings may not generalize to other child care centers around the country. For example, the prevalence of overweight and obesity in this sample was only 16.4% versus the 21.2% national average for 2 to 5 year olds. Finally, it is not possible to determine the degree to which the particular vegetables chosen for the study affected the outcome; future research to examine whether the findings hold across a range of vegetables is recommended.

Particular strengths of the study include its demonstration of the feasibility in a community-based preschool setting of both pairing of familiar, liked foods with vegetables and visual appeal enhancement strategies. Weighing meal components is also deemed to be the most valid, reliable technique to determine consumption and willingness to taste.

Conclusions

Consumption of vegetables by preschool children in a CACFP-participating site did not increase significantly based on visual appeal enhancement or pairing with a liked food; however, these strategies remain promising and should be tested among children with lower baseline levels of vegetable intake, using a larger sample. A much higher intake of vegetables at snack time (vs. lunch) highlights the potential for child care centers to increase consumption of vegetables among preschoolers by adding them to the snack menu. Further, pairing of a vegetable with a familiar food appears to have increased the children’s willingness to try the vegetable. Results may provide evidence for policy makers on promising strategies to improve the nutrition profile of children in CACFP-participating child care centers.

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