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A Garden Pilot Project Enhances Fruit and Vegetable Consumption among Children

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ABSTRACT

Fruit and vegetable intake among children is inadequate. Garden-based nutrition education programs may offer a strategy for increasing fruit and vegetable intake in children. A 12-week pilot intervention was designed to promote fruit and vegetable intake among 4th to 6th grade children (n=93) attending a YMCA summer camp. Children participated in garden-based activities twice per week. Weekly educational activities included fruit and vegetable taste tests, preparation of fruit and vegetable snacks, and family newsletters sent home to parents. The pilot intervention was evaluated using a pre and post survey to determine participant satisfaction and the short-term impacts of the program. The process evaluation focused on program satisfaction, whereas the short-term impact evaluation assessed fruit and vegetable exposure, preference, self-efficacy, asking behavior, and availability of fruits and vegetables in the home. Data from the impact evaluation were compared from baseline to follow-up using McNemar's test (dichotomous variables) and Wilcoxon signed rank test (scales/continuous variables). Children reported high levels of enjoyment in the intervention activities. Most children (97.8%) enjoyed taste-testing fruits and vegetables. Children also liked preparing fruit and vegetable snacks (93.4%), working in their garden (95.6%), and learning about fruits and vegetables (91.3%). Impact data suggest that the intervention led to an increase in the number of fruits and vegetables ever eaten ($P<0.001$), vegetable preferences ($P<0.001$), and fruit and vegetable asking behavior at home ($P<0.002$). Garden-based nutrition education programs can increase fruit and vegetable exposure and improve predictors of fruit and vegetable intake through experiential learning activities. Participation in the "seed to table" experience of eating may help promote healthful eating behaviors among youth. Food and nutrition professionals should consider garden-based nutrition education programs that connect children with healthful foods through fun, hands-on activities.

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Although evidence suggests that eating fruits and vegetables promotes health and prevents several chronic diseases, fewer than 10% of children (age 4 to 13 years) meet MyPyramid (1) recommendations for these foods (2,3). A review of 21 studies on fruit and vegetable consumption in children found preference and availability were most predictive of fruit and vegetable consumption (4). The results of this review indicate that it is important for children to have repeated opportunities to taste and eat fruits and vegetables. For instance, five to 10 exposures are often required to increase acceptance and intake of new foods (5-8). Other predictors of fruit and vegetable intake include self efficacy, child asking behavior, and food-preparation skills (9-12). A major challenge facing nutrition educators today is how to develop and implement interventions that both support fruit and vegetable intake and engage children.

The resurgence of school and community gardens presents considerable potential to improve children's fruit and vegetable intake through experiential learning. Gardening experiences that include planting, weeding, harvesting, and food preparation support hands-on learning and a personal connection with food. Several studies have demonstrated an increase in children's fruit and vegetable intake (13-15), willingness to taste (16-18), and preference (19,20) for fruits and vegetables after participation in garden-based nutrition education programs. McAleese and Rankin (14) found that 10- to 13-year-old youth who participated in garden-based nutrition education increased their servings of fruits and vegetables and, hence, intake of vitamin A, vitamin C, and fiber more than did students in the nutrition education only and control groups. Another study found 4th-grade students exposed to gardening had a greater increase in vegetable preferences compared with the nutrition education only and control groups (20). Results from garden-based research are promising, but have often been conflicting, and to date have not measured short-term impacts on the home food environment or level of participant satisfaction.

The present study evaluates the *Delicious and Nutritious Garden*, a 12-week garden-based nutrition intervention integrated within a YMCA summer camp. The study builds on previous research, with the addition of weekly

activities including: (a) taste-testing of fruit and vegetables, (b) preparation of healthful snacks, and (c) family newsletters. The primary objectives of the *Delicious and Nutritious Garden* intervention were to assess participant satisfaction and determine whether participation increased fruit and vegetable exposure, preferences, self-efficacy, asking behavior, and home availability of fruits and vegetables among school-age children.

METHODS

Study Design and Population

A convenience sample of children entering 4th to 6th grade (n=93) was recruited from a 12-week YMCA summer camp to participate in the *Delicious and Nutritious Garden* (named by participants) intervention. Given the pilot nature of this study, a pre-post design was used. Self-administered surveys were given to each child and one parent/primary caregiver who, respectively, provided written assent and consent. Child and parent survey measures were adapted from existing measures and constructs that have been used in similar populations (21-24). Experts in the fields of pediatric and public health nutrition reviewed surveys for content and face validity.

Approximately half of the participants (n=43) who enrolled 4 weeks before the start of the intervention were invited to participate via a mailed consent form and parent baseline survey. Children who joined camp after this mailing were recruited during camp drop-off and pick-up times. Children who enrolled in camp at week 9 or later were not recruited. Children's baseline surveys were completed before participating in garden-based activities. Follow-up surveys were completed during the last week of camp. A small portion of children and parents (16%) who did not complete follow-up surveys during the last week of camp received a mailed survey. Surveys received more than 2 weeks after the completion of the intervention were excluded. Ninety-three percent of children completed both baseline and follow-up surveys. Children and parents/primary caregivers each received a $5 gift card as an incentive to complete each survey. The Human Subjects Institutional Review Board at the University of Minnesota approved study procedures.

A total of 93 youth participated in the study. Participants were equally distributed by sex (51% boys, 49% girls) with a mean age of 9.7 years (range 8 to 11 years). Most children were white (78%), followed by Hispanic (8%), Asian American (6%), mixed/other (5%), and African American (3%).

Description of the Intervention

The *Delicious and Nutritious Garden* was a new component of a 12-week summer camp for children from June through August 2007. Program exposure varied among participants because children signed up for camp on a weekly basis. Almost half of the children (46%) attended camp for more than 6 weeks. The first author and a Master Gardener with 24 years of experience working with youth gardens facilitated intervention activities. Before the intervention began, community leaders and organizations met to align interests and determine organizational roles within the intervention. A garden training was also provided for all YMCA counselors.

Children participated in a variety of intervention activities twice per week for 20 to 30 minutes. Social cognitive theory (SCT) and experiential learning principles guided intervention activities (Figure). The principles of SCT emphasize that children's thoughts and beliefs about food can influence their behaviors. A 25-foot×25-foot plot was designed and prepared. Beans, beets, carrots, cabbage, cucumbers, eggplant, kohlrabi, leaf lettuce, okra, onions, peppers, radishes, strawberries, Swiss chard, summer squash, tomatoes, zucchini, and herbs were planted by children in the first and second weeks of the intervention. Children also learned to weed, observe, and harvest their garden. Garden-based activities included learning about the origins of food, plant parts, nutrient needs of humans and plants, environmental stewardship, MyPyramid for Kids (1), goal setting, and role-playing. The activities were adapted from several garden, cooking, and nutrition education curricula (25-33) and were reviewed for developmental appropriateness by the senior program director, youth development supervisor, and camp director at the YMCA.

Each week children tasted a local fruit and/or vegetable from the farmers' market. Of the 16 fruits and vegetables presented during these taste tests, only six were not grown in the garden (spinach, sugar snap peas, apples, raspberries, cantaloupe, and watermelon). The origin, nutritional benefits, trivia questions, and ways to eat the fruit or vegetable were discussed. Prior to tasting, children were encouraged to look at, smell, and feel the fruit or vegetable.

In addition, the children prepared a dozen healthful snacks with produce from their garden, including two snacks for younger campers to promote peer modeling of fruit and vegetable intake. All children received a cookbook containing recipes for the fruits and vegetables they taste-tested and prepared throughout the intervention. Children were encouraged to act as agents of change by sharing their experiences with family members and asking for the fruits and vegetables they grew, tasted, or prepared during the intervention. Parents/primary caregivers were encouraged to improve fruit and vegetable availability and accessibility through weekly newsletters, recipes, and take-home activities.

Process Measures

The follow-up children's survey included seven questions that asked children about their personal level of enjoyment for each intervention activity. Response categories were: *disagree a lot*, *disagree a little*, *agree a little*, or *agree a lot*. The process evaluation also collected data from four open-ended questions asking children to explain what they liked and disliked about the intervention, how they would improve it, and whether they would be interested in participating the following year. Representative themes and quotes were selected from each question.

Outcome Measures

Fruit and Vegetable Exposure. The children's survey assessed whether children had ever eaten 11 specific vegetables and 5 fruits with the question, "Have you ever eaten this food?" Response options were: *no* or *yes*.

Variables	Description of Intervention Component
Behavioral Factors	
• Food consumption habits • Tasting of fruits and vegetables • Ability/skill to prepare fruits and vegetables for meals/snacks	1. Gardening twice per week (planting, weeding, observing, harvesting) 2. Weekly fruit and vegetable taste-testing 3. Preparation of 12 fruit and vegetable recipes 4. Children provided with a fruit and vegetable cookbook at the end of camp
Personal Factors	
• Self-efficacy ○ To try new fruits and vegetables when available ○ To prepare healthy meals/snacks with fruits and vegetables ○ To ask for fruits and vegetables at home ○ Confidence to eat fruits and vegetables when other palatable foods are available • Like/dislike for fruits and vegetables • Like/dislike for high-fat/high-sugar foods	1. Encouraged children to taste with all their senses 2. Weekly discussion encouraged children to ask for the fruits and vegetables taste-tested, grown, and/or prepared 3. Perceived ownership of the fruits and vegetables grown in the garden and the fruit and vegetable recipes prepared 4. Children provided with a fruit and vegetable cookbook at the end of camp 5. Children learned about: the origins of food, plant parts, the environment, nutrient needs of plants, and MyPyramid for Kids 6. Children practiced setting goals and role-played ways to increase fruit and vegetable intake when presented with common barriers
Socioenvironmental Factors	
• Availability of fruits and vegetables at camp and home • Accessibility of fruits and vegetables (eg, in child's reach on kitchen counter or cut up in refrigerator) • Availability and accessibility of high-fat/high-sugar foods at day camp and at home • Peers and family eat fruits and vegetables • Fruits and vegetables present at mealtime and for snacks • Parental support for fruit and vegetable consumption • Family ability to buy fruits and vegetables	1. Children were mobilized as agents of change for their home food environment by sharing garden experiences and asking for fruits and vegetables at home 2. Twelve opportunities to prepare a fruit and vegetable meal/snack (Two recipes were shared with younger campers to promote peer modeling of fruits and vegetables) 3. Children brought home vegetables grown in their garden to be shared with family 4. Weekly family newsletters: (a) summarized the week's activities; (b) provided helpful information to parents/primary caregivers to increase family's fruit and vegetable intake; (c) presented a take-home challenge (eg, find and eat a new vegetable at the farmers' market this weekend); (d) offered a simple fruit and vegetable recipe

Figure. Behavioral, personal, and socio-environmental factors affecting fruit and vegetable behaviors of children with corresponding descriptions of the Delicious and Nutritious Garden intervention components.

Preferences. Three scales were created from the children's survey that examined fruit and vegetable preferences: (a) an 11-item vegetable scale (Cronbach's α coefficient=.59), (b) a 5-item fruit scale (Cronbach's α coefficient=.68), and (c) an 8-item snack scale (Cronbach's α coefficient=.65). The vegetable and fruit scales were adapted from Domel and colleagues and included fruits and vegetables taste-tested and grown in the garden (24). The question asked, "What do you think about this food?" The Likert scale included five responses: *I really do not like it!*, *I do not like it*, *It is OK*, *I like it a little,* and *I really like it a lot!* Questions in the snack scale asked children to choose between a favorite fruit/vegetable and another snack (eg, "When I get home from Discover Y Day Camp, I would prefer to have . . . my favorite fruit OR my favorite cookie.") (24).

Self Efficacy. Children's self-efficacy was assessed with a 5-item scale (Cronbach's α coefficient=.62) including questions such as, "How sure are you that you could eat fruit for a snack when you are hungry?" (34). Response options included: *not at all sure*, *somewhat sure*, *sure*, and *very sure*.

Asking Behavior. Child asking behavior was measured using a 7-item scale (Cronbach's α coefficient=.58) (eg, "In the last WEEK, did you ask someone in your family to . . . buy fruits or vegetables?"). Response options were: "no," "yes," and "I don't have to ask. They already do this." Child asking behavior was ranked in a hierarchal fashion where a response of "no"=1; "yes"=2; and "I don't have to ask. They already do this."=3 (35).

Home Availability. The child survey assessed availability using a 7-item scale (Cronbach's α coefficient=.54) that asked questions such as: "How often are the following true? . . . In my home, there are cut-up vegetables in the fridge for me to eat." Response categories were: *hardly ever*, *sometimes*, *often*, and *almost always* (21).

Demographics. Parents/primary caregivers reported their children's age, grade level, sex, and race/ethnicity. Children were classified by grade level: 4th, 5th, or 6th grade.

Race/ethnicity was determined in two steps with these two questions: "Is this child Hispanic or Latino?" (a) yes, (b) no; and "Do you consider this child (a) white, (b) black or African American, (c) Asian, (d) Native Hawaiian or other Pacific Islander, (e) American Indian or Alaskan Native?" Parents reporting more than one response for the second question were coded as mixed/other.

Data Analysis

Data were analyzed using the statistical package SAS 9.1 (2002-2003, SAS Institute Inc, Cary, NC). Descriptive statistics (percentages, frequencies) were generated for demographic characteristics of the sample and participant satisfaction. Eight scales were created to examine the outcomes of interest; the items within each scale were summed and averaged. Data were compared from baseline to follow-up using McNemar's test (dichotomous variables) and Wilcoxon signed-rank test (scales/continuous variables) to determine whether scores changed. An α level $P<0.05$ was selected to indicate statistical significance. Due to the small sample size an α level $P<0.10$ was used to indicate results approaching statistical significance.

RESULTS

Process Measures

Process data suggest the *Delicious and Nutritious Garden* was well-accepted and valued by the children. Nearly all of the children (97.8%) enjoyed taste-testing different fruits and vegetables. Children also liked preparing fruit and vegetable snacks (93.4%), working in their garden (95.6%), and learning about fruits and vegetables (91.3%). When asked what they liked most about the *Delicious and Nutritious Garden*, children replied:

- "Being able to pick fruits and vegetables and eat the same ones."
- "We got to make snacks that were really really good."
- "Trying different fruits and vegetables."
- "We learned about worldwide recipes!"
- "I liked that we did it ourselves and we have the pride for it."

When asked what they liked least, 44% of children wrote "nothing" or "I liked everything." Some children stated that they did not like getting "muddy" or "pulling weeds." Others responded: "That we did not get to taste test every day," or, "We didn't get to spend enough time in the garden."

Few children (5%) reported they would not like to be a part of the program next year; most (80%) would participate in the program again next year because they felt the garden was "fun." When asked about future participation, children responded:

- "Yes, because it was fun trying foods I have never tried before."
- "Yes, because I like to be a part of things."
- "I would because it's fun learning about new foods."
- "Yes! Because it is a fun way to inspire kids to eat healthy."

Children were also asked how they would improve the program. Answers included adding more fruit, planting more vegetables, making a bigger walking path, and increasing the time spent in the garden.

Outcome Measures

At baseline, more than two thirds of children had tried at least 75% of the 16 fruits and vegetables. Fewer than half of the children had ever eaten radishes, zucchini, or beets, whereas 90% of children had eaten lettuce, carrots, beans, apples, strawberries, raspberries, cantaloupe, and watermelon at baseline. At follow-up, children reported a significant increase in the number of fruits and vegetables ever eaten, specifically cucumbers, spinach, sugar snap peas, radishes, peppers, zucchini, beets, and cantaloupe (Table 1). In addition, children reported a significant increase in vegetable preferences (Tables 1 and 2).

Fruit preferences were high at baseline and remained unchanged from baseline to follow-up (Table 2). Most children chose a fruit or vegetable snack over a non-fruit and vegetable snack at baseline. There was no statistically significant change observed in snack preferences from baseline to follow-up (Table 2). Self-efficacy to consume fruits and vegetables from baseline to follow up did not change. There was a significant increase in child asking behavior from baseline to follow-up. Reported availability of fruits and vegetables in the home was high at baseline and there were no significant changes at follow-up (Table 2).

DISCUSSION

The current study examined participant satisfaction and the short-term effectiveness of a garden-based nutrition education program on fruit and vegetable exposure, preferences, self-efficacy, asking behavior, and home availability among children. Process data suggest children were actively engaged in the intervention activities and overwhelmingly reported enjoying the *Delicious and Nutritious Garden*. Impact data suggest that the intervention increased the number of fruits and vegetables ever eaten, vegetable preferences, and fruit and vegetable asking behavior at home.

The *Delicious and Nutritious Garden* placed great value on the "seed to table" experience of eating. More than 90% of children valued the intervention's hands-on activities, such as planting, maintaining, harvesting, and preparing the foods produced in their garden. The sense of ownership and pride generated by the intervention activities increased the number of fruits and vegetables ever eaten and vegetable preferences. The *Delicious and Nutritious Garden* proved to be an innovative strategy to expose children to the benefits of fruits and vegetables through a variety of experiential learning activities.

Findings of increased vegetable preferences are congruent with research from two similar interventions (19,20) that also used questions from Domel and colleagues (24). Lineberger and Zajicek (19) found that 3rd and 5th grade students increased their vegetable preferences after participating in 10 units of a garden-based nutrition education program. In contrast, four other studies (three using the same preference questionnaire) reported no increase in vegetable preferences (16,36-38).

Table 1. Influence of the *Delicious and Nutritious Garden* intervention on children's fruit and vegetable exposure and preferences from baseline to follow-up

	Exposure			Preference	
	Baseline (%)	Follow-up (%)	*P* value	Mean Change (Baseline to Follow-up)	*P* value
Cucumber	77.6	92.6	0.001	0.39	0.003
Lettuce	97.9	98.9	0.564	0.16	0.140
Spinach	58.5	74.5	0.005	0.35	0.009
Tomatoes	84.6	89.0	0.248	−0.02	0.849
Sugar snap peas	62.0	77.2	0.013	0.28	0.091
Carrots	98.9	97.9	0.564	−0.15	0.195
Beans	90.4	95.7	0.166	0.08	0.577
Radishes	48.4	67.7	<0.001	0.51	<0.001
Peppers	70.7	81.5	0.025	0.34	0.035
Zucchini	48.4	67.7	0.002	0.65	<0.001
Beets	45.2	79.6	<0.001	0.48	0.002
Apples	100	100	1.00[a]	−0.08	0.265
Strawberries	96.8	97.9	0.655	0.00	1.000
Raspberries	89.1	92.4	0.257	−0.05	0.567
Cantaloupe	90.4	96.8	0.058	0.01	0.909
Watermelon	100	100	1.00[a]	−0.10	0.253

[a]All children had eaten at baseline and follow-up.

Table 2. Influence of the *Delicious and Nutritious Garden* intervention on children's fruit and vegetable exposure, preference, self-efficacy, asking behavior, and home availability

	Baseline	Follow-up	*P* value
	← *mean*± *standard deviation* →		
Vegetables ever eaten (0 to 11)	7.80±2.24	9.17±2.09	<0.001
Fruits ever eaten (0 to 5)	4.72±0.61	4.86±0.41	0.0187
Vegetable preferences (1 to 5)	3.17±0.75	3.40±0.71	<0.001
Fruit preferences (1 to 5)	4.56±0.58	4.50±0.73	1.000
Snack preferences (0 to 1[a])	0.65±0.26	0.67±0.27	0.464
Self-efficacy (1 to 4)	3.00±0.64	3.08±0.64	0.731
Asking behavior (1 to 3)	2.16±0.47	2.32±0.51	0.002
Availability (1 to 4)	3.11±0.54	3.12±0.57	0.721

[a]Denotes a fruit or vegetable snack choice.

The present study was consistent with other garden research in finding no significant increase in fruit preferences (19,36-38); fruit preferences in the current study were high at baseline and at follow-up. Previous studies note that an inadequate number of taste tests, high preference at baseline, small sample size, program length, and actual gardening time may have influenced fruit and vegetable preference results (16,36,38).

At least two studies found that fruit and vegetable preference was the strongest predictor of fruit and vegetable intake in children (10,34). Although children prefer sweet and salty foods, these preferences are readily altered through experiences with food and eating (39). This may partially explain why the present study found a strong preference for fruits at baseline and significantly increased preference for vegetables at follow-up due to greater exposure to these foods during the program. No significant change in exposure or preference was found between baseline and follow-up for common vegetables (eg, lettuce, carrots, and beans) that most children reported trying prior to the intervention. These results support previous findings that increased fruit and vegetable exposure may influence preferences for and, subsequently, intake of fruits and vegetables (5-8).

To our knowledge, the *Delicious and Nutritious Garden* is the first garden-based nutrition education intervention that has examined fruit and vegetable asking behavior and home availability. Child asking behavior is important because it can influence the home food environment. A survey of parents found that 50% of food decisions are made by their children. The same parents reported that their children are more influential than their own thoughts and beliefs when choosing snacks or where to go out to eat (40). As a result, children with the skills to ask for fruits and vegetables may influence availability of fruits and vegetables in the home (4). The high fruit and vegetable home availability reported at baseline and concurrent fruit and vegetable exposure may have contributed to the positive changes seen in the current sample.

This pilot study has several strengths that build on existing garden research. Researchers have strongly encouraged interventions that focus on increasing vegetable intake and youth gardens may be an ideal strategy (41,42). The focus on repeated fruit and vegetable exposures through weekly taste-tests, work in the garden, and preparation of fruit and vegetable recipes engaged chil-

dren in experiential learning. It also targeted children to act as agents of change for their home food environment.

Several study limitations affect the interpretation of these results. This study included a relatively homogenous convenience sample of children with no control group. Although the sample size was comparable to existing garden-based nutrition interventions, insufficient statistical power made it difficult to determine to what extent covariates such as age, sex, race/ethnicity, and program length may have affected youth in different groups. Further, as in any study measuring outcomes by self-report, social desirability may have influenced results.

CONCLUSIONS

The *Delicious and Nutritious Garden* proved to be an intervention that engaged children and influenced predictors of fruit and vegetable intake. Further garden-based nutrition intervention research with larger sample sizes, comparison groups, and rigorous evaluation methods could build on the findings from this and previous studies to confirm the efficacy of garden-based nutrition education programs. Because fruit and vegetable availability is a predictor of fruit and vegetable intake, future research should also examine the impact of child participation in a garden-based nutrition education program on the child's family and home food environment. Food and nutrition professionals should consider garden-based nutrition education programs that connect children with healthful foods through fun, hands-on activities.

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