AN EVALUATION OF INNER-CITY YOUTH GARDEN PROGRAM PARTICIPANTS' DIETARY BEHAVIOR AND GARDEN AND NUTRITION KNOWLEDGE

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Abstract

Unhealthful eating patterns established early in life tend to be maintained into adulthood, and as a result, chronic diseases such as heart disease, cancer, and obesity may develop. These nutrition-related problems could be reduced through dietary changes; and to facilitate these changes, nutrition education for youth that is delivered experientially may be an effective beginning. Garden curricula, which have a strong experiential learning basis, have been proposed as a method to reinforce nutrition education. Therefore, the purpose of this study was to evaluate dietary behaviors as well as nutrition/gardening knowledge among multiethnic inner-city youth garden program participants using the expanded theory of planned behavior. Youth attending a 10-week garden program completed a pre- and post-survey. Results indicated that gender and age differences were present in both dietary behavior and nutrition/gardening knowledge. Boys significantly increased their fruit and vegetable intake from the pre- to post-survey, whereas girls significantly increased meat and cholesterol consumption. Garden programs have the potential to positively affect inner-city youths' dietary behaviors and nutrition/gardening knowledge; but because results suggest that learning style differences were present in terms of gender and age, , further evaluation is needed for the development of appropriate programs.

Introduction

Contrary to recommendations, youth are consuming diets that are high in total energy (McGinnis, 1992), fat (Birch & Fisher, 1997; McGinnis) and sugar (Gleason & Suitor, 2001) but low in complex carbohydrates (Birch & Fisher) and fruits and vegetables (American Dietetic Association [ADA], 2003). Unhealthful eating patterns established early in life tend to be retained into adulthood (Kelder, Perry, Klepp, & Lytle, 1994) and as a result, chronic diseases such as heart disease (Freedman, Dietz, Srinivasaan, & Berenson, 1999), cancer (Freedman et al.), and increased weight status (Kuczmarski, Flegal, Campbell, & Johnson, 1994) develop. These nutrition-related problems could be reduced through dietary changes, and to facilitate this, nutrition education for youth is an effective beginning (Powers, Struempler, Guarino, & Parmer, 2005).

Nutrition education can serve as a powerful tool in creating nutrition behavioral change; however, the way the education is delivered may determine its success. For instance, researchers have used both passive and experiential learning techniques to influence behavioral change; however, each technique has had varied success (Centers for Disease Control [CDC], 1996; Contento et al., 1995; Klohe-Lehman, et al., 2006; Luepker et al., 1996; Powers et al., 2005). Experiential learning occurs when one performs an activity, looks back at it critically, determines what was useful or important to remember, and then uses this information to perform a subsequent activity (Boyd, 2001). Learning occurs by completing the activity and then by analyzing the experience through reflection, evaluation, and reconstruction of it in order to draw meaning from it (Anderson, Boud, & Cohen, 1995). Experiential learning techniques have been found to be useful for teaching inner-city youth leadership skills because of the reflection component (Boyd, 2001). Powers et al. (2005) employed both experiential and passive techniques and found significant dietary behavior and overall nutrition knowledge improvements when the two techniques were used together.

Although a knowledge component is essential in nutrition education, it may not be solely effective in promoting behavior change (Contento et al., 1995). For example, experiential centered approaches, such as behavioral skill-building and efficacy-enhancing experiences, may increase intervention effectiveness (CDC, 1996). Nutrition education programs that focus on behavioral change have achieved significant success in positively changing youth eating behaviors (Luepker et al., 1996).

Some research has found a positive relationship between nutrition knowledge disseminated passively and behavioral change (Klohe-Lehman et al., 2006); others have observed a weak relationship (CDC, 1996). Passive learning techniques have been found to be ineffective in facilitating student learning because they do not encourage students to actively process information (Shakarian, 1995). Thus, there is a strong consensus that education for youth should include experiential learning techniques in science fields (Mabie & Baker, 1996). Garden curricula, which have a strong experiential learning basis, have been proposed as a method to reinforce nutrition education (Morris & Zidenberg-Cherr, 2002; Viola, 2006) because youth who plant and harvest their own produce are more likely to eat it (Morris et al.). English et al. (1997) reported that Vietnamese children exposed to a nutrition/gardening curriculum, that included both passive- and experiential-based, consumed significantly more fruit, vegetables, energy, protein, vitamin A, and iron at follow-up than their nonintervention counterparts. A cooking component also has an experiential learning foundation and has been used to increase fruit and vegetable consumption (Brown & Hermann, 2005) and nutrition knowledge among youth (Liquori, Koch, Contento, & Castle, 1998), by increasing familiarity with healthy foods through preparation and consumption. Anderson, Bell, Adamson, and Moyniham (2002) suggested that cooking may be a practical method to increase nutrition knowledge, improve attitudes towards foods, and increase consumption of more ‘healthful’ foods. An enhanced understanding of science concepts can result from engagement in hands-on activities because of the provision of meaningful and concrete experiences (Meichtry, 1992). Therefore, because agriculture is by nature hands-on, it makes sense that this approach is utilized in youth garden projects (Mabie & Baker). Mabie and Baker found that youth participation in experiential activities helped students in their ability to observe, communicate, compare, relate, order, and infer information. Although there is good research on youth gardening outside the United States (English et al.; Viola), to date, there is a paucity of research examining nutrition/garden knowledge and dietary changes in the United States.

The theory of planned behavior (TPB) has been used to study decision-making behavior in youth (Fila & Smith, 2006; Lautenschlager & Smith, 2007a). It was first described by Ajzen in 1991 as an individual based theory that measures theoretical constructs that relate to motivation or decision making. Intention is a direct determinant of behavior with the constructs of attitude, subjective norm, and perceived behavioral control (PBC) as direct determinants of intention (Ajzen) (Figure 1). PBC has a direct causal effect on behavior.

This research project assessed changes in dietary behavior and nutrition/garden knowledge using an expanded version of the TPB as the theoretical framework among youth attending a garden program that incorporates both passive and experiential learning approaches. We specifically investigated (a) whether an inner-city garden program can change youth knowledge concerning gardening and nutrition, (b) what predicts youth nutrition/gardening knowledge, and (c) whether participation in a gardening program influences youth dietary behavior. Readers of this journal will find this article significant because a garden program inherently incorporates agricultural education and can educate youth at an early age about nutrition from a food system’s perspective and whether educators can plan or expect behavioral change with garden/nutrition curriculum implementation.

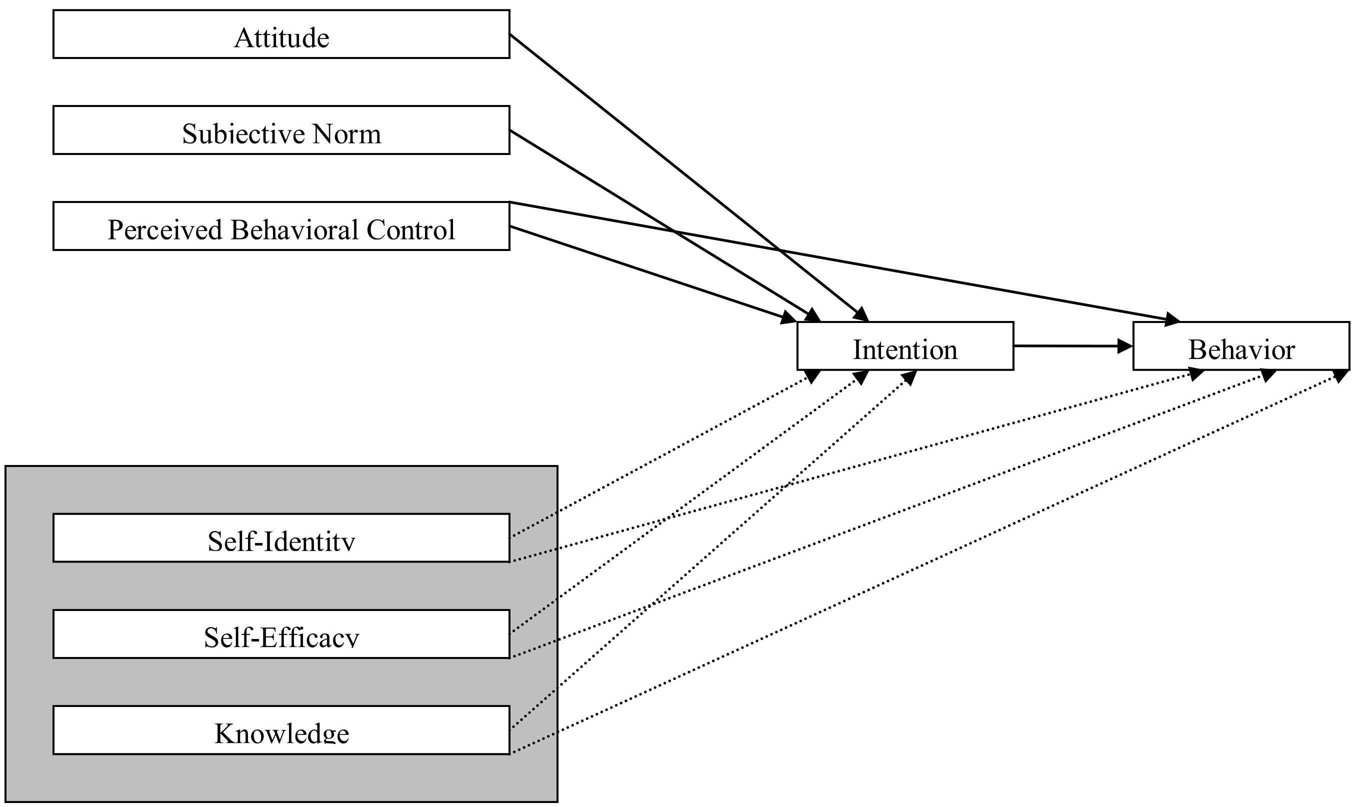

Figure 1. Study model of gardening and dietary behaviors based on the expanded theory of planned behavior model.
Note: The entire figure shows the expanded TPB; removal of the shaded regions depicts the original TPB.

Methods

Study Population and Design

This study evaluated the Youth Farm and Market Project (YFMP), a 10-week garden program working with inner city youth. The YFMP began in 1994 and educates multi-ethnic youth about environmental responsibility, cultural diversity, and the food system (YFMP, 2005). At the three YFMP locations, youth learned about these concepts through experiential learning via gardening and cooking activities and a passive nutrition education curriculum 3 days a week.

Youth ages 8 to 15 years provided information on their age, grade, gender, and ethnicity. Youth also completed a 24-hour recall at pre- and post-survey. Attrition at post-survey was examined for differences in race, gender, grade of education, and YFMP location, and results indicated that only race was significantly different, with more Hmong youth dropping out of the study. Possible cause for the attrition is that some Hmong families grow crops and may have needed their children to assist in their fields. Staff reported that other youth may have discontinued the program to attend summer school or to work for money. The University of Minnesota's Institutional Review Board for Human Subjects approved this study.

Description of Survey

Self-administered surveys were given to youth at the beginning and end of the program and took 20 to 30 minutes to complete. The survey consisted of 177 questions; however, some questions were worded differently to capture changed behavior. Participants were given instructions on how to complete the survey and for youth with difficulties reading, and/or understanding questions, research assistants were present to help. Upon completion, surveys were checked for multiple answers and/or missing information and youth were asked to complete missing data. A 5-point Likert response scale was used for most questions; youth had to choose from "strongly agree," "agree," "don't know," "disagree," or "strongly disagree." Positively worded questions were coded from +2 to -2, and negatively worded questions were coded from -2 to +2. Questions relating to the frequency of certain behaviors were coded from either 0 to 5 (e.g., fruit or vegetable consumption) or 1 to 4 (e.g., ethnic food consumption).

Surveys were developed based on a review of the literature, informal discussions with YFMP staff, and formative data collected through six focus groups conducted earlier with YFMP participants and non-YFMP participants (Lautenschlager & Smith, 2007b). Experts in the fields of nutrition, public health, and agriculture reviewed the surveys for face validity and content. The survey was then pilot tested for understandability and ease of completion with 25 program eligible youth. Internal consistency of construct scales for the pilot survey were evaluated using Cronbach's alpha coefficients, which is an index of how well a set of variables measures a single unidimensional latent construct (UCLA, 2005). After slight modifications to the survey, the Cronbach's alpha coefficients were in the substantial to almost perfect range (Landis & Koch, 1977) for the pre- and post-surveys (0.65 to 0.92).

The surveys were developed to evaluate factors predicting youth dietary and gardening behavior using the TPB as the theoretical framework. The original TPB model was expanded to include three additional constructs, self-identity, self-efficacy, and knowledge, along with the original constructs of attitude, subjective norm, and PBC (Ajzen, 1991). More specifically, attitude is an individual's overall evaluation of a behavior (Ajzen, 1991), and 53 questions were used in the survey as a direct measure (e.g., *I like to try new foods*). Subjective norm measures an individual's belief about what others who are important to them want them to do and their motivation to comply with that referent (Ajzen). An indirect measure of an individual's subjective norm was calculated by taking the product of the normative belief about each referent (e.g., *My family tells me to cook*) (17 questions) and the individual's motivation to comply (e.g., *I cook when my family tells me to*) (17 questions) and summing it across all referents (Montano & Kasprzyk, 2002). PBC is an individual's belief about the amount of control they feel they have to successfully complete a behavior (Ajzen), and 17 questions were used in the survey as a direct measure (e.g., *It is hard to eat foods that are good for me because they are not around*).

Because theories can be modified, three additional constructs were added to the original model for this project, including self-efficacy, self-identity, and knowledge (Figure 1). Ajzen (1991) agrees that additional constructs can be added to the model, providing they capture a significant proportion of the variance in either intention or behavior. Previous researchers have added self-efficacy (Armitage & Conner, 2001), self-identity (Fila & Smith, 2006; Robinson & Smith, 2002), and knowledge (Feng & Wu, 2005) to the TPB. Self-efficacy measures an individual's opinion of how well they can perform a behavior under various inhibiting conditions (Bandura, 1991). Thirteen self-efficacy survey questions were worded *I can…*(e.g., *I can try new foods*). Alternatively, self-identity represents "the distinguishing set of characteristics and behaviors that a person feels defines his or her essence" (Wetter et al., 2001, S14). Eight survey questions measured youths' perceptions of how they identified themselves, for example, *I consider myself a fast food eater*.

The knowledge construct measured youths' understanding of nutrition/garden related concepts. Responses to 11 questions about local foods, sustainability, and specific nutrients (e.g., *Corn tortillas are an example of a whole grain*) were used to assess knowledge. Questions were derived from the existing YFMP nutrition/garden curriculum. Lessons from the nutrition curriculum included (a) regional foods, (b) cooking skills, (c) food origins, (d) nutrients, and (e) healthy eating, whereas lessons from the garden curriculum included (a) the food system, (b) planting basics, (c) food origins, (d) farm maintenance and stewardship, (e) soil and fertilizing, (f) weeds and pests, (g) composting, and (h) harvesting. Knowledge questions were the same for both pre- and post-survey. The nutrition/gardening knowledge scores were recoded so that "strongly agree" and "agree" equaled +1 and "strongly disagree," "disagree," or "don't know" equaled 0. The values assigned to each question were then summated to give each youth a nutrition/gardening knowledge score, with the maximum being 11.

Description of 24-Hour Recall

Researchers collected 24-hour recalls at pre- and post-surveys using the same protocol. Youth were asked to report what they consumed the previous day along with the preparation method used. Three-dimensional food models and measuring cups were used to increase the reporting accuracy of amounts consumed. All combination food items (e.g., sandwich) were broken down by ingredient (e.g., vegetables, meat, bread type, and dressing). Data were analyzed for nutrients and food groups using ESHA Food Processor (v. 7.5, 2000).

Data Analysis

Survey, food group, and nutrient data were analyzed using the Statistical Package for Social Sciences (SPSS, v. 12.0, 2003). Means and standard deviations were calculated for constructs and food group and nutrient data. Differences between ethnicity and gender on outcome variables were evaluated using Mann-Whitney U analyses because construct data, food group, and nutrients were non-normally distributed. Ethnic differences were not found, but gender differences were evident for food groups, nutrients, and all constructs except the nutrition/gardening knowledge score. Therefore, with the exception of the stepwise regression for the nutrition/gardening knowledge score, further statistical analyses were stratified by gender.

Pearson correlations examined associations between the constructs for both pre- and post-surveys. Two stepwise regression analyses were also conducted to investigate first, demographic variables and second, the constructs of the TPB most predictive of nutrition/gardening knowledge score at pre and post-survey. For the first model, the nutrition/gardening knowledge score was the dependent variable, and demographic information (age, gender, ethnicity, YFMP location) were independent candidate variables. In the second model, the nutrition/gardening knowledge score was the dependent variable, and constructs (attitude, subjective norm, PBC, self-efficacy, self-identity, intention, and behavior) were independent candidate variables.

To evaluate change in knowledge between pre- and post-surveys, Wilcoxon Signed Rank tests were conducted on individual nutrition/gardening knowledge questions. Change in the nutrition/gardening knowledge score from pre- to post-survey was analyzed using a paired *t*-test. Change in nutrient and food group consumption from pre- to post-survey, as measured with the 24-hour recall and survey questions, were analyzed using a Wilcoxon Signed Rank test.

Fruit and vegetable consumption behavior was determined from a mean computed from the responses to the fruit and vegetable behavior survey questions measured from 0-5 servings in the previous 24-hours and the 24-hour recall food group data. The responses to the survey questions *How many pieces of fruit did you eat yesterday* and *How many vegetables did you eat yesterday* were added to the fruit and vegetable data, respectively, from the 24-hour recall and divided by 2. For example, if a youth reported eating two pieces of fruit on the survey and three pieces during the 24-hour recall, the youth would have a final fruit consumption of 2.5 servings.

Results

Sample Characteristics

Ninety-six youth completed the pre-survey; 69% completed the post-survey (Table 1). Approximately one third of the group was African American, one third was White, and the remainder was Hispanic and Hmong (Table 1).

Results of the stepwise regression for the pre-survey found that age (R^2 = 0.067), although weak, was most predictive of the nutrition/gardening knowledge score and age ($R^2 = 0.092$) was also most predictive of the nutrition/gardening knowledge score at post-survey. When the nutrition/gardening knowledge score was run as the dependent variable against all constructs (attitude, subjective norm, PBC, self-efficacy, self-identity, intention, and behavior) as independent candidate variables, attitude ($R^2 = 0.129$) was most predictive of the nutrition/gardening knowledge score at pre-survey. However, at post-survey, self-efficacy ($R^2 = 0.226$) and subjective norm ($R^2 = 0.280$) were most predictive.

Table 1
Sample Characteristics of Youth Farm and Market Project Participants

	Characteristic	Pre *N*	%	Post *N*	%
Total		96		66	
Sex	Boys	42	43.8	25	37.9
	Girls	54	56.3	41	62.1
Age	8-10	33	34.3	26	39.4
	11-12	39	40.7	25	37.9
	13-15	24	25.0	15	22.8
Ethnicity	African American	34	35.4	24	36.4_a
	White	32	33.3	28	42.4_a
	Hispanic	16	16.7	7	10.6_a
	Hmong	12	12.5	5	7.6_b
	American Indian	1	1.0	1	1.5_a
	Other	1	1.0%	1	1.5_a

Note. Means with different subscripts differ significantly ($p < 0.05$).

Boys

Examination of the pre-survey expanded TPB model constructs found that attitude($r = 0.72$), subjective norm ($r = 0.77$), PBC ($r = 0.43$), self-efficacy ($r = 0.56$), and self-identity ($r = 0.64$) were correlated with intention to change, whereas at post-survey, all constructs were correlated with intention to change (attitude $r = 0.71$; subjective norm $r = 0.73$; PBC r = 0.68; self-efficacy r = 0.52; self-identity $r = 0.40$). The nutrition/gardening knowledge score was not correlated with either intention or behavior at pre-survey but was correlated with intention on the post-survey ($r = 0.42$). Although the original model proposes that PBC is correlated with behavior, in our model, no association was found. Also, no constructs from the expanded model were associated to behavior at pre- or post-survey.

The nutrition/gardening knowledge score significantly increased from pre- to post-survey ($p = 0.000$) (Table 2). Analysis of the 24-hour recall data indicated that consumption of fruit ($p = 0.030$) and vegetables ($p = 0.007$) significantly increased from pre- to post-survey (Table 3). Additional food groups (e.g. dairy, meat, bread, fats, oils, and sweets) were analyzed; however, no significant changes from pre- to post-survey were evident.

Table 2
Boys' and Girls' Pre- and Post-Survey Nutrition and Gardening Knowledge Question Means

	Boys (*n* = 25)			Girls (n = 41)		
Knowledge survey questions[a]	Pre Mean (*SD*)	Post Mean (*SD*)	*p*	Pre Mean (*SD*)	Post Mean (*SD*)	*p*
It is good to eat foods grown nearby because it does not waste gas.	0.36 (0.95)	0.64 (1.08)	0.124	0.56 (0.81)	0.73 (0.78)	0.271
Pineapple is an example of a food grown in Minnesota.	0.80 (1.15)	0.68 (1.22)	0.755	0.63 (1.04)	0.78 (0.91)	0.340
Dark green leafy vegetables like spinach are good for your eyes.	-0.36 (0.86)	0.20 (0.91)	0.086	-0.07 (0.75)	0.00 (0.77)	0.726
Whole grains are not good for you; white bread is better for your body.	0.40 (1.15)	0.48 (1.19)	0.635	1.00 (0.84)	1.07 (0.75)	0.426
Carbohydrates are grains, bread products, and sugars.	0.48 (0.77)	0.40 (0.91)	0.564	0.32 (0.61)	0.17 (0.74)	0.109
Corn tortillas are an example of a whole grain.	0.28 (0.94)	0.52 (0.96)	0.271	0.46 (0.64)	0.34 (0.62)	0.251
Nuts contain protein and fiber.	0.48 (0.77)	0.60 (0.96)	0.564	0.44 (0.67)	0.54 (0.67)	0.248
Certain fats, like trans fat, can clog your arteries.	0.56 (0.71)	0.68 (0.99)	0.490	0.54 (0.78)	0.39 (0.63)	0.180
Protein is found in foods such as cheese and soy.	0.52 (0.82)	0.56 (1.00)	0.805)	0.32 (0.79)	0.63 (0.66)	0.014*
Garlic is an herb we grow in the garden.	0.60 (1.04)	0.56 (1.00)	0.857	0.63 (0.99)	0.78 (0.85)	0.431
Buying fast food[b] helps us be closer to where our food comes from.	0.28 (1.14)	0.48 (1.19)	0.313	0.78 (0.96)	0.76 (0.99)	0.832
Knowledge construct mean[ac]	0.40 (0.44)	0.53 (0.56)	0.038*	0.51 (0.40)	0.56 (0.43)	0.255
Nutrition/gardening knowledge score[de]	4.00 (3.20)	5.24 (3.33)	0.000*	5.10 (2.39)	5.46 (3.03)	0.403

[a]Denotes Wilcoxon Signed Ranks test performed. [b]Defined in survey as "McDonalds, Burger King, Taco Bell, KFC, burgers, fries, shakes, and pizza." [c]Knowledge construct means were obtained by summating all response values and dividing by 11. [d]Summation of responses to knowledge questions. Correct responses were coded as +1 and incorrect responses were coded as 0 with 11 being the highest possible score. [e]Denotes paired sample *t*-test performed. * $p < 0.05$.

Girls

Similar to the boys' pre-survey results, constructs associated with intention included attitude ($r = 0.62$), subjective norm ($r = 0.54$), PBC ($r = 0.37$), self-efficacy ($r = 0.35$), and self-identity ($r = 0.39$), whereas at post-survey, attitude ($r = 0.53$), subjective norm ($r = 0.52$), PBC ($r = 0.60$), and self-identity ($r = 0.56$) were correlated. However, unlike the boys' pre- and post-survey results, behavior was correlated with PBC at both surveys (pre-survey $r = 0.45$;

post-survey r = -0.35), in addition to self-identity on the post-survey. The nutrition/gardening knowledge score was not correlated to either intention or behavior on either survey. Similar to the boys' pre- and post-survey results, no association was found between intention and dietary behavior at either survey.

The nutrition/gardening knowledge score did not significantly increase from pre- to post-survey. However, when analyzed individually, one knowledge question (*Protein is found in cheese and soy*) showed a significant change from pre- to post-survey (p = 0.014) (Table 2).

Analysis of the 24-hour recall data indicated that consumption of cholesterol (p = 0.015), and meat (p = 0.041) increased from pre- to post-survey (Table 3). Additional food groups (e.g. dairy, fruit, vegetable, bread, fats, oils, and sweets) were analyzed; however no significant changes from pre- to post-survey were evident.

Table 3
Boys' and Girls' Pre- and Post-Survey Nutrient and Food Group Means

	Boys (n = 25)			Girls (n = 41)		
Nutrient	Pre Mean (*SD*)	Post Mean (*SD*)	p	Pre Mean (*SD*)	Post Mean (*SD*)	p
Calories (kcal/day)	2364.73 (1103.1)	2679.92 (1833.5)	0.58	2240.37 (1667.8)	2507.99 (1390.6)	0.07
Protein (g/day)	83.29 (38.0)	86.06 (49.9)	0.93	67.98 (36.7)	82.60 (48.3)	0.15
Carbohydrate (g/day)	336.21 (181.6)	361.29 (231.5)	0.53	317.60 (212.5)	349.52 (179.7)	0.22
Fiber (g/day)	15.07 (7.2)	21.16 (13.2)	0.09	22.57 (15.8)	21.67 (13.3)	1.00
Fat (g/day)	89.85 (61.7)	103.02 (93.2)	0.72	81.90 (84.9)	89.46 (67.2)	0.09
Saturated fat (g/day)	31.97 (23.0)	29.93 (25.6)	0.70	28.26 (25.9)	30.76 (25.4)	0.48
Cholesterol (mg/day)	245.32 (215.4)	251.95 (254.2)	0.71	140.65 (143.2)	235.21 (257.0)	0.02*
Vitamin A (µg/day)	1047.94 (810.8)	997.36 (771.1)	0.72	1257.28 (1252.4)	1371.99 (1496.9)	0.73
Thiamin (mg/day)	1.53 (1.1)	1.74 (1.1)	0.58	1.73 (1.3)	1.52 (0.9)	0.72
Riboflavin (mg/day)	1.89 (1.5)	2.08 (1.5)	0.80	1.91 (1.4)	1.80 (1.1)	0.96
Niacin (mg/day)	19.95 (12.2)	22.02 (17.8)	0.51	20.34 (15.0)	18.91 (11.9)	0.97
Vitamin B6 (mg/day)	1.68 (1.5)	2.02 (1.7)	0.26	1.78 (1.5)	2.23 (3.7)	0.81
Vitamin B12 (µg/day)	2.63 (2.6)	3.42 (4.7)	0.60	2.67 (2.8)	3.36 (3.3)	0.21
Vitamin C (mg/day)	115.26 (77.1)	137.50 (131.5)	0.74	132.86 (118.1)	129.08 (115.7)	0.78
Calcium (mg/day)	993.18 (749.0)	1066.21 (924.3)	0.72	920.27 (551.4)	1050.29 (850.7)	0.82
Magnesium (mg/day)	195.99 (96.5)	265.20 (134.3)	0.09	254.82 (175.4)	220.82 (125.2)	0.32
Phosphorus (mg/day)	998.56 (622.7)	1277.96 (789.1)	0.37	1056.91 (637.1)	1117.50 (818.1)	0.89

	Boys (n = 25)			Girls (n = 41)		
Food Group	Pre Mean (SD)	Post Mean (SD)	p	Pre Mean (SD)	Post Mean (SD)	p
Fats, oils, and sweets (servings/day)	22.95 (16.0)	23.30 (21.0)	0.63	24.28 (42.5)	22.79 (22.9)	0.64
Dairy (servings/day)	2.02 (2.0)	2.48 (2.6)	0.82	1.80 (1.5)	2.43 (2.5)	0.33
Meat (servings/day)	1.90 (1.4)	1.82 (1.7)	0.85	1.01 (1.0)	1.49 (1.4)	0.04*
Fruit[a] (servings/day)	2.01 (1.7)	3.05 (2.1)	0.030*	2.64 (1.6)	2.58 (2.1)	0.25
Vegetable[a] (servings/day)	2.05 (1.3)	3.43 (2.5)	0.007*	2.85 (2.4)	2.91 (1.9)	0.68
Bread (servings/day)	8.82 (6.1)	10.23 (7.6)	0.65	10.11 (8.8)	9.59 (6.5)	0.57

[a]Fruit and vegetable consumption was calculated as the mean of the survey behavior questions and 24-hour dietary recall data. * $p < 0.05$.

Conclusion

This study investigated the effects of a 10-week garden program on dietary behavior and nutrition and gardening knowledge in an inner-city group of multi-ethnic youth. Key findings were that modest changes in youth knowledge concerning gardening and nutrition were evident after program participation; age, attitude, self-efficacy, and subjective norm predicted nutrition and gardening knowledge in youth; and dietary intakes of several food groups significantly improved for boys and girls after garden program participation.

Change in Knowledge

Both genders increased their nutrition/gardening knowledge score from pre- to post-survey; however, the results were significant only for boys. The response to the protein question significantly improved from pre- to post-survey for girls. The limited change in knowledge at post-survey for the girls may be attributed to the boys catching up to the girls, who had a higher level of knowledge at the pre-survey.

An inappropriate nutrition and/or garden curriculum for the younger age group (e.g., 8 to 10 years) may also explain the limited change in knowledge at post-survey. The YFMP was designed to include both older and younger youth in the program with the idea that older youth would mentor younger youth. While conceptually this is a good idea, in practice it takes more work to incorporate knowledge that is appropriate for so many ages into a single curriculum. Results of the stepwise regression indicated that among the candidate demographic variables (age, gender, ethnicity, and YFMP location), age was most predictive of nutrition/gardening knowledge score at both pre- and post-survey, thus suggesting the curriculum may not have been age appropriate for all of the youth. Concepts such as fat classification (e.g. trans fat)specific vitamins and minerals, and food origin topics in the YFMP curriculum may be too difficult for younger age groups because they may not understand abstract concepts such as the nutrient content of foods or the classification of food into food groups (Lieberman, Clark, Krone, Orlandi, & Wynder, 1992). ,Consequently, education for younger youth should include concrete experiences, such as increasing exposure to healthy foods and building skills to choose healthy foods (Contento, Kell, Keiley, & Corcoran, 1992). Alternatively, older youth (e.g., middle school) are better able to understand more abstract concepts, such as the connection between eating behaviors and health (Contento et al., 1995).

Another possible explanation for the low nutrition/gardening knowledge scores may be the result of exposure time for the reinforcing activity. Although all youth were actively involved in harvesting the produce and cooking meals at YFMP, the exposure time (10 weeks) may not have been enough to facilitate a change in knowledge. To allow all participants the opportunity to partake in activities, youth spent a maximum of 3 days rotating through the YFMP's various experiential learning activities such as cooking. Bergen (1993) found that 10 to 15 hours of education were needed to expect "large" effects in program specific knowledge. Because YFMP youth experienced only 3 hours of the cooking curriculum, they may not have received enough exposure to facilitate a change in knowledge. Although research concerning exposure time and behavioral change is limited, if more time had been allotted to the skills taught at YFMP, the resulting behavioral change might have been improved. Similarly, the cooking and gardening components are primarily experiential; however, the nutrition education curriculum tends to be passive at YFMP and may not be hands-on enough to foster a change in knowledge. Perhaps additional nutrition education could be incorporated into the cooking and gardening curriculums rather than taught separately.

Knowledge Predictors

Attitude (pre-survey) and self-efficacy and subjective norm (post-survey) were constructs most predictive of the nutrition/gardening knowledge score. The purpose of YFMP is to empower youth to be environmentally responsible while also building teamwork and cooperation skills through a gardening, cooking, and nutrition curriculum. In the process, it appears to instill self-efficacy in the youth. Self-efficacy is an individual's opinion of how well they can perform a behavior under various inhibiting conditions (Bandura, 1991), and this may be why pre-survey self-efficacy was low but had increased at the end of the 10 weeks. We suggest that through YFMP participation, the youth were empowered to believe they could garden and cook foods not previously tried. They learned that they could do many things that they previously felt they could not do, resulting in a "can-do" attitude, as evidenced by increased self-efficacy scores. Though self-efficacy has not been evaluated with gardening programs, Stevens et al. (2003) also found increased self-efficacy after exposure to a nutrition and physical activity intervention among American Indian girls.

Subjective norm, an individual's belief about what others who are important to them want them to do and their motivation to comply with that referent, (Ajzen, 1991) may have increased because youth felt important referents influenced the development of their nutrition and gardening skills, and as a result this added to the prediction of their nutrition/gardening knowledge score. To date, there are limited data concerning the relationship of subjective norm and behavior change in youth, but from our results it appears to be an important predictor. During focus groups discussions, we found that youth identified parents, peers, the media, and YFMP staff as social influences that impacted their food consumption behaviors (Lautenschlager & Smith, 2007b). In another study, Fila and Smith (2006) found that subjective norm, family, TV, and after school program staff were most predictive of Native American boys' eating behavior, accounting for 86% of the variance. It might be beneficial for youth programs to both assess who or what youth consider important prior to program initiation and then incorporate these referents into their curriculum. By doing so, this would create a program that may have more relevance for the youth.

Because health concerns, eating patterns, food preferences, and attitudes differ depending on one's cultural background (CDC, 1996; Harala, Smith, Hassel, & Gailfus, 2005), we had hypothesized that ethnicity would be a predictor of the nutrition/gardening knowledge score, in addition to age. However, our results indicated that age was the only demographic predictor of the nutrition/gardening knowledge score. Although it is difficult to determine the exact etiology of these results, the youth in this study reside in multi-ethnic communities and tend to mingle more among the various ethnic groups than what is seen in other areas. Thus, ethnicity may not be a predictor of nutrition/gardening knowledge because the social environment promotes cooperation and tolerance among the various ethnic groups.

Change in Dietary Intake

Analysis of boys' dietary intake showed positive findings that may be attributed to participation in YFMP. Intake from only the fruit and vegetable food groups significantly increased from pre- to post-survey. The boys may have increased their consumption of fruits and vegetables because they were able to experience the food system process by growing produce, harvesting it, taking it to the table, and ultimately enjoying the fruits (and vegetables) of their labor at snack and lunch time at YFMP. All youth at YFMP were involved in meal preparation at some point during the program, which always included fruits and vegetables. Morris et al. (2002) also found that youth who plant and harvest their own produce were more likely to eat it. Youth involved in garden-based nutrition education had a higher preference for vegetables, and this was maintained longer compared with either classroom-based nutrition education or the control (Morris & Zidenberg-Cherr, 2002).

Nutrient and food group analysis for the girls also showed change from pre- to post-survey, with increased consumption found in cholesterol and the meat food group. Although girls' cholesterol intake did increase, the mean intake was still well below the dietary guideline (300 mg/day) (Brown, 2005). The finding that girls increased their consumption of meat from pre- to post-survey without increases in saturated fat is a positive finding because iron deficiency anemia among low-income females is common (Looker, Dallman, Carroll, Gunter, & Johnson, 1997). However, unlike the boys, the girls did not increase fruit and vegetable consumption.

In conjunction with the minor improvement in nutrition/gardening knowledge score at post-survey, we offer tentative suggestions as to why the gardening program did not yield the same effect for girls as for boys. It may be that the curriculum was not as appropriate, or as relevant, to the girls. The girls may not have been engaged with the information and therefore did not transform the knowledge into a behavior change. Also, through casual observation it appeared that the girls used YFMP more as an opportunity to socialize and therefore may not have gained as much from the nutrition education component as the boys but may have benefited more in reinforcing communication and social skills. The CDC (1996) recommends that the benefits of healthy eating should be presented to youth in a context of what is already important to them. Prior to program initiation, YFMP and similar programs might consider conducting formative assessments of participants' values, attitudes, and interests in order to create and disseminate information in a more meaningful manner. With girls, including "break-out" or group learning activities, into the nutrition curriculum might improve knowledge transfer.

Current research in the United States focusing on youth garden programs is limited and has only assessed changes in fruit and vegetable preferences and intake (Morris & Zidenberg-Cherr, 2002). No U.S. research to date has evaluated changes in knowledge, nutrients, or other food groups after garden program participation, particularly with inner-city youth. In contrast, gardening research in rural Asia and Australia have evaluated changes in knowledge (Viola, 2006), garden skills (Viola), fruit and vegetable consumption (English et al, 1997), and specific nutrients (English et al.). As with our findings, Viola reported increased nutrition knowledge after exposure to a 6-month garden project in Australia. Similarly, in Vietnam, English et al. found increased consumption of fruits and vegetables by youth after garden program participation. However, it is important to consider that this research was conducted with rural youth (Viola,2006) and some of the gardens were created with the primary objective to improve food production and security (English et al).

Limitations

This study shows the importance of youth gardening programs; however it is not without limitations. The program only met 3 days a week (Tuesday, Wednesday, and Friday) making it difficult to assess the dietary intake of all youth for nonprogram days. Also, because some of our sample of Hmong youth may have gardened with their families (Lautenschlager & Smith, 2007b), it is possible that this group exerted a bias on part of the sample. However, gardening experience is something that would be difficult to control for because all youth bring different agriculture skill sets to the program because the Minneapolis/St. Paul area is known for garden utilization (ACGA, 1998). Lastly, this study did not include a control group because of program constraints. The small sample size made it difficult to split the group, and YFMP staff felt it would be unethical to not expose a subgroup of YFMP to the new curriculum.

Implications

Garden programs have the potential to positively impact inner-city youth nutrition and gardening knowledge, and dietary behaviors. Most importantly, youth appeared to be empowered to try new behaviors (e.g., cooking, gardening, eating new and healthy foods) as a result of participation in this program. However, the long-term sustainability of resulting behavior change is unknown, and further investigation is warranted. It appears from our results that there is a gender and age difference in regard to learning styles, and this needs further evaluation to ensure appropriate development of future programs.

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