Students Growing Food: The Study of a Food-Production Focused Intervention in a California High School: Differences in Food Habits and Attitudes between Program and Control Students

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Abstract

This paper examines the impact of a high school food-production program on students in Richmond, Calif. The Urban Agriculture Institute in Richmond, California, involves student food production from seed to fork and the establishment of a Community Supported Agriculture (CSA) endeavor for families at the school. Students in the piloted program grew over a thousand pounds of produce and distributed it into their community, while simultaneously learning about the food system, engaging in cooking and participating in other food related activities. An intervention/control survey study of 19 program students and 42 control students was conducted to measure fruit and vegetable consumption and preference, food habits and knowledge, physical activity, and self-efficacy. The study demonstrated significant results in program students meeting the *Healthy People 2010* recommendation of 5 servings of fruits and vegetables per day *(P<0.07)*, the variety of different fruits and vegetables tried over a two-week period *(P<0.0005)*, the number of fruit and vegetable snacks per day *(P<0.06)*, and the limiting of sugar-sweetened beverage consumption (P<.005). In the midst of a growing school garden, community garden and home gardening movement, the results of this study demonstrate the need for further research on school garden programs where *food production* is the focus of the intervention.

Introduction

Enthusiasm for school gardens has been increasing as a potential tool for healthy youth development and more recently as a place to promote the consumption of fruits and vegetables in the midst of the current childhood obesity epidemic. (Ozer, 2007) This study takes a preliminary look at an intervention designed to change the relationship between adolescents and food. Before turning to the research questions examined in this paper, a background of nutritional concerns facing the nation, and to a larger extent the students in Richmond, California, along with a description of the Urban Agriculture Institute and its theoretical foundation is appropriate.

A recent study estimates that at present rates, 75 percent of the U.S. adult population will be overweight and 41 percent will be obese by 2015. (Wang & Beydoun, 2007) Among school aged children between 1976-1980 and 2007-2008 obesity increased from 6.5 to 19.6% among 6-11 year olds, and among adolescents aged 12-19, obesity increased from 5 to 18.1%. (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010) While reports show a leveling off of the rate of increase in obesity, the numbers remain high. (Ogden et al., 2010) The focus on childhood obesity from public health professionals, politicians, the media and the general public comes amidst the scientific speculation that this generation of youth will be the first to experience a shorter life expectancy than their parents. (Olshansky et al., 2005) The focus on childhood obesity also comes from the general acceptance that health habits are easier to change and easier to maintain change as children grow into adulthood. An obese three year-old has less than a 20 percent chance of being an overweight adult, but an obese 12-17 year-old has almost a 60 percent chance of being overweight as an adult. (Guo, Wu, Chumlea, & Roche, 2002) Risk factors associated with obesity make children and adolescents more susceptible to health problems during their youth and as adults. During their youth, obese children and adolescents are more likely to face risk factors associated with cardiovascular disease (such as high blood pressure, high cholesterol, and Type 2 diabetes) than are other children and adolescents. (Freedman, Mei, Srinivasan, Berenson, & Dietz, 2007) Overweight and obese youth may also have problems with sleep apnea, bone and joint health problems and social and psychological issues surrounding self-esteem and stigmatization. (Daniels et al., 2005)

Youth in the United States consume do not consume the recommended servings of fruits and vegetables. It is known that fruit and vegetable consumption has a strong link to health. Studies have shown fruit and vegetable consumption plays a protective role in the prevention of

cardiovascular disease, certain cancers, and obesity. (Van Duyn & Pivonka, 2000) Although few studies have shown a direct link between consumption of fruits and vegetables and weight loss, there are studies showing eating calorically less dense foods does help with weight loss and weight management. (Duncan, Bacon, & Weinsier, 1983; Yao & Roberts, 2001) It is not surprising then that the federal government, states, and cities are promoting fruit and vegetable consumption, especially with children. We know, however that despite these efforts, only 6.8 to 20 percent of children and adolescents eat the recommended five or more servings of fruits and vegetables. (Reynolds, Hinton, Shewchuk, & Hickey, 1999) By another measure, less than half of youth ages 4-18 years old consume more than 5 servings of fruits and vegetables daily. (Robinson-O'Brien, Story, & Heim, 2009) Those results remain even as studies often conclude that knowledge of fruits and vegetables and their benefits is high. Objectives for Healthy People 2020 call for children ages two and up to increase their consumption of fruits and vegetables and to increase the variety of fruits and vegetables they consume as part of a healthy diet. At the same time, it calls for all child age groups to lower the proportion of children that are overweight and obese. (*Draft objectives: healthy people 2020 public meetings*) Many people see the healthy nutrition associated with fruit and vegetable consumption to be one part of a larger effort to reduce the prevalence of childhood obesity.

The Program: Richmond High School's *Urban Agriculture Institute*

Richmond, California is a community where 35.2% of the children are overweight or obese, significantly higher than California as a state (28.1%). (*Overweight children in California counties, 2004*) It follows the trend of lower-income areas exhibiting higher than average obesity rates. Richmond High School has a student body of approximately 1800 students with 72% Hispanic, 14% African American, and 12% Asian demographics. The school is located in a

lower-income neighborhood, with approximately 70% of the students receiving free or reduced lunch. (*Common core of data (CCD)*. 2005)

The program in Richmond, Calif was centered on a food production, rather than a nutritional education model. A local non-profit organization, Urban Tilth, whose mission is to build a sustainable food system and grow 5% of the food supply from within the local West Contra Costa County, used a California Stewardship Grant to fund the program. The public/private partnership between Urban Tilth and Richmond High School (RHS) used the funding to help pay for the instructor while Urban Tilth donated staff hours, equipment and technological assistance and the school allocated the land and classroom space for the program. The pilot program began in 2009 and has continued into its second year. Unlike all of the school gardening programs identified in the peer reviewed literature, the Urban Agriculture Institute focused on food production for the community, rather than solely for the purposes of nutritional education. Looking at the conceptual model *(Figure 1)* the class featured food production as its core activity with nutritional education, cooking activities, community service and local food system analysis as added activities.

The class of 22 students was tasked with creating a working CSA (Community Supported Agriculture) for a small group of families at the school. A CSA is an agricultural distribution system where participants buy a "share" in the grown produce and can pick it up or have it delivered at designated times. Usually the participants pay before the growing season starts and have limited knowledge of what the farmer is planning on growing. Participants accept the weekly produce and provide the farmer with a consistent market base. In this program the participants in the CSA were families in the school that were recruited by the students in the program to receive a share of produce every two weeks. The box cost the family $5 and usually

had over 10 pounds of produce in each box even though the typical CSA prices in nearby San Francisco cost between $25 and $40 per box. The price was kept low because much of the cost of the program was covered by a grant, and the families in the CSA had limited economic resources. In a short spring growing season from February to June, students planted, tended, harvested and distributed over 700 pounds of produce to 70 different families in the school along with taking home hundreds of pounds of produce themselves. While each harvest fed 10 families, the program rotated through a list of 70 families that had signed up to receive a box of produce. In future years the program plans to generate CSA boxes throughout the year as the California growing season will allow for such production. The expectation is that yields will drastically increase with the inclusion of heavier produce that is harvested in the fall.

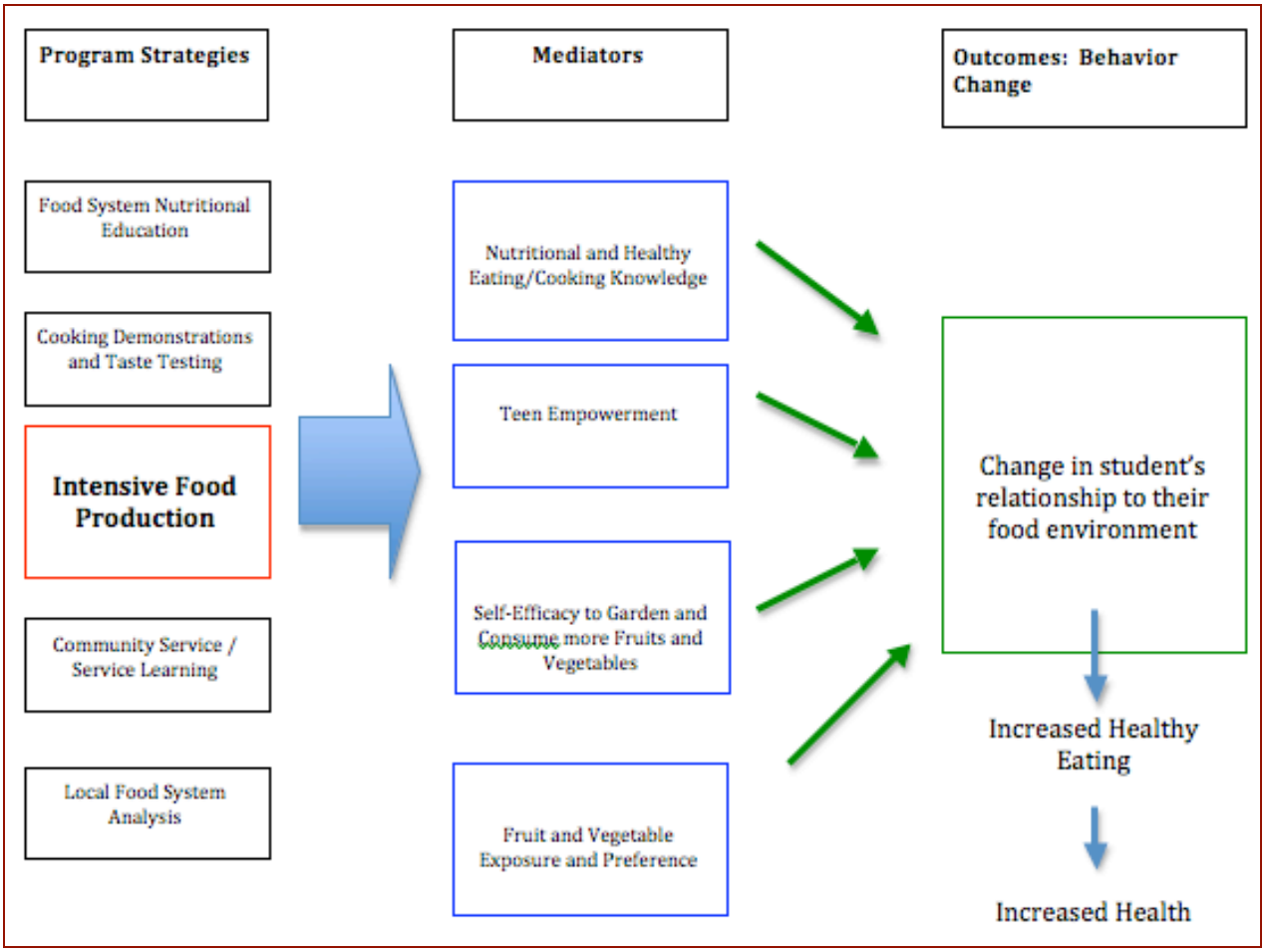


FIGURE 1: Conceptual Model for the Urban Agriculture Institute

Note: Intensive food production is presented as the most central tenet of the conceptual model. The belief was that the ultimate outcomes were going to be achieved with a focus on food production. The program strategies work

through different mediators, but all the mediating factors provide the tools that the youth need to change their ultimate relationship with food.

The Urban Agriculture and Food Systems class met bi-weekly on Tuesdays and Thursdays during "eighth period," which is technically after the official school day is over. Even though the students attended after school, the students received graduation credit and the class counted as a science elective for university enrollment. The structure of the class was divided up into four different sections of time and it repeated on a two-week cycle: garden work days, in-class learning days, working groups sessions and Community-Supported Agriculture (CSA) harvest days.

Garden work-days involved weeding, watering, transplanting and other garden maintenance tasks. The in-class portion of the class involved a variety of activities to stimulate critical thinking about the students' food system. Activities included a lecture on the history of agriculture, watching a movie on Cuba's oil crisis and the country's movement towards urban agriculture, analyzing and learning about the soil food web, guest lectures from local food justice organizations, acting out the process of photosynthesis, or learning how to graft a fruit tree. The working groups were self-selected groups that worked independently on different aspects of the larger CSA program. There were four groups in total and students chose to be in one group at the beginning of the class. One group, called the documentation group, was tasked with making monthly videos to post on youtube.com and document the progress and goings on of the class. Another group, labeled the "marketing group" was in charge of recruiting families, writing a bi-weekly newsletter describing the produce in the CSA and providing healthy facts. They also handled all of the financial transactions and communication with the families. The "community food system" group was tasked with surveying all the local food stores within a square mile of the school and measuring their "health" factor using the RFEI (Retail Food Environment Index) as a tool to determine the health of their neighborhood. And the last group was the "nursery and

propagation" group, which was tasked with starting all of the crops from seeds in the greenhouse to make sure the group always had transplants available and general garden maintenance.

On CSA harvest days, the students would finish school and begin harvesting either at the school garden on the Richmond High campus or travel to a nearby middle school where the students helped Urban Tilth run a mini-farm. The students would harvest, wash and pack bags of produce for the families to pick up the next day.

Differences between the Urban Agriculture Institute (UAI) and other school garden programs?

Emphasis on Food Production: The emphasis on food production is the biggest difference between the Urban Agriculture Institute (UAI) and other school garden programs described in the literature. (Robinson-O'Brien, Story, & Heim, 2009) All the programs in the peer-reviewed literature are built and maintained for educational purposes and do not generate enough produce to give significant amounts to the community, nor significant amounts for the students to take home themselves. This may be because often studies are performed to evaluate specific garden/nutritional curricula like: *Junior Master Gardener, Delicious and Nutritious Garden, Nutrition in the Garden*. (O'Brien & Shoemaker, 2006) (Lineberger & Zajicek, 2000) (McAleese & Rankin, 2007) The centerpiece of the UAI as noted in the conceptual model (*Figure 1*) is food production.

Length of Intervention: The UAI program was 20 weeks, much longer that most programs documented in the literature. Of the programs in Robinson-O'Brien's 2009 literature review that reported duration, the mean length of duration for the program was approximately 11 weeks. (Robinson-O'Brien, Story, & Heim, 2009) Additionally the intensity of the intervention, the amount of time students spent on the project, was larger as well. Students were engaged in food

production two to five hours per week. This length of time, both in hours per day and the total intervention is hypothesized as a major mediator that may reveal the changes many school programs are working towards. As work continues to evolve on childhood obesity, the interconnectedness of factors and their influence on behavior shows a complex picture that requires more study about the length of interventions and their success.

A detailed look at the various intervention points to combat food health issues in the current literature show that longer interventions are probably necessary to combat a complex problem like childhood obesity. For example, often times interventions focus on schools because students are there for a significant portion of the day, but without considering the food atmosphere at home and around the school, any change could be mitigated by these other factors. Barlow and Deitz show that parental involvement and control plays a big role in childhood obesity, adding to the scope and time needed for change. (Barlow & Dietz, 1998) Behavior change theories that fit the work being done in the UAI, require large amounts of time not given by the interventions in the school garden literature. Prochaska and DiClemente's Stages of Change Model takes time for the individual to work themselves through "pre-contemplation" to the "action" stages and eventually to "maintenance" of the change, regardless of what stage they start in. Similarly, much of the work done in the Urban Agriculture Institute is about teen empowerment through food production, which is based on the Theory of Reasoned Action (TRA) and the Social Cognitive Theory (SCT). The Theory of Reasoned Action states that a person's behavior is determined by the intention to perform the behavior and that intention is shaped by the attitude one has about the behavior and social norms. Social Cognitive Theory states that there is an interaction between the physical environment, the social environment, and people's cognitive and perceptual situation. A core concept of SCT is the idea of self-efficacy, that a person's belief in their own ability to change a behavior is one of the first steps to actually changing the

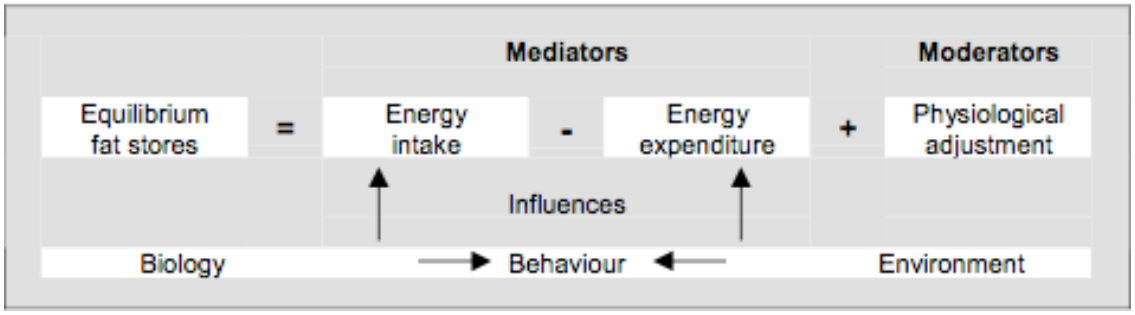
behavior. The self-efficacy and intention to act needed to create behavior change takes time.

The mediators in *Figure 1* are not easily attained. Food habits are some of the most engrained behaviors that people have. They encompass parental factors, cultural factors, biological and evolutionary factors, commercial marketing determinants and social determinants like income and education. The idea that a food system intervention of limited intensity and duration could achieve lasting behavioral change when food habits are so complex and deeply meshed with factors like culture, social norms, taste is difficult to support. While a piloted intervention, the Urban Agriculture Institute existed as a class (lasting a semester of 20 weeks) and is continuing as a full year course (40 weeks) that students can stay involved in throughout their high school career. This could create opportunities for further research as to whether duration of intervention solidifies or increases any associations between the program and healthy eating habits.

Theoretical Underpinnings

Ecological approaches to community obesity prevention like that of Egger and Swinburn (*Figure 2)* show the various areas in which an organization could intervene for health. The framework shows biology, the mediators of energy input and energy output (where interventions focus on behavior) and the food environment. (Egger & Swinburn, 1997)

Figure 2



(Egger & Swinburn, 1997)

When deconstructing this model, individuals and organizations interested in children's health have begun looking at innovative ways to change nutritional and physical activity habits and alter the food environment for children. For example, California became the first state to outlaw the sale of sodas in public schools in an attempt to address the food environment. (Schwarzenegger bans soft drinks in California high schools. 2005) Many other states and school districts have followed suit. Schools should continue to focus on increasing physical activity and nutritional education to combat childhood obesity, especially because daily physical education is offered in only 3.8% of elementary schools, 7.1% of middle schools, and 2.1% of high schools. (Lee, Burgeson, Fulton, & Spain, 2007) However, results are often disappointing. In a review of 57 randomly controlled trials from 1985 to 2003, which focused on nutritional education and/or increasing physical activity, only four achieved both statistical and clinically significant outcomes between comparison groups. (Thomas, 2006) Many of these programs and others have increased knowledge and attitudes in favor of fruit and vegetable consumption and healthy habits, but significant behavior change has remained elusive.

Interventions have used school gardens as a form of nutritional education to connect students with how fruits and vegetables are grown. School gardens have become an interactive way to attempt to tackle some of these health problems. They give students exposure to fruits and vegetables in a naturally engaging environment, where students are encouraged to touch, feel and taste different produce. Planting, tending and harvesting produce is an exciting activity that anecdotally generates positive feelings towards produce and its consumption. (Ozer, 2007) Often, garden programs exist in conjunction with nutrition lessons. Through anecdotal reports by advocates, observers believe that school gardens are a good promoter of healthy eating, nutrition, science learning and student achievement, however, the empirical research is lacking and there are not enough peer-reviewed studies. (Ozer, 2007)

A 2009 literature review of garden-based nutrition programs in the United States revealed 11 peer-reviewed studies. (Robinson-O'Brien et al., 2009) Of these studies, variation was large with regards to how the garden was used and how much time was spent exposed to the garden. This limited gardening literature echoes similar problems associated with physical activity and nutritional education literature, demonstrating increases in knowledge and attitudes, but not behavior change. Of those 11 studies, while seven showed increases in fruit and vegetable knowledge and/or preference, only three showed significant increases in fruits and vegetable consumption. (Robinson-O'Brien et al., 2009) Of those three, one based its statistical significance of increased consumption on a one-question survey response to, "I eat vegetables everyday." (Hermann et al., 2006) Additionally, the studies varied significantly on the amount of time spent gardening and the duration of the nutritional program itself. Ranging from lessons once a week for 8 weeks to 9 lessons over 17 weeks. Some programs had very intensive gardening activities and others were in the garden for only some of the total lessons and even then for around twenty minutes. (Poston, Shoemaker, & Dzewaltowski, 2005) Despite the absence of overwhelming evidence for behavior change, school gardens are growing in popularity as a teaching tool for nutrition and science, and for their overall perceived impact on the health and wellness of children. Gardens on the White House lawn, at the USDA and their presence in new national legislation like the Child Nutrition Act represent a new dialogue in the national conversation about health and food and school. Gardens are becoming a significant part of that conversation.

Research Questions

The purpose of this study was to measure the differences in food habits and attitudes of the participants in the Urban Agriculture Institute compared to control students within the high school. While the Urban Agriculture Institute focused on training the students in food production techniques and methods, the study was not measuring gain in knowledge or techniques of food

production. The study was focused on measuring behaviors and attitudes regarding food, the environment, and self-efficacy to change their habits. Did students who went through the program consume more fruits and vegetables than others? Did the students who went through the program consume less "unhealthy" food? Was there a difference in the way that program students thought about food: nutritionally, environmentally or regarding food as a social justice issue? Did the program empower the teen's self-efficacy to change their eating habits and their community?

A second study of the 2010 cohort of students will measure the impact using a pre/post design, however, the data presented in this pilot study is cross-sectional and cannot distinguish between impacts of the program and underlying differences that already existed in the students that self-selected to be in the program.

Methods

Design and Participants: This study was quasi-experimental with an intervention and control design. The site of the study and impact evaluation was Richmond High School (RHS) in Richmond, Calif. Control students were chosen by randomizing the classes of the participating teachers. Three control teachers were selected (math, English and biology teachers) and a random class from each of their teaching responsibilities was chosen. Each teacher has 5 classes and from those classes one class was chosen at random to take the survey. 42 control students from the three classes eventually took the survey, compared with 19 students who were program participants. The program participants self-selected enrollment in the Urban Agriculture Institute, which was created as a course in the high school, titled, "Urban Agriculture and Food Systems." All grades from 9th to 12th grade were informed of the class through announcements over the public address system and classroom presentations. All students were accepted as

participants, although not all students could fit it into their schedule. 22 participants completed the program in 2009. 19 of those 22 students completed the survey.

Program and control students were taken to the computer lab at RHS by their teacher to take an online survey regarding their fruit and vegetable consumption habits, eating habits, physical activity, attitudes about food and school food and questions to probe their self-efficacy for fruit and vegetable consumption and ability to change. Program students that graduated as seniors in 2009 were sent the survey via email.

Fruit and vegetable consumption was determined from a modified 24-hour recall measure. Students were given an explanation of what a serving size of fruits and vegetables looked like and then asked in a series of question how many servings they ate for their last three meals and any snacks in between. Most students taking the survey during the day would have reported on their dinner from the previous night, their breakfast that morning and their lunch that day. Fruit and vegetable consumption was assessed by totaling the number of servings reported for their last three meals plus any snacks that were reported.

Statistical Analysis: Most of the analysis was done using chi-square tests for significance. Measurements of fruit and vegetable preference over a two-week period used a two-sided t-test of the difference in means. Measurements for sugary beverage consumption were dichotomized on one sugary beverage per day. The rationale for dichotomizing on one sugar-sweetened beverage per day was based on literature that for every sugar-sweetened beverage consumed beyond one per day leads to a 60% increased likelihood obese. (Ludwig, Peterson, & Gortmaker, 2001) Measurements of physical activity were dichotomized above or below one hour per day because that is the recommendation of the *Physical Activity Guidelines for Americans* and

"gardening" was put on the survey as one of the examples of physical activity. When responses were not given for a question, those responders were taken out of the analysis for that question.

The demographics of the program group and control group are available in *Table 1*. Girls encompassed a much larger portion of the program group than the control group. A good variety in both groups came from differing grades. Ethnicities reflected the status of the school as having a high Latino concentration and both groups had similar levels of students on free and reduced lunch, a proxy indicator for household income level.

Table 1: **Demographic Data∗ Program Participants /Control Group**

	Program (n=19)	**Control (n=42)**
Grade		
9th Grade	10.5% (2)	28.6% (12)
10th Grade	21% (4)	12% (5)
11th Grade	42% (8)	47.6% (20)
12th Grade	26% (5)	12% (5)
Gender		
Male	16% (3)	47.6% (20)
Female	84% (16)	52.4% (22)
Ethnicity		
Latino	84.5% (16)	81% (31)
African-American	5.2% (1)	9.5% (4)
Asian	5.2% (1)	4.8% (2)
White	5.2% (1)	4.8% (2)
Native American	0	2.4% (1)
Middle-Eastern	0	4.8% (2)
Other	0	0
Free or Reduced Lunch at School∗∗		
Yes	68% (13)	78% (33)
No	26% (5)	16% (7)
Family Members with Diabetes		
Zero	21% (4)	31% (13)
One	26% (5)	19% (8)
Two	16% (3)	12% (5)
Three	26% (5)	9.5% (4)
Four	5.2% (1)	2.4% (1)
More than four	5.2% (1)	21% (9)

∗ Program Participants enrolled in a 20-week semester food production course titled "Urban Ag and Food Systems"
∗∗ Free and reduced lunch is part of of the National Lunch Program where students who meet low income eligibility requirements receive a free or reduced price breakfast and lunch.

The author of this study was also the co-teacher of the Urban Agriculture Institute at Richmond High School. Steps were taken to assure anonymity of the student responses and to limit any interference brought on by the fact that the teacher was also doing the study. Students were given codes by participating teachers at the school to input into the survey and the researcher had no access to the codes.

Results

Table 2 outlines differences in behavior between program and control groups. In the first analysis, fruit and vegetable consumption by the control and program groups was compared against the recommendations of "Healthy People 2010" which calls for consumption of 5 or more servings of fruits and vegetables every day. An analysis was done to see what proportion of students in each group met the threshold using their responses from the survey. In the analysis, 52.6% of program students met the threshold, while 28.5% of control students met the recommended levels of at least 5 servings a day *(P<0.07)*. Nationwide, only 6.8 to 20 percent of children and adolescents eat the five or more servings of fruits and vegetables that are recommended. (Kann, Warren, Harris, & et al, 1995; Reynolds et al., 1999)

To examine fruit and vegetable consumption in a different way, the survey asked the students to choose from a list of 45 common fruits and vegetables and click on how many they had eaten in the past two weeks. While not a proxy for total vegetable consumption, this measures preference and exposure to varieties of produce. The mean for the control group was approximately 13.25 [95% CI (10.9-15.6)] meaning that students in the control group on average stated that they ate approximately 13 different types of produce in the past two weeks. The program group reported consumption of approximately 21 different fruits and vegetables [95% CI (17.2-24.3)] *P<0.005*. Student snack consumption showed 84% of the program group eating a fruit or vegetable snack

at least once per day compared with 60% of the control group *(P<0.07)*.

Behaviors regarding food choices showed 74% of program students reported drinking a sugar-sweetened beverage (defined as any drink with added sugar) zero or one times a day, while 26% reported drinking 2 or more sugary beverages. Whereas, 65% of control students reported drinking two sugary beverages or more per day and only 35% reported drinking one or fewer sugar-sweetened beverages *(P<0.005)*. Over twice the amount of program students reported drinking zero or one sugar-sweetened beverage per day. Analysis of fast food consumption and physical exercise showed higher percentages of program students getting less than one hour of exercise per day and comparable percentages between program and control on frequency of consuming fast food with no statistical significance. Gardening was included as physical activity on the survey, however, 75% of the program students did not report getting an hour or more of physical activity per day.

Table 2 – Impact Measurements of Food Production Program

Percent Meeting "Healthy People 2010" Recommended Servings of 5 Fruits and Vegetables per day			
Control (n=42) and Program (n=19) unless otherwise noted			
	Less than USDA recommendation	Greater than or equal to the USDA recommendation	Chi Square
Control Group	71% (30)	28.5% (12)	P<0.07
Program Group	47% (9)	52.6% (10)	
Vegetable Preference and Variety (Number of Different Vegetables eaten in last 2 weeks)			
		Mean	P<0.0005
Control Group (n=39)		13.25	95% CI (10.9-15.6)
Program Group (n=19)		20.84	95% CI (17.2-24.3)
Fruit and Vegetable Snack			
	Zero F+V Snack	F + V Snack at least once per day	P<0.06
Control Group	40% (16)	60% (24)	
Program Group	16% (3)	84% (16)	
Sugary Beverage Consumption			
	Zero or One SSB/per day	More than one SSB/per day	P<0.005
Control Group	35% (14)	65% (26)	
Program Group	74% (14)	26% (5)	
Fast Food Consumption Frequency			
	Once a week or less	More than once a week	P<0.55
Control Group	45% (18)	55% (22)	
Program Group	37% (7)	63% (12)	
Physical Activity			
	< 1 hour physical activity	≥1 hour physical activity	P<0.51
Control Group	65% (26)	35% (14)	
Program Group	74% (14)	26% (5)	

Table 3 demonstrates comparisons in food "attitudes" between the two groups. 57% of the program group responded that they "sometimes or always" read food labels, whereas 37.5% of the control group responded in a similar fashion *(P<0.14)*. When asked whether the students think about where food comes from, 79% of the program group responded that they sometimes or always think about it, and 31.5% of the control group responded in that fashion *(P<0.003)*. The self-efficacy measures showed high results for both groups, 85% of the control group and 100% of the program group felt that they could change the things they ate *(P<0.07)* and 82.5% and 95% respectively felt that they could eat more vegetables if they wanted to *(P<0.20)*.

Table 3 – Food Attitudes

"When I buy a packaged product in the supermarket, I read the nutritional labels."			
	Rarely or Never Reads Labels	Sometimes or Always Reads Labels	
Control Group	62.5% (25)	37.5% (15)	P<0.14
Program Group	42% (8)	58% (11)	
"When I buy food in the supermarket, I think about where it came from (what country or what part of the U.S.)"			
	Rarely or Never thinks about origin	Sometimes or Always thinks about origin	
Control Group	62.5% (25)	37.5% (15)	P<0.003
Program Group	21% (4)	79% (15)	
Self Efficacy - "I can change the things I eat"			
	Disagree	Agree	
Control Group	15% (6)	85% (34)	P<0.07
Program Group	0%	100% (19)	
Self Efficacy - "I can eat more fruits and vegetables"			
	Disagree	Agree	
Control Group	17.5% (7)	82.5% (33)	P<0.20
Program Group	5% (1)	95% (18)	

Discussion

Summary of Findings

- 52.6% of program group met the "5 servings per day of fruits and vegetables" recommendation while 28.5% of the control group met it. P<0.07

- In the last two weeks, the control group reported eating an average of 13 different fruits and vegetables, whereas the program group reported eating 21 different varieties. $P<0.0005$
- 60% of the program group reported eating a snack of fruits and vegetables, while 40% of the control group reported the same. $P<0.06$
- 74% of the program group reported having zero or one sugar-sweetened beverage per day, while 35% of the control group reported the same. $P<0.005$
- 100% of the program group reported that they could change the things they ate. $P<0.07$
- 81% of the program group and 37.5% of the control group reported that they "always or sometimes" thought about the origin of the food that they were eating. $P<0.001$
- 57% of the program group and 37.5% of the control group reported that they "always or sometimes" read food labels. $P<0.14$

Richmond, California is a community where 35.2% of the children are overweight, significantly higher than California as a state (28.1%). (*Overweight children in california counties, contra costa county. 2004*) With recent emphasis on the childhood obesity epidemic and the experimentation of new programs for increasing healthy eating like farm to school programs, wellness policies and school gardens, it is important to evaluate and report on programs targeting eating habits and child health to help generate a state-based or national consensus on the way forward. The preliminary findings from this study show significant differences in the program students and follow up studies will look at potential for behavior change at the high school level. Additionally, it shows that focusing on food production from seed to fork as the main component of a health program is worth further exploration as a tool for teaching healthy eating and increasing healthy behaviors within the food system.

So much of nutritional education is focused on elementary school students, but food production, because of its physical strength requirements, organization and complexity of thought could be an appropriate intervention for adolescents. To repeat an earlier statistic, an obese three year-old has less than a 20 percent chance of being an overweight adult, but an obese 12-17 year-old has almost a 60 percent chance of being overweight as an adult. (Guo et al., 2002) As eating habits ingrain themselves over time, it is valuable for schools to do what they can to improve the chances those early habits are healthy habits, and to continue that focus on healthy lifestyles throughout adolescence. From anecdotal conversations with students, many of them remember that school garden in elementary school, but the lessons learned from those experiences have vanished in the face of an obesogenic food environment, heavy food marketing, the ubiquity of snacking, and the lack of connection to how food is grown and processed. A logical continuation of the elementary school garden is a chance to move forward with more advanced and larger food production throughout adolescence.

This was a food production based program where the stated goal was to generate enough produce to provide food for the community through a CSA (community supported agriculture) service. The program also included learning about the American food system and studying the students' local food system, however, the impact measurement of this study focused on eating habits, fruit and vegetable consumption and attitudes about food, instead of some other measurement about food production knowledge or knowledge of the food system. There were no traditional nutrition lessons discussing the benefits of fruits and vegetables, although discussion of their benefits occurred throughout the program, especially when comparing foods from the modern industrial food system.

What then is the rationale for why an adolescent engaging in food production will change their attitudes about food and eventually their eating habits? The creators of this program believe that the key aspect in this is teen empowerment. Looking at the present industrial food system, there is very little empowerment. People make consumer choices without understanding how, where or with what their food is made; many people do not understand the ingredients that are in their food. They don't know how the food was grown and/or processed. Much of the present day food system is based on thoughtless consumption. This program did a few things that may have created the differences we see between the two groups. The first is that the program, through hands-on food production, showed the students how food is grown. Some students did not even know that lemons were fruits, others did not understand that produce like beans and peas came from the flowers of a plant, and still others did not understand that carrots grew underneath the soil. That alone could change your viewpoint on food, but the program also placed our present industrialized food system within the context of agriculture throughout the history of humankind and laid out for the students how food is produced, processed, packaged and brought to us. The teens in this program were exposed to a lot of information from which to make consumer decisions in the food system. The program looked towards "teen empowerment" as a modifier that could lead to healthier decisions. The ultimate outcome the program was attempting to change is the "relationship" that students had with food. A changed "relationship" could come in many forms, from thinking more deeply about the nutritional level of what students are eating, to deciding to try and eat more organic foods, to starting a vegetable garden in the backyard. It is not known at this time how different changes in the relationship with food may or may not cause changes in behavior.

Additionally, it is possible that there was a level of "commitment" that came along with the program. Social psychology discusses the idea that as people "commit" to an idea they are more

likely to follow through with it. (Caldini, 1984) It is possible the program was simultaneously teaching the students about food production and asking for their commitment to a new way of thinking about food. In addition, by handing families healthy food to eat, there may have been further "commitment" because students were making a public statement that eating healthy is the right thing to do and thus would be more likely to follow those behaviors themselves.

A central question lingering over this preliminary study is whether the students in the program already had these beliefs before joining the program. Most of the demographics of the two groups match up well, however, there was a significantly higher percentage of girls in the program group. This could have had an effect on the results. It is frequently noted that girls may pay closer attention to issues regarding food and weight based on the importance of physical appearance in adolescence. As a result, girls may also have a better understanding of healthy behaviors and reported their behavior accordingly. A secondary study of the program with a pre/post design currently underway will help answer this question.

Improving the relationship between adolescents and food is a complex task. There were several questions asked of the students that together could provide some evidence of a changed relationship with food:

Fruit and Vegetable Consumption: The survey showed differences in total consumption, variety of produce consumed and snack consumption of fruits and vegetables consumed. Unhealthy snacking has the potential to add the calories that take adolescents out of energy balance. Jahns et al has reported that, from 1976-1996 when the prevalence of childhood overweight has grown from 8% to 14% for children and from 6% to 12% for adolescents, the frequency of snacking by children and adolescents also increased significantly. In addition, snacks tended to be more energy dense and higher in fat than meals, contributing to increased energy and fat intakes.

(Jahns, Siega-Riz, & Popkin, 2001) Hence the more snacks that are replaced with low-energy density fruit and vegetable snacks the better for energy balance.

Nutrition and Origins of Food: Higher percentages of program students looked at nutritional labels and thought about where food comes from before it reaches the students. Reading food labels, whether it be for nutrition information or looking at the ingredients increases the level of engagement with the food and thus changes the relationship. The students who read labels may be considering the calories in food, the levels of fat, or pondering about chemical ingredients in our modern food system that they cannot pronounce or understand. When higher percentages of students report that they thought about where food comes from, they may be articulating a major focus of the program, which was a focus on local food and the environmental, economic, social justice and community benefits of local food.

Food Habits: Questions about food habits, specifically sugar-sweetened beverage consumption and fast food consumption yielded mixed results which were surprising. Sugar-sweetened beverage consumption showed a statistically significant difference between the two groups, yet fast food consumption did not. It may be that it is easier to change something small like a beverage, which is only part of a meal or snack than to change the entire meal. Fast food had a broad definition in the survey, including pizza and all chain fast food restaurants so in an area like Richmond with a high concentration of fast food eateries it may have been difficult to change behavior. In addition, a decision to eat fast food may be influenced by peers and family to a higher extent than sugar-sweetened beverages. Other individuals may decide where the family or peer group is eating, but the individual still has some control over whether a beverage is ordered.

Strengths and Limitations

Additions to the literature: This study design expands the relatively scarce literature on school

garden programs to include work being done with older adolescents and high school students. High school students must be approached differently than elementary students, the more common target of such garden interventions. Without research on older adolescents, are we saying that it is too late to modify behavior with regards to food? High school students can perform more complex food production tasks because of physical strength, their ability to organize information, the absence of some safety issues and their autonomous nature. Additionally, older students are more cognizant of community food issues and can think critically about the complex and deeper issues affecting the United States food system.

This study also adds the model of an intensive food production program to the literature. These differences between UAI and most other school garden programs studied in the literature are significant and point a new direction for these interventions which must be studied more thoroughly. This study illustrates a growing movement of the types of programs that are beginning to focus on food production as a way to feed communities, educate kids and change their behavior at the same time.

Data Analysis: Program participants were surveyed more than 6 months after finishing the program, so behaviors and /or attitudinal and knowledge difference demonstrated has potentially remained through time. Control classes were randomly selected and age and ethnicity of the control and program groups were well matched. The program group had a response rate of 86%.

Limitations

Small sample: This study was a pilot program evaluation; the small "n" poses several limitations for determining statistical differences. This limitation creates opportunities for further research as more and more students pass through the program. Increasing the sample size would increase the power of the impact evaluation.

Selction Bias: The students chose to be in the program. Some teachers at the school encouraged

students to be in the class and the teacher of the program was also a teacher at the school, which meant that many of the students in the program were also students from that teacher's classes. The question becomes, were those students significantly different in their behaviors and attitudes about food before entering the program? A future study currently underway will help illuminate that issue by establishing baseline data with a second cohort of students who became involved when the evaluator was not teaching. That pre/post design will help determine change across time.

Generalizable Results: Another question is how much can we generalize from the program and its results? The premise of the program is food production. Will every school that engages in an authentic food production program yield similar results? The model of setting aside some part of school property to engage in authentic food production can be duplicated in many schools across the country, although not all. While this program did not draw upon-a standardized curriculum, one could be easily developed for the in-class portion of the program. The focus on food production and in turn distributing that food direct to the community is much of where the engagement takes place, whether the surrounding activities were nutritional, food system or social justice centered makes little difference.

Cross Sectional Study Design: The cross-sectional nature of the design gives a snap shot in time. This study does not illuminate change over time, and while many of the comparisons were significant and demonstrate differences regarding food attitudes and behaviors, further research is needed.

Social Desirability Bias: While the attitudes expressed seem to match the self-reported fruit and vegetable intake, it is hard to determine whether the students actually had those food behaviors. After taking part in the program, they would have had a high level of knowledge to give socially desirable responses. Future research cohorts of this program should explore other methods of accounting for food behaviors.

Further Research

Further research should begin seeking out new innovative models that are being tried around the country with regards to youth and food production. A new set of school gardening models should be categorized relating to their level of food production. There is a discernable difference regarding intensity, duration and student involvement between programs that are heavy on classroom education with a garden component and programs that focus on food production with education and nutrition in a supporting role. Those two models should be compared in future research.

Policy Implications

Note: *As this is a preliminary study and shows no direct causal effects, should follow-up studies demonstrate causal associations, the following are some policy implications that could be developed.*

Food production as a health promoting model: While there is already strong implied political support for the urban agriculture movement demonstrated by an organic garden on the White House lawn and People's Garden at the USDA, the fact remains that most school gardens are established with no official funding and rely heavily on donations of time and money from various sources within the school and community. (Ozer, 2007) When teachers' time is uncompensated, and there is no source of funds to build gardens, barriers exist which will slow the expansion of the school garden movement. Food production programs have the potential to mitigate some of the lack of funding dedication because they most often come in the form of public/private partnerships. The schools must dedicate the staff and room in the scheduled day, but often the technological knowledge, materials and equipment can be supported by non-profit organizations. Currently, obesity costs for the United States are estimated at **147 billion dollars** per year, (Finkelstein, Trogdon, Cohen, & Dietz, 2009) while piloted federal funds for "farm to school" and school gardens combined remains in the tens of millions. Interventions of longer duration focused on the act of bringing food from seed to fork show promise and deserve

increased funding to explore their potential through rigorous research.

Food Production as a possible way to decrease energy in the food sector: Programs like these also have implications with regards to domestic energy use in the food sector. Local school-based food production programs have the potential to increase sources of local, low-energy input farming that adds to the food shed of cities and towns. The most recent ERS (Economic Research Service) report from the USDA points out that while per capita energy use in the U.S. declined 1.8% from 1997-2002, food related energy use increased 16.4%. (Canning, Charles, Huang, Polenske, & Waters, 2010) The report pointed out that significant increases came from the increased processing of our foods and the increased energy use as Americans change to eating more prepared foods and more meals outside of the household. Food production interventions like the Urban Agriculture Institute address many of these energy issues. First, the food production itself has low energy inputs, with no synthetic fertilizers or heavy machinery used. Second, the food production moves into the homes of the community with no processing and very little transport. The educational component and cooking components of the program act to increase home consumption of fresh ingredients and eating less processed foods. In the coming era of peak oil and global climate change, food production programs similar to these could have positive impacts of the energy use in the food sector. During World War II, close to a third of all produce consumed in the United States were grown in victory gardens, so the potential for energy savings in a time of increasing home gardens and urban agriculture is significant.

Food production as a way to improve academic achievement: Food production programs have the potential to affect students in multiple pathways towards healthier development. It is estimated that food production programs could positively affect nutritional intake, academic achievement, social bonding, teen self-esteem, physical activity, community efficacy and social capital. (Ozer, 2007) Linking food production and/or school gardens to academic achievement

should be a goal of researchers interested in school gardens and their influence on childhood obesity and general health because in this time of high-stakes testing and limited budgets, a program that shows academic improvement will be much more palatable than one focused on child health. A recent working paper out of the UK did just that, linking Chef Jamie Oliver's 2004 "Feed Me Better" program with higher test scores and lower absenteeism. (Belot & James, 2009) Well-positioned research would also look at increased "school bonding" with students involved in school gardens/food production programs. Research has shown that that increases in school bonding in adolescence yields higher levels of school achievement and official GPA, and was correlated with less school misbehavior, substance use, and sexual activity. (Hawkins, Guo, Hill, Battin-Pearson, & Abbott, 2001)

Conclusion

The results from this small sample study is the first step in the study of many new innovative types of food production programs involving adolescents and their relationship with the food environment. This cross-sectional study with a limited sample demonstrated both knowledge and attitude differences and significant behavioral differences between students in the control group and program participants. The differences are significant enough to warrant further research and exploration of food production as a public health model beyond the educational school garden. This model of food production focused gardens and mini-farms should be compared against the traditional educational school garden to determine the efficacy and behavior change implications.

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Full Disclosure

The author of this study was also the co-teacher of the Urban Agriculture Institute at Richmond High School. Steps were taken to assure anonymity of the student responses and to limit any interference brought on by the fact that the teacher was also doing the study. Students were given codes by participating teachers at the school to input into the survey and the researcher had no access to the codes. The researcher is also a board member of Urban Tilth, the non-profit

organization that supports this program, but has no pathway to financial gain from any results of the study.

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