

ASSESSING HOW PARTICIPATION IN GARDENING AFFECTS DIET  
QUALITY: A REVIEW

By

Megan Lynn Meyer

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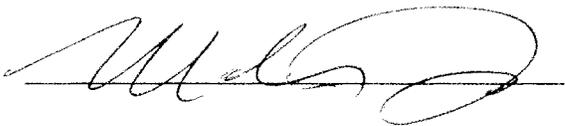
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A handwritten signature in black ink, appearing to read 'M. Hingle', written over a horizontal line.

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## **Systematic Review**

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### **ABSTRACT**

*Objective.* Diet quality is poor in the United States and is an area of concern for the health of the population. Gardening interventions are promising ways to improve diet quality. The most effective gardening method to improve diet quality remains unclear. A systematic review of gardening and nutrition knowledge interventions was conducted to determine interventions that improve diet quality and the most effective intervention.

*Method.* Studies published between 2007 and 2012 were identified through a library database search. Studies involved youth in the United States and the impact of gardening intervention on diet quality. Fruit and vegetable intake, willingness to taste and preference for fruits and vegetables, and other nutrition related outcomes were examined. This review only includes peer-reviewed articles in English.

*Results.* Six studies were reviewed. Four took place on school grounds where the nutrition education and gardening took place within school curriculum and two studies were conducted during youth summer camps. Studies include youth from 8 to 15 years.

*Conclusion.* Findings from this review suggest that garden-based nutrition intervention programs may have the potential to improve diet quality. However, there is still need for well-designed, evidence-based, peer-reviewed studies to determine program effectiveness and impact.

Limitations of the studies as well as suggestions for future research directions are provided.

## INTRODUCTION

As chronic illnesses continue to threaten the health of the nation, the impact of diet on health and these diseases remains important. The association between diet quality and health status is undeniable and programs that can improve diet quality are of interest. The diet quality and nutritional intake of youth in the United States is a national concern<sup>7</sup>, and this population is at a stage in life where nutrition intervention can make a significant difference to their lifelong health<sup>7</sup>. Gardening is one nutrition intervention program of particular interest because it promotes the growth of foods (primarily fruits and vegetables) that help prevent cardiovascular disease, certain types of cancers, obesity, and other chronic illnesses<sup>1</sup>. Studies suggest that fewer than half of boys and girls between the ages of 4 and 18 years consume the minimum recommendation of 5 servings of fruit and vegetables a day<sup>1</sup>. Efforts are underway to increase fruit and vegetable consumption in this population. School-based nutrition education is a promising tool to increase fruit and vegetable intake. In addition, hands-on gardening experience that is engaging and interactive is a promising intervention technique. Youth garden and education programs have been implemented nationwide and there are numerous reports of the positive impact the programs have had on youth diet quality and fruit and vegetable consumption<sup>1</sup>. Additional benefits of garden intervention programs include positive environmental and nutritional attitudes, increased community spirit, social skills, self-confidence, leadership skills, volunteerism, motor skills, and scholastic achievement<sup>1</sup>. While garden-based nutrition education programs are promising intervention techniques to improve diet quality, there is a lack of evidence-based research evaluating the impact of garden intervention programs on diet quality. As registered dietitians, community nutritionist, and food and nutrition professionals seek effective ways to improve youth diet quality and dietary intake, this review

offers insight into the potential effectiveness of utilizing garden-based nutrition education intervention programs and provides suggestions for future research directions.

It is important to note that food and nutrition professionals define diet quality in youth based on seven categories because they may help prevent excessive weight gain and are unlikely to cause harm. They include: limiting consumption of sugar-sweetened beverages, encouraging consumption of diets with recommended quantities of fruits and vegetables, limiting television and other screen time by allowing a maximum of two hours a day, eating breakfast every day, limiting eating out at restaurants, especially fast food restaurants, encouraging family meals in which parents and children eat together, and limiting portion sizes to more appropriate amounts<sup>6</sup>.

The studies reviewed in this article examine the fruit and vegetable intake component of diet quality. The studies also assess children's willingness to try different fruits and vegetables and their preference for fruits and vegetables.

## **OBJECTIVES**

Given the rise in childhood obesity, it is important to assess techniques that can help combat and reverse this trend<sup>7</sup>. A large part of diet quality is nutrient intake, which is significantly influenced by fruit and vegetable intake. The purpose of this review was to investigate the relationship between youth participation in gardening activities and diet quality. Additional factors that may influence dietary behaviors (e.g., preference, knowledge, and willingness to taste) were included.

## **METHODS**

Articles published between 2007 and 2012 were identified from searching PubMed database.

This review includes articles published in English in peer-reviewed journals. The following key

words were searched singularly and in various combinations: youth, children, school gardens, community gardens, garden, nutrition education, and diet quality. Studies were included in this review if they examined the impact of garden intervention and garden-based nutrition education on youth fruit and/or vegetable intake, willingness to taste fruits and/or vegetables, preferences for fruits and/or vegetables, and other nutrition-related outcomes and enrolled children and adolescents in the United States. Articles targeting adults, the community as a whole or were studies conducted in different countries were excluded from this review. Six studies were identified that met the review criteria. This review is organized by providing an overview of the study characteristics, descriptions of intervention methodologies and measurement tools, and summaries of study outcomes. These are provided for two general categories: in-school garden-based nutrition education research and afterschool or summer garden-based nutrition education research. Limitations of the studies and implications for future research are discussed.

## **RESULTS**

### **Overview of Study Characteristics**

This review article addresses 6 studies that include children and adolescence in America between the ages of 7 and 15 with the majority of youth enrolled in the sixth grade. The studies represent a variety of geographic regions across the United States. The studies include in-school nutrition education and gardening interventions or a summer garden-based nutrition education intervention. Studies differed in design and types of outcome evaluation tools utilized. Studies ranged from gardening participation and/or nutrition education taking place weekly over 10 to 28 weeks, with an average duration of 12 weeks. Four studies were located on school grounds and were integrated into school curriculum<sup>1,2,3,4</sup>. Two were conducted during summer programs<sup>1,5</sup>.

The four in-school intervention studies included garden-based nutrition education intervention groups<sup>1,2,3</sup>, nutrition education only<sup>1,2,3</sup>, and control groups<sup>1,2,3</sup>. All six studies used pre- and post-tests within the same population. Evaluation tools include 24 hour recalls<sup>1,2,4</sup>, fruit and vegetable intake survey and preference questionnaire<sup>3,5</sup>, lunchroom observation<sup>3</sup>, Garden Vegetable Frequency Questionnaire<sup>4</sup>, and taste tests<sup>4</sup> which assessed fruit and vegetable intake, willingness to try fruits and vegetables, and preference for fruits and vegetables.

Table 1 represents the characteristics of each study reviewed, including study location, population, design and duration, measurement tools utilized, and study outcomes. The following overview of the literature provides more details about study design, measurement tools and methodologies, and the impact of youth garden-based nutrition education on fruit and vegetable intake, willingness to taste fruits and vegetables, preferences for fruits and vegetables, and other nutrition-related outcomes.

### **Location**

Studies in this review were conducted in various regions and states across the United States. Two studies took place in schools in Idaho<sup>1,2</sup>. The other two school interventions took place in California and southeastern United States<sup>3,4</sup>. The two summer garden programs took place in Minnesota<sup>1,5</sup>.

### **Population**

This review assesses the effects of gardening on children and adolescent, specifically participants between the ages of 7 and 15. All studies included both male and female participants. Three in-school gardening intervention studies evaluated 6<sup>th</sup> graders (n=95, n=99, n=320, respectively)<sup>1,2,4</sup> and one evaluated second graders (n=115)<sup>3</sup>. One summer school intervention evaluated boys and girls 8-15 years old (n=96 completed the baseline survey and n=66 completed the post-

intervention follow-up survey)<sup>1</sup> and the other evaluated students entering the 4<sup>th</sup>, 5<sup>th</sup>, and 6<sup>th</sup> grades (n=93)<sup>5</sup>.

### **Design, Frequency, and Duration**

All six studies in this review were designed to assess pre-post effects of the intervention using surveys, questionnaires, or other assessment tools. Four in-school studies each had a control group and two intervention groups, a nutrition education only and a nutrition education plus gardening group<sup>1,2,3</sup>. One study had 25 students in the nutrition education group, 45 in the nutrition education plus gardening, and 25 in the control group<sup>1</sup>. Another had 29 students in the nutrition education group, 45 in the nutrition education plus gardening group, and 25 in the control group<sup>2</sup>. A third study divided six classes from schools in the southeastern United States and randomly assigned two classes to each of three groups, nutrition education, nutrition education and gardening, and a control group<sup>3</sup>. The fourth in-school study had 170 students participate in one of two intervention groups and had 150 students in the control group<sup>4</sup>. This population consisted of 90% of the participants were minority, (22% African American, 29% Asian American, 9% Filipino American, 30% Latino, 3% Pacific Islander, and 7% White/other). One in-school study randomly assigned two of the six schools in Southeastern United States to each of the groups, nutrition education and gardening, nutrition education-only, and control group. The summer programs, however, only evaluated one intervention group and did not assign participants to a control group. 96 children from one summer program completed the surveys at baseline and 66 completed the surveys after the gardening program<sup>1</sup>. The second summer gardening intervention had 93 participants<sup>5</sup>.

There were two in-school 12-week studies where the two intervention groups received an hour of intervention each week<sup>1,2</sup>. Gardening activities included weeding, watering, and harvesting

strawberries, cantaloupe, and a variety of fall crops. Another in-school study lasted 28 weeks where nutrition education and gardening were taught for an hour each week on alternating weeks<sup>3</sup>. The nutrition education-only group participated in nutrition lessons every other week. The fourth in-school intervention took place over a four month period where the intervention program included garden-based learning sessions that were integrated into student's science class. The intervention consisted of approximately 1 hour per week for four months, for a total of 13 hours of garden-based learning<sup>4</sup>. Each session consisted of 20 minutes of instruction in the classroom or garden and 40 minutes of hands-on gardening experiences. Gardening activities included planting seeds, watering, weeding, harvesting, washing, and preparing garden-grown vegetables, preparing and cooking ethnic meals with their produce, and hosting a salad day with lettuce from their school gardens. The control group received the health and science classroom lessons but did not participate in any gardening activities.

One summer program evaluated the impact of a 12 week summer gardening and nutrition education intervention. The intervention took place during a 12 week YMCA summer camp in Minnesota and was called *Delicious and Nutritious Garden*<sup>5</sup>. The other summer program was a 10-week community-based intervention where children participated in the intervention program 3 days a week for 10 weeks during the summer. Participants were taught about nutrition, cooking, and gardening lessons<sup>1</sup>.

### **Measures and Measurement Tools**

Four studies evaluated fruit and vegetable intake via 24 hour recalls<sup>1,2,4</sup> and a Garden Vegetable Frequency Questionnaire<sup>4</sup>. One study used three-day 24 hour recall workbooks<sup>2</sup> and the other three used one day 24 hour recalls<sup>1,4</sup>. Two studies measured fruit and vegetable knowledge, preference, and taste ratings through self-administered surveys and Taste Tests<sup>4,5</sup>. Some of the

self-administered surveys were completed by the children as well as their parents/caregivers<sup>5</sup>. One study assessed participant's willingness to taste fruits and vegetables with self-administered surveys<sup>4</sup>. One study evaluated fruit and vegetable exposure, preference, self-efficacy or ability to choose to consume fruits and vegetables on their own, asking behavior or ability to ask caregiver for fruits and vegetables, and availability of fruits and vegetables in the home. This was measured by fruit and vegetable intake surveys, fruit and vegetable preference questionnaires, and lunchroom observation<sup>3</sup>.

### **Nutrition Outcomes**

Two of the in-school studies showed an increase in fruit and vegetable intake for the nutrition education plus gardening groups<sup>1,2</sup>. These groups also demonstrated an increase in Vitamin A, C, and fiber intake. The nutrition education only and control groups in both of these studies maintained the same nutrient intakes between baseline to follow-up assessments<sup>1,2</sup>. In another in-school study, youth in the nutrition education plus gardening and nutrition education only groups showed statistically significant improvements in nutrition knowledge and taste ratings when compared to the control group<sup>3</sup>. In addition, this study revealed that children in the nutrition education plus gardening group were more likely to choose and consume vegetables in a lunchroom setting at post-assessment than either the nutrition education only group or the control group<sup>3</sup>. The fourth in-school study concluded that students in the nutrition education plus gardening group were better able to identify vegetables, had an increased preference and willingness to taste vegetables, and had an increase in the average number of vegetable varieties they consumed more than once a month. In this particular study, there was actually a decrease in the control group's vegetable consumption from baseline to follow-up<sup>4</sup>. In one of the summer program intervention studies, there was an increase in the fruit and vegetable intake for the boy,

but not girl, participants in the study. In the second summer gardening program, pre-post increases in the number of fruits and vegetables eaten, vegetable preferences, and fruit and vegetable asking behavior at home were reported<sup>5</sup>.

Based on these findings, four studies revealed an increase in fruit and vegetable intake<sup>1,2,5</sup>. Two studies showed significant increases in fruit and vegetable knowledge including the ability to correctly identify fruits and vegetables<sup>3,4</sup>. Two studies showed an increase in vegetable preference and willingness to taste<sup>4,5</sup>. Additional nutrition related outcomes are outlined in Table 1.

### **Summary of Outcomes**

Outcomes assessed in this review include four studies that evaluated changes in fruit and/or vegetable intake, three studies that evaluated changes in fruit and/or vegetable preference<sup>1,2,5</sup>. Two studies evaluated changes in willingness to taste or taste ratings of fruit and/or vegetables<sup>4,5</sup>. All four studies that evaluated fruit and/or vegetable intake showed an increase in intake. One of these studies reported significant increases in fruit and vegetable intake for boys only<sup>1</sup>. Two of three studies that assessed children's preference for fruit and/or vegetables showed improvements<sup>3,4,5</sup>. The study that assessed willingness to taste fruits and/or vegetables showed improvements<sup>4</sup>.

While fruit and vegetable intake, preference, and willingness to taste were the primary outcomes of the studies in this review, other nutrition-related outcomes were reported and are important when analyzing overall diet quality. Knowledge of fruits and/or vegetables and ability to correctly identify them was evaluated in two studies<sup>3,4</sup> and fruit and/or vegetable exposure, asking behavior, self-efficacy, and availability at home was evaluated by another study<sup>5</sup>. Fruit and vegetable asking behavior at home increased as well as students' ability to correctly identify

fruits and/or vegetables<sup>5</sup>. In addition, the nutrition education plus gardening and the nutrition education only groups in showed increased fruit and vegetable knowledge<sup>3,4</sup>. Another nutrition-related outcome was that the children's intake of Vitamin A, Vitamin C, and fiber increased<sup>1,2</sup>. Results from the studies in this review provide evidence for the effectiveness and potential health benefits of garden-based nutrition education. Investigators used a variety of evaluation tools to measure the outcomes of interest.

Some limitations to the studies reviewed include, small sample sizes, lack of long-term follow-up data, and lack of process evaluation data. Another limitation to the in-school intervention research was the constraints of the school setting because the research design could not be a randomized, controlled trial with a larger sample size and most could not include follow-up assessment to determine long-term results. In addition, some of the in-school interventions included mostly white participants in a specific grade and this may not generalize to other populations. A limitation of another study was the fact that the study measured the number of different vegetable varieties eaten but not the actual amount of vegetables consumed. Therefore, it is difficult to conclude whether or not vegetable intake had increased. Another limitation of both the in-school and summer program interventions is that the knowledge and gardening benefits may not be carried over to the home as to maximize benefits. Community garden programs may be beneficial to teach people how to plant, care for, and harvest in-home gardens. This will allow gardening participation and knowledge to carry over into the home setting and potentially provide further diet quality improvements. The two summer program studies did not include a control group and the in-school studies only had one control group and two intervention groups. Control groups allow researchers to compare results of the treated group to the untreated/control group and provides more confidence as to whether or not the treatment had

an effect. Geographic representation was limited (San Francisco, California, Idaho, Minnesota, and the southeastern United States only).

## **DISCUSSION AND FUTURE PRACTICE AND RESEARCH**

The current literature on the impact of gardening on youth diet quality although limited is promising. Gardening has been an important aspect since the early 1900s but has received much attention lately and is experiencing a growing movement<sup>8</sup>. Importantly, it has shown to improve health and diet quality. There are changes that have to be made to improve the health status of American youth and gardening shows promises of being a beneficial intervention tool<sup>8</sup>. Studies in this review show statistical significance for the positive effect that gardening has on the diet quality of children and adolescents. Gardening has also been associated with improvements in testing scores of elementary school students in numerous studies<sup>8</sup>. School gardening has been shown to be an engaging, interactive, and fun activity for children and can contribute to community building, teamwork, and student bonding<sup>8</sup>. In fact, one of the studies reviewed in this article report that children liked preparing fruit and vegetable snacks (93.4%), working in their garden (95.6%), and learning about fruits and vegetables (91.3%) in their garden intervention program<sup>5</sup>.

This review addressed whether or not gardening has a positive impact on diet quality of children and adolescents. Of the garden-based studies published from 2007 to 2012, all six of the studies demonstrated a positive outcome on participants' diet quality or mediators of diet quality (e.g., preferences, willingness to taste). Improvements in diet quality include increased fruit and vegetable intake, increased knowledge about fruits and vegetables, increased preference and willingness to taste fruits and vegetable, and increases in self-efficacy and asking behavior.

Based on these limited studies, school and community gardens are promising ways to teach about the importance of health and to impact the diet quality of youth in the United States. One important observation is that once children enter middle school, they often have more control over what they consume. Therefore, this is a vulnerable population and time in their lives that can be positively impacted by the efforts of a garden program. Garden-based education may impact middle school children's choices and preference of fruits and vegetables. Gardening can also impact the lives of elementary school children as it may set a precedent for their interests and knowledge about fruit and vegetable intake. These nutrition-related improvements, such as increased fruit and vegetable intake may be extrapolated to show improvement in other areas of diet quality, such as reduced screen time and healthful eating habits and means of receiving meals. This is because more time outdoors in the garden and preparing meals with the products of the garden may help reduce screen time. Gardening may also provide the means to prepare homemade meals for families and therefore limit the amount of times families eat out at restaurants.

Because there are limited studies for this topic and with the targeted population, more research will be beneficial to better understand the most ideal way to implement garden-based nutrition education. It remains unclear as to what specific intervention style is the most promising, such as what are the most beneficial time frame and amount of gardening intervention.

Ideally, garden-based nutrition education will extend beyond the classroom and school and be implemented in the community and homes of children as well. This allows a holistic approach to gardening, health, and nutrition and will allow for the benefits to be reiterated in more than one environment that children are a part of.

Future studies can assign more than one control group to provide additional comparison information. Also randomly assigning participants may provide more statistical significance over convenience studies. There is a need for studies that assess the impact of community gardens on children and adolescent diet quality.

## **OBSERVATION COMPONENT**

I had the opportunity to experience hands-on, the impact of gardening for families in the Tucson community. I have volunteered and attended programs implemented by the Garden Kitchen, a cooperative extension program of the University of Arizona. This was not an intervention study but it is a garden program that teaches how to garden, offers free cooking demonstrations using produce from the garden, as well as additional food and garden related programs. The Garden Kitchen has provided a means for families and community members to learn about gardening, help one another with the gardening process, share tips and hints for a successful garden, and serve as a support system for each other.

Besides reading peer-reviewed literature on the impact of gardening, I had the opportunity to interview a lady that implemented a school garden at an elementary school in Maine. She worked in rural Maine and established a garden and integrated the produce from the garden into the meals that were served at the school. She states “I saw first-hand many children eating vegetables they grew themselves that they had never tried before...and they loved it! I like to say, if you grow it you will eat it.” Child participation in gardening and seed to table process included planting, tending, and harvesting, and greatly impacted their outlook on fruits and vegetables. They enjoyed the activities and enjoyed eating the results of their hard work. She worked with children that had been adopted by grandparents due to family troubles. One girl’s mother was a

drug addict and was therefore adopted by her grandparents. Another girl had never seen a carrot before the gardening program with Julie. A boy in the group that has behavioral problems loved gardening and through working in the garden was persuaded that raw zucchini is actually “yummy.” He was willing to try anything that Julie asked him to<sup>9</sup>. This is not a formal assessment or evaluation study but it is similar to a lunchroom observation study and Julie’s observations support the research in that gardening is promising in having a healthful affect on the diet quality of youth as well as life aspects beyond diet.

Author, year	State	Study population (n)	Design (duration)	Measures	Measurement Tools	Nutrition Outcomes
<b>In-school</b>						
McAleese and Rankin (2007)	ID	Sixth graders male/female n=95	pre-post intervention/control 12 week	FV Intake	24 hour recall	NE+G group increased fruit and vegetable intake significantly. Also showed significant increase in vitamin A, C and fiber. NE and control group stayed about the same.
McAleese and Rankin (2007)	ID	Sixth graders male/female n=99	pre-post intervention/control 12 week	FV Intake	3-day 24 hour recall workbooks	NE+G group increased their fruit and vegetable intake more than the other two groups. Also showed significant increase in vitamin A, C and fiber.
Parmer, S. M., Salisburg-Glennon, J., Shannon, D., & Struempfer, B. (2009)	Southeastern US	2nd graders male/female n=115	pre-post intervention/control 28 week	FV intake, knowledge, preference, and taste ratings	FV intake survey, FV preference questionnaire, and lunchroom observation.	Participants in the NE+G and NE treatment groups exhibited significantly greater improvements in nutrition knowledge and taste ratings than did participants in the CG. NE+G group was more likely to choose and consume vegetables in a lunchroom setting at post-assessment than either NE or CG.
Ratcliffe, M.M., Merrigan, K.A., Rogers, B.L. and Goldberg, J.P. (2011)	CA	6th graders male/female Over 90% of students participants were of color. n=320	pre-post intervention/control 4 months	Knowledge, behavior, preference, willingness to taste and attitudes towards vegetables	2 self-administered surveys, the Garden Vegetable Frequency Questionnaire and the Taste Test and a 24-hour recall.	Students were better able to identify vegetables, showed increased preference and willingness to taste vegetables, and increased average number of vegetable varieties they consumed more than once a month in the NE+G group. There was a decline in CG's vegetable consumption.
<b>Summer Program</b>						
Lautenschlager and Smith (2007)	MN	Ages 8-15 male/female n=96 baseline. n=66 follow-up	pre-post intervention 10 weeks	FV Intake	Survey questions and 24 hour recall data.	Boy's FV intake significantly increased from baseline to follow-up.
Heim, S., Stang, J., & Ireland, M. (2009)	MN	4th-6th graders male/female n=93	pre-post intervention 12 weeks	FV exposure, preference, self-efficacy, asking behavior, and availability of FV in the home	Self-administered surveys given to parents and children	Increase in the number of FV ever eaten, vegetable preferences, and fruit and vegetable asking behavior at home from baseline to follow-up.
						FV=fruit and vegetable
						NE=Nutrition Education group
						NE+G=Nutrition Education and Gardening group
						CG=Control Group

Table 1: Study Characteristics

## REFERENCES

1. Robinson-O'Brien, Story M, Heim S. (2009). Impact of garden-based youth nutrition intervention programs: A review. *Journal of American Dietetic Association*. 109, 273-280.
2. McAleese, J. D., & Rankin, L. L. (2007). Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *Journal of the American Dietetic Association*. 107, 662–665.
3. Parmer, S. M., Salisbury-Glennon, J., Shannon, D., & Struempfer, B. (2009). School gardens: An experiential learning approach for a nutrition education program to increase fruit and vegetable knowledge, preference, and consumption among second-grade students. *Journal of Nutrition Education and Behavior*. 41:3, 212–217.
4. Ratcliffe, M.M., Merrigan, K.A., Rogers, B.L. and Goldberg, J.P. (2011). The effects of school garden experiences on middle school-aged students' knowledge, attitudes, and behaviors associated with vegetable consumption. *Health promotion Practice*. 12:1, 36-43.
5. Heim, S., Stang, J., & Ireland, M. (2009). A garden pilot project enhances fruit and vegetable consumption among children. *Journal of the American Dietetic Association*. 109, 1220–1226.
6. Barlow, S. (2007). Expert Committee Recommendations Regarding the Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report. *Pediatrics*. 120, S164-S192.
7. Hingle, M.D. et al. Parental Involvement in Interventions to Improve Child Dietary Intake: A Systemic Review. *Preventive Medicine*. 1-9.

8. Blair, D. (2009). The child in the garden: An evaluative review of the benefits of school gardening. *Journal of Environmental Education*, 40, 15–38.
9. Osmsberg, Julie. Personal interview. 14 February 2013.