Growing Minds: Evaluating the Relationship between Gardening and Fruit and Vegetable Consumption in Older Adults

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Summary. **New dietary guidelines recommend eating more than five servings of fruit and vegetables each day without setting upper limitations. Although older adults tend to report a higher intake of fruit and vegetables than other age groups, over half of the U.S. older population does not meet the recommendation of five daily servings of fruit and vegetables. Research has shown that gardening is one way of improving fruit and vegetable intake. The primary focuses of this study were to examine and compare fruit and vegetable consumption of gardeners and nongardeners and to investigate any differences in fruit and vegetable consumption of long-term gardeners when compared with newer gardeners in adults older than age 50 years. An online survey was designed to be answered by older adults (50 years or older) and respondents self-selected themselves for inclusion in the study. A total of 261 questionnaires was completed. Data collected were analyzed using statistical procedures, including descriptive statistics, Pearson's product-moment correlations, and multivariate analysis of variance. The results of this research supports previous studies that indicated gardeners were more likely to consume vegetables when compared with nongardeners. However, these results were not found with regard to fruit consumption between gardeners and nongardeners. Additionally, the length of time an individual reported having participated in gardening activities seemed to have no relationship to the number of vegetables and fruit reported as consumed, which suggests gardening intervention programs late in life would be an effective method of boosting vegetable and fruit consumption in older adults. Gender was also evaluated with no statistically significant differences found for overall fruit and vegetable intake.**

Older adults represent a growing portion of the population of the United States. By 2004, life expectancy had increased to 77.8 years of age (Arias, 2007), and by 2010, older adults (65 years or older) are expected to increase to 40 million in the United States (U.S. Department of Health and Human Services, 2005). The generation entering older adulthood is one that welcomed fast food and meal replacement foods allowing them to adapt to a more sedentary lifestyle and to need preventative health programs (Chappa et al., 2004).

In Mar. 2007, the national "5-A-Day" fruit and vegetable program led by the Centers for Disease Control (CDC) became the National Fruit and Vegetable Program (CDC, 2007b). This program launched a new public health initiative, *Fruit & Veggies—More Matters*, to reflect new dietary guidelines, which recommended increasing the quantity of fruit and vegetables consumed per day (CDC, 2007b). Specifically, the new recommendations included 2 to 6–1/2 cups (473 to 1538 mL) of fruit and vegetables, or the equivalent of four to 13 servings per day (CDC, 2007b).

As a result of decreased physical activity, dietary changes, and alterations in metabolic rate, older adults are susceptible to an increased rate of diseases (Arterburn et al., 2004). In fact, according to the CDC (2007a), "chronic diseases disproportionately affect older adults and are associated with disability, diminished quality of life, and increased costs for health care and long-term care" and account for almost one-third of healthcare expenditures. Because older adults represent a growing part of the population of the United States, it becomes increasingly important to focus research on the factors influencing their health.

Poor nutrition is one of several factors responsible for mortality and morbidity in the elderly (Schlettwein-Gsell, 1992) and is comparable to deaths caused from cigarette smoking (Nestle, 2007). In a study based on the "5-A-Day" program, over half of the U.S. older adult population did not report adequate consumption of these foods (Sahyoun et al., 2005). Another study of adults older than age 60 years reported that 72.5% of participants did not meet the recommended minimum guidelines for fruit and vegetable consumption (Prochaska et al., 2005). Information collected by the American Public Health Association (no date) states that "Access to healthy food plays a major role in the ability of individuals to follow a healthful diet." "Unfortunately, income, or lack of it, can decrease the ability to access healthy food and increase access to fast food restaurants, convenience stores, and liquor stores where there is poor selection and quality of fresh foods." Research in chronic diseases has consistently shown health benefits from diets rich in fruit and vegetables (Nestle, 2007).

The combination of moderate physical activity and increased consumption of fruit and vegetables has been reported to dramatically reduce an adult's risk for many chronic diseases (Blanchard et al., 2004; CDC, 2007a; Jane Higdon Linus Pauling Institute, 2005). These effects included lower blood pressure and a lower risk of developing type 2 diabetes mellitus (Jane Higdon Linus Pauling Institute, 2005) and a decrease in coronary heart disease and stroke (Ness and Powles, 1997). It is important to continue to emphasize the necessity of fruit and vegetable consumption as a practical and important means for optimizing nutrition to reduce disease risk and maximize good health (Van Duyn and Pivonka, 2000).

Studies have shown that gardening is a favorite leisure time physical activity among older adults (Bertera, 2003; Yusuf et al., 1996). Adults participate in gardening for many reasons, including physical health and exercise, mental health, recreation, creativity, intellectual expansion, friendship, produce quality and

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nutrition, spiritual reasons (including contact with nature), self-expression/self-fulfillment, and cost and convenience (Ashton-Shaeffer and Constant, 2005; Blair et al., 1991). Gardening has been shown to influence dietary habits in programs as short as 3 months, including increasing fruit and vegetable consumption (Blair et al., 1991; Koch et al., 2006; Mummery et al., 2007; Sahyoun et al., 2005). Studies examining fruit and vegetable consumption of older adults report that factors such as ownership of a garden at some point, experiences with foods eaten from a garden (past or present), early exposure to the taste of fresh fruit and vegetables, the availability of fresh produce, and eating with others can enhance fruit and vegetable consumption of this population (Devine et al., 1999).

The primary focuses of this study were to examine and compare fruit and vegetable consumption in gardeners and nongardeners and to investigate any differences in fruit and vegetable consumption in long-term gardeners when compared with newer gardeners in a study evaluating the effect of gardening on older adults (Sommerfeld et al., 2010).

Materials and methods

SAMPLE. The target population in this study was adults aged 50 years or older. The sample was obtained through an online survey. The survey was designed to be answered by older adults (50 years or older) and respondents self-selected themselves for inclusion in the study by visiting the web page and choosing to answer the survey. A total of 298 participant responses were gathered. This initial sample was reduced to 261 responses for the final data analysis eliminating duplicate and incomplete surveys. Respondents differentiated themselves as gardeners or nongardeners by responding positively or negatively to the general survey question, "do you garden?"

INSTRUMENTATION. The instrument used in this study was a survey posted online for ≈1 month from mid-Apr. to mid-May 2005. An information sheet was provided at the beginning of the survey and a link marked "take the survey," which, once clicked, indicated informed consent from the respondent. The instrument

Table 1. Multivariate analysis of variance indicating differences in the mean responses of the number of times gardeners and nongardeners, male and female, reported eating each specific vegetable and fruit per month,[z] and the total number of vegetables,[y] total number of fruit,[x] and total number of vegetables and fruit combined[w] in the study evaluating the relationship between gardening and fruit and vegetable consumption in older adults.

Source	Dependent variable	df	Means squared	F	*P*
Gender	Peppers (*Capsicum* spp.)	1	1.958	0.403	0.526
	Tomatoes (*Solanum lycopersicum*)	1	0.006	0.002	0.962
	Iceberg lettuce (*Lactuca sativa*)	1	2.521	0.546	0.460
	Peas (*Pisum sativum*) and beans (*Phaseolus* spp.)	1	0.032	0.012	0.914
	Cole crops (*Brassica* spp.)	1	2.459	0.777	0.379
	Herbs in quantity	1	3.852	0.718	0.397
	Potatoes (*Solanum tuberosum*)	1	1.059	0.248	0.619
	Carrots (*Daucus carota*)	1	1.558	0.402	0.527
	Salad greens	1	2.640	1.175	0.279
	Corn (*Zea mays*)	1	6.191	1.794	0.182
	Sweet potatoes (*Ipomoea batatas*)	1	0.278	0.089	0.766
	Fruit	1	23.933	0.555	0.457
	Melon (*Cucumis* spp.)	1	15.988	4.311	0.039*
	Citrus (*Citrus* spp.)	1	1.028	0.242	0.623
	Bananas (*Musa paradisiaca*)	1	3.849	0.813	0.368
	Apples (*Malus ×domestica*)	1	1.733	0.423	0.516
	Total vegetables	1	8.227	0.066	0.797
	Total fruit	1	23.933	0.555	0.457
	Total vegetables and fruit	1	4.096	0.017	0.876
Gardener	Peppers	1	37.341	7.685	0.006*
	Tomatoes	1	8.154	3.179	0.076
	Iceberg lettuce	1	2.039	0.442	0.507
	Peas and beans	1	12.939	4.744	0.030*
	Cole crops	1	8.048	2.545	0.112
	Herbs in quantity	1	3.604	0.672	0.413
	Potatoes	1	0.531	0.124	0.725
	Carrots	1	0.064	0.017	0.898
	Salad greens	1	2.099	0.934	0.335
	Corn	1	0.103	0.030	0.863
	Sweet potatoes	1	3.778	1.211	0.272
	Fruit	1	3.707	2.329	0.128
	Melon	1	3.723	1.004	0.317
	Citrus	1	1.151	0.271	0.603
	Bananas	1	20.199	4.267	0.040*
	Apples	1	3.613	0.881	0.349
	Total vegetables	1	525.097	4.227	0.041*
	Total fruit	1	55.704	1.292	0.257
	Total vegetables and fruit	1	922.853	3.803	0.052
Gender × Gardener	Peppers	1	14.329	2.949	0.087
	Tomatoes	1	0.483	0.189	0.665
	Iceberg lettuce	1	6.033	1.308	0.254
	Peas and beans	1	0.162	0.059	0.808
	Cole crops	1	0.062	0.020	0.889
	Herbs in quantity	1	2.031	0.379	0.539
	Potatoes	1	0.019	0.004	0.927
	Carrots	1	3.346	0.864	0.354
	Salad greens	1	0.577	0.257	0.613
	Corn	1	0.015	0.004	0.948
	Sweet potatoes	1	0.005	0.002	0.967
	Fruit	1	0.228	0.143	0.706

(*Continued on next page*)

Table 1. (*Continued*)

Source	Dependent variable	df	Means squared	F	*P*
	Melon	1	0.243	0.065	0.798
	Citrus	1	7.969	1.875	0.172
	Bananas	1	5.542	1.171	0.280
	Apples	1	1.726	0.421	0.517
	Total vegetables	1	0.044	0.000	0.985
	Total fruit	1	0.741	0.017	0.896
	Total vegetables and fruit	1	0.423	0.002	0.967

[z]Possible responses ranged from 0 to more than 5 with more than 5 being coded as 6.
[y]Possible responses ranged from 0 to 66 with actual responses ranging from 10 to 66.
[x]Possible responses ranged from 0 to 30 with actual responses ranging from 0 to 30.
[w]Possible responses ranged from 0 to 96 with actual responses ranging from 12 to 96.
*Statistically significant at the 0.05 level.

Table 2. Frequency statistics indicating the mean number of times gardeners and nongardeners reported consuming peppers, peas and beans, bananas, and total vegetables in the study evaluating the relationship between gardening and fruit and vegetable consumption in older adults.

		Do you garden?		
		No	Yes	*P*
Peppers	Mean	2.66	3.51	0.006*
	SD	2.14	2.24	
Peas and beans	Mean	4.50	4.99	0.030*
	SD	1.83	1.51	
Bananas	Mean	3.85	4.44	0.040*
	SD	2.15	2.20	
Total vegetables	Mean	40.77	43.65	0.041*
	SD	11.92	10.53	

*Statistically significant at the 0.05 level.

Table 3. Multivariate analysis of variance indicating differences in the number of times gardeners and nongardeners responded "5 or more times" per month for vegetables,[z] fruit,[y] and vegetables and fruit combined[x] in the study evaluating the relationship between gardening and fruit and vegetable consumption in older adults.

Dependent variable	df	Means squared	F	*P*
"5 or more times" per month for vegetables[z]	1	45.802	6.447	0.012*
"5 or more times" per month for fruit[y]	1	10.421	4.872	0.028*
"5 or more times" per month for vegetables and fruit combined[x]	1	99.918	7.768	0.006*

[z]Total number of vegetables responses ranged from 10 to 66.
[y]Total number of fruit responses ranged from 0 to 30.
[x]Total number of vegetables and fruit combined responses ranged from 12 to 96.
*Statistically significant at the 0.05 level.

required respondents to control boxes or fill in radio circles in addition to text boxes for open-ended questions. The instrument was divided into three sections containing a total of 33 questions. A combination of horticultural researchers and researchers in the social sciences evaluated each section of the survey for content validity.

Nutrition section. Questions concerning nutrition were compiled from similar instruments and included a total of 16 questions that asked the frequency at which respondents consumed specific fruit and vegetables per month (Koch et al., 2006; Waliczek et al., 1996). Responses were radio box style (forcing the respondent to choose only one response) ranging from "1" to "more than 5."

The nutritional section of the instrument (section 1) was scored using an Excel spreadsheet (Version 12.0; Microsoft, Redmond, WA). Nutritional questions that requested numbers for specific fruit and vegetables eaten per month were given the option to select an answer from 1-point increments ranging from "0" to "5 or more." A "5 or more" answer indicated that respondents consumed that individual fruit or vegetable more than five times a month and was scored as a 6. Data originally entered separately (by specific fruit or vegetable) were then calculated as total fruit and vegetables, vegetables alone including herbs, and fruit alone. A range of scores on the vegetable section alone including herbs was 0 to 66, whereas the fruit section alone had a possible score range from 0 to 30. Based on these ranges, total fruit and vegetable consumption range per month was 0 to 96 with the higher the number, the more times per month fruit and/or vegetables were consumed. A Cronbach's alpha reliability test reported the nutrition survey instrument to have high reliability ($\alpha = 0.81$) (Gall et al., 2006).

Demographic section. The second section of the survey contained 12 questions that asked demographic information about each respondent. This information gathered included age, level of physical activity, overall health perception, and gardening experience along with typical demographic information such as gender, income, and education level.

Gardening section. If participants answered yes to the question, "do you garden," they were directed to five questions that asked for information such as respondents' length, type, and reasons for gardening. The gardening questions were derived from questions used by Waliczek et al. (1996).

Gardeners quantified the number of hours per week spent gardening during the growing season. Possible responses included "less than 2 hours per week," "2–4 hours per week," "4–6 hours per week," "6–8 hours per week," and "more than 8 hours per week." The response of "less than 2 hours per week" was coded into SPSS (Version 11.5; SPSS,

Table 4. Frequency statistics indicating the mean number of times gardeners and nongardeners responded "5 or more times" per month for vegetables,[z] fruit,[y] and vegetables and fruit combined[x] in the study evaluating the relationship between gardening and fruit and vegetable consumption in older adults.

		Do you garden?		
		No	Yes	*P*
Number of times responding 5 or more vegetables[z]	Mean	3.74	4.59	0.012*
	SD	2.786	2.584	
Number of times responding 5 or more fruit[y]	Mean	2.12	2.53	0.028*
	SD	1.490	1.444	
Number of times responding 5 or more vegetables and fruit combined[x]	Mean	5.85	7.12	0.006*
	SD	3.766	3.465	

[z]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific vegetable. Scores ranged from 0 to 11.
[y]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific fruit. Scores ranged from 0 to 5.
[x]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific vegetable and fruit combined. Scores ranged from 0 to 16.
*Statistically significant at the 0.05 level.

Table 5. Correlation matrix indicating the Pearson's product-moment correlation among gardeners among numbers of hours per week gardening during the growing season,[z] number of times reporting "5 or more times" per month for vegetables,[y] number of times reporting "5 or more times" per month for fruit,[x] and the number of times reporting "5 or more times" per month for vegetables and fruit combined[w] in the study evaluating the relationship between gardening and fruit and vegetable consumption in older adults.

Scale		Number of hours gardening per week[z]
Number of times reporting "5 or more times" per month for vegetables[y]	Pearson correlation	0.224
	P	0.110
	No.	52
Number of times reporting "5 or more times" per month for fruit[x]	Pearson correlation	0.322
	P	0.020*
	No.	52
Number of times reporting "5 or more times" per month for vegetables and fruit combined[w]	Pearson correlation	0.297
	P	0.032*
	No.	52

[z]Responses were coded from 1 to 5 with 1 being the fewest reported and 5 being the most reported.
[y]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific vegetable. Scores ranged from 0 to 11.
[x]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific fruit. Scores ranged from 0 to 5.
[w]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific vegetable and fruit combined. Scores ranged from 0 to 16.
*Statistically significant at the 0.05 level.
No *P* value was low enough to meet the stricter requirement of the Bonferroni correction.

Chicago, IL) as 1, "2–4 hours per week" was coded with 2, "4–6 hours per week" was coded with 3, "6–8 hours per week" was coded with 4, and "more than 8 hours per week" as 5.

Gardeners also responded to a checklist asking reasons for gardening. Gardeners could select multiple reasons from the list that included: "recreation," "physical health and exercise," "spiritual reasons/contact with nature," "cost/convenience," "mental health (reduce stress, pride), "produce quality and nutrition," and "self-expression/self-fulfillment."

SCORING AND DATA ANALYSIS. Once respondents entered their online answers, responses were automatically downloaded into an electronic spreadsheet. From the 261 participants 50 years or older, participant composition included 158 gardeners and 103 nongardeners. The data were saved into an Excel spreadsheet and then transferred and analyzed using SPSS (Version 11.5). Statistical procedures included descriptive statistics, Pearson's product-moment correlations, and multivariate analysis of variance (MANOVA).

Results and discussion

GARDENERS VERSUS NONGARDENERS. Gardeners and nongardeners were compared to investigate differences between the two groups on fruit and vegetable consumption. A MANOVA was calculated to investigate differences in the mean responses of the number of times gardeners and nongardeners, male and female, reported eating each specific vegetables and fruit per month as well as the total number of vegetables, total number of fruit, and total number of vegetables and fruit combined. No interaction effects between gardening status and gender were found indicating that males and females of both the gardening and nongardening categories reported similar numbers of fruit and vegetables consumed per month. A statistically significant simple main effect for gender was found in the melon category ($P = 0.039$) indicating that males and females reported different levels of consumption of melons (*Cucumis* spp.) per each month. Descriptive statistics showed that males consumed a mean of 2.17 melons per month and females a mean of 2.66 melons each month.

Statistically significant simple main effects for gardening status were found for peppers (*Capsicum* spp.) ($P = 0.006$), pea (*Pisum sativum*) and beans (*Phaseolus* spp.) ($P = 0.03$), bananas (*Musa paradisiaca*) ($P = 0.04$), and total vegetables ($P = 0.04$) (Table 1). This indicated that gardeners and nongardeners reported different levels of consumption for each of these items. Descriptive statistics showed that consumption scores for gardeners were higher within each category when compared with nongardeners (Table 2).

To further investigate these data, responses of "5 or more times per month" were tabulated for each category, vegetables, fruit, and vegetables and fruit combined based on the responses indicated by each participant. The "5 or more times per month" scores were analyzed using MANOVAs for gardeners and nongardeners. Statistically significant differences in the mean scores between gardeners and nongardeners were found for each of the categories, including vegetables ($P = 0.012$), fruit ($P = 0.028$), and vegetables and fruit combined ($P = 0.006$; Table 3).

Frequency statistics indicated that gardeners reported consuming specific fruit and vegetables "5 or more times per month" more times when compared with nongardeners (Table 4) indicating that there may be a difference between gardener and nongardener consumption that is not revealed by overall means as a result of the lack of variability in answer choices available on this survey.

Analysis of gardeners. Data collected from the group of respondents who indicated "yes" to the question "do you garden?" were evaluated. Participants who responded yes to this question had a range of 1 to 45 years of experience in gardening with a mean of 26.02 years.

The strength of the association between the number of hours per week reported gardening during the growing season and fruit and vegetable consumption, using "5 or more times per month" for vegetables, fruit, and fruit and vegetables combined, was analyzed using Pearson's product-moment correlations. Participants who did not indicate how many hours per week they participated in gardening activities during the gardening season were removed from this analysis. Although statistically significant correlations were found for number of times responding "5 or more times" per month for fruit ($r = +0.322$, $P = 0.020$) and for number of times responding "5 or more times" per month for vegetables and fruit combined ($r = +0.297$, $P = 0.032$), these correlations were no longer significant after a Bonferroni correction for three correlations, which reduced the critical alpha level to 0.017, was applied (Shaffer, 1995). This indicated that the act of gardening alone is more important than how often a person gardens (Table 5) when considering consumption of vegetables and fruit.

The reasons gardeners provided for participating in gardening activities were also evaluated. Specifically, this study investigated whether gardeners needed to garden specifically for physical health reasons to consume a greater quantity of vegetables and/or fruit. Gardeners who selected either "physical health and exercise" or "produce quality and nutrition" were considered as gardening for physical health reasons. Gardeners who did not select either of these reasons but did select some alternative reason were considered as not gardening for physical health reasons. Finally, a third group was categorized by those gardeners who did not indicate any reason for gardening. A MANOVA revealed no statistically significant differences in vegetable and fruit consumption between these groups (Table 6). This indicated that gardeners do not need to garden specifically for health benefits to reap the benefits in terms of increased fruit and vegetable consumption.

New gardeners versus old gardeners. The strength of association between the number of years reported gardening and fruit and vegetable consumption was analyzed using Pearson's product-moment correlations. The numbers of years participating in gardening were correlated with the total number of vegetables, the total number of fruit, and the total number of fruit and vegetables combined. No statistically significant correlations were identified (Table 7) indicating that there was no relationship between the number of years reported gardening and the number of fruit and vegetables reported consumed by those respondents who indicated that they were gardeners.

To further investigate these data, responses of "5 or more times per month" were analyzed using Pearson's product-moment correlations with the number of years participating in gardening reported. The number of times each respondent provided this answer was tabulated for vegetables, fruit, and vegetables and fruit combined. This analysis also revealed no statistically significant relationships (Table 8).

Conclusions

Although this study specifically investigated adults 50 years or older, the results of this research support previous studies that indicated gardeners were more likely to consume vegetables when compared with nongardeners (Blair et al., 1991; Koch et al., 2006; Mummery et al., 2007; Sahyoun et al., 2005). These results were not consistent with previous results for fruit (Blair et al., 1991; Koch et al., 2006; Mummery et al., 2007; Sahyoun et al., 2005). With the exception of bananas, gardeners did not report eating a different quantity of fruit when compared with nongardener respondents.

One possible reason for this may be the result of the increased sugars

Table 6. Multivariate analysis of variance indicating differences in the vegetable and fruit consumption among those who selected no reason for gardening,[z] those who selected some reason, but not health-related,[y] and gardeners who selected physical health related reasons[x] for gardening in the study evaluating the relationship between gardening and fruit and vegetable consumption in older adults.

Dependent Variable	df	Means squared	F	*P*
"5 or more times" per month for vegetables[w]	1	0.173	0.027	0.870
"5 or more times" per month for fruit[v]	1	0.019	0.008	0.928
"5 or more times" per month for vegetables and fruit combined[u]	1	0.077	0.006	0.938
Total number of vegetables reported eaten per month[t]	1	1.558	0.011	0.916
Total number of fruit reported eaten per month[s]	1	0.942	0.016	0.899
Total number of vegetables and fruit combined eaten per month[r]	1	0.077	0.000	0.987

[z]Respondents indicated that they participated in gardening, but did not indicate any particular reason for gardening.
[y]Respondents selected some reason for gardening, but none related to physical health.
[x]Respondents selected at least one of two physical health-related reasons for gardening.
[w]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific vegetable. Scores ranged from 0 to 11.
[v]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific fruit. Scores ranged from 0 to 5.
[u]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific vegetable and fruit combined. Scores ranged from 0 to 16.
[t]Total number of vegetables responses ranged from 10 to 66.
[s]Total number of fruit responses ranged from 0 to 30.
[r]Total number of vegetables and fruit responses ranged from 12 to 96.

Table 7. Correlation matrix indicating the Pearson's product-moment correlation among gardeners among numbers of years spent gardening,[z] total number of vegetables reported consumed per month,[y] total number of fruit reported consumed per month,[x] and the total number of fruit and vegetables reported consumed per month[w] in the study evaluating the relationship between gardening and fruit and vegetable consumption in older adults.

Scale		Number of years participating in gardening[z]
Total number of vegetables consumed per month[y]	Pearson correlation	0.135
	P	0.370
	No.	46
Total number of fruit consumed per month[x]	Pearson correlation	0.174
	P	0.247
	No.	46
Total number of vegetables and fruit combined consumed per month[w]	Pearson correlation	0.087
	P	0.567
	No.	46

[z]Responses ranged from 1 to 45 years with a mean of 26.02 years.
[y]Total number of vegetables responses ranged from 10 to 66.
[x]Total number of fruit responses ranged from 0 to 30.
[w]Total number of vegetables and fruit responses ranged from 12 to 96.

Table 8. Correlation matrix indicating the Pearson's product-moment correlation among gardeners among numbers of years participating in gardening,[z] the number of times indicating 5 or more of a specific vegetable consumed per month,[y] the number of times indicating 5 or more of a specific fruit consumed per month,[x] and the total number times indicating 5 or more of specific vegetables and fruit consumed per month[w] in the study evaluating the relationship between gardening and fruit and vegetable consumption in older adults.

Scale		Number of years participating in gardening[z]
Number of times indicating 5 or more of a specific vegetable consumed per month[y]	Pearson correlation	0.101
	P	0.504
	No.	46
Number of times indicating 5 or more of a specific fruit consumed per month[x]	Pearson correlation	0.279
	P	0.061
	No.	46
Number of times indicating 5 or more of specific vegetables and fruit consumed per month[w]	Pearson correlation	0.191
	P	0.203
	No.	46

[z]Responses ranged from 1 to 45 years with a mean of 26.02 years.
[y]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific vegetable. Scores ranged from 0 to 11.
[x]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific fruit. Scores ranged from 0 to 5.
[w]Score derived from calculating the number of times a respondent indicated "5 or more times per month" for each specific vegetable and fruit combined. Scores ranged from 0 to 16.

and sweet taste of fruit. According to Drewnowski (1997), the appeal of sweet foods is "innate and universal." Drewnowski (1997) goes on to indicate that according to the Food Marketing Institute, taste is the single most important factor in determining food selection (Food Marketing Institute, 1997). This finding that fruit and vegetable intakes vary among different populations supports Trudeau's et al. (1998) hypothesis that fruit and vegetable intake and determinants for consumption should be studied individually and not grouped together because fruit and vegetables are very different in culinary use and taste.

There are a number of other factors that may be possible reasons for not seeing a difference in fruit consumption between gardeners and nongardeners. According to Vossen and Silva (no date), particular fruit tree types can be grown in most areas of the United States. However, they noted that different varieties have specific climates in which they grow best. They also noted that growing fruit trees requires more attention, planning, knowledge, and research when compared with vegetable gardening (Vossen and Silva, no date). The increased knowledge and work requirements of growing fruit as opposed to vegetables may serve as a barrier to home fruit production.

With regard to gender issues, previous research indicated gender differences in fruit and vegetable consumption in older adults (Baker and Wardle, 2003). The results of this study do not confirm these findings, and in fact, no statistically significant differences were found between males and females with regard to fruit or vegetable consumption with the exception of the melon category in which females reported more consumption per month when compared with males.

Results also found that there was no relationship between the number of years reported gardening and the numbers of fruit and vegetables consumed. This would indicate that gardening programs for nongardeners late in their lives may be an effective method for improving nutrition in this population. Also, the number of hours per week spent gardening did not appear to be a factor in vegetable and fruit consumption. Thus, even those with limited time or abilities who spend lesser amounts of time gardening may consume greater quantities of vegetables and fruit than their nongardener counterparts. Finally, the reason for gardening also has no relationship with the quantity of vegetables and fruit consumed. Thus, programs designed to draw this population into gardening may appeal to any reason to encourage this age group to participate in gardening and need not promote the health benefits derived from gardening exclusively. Although it may be desirable to appeal to the health benefits from gardening, older adults who garden seem to consume more fruit and vegetables when compared with nongardeners regardless of their purpose in participating in gardening activities.

One major limitation of this study was the range of possible responses available to indicate specific quantities of fruit or vegetable consumption. Expanding the possible responses to include more than five or more times per month or reducing the timeframe for which a respondent

is requested to indicate would greatly improve on the methods of this study and allow for greater variability in the data. Future research should focus on obtaining greater specificity in the quantity of fruit and vegetables consumed and continue to focus on fruit and vegetables separately to better identify different intervention needs and strategies.

Finally, because of the correlational nature of the study, no causal relationships between fruit and vegetable consumption and household gardening activities in older adults can be drawn. Older adults who prefer to eat vegetables may be more likely to seek gardening activities as hobbies rather than gardening having a positive influence on consumption. Experimental studies in this area incorporating gardening and other nutrition advocacy techniques would be beneficial to this line of research.

Literature cited

American Public Health Association. No date. Promoting good nutrition: Preventing chronic disease, overweight and obesity, and premature death. 3 Jan. 2010. <http://www.apha.org/NR/rdonlyres/630BF9C3-D550-41B7-8B3B-53FA6EFA6EF6/0/NutritionFactSheet.pdf>.

Arias, E. 2007. United States life tables, 2004. Natl. Vital Stat. Rep. 56:1–6.

Arterburn, D.E., P.K. Crane, and S.D. Sullivan. 2004. The coming epidemic of obesity in elderly Americans. J. Am. Geriatr. Soc. 52:1907–1912.

Ashton-Shaeffer, C. and A. Constant. 2005. Why do older adults garden? Act. Adaptation Aging 30:1–18.

Baker, A.H. and J. Wardle. 2003. Sex differences in fruit and vegetable intake in older adults. Appetite 40:269–275.

Bertera, E.M. 2003. Physical activity and social network contacts in community dwelling older adults. Act. Adaptation Aging 27:113–127.

Blair, D., C.C. Giesecke, and S. Sherman. 1991. A dietary, social, and economic evaluation of the Philadelphia urban gardening project. J. Nutr. Educ. 23:161–167.

Blanchard, C.M., K.D. Stein, F. Baker, M.F. Dent, M.M. Denniston, K.S. Courneya, and E. Nehl. 2004. Association between current lifestyle behaviors and health-related quality of life in breast, colorectal, and prostate cancer survivors. Psychol. Health 19:1–13.

Centers for Disease Control and Prevention. 2007a. Improving the health of older Americans: A CDC priority. Chronic Dis. Notes Rpt. 18:1–7.

Centers for Disease Control and Prevention. 2007b. About the national fruit & program. 3 Jan. 2010. <http://www.fruitandveggiesmatter.gov/health_professionals/about.html>.

Chappa, S., S. Chao, and S. Edelstein. 2004. Boomer ready initiative: Identification of wellness needs. J. Amer. Dietetic Assn. 104:878–882.

Devine, C.M., W.S. Wolfe, E.A. Frongillo, and C.A. Bisogni. 1999. Life-course events and experiences: Association with fruit and vegetable consumption in 3 ethnic groups. J. Amer. Dietetic Assn. 99:309–314.

Drewnowski, A. 1997. Taste preferences and food intake. Annu. Rev. Nutr. 17: 237–253.

Food Marketing Institute. 1997. Trends in the United States: Consumer attitudes and the supermarket. Food Marketing Institute, Chicago, IL.

Gall, M.D., W.R. Borg, and J.P. Gall. 2006. Educational research: An introduction, 8th Ed. Allyn and Bacon, White Plains, NY.

Jane Higdon Linus Pauling Institute. 2005. Fruit and vegetables. 3 Jan. 2010. <http://lpi.oregonstate.edu/infocenter/foods/fruitveg/>.

Koch, S., T.M. Waliczek, and J.M. Zajicek. 2006. The effect of a summer garden program on the nutritional knowledge, attitudes, and behaviors of children. HortTechnology 16:620–625.

Mummery, W.K., G. Kolt, G. Schofield, and G. McLean. 2007. Associations between physical activity and other lifestyle behaviors in older New Zealanders. J. Phys. Act. Health 4:411–422.

Ness, A.R. and J.W. Powles. 1997. Fruit and vegetables, and cardiovascular disease: A review. Int. J. Epidemiol. 26:1–13.

Nestle, M. 2007. Food politics: How the food industry influences nutrition and health. University of California Press, Berkeley, CA.

Prochaska, J.D., J.R. Sharkey, M.G. Ory, and J.N. Burdine. 2005. Assessing healthful eating among community dwelling rural older adults using self-reported fruit and vegetable consumption via a community-wide mail-out health status assessment. J. Nutr. Elder. 25:101–112.

Sahyoun, N.R., X.L. Zhang, and M.K. Serdula. 2005. Barriers to the consumption of fruit and vegetables among older adults. J. Nutr. Elder. 24:5–21.

Schlettwein-Gsell, D. 1992. Nutrition and the quality of life: A measure for the outcome of nutritional intervention? Am. J. Clin. Nutr. 55:1263S–1266S.

Shaffer, J.P. 1995. Multiple hypothesis testing. Annu. Rev. Psychol. 46:561–584.

Sommerfeld, A.J., T.M. Waliczek, and J.M. Zajicek. 2010. Growing minds: Evaluating the effect of gardening on quality of life and physical activity level of older adults. HortTechnology 20:705–710.

Trudeau, E., A.R. Kristal, S. Li, and R.E. Patterson. 1998. Demographic and psychosocial predictors of fruit and vegetable intakes differ: Implications for dietary interventions. J. Amer. Dietetic Assn. 98: 1412–1417.

U.S. Department of Health and Human Services. 2005. A profile of older Americans: 2005. U.S. Dept. Health and Human Services, Washington, DC.

Van Duyn, M.A.S. and E. Pivonka. 2000. Overview of the health benefits of fruit and vegetable consumption for the dietetics professional selected literature. J. Amer. Dietetic Assn. 100:1511–1521.

Vossen, P.M. and D. Silva. No date. Growing temperate tree fruit and nut crops in the home garden. Univ. California Coop. Ext. Davis.

Waliczek, T.M., R.H. Mattson, and J.M. Zajicek. 1996. Psychological benefits of community gardening. J. Environ. Hort. 14:204–209.

Yusuf, H.R., J.B. Croft, W.H. Giles, R.F. Anda, M.L. Casper, C.J. Caspersen, and D.A. Jones. 1996. Leisure-time physical activity among older adults. Arch. Intern. Med. 156:1321–1326.