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## Harvest for Health Gardening Intervention Feasibility Study in Cancer Survivors

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### Abstract

**Background**—Cancer survivors are at increased risk for second malignancies, cardiovascular disease, diabetes, and functional decline. Evidence suggests that a healthful diet and physical activity may reduce the risk of chronic disease and improve health in this population.

**Methods**—We conducted a feasibility study to evaluate a vegetable gardening intervention that paired 12 adult and child cancer survivors with Master Gardeners to explore effects on fruit and vegetable intake, physical activity, quality-of-life, and physical function. Throughout the year-long study period, the survivor-Master Gardener dyads worked together to plan/plant 3 gardens, harvest/rotate plantings, and troubleshoot/correct problems. Data on diet, physical activity, and quality-of-life were collected via surveys; anthropometrics and physical function were objectively measured. Acceptability of the intervention was assessed with a structured debriefing survey.

**Results**—The gardening intervention was feasible (robust enrollment; minimal attrition) and well-received by cancer survivors and Master Gardeners. Improvement in 3 of 4 objective measures of strength, agility, and endurance was observed in 90% of survivors, with the following change scores (median [interquartile range]) noted between baseline and 1-year follow-up: hand grip test (+4.8 [3.0, 6.7] kg), 8 foot Get-Up-and-Go (−1.0 [−1.8, −0.2] seconds), 30-second chair stand (+3.0 [−1.0, 5.0] stands), and 6-minute walk (+38 [20, 160] feet). Increases of 1 fruit and vegetable serving/day and 30 minutes/week of physical activity were observed in 40% and 60%, respectively.

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**Conclusion**—These preliminary results support the feasibility and acceptability of a mentored gardening intervention and suggest that it may offer a novel and promising strategy to improve fruit and vegetable consumption, physical activity, and physical function in cancer survivors. A larger randomized controlled trial is needed to confirm our results.

### Keywords

cancer survivors; gardening; intervention; health; diet

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### Background

Despite tremendous improvements in survival rates, adult and child cancer survivors are at increased risk for treatment-related comorbidity, including second malignancies, cardiovascular disease, diabetes, osteoporosis, endocrine problems, and impaired physical functioning [1-5]. Improving health behaviors may help prevent, delay or mitigate diagnosis and treatment related late effects and comorbidities in cancer survivors. Additionally, healthy lifestyle behaviors can ameliorate the rate of functional decline, which is inversely related to the ability to live independently [6, 7]. While numerous lifestyle interventions conducted in cancer survivors have demonstrated efficacy in improving diet, physical activity, or physical function, the long-term durability of these interventions remains unanswered, and the potential for widespread dissemination for many of these clinic-based programs is limited.

Vegetable gardening is an integrated approach to promote a healthful diet, physical activity, and psychosocial well-being. Emerging evidence suggests that school- or community-based garden programs promote healthy eating attitudes and behaviors in children and adolescents. Participation in these intervention programs has led to increased nutrition knowledge [8], preference for vegetables [8, 9], or consumption of fruits and vegetables [10], and among younger children, an increased willingness to taste fruits and vegetables [11]. Results from community-based gardening interventions in adults have shown that gardening is associated with a healthier diet, increased physical activity and functioning, and improvements in psychosocial well-being, as well as health-related quality of life [12-14]. Chen et al. reported that older (> 65 years) gardeners had fewer chronic conditions and functional limitations, and performed better on physical function tests of balance and gait speed, compared to non-gardeners [13]. Even indoor container gardening interventions have shown significant improvements in activities of daily living (transfer, eating, and toileting) [12] and social well-being including reassurance of self-worth, social integration, and life satisfaction among elderly nursing home residents [12, 14].

To date, few gardening interventions have been conducted in high risk patient populations, and none have been explored in cancer survivors. The objective of this pilot study was to develop and evaluate a one-year mentored vegetable gardening intervention that paired cancer survivors (and primary caregivers of child survivors) with certified Master Gardeners from the Alabama Cooperative Extension System. We assessed the feasibility of recruiting and retaining both cancer survivors and Master Gardeners, and evaluated the effects of the intervention on health-related outcomes. We hypothesized that a gardening intervention would improve fruit and vegetable intake, physical activity, quality of life, and physical functioning in child and adult cancer survivors.

## Methods

### Study Design

This investigation was a single-arm feasibility study whereby all participants received the one-year mentored gardening intervention. Post-intervention outcomes were compared to baseline, thus each participant served as their own control. The study was conducted from October 2010 through March 2012 and was approved by the University of Alabama at Birmingham (UAB) Institutional Review Board. Written informed consent was obtained from adult cancer survivors and the parents of the child cancer survivors. Assent was obtained from child cancer survivors.

### Study Participants

The targeted accrual for this pilot study was 12 cancer survivors (8 adults, 4 children), with an even distribution of males and females and at least 25% minority representation. The primary caregivers of child survivors were also enrolled. Potential participants were identified from the UAB cancer registry and the Children's Hospital of Alabama. After obtaining permission from the oncology care physician, patients were contacted via a letter of invitation (adult survivors) or by telephone (child survivors referred by their primary oncologist). Interested patients were screened for eligibility, and if eligible, scheduled for their baseline assessment.

Individuals were eligible if they resided in the greater Birmingham area and were diagnosed with breast, prostate, or any childhood cancer during September 2008 through August 2009. Adult subjects were recruited post-primary treatment; childhood cancer survivors could be receiving ongoing treatment, since extended courses of treatment for some pediatric malignancies is common. Exclusion criteria included (i) any pre-existing medical condition that precluded unsupervised physical activity, e.g., severe orthopedic conditions, impending hip or knee replacement, paralysis, unstable angina, dementia, or recent history of myocardial infarction, congestive heart failure, or pulmonary conditions that required oxygen or hospitalization within six months, (ii) any medication that precluded increased intake of fruits and vegetables, e.g., pharmacologic doses of warfarin, (iii) routine, annual practice of vegetable gardening, and (iv) unable to accommodate a small garden (four Earthboxes® or a 4'x8' raised bed, with at least 4 hours of sunlight).

### Gardening Intervention

This pilot study was a community-based partnership between UAB and the Alabama Cooperative Extension System. The Master Gardener Program, one of many educational outreach programs offered in each U.S. state by the National Institute of Food and Agriculture through the Cooperative Extension System, recruits and trains volunteers to help disseminate research-based information on landscaping and gardening to the general public. The certification criteria for a Master Gardener typically requires a minimum of 60 hours of combined instruction and community service, with many states requiring additional volunteer service annually to maintain active status. Trainees who recently completed their coursework in the Jefferson County Master Gardener Program were approached to mentor cancer survivors in a vegetable gardening intervention. Within two weeks, the twelve volunteers needed for the study were enrolled. The intervention paired cancer survivors (and caregivers of child survivors) with Master Gardeners based on geographic location. The survivor-Master Gardener dyads worked together to plan, plant, maintain, and harvest three seasonal gardens at the participants' homes.

Participants were provided with a 4'x8' raised bed or 4 Earthboxes® (comparable square footage) depending upon residential accommodations. Additionally, participants received

soil mix, fertilizer, plants and seeds, and gardening supplies (watering cans and hoses, weeding hoes, etc.). Participants also received print materials on garden design, gardening safety and health, and nutrition; however, most gardening knowledge was imparted by working with their assigned Master Gardener. After the initial garden was designed and planted, the Master Gardeners made bimonthly visits to the participants' homes to monitor progress of the garden, assist with replacing expired plants with new plants, and provide guidance with any problems. Between visits, communications occurred between dyads via telephone or e-mail to review care of the garden (e.g., care of soil, watering, pest management), review progress, answer questions, and suggest solutions to correct problems.

### Study Outcomes

Study outcomes were assessed at baseline, 6 months, and 1 year at the UAB Center for Clinical and Translational Science Clinic. Measured height and weight were used to calculate body mass index (BMI; kg/m<sup>2</sup>) for adults and age- and sex-specific BMI percentiles for children. Overweight/obese was defined as a BMI  $\geq$  25 kg/m<sup>2</sup> in adults and 85<sup>th</sup> percentile in children. The Charlson Comorbidity Index was used to assess chronic medical conditions and information on acute medical conditions and changes in medication was also collected through self-report. Fruit and vegetable intake was assessed using the NIH Eating at America's Table Fruit and Vegetable Screener. Mild, moderate, and vigorous physical activity was assessed using the Godin Leisure Time Physical Activity Questionnaire. The SF36 Health Related Quality of Life Index and the Pediatric Quality of Life Inventory were used to assess quality of life in adults and children, respectively. Objective measures of physical function included the following tests [15]: (i) 30-second chair stand, the number of stands from a seated position in 30 seconds (measure of lower body strength), (ii) 8 foot Get Up & Go Test, the number of seconds to stand, walk 8 feet, return and sit down (measure of agility and dynamic balance), (iii) 6-minute walk test, the number of feet walked in 6 minutes (measure of endurance), and (iv) grip strength, measured with a digital dynamometer (indicator of hand strength related to age-related functional decline in adults [16] and strongly correlated with total muscle strength in children [17]).

Fasting (4 hours) blood samples were obtained at baseline and 1-year follow-up to assess biomarkers of fruit and vegetable intake (carotenoids) and sun exposure (Vitamin D). Blood samples were protected from light and centrifuged within 30 minutes of collection. Serum samples were flash-frozen and stored at  $-80^{\circ}\text{C}$  until batch analysis at study completion. Biomarker analyses were conducted by the Moores Cancer Center Nutrition Analytical Laboratory at the University of California, San Diego. HPLC methodology was used to quantify serum carotenoids and Vitamin D.

At 1-year follow-up a semi structured debriefing telephone survey was conducted to elicit the perceived effect of the intervention on diet and vegetable consumption, and physical activity, as well as on the intention to engage in further gardening. In addition, both participants and master gardeners were asked about their overall perceptions of the intervention and any suggestions or recommendations for future studies via open-ended questioning.

### Statistical Analyses

The primary outcomes of this feasibility study were accrual and retention of the cancer survivors (including caregivers of child survivors) and paired Master Gardeners, throughout the one-year intervention and collection of preliminary data. Since this study was not powered for efficacy, only descriptive data were presented. Continuous data were summarized and presented as medians, interquartile ranges (IQRs), and minimum and

maximum values. Because fruit and vegetable intake and physical activity are seasonally influenced [18, 19], changes observed since baseline are only presented for the 1-year follow-up (and not the six month follow-up).

## Results

### Feasibility

Aiming to recruit our full study sample within one month, 112 cancer survivors (68 breast, 26 prostate, and 18 childhood) were approached for the pilot study. Within one week of mailing letters of invitation, our targeted accrual of eight adult survivors were enrolled and we had to turn interested individuals away. Within one month of placing telephone calls, eight of 18 childhood cancer survivors and their primary caregivers expressed interest and four dyads were deemed eligible and enrolled. Of the original 12 recruited participants, two participants withdrew shortly after baseline prior to instituting the intervention and were replaced. Of the 12 participants who were enrolled, ten subjects completed the one-year protocol including planting and harvesting three gardens and completing follow-up measurements. Unfortunately, two participants were forced to withdraw after their homes were destroyed by an EF-5 tornado in April of 2011; no other adverse events were reported. The retention rate for the Master Gardener mentors also was high (10/12=83.3%). One mentor withdrew due to a personality conflict with their survivor, and another mentor moved from the area. Given the high level of interest and enthusiasm among the Master Gardeners, volunteer mentor replacements were quickly and easily obtained.

### Health Outcomes

The mean age of adult and child cancer survivors was approximately 56 and 10 years, respectively (Table 1). At baseline, few participants met the recommended 5 or more fruit and vegetable servings per day or 5 days of physical activity (≥ 30 minutes/day). Over half of the cancer survivors and parents were overweight or obese. Few comorbidities were reported by cancer survivors (i.e., asthma [n=1] and diabetes [n=1]) or the parent caregivers (i.e., asthma [n=1] and stomach ulcers [n=1]).

At study completion, the greatest improvement was observed for physical function (Table 2, Figure 1). Compared to baseline, one-year follow-up median (IQR) scores improved for the 30-second chair stand, the Get Up & Go test, and the 6-minute walk test. Hand grip strength improved in both hands. Improvement in 3 of 4 functional tests was noted in 90% of the cancer survivors (6 of 6 adults, 3 of 4 children). Forty percent of survivors increased their fruit and vegetable intake by ≥ 1 serving(s)/day and 60% increased their physical activity by ≥ 30 minutes/week. Among the caregivers of the child cancer survivors, an increase of ≥ 30 minutes/week of physical activity and an improvement in 3 out of 4 functional tests was observed in 75% and 100% of caregivers, respectively. All 6 adult survivors and 3 out of 4 parent caregivers achieved two out of three of the health behavior/function goals (increase of ≥ 1 fruit and vegetable servings/day, an increase of ≥ 30 minutes/day of physical activity, and improvement in 3 out of 4 of the physical function measures).

No meaningful weight loss or improvements in QoL scores (overall or subscales) were observed in either adult or child cancer survivors, or the parent caregivers. All four of the child cancer survivors were classified as overweight (≥ 85th percentile) by the end of the one-year study. Trends toward an increase in total carotenoids and a decrease in total serum Vitamin D were observed over the one-year study period.

## Program Evaluation

Feedback from both cancer survivors and Master Gardeners obtained during and after completion of the intervention was extremely positive. A synopsis of findings from structured questions, as well as general themes expressed to open-ended survey items from intervention participants are featured in Table 3. Most cancer survivors reported that the gardening experience motivated them to eat a healthier diet overall and to eat more vegetables in particular. All of the participants plan to continue gardening and most even planned to expand their garden (see Table 3). Furthermore, one participant enrolled in the Master Gardener Program with an expressed interest to use her newly-acquired gardening knowledge and skills to help other cancer survivors.

Similarly, acceptability of the pilot intervention among Master Gardeners also was high. All of the Master Gardeners who completed the program indicated they would do it again. Furthermore, 71% indicated they were interested in participating in a larger, longer (2-year) study and they would be willing to help train other Master Gardeners. Satisfaction with mentoring cancer survivors during the year-long gardening intervention is further supported by selected comments received from the Master Gardeners.

- “It was both educational for me and challenging to share the experiences of another individual with a totally different background and life. It was refreshing to see how something as simple as regular communication and support could make a radical difference in attitude and approach to life.”
- “I just love this project. Thank you all for the opportunity to be involved in such an outstanding project!”
- “I believe I have gotten far more from this program than I ever gave. This experience has filled me with joy.”
- “In my fourteen years as a master gardener, this has been the most exciting and rewarding project I have participated in. ”

## Discussion

The results from this pilot study support the feasibility and acceptability of a mentored vegetable gardening intervention that paired cancer survivors with certified Master Gardeners. Both cancer survivors and Master Gardeners were quickly recruited, resulting in the need to turn away interested respondents. The intervention was well-received; all of the survivors plan to continue gardening and the majority of Master Gardeners are interested in volunteering for a larger trial. Results from our intervention also provide preliminary support for improvements in fruit and vegetable intake, physical activity levels, and physical functioning.

Although the results of our gardening intervention are encouraging, several limitations should be considered. The primary limitations were the small sample size and lack of a control group. As this was a feasibility study, a larger controlled trial will be needed to evaluate the efficacy of this intervention. The potential for improvement in some of our outcomes was limited by a minimal set of exclusion criteria, such that a few participants were already meeting the recommended guidelines for fruit and vegetable intake ( 5 servings/day) and physical activity ( 30 minutes for 5 days/week). Without a control group, other explanations for any observed improvements must be considered. It is possible that physical activity and functioning increased due to elapsed time since diagnosis and treatment or to uptake of other forms of exercise. Another limitation was the use of self-report to assess fruit and vegetable intake and physical activity. While the brief

questionnaires were less burdensome to study participants, more detailed assessment in conjunction with objective measures may provide more precise estimates of these behaviors.

While preliminary, our results of improvement in physical functioning in both child and adult cancer survivors are encouraging. Impaired physical functioning can lead to diminished quality of life, and in older adults, threatens the ability to live independently. Evidence suggests that some types of cancer treatment (e.g., leukemia, brain) and young age at diagnosis are significantly associated with functional limitations in childhood cancer survivors [20], whereas in older adult survivors, the strongest predictor is the presence of multiple comorbidities [21]. The risk for physical performance limitations in childhood cancer survivors begins soon after treatment and likely increases with age [20]. Studies of objective measures of physical performance limitations have shown that young and middle-aged adult survivors of childhood cancer have a significant reduction in muscle strength (e.g., hand grip, knee extension, ankle/wrist dorsiflexors) [22], functional mobility (e.g., Timed Up and Go, walking tests) [22], and motor performance (tests of hand function, ball skills, and balance skills) [23] compared with healthy controls or population normative values. Older survivors of adult-onset cancer have a 2-fold increased risk of having one or more functional limitations; however, the risk is 5-fold in the presence of comorbid conditions [1]. Gardening includes both low intensity (tasks that primarily work the upper body) and moderate intensity (tasks working both upper and lower body) physical activity [24], and as such, is a promising strategy for improving overall physical functioning.

Similar to many cancer survivors, a large proportion of our sample was overweight or obese [25]. Thus, we had hoped that the gardening intervention might improve weight status. While there was minimal change in BMI among adult survivors, the fact that we did not observe the typical 0.48 kg gain over the 1-year period that is usually noted among American adults [26] is favorable. In contrast, a trend toward increased weight status was observed among child cancer survivors. This weight gain cannot be attributed to the intervention, but rather is likely associated with the concomitant effects of reduced stature and weight gain that have been documented with the treatment of childhood acute lymphoblastic leukemia and brain cancer [27].

Among our outcomes of interest, the least amount of change was observed for the quality of life scores; however, baseline scores were relatively high, and several adult and child survivors reported medical issues during the course of the study. Cancer recurrence was reported in two participants and long-term ( 4 weeks) acute illness was reported by two other participants on two separate occasions. While the validity and reliability of the quality of life questionnaires used in our pilot study are relatively high, it is possible that some of the benefits of gardening were not easily captured by this instrument.

This intervention has great potential for sustainability given its holistic nature and the wide range of benefits of gardening. The variety of gardening activities and tasks may prevent satiation, which is common with other exercise programs and can jeopardize adherence long term [28]. Additionally, gardening may provide a sense of accomplishment and an increased satisfaction and zest for life that comes from nurturing and observing new life and growth. Furthermore, gardening provides natural motivation since plants require regular care (watering, pest control) and attention (harvesting). Gardening is an activity that can be enjoyed by people of all ages as the size, type (container, plot), and location (indoor, outdoor) can be modified to accommodate changes in physical functioning or place of residence, as exemplified by the studies that range from school-age children to nursing-home residents [12, 14]. Albeit, the perceived benefits of gardening interventions and the “active ingredient (s)” of such are likely to differ depending on the study sample characteristics.

After conducting this pilot study; however, we propose that the theoretical frameworks that are most likely to serve well for future research on vegetable gardening interventions are a combination of Social Cognitive Theory (SCT) [29], and the Social Ecologic Model (SEM) [30]. We posit these frameworks given the emphasis of SCT on developing self-efficacy and skills (modeling) to promote behavioral change. In this case, the Master Gardeners served as role models and mentors to promote gardening self-efficacy, provide incremental guidance to participants throughout the year, provide reinforcement and encouragement as needed, and strategize to overcome barriers. Moreover these behaviors, as well as physical functioning and quality of life, also could be influenced by the relationships between the survivor and their social (e.g., social support from Master Gardener mentor) and physical (e.g., outdoor environment including sunshine, fresh air, etc.) environments according to the Social Ecological Model.

Mentored gardening interventions have the potential for wide-spread dissemination as the Cooperative Extension Master Gardener Programs exist in all 50 U.S. states. With minor adaptations (e.g., cold framing) for colder climates with only two growing seasons, this intervention could be implemented in 84% of the U.S. states. Furthermore, these programs typically have wide-spread coverage throughout the state, thus allowing both urban and rural individuals the opportunity to participate. Similar Master Gardener Programs exist in the majority of Canadian provinces as well as several regions of the United Kingdom.

In summary, a mentored gardening intervention among cancer survivors represents a novel and holistic strategy to improve physical function, fruit and vegetable consumption, and physical activity in cancer survivors. Randomized controlled trials are needed to evaluate efficacy and durability of vegetable gardening interventions. Given an extant infrastructure for sustainability and dissemination plus great enthusiasm and proof of feasibility, such a program could have great public health significance not only for cancer survivors, but also for other vulnerable patient populations.

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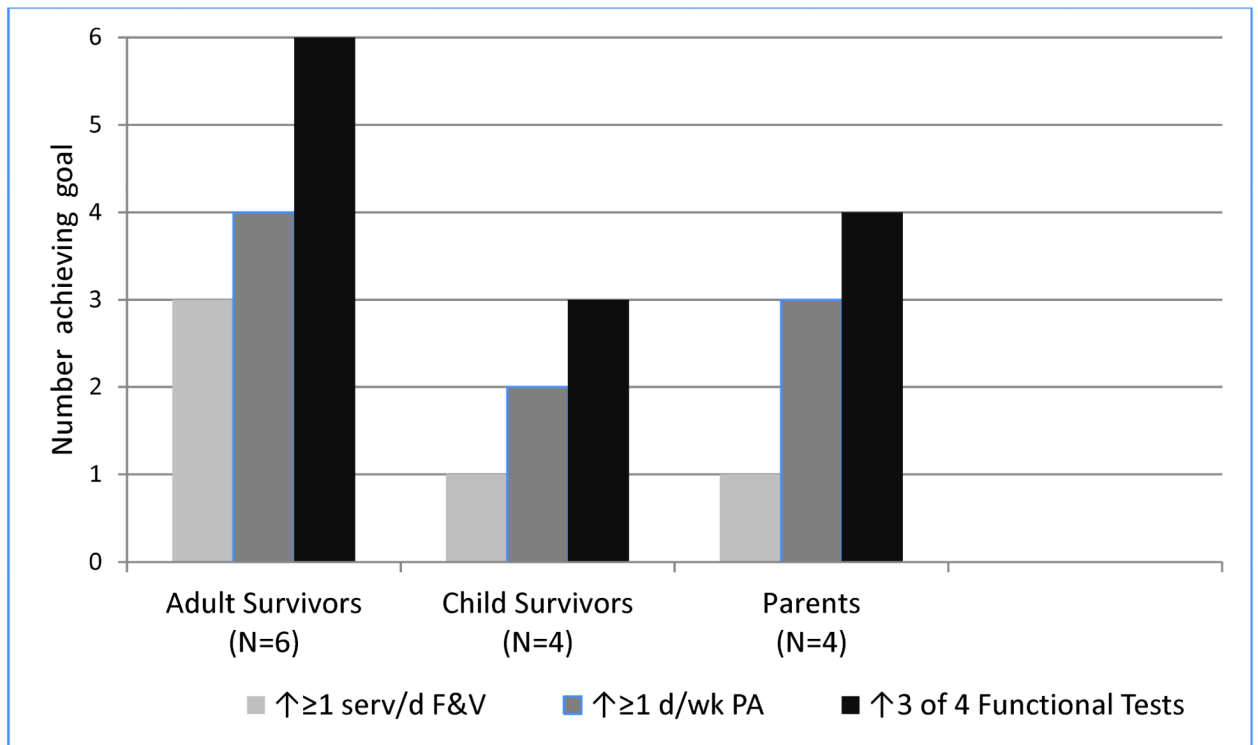
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**Figure 1.** Achievement of health goals after a one-year vegetable gardening intervention: increase in 1 fruit and vegetable servings per day, increase in 30 minutes per week of moderate or vigorous physical activity, and improvement in 3 out of 4 physical function measures.

**Table 1**

Demographic and lifestyle characteristics of the participants at baseline

	Adult Survivors (N=8)	Child Survivors (N=4)	Parents of Children (N=4)
Age (mean, sd)	56.3 ± 4.4	9.8 ± 1.0	37.5 ± 4.7
Female	4 (50%)	4 (100%)	3 (75%)
Non-Hispanic White	6 (75%)	2 (50%)	2 (50%)
College Education	4 (50%)	NA	3 (75%)
Cancer Type	Prostate (50%) Breast (50%)	Leukemia (75%) Brain (25%)	NA
Cancer Treatment			
Surgery (N, %)	8 (100%)	1 (25%)	
Radiation (N, %)	2 (25%)	1 (25%)	NA
Chemotherapy (N, %)	2 (25%)	4 (100%)	
Years since diagnosis (Med., IQR)	1.2 (1.0, 1.9)	1.7 (1.4, 3.8)	NA
Years since treatment completion <sup>δ</sup>	1.0 (0.8, 1.7)	0.0 (-0.9, 1.8)	NA
Ever smoker	2 (25%)	0 (0%)	2 (50%)
BMI (kg/m <sup>2</sup> or percentile) <sup>*</sup>			
Median, IQR	32.3 (27.1, 32.8)	83.3 (74.2, 87.3)	25.6 (24.4, 42.2)
Overweight/obese (N, %)	7 (88%)	2 (50%)	2 (50%)
Servings/day fruit & vegetables <sup>‡</sup>			
Median, IQR	3.5 (1.8, 4.2)	3.2 (1.7, 3.5)	1.9 (1.2, 2.9)
5 servings/day	1 (13%)	0 (0%)	0 (0%)
Days/week physical activity <sup>‡</sup>			
Median, IQR	3.0 (2.0, 4.5)	5.0 (4.5, 5.0)	2.5 (1.5, 4.0)
5 days/week	2 (25%)	3 (75%)	1 (25%)
1 comorbid conditions	1 (13%)	1 (25%)	2 (50%)

NA=Not applicable; IQR = interquartile range

<sup>δ</sup>Two childhood cancer survivors were still receiving treatment (chemotherapy) during most of the intervention<sup>\*</sup>Overweight/obese: BMI < 25 kg/m<sup>2</sup> for adults; 85th age- and sex-specific BMI percentile for children<sup>‡</sup>Fruit and vegetable servings/day calculated from the NIH Fruit & vegetable screener from the Eating at America's Table Study<sup>‡</sup>Number of days participant was physically active for at least 30 minutes per day

Table 2

Change in fruit and vegetable intake, physical activity and function, and Quality of Life following a one-year gardening intervention in cancer survivors (N=10)

Outcome Measure	Baseline Median (IQR) (min, max)	6 Months Median (IQR) (min, max)	1 Year Median (IQR) (min, max)	Baseline to 1 Year Median Change (IQR) (min, max)
<b>Physical Function</b>				
<b>Tests</b>				
Chair Stand (stands/30 sec.)	15.0 (13.0, 18.0) (12.0, 18.0)	17.0 (14.0, 18.0) (13.0, 22.0)	17.5 (15.0, 20.0) (12.0, 24.0)	3.0 (-1.0, 5.0) (-3.0, 9.0)
Get Up & Go Test (sec.) <sup>†</sup>	6.2 (4.8, 6.9) (4.1, 7.4)	4.7 (4.0, 5.3) (3.3, 6.0)	5.0 (4.4, 5.4) (3.8, 6.0)	-1.02(-1.75, -0.20) (-2.73, 0.33)
6-minute walk (feet)	1880 (1750, 1980) (1400, 2345)	2090 (1720, 2410) (1595, 2890)	1900 (1780, 2000) (1615, 2500)	37.5 (20.0, 160.0) (-260, 270)
Grip Test (kg)				
Left hand	22.9 (12.1, 45.3) (11.2, 51.8)	24.6 (16.6, 47.0) (12.4, 54.5)	24.0 (15.4, 47.7) (13.3, 56.1)	2.00 (0.05, 3.60) (-1.35, 9.55)
Right hand	24.8 (13.7, 44.7) (11.9, 55.4)	26.4 (18.0, 50.3) (11.1, 57.3)	27.3 (20.7, 48.4) (12.7, 61.2)	4.83 (3.00, 6.65) (-1.25, 10.85)
<b>Physical Activity</b> <sup>‡</sup>				
times/week ( 15 min/time.)	2.0 (2.0, 4.0) (1.0, 12.0)	3.5 (2.0, 7.0) (0.0, 15.0)	4.0 (0.0, 9.0) (0.0, 26.0)	0.5 (-2.0, 4.0) (-2.0, 22.0)
Days/week ( 30 min/day)	4.0 (2.0, 5.0) (1.0, 7.0)	5.0 (2.0, 7.0) (0.0, 7.0)	4.5 (3.0, 6.0) (0.0, 7.0)	0.0 (0.0, 2.0) (-3.0, 3.0)
<b>Fruit &amp; Vegetables</b> (servings/day)	3.4 (2.4, 3.7) (0.5, 9.2)	3.4 (2.9, 4.2) (0.4, 7.5)	3.5 (2.7, 7.2) (1.0, 8.3)	0.73 (-0.22, 3.39) (-2.3, 4.1)
<b>Biomarkers</b> <sup>§</sup>				
Total Vitamin D (ng/mL)	33.30 (25.40, 45.50) (20.30, 48.80)	NA	32.20 (24.60, 39.40) (18.60, 55.50)	-2.50 (-6.10, -0.80) (-11.00, 8.00)
Total Carotenoids (μmol/L)	1.243 (0.967, 1.467) (0.473, 2.397)	NA	1.479 (1.268, 1.777) (0.790, 2.264)	0.317 (0.033, 0.573) (-1.116, 0.890)
<b>Quality of Life</b> <sup>¶</sup>				
Adult Survivors	87.6 (83.3, 93.9) (54.3, 95.1)	89.2 (83.3, 90.7) (26.6, 98.2)	88.4 (63.0, 95.9) (51.4, 96.2)	0.73 (-2.86, 2.00) (-24.0, 4.9)
Child Survivors	79.9 (68.8, 89.3) (67.0, 89.3)	71.0 (61.2, 78.1) (54.5, 82.1)	72.8 (64.7, 81.3) (57.1, 89.3)	1.3 (-16.1, 4.0) (-32.1, 5.4)
Body Mass Index				
Adult Survivors (kg/m <sup>2</sup> )	32.3 (27.2, 32.7) (25.0, 34.3)	31.5 (27.4, 33.3) (24.2, 33.3)	31.5 (27.5, 32.8) (24.8, 34.2)	-0.06 (-0.13, 0.30) (-2.0, 0.5)
Child Survivors (percentile) <sup>**</sup>	82.8 (76.4, 86.0) (70.8, 88.5)	89.1 (86.2, 90.9) (84.9, 91.2)	91.0 (87.5, 92.9) (84.4, 94.2)	5.83 ( 1.98, 16.0) (0.86, 23.4)

<sup>†</sup>Decrease in scores on the Get Up & Go Test represents a faster speed and therefore an improvement

<sup>‡</sup>Times/week: average number of times per week of moderate or vigorous physical activity, 15 minutes/time; Days/week: average number of days per week ( 30 minutes/day) of physical activity that increases heart and breathing rate

<sup>§</sup>Follow-up blood sample missing for 1 individual

<sup>¶</sup>RAND 36-Item Health Survey (version 1.0) for adults and Peds QL Pediatric Quality of Life Inventory (Child Report ages 8-12)

<sup>\*\*</sup>age- and sex-specific BMI percentiles

**Table 3**

## Debriefing summary of the vegetable gardening intervention

Debriefing Question	Response	Comments
<b>Effect of the intervention on motivating behavior change to (10 point scale from 1 (not at all) to 10 (very much))</b>		
eat a healthier diet?	Mean (SD): 8.9 (1.4)	
eat more vegetables?	Mean (SD): 8.1 (2.2)	
be more physically active?	Mean (SD): 6.8 (2.3)	5 participants responded that they were already very active at baseline; Others were motivated to do more yard work, walking, or bicycling.
<b>Intention of future gardening (anchors: No, not at all; Probably no; Maybe; Probably yes; Yes, most definitely)</b>		
Do you plan to continue the garden?	92% yes, most definitely 8% probably yes	
Do you plan to expand your garden?	89% yes, most definitely 11% maybe	
<b>Suggestions and recommendations for future gardening studies *</b>		
Would you have liked more information on gardening?	63% Yes 37% No	Provide more information on the square foot/raised bed gardening method, helpful websites (e.g., organic gardening), written instructions for using fertilizer and protecting the garden from heat/pests/animals, and additional possible plants each season.
Would you have liked more information on healthy eating?	37% Yes 63% No	Distribute recipes, particularly for different ways to prepare vegetables, ideas for cooking quick and healthy meals.
Additional suggestions		Create a website/Facebook to share gardening photos and discuss gardening problems/solutions.
<b>Select comments provided during the intervention or at study completion</b>		
"The study also helped my husband and my family to eat better."		
"Gardening helped loosen up my joints and to feel better, so I decided to do more work in my yard."		
"Please know the garden has been a real solace to me. It has helped me to get my mind to a better place several times in the last several months." (in reference to dealing with his/her cancer recurrence and metastasis)		
"I may not always feel up to it, but if I know there's a tomato or something else to be picked, you better believe that I am not going to sit here and let them rot." (from a cancer survivor with multiple comorbidities)		
"This was a wonderful thing to do. I'm glad I did it."		
"The program not only taught me how to grow my own fruits and vegetables and the importance of eating more fruits and vegetables, but also to focus on the circle of life. This provided me with a more optimistic outlook on life in general, which was greatly needed at that point in my recovery."		

\* The suggestions and recommendations for future gardening studies include responses from the parents of the child cancer survivors since the children deferred to their parent.