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A Home-Based Mentored Vegetable Gardening Intervention Demonstrates Feasibility and Improvements in Physical Activity and Performance Among Breast Cancer Survivors

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Abstract

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Background—This study assessed the feasibility of a mentored home-based vegetable gardening intervention and examined changes in health-related outcomes among breast cancer survivors (BCS).

Methods—BCSs were randomized to either a year-long vegetable gardening intervention to begin immediately or a wait-list control. Master Gardeners (MG) mentored participants in planning, planting and maintaining three seasonal gardens over a year. Participant accrual, retention, and satisfaction rates of 80% served as feasibility (primary outcome) benchmarks. Secondary outcomes (i.e., vegetable consumption, physical activity, performance and function, anthropometrics, biomarkers, and health-related quality of life) were collected at baseline and post-intervention (one-year follow-up) using subjective and objective measures.

Results—The trial surpassed all feasibility benchmarks: 82% of targeted accrual; 95% retention; and 100% satisfaction (i.e., experience ratings of “Good-to-Excellent” and willingness to “do it again”). Compared to the controls, intervention participants reported significantly greater improvements in moderate physical activity (+14 vs. -17 minutes/week) and demonstrated improvements in the 2-Minute Step Test (+22 vs. +10 steps), and Arm Curl (+2.7 vs +0.1 repetitions) (p-values<0.05). A trend toward improved vegetable consumption was observed (+0.9 vs. +0.2 servings/day; p=0.06). Eighty-six percent continued to garden at two-year follow-up.

Conclusions—Findings suggest that a mentored, home-based vegetable gardening intervention proved feasible and offers an integrative and durable approach to improve health behaviors and outcomes among BCSs. Harvest for Health led to establishing a group of trained MGs and gave rise to local and global community-based programs. Larger studies are needed to confirm results and define applicability across broader populations of survivors.

Keywords

Survivorship; Vegetable Gardening; Nutrition; Physical Function; Breast Cancer

Introduction

More than 3.5 million women in the United States have a history of breast cancer, and are at an increased risk for secondary malignancies, cardiovascular disease, and diabetes, as well as impaired physical functioning and reduced health-related quality of life (HRQOL).¹ Evidence indicates that adopting healthier lifestyle behaviors may improve overall health, physical functioning, and HRQOL among breast cancer survivors (BCSs).²⁻⁴ The American Cancer Society recommends that cancer survivors eat at least five daily servings of vegetables and fruits and engage in 150 minutes of moderate or 75 min of vigorous physical activity/week.⁵ However, research indicates that most BCSs do not meet these recommendations.^{6,7}

Vegetable gardening may provide a holistic approach to improving diet quality, physical activity, body weight status, and psychosocial well-being.⁸⁻¹¹ Vegetable gardening improves access to fresh produce and has been demonstrated to increase vegetable consumption across several populations.^{8,9} Healthy senior adults have been shown to meet physical activity recommendations through gardening.¹⁰ The Growing a Healthier Older Population project found that 68% of gardeners met physical activity recommendations, compared to only 25%

of same-aged non-gardeners.¹² Community gardeners are less likely to be overweight or obese as compared to age- and gender-matched non-gardeners living in the same neighborhood.¹¹ Moreover, the therapeutic nature of gardening is associated with improved physical and psychosocial well-being.^{13,14} Previously, in other populations of cancer survivors, we have found that vegetable gardening interventions have resulted in improvements in diet quality, physical activity and function, and HRQOL.^{9,15}

The current Harvest for Health initiative, the Birmingham Breast Cancer Survivors (BBCS) feasibility trial, delivered and evaluated a one-year home-based vegetable gardening intervention among BCSs residing in the Birmingham, Alabama metropolitan area. Here we report feasibility and changes in measures of health-related outcomes among BCSs.

Methods

This two-arm, feasibility trial randomly assigned BCSs to a one-year mentored vegetable gardening intervention or to a wait-list control. Most study staff were blinded to randomization status, and all study staff who collected follow-up data were blinded with regard to previously collected data. A detailed description of the study protocol was published previously.¹⁶

Ethical Considerations

The study protocol received approval from the University of Alabama at Birmingham (UAB) Institutional Review Board. Written informed consent was obtained from all participants before baseline data collection.

Setting and Population

BCSs residing in the Birmingham metropolitan area were recruited via mailed invitation between August 2013 and May 2014. Potential participants were identified via the Alabama State Cancer Registry and individual hospital registries. Self-referrals were sought using support groups and various media (e.g., television, radio). Interested participants were screened to ensure they met study eligibility criteria.

Inclusion/exclusion criteria were delineated to reduce ceiling effects on behavioral or health outcome data, intervention failure, or adverse events (e.g., potential infections arising from contact with fertilizer/soil during immunocompromised states). Inclusion criteria were: (1) completion of cancer treatment (i.e., surgery, chemotherapy, and/or radiation therapy); (2) currently eating <5 servings of vegetables and fruits/day; (3) exercising <150 minutes/week; (4) 1 physical function limitation; (5) English-speaking and -writing; (6) residing 15 miles of a Master Gardener (MG); (7) residence with 6 hours of sun/day, running water, and accommodation for one raised bed (4' x 8') or four Grow Boxes (24" x 50"); and (8) willingness to be randomized to either study group. Exclusion criteria were: (1) comorbid conditions that would impair ability to complete study assessments or participate in unsupervised physical activity; (2) currently taking pharmacologic doses of warfarin; or (3) tended a successful vegetable garden within the past two years.

Intervention

BCSs were individually paired with Cooperative Extension-certified MGs. The Cooperative Extension is affiliated with land-grant universities nationwide and certifies MGs across North America (<http://articles.extension.org/mastergardener>). To maintain certification, MGs must volunteer 50 hours/year. A survey conducted among over 2,200 MGs in Alabama suggested that 71% were extremely interested in volunteering for this project. These MGs interfaced bi-monthly (home visits alternating with telephone or email contact) with BCSs to mentor in the planning, planting, and maintaining of three (Spring, Summer, Fall) home-based vegetable gardens over the course of a year. BCSs were provided with: (1) one raised bed or four Grow Boxes; (2) gardening supplies (i.e., soil, seeds, plants, fertilizer, natural pest repellent, gardening hose and tools, watering can, frost cover, and trellis); (3) gardening workbook detailing the planning, planting, tending, and harvesting of the three gardens; (4) a MG contact schedule; (5) contact information for their MG, county Cooperative Extension agent, and the study staff; and (6) a gardening journal to record their observations and notes.¹⁶ Additionally, BCSs were encouraged to participate in a private Facebook® group to facilitate interaction with other BCSs and MGs.

Intervention Adherence and Fidelity

Process data were used to evaluate adherence to and fidelity with the intervention. MG monthly home-visits, garden photographs, and bi-monthly emails/phone calls were tracked by study staff.

Data Collection

Feasibility—Feasibility (primary outcome) criteria consisted of participant accrual, retention, and satisfaction rates of 80% and intervention safety (no adverse events attributable to the intervention). Targeted accrual was set at 100 and based on building MG capacity in the greater Birmingham metropolitan area (i.e., establishing a critical mass of trained MGs who could sustain the intervention long-term). Data on participant satisfaction, gardening fidelity, future gardening plans, and study suggestions were collected after study completion via a 22-item structured telephone debriefing. To explore gardening sustainability among intervention participants, an extended follow-up was conducted at two-years via a three-item telephone survey.

Health-related outcomes—Health-related outcomes (secondary outcomes of vegetable consumption, physical activity, performance and function, HRQOL, anthropometrics, and biomarkers) were collected in participant's homes at baseline and post-intervention (one-year later). Study questionnaires and accelerometers were mailed to participants two weeks prior to their scheduled appointment. To minimize attrition, participants were compensated \$15 for each completed home visit.

Vegetable Consumption: Vegetable consumption data were collected using the NCI Diet History Questionnaire,¹⁷ a food frequency questionnaire consisting of 144 food items. Fifteen items assessing vegetable intake over the previous 12 months were analyzed.

Physical Activity: Self-reported physical activity data were collected using the Godin Leisure-Time Exercise Questionnaire,¹⁸ a five-item questionnaire that measures usual leisure-time physical activity frequency over a seven-day period. Objective physical activity data were collected via accelerometers (ActiGraph®, Fort Walton, FL),¹⁹ which were preprogrammed and included instructions for a seven-day data collection.

HRQOL: The Medical Outcomes Survey Short-Form 36 Health Survey (SF-36),²⁰ a 36-item questionnaire, was used to measure HRQOL across both physical and mental domains.

Physical Performance: The physical performance battery included: 1) 30-Second Chair Stand (lower body strength); 2) Arm Curl (upper body strength); 3) Sit-and-Reach (lower body flexibility); 4) Back Scratch (upper body flexibility); 5) 8-Foot Get-Up & Go (agility/dynamic balance); 6) 2-Minute Step Test (endurance); 7) and Hand Grip Strength (via dynamometer [Omron®, Kyoto, Japan]).^{21,22}

Anthropometrics: Anthropometric measures included height, body weight, and waist circumference using a calibrated scale and non-stretch tape measure. Standard measures were taken to the nearest tenth of a kilogram (weight) or centimeter (height and waist circumference) in light clothing and without shoes.²³

Biomarkers: Using the methods of Warnock et al.,²⁴ cortisol was assessed in toenail clippings and served as a measure of chronic stress levels.²⁵ Telomerase (biomarker associated with healthful aging) was assessed in peripheral blood mononuclear cells via the methods of Saldanha et al.²⁶ Interleukin (IL)-6 (biomarker of inflammation) was assessed in plasma via electrochemiluminescence.

Statistical Analyses

Feasibility-based outcomes (i.e., accrual, retention, satisfaction, and absence of serious adverse events) were the primary focus of this investigation. Other comparisons were secondary and conducted using SAS® version 9.4 (Cary, NC). Within-group comparisons over time were assessed using paired t-tests (interval data) and McNemars tests (dichotomous data). Baseline to post-intervention change scores between groups were compared using paired t-tests and chi-square tests, controlling for the number of comorbidities. While feasibility was the focus of this investigation, *a priori* power calculations indicated 80% power to detect a between-group difference of at least five points on the SF-36 physical function subscale with the assumptions of 20% attrition, alpha <0.05, and a proportional between-group difference of 15% vs. 55% using the Fisher's exact test for proportions.

Results

Feasibility

Accrual, Retention, and Safety: Figure 1 (CONSORT diagram), details case ascertainment, eligibility, and retention. The study enrolled 82 BCS (60% cancer registry; 40% self-referral), thus achieving 82% of the accrual target. Of the 82, four did not complete

the study (two refused to be wait-listed due to wanting to garden immediately, one withdrew due to family illness, and one was lost to follow-up), resulting in a 95% retention rate over the one-year study period. During the course of the study, there were no adverse events attributable to the intervention.

Participant Characteristics: Participants consisted of Caucasian and African-American BCSs with a mean age of 60 years (Table 1). Overall, participants were well-educated (most having attended or graduated from college), employed, married, and living with other family members. Most resided in urban counties, as compared to rural counties. Mean time since diagnosis was five years, with most diagnosed with localized breast cancer. Most participants were overweight or obese, and living with multiple co-morbidities and functional limitations. Nearly 10% were current smokers. Mean daily consumption of vegetables and weekly minutes of physical activity were well below recommendations for cancer survivors.⁵

Participant Satisfaction: All participants completing the intervention (n=42) rated their experience as “Good-to-Excellent,” reported that they would “do it again,” and planned to “continue to garden.” Over 88% of participants reported gardening either daily or several times weekly. When asked about the influence of gardening on motivating behavior change, participants reported that gardening strongly motivated them to “eat a healthier diet,” “eat more and try new vegetables,” and “become more physically active,” though gardening was not attributed to increasing fruit consumption.

MG communication occurred less frequently than bi-monthly among 61% of the participants, with 43% of the participants preferring more communication. Overall, MGs were rated strongly (scores exceeding 4-out-of-5) with regard to the design and planting of gardens and answering questions. Participants giving lower MG ratings would have preferred a MG who was “more supportive,” “communicated better,” and was “more hands-on.” When asked about the need for additional information on gardening or healthy eating, most replied “no;” however, some requested more information on pest control, fertilizers, planting schedules, and healthy recipes. All gardening tools, except the watering can, were considered useful. While some valued the intervention below the actual cost, the clear majority valued the intervention at or above \$500, with 20% indicating that the intervention was “invaluable.” Many participants voiced positive feelings about Harvest for Health’s impact on their lives. One participant stated, “I learned something new, changed my life, and nourished my body!”

Gardening Sustainability: At two-years, 86% of the intervention participants who completed the study reported that they were still gardening, with 36% of these gardeners reporting a garden expansion. Garden expansions included additional raised beds, containers, planting tables, converting of existing flower gardens, and tilling in-ground gardens.

Health-Related Outcomes

Changes in vegetable consumption, physical activity, performance and function, anthropometrics, biomarkers, and HRQOL are reported in Table 2. Since this was a feasibility study, directionality of the data was the focus of the secondary outcomes and was assessed via change scores; however, within- and between-group differences were explored. Vegetable consumption increased significantly in the intervention group but not among controls, with the resulting between-group difference approaching significance ($p=0.06$). A statistically significant between-group difference was observed for self-reported moderate physical activity, with change scores of +14 minutes/week in the intervention and -17 minutes/week among controls. However, accelerometers detected no statistically significant within- or between-group differences over time. Positive change scores in HRQOL were seen in 9-of-10 summary and subscale scores among both groups. Statistically significant improvements in emotional role among the control group were observed, with no other within- or between-group differences. Non-significant trends were observed for body weight and BMI, with decreases in intervention participants and increases in controls. In contrast, significant increases in waist circumference were observed in both groups over the year-long study. Overall, positive change scores were observed among both groups in 7-of-7 physical performance measures; however, the intervention group demonstrated significant improvements in 6-of-7 tests, compared to only 2-of-7 among controls. In the 2-Minute Step Test and the Arm Curl, improvements were significantly greater in the intervention group compared to controls. No significant between-arm differences and few within-arm differences were observed in biomarkers. Telomerase decreased in both groups, though only statistically significant among controls.

Discussion

Feasibility (Primary Outcome): The BBSCS feasibility trial proved to be safe and surpassed all feasibility benchmarks. Moreover, the vast majority of intervention participants were still gardening at two-year follow-up, demonstrating the potential for this intervention to have long-lasting benefits. However, recruitment was a challenge. Initial contact with cancer survivors using the cancer registry data was difficult, since current address information was often missing. Additionally, survivors residing in rural, farming communities were already gardening and thus ineligible. Also, many cancer survivors screened-out because they were high functioning and adhered to healthy lifestyles. These issues were inherent with the research design and the need to avoid ceiling effects, which are not a concern for community-based programs, as discussed later.

Health-Related (Secondary) Outcomes: Compelling data were seen for vegetable consumption and physical performance. Of clinical relevance were the daily serving increase in vegetable consumption and improvements in seven objective measures of physical performance in the intervention group. This improvement in physical function may translate into the reduction of premature mortality among cancer survivors. Brown and colleagues found that each one-unit increase in the short physical performance battery score predicted a 12% reduction in premature mortality.²⁷ Moreover, a 2014 meta-analysis on a pooled cohort

of 833,234 adults found increasing vegetable consumption by one serving/day decreased all-cause mortality by 5%.²⁸

While underpowered, positive trends were seen in body weight status, physical activity, and HRQOL. Among BCSs, weight gain is associated with higher all-cause mortality rates.²⁹ A recent meta-analysis revealed that, among pre- and post-menopausal BCS each 5 kg/m² increment of BMI increased risks for breast cancer mortality (29%) and all-cause mortality (8%).³⁰ Current cancer survivorship guidelines recommend that survivors achieve and maintain a healthy body weight (18.5 kg/m² BMI 24.9 kg/m²) and engage in 150 minutes of moderate physical activity/week.⁵ Our findings suggest that vegetable gardening may aid BCSs in this endeavor. Given that the majority of participants were either overweight or obese, improvements in body weight status and physical activity (even if small) may be beneficial.^{4, 29-31}

Strengths and Limitations: As with all studies, this feasibility trial had both strengths and limitations. Strengths included representation of African-American BCSs (26.8%), high retention (95%), and use of objective and subjective measures. Limitations included a modest sample size (n=82), no attention control group, and participant representation from only one geographical area (i.e., the Birmingham, Alabama metropolitan area). The design of the intervention was both a strength and a weakness. A notable strength was the reliance on the Cooperative Extension MG program, an extant and sustainable resource available across North America; thus, enhancing potential for dissemination. However, while the home-based garden eliminated survivors' barriers to travel and was well received, it required more time from MGs than community-based classes or gardens (described in projects that follow). Also, to assure intervention standardization, gardening supplies were provided to all participants. Again, this approach has merit within the context of a controlled clinical trial, but is an obvious barrier to dissemination since external support is required for sustainability. Cost effectiveness studies could be undertaken to assess whether the \$500 in gardening supplies is offset by charges in hospital or nursing home admissions, doctor appointments, medical procedures, and/or medications assessed through insurance/Medicare claims. This approach is currently being implemented in a larger, R01-funded clinical trial of Harvest for Health among 426 older cancer survivors across Alabama (NCT02985411).

Further Dissemination: In addition to the larger clinical trial, Harvest for Health has been expanded to other local and global communities. In Alabama, Harvest for Health has validated and supported the creation of Forge Breast Cancer Survivor Center's community-outreach Gardening Lifestyle Program (www.forgeon.org). In partnership with the Birmingham Botanical Gardens (www.bbgardens.org), the Alabama Cooperative Extension System (www.aces.edu), and the Jefferson County MGs (www.jeffcomg.org), Forge's monthly gardening lifestyle classes (serving approximately 300 participants annually) link gardening with survivorship concerns and health. Globally, Harvest for Health has informed the development of Healing Gardens (www.healinggardenswur.nl), a six-month supervised community-based vegetable gardening intervention among cancer survivors in the Netherlands led by Wageningen University.

Conclusions

The vegetable gardening intervention proved to be feasible and provided new knowledge about the influence of gardening on motivating behavior change among BCSs. Findings suggest that mentored home-based vegetable gardening may offer an integrative approach to improve vegetable consumption, physical activity and function, body weight status, and HRQOL among BCSs. In addition, Harvest for Health has led to the establishment of a group of trained MGs and given rise to local and global community-based programs. Nevertheless, larger and broader studies are warranted to document the potential benefits of gardening across various groups of cancer survivors.

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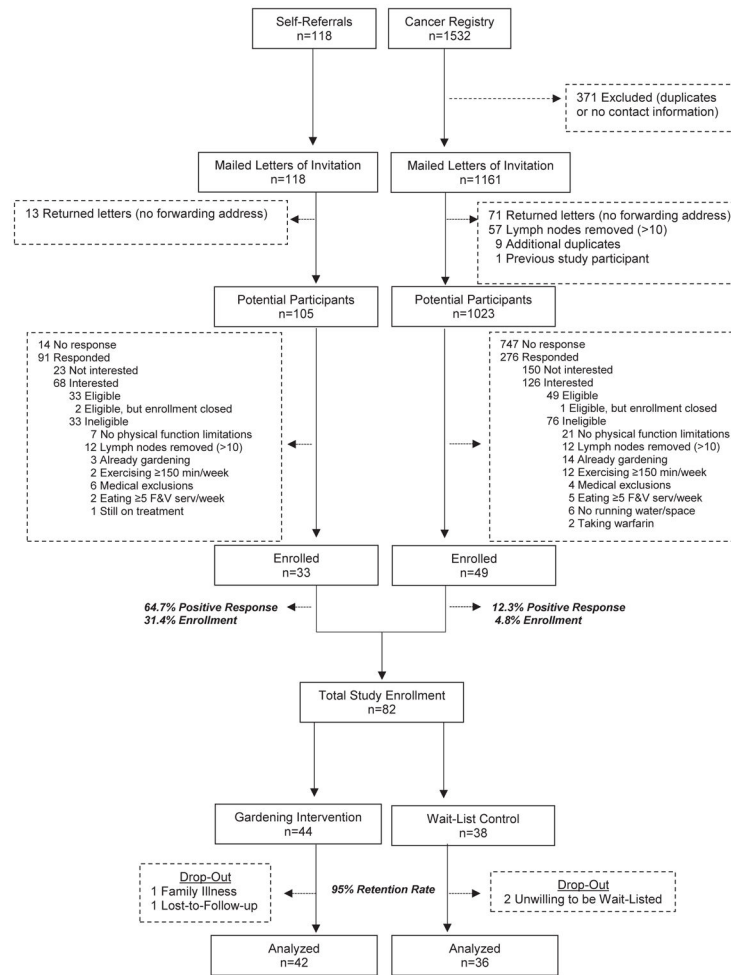


Figure 1.
CONSORT diagram

Table 1

Characteristics of breast cancer survivors participating in a vegetable gardening trial

Variable	Total (N=82)		Intervention (n=44)		Control (n=38)		Between Group Difference <i>p</i> -value
	Mean(SD) Range	n(%)	Mean(SD) Range	n(%)	Mean(SD) Range	n(%)	
Age (years)	60.5(9.4) 32–84		60(8.4) 39–79		61(10.5) 32–84		0.66
Race							0.11
Caucasian		60(73.2%)		29(65.9%)		31(81.6%)	
African-American		22(26.8%)		15(34.1%)		7(18.4%)	
Education							0.18
<High School		5(6.1%)		4(9.1%)		1(2.6%)	
High School Grad		7(8.5%)		6(13.6%)		1(2.6%)	
Some College		25(30.5%)		12(27.3%)		13(34.2%)	
College Grad		19(23.2%)		11(25.0%)		8(21.1%)	
Post-Grad		24(29.3%)		11(25.0%)		13(34.2%)	
Marital Status							0.24
Married		48(58.5%)		23(52.3%)		25(65.8%)	
Widowed		6(7.3%)		4(9.1%)		2(5.3%)	
Divorced/Separated		21(25.6%)		14(31.9%)		7(18.4%)	
Single		5(6.1%)		3(6.8%)		2(5.3%)	
Rural County of Residence							0.59
Currently Employed		15(18.3%)		9(20.5%)		6(15.8%)	
Persons in Household		38(46.3%)		20(45.5%)		18(47.4%)	
1		22.0%(18)		11(25.0%)		7(18.4%)	
2		46.3%(38)		19(43.2%)		19(50.0%)	
3 or more		29.2%(24)		14(31.9%)		10(26.3%)	
Time Since Diagnosis (years)	5.4(4.8) 0.5–23		4.6(3.3) 0.5–14		6.3(6.0) 0.8–23		0.12
Breast Cancer Stage							0.33
Stage 0		12(14.6%)		8(18.1%)		4(10.5%)	
Stage I		35(42.7%)		16(36.4%)		19(50%)	

Variable	Total (N=82)		Intervention (n=44)		Control (n=38)		Between Group Difference
	Mean(SD) Range	n(%)	Mean(SD) Range	n(%)	Mean(SD) Range	n(%)	
Stage 2		18(22%)		9(20.5%)		9(23.7%)	
Stage 3		2(2.4%)		2(4.5%)		0	
Unknown		15(18.3%)		9(20.5%)		6(15.8%)	
Cancer Treatment							
Surgery		80(97.6%)		43(100%)		36(94.7%)	0.36
Radiation		53(64.6%)		27(61.4%)		24(63.2%)	0.72
Chemotherapy		51(62.2%)		29(68.2%)		23(60.5%)	0.74
Hormonal Therapy		34(41.5%)		17(36.4%)		16(42.1%)	0.66
Co-morbidities							0.04
	3.5(2.6) 0-12		3.0(2.3) 0-9		4.2(2.8) 1-12		
Functional Limitations							
	4.6(2.8) 1-10		4.4(3.0) 1-10		4.8(2.6) 1-9		
1		11(13.4%)		8(18.2%)		3(7.9%)	0.54
2 or more		71(86.6%)		36(81.8%)		35(92.2%)	0.43
Body Weight Status							0.99
Under weight (BMI<18.5)		2(2.4%)		1(2.3%)		1(2.6%)	
Normal weight (BMI=18.5-24.9)		13(15.9%)		7(15.9%)		6(15.8%)	
Overweight (BMI=25.0-29.9)		23(28.0%)		13(29.5%)		10(26.3%)	
Obese (BMI>30)		44(53.7%)		23(52.3%)		21(55.3%)	
Current Smoker		8(9.8%)		6(13.6%)		2(5.3%)	0.23

p-values in bold text indicate significance at $p < 0.05$

Table 2

Health-Related Outcomes

	Intervention				Control				
	Baseline (n=44)	Post-Intervention (n=42)	Change Score (n=42)	Within-Group Difference	Baseline (n=38)	Post-Intervention (n=36)	Change Score (n=36)	Within-Group Difference	Between-Group Difference
	Mean(SD)	Mean(SD)	Mean(SD)	p-value	Mean(SD)	Mean(SD)	Mean(SD)	p-value	p-value
Lifestyle Behaviors									
Vegetable Consumption (servings/day)	1.46(1.21)	2.41(2.13)	+0.86(1.27)	0.0002	1.89(1.06)	2.20(1.71)	+0.23(1.38)	0.36	0.06
Physical Activity									
- Self-report (Moderate minutes/week)	37.9(61.0)	54.2(93.1)	+14.2(94.8)	0.34	34.4(55.2)	17.3(31.7)	-17.1(54.3)	0.08	0.02
- Accelerometer (MET hours/week)	47.3(24.5)	45.1(24.5)	-2.0(24.8)	0.68	39.2(25.9)	36.8(24.6)	-2.1(25.6)	0.71	0.93
Health Related Quality of Life									
Physical Health Component Score									
- Physical functioning	71.31(23.27)	73.54(27.57)	+1.76(13.16)	0.40	67.18(19.09)	67.29(22.80)	+1.23(17.98)	0.69	0.88
- Physical role limitations	75.43(26.29)	75.30(28.33)	-0.46(22.98)	0.90	64.24(27.17)	64.11(29.01)	-0.38(22.56)	0.92	0.88
- Pain	66.88(23.43)	66.71(25.34)	+0.67(22.72)	0.85	58.40(18.24)	61.21(22.13)	+3.82(17.89)	0.22	0.35
- General Health	63.10(21.96)	65.85(20.46)	+2.65(11.73)	0.16	58.61(20.34)	60.25(19.69)	+0.11(12.75)	0.96	0.37
Emotional Health Component Score									
- Emotional well-being	72.01(20.65)	74.07(20.95)	+2.12(14.10)	0.34	68.16(15.32)	71.40(19.73)	+4.01(14.52)	0.12	0.57
- Emotional role limitations	75.45(20.20)	76.71(20.93)	+1.83(12.08)	0.34	74.03(14.97)	75.43(19.30)	+1.03(14.13)	0.67	0.79
- Vitality	80.49(24.44)	80.69(27.54)	+0.81(25.06)	0.84	77.31(19.68)	83.57(23.7)	+9.07(19.72)	0.01	0.07
- Social Functioning	54.55(21.58)	57.47(22.06)	+3.51(15.88)	0.17	46.99(16.19)	49.11(23.44)	+2.27(15.55)	0.40	0.74
- Social Functioning	77.56(26.77)	81.40(25.33)	+3.96(23.79)	0.29	74.31(21.12)	77.50(24.59)	+3.68(22.09)	0.34	0.96
Anthropometric Measures									
Weight (kg)	80.41(16.75)	78.26(15.25)	-1.00(5.82)	0.28	80.42(17.12)	80.60(16.71)	+0.15(5.72)	0.88	0.39
BMI (kg/m ²)	30.90(7.25)	29.87(6.51)	-0.35(2.20)	0.32	30.54(6.43)	30.65(6.25)	+0.03(2.18)	0.60	0.21
Waist Circumference (cm)	92.2(12.9)	95.3(12.6)	+4.2(7.6)	0.001	93.2(11.8)	97.8(13.92)	+4.5(7.1)	0.0005	0.82
Physical Performance									
2-Minute Step Test (steps)	63.9(23.2)	89.1(23.6)	+21.9(22.0)	< 0.0001	63.71(16.9)	71.2(22.1)	+10.0(15.4)	0.001	0.01
8-Foot Get-Up & Go (seconds)	7.7(3.4)	7.0(1.9)	-0.3(1.6)	0.54	8.4(2.8)	8.1(3.0)	+0.4(1.5)	0.15	0.80
30-Second Chair Stand (# of rises)	12.6(3.3)	14.2(3.7)	+1.5(2.5)	0.0004	11.1(2.8)	12.6(3.6)	+1.5(2.9)	0.005	0.95
Chair Sit & Reach (inches)	0.2(3.7)	1.4(2.8)	+0.9(2.0)	0.01	0.1(4.7)	1.1(3.9)	+1.21(4.1)	0.09	0.63

	Intervention				Control				
	Baseline (n=44)	Post-Intervention (n=42)	Change Score (n=42)	Within-Group Difference	Baseline (n=38)	Post-Intervention (n=36)	Change Score (n=36)	Within-Group Difference	Between-Group Difference
	Mean(SD)	Mean(SD)	Mean(SD)	p-value	Mean(SD)	Mean(SD)	Mean(SD)	p-value	p-value
Back Scratch (inches)	-3.6(4.6)	-2.1(3.9)	+1.5(4.2)	0.03	-4.02(4.0)	-3.4(4.1)	+0.8(3.5)	0.17	0.51
Arm Curl (# of curls)	15.9(4.0)	18.7(4.1)	+2.7(3.3)	<0.0001	15.9(4.0)	15.9(3.3)	+0.1(4.0)	0.93	0.002
Hand Grip Strength (kg)	23.1(4.5)	24.4(4.8)	+1.4(4.2)	0.04	21.63(4.8)	23.5(4.4)	+1.9(3.6)	0.004	0.61
Biomarkers									
Toenail Cortisol (ng/g)	0.02(0.07)	0.007(0.01)	-0.001(0.01)	0.67	0.03(0.09)	0.009(0.01)	-0.03(0.09)	0.24	0.18
Telomerase	0.12(0.13)	0.07(0.08)	-0.05(0.16)	0.08	0.11(0.13)	0.06(0.04)	-0.05(0.13)	0.02	0.80
IL-6 (pg/ml)	1.24(0.77)	1.44(1.57)	+0.23(1.40)	0.30	2.16(3.44)	2.02(2.70)	-0.15(1.91)	0.65	0.33

p-values in bold text indicate significance at $p < 0.05$