

Feasibility, Preliminary Efficacy, and Lessons Learned From a Garden-Based Lifestyle Intervention for Cancer Survivors

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Background: Cancer survivors remain at increased risk for secondary malignancies, comorbidities, and all-cause mortality. Lifestyle behaviors, such as diet and physical activity, are strongly linked to a decreased risk of chronic disease and improved health outcomes, yet a paucity of research has been conducted in this vulnerable population.

Methods: Adult cancer survivors were recruited to participate in Growing Hope, an experimental single-group study designed to assess the feasibility and efficacy of a theory-driven and evidence-based intervention. For 4 months, 22 participants received group and individual education and had access to harvesting fresh produce at an urban garden. Data on program satisfaction, compliance, diet, and physical activity were collected via surveys; anthropometrics, blood values, and skin carotenoids were objectively measured.

Results: The intervention resulted in significant improvements in consumption of fruits and vegetables ($P = .003$), decreased consumption of red and processed meats ($P = .030$) and sugar-sweetened beverages ($P = .020$). Levels of skin carotenoids, fasting blood glucose, and non-high density lipoprotein cholesterol were also significantly improved ($P = .011$, $P = .043$, and $P = .05$, respectively).

Conclusions: The results of this study support the feasibility and efficacy of a multifaceted, garden-based intervention for cancer survivors. In addition, these preliminary results demonstrate a positive impact aligning with the current lifestyle recommendations for cancer survivorship. Larger randomized controlled trials are warranted to define impact on sustained health outcomes.

Introduction

Advances in early cancer detection and treatment have increased the number of Americans who survive cancer.¹ In 1971, cancer survivors were numbered at 3 million; by 2022, the number of survivors is expected to exceed 18 million.² Yet the completion of active cancer treatment frequently does not signal an end to the disease or its ill effects. Cancer survivors often face ongoing medical issues as well as emotional and financial challenges.³⁻⁶ In addition, survivors remain at increased risk for recurring primary cancers and secondary malignancies as well as comorbidities such as osteoporosis,

cardiovascular disease, and type 2 diabetes mellitus.⁷⁻⁹ Long-term secondary effects of treatment often affect this population, resulting in higher rates of all-cause mortality.^{10,11}

Cancer survivors often lack consistent follow-up care and management as they transition from active patient with cancer to a cancer survivor.^{3,4,12} For many, the encounter with cancer provides a renewed appreciation for health and an opportunity for empowerment. Survivors demonstrate a desire to take “ownership” of their own health and make changes that enhance or contribute to the success of cancer therapy, the amelioration of treatment-related toxicity, and the overall quality of survivorship.

Modifiable lifestyle behaviors, including consuming a plant-based diet and engaging in physical activity, have been shown to increase the quality of life in cancer survivors.^{13,14} More than 35% of cancer-related deaths are estimated to have been prevented by diet, physical activity, and other lifestyle modifications.^{13,15,16} However, the dietary and physical activity patterns of the majority of cancer survivors mirror that of the US population and remain suboptimal.¹⁷ Most cancer survivors consume diets high in saturated fat and low in fruits, vegetables, and whole grains, and they often fail to meet physical activity guidelines.^{7,18}

Impactful programs regarding diet, nutrition,

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Submitted February 18, 2016; accepted April 4, 2016.

This project was supported by the OSU Food Innovation Center, the National Center for Advancing Translational Sciences, National Institutes of Health, through Grant UL1TR001070, JamesCare for Life, and Waterman Farm. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

and lifestyle are critical for survivorship. Modifiable lifestyle behaviors, including engaging in regular physical activity, consuming a plant-based diet, and maintaining a healthy body weight, have been shown to improve outcomes, overall functioning, and quality of life among cancer survivors.^{17,19-21} Expert committees, such as the American Institute for Cancer Research/World Cancer Research Fund and the American Cancer Society, have defined evidence-based recommendations for physical activity and dietary patterns relative to cancer survivors.^{13,14,22,23} Results of the largest prospective study on diet and lifestyle behaviors of more than 520,000 individuals revealed that participants with the greatest adherence to the American Institute for Cancer Research/World Cancer Research Fund guidelines had a 34% lower rate of death from all causes, including cancer-related death, than those with the lowest concordance with the recommendations.²⁴ Because lifestyle behaviors are influenced by a myriad of factors, the Academy of Nutrition and Dietetics recommends interventions that address several key components, rather than targeting any single factor, when creating programs to facilitate behavioral change.^{25,26}

Purpose

The purpose of this study was to determine the feasibility, acceptability, and preliminary efficacy of a multifaceted, evidence-based intervention for cancer survivors transitioning out of active treatment and orchestrated around a season of herb, fruit, and vegetable harvesting in an urban garden.

Methods

Participants and Recruitment

Adult cancer survivors were recruited from the James Cancer Hospital and Solove Research Institute (Columbus, OH) at The Ohio State University (OSU) Comprehensive Cancer Center, its associated oncology clinics, and its affiliated JamesCare for Life community-based cancer survivor outreach program. Study brochures were distributed, and interested individuals were instructed to e-mail the study coordinator and complete an 11-item eligibility screening.

Participation inclusion criteria included: adults 18 years of age or older, an English speaker, access to the Internet, basic computer skills, and cancer survivors who had completed active cancer treatment (chemotherapy, radiotherapy, and/or surgery) within the previous 24 months. Use of adjuvant hormone therapy was acceptable. Exclusion criteria were: cognitively unable to provide informed consent, had physical or mental limitations that would prevent full participation in the program, receiving active cancer treatment, preexisting medical conditions that precluded unsupervised physical activity (eg, severe orthopedic conditions, un-

stable angina), taking medications that did not allow for increased intake of fruits and vegetables (eg, warfarin), planning to begin medications during the course of the intervention, use of select nonprescription substances (eg, herbs, botanical products), active metabolic or digestive illnesses (Crohn disease, celiac disease, irritable bowel syndrome), renal or hepatic insufficiency, cachexia, or women who were pregnant. All study procedures were approved by the Institutional Review Board and informed consent was obtained from all individual participants included in the study.

Study Design

This single-arm study was designed to assess feasibility and compliance with a novel and multifaceted intervention. Drawing on successful theoretical principles specific to cancer survivorship, the intervention was based on social cognitive theory framework and supplemented by motivational interviewing.²⁷⁻²⁹ After completion of baseline clinical, anthropometric, and dietary assessments, study participants were involved in a multifaceted intervention focusing on cancer survivor-specific nutrition, physical activity, and behavioral modifications delivered within a garden setting. The 4-month intervention components included^{13,14,22,23,30}:

- Harvesting produce (fruit, vegetables, herbs) ≥ 3 times/week at an urban garden aligned with a comprehensive cancer center supported by the National Institutes of Health
- Biweekly group education classes structured around evidence-based cancer survivor guidelines
- Access to remote motivational interviewing coaching by a trained registered dietitian nutritionist
- Access to a secure online web portal to provide lifestyle behavior recommendations and survivor-specific health and wellness tips, recipes, and other resources

At the end of the 4-month intervention, the clinical, anthropometric, and dietary assessments were repeated.

Garden Harvesting and Tracking: JamesCare for Life, an extension of the OSU Comprehensive Cancer Center, provides resources and services to assist cancer survivors and their families during their cancer journey. Among the offerings at JamesCare for Life, programs to educate cancer survivors on the critical role of nutrition, physical activity, and other modifiable lifestyle behaviors for cancer prevention and survivorship are available. One such program is the Waterman Farm's Garden of Hope, a community garden established in 2012, which is supported by the OSU College of Food, Agriculture, and Environmental Sciences. The garden is a 2.5-acre plot with herbs, fruits, and vegetables. Cancer survivors enrolled in the JamesCare for Life program were permitted to harvest up to 3 times per week (in 2-hour blocks) during the growing season

(typically May to October) free of charge.

Prior to harvesting at the Garden of Hope, participants attended a mandatory garden orientation to complete registration forms, receive harvesting instructions, become familiar with the policies and procedures of Waterman Farm, and meet the support staff at JamesCare for Life. At this orientation, participants were given a red harvest bag and a registration card with a unique bar code to electronically track the number of harvests attended throughout the season.

At the harvest check-in station, participants presented their Garden of Hope registration cards to staff at JamesCare for Life. Using a mobile scanning device, the staff members at JamesCare for Life scanned each participant's unique bar code to track harvest visits. During each 2-hour harvest block, Garden of Hope registrants were encouraged to fill up their red bag with fresh garden produce and interact with dietetic interns and dietitians that attended each harvest. These trained volunteers were accessible to participants and provided safe food-handling tips, recipe suggestions, nutrition education, harvesting assistance, and additional motivation and support.³⁰

Group Education and Training: In addition to harvesting, study participants attended 10 expert-led classes in a group setting focusing on cancer survivor-specific guidelines. These 1-hour classes, presented in a conference room adjacent to the garden, were held biweekly on Monday evenings, and they offered in-depth discussions of evidence-based survivorship guidelines. Each class focused on a different recommendation and detailed evidence behind the recommendation, application of the guidelines into practice, and behavioral regulation guidance (goal setting, overcoming barriers, coping strategies, and self-management). In addition, each class ended with a cooking demonstration that utilized produce harvested from the garden that day to demonstrate safe food-handling and preparation methods, to share healthy recipes, and to serve as an example of translating guidelines into practice. The chef and dietitians at the medical center led these cooking demonstrations.

Motivational Interviewing: Motivational interviewing is a clinical practice that grew out of theoretical and practical considerations. Motivational interviewing relies on both relational aspects between interventionist and client as well as behavioral reinforcement.³¹ Our motivational interviewing coach was a registered dietitian nutritionist trained and competent in motivational interviewing techniques as well as medical nutrition therapy, theoretical behavioral constructs, oncology, and sports nutrition.^{29,31} Participants communicated with the motivational interviewing coach via e-mail, text, voice-over internet protocol methods, or phone throughout the intervention. In addition to monitoring participant progress each

week, the motivational interviewing coach sent weekly e-mails, text messages, or both to encourage adherence to the recommendations and to emphasize the key points of the group education sessions.

Web Portal: Participants were provided unlimited access to a secure web portal where they could access additional evidence-based lifestyle recommendations, current research, cancer survivor-specific health and wellness tips, recipes utilizing produce from the garden, links to external websites with evidence-based content, nutritional information, and updated lists of the produce ready to harvest each week at the garden. Participants also had access to the group education calendar that listed expert presenters, class topics, and objectives. The web portal also housed electronic copies of all class handouts, slides, and recipes from each session.

Data Collection and Analysis

Medical, dietary, and lifestyle questionnaires were collected at baseline (month 0) and immediately post-intervention (month 4). Similarly, objective anthropometric and clinical biomarkers were collected at the baseline and postintervention periods during clinical laboratory visits. To obtain additional programmatic feedback, participants completed a class evaluation after each group education session throughout the program. Study data were collected and managed using the Research Electronic Data Capture data capture tools hosted at OSU.³²

Feasibility

To determine feasibility, the reach, adoption, adherence, and acceptability of the program were measured.³³ Each component of the intervention was also evaluated for translation of research into practice.^{34,35} Reach of the program was measured via recruitment and enrollment logs. Adoption of the program was evaluated through participant retention and questionnaires. Tracking of participation at all harvests and group education sessions were tallied throughout the intervention to further define compliance and use of the program. To assess acceptability of the intervention, individual group education evaluations and overall programmatic satisfaction surveys were completed.

Dietary Intake

The validated, 26-item Dietary Screener Questionnaire developed by the National Cancer Institute was used to evaluate dietary intake.³⁶ This screening tool assesses the frequency of consumption of a wide variety of foods and beverages. Participants were asked to report their frequency of consumption of food items during 1 month prior, and these data were used to estimate intakes of fruits, vegetables, red and processed meats, dairy, and added sugars.

Clinical Measurements

Participants completed laboratory visits at baseline and postintervention to assess clinical and biological indices of health risk. Prior to these laboratory visits, participants were instructed to adhere to a 12-hour fasting period, hydrate, and abstain from vigorous exercise and alcohol consumption 72 hours prior to the visit. Fasting samples were collected between 7:00 and 10:00 AM to control for diurnal variation.

Anthropometric data (height, weight) were collected to calculate body mass index.³⁷ Participants were weighed wearing light clothing and without shoes on a standard and calibrated digital scale, standing height was measured, and blood pressure was obtained.

Capillary blood samples were taken by trained personnel using standardized sterile techniques. Lipid profile and blood glucose screening with a single finger stick were performed. Skin carotenoid levels were measured with a scanner that uses Raman spectroscopy to estimate skin carotenoids. The scanner has been demonstrated to be sensitive, reproducible, and correlative with both plasma carotenoid levels and fruit and vegetable intake.³⁸⁻⁴⁴

Statistical Analysis

Descriptive statistics were generated for all demographic and outcome measurements. All analyses were performed using SPSS version 21 (IBM SPSS Statistics, Armonk, NY). Compliance was assessed using attendance records from harvests and the group education classes. Participants were considered compliant if they attended 75% of the offered sessions.

Statistical analysis for the effect of the intervention on anthropometric, dietary, and clinical measures were conducted by comparing the prestudy and poststudy scores. The hypothesis of no change in these variables was tested with paired *t* tests to determine which were significantly different. The *P* values of the individual *t* tests were adjusted via a Bonferroni correction. Statistical analysis for efficacy of the intervention was performed using descriptive statistics for the outcome variables. A paired *t* test was performed to assess the significance of the shift in the relevant outcomes variables.

Results

The recruitment goals for this intervention were met within 4 weeks. A total of 35 adult cancer survivors were screened for eligibility and 25 (*n* = 20 women, *n* = 5 men) were deemed eligible and enrolled. During the course of the intervention, 3 female participants withdrew from the study secondary to cancer recurrence or related health concerns (*n* = 2) or personal issues that interfered with full participation (*n* = 1). Of the final cohort (*N* = 22), the majority was white and women; the mean age was 62 years and the mean age of ini-

tial cancer diagnosis was 59 years (Table 1). Breast and prostate cancers were the most prevalent primary cancers reported in this cohort (see Table 1).

A total of 88% of participants completed preintervention and postintervention questionnaires, 80% attended both laboratory visits, and 73% completed the postintervention programmatic evaluation. Overall study retention was high at 88% (*n* = 22/25), and no ad-

Table 1. — Baseline Characteristics of Study Participants (N = 22)

Demographics		No. of Participants, n (%)
Age, y	Start of study	61.7 (mean)
	Primary cancer diagnosis	59.3 (mean)
Sex	Male	5 (22.7)
	Female	17 (77.3)
Race/Ethnicity	Black/African American	1 (4.5)
	White	21 (95.5)
	Other ^a	0 (0)
Marital Status	Married	13 (59.1)
	Divorced	6 (27.3)
	Never married	1 (4.5)
	Widowed	2 (9.1)
	Other ^b	0 (0)
Education	Completed < grade 12	0 (0)
	Completed ≥ grade 12 or General Education Development equivalent	3 (13.6)
	Completed 1–3 y college	2 (9.1)
	Completed ≥ 4 y college	7 (31.8)
	Earned professional or graduate degree	10 (45.5)
Employment	Employed or self-employed	10 (45.5)
	Retired	9 (40.9)
	Homemaker	3 (13.6)
Annual Household Income, \$	≤ 19,999	0 (0)
	20,000–24,999	2 (9.1)
	25,000–34,999	2 (9.1)
	35,000–49,999	2 (9.1)
	50,000–74,999	3 (13.6)
	≥ 75,000	9 (40.9)
	Prefer not to answer	4 (18.2)
Primary Cancer	Breast	12 (54.5)
	Prostate	4 (18.2)
	Other ^c	6 (27.3)

^aAmerican Indian, Asian, Hispanic, not specified, and Pacific Islander.

^bSeparated or domestic partner.

^cColorectal, endometrial, leukemia, lung, lymphoma, melanoma, not specified, ovarian, skin, thyroid, and tonsillar.

verse events were reported as part of this study.

The results of the postintervention programmatic evaluation showed that more than 90% of the participants reported the dates and times for both harvesting (Monday evening, Thursday morning, Saturday morning) and biweekly group classes (Monday evenings) were convenient (Table 2). All participants rated the overall program as either “very good” or “excellent” and would recommend the program to other survivors, and they also reported that the program helped them achieve better adherence to the evidence-based dietary recommendations and had a positive impact on their health (see Table 2). Open-ended participant feedback from the postintervention evaluation appears in Table 3.

On average, participants harvested 1.5 times per week during the 4-month growing season. The mean attendance rate for the group education was 73% ($n = 16$). Objectively, participants rated each separate education class positively utilizing a Likert-type scale (0–5). More than 90% of participants rated the educational sessions as “very good” or “excellent” (see Table 2). Overall, 95% of session attendees “agreed” or “strongly agreed” that expert presenters met the class objectives. Subjective data were also positive on all postclass evaluations, with recurring statements that included words like “educational,” “informative,” and “entertaining” (see Table 3).

Fifteen of the participants (68%) utilized the motivational interviewing coach and all of them indicated they would utilize the motivational interviewing coach if offered again in the future. Furthermore, 93% of those participating in the motivational interviewing coaching “agreed” or “strongly agreed” that individualized motivational interviewing reinforced the group education sessions. When asked to describe the most beneficial part of the motivational interviewing coach, the majority of comments indicated satisfaction: Recurring phrases praised the accessibility, knowledge, and support of the motivational interviewing coach (see Table 3).

Sixteen participants (73%) utilized the web portal with mixed results related to ease of use. Fifteen (94%) of the portal users “somewhat” or “strongly” agreed the web portal reinforced the group education objectives and key topics. Of those who did not utilize the web portal, qualitative feedback included difficulty with portal access (log in), frustration navigating through the portal efficiently, and a preference for in-person or telephonic correspondence (see Table 3).

Based on the dietary intake data, participant adherence to the evidence-based guidelines for cancer survivorship improved during the course of the intervention. Significant improvements included increased consumption of fruits and vegetables ($P = .003$), decreased consumption of added sugars ($P = .020$), and

Table 2. — Comprehensive Postintervention Programmatic Evaluation

Question	Response	No. of Responses, %
Were the Garden of Hope harvesting times (Monday evening and Thursday and Saturday mornings) scheduled at a convenient time for you?	Yes	15 (93.8)
	No	1 (6.3)
Were the group educational classes (Monday evenings at 6 PM) scheduled at a convenient time for you?	Yes	16 (100)
	No	0 (0)
How would you rate the group educational sessions?	Poor	0 (0)
	Fair	0 (0)
	Good	1 (6.3)
	Very good	8 (50.0)
	Excellent	7 (43.8)
Did the program help you to achieve better dietary patterns that more closely aligned with the evidence-based recommendations (primarily plant-based, rich in whole grains, fruits, and vegetables and low in sodium, simple sugars, and red/processed meats)?	Yes	16 (100)
	No	0 (0)
Did the program impact your overall health in a positive way?	Yes	16 (100)
	No	0 (0)
Did the program provide you with a sense of community and support?	Yes	15 (93.8)
	No	1 (6.3)
Which program activity was the <u>most</u> effective for you?	Group classes	9 (56.3)
	Harvesting	4 (25.0)
	Remote motivational interviewing coaching	1 (6.3)
	Web portal	2 (12.5)
Would you recommend this program to other survivors?	Yes	16 (100)
	No	0 (0)
How would you rate the Harvesting Health Program as a whole?	Poor	0 (0)
	Fair	0 (0)
	Good	0 (0)
	Very good	2 (12.5)
	Excellent	14 (87.5)

decreased red and processed meat intake ($P = .030$; Fig). No participants reported smoking at baseline or postintervention, and all participants reported alcohol consumption within the recommended goal range at both baseline and postintervention.

Positive trends were noted in multiple clinical indices of health (Table 4). Blood pressure was the single variable that did not trend positively, yet the difference was clinically insignificant. Significant changes were noted in values of fasting blood glucose, non-high

Table 3. — Qualitative Postintervention Programmatic Evaluation

Intervention Component	Participant Feedback
Garden harvesting	The volunteers (students) in and out of the garden were extremely helpful.
	I liked the wonderful produce from the garden, the friendly and helpful volunteers ... the study was a gift!
	This study was one of the highlights of my life. I can't believe how much I have learned about "real" food!
Group education	Until now, I did not know all the health benefits associated with my dietary changes. Thank you for a wonderful opportunity. I feel very privileged. This has forever changed my life and way of eating.
	The classes were excellent and well presented.
	The Monday night classes and cooking demonstrations were very interesting. I can't say enough good things about the health coaching and the website. It has made a lasting impression on my health.
	I thoroughly enjoyed attending the Monday night classes and following the weekly tips. ... It has been a fantastic opportunity and I will miss all of you.
Remote coaching	I appreciated her knowledge base and sincere willingness to help. She had good ideas and made them relevant to me. The goals she helped me set were realistic. I loved having someone to be accountable to.
	I am definitely more informed about my food choices and have started making better choices more often. I'm trying to approach one issue at a time ... and will continue to improve.
	"I got materials from [the remote motivational interviewing coach] to look at my own diet and track and develop my own dietary patterns. I think those were helpful for me and would be for others, too.
	Loved having a health coach and [the study principal investigator] in my back pocket. With their support and energy, I felt like I could do it.
	Being able to discuss my own personal nutrition issues was the most beneficial part of the health coaching. [The remote motivational interviewing coach] always provided helpful information and was supportive of any positive steps (no matter how small) that I made.
	Every communication appears to be online. It might have made a difference in my decision if the coach had made a telephone call. Some of us need to hear a voice until we get used to technology.
Web portal	The portal was very easy to use.
	I liked the website, the recipes, the tips, the help from [the remote motivational interviewing coach] ... everything was valuable!
	The discussion boards took a little while to get used to navigating them and following the discussions. If there are other formats to use, that might help.
Group support	I did make <u>many</u> changes to my eating habits, and my husband has made the changes right along beside me. I only wish this kind of support were available while I was going through cancer treatment.
	When I first started in the study, I thought I knew a lot about nutrition. I discovered I did not. For the first time since my cancer diagnosis I felt like I had the know-how and support to make life-long changes.
	I enjoyed the camaraderie with other participants.
	I very much enjoyed the spirit of community.
	All of the study team was fabulous to work with, very knowledgeable, helpful, and enthusiastic. I was blessed to be a participant in this study.

density lipoprotein cholesterol, and skin carotenoids ($P = .043$, $P = .050$, $P = .011$, respectively; see Table 4 and Fig).

Discussion

This study demonstrated the feasibility, acceptability, and preliminary efficacy of a comprehensive intervention delivered at an urban garden targeted toward cancer survivors. Feasibility was evaluated from participant attendance records

Table 4. — Clinical Laboratory Results

Variable	No. of Participants	Baseline (mean)	Postintervention (mean)	Difference, <i>P</i> value
Weight, pounds	20	170.7	169.4	-1.2 (.603)
Body mass index, kg/m ²	20	28.1	27.9	-0.2 (.586)
Systolic blood pressure, mm Hg	20	132.9	133.5	+0.7 (.815)
Diastolic blood pressure, mm Hg	20	82.5	83.2	+0.7 (.704)
Total cholesterol, mg/dL	19	211.3	201.7	-9.5 (.150)
HDL cholesterol, mg/dL	18	61.4	65.2	+3.7 (.176)
Non-HDL cholesterol, mg/dL	18	152.3	137.9	-14.4 (.050)*
Fasting blood glucose, mg/dL	19	97.5	93.8	-3.7 (.043)*
Skin carotenoid score (RRS)	20	38,225.5	43,251.4	+5,025.9 (.011)*

*Statistically significant ($P \leq .05$).
HDL = high density lipoprotein, RRS = resonance Raman spectroscopy.

and follow-up questionnaires. The rates of rapid recruitment, high enrollment, and low attrition suggest that the intervention was acceptable and well received. Previous behavioral interventions report approximately two-thirds of participant attendance at education classes.⁴⁵⁻⁴⁷ The ability to meet recruitment goals within 30 days suggests demand for this type of intervention and appropriateness for the target population. The accrued sample was relatively modest in size and homogenous in terms of primary cancer site (mainly breast and prostate), primarily white, older, well educated, and upper middle class. These factors are likely to have contributed to higher attendance and overall adherence rates.

The group education classes were led by an experienced expert aligned with the evidence-based topic presented. For example, the Food Safety for Survivors session was led by the state extension specialist in food safety. Other classes were taught by registered dietitians, medical oncologists, and academic researchers. This level of expertise allowed for additional support and discussions of issues pertaining to advanced topics such as adjuvant therapy, post-treatment considerations, and ongoing survivor care plans. Overall, the majority of participants reported that the group classes were the most important component of the intervention leading to their success. Harvesting free produce

was rated as the second most important intervention component.

Nearly 70% of participants took advantage of the remote motivational interviewing coach. Consistent users reported that the remote motivational interviewing reinforced the classes and was critical in providing an additional level of support often overlooked in other behavioral interventions.⁴⁸ Those who declined help from the motivational interviewing coach felt that they did not have enough time or did not need coaching to achieve their goals.

The secure web portal was utilized with mixed results in almost three-quarters of the study cohort. The majority of participants enjoyed the website and commented that they appreciated the print-ready recipes, copies of class handouts, safe food-handling tips, web links, and continued updates. However, low computer literacy was evident in a subset of the older participants throughout the intervention. The research team and motivational interviewing coach attempted to resolve these issues throughout the study but remained largely unsuccessful. These participants appeared to prefer face-to-face or telephonic contact and had little interest in learning to navigate the website. Similar findings have been found in other interventions targeting older individuals.^{49,50}

Using evidence-based guidelines for cancer pre-

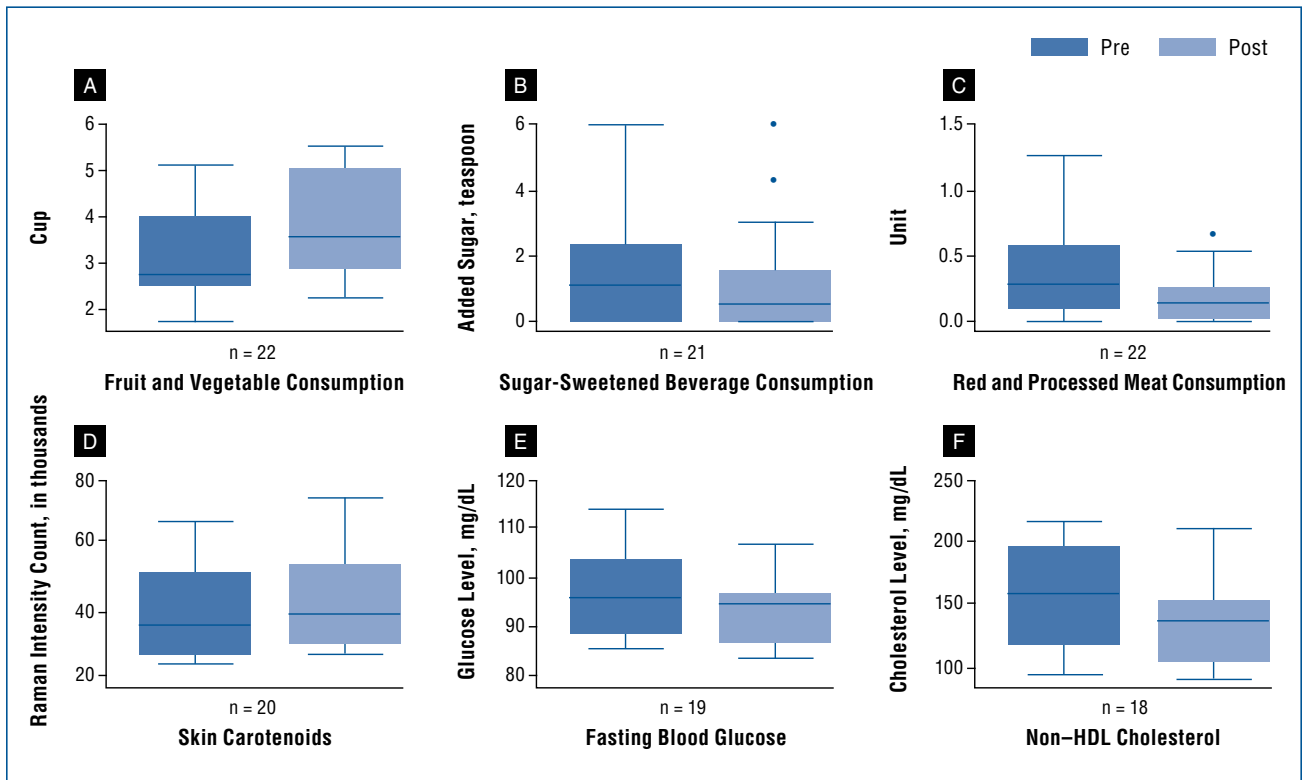


Fig A–F. — Preintervention to postintervention changes in dietary intake and indices of health. Box plots depicting significant differences in (A) fruit and vegetables ($P = .003$), (B) sugar-sweetened beverages ($P = .020$), (C) red and processed meats ($P = .030$), (D) skin carotenoids ($P = .011$), (E) fasting blood glucose ($P = .043$), and (F) non-HDL cholesterol ($P = .050$). HDL = high density lipoprotein.

vention and survivorship, significant improvements aligning with current recommendations were demonstrated for dietary intake (increased consumption of fruits and vegetables and decreased consumption of red, processed meats and sugar-sweetened beverages) and clinical indices of health (improved fasting blood glucose, systolic blood pressure, non-high density lipoprotein cholesterol, and skin carotenoids).

Limitations

A limitation to this study was the small sample size and lack of control group, although the size was appropriate for a feasibility pilot study. A Hawthorne effect — whereby the mere presence of the intervention, not the intervention itself, is associated with favorable changes in outcome measures — must be considered. Biases associated with drop-out rates, although minimal, may have resulted in an overestimation of the effect of the intervention. It is possible that observed changes were caused by a “healthy participant effect,” in which participants may have self-reported healthier lifestyles than nonparticipants and, thus, may have been more likely to comply with the study protocol. However, improvements seen in biological indices of health were aligned with self-reported gains (eg, fruit and vegetable intake, skin carotenoid levels), thus providing more information than either presented in isolation. In addition, we did not have a diverse or large enough sample to permit adequate comparisons between variables of interest.

Conclusions

The results of this study support the feasibility and efficacy of a multifaceted, garden-based intervention for cancer survivors. In this pilot study, the intervention resulted in significant improvements in dietary intake and key biomarkers of health. The intervention was staged within the season of an urban garden. This innovative clinical intervention might be a model for health care professionals to use to address the gap in programs for patients transitioning from active cancer treatment to becoming healthy cancer survivors.

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