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Outcomes of a Weight Loss Intervention among Rural Breast Cancer Survivors

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Abstract

Obese breast cancer survivors have increased risk of recurrence and death compared to their normal weight counterparts. Rural women have significantly higher obesity rates, thus weight control intervention may be a key strategy for prevention of breast cancer recurrence in this population. This one arm treatment study examined the impact of a group-based weight control intervention delivered through conference call technology to obese breast cancer survivors living in remote rural locations. The intervention included a reduced calorie diet incorporating prepackaged entrees and shakes, physical activity gradually increased to 225 min/week of moderate intensity exercise, and weekly group phone sessions. Outcomes included anthropomorphic, diet, physical activity, serum biomarker, and quality of life changes. Ninety-one percent of participants (31 of 34) attended > 75% of intervention sessions and completed post-treatment data collection visits. At 6 months, significant changes were observed for weight (-12.5 ± 5.8 kg, 13.9% of baseline weight), waist circumference (-9.4 ± 6.3 cm), daily energy intake (-349 ± 550 kcal/day), fruits and vegetables ($+3.7 \pm 4.3$ servings/day), percent kcal from fat ($-12.6 \pm 8.6\%$), physical activity ($+1235 \pm 832$ kcal/week; all p 's < .001), as well as significant reductions in fasting insulin (16.7% reduction, $p = .006$) and leptin (37.1% reduction, $p < .001$). Significant improvements were also seen for quality of life domains including mood, body image, and sexuality. In conclusion, the intervention produced > 10% weight loss as well as significant improvements across multiple endpoints. The group phone-based treatment delivery approach may help disseminate effective weight control intervention to hard-to-reach breast cancer survivors.

Keywords

breast cancer; survivors; rural; weight control; physical activity

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CONFLICT OF INTEREST: None

Both obesity and weight gain of 6 to 10 kg or more after breast cancer diagnosis are associated with poor outcomes including increased recurrence, breast cancer deaths, and all cause mortality [1-3]. Biochemical mediators of risk are thought to be an increase in bioavailable hormones, insulin, and an increase in unfavorable adipocytokines such as leptin and IL-6 and a reduction in favorable adipocytokines such as adiponectin [4, 5]. Weight loss and physical activity have been shown to reduce insulin [6], which is important for breast cancer survivors as increasing evidence indicates that high insulin levels increase the risk of breast cancer recurrence and death [7]. Leptin and adiponectin may be involved with the regulation of insulin sensitivity [8] as well cell growth, invasion, and angiogenesis [9]. These adipocytes are potential mechanistic targets for reducing obesity-related cancer risk [4, 10]. Although it is not clear the exact amount of weight loss needed to reduce risk of recurrence or new primary breast cancer in overweight and obese women, preliminary studies suggest a sustained weight loss of 10% of initial weight [11, 12].

Rural women, which constitute 20% of women in the U.S., have significantly higher obesity rates [13, 14]. Structured behavioral weight loss and maintenance programs are considered the standard of care, but along with support groups and survivorship programs they are often difficult for rural women to access. Accordingly rural women constitute one of the largest medically underserved groups of breast cancer survivors [15]. A group phone based behavioral weight control intervention which combines calorie reduction and physical activity in a breast cancer support group environment may be a key strategy for prevention of recurrence and improving quality of life for rural women.

Using conference call technology to deliver group-based intervention is well-suited for rural breast cancer survivors because it is easily accessible, provides real-time peer support, and appears to produce superior results compared to the traditional one-on-one phone counseling approach [16]. The purpose of this one-arm treatment study was to examine the feasibility and impact of a 6-month group phone-based weight control intervention addressing lifestyle modification and survivorship support on weight, diet, physical activity, serum biomarkers, and quality of life outcomes. Serum biomarkers included

METHODS

Participants

Women were recruited from three rural cancer centers in the state of Kansas located in towns ranging in population from 20,000 to 47,000. A large percentage of patients treated at these sites resided in surrounding areas within a two hour drive. Breast cancer survivors who responded to a previous survey study assessing weight control needs [17] and who expressed interest in being contacted for an intervention study were mailed a study flyer and contacted by phone. Eligible women resided in a rural area (large rural core to isolated rural) as defined by the Rural Urban Commuting Area (RUCA) codes developed by the U.S. Department of Agriculture, Economic Research Service. Only postmenopausal women under the age of 75 who had a body mass index (BMI) of 27 to 45 kg/m², and had been treated for Stage I- IIIc breast cancer within the past 10 years were eligible. Candidates must have completed local treatment and chemotherapy at least 3 months from date of entry but concurrent endocrine therapy was allowed. Candidates must also have been weight stable (no more than 10 lb. weight fluctuation within previous 3 months), free from serious medical risk such as unstable cardiac condition or severe pulmonary disease, able to walk briskly unassisted for at least 10 minutes, and able to obtain clearance to participate from oncology or primary care provider who verified medical risk exclusion criteria. Breast cancer diagnosis and treatment history was confirmed by medical chart review. The study was approved by the Human Subjects Committee at the University of Kansas Medical Center.

Intervention

The intervention was guided by a social cognitive framework and incorporated self-regulation skills (goal-setting, self-monitoring, problem-solving, stimulus control) and social support to enhance self-efficacy for diet and physical activity behavior change, targeting 10% weight loss [19]. The intervention was tailored to the special needs of breast cancer survivors and rural women. The intervention provided opportunity for shared identity among rural breast cancer survivors while at the same time recognizing that traditions and access to resources vary from town to town and from farm to town. Breast cancer survivorship topics included dietary and physical activity recommendations related to breast cancer risk, body image as impacted by breast cancer treatment and weight, and managing lymphedema, arthralgia, and other late side effects. Topics targeted for rural women included problem-solving regarding barriers to accessing physical activity facilities and healthy foods in grocery stores and restaurants, linking behavior change to cultural values related to family and hard work, and modifying traditional “country cooking” or “potluck” dishes to be low calorie, including a cookbook of recipes submitted by the participants and modified by dietitian staff. Session topics are included in Table 1.

Participants were instructed to follow a diet that included ≥ 5 fruit and vegetable servings per day, approved prepackaged frozen entrees (2 per day at < 350 kcal and < 9 g of fat each) or their equivalent (e.g. soup, other portion-controlled meals), and shakes (2 per day at 110 kcal each, Safely Slim®, Science Foods, LLC). Participants purchased food in their local grocery stores except for shakes which were provided to them. Prepackaged meals and shakes have consistently shown greater weight loss and weight loss maintenance compared to diets that rely completely on individuals preparing all their own meals [20-23], as well as greater adherence and nutrition improvement (greater increases in fruit and vegetables and fiber, greater decrease in fat intake) [21, 24-26]. Participants were given a calorie goal of 1200, 1400, 1600, or 1800 kcal/day calculated by subtracting 1000 kcal/day from maintenance requirements as determined by the Harris-Benedict equation [27] and rounding to the nearest calorie goal level. Participants were instructed on how to modify the diet to include home-prepared and restaurant foods while staying within their calorie range. Participants kept daily records of number of fruit and vegetable servings, shakes and entrees, snacks, and meals out, and they reported this information by email, fax, or voice message to their group leader the morning of each session. For one week per month, they also kept a complete food log including calorie information and mailed the log to their group leader. Group leaders reviewed all weekly reports and food logs and provided feedback during the conference calls in the context of group problem-solving. For participants who emailed their weekly records, group leaders responded to the email acknowledging receipt and providing a brief note of encouragement and feedback.

Participants were guided to gradually increase their physical activity over the first 12 weeks to 225 minutes per week of moderate intensity activity (brisk walking), consistent with national guidelines for weight loss maintenance [28]. Participants were instructed in types of activities (any moderate intensity planned activity lasting 10 minutes or longer), as well as strategies to monitor intensity, plan for weather, and increase enjoyment. To enhance functional fitness, light resistance training was included as an optional component using lightweight dumbbells with visual guidance provided by a module-based DVD for breast cancer rehabilitation titled “*Strength and Courage*” (www.strengthandcourage.net). Participants received a pedometer and self-monitoring calendars and charts and reported their physical activity minutes and steps on their weekly log.

Participants met for 24 consecutive weeks in groups of 8 to 14 by calling a toll-free conference line at a standing meeting time. Group sessions were 60 minutes and were structured to allow all participants opportunity to contribute. Ground rules and group norms

included no multi-tasking while on the call, being in a location free from distractions, and active member-to-member interaction. Group counselors called on individuals during the session if they had not spoken and directed participants to speak directly to one another to normalize active participation among all members. Each session began with an open-ended check-in question relevant to the previous session's topic, followed by review of weekly progress toward goals, and ended with a diet, physical activity, behavioral, or survivorship topic of the week. A trained masters-level dietitian and a doctorate-level clinical psychologist with experience in delivering a structured weight control intervention and understanding of breast cancer survivorship topics provided the counseling. Individual sessions were not provided, and participants did not have routine contact with one another outside of the group sessions. If participants called the group leader outside of the regular group session, the group leader addressed the concern and encouraged them to bring their questions or concerns to the group as appropriate. Group counselors followed a standardized treatment manual that outlined the structure of the calls, group phone facilitation strategies, and the content and goals of each session. All sessions were recorded. After each session, group counselors completed treatment fidelity checklists documenting the content covered and the quality of the group interaction to facilitate on-going supervision and help ensure standardized delivery. The primary investigator met weekly with group leaders and listened to sessions, reviewed treatment fidelity, and discussed counseling strategies.

Measures

Data collection occurred at baseline and 6 months during in-person individual visits held at the local cancer centers. Visits were scheduled in the morning, and participants were fasting.

Weight and height—Participants were weighed without shoes in light clothing (shorts and t-shirt) to the nearest 0.1 pound using a digital scale (Befour, Inc). Height was measured without shoes and rounded to the nearest 0.1 cm. Height and weight measurements were used to calculate body mass index (BMI; kg/m^2).

Dietary intake—Two 24-hour dietary recalls were conducted at each time period using the U.S. Department of Agriculture multiple-pass approach [29]. Trained data collectors recorded specific and quantitative detail of every food and drink consumed during the previous day and entered them into the Nutrition Data System for Research software. The two recalls included one week day and one weekend day. Outcome variables included daily kcals, percent kcals from fat, and daily fruit and vegetable servings (excluding fried potatoes and fruit juice).

Physical activity—The Minnesota Physical Activity Questionnaire assesses weekly frequency and duration of 41 physical activities, including sports and lifestyle activities [30]. Activities are assigned a MET value (energy cost of activity as a multiple of resting metabolic rate in kcal/kg/hr), and scoring yields estimates of energy expenditure (kcal/week) [31]. Because the intervention targeted planned physical activity, lifestyle activities involving housework and gardening were not included in the scoring.

Blood draws and serum assays—Twelve-hour fasting blood for insulin, leptin, and adiponectin was collected in gel clot tubes at pre- and post-intervention. Because two-thirds of the women were on endocrine therapy (tamoxifen or aromatase inhibitors) we did not assess change in hormone levels. Samples were centrifuged for 15 minutes at 3500 RPM, aliquoted into cryo-vials within 30 minutes, and frozen at -80°C freezer for long term storage until study completion. Pre- and post-study samples were run together to avoid batch variation. Insulin was measured in serum using an ELISA kit (80-INSHU-E01.1; Alpco Diagnostics; Salem, NH) following the assay manual. The mean intra-assay coefficient of

variation for the low and high-range quality control samples were 3.2% and 5.1%, respectively. Leptin and adiponectin were also analyzed by ELISA kits (11-ILEPHU-E01 & 47-ADPHUT-EO1, respectively; Alpco Diagnostics; Salem, NH). For leptin, the mean intra-assay coefficient of variation was 3.7% for low values and 5.0% for high values. For adiponectin, the mean coefficients of variation for low- and high-range quality control sample were 5.4% and 5.3%, respectively.

Quality of life domains—The Breast Cancer Prevention Trial Symptom Checklist assesses the severity of 8 physical symptoms with reliable subscales that are clinically relevant to breast cancer treatment, particularly anti-hormone therapy [32]. We included 3 subscales that are potentially modified by physical activity and weight loss, including cognitive (difficulty concentrating), musculoskeletal (joint pain), and vasomotor (hot flashes) symptoms. Items are scored from 0 to 4 based on symptom bother (“not at all” to “extremely”). The Brief Fatigue Inventory assesses cancer-related fatigue with 3 items assessing severity at “worst”, “usual” and “now” (0 = “no fatigue” and 10 = “fatigue as bad as you can imagine”) and 6 items assessing interference with activity, mood, walking, work, relationships, and life enjoyment [33]. The widely-used Patient Health Questionnaire (PHQ-9) assesses depression severity as the frequency of nine depression symptoms (0 = “not at all” to 3 = “nearly every day”) [34]. Finally, the 32-item Body Image and Relationships Scale assesses body image and sexuality specifically for breast cancer survivors [35]. Items are on a 5-point Likert scale (“strongly disagree” to “strongly agree”) and form three reliable subscales: Strength and Health (e.g., “I felt confident I could make myself stronger”), Social Barriers (e.g., “I was uncomfortable with or embarrassed by physical symptoms that I attribute to my breast cancer treatment”), and Appearance and Sexuality (e.g., “I was comfortable with the appearance of my body,” “I have felt sexually attractive”). Higher scores reflect more negative body image, and scale scores are divided by the number of items per subscale. The scale domains have been shown to improve after a 12-month strength training program for breast cancer survivors [36].

Statistical analyses

Effects of treatment on outcomes were analyzed using paired t-tests. Analysis of weight change was conducted for both completers only and the total sample with missing data imputed as no change from baseline. Completers were defined as completing 75% or more of sessions and returning for 6-month follow-up. Exploratory analyses were conducted with the total sample examining baseline correlates of percent weight loss using t-tests or analysis of variance for categorical variables (history of chemotherapy, current anti-hormone therapy, large vs. small rural, education level) and Pearson correlation for continuous variables (age, time since treatment).

RESULTS

Across the three rural cancer center sites, 120 women were contacted by phone, 84 were screened, 42 were eligible, and 35 enrolled (83% enrollment rate of those who were eligible). There were no differences in age, education, or time since treatment between women who were screened and those who declined screening. The most common reasons for exclusion were not being weight stable (> 10 lb. weight change in previous 3 months; 28%), Stage 0 breast cancer (24%), and unable to walk briskly unassisted due to joint or other medical conditions (19%). One participant who enrolled injured her foot prior to the start of the intervention and was deemed ineligible for participation in the study. Thirty-one women completed the study (91% retention). All three non-completers attended less than 75% of sessions, and two did not return for follow-up. Average session attendance was 91% among the 31 women who completed the study and 85% among all 34 women who enrolled.

Participant characteristics are shown in Table 1. Thirty-five percent of women resided in the town of the collaborating cancer center; the remaining 65% lived an average distance of 55.0 ± 24.9 miles from town.

Among the total sample, with missing data imputed as no weight change, mean weight loss at 6 months was 11.6 ± 6.5 kg, or $12.8 \pm 6.8\%$ of baseline weight. Among completers only, mean weight loss was 12.5 ± 5.8 kg, or $13.9 \pm 5.9\%$ of baseline weight (Table 2). Seventy-four percent of completers and 68% of the total sample achieved 10% loss of baseline weight. Among completers, significant changes from baseline to 6 months were also observed for waist circumference (-9.4 ± 6.3 cm), daily energy intake (-349 ± 550 kcal/day), fruits and vegetables ($+3.7 \pm 4.3$ servings/day), percent kcal from fat ($-12.6 \pm 8.6\%$), and physical activity ($+1235 \pm 832$ kcal/week or $+196.5 \pm 115.5$ min/week); all p 's $\leq .001$. Seventy-one percent of completers met the 225 min/week physical activity goal at 6 months. For serum biomarkers, significant reductions were observed from baseline to 6 months in insulin (16.7% reduction, $p = .006$) and leptin (37.1% reduction, $p < .001$) whereas no change was observed for adiponectin.

Changes in quality of life domains are also shown in Table 2. Significant improvements were seen for joint pain ($p = .001$), depressive symptoms ($p = .001$), and body image subscales ($p = .02$ to $< .001$). On the Body Image and Relationships Scale, women reported, on average, feeling stronger and healthier and having more subjective control over their health (Strength and Health), less impairment in social interactions due to embarrassment about physical symptoms (Social Barriers), and greater satisfaction with appearance and sexual activity (Appearance and Sexuality).

Baseline correlates of percent weight loss were explored. Age, education level, degree of rurality, history of chemotherapy, time since treatment, and current anti-hormone therapy use were not significantly related to successful weight loss ($p = .42$ to $.88$).

DISCUSSION

The results of this study demonstrate feasibility and favorable outcomes of a group phone-based weight loss intervention delivered remotely to rural breast cancer survivors. Average weight loss at 6 months exceeded the 10% goal at 12.8% (11.6 kg) among the total sample and compares favorably to weight losses achieved in other weight control interventions among rural women [16, 37] and urban breast cancer survivors which have ranged from 6 to 10 kg [38-40]. This represents clinically meaningful weight loss believed to favorably modify risk for breast cancer [11] as well as diabetes and cardiovascular disease [19]. Furthermore, the significant reductions observed for insulin and leptin represent favorable modulation of biomarkers implicated in the obesity and breast cancer link [4]. We did not observe a significant change in adiponectin which may require greater weight losses overall [41].

Dietary and physical activity behavioral changes were also significant and consistent with the energy deficit required for the weight losses achieved. The reduction in percent kcal from fat and increase in fruits and vegetables were similar to the intervention goals of large-scale dietary trials targeting primary [42] and secondary breast cancer prevention [43]. The average physical activity level was within the 225 to 300 minutes per week range recommended for weight loss and weight loss maintenance, with 71% of participants who completed the program achieving the 225 minutes per week goal. Irwin et al. demonstrated that a physical activity intervention consisting of 150 minutes per week of moderate intensity exercise modulated insulin and insulin-like growth factors among breast cancer

survivors [44]. These levels of physical activity have been associated with 50% reduction in recurrence and all-cause mortality [45-47].

Improvements in joint pain, depressive symptoms, and body image indicate the intervention also had a positive impact on some important dimensions of quality of life. Breast cancer treatment often negatively impacts body image, sexual desire, and performance resulting in poorer overall quality of life [48-50]. The improvements seen at 6 months in perceptions of appearance, strength, and sexual satisfaction are important proximal benefits of the intervention.

Overall, participants demonstrated a high level of motivation to make diet and physical activity changes and to adhere to the recommendations of the intervention. Ninety-one percent of women completed the 6-month intervention with 90% session attendance among completers. Retention, session attendance, and treatment outcomes reflect the participants' high levels of motivation to engage in lifestyle change. The group conference calls provided opportunity for support and accountability among peers and other breast cancer survivors, which appeared to fill a support gap for many women. Our observations were that the women formed highly cohesive groups that we believe facilitated engagement in behavior change and normalized their experiences both as breast cancer survivors and as women striving for greater weight control. The participants grew to know one another by voice and their stories, and we observed the benefits of group treatment that evolve from cohesiveness, such as interpersonal learning, imparting information to others, and developing optimism and hope for change [51].

The current study has several limitations. The sample reflects the predominantly White non-Hispanic racial composition of the targeted rural areas, and the findings may not generalize to rural racial/ethnic minorities. The diet and physical activity measures are subject to bias inherent in self-report, however, the changes reported are consistent with the weight losses achieved. The study did not have a control group, although the amount of weight loss was clinically meaningful and greater than weight losses typically seen in the absence of intervention. Future randomized controlled trials with sufficient sample size are needed to examine potential effect moderators such as time since treatment and cancer treatment history. In addition, a longer intervention period is needed to examine the effectiveness of using group conference call delivery for sustaining weight loss maintenance for a year or longer. Finally, the intervention needs to be tested against less intensive and less costly interventions. Our previous work has demonstrated that the group phone counseling approach is more cost effective than individual phone counseling for weight loss among rural women [16], and other trials are currently underway to determine the most cost-effective treatment intensity in regards to number, timing, and delivery modality of treatment sessions.

In conclusion, this study demonstrates that weight loss can be achieved among breast cancer survivors who live at a distance from the intervention team in historically underserved areas. Delivery of the intervention through conference calls extends the benefits of group support to remote and even isolated rural locations. We are currently recruiting for a weight loss maintenance trial among rural breast cancer survivors comparing the group conference call intervention to a newsletter intervention on weight loss maintenance from 6 to 18 months (R01 CA155014). This research will inform strategies for disseminating weight control interventions to rural women and other women with access barriers, with the ultimate goal to improve breast cancer survival.

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References

1. Chlebowski RT, Aiello E, McTiernan A. Weight loss in breast cancer patient management. *J Clin Oncol*. 2002; 20(4):1128–1143. [PubMed: 11844838]
2. Kroenke CH, Chen WY, Rosner B, Holmes MD. Weight, weight gain, and survival after breast cancer diagnosis. *J Clin Oncol*. 2005; 23(7):1370–1378. [PubMed: 15684320]
3. Cleveland RJ, Eng SM, Abrahamson PE, Britton JA, Teitelbaum SL, Neugut AI, Gammon MD. Weight gain prior to diagnosis and survival from breast cancer. *Cancer Epidemiol Biomarkers Prev*. 2007; 16(9):1803–1811. [PubMed: 17855698]
4. Hursting SD, Lashinger LM, Wheatley KW, Rogers CJ, Colbert LH, Nunez NP, Perkins SN. Reducing the weight of cancer: mechanistic targets for breaking the obesity-carcinogenesis link. *Best Pract Res Clin Endocrinol Metab*. 2008; 22(4):659–669. [PubMed: 18971125]
5. Renehan AG, Roberts DL, Dive C. Obesity and cancer: pathophysiological and biological mechanisms. *Arch Physiol Biochem*. 2008; 114(1):71–83. [PubMed: 18465361]
6. Knowler WC, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med*. 2002; 346(6):393–403. [PubMed: 11832527]
7. Goodwin PJ, Ennis M, Pritchard KI, Trudeau ME, Koo J, Madarnas Y, Hartwick W, Hoffman B, Hood N. Fasting insulin and outcome in early-stage breast cancer: results of a prospective cohort study. *J Clin Oncol*. 2002; 20(1):42–51. [PubMed: 11773152]
8. Tian YF, Chu CH, Wu MH, Chang CL, Yang T, Chou YC, Hsu GC, Yu CP, Yu JC, Sun CA. Anthropometric measures, plasma adiponectin, and breast cancer risk. *Endocr Relat Cancer*. 2007; 14(3):669–677. [PubMed: 17914097]
9. Rose DP, Gilhooly EM, Nixon DW. Adverse effects of obesity on breast cancer prognosis, and the biological actions of leptin. *Int J Oncol*. 2002; 21(6):1285–1292. [PubMed: 12429979]
10. Campbell KL, McTiernan A. Exercise and biomarkers for cancer prevention studies. *J Nutr*. 2007; 137(1 Suppl):161S–169S. [PubMed: 17182820]
11. Eliassen AH, Colditz GA, Rosner B, Willett WC, Hankinson SE. Adult weight change and risk of postmenopausal breast cancer. *JAMA*. 2006; 296(2):193–201. [PubMed: 16835425]
12. Teras LR, Goodman M, Patel AV, Diver WR, Flanders WD, Feigelson HS. Weight loss and postmenopausal breast cancer in a prospective cohort of overweight and obese US women. *Cancer Causes Control*. 2011; 22(4):573–579. [PubMed: 21327461]
13. Jackson JE, Doescher MP, Jerant AF, Hart LG. A national study of obesity prevalence and trends by type of rural county. *J Rural Health*. 2005; 21(2):140–148. [PubMed: 15859051]
14. Patterson PD, Moore CG, Probst JC, Shinogle JA. Obesity and physical inactivity in rural America. *J Rural Health*. 2004; 20(2):151–159. [PubMed: 15085629]
15. Bettencourt BA, Schlegel RJ, Talley AE, Molix LA. The breast cancer experience of rural women: a literature review. *Psychooncology*. 2007; 16(10):875–887. [PubMed: 17611958]
16. Befort CA, Donnelly JE, Sullivan DK, Ellerbeck EF, Perri MG. Group versus individual phone-based obesity treatment for rural women. *Eat Behav*. 2010; 11(1):11–17. [PubMed: 19962115]
17. Befort CA, Austin H, Klemp JK. Weight control needs and experiences among rural breast cancer survivors. *Psychooncology*. 2010 August 23. Online ahead of print.
18. U.S. Department of Agriculture, Economic Research Service. [21 October 2009] Rural-Urban Commuting Area Codes. 2000. <http://www.ers.usda.gov/Data/RuralUrbanCommutingAreaCodes/2000/>

19. NHLBI Expert Panel on the Identification, Evaluation, and Treatment of Overweight in Adults. Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: Executive summary. *Am J Clin Nutr.* 1998; 68(4):899–917. [PubMed: 9771869]
20. Heymsfield SB, van Mierlo CA, van der Knaap HC, Heo M, Frier HI. Weight management using a meal replacement strategy: meta and pooling analysis from six studies. *Int J Obes Relat Metab Disord.* 2003; 27(5):537–549. [PubMed: 12704397]
21. Ashley JM, St Jeor ST, Perumean-Chaney S, Schrage J, Bovee V. Meal replacements in weight intervention. *Obes Res.* 2001; 9(Suppl 4):312S–320S. [PubMed: 11707559]
22. Wing RR, Jeffery RW, Burton LR, Thorson C, Nissinoff KS, Baxter JE. Food provision vs structured meal plans in the behavioral treatment of obesity. *Int J Obes Relat Metab Disord.* 1996; 20(1):56–62. [PubMed: 8788323]
23. LeCheminant JD, Jacobsen DJ, Hall MA, Donnelly JE. A comparison of meal replacements and medication in weight maintenance after weight loss. *J Am Coll Nutr.* 2005; 24(5):347–353. [PubMed: 16192259]
24. Jeffery RW, Wing RR, Thorson C, Burton LR, Raether C, Harvey J, Mullen M. Strengthening behavioral interventions for weight loss: a randomized trial of food provision and monetary incentives. *J Consult Clin Psychol.* 1993; 61(6):1038–1045. [PubMed: 8113481]
25. Pi-Sunyer FX, Maggio CA, McCarron DA, Reusser ME, Stern JS, Haynes RB, Oparil S, Kris-Etherton P, Resnick LM, Chait A, et al. Multicenter randomized trial of a comprehensive prepared meal program in type 2 diabetes. *Diabetes Care.* 1999; 22(2):191–197. [PubMed: 10333932]
26. Metz JA, Stern JS, Kris-Etherton P, Reusser ME, Morris CD, Hatton DC, Oparil S, Haynes RB, Resnick LM, Pi-Sunyer FX, et al. A randomized trial of improved weight loss with a prepared meal plan in overweight and obese patients: impact on cardiovascular risk reduction. *Arch Intern Med.* 2000; 160(14):2150–2158. [PubMed: 10904458]
27. Frankenfield DC, Rowe WA, Smith JS, Cooney RN. Validation of several established equations for resting metabolic rate in obese and nonobese people. *J Am Diet Assoc.* 2003; 103(9):1152–1159. [PubMed: 12963943]
28. Haskell WL, Lee IM, Pate RR, Powell KE, Blair SN, Franklin BA, Macera CA, Heath GW, Thompson PD, Bauman A. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc.* 2007; 39(8):1423–1434. [PubMed: 17762377]
29. Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. *Am J Clin Nutr.* 2003; 77(5):1171–1178. [PubMed: 12716668]
30. Richardson MT, Leon AS, Jacobs DR Jr, Ainsworth BE, Serfass R. Comprehensive evaluation of the Minnesota Leisure Time Physical Activity Questionnaire. *J Clin Epidemiol.* 1994; 47(3):271–281. [PubMed: 8138837]
31. Montoye, HJ.; Kemper, H.; Saras, W.; Washburn, RA. Measuring physical activity and energy expenditure. Human Kinetics; Champaign, IL: 1996.
32. Cella D, Land SR, Chang CH, Day R, Costantino JP, Wolmark N, Ganz PA. Symptom measurement in the Breast Cancer Prevention Trial: psychometric properties of a new measure of symptoms for midlife women. *Breast Cancer Res Treat.* 2008; 109(3):515–526. [PubMed: 17851765]
33. Mendoza TR, Wang XS, Cleeland CS, Morrissey M, Johnson BA, Wendt JK, Huber SL. The rapid assessment of fatigue severity in cancer patients: use of the Brief Fatigue Inventory. *Cancer.* 1999; 85(5):1186–1196. [PubMed: 10091805]
34. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* 2001; 16(9):606–613. [PubMed: 11556941]
35. Hormes JM, Lytle LA, Gross CR, Ahmed RL, Troxel AB, Schmitz KH. The body image and relationships scale: development and validation of a measure of body image in female breast cancer survivors. *J Clin Oncol.* 2008; 26(8):1269–1274. [PubMed: 18323550]
36. Speck RM, Gross CR, Hormes JM, Ahmed RL, Lytle LA, Hwang WT, Schmitz KH. Changes in the Body Image and Relationship Scale following a one-year strength training trial for breast

- cancer survivors with or at risk for lymphedema. *Breast Cancer Res Treat.* 2010; 121(2):421–430. [PubMed: 19771507]
37. Perri MG, Limacher MC, Durning PE, Janicke DM, Lutes LD, Bobroff LB, Dale MS, Daniels MJ, Radcliff TA, Martin AD. Extended-care programs for weight management in rural communities: the treatment of obesity in underserved rural settings (TOURS) randomized trial. *Arch Intern Med.* 2008; 168(21):2347–2354. [PubMed: 19029500]
 38. de Waard F, Ramlau R, Mulders Y, de Vries T, van Waveren S. A feasibility study on weight reduction in obese postmenopausal breast cancer patients. *Eur J Cancer Prev.* 1993; 2(3):233–238. [PubMed: 8490542]
 39. Jen KL, Djuric Z, DiLaura NM, Buison A, Redd JN, Maranci V, Hryniuk WM. Improvement of metabolism among obese breast cancer survivors in differing weight loss regimens. *Obes Res.* 2004; 12(2):306–312. [PubMed: 14981223]
 40. Klemp JK, Cox S, Befort C, Papsek S, Khan QJ, Sharma P, Yeh HY, Fabian CJ. Feasibility of a diet, exercise, and behavior modification intervention for post-menopausal breast cancer survivors. *Cancer Res.* 2009; 69(24):557S.
 41. Madsen EL, Rissanen A, Bruun JM, Skogstrand K, Tonstad S, Hougaard DM, Richelsen B. Weight loss larger than 10% is needed for general improvement of levels of circulating adiponectin and markers of inflammation in obese subjects: a 3-year weight loss study. *Eur J Endocrinol.* 2008; 158(2):179–187. [PubMed: 18230824]
 42. Prentice RL, Caan B, Chlebowski RT, Patterson R, Kuller LH, Ockene JK, Margolis KL, Limacher MC, Manson JE, Parker LM, et al. Low-fat dietary pattern and risk of invasive breast cancer: the Women's Health Initiative Randomized Controlled Dietary Modification Trial. *JAMA.* 2006; 295(6):629–642. [PubMed: 16467232]
 43. Chlebowski RT, Blackburn GL, Thomson CA, Nixon DW, Shapiro A, Hoy MK, Goodman MT, Giuliano AE, Karanja N, McAndrew P, et al. Dietary fat reduction and breast cancer outcome: interim efficacy results from the Women's Intervention Nutrition Study. *J Natl Cancer Inst.* 2006; 98(24):1767–1776. [PubMed: 17179478]
 44. Irwin ML, Varma K, Alvarez-Reeves M, Cadmus L, Wiley A, Chung GG, Dipietro L, Mayne ST, Yu H. Randomized controlled trial of aerobic exercise on insulin and insulin-like growth factors in breast cancer survivors: the Yale Exercise and Survivorship study. *Cancer Epidemiol Biomarkers Prev.* 2009; 18(1):306–313. [PubMed: 19124513]
 45. Sternfeld B, Weltzien E, Quesenberry CP Jr, Castillo AL, Kwan M, Slattery ML, Caan BJ. Physical activity and risk of recurrence and mortality in breast cancer survivors: findings from the LACE study. *Cancer Epidemiol Biomarkers Prev.* 2009; 18(1):87–95. [PubMed: 19124485]
 46. Holick CN, Newcomb PA, Trentham-Dietz A, Titus-Ernstoff L, Bersch AJ, Stampfer MJ, Baron JA, Egan KM, Willett WC. Physical activity and survival after diagnosis of invasive breast cancer. *Cancer Epidemiol Biomarkers Prev.* 2008; 17(2):379–386. [PubMed: 18250341]
 47. Irwin ML, Smith AW, McTiernan A, Ballard-Barbash R, Cronin K, Gilliland FD, Baumgartner RN, Baumgartner KB, Bernstein L. Influence of pre- and postdiagnosis physical activity on mortality in breast cancer survivors: the health, eating, activity, and lifestyle study. *J Clin Oncol.* 2008; 26(24):3958–3964. [PubMed: 18711185]
 48. Fobair P, Stewart SL, Chang S, D'Onofrio C, Banks PJ, Bloom JR. Body image and sexual problems in young women with breast cancer. *Psychooncology.* 2006; 15(7):579–594. [PubMed: 16287197]
 49. Ganz PA. Breast cancer, menopause, and long-term survivorship: critical issues for the 21st century. *Am J Med.* 2005; 118(Suppl 12B):136–141. [PubMed: 16414339]
 50. Carver CS, Pozo-Kaderman C, Price AA, Noriega V, Harris SD, Derhagopian RP, Robinson DS, Moffat FL Jr. Concern about aspects of body image and adjustment to early stage breast cancer. *Psychosom Med.* 1998; 60(2):168–174. [PubMed: 9560865]
 51. Yalom, ID. *The Theory and Practice of Group Psychotherapy.* BasicBooks; New York: 1995.

Fig 1.
Weight (kg) at baseline and 6 months among study completers (n = 31)

Table 1**Weekly session topics for weight loss intervention**

Week 1 – Getting Started: Program Requirements and Diet Guidelines
Week 2 – Self-Monitoring: A Key to Success
Week 3 – Get Moving to Better Health: Exercise Benefits, Recommendations, and Resources
Week 4 – Goal Setting for Success: Using SMART Goals
Week 5 – Fruits and Veggies: More Matters
Week 6 – Physical Activity Benefits for Breast Cancer Survivors
Week 7 – Courage and Strength: Resistance Training for Breast Cancer Survivors
Week 8 – Food Labels: Understanding Labels and Health Claims
Week 9 – Taking Charge of What’s Around You: Understanding Your Triggers
Week 10 – Grocery Shopping: Finding Budget-Friendly Healthy Foods in Your Area
Week 11 – Eating on the Go: Healthy Options for Snacking and Eating Out
Week 12 – Eating More for Less: The Importance of Energy Density
Week 13 – Nutrition and Breast Cancer
Week 14 – How Do You See Yourself? Body Image after Breast Cancer
Week 15 – MyPyramid Overview
Week 16 – My Personal Plan for Meal Planning
Week 17 – Maintaining Motivation
Week 18 – Menopausal symptoms; Reconstruction
Week 19 – Mental Traps: Positive Thinking for Long-Term Success
Week 20 – Relapse Prevention: Planning for Roadblocks
Week 21 – Holiday and Potluck Eating
Week 22 – Making Social Cues Work for You
Week 23 – Managing Stress
Week 24 – Planning for the Future

Table 2

Participant baseline characteristics (n = 34)

	Mean(SD) or n (%)
Age	58.9 (7.8) (range = 46 – 74)
BMI (kg/m ²)	33.7 (4.4) (range = 27 – 44)
Rurality ^a	
Large rural	17 (50%)
Small and Isolated rural	17 (50%)
Race, White non-Hispanic	33 (97%)
Marital status	
Married	28 (82%)
Divorced/Separated/Single	4 (12%)
Widowed	2 (6%)
Education level	
H.S. degree or less	9 (26%)
Some college	15 (44%)
College degree +	10 (29%)
Employment status	
Full-time	21 (62%)
Part-time	5 (15%)
Retired	6 (18%)
Not employed	2 (6%)
Income	
< \$20k	2 (6%)
\$20-60k	22 (65%)
> \$60k	10 (29%)
Time since treatment, years	3.1 (1.6) (range = .25 – 7)
Cancer stage, chart-verified	
Stage I	18 (53%)
Stage II	13 (38%)
Stage III	3 (9%)
Anti-hormone therapy, % current	21 (62%)
BrCa surgery, % yes	
Lumpectomy	24 (71%)
Mastectomy	10 (29%)
Chemotherapy, % yes	20 (59%)
Radiation, % yes	26 (76%)
Co-morbid conditions	
Hypertension	22 (63%)
Diabetes	7 (20%)
Arthritis/arthralgia	24 (71%)

^aRural Urban Commuting Area Codes; Large rural core = areas in which primary flow is within an urban cluster of 10,000 to 49,999; Small rural core = the primary flow is within an urban cluster of 2,500 to 9,999; Isolated rural = the primary flow is to a tract outside any urban area or cluster.

Table 3

Means (SD) for measures at baseline and 6 months among study completers (n = 31)

	Baseline Mean (SD)	6 months Mean (SD)	p value ^a (change)
Weight (kg)	89.8 (13.6)	77.2 (12.5)	< .001
BMI (kg/m ²)	34.1 (4.4)	29.3 (4.2)	< .001
Waist circumference (cm)	101.4 (10.2)	92.8 (10.7)	< .001
Physical activity (kcal/week)			
Kcal/week	680 (812)	1912 (1129)	< .001
Min/week	100.0 (130.9)	296.5 (162.9)	< .001
Diet			
Daily kcal	1639 (489)	1311 (334)	.001
Fruit and vegetable servings/day	4.6 (2.9)	7.9 (4.3)	< .001
% kcal from fat	37.6 (7.3)	25.8 (9.6)	< .001
Serum biomarkers			
Insulin (μIU/ml)	10.5 (8.6)	6.0 (4.4)	.006
Leptin (ng/ml)	56.2 (22.0)	32.3 (22.1)	< .001
Adiponectin (μg/ml)	9.6 (3.1)	9.8 (3.1)	.58
Breast Cancer Prevention			
Trial Symptom Checklist			
Cognitive symptoms	.86 (1.04)	.76 (1.01)	.48
Joint pain	1.95 (1.35)	1.10 (1.09)	.001
Hot flashes	1.00 (1.04)	.83 (.92)	.06
Brief Fatigue Inventory	2.08 (1.69)	1.57 (2.00)	.12
PHQ-9 (Depression)	4.50 (3.36)	2.82 (2.70)	.001
Body Image & Relationships Questionnaire ^b			
Strength and Health	3.07 (.64)	2.13 (.67)	< .001
Social Barriers	2.02 (.59)	1.76 (.64)	.02
Appearance and Sexuality	2.96 (.50)	2.26 (.41)	< .001

^aPaired t-test.^bHigher scores reflect worse body image.