



Published in final edited form as:

*J Cancer Surviv.* 2013 September ; 7(3): 355–368. doi:10.1007/s11764-013-0279-5.

## A Randomized Trial of a Facebook-based Physical Activity Intervention for Young Adult Cancer Survivors

Carmina G. Valle<sup>1,2,3</sup>, Deborah F. Tate<sup>1,2,3,4</sup>, Deborah K. Mayer<sup>3,5</sup>, Marlyn Allicock<sup>1,2,3</sup>, and Jianwen Cai<sup>2,6</sup>

<sup>1</sup>Department of Nutrition, University of North Carolina at Chapel Hill, Chapel Hill, NC

<sup>2</sup>Gillings School of Global Public Health, University of North Carolina at Chapel Hill, Chapel Hill, NC

<sup>3</sup>Lineberger Comprehensive Cancer Center, University of North Carolina at Chapel Hill, Chapel Hill, NC

<sup>4</sup>Department of Health Behavior, University of North Carolina at Chapel Hill, Chapel Hill, NC

<sup>5</sup>School of Nursing, University of North Carolina at Chapel Hill, Chapel Hill, NC

<sup>6</sup>Department of Biostatistics, University of North Carolina at Chapel Hill, Chapel Hill, NC

### Abstract

**Purpose**—Over half of young adult cancer survivors do not meet physical activity (PA) guidelines. PA interventions can enhance health and quality of life among young adult cancer survivors. However, few exercise interventions have been designed and tested in this population. This study evaluated the feasibility and preliminary efficacy of a 12-week, Facebook-based intervention (FITNET) aimed at increasing moderate-to-vigorous intensity PA compared to a Facebook-based self-help comparison (SC) condition.

**Methods**—Young adult cancer survivors (n=86) were randomly assigned to the FITNET or SC group. All participants were asked to complete self-administered online questionnaires at baseline and after 12 weeks.

**Results**—Seventy-seven percent of participants completed post-intervention assessments, and most participants reported using intervention components as intended. Participants in both groups would recommend the program to other young adult cancer survivors (FITNET: 46.9% vs. SC: 61.8%;  $p=0.225$ ). Over 12 weeks, both groups increased self-reported weekly minutes of moderate-to-vigorous PA (FITNET: 67 minutes/week,  $p=0.009$  vs. SC: 46 minutes/week,  $p=0.045$ ), with no significant difference between groups. Increases in light PA were 135 minutes/week greater in the FITNET group relative to the SC group ( $p=0.032$ ), and the FITNET group reported significant weight loss over time ( $-2.1$  kg,  $p=0.004$ ;  $p=0.083$  between groups).

**Conclusions**—Facebook-based intervention approaches demonstrated potential for increasing PA in young adult cancer survivors.

---

Corresponding Author: Carmina G. Valle, Ph.D., M.P.H., Department of Nutrition, Gillings School of Global Public Health, University of North Carolina at Chapel Hill, CB #7294, Chapel Hill, NC 27599, USA, Phone: (919) 843-4211; Fax: (919) 843-6663, carmina.valle@unc.edu.

**Clinical Trials Registration:** ClinicalTrials.gov, NCT01349153

**Conflict of Interest Statement:** The authors declare that they have no conflict of interest.

**Implications for Cancer Survivors**—Social networking sites may be a feasible way for young adult cancer survivors to receive health information and support to promote PA and healthy behaviors.

### Keywords

young adults; cancer survivors; physical activity; social networking site; randomized trial; intervention

### Introduction

Cancer is the most common cause of disease-related death among adolescents and young adults between the ages of 15–39 [1]. Cancer exacts a tremendous burden, as survivors have greater medical and psychological needs and may be at increased risk for mortality, second cancers, recurrence, cardiovascular disease, diabetes and other chronic illnesses [2–5]. For young adult cancer survivors, defined here as those diagnosed between the ages of 18 and 39, this can mean many more years with increased risks and co-morbidities, which may be due in part to cancer treatment, genetic predisposition, and lifestyle behaviors [5–7]. As such, young adult cancer survivors are a vulnerable population with unique needs [6–8]. Considering the growing body of evidence that regular physical activity (PA) may help prevent recurrence and improve post-treatment quality of life in cancer survivors [3, 9–11], PA interventions represent important opportunities to potentially ameliorate these risks and provide benefits for young adult cancer survivors [5, 6, 8, 12].

Currently there are an estimated 565,450 young adult cancer survivors between the ages of 20 and 39 in the United States [13]. Yet, research examining the needs of young adult cancer survivors diagnosed specifically during young adulthood, as opposed to during childhood, has emerged only recently [14–17]. Few studies have investigated PA behaviors in young adult cancer survivors [18–23]. Despite their increased risks for long-term morbidity [7] and the positive effects of PA, an estimated 59.3% of U.S. cancer survivors between the ages of 18–39 do not meet physical activity guidelines, and 52.1% are overweight or obese [24]. A more recent survey of 60 young adult cancer survivors in the U.S., ages 18–40, found that 63% were not engaging in the recommended levels of either moderate- or vigorous-intensity PA [20], which is greater than the proportion of U.S. young adults, ages 18–40, that are physically inactive (58.9%) [25]. While young adult cancer survivors have expressed interest in lifestyle interventions and PA counseling [17, 19, 20, 23], few empirical studies have tested PA interventions among cancer survivors diagnosed in young adulthood and outcomes of randomized trials have not been published to date. Therefore, there is a need to evaluate behavioral interventions to promote healthy PA behaviors aimed specifically at young adult cancer survivors.

Young adult cancer survivors have shown specific preferences for intervention approaches that offer social support and are delivered remotely [26], and peer support and technology-based approaches are emerging as effective strategies to reach and promote health among young adult cancer survivors [27]. While web-based behavioral interventions have shown promise for increasing PA [28, 29], few randomized controlled trials have evaluated the potential of online social networking sites as an intervention delivery channel [30–32]. Online social networks are increasingly being used for health communication [33] and have the potential to promote healthy behaviors [34] and facilitate social support [35], factors that may encourage increased PA among young adult cancer survivors. A recent survey (n=1,060) indicated that among those ages 18–24, almost 90% had viewed health-related information or ever done health-related activities via social media and over 80% were likely to share health information through social media [36]. Facebook, in particular, provides the

opportunity for patients and health professionals to communicate and share experiences related to a specific disease and its management [37]. One study demonstrated that Facebook user groups related to malignant neoplasms had the largest number of individuals associated with them, which is consistent with the high prevalence of cancer in the overall population [37]. With 1 billion Facebook users to date [38] and an estimated 92% of adults on social networking sites using Facebook [39], it has become increasingly important to empirically investigate the potential to deliver health communication interventions through this existing technology platform.

Therefore, we conducted the first randomized controlled trial to evaluate the feasibility and preliminary efficacy of a behavioral intervention, delivered through Facebook, that was aimed at improving PA behaviors among young adult cancer survivors. Specific goals were to determine adherence to and acceptability of Facebook-based intervention approaches, and to evaluate whether the approaches would produce differences in moderate-to-vigorous intensity PA (MVPA). We hypothesized that young adult cancer survivors assigned to a Facebook-based intervention (FITNET) group would achieve greater self-reported MVPA minutes per week at 12-week follow-up relative to those in the Facebook self-help comparison (SC) group. Secondary assessments included body weight, body mass index, and quality of life.

## Methods

### Participants

We recruited and enrolled young adult cancer survivors by working with community-based organizations and advocates dedicated to young adults with cancer. Interested organizations posted recruitment advertisements through various mass distribution channels such as Facebook, Twitter, listservs, flyers and email. Recruitment strategies also included disseminating study information through a mass email to the University of North Carolina at Chapel Hill (UNC) community, flyers in UNC clinics, message boards, and via the study administrator's personal Facebook and Twitter accounts. Participants met the following eligibility criteria: young adults between ages 21–39 diagnosed with cancer (excluding non-melanoma skin cancer) at age 18 or older; 1 year beyond date of diagnosis with no evidence of progressive disease or second primary cancers; completed cancer treatment; English-speaking and writing; no pre-existing medical condition(s) or contraindications that preclude adherence to an unsupervised exercise program, including cardiovascular disease, heart failure, pulmonary conditions, renal disease, and severe orthopedic conditions; not adhering to the American Cancer Society's recommendation of at least 150 minutes of moderate-intensity exercise per week (<150 minutes/week) [11]; having access to Internet service and an active Facebook account.

Recruitment advertisements directed interested individuals to the study website with a link to a brief, online screening questionnaire. To confirm eligibility, the self-administered screener assessed: current age; cancer diagnosis when at least 18 years old; cancer diagnosis at least 1 year prior; completion of cancer treatment; regular access to the Internet; active Facebook account; 2 items assessing weekly minutes of moderate-intensity PA [40]; and the Physical Activity Readiness questionnaire (PAR-Q), a standard 7-item questionnaire that evaluates possible contra-indications to exercise [41]. Respondents that endorsed any of the PAR-Q items were excluded.

### Study Design

This study was a 2-arm randomized trial, delivered through Facebook and the Internet, that aimed to increase MVPA among young adult cancer survivors to at least 150 minutes per

week with a focus on walking. Based on screening responses, the study administrator emailed eligible individuals a study invitation with a unique web link to an online informed consent. When the number of consenting survivors approached the target sample size, all participants were emailed a link to a self-administered online baseline questionnaire. Following baseline data collection and using a computer-generated random numbers list, participants were randomly assigned with equal allocation to one of two study groups: Facebook-based self-help comparison (SC; n=41) or Facebook-based intervention (FITNET; n=45). After completion of the 12-week study period, follow-up data collection occurred using another online self-administered questionnaire. If necessary, we sent emails and Facebook messages to non-respondents prompting them to complete the follow-up questionnaire. All participants gave online informed consent, and participants received a \$30 gift card for completion of the baseline and post-intervention online questionnaires. The study was conducted from April-December 2011 and was approved by the Public Health-Nursing Institutional Review Board of UNC.

### **Procedures for Self-help Comparison (SC) Group**

Table 1 provides an overview of the differences between study group procedures. All participants received a Digi-Walker SW-200 pedometer (Yamax, Tokyo, Japan) through the mail with instructions on how to use the step counter and record their total daily steps. The study administrator sent participants an introductory email stating the intervention goal and recommendation to increase their moderate-intensity PA levels to at least 150 minutes per week. Once enough participants accrued to meet the planned sample size, the study administrator sent Facebook friend requests and invited participants to become a member of either the SC or FITNET Facebook groups. This ensured that all group members gained access to the groups at the same time and experienced similar opportunities to participate in peer support activities. The Facebook groups were “secret,” a functionality with the following restrictions: 1) membership is by invitation only; 2) the group does not appear in search results or in member profiles; and 3) only members can see the group information and content.

After participants had initially joined the Facebook group, the study administrator posted to the group wall a welcome message, a reminder about respectful Facebook communications and maintaining confidentiality, and resources on Facebook privacy. Each week during the 12-week study period, participants received a message through the Facebook messages feature with basic information and tips related to PA and several links to publicly available websites. The websites included resources on PA specifically for cancer survivors and covered other topics such as PA benefits, overcoming exercise barriers, goal-setting, and social support. Other web resources focused on cancer survivorship, including some on young adults in particular, and all were from credible sources (e.g., National Cancer Institute (NCI) [42], LIVESTRONG [43], American Cancer Society [44]). While SC group participants had access to all of the Facebook group features (e.g., ability to post comments, links, videos to the group wall), the study administrator did not post any discussion questions to encourage interaction, so any posting or interaction was self-directed.

### **Procedures for FITNET Group**

FITNET participants received all of the above plus additional intervention components that were designed based primarily on social cognitive theory [45] and focused on strategies to enhance self-efficacy, behavioral capability, self-monitoring and social support. The Facebook message sent to FITNET participants during each of the 12 weeks was an expanded behavioral lesson with more specific guidance on PA and behavioral strategies, such as enlisting social support, incorporating PA into daily routines, problem solving, self-monitoring and maintaining PA. We modified lessons and tips used in previous intervention

studies [46–48] to be suitable for self-directed learning and appropriate for young adult cancer survivors.

In addition, participants had password-protected access to a separate study website with a goal-setting tool and PA diary. The website offered tips on setting short-term, achievable PA goals and allowed survivors to specify weekly goals (i.e., numbers of 10-minute blocks of activity). Participants were encouraged to wear their pedometers every day and to record their exercise type, intensity and duration at the end of each day using the PA tracker. In addition, the PA diary included a separate entry for walking steps, and the website provided personalized feedback charts comparing individuals' recorded PA minutes with his/her weekly exercise goal and in comparison to the overall intervention goal of 150 minutes per week.

To foster group interaction and social support within the Facebook group, the study administrator posted various prompts to the group wall, including: 1) discussion questions; 2) links to videos, exercise- or cancer-related news articles, or electronic PA resources; and 3) a weekly reminder to set an exercise goal, log daily PA, and check out the Facebook group. During the first four weeks, discussion questions were posted twice a week to support initial group interactions; one question related to PA and the other to cancer survivorship. Throughout the last eight weeks of the study, discussion questions were posted once a week. The study administrator also posted one other resource and a reminder during each week of the program, answered any questions posted by participants, and offered general words of encouragement and support.

## Measures

Baseline and post-intervention survey items included measures of the primary outcomes of PA and feasibility, and secondary outcomes of body weight and quality of life.

**Demographics and health-related variables**—We assessed age, race/ethnicity, education level, marital status, income, employment status and living arrangements. We also asked participants about their cancer type, date of diagnosis, cancer stage and treatment type.

**Physical activity**—PA was assessed using the leisure score index of the Godin Leisure Time Exercise Questionnaire (GLTEQ), which includes four items regarding the frequency of strenuous, moderate and mild intensity (i.e., light activities, such as yoga and easy walking) exercise over the last week [49]. The self-administered GLTEQ is appropriate for assessing leisure time activity in a community setting and has been used in several studies of PA in cancer survivors [50–52]. Consistent with these studies and to allow for comparability, we modified the GLTEQ by asking participants to report times per week of strenuous, moderate and light exercise, along with average duration by intensity. Minutes per week of PA were calculated by multiplying days and minutes of reported activity for each intensity; for baseline and post-intervention time points, MVPA was calculated from the sum of moderate and strenuous exercise, and total PA from the sum of moderate, strenuous and light exercise. Change in PA for each PA category was calculated by subtracting the baseline measure from the post-intervention measure. The GLTEQ has demonstrated test-retest reliability of 0.62–0.81 and concurrent validity of 0.32–0.56 when compared to several self-report and objective exercise measures ( $V_{O_2}$  max, accelerometer) in different populations [49, 53–55].

**Adherence and acceptability**—We collected data on adherence to study components in the 12-week assessment. Measures were adapted from previous studies [46, 47] and assessed

intervention exposure, attention, and recall, as well as satisfaction with intervention components and whether participants would recommend the intervention to peers. Objective engagement data on goal-setting frequency, number of PA entries, number of walking steps entries, and number of posts to the Facebook group wall were also collected. Tertiles of intervention adherence were constructed from objective data on numbers of PA entries, steps entries, weekly goals, and Facebook posts, and from a composite score that summed tertile scores of PA entries and weekly goals.

**Height and weight**—Participants self-reported their height and weight with survey items used in the NCI's Health Information National Trends Survey [56]. The questions included: “*About how tall are you without shoes?*” (feet, inches) and “*About how much do you weigh without shoes?*” (pounds). Body mass index (BMI) was calculated using the standard equation [weight (kg)/(height (m))<sup>2</sup>] [57].

**Quality of life**—Participants completed the Functional Assessment of Cancer Therapy-General (FACT-G) questionnaire, originally developed by Cella to assess four primary domains of quality of life (QOL): physical well-being, social/family well-being, emotional well-being, and functional well-being [58]. The FACT-G (version 4, 2007) consists of 27 Likert-type items rated on a 0–4 point scale of agreement from “*not at all*” to “*very much*.” The range of possible scores was 0–108, with higher scores indicating a better QOL. The FACT-G has been shown to be reliable and valid among cancer patient populations with internal consistency alphas on the subscales from 0.60 to 0.89 [58–60].

## Statistical Analyses

All data analyses were performed using SAS statistical software (Version 9.2, Cary, NC). We estimated study sample size based on assumptions of within-group standard deviation and effect sizes from previous 12-week PA intervention trials among cancer survivors [61, 62]. To observe a group difference of 92 minutes per week of MVPA, we aimed for a sample size of  $n=50$  per group to test our primary hypothesis. Assuming 30% attrition, a loss of 15 participants from each group would result in 80% power ( $\alpha = 0.05$ , two-tailed  $t$ -test) to detect a group difference of 111 MVPA minutes per week.

We assessed measures for normality, conducted outlier analyses, and used transformations when necessary. To maximize sample sizes for analyses, all self-reported data were used, with any outliers ( $z$ -scores  $> 3.29$ ) adjusted to be one unit lower than the next highest reported measure [61, 63]. Outliers for PA outcome data were identified and adjusted for five participants (FITNET:  $n=3$ ; SC:  $n=2$ ). Descriptive analyses compared groups on baseline demographics and health-related variables using chi-square or Fisher's exact tests for categorical variables and/or Student's  $t$ -tests for continuous variables. To evaluate the primary outcome of PA and secondary outcomes, we compared the groups on changes in PA behaviors and secondary outcomes over time. Under the assumption that follow-up data were missing completely at random, we used maximum likelihood methods (PROC GENMOD) to conduct mixed model analyses with repeated measures. Models included a random intercept, time, group, and group  $\times$  time variables to estimate each outcome measure at baseline and follow-up, and to test for statistical differences between groups in changes over 12 weeks. For the outcome analyses reported, we used all available data at baseline ( $n=86$ ) and at follow-up ( $n=66$ ) and estimated mean changes in unadjusted models and with adjustment for covariates: months post cancer diagnosis, marital status, and Facebook use time. Data were also analyzed when baseline observations were carried forward (BOCF) for dropouts as in an intent-to-treat approach. Spearman correlations were calculated to assess relationships between intervention adherence or change in weight and change in PA outcomes. In addition, logistic regression procedures were used to compare the groups on

the proportion achieving PA guidelines, and chi-square tests were performed to assess level of statistical significance.

To explore the relationship between intervention adherence and PA outcomes at 12 weeks, ANCOVAs were conducted in a subsample of FITNET completers and SC completers. Analyses evaluated whether PA outcomes differed among tertiles of adherence while adjusting for baseline PA values. All reported *p*-values are for two-sided tests with no adjustment for multiple comparisons; *p*-values of 0.05 are considered statistically significant.

## Results

### Baseline Characteristics

Of 167 potential participants who completed the screener between April-August 2011, 58% (97 of 167) were eligible and consented to participate, and 89% (86 of 97) completed the baseline questionnaire and were randomized (Figure 1). Reasons for exclusion were cancer diagnosis less than 1 year prior (*n*=22), endorsed 1 PAR-Q items (*n*=13), exercising 150 minutes per week (*n*=10), currently undergoing cancer treatment (*n*=6), age younger than 21 or older than 39 (*n*=5), never diagnosed with cancer (*n*=2), cancer diagnosis before age 18 (*n*=1), and no active Facebook account (*n*=1). Participants were a mean age of 31.7 (SD=5.1) years old, 91% female, and mostly of non-Hispanic white race (91%). The young adult cancer survivors reported diagnoses of 18 different cancer types (20% breast) and were on average 58.2 months (SD=44.0) post-diagnosis (Table 2). There were no differences in baseline characteristics between groups, except FITNET participants reported higher daily Facebook use ( $2.6 \pm 1.4$  vs.  $2.0 \pm 1.0$ ; *p*=0.049).

### Retention

Seventy-seven percent (*n*=66) of randomized participants completed the final questionnaire. Retention rates did not differ between groups (FITNET: 71.1 % vs. SC: 82.9%;  $\chi^2=1.68$ ; *p*=0.195), but non-completers were disproportionately less likely to be married ( $\chi^2=4.17$ ; *p*=0.041) and were fewer months post-diagnosis compared to completers (*t*=3.31; *p*=0.001).

### Changes in Physical Activity

From baseline to 12 weeks, the estimated increase in weekly minutes of MVPA (Table 3, unadjusted model) was 67.0 minutes (95% CI: 13.6, 143.4; *p*=0.009) in the FITNET group and 46.3 minutes (95% CI: 0.8, 109.0; *p*=0.045) in the SC group, with no significant group x time interaction. There was a significant difference between groups in estimated change in light PA minutes/week over 12 weeks (*p*=0.032), with FITNET participants increasing by about 135 min/week more than SC participants. The FITNET group reported an increase of 237.0 weekly minutes of total PA (95% CI: 74.0, 501.7; *p*=0.001) compared to 75.7 minutes (95% CI: 12.6, 157.6; *p*=0.015) in the comparison group, with the group x time interaction suggestive of a difference between groups in minutes over time (*p*=0.078) (Table 3, unadjusted model).

The adjusted models and BOCF analyses (data not shown), demonstrated consistent results with some attenuation of group differences, but significant increases over time in weekly minutes of MVPA, light PA and total PA remained for the FITNET group and for total PA in the SC group. At 12 weeks, no difference was observed in the achievement of recommended PA levels (150+ moderate minutes/week or 75+ vigorous minutes/week) (FITNET= 43.7% vs. SC=44.1%;  $\chi^2=0.001$ ; *p*=0.976). In BOCF analyses, the proportions were smaller, and the group effect remained nonsignificant (42.2% vs. 39.0%;  $\chi^2=0.091$ ; *p*=0.763).

## Adherence and Engagement

All study completers recalled receiving Facebook messages, and there was no difference between groups in the proportion that reported receiving 10 or more messages (FITNET=81.3% vs. SC=82.4%;  $\chi^2 = .01$ ;  $p = 0.908$ ). A total of 62.5% of intervention participants and 79.4% of SC participants reported usually reading *some to all/most* of the Facebook messages ( $\chi^2 = 2.30$ ;  $p = 0.129$ ). Both groups reported using various Facebook group features 1 to 2 days a week (1 to 6 with 6=*several times a day*): visited the Facebook group (FITNET=2.6  $\pm$  1.3; SC=2.9  $\pm$  1.1;  $p = 0.271$ ); saw a FITNET group post in their News Feed (FITNET=2.8  $\pm$  1.0; SC=2.6  $\pm$  1.0;  $p = 0.456$ ); and read FITNET group discussions (FITNET=2.7  $\pm$  1.1; SC=2.6  $\pm$  1.0;  $p = 0.886$ ).

FITNET participants posted a total of 153 Facebook comments to the group wall over 12 weeks compared to 188 comments by SC participants. There was no difference in mean number of posts over the 12-week program (FITNET=3.4  $\pm$  4.6 vs. SC=4.6  $\pm$  7.8;  $p = 0.388$ ), and almost half of participants in both groups made 2 or more Facebook posts over the course of the study period (FITNET: 48.9%,  $n = 22$ ; SC: 48.8%,  $n = 20$ ). In exploratory adherence analyses among FITNET group completers, participants in the highest tertile of Facebook posting commented an average of 10  $\pm$  5.6 times. Post-intervention minutes of PA did not differ among Facebook posting tertiles for MVPA ( $F_{2, 28} = 1.29$ ,  $p = 0.291$ ), light ( $F_{2, 28} = 0.81$ ,  $p = 0.456$ ), or total PA ( $F_{2, 28} = 1.78$ ,  $p = 0.186$ ). Similarly, number of Facebook posts was not associated with PA outcomes in the SC group, as PA minutes at 12 weeks were not different across tertiles (MVPA:  $F_{2, 30} = 0.15$ ,  $p = 0.863$ ; light:  $F_{2, 30} = 1.24$ ,  $p = 0.304$ ; total:  $F_{2, 30} = 0.17$ ,  $p = 0.842$ ).

**FITNET only**—FITNET participants set an average of 4.2  $\pm$  4.8 goals (range: 0–13) over 12 weeks, and 66.7% ( $n = 30$ ) used the goal-setting feature at least once. Participants in the highest tertile of goal setting set at least 83% or 10 weekly goals (Mean=11.6  $\pm$  1.0) and reported higher vigorous PA at post-intervention compared to individuals in tertile 2 (82.7 minutes/week, SE=16.9 vs. 30.7 minutes/week, SE=17.7;  $p = 0.043$ ). Differences across goal-setting tertiles in weekly minutes of MVPA showed a trend toward significance ( $F_{2, 28} = 2.44$ ,  $p = 0.105$ ), while other PA outcomes did not differ among goal-setting tertiles.

Participants submitted a mean of 21.9  $\pm$  37.9 PA entries (range: 0–170) and 13.1  $\pm$  24.2 steps entries (range: 0–78) over the 12-week program with 71.1% ( $n = 32$ ) tracking any exercise data at least once. Frequency of PA entries decreased over the study period from a mean of 2.1  $\pm$  3.4 entries in week 1 to 1.5  $\pm$  3.4 during week 12. Similarly, steps entries declined from an average of 1.3  $\pm$  2.2 to 0.7  $\pm$  1.7 over 12 weeks. The proportion of participants logging either PA or steps declined from 57.8% ( $n = 26$ ) in week 1 to 24.4% ( $n = 11$ ) in week 12.

In dose-response analyses, participants in the highest tertile of PA entries reported more MVPA minutes compared to tertile 2 (222.9 minutes/week, SE=49.6 vs. 72.7 minutes/week, SE=51.4;  $p = 0.039$ ) and greater vigorous PA minutes relative to those in tertile 2 (82.6 minutes/week, SE=16.6 vs. 30.3 minutes/week, SE=16.6;  $p = 0.034$ ) at 12 weeks. For number of steps entries, tertiles of participants did not differ in PA outcomes. When ranking participants according to a composite score of adherence to logging PA entries and setting weekly goals, those in the tertile of highest participation reported greater MVPA minutes as compared to those in tertile 2 (222.9 minutes/week, SE=49.6 vs. 72.7 minutes/week, SE=51.4;  $p = 0.039$ ), but was not different from those with the lowest participation (222.9 minutes/week, SE=49.6 vs. 203.4 minutes/week, SE=52.0;  $p = 0.792$ ).



## Acceptability and Satisfaction

Both groups agreed (1=*strongly disagree* to 7=*strongly agree*) that accessing study information was very easy (FITNET=5.1 ± 1.4; SC=5.7 ± 1.5;  $p=0.087$ ), and that accessing study information was an effective way to get information about exercise (FITNET= 4.9 ± 1.4; SC=5.2 ± 1.9;  $p=0.348$ ). On average, participants agreed with the statement “*I enjoyed participating in this study*” (FITNET=4.6 ± 1.7; SC=4.9 ± 1.9;  $p=0.480$ ). At follow-up, 46.9% of FITNET participants and 61.8% of SC participants agreed or strongly agreed with the statement, “*I would recommend the FITNET program to other young adult cancer survivors*” ( $\chi^2= 1.47$ ;  $p=0.225$ ).

## Changes in Body Weight, BMI and QOL

Comparisons between the groups in body weight, BMI and QOL are shown in Table 3. At 12 weeks, the FITNET group had lost an estimated -2.1 kg (95% CI: -3.6, -0.7;  $p=0.004$ ) compared to no significant weight loss in the SC group (-0.1 kg, 95% CI: -1.9, 1.7;  $p=0.904$ ); weight changes over time were not different between groups, but approached significance ( $p=0.083$ ). There was no difference between groups in reported changes in QOL over 12 weeks. In unadjusted and adjusted analyses with BOCF (data not shown), weight loss over time remained significant in the FITNET group (both  $p=0.041$ ), and the group x time interaction was attenuated (both  $p=0.219$ ). Among FITNET participants, the association between change in vigorous PA and weight loss over 12 weeks approached significance ( $r_s=-0.27$ ,  $p=0.056$ ), while change in PA was not associated with weight loss for SC participants (all  $p>0.05$ ).

## Discussion

The FITNET study is the first to report randomized trial outcomes of a Facebook-based intervention to promote PA in young adult cancer survivors and demonstrates that delivery of behavioral interventions through Facebook is feasible among young adult cancer survivors. The study had a retention rate that was comparable with other Internet-based studies, and most participants reported using intervention components as intended. Participants in both groups agreed that accessing study information was easy and an effective way to get information about exercise. On average, both groups enjoyed participating in the study and would recommend the program to other young adult cancer survivors. Rather than increasing MVPA, which was the intervention focus, the FITNET intervention produced increases in light PA minutes per week (activities such as easy walking and yoga) compared to the SC group. The weight loss over time in the FITNET group was an unexpected finding, as interventions focused solely on PA without a dietary component typically produce little weight loss [64], and since self-report measures of PA suggest the only difference between groups was in light activity. Taken together, these findings suggest support for the feasibility of Facebook-based approaches to delivering behavioral interventions to young adult cancer survivors.

Although differences in light PA were achieved, weekly minutes of MVPA were not different between the FITNET and SC groups. On the contrary, previous 12-week home-based interventions among breast cancer survivors produced significant increases in self-reported MVPA ranging from 57 to 98 minutes/week relative to a comparison group [61, 62]. However, it is difficult to make comparisons with these previous trials, as our study is the first to be delivered primarily via Internet, to focus specifically on young adults diagnosed with cancer during young adulthood, and to include young adult survivors of various cancer types. After 12 weeks, the FITNET intervention produced an average increase of 67 MVPA minutes/week; this was comparable to increases of 70–89 MVPA minutes/week among breast cancer survivors receiving a home-based intervention with step

pedometers and/or print materials [61], but we observed much greater within-group standard deviations in self-reported PA minutes/week. In the present study, the lack of an intervention effect on MVPA relative to the SC group could be due to insufficient power to detect a significant difference as a result of a small sample size and large within-group variance. It is also possible that the lack of differences in MVPA may be attributable to the particular intervention strategies used. The comprehensive nature of the FITNET program, with multiple components targeting multiple psychosocial constructs, precluded us from determining the extent to which specific strategies accounted for group changes in PA.

Considering that the FITNET intervention focused on walking, and several studies indicate that walking is the preferred exercise type for an estimated 55%–81% of survivors of varying cancer types [65–67], the observed increase in light PA relative to the SC group is not unexpected. At baseline, 8.9% of FITNET participants were completely sedentary and 22.2% reported no moderate-intensity PA. It is possible that some participants were slowly increasing exercise intensity over time, the importance of which was emphasized in study messages. Furthermore, participants were encouraged to wear their pedometers every day and may have spent more time doing light, as opposed to brisk walking, which competed with time spent on MVPA. Though there were no reports of adverse events or injuries, participant scores on physical well-being were lower than those reported in previous PA trials and studies among cancer survivors [52, 68]. This suggests that survivors may have been limited in their ability to engage in higher-intensity PA. Given the limited empirical data on PA interventions focused specifically on young adult cancer survivors, it is challenging to put this increase in light PA in context. However, since recent PA guidelines for cancer survivors assert that any activity is better than none [11, 69], the observed increases in light PA are still encouraging.

While it is unclear what accounts for the group differences in light PA, the increases in PA over time among both groups suggest that young adult cancer survivors are interested in behavioral interventions as demonstrated by previous studies [17, 19, 20, 23], and their cancer experiences may serve as a teachable moment that motivates them to make behavior changes. Results indicate the acceptability of using Facebook to deliver PA interventions to young adult cancer survivors. Though not significantly different from the FITNET group, higher proportions of SC group participants reported attending to study components (i.e., received and read Facebook messages, visited Facebook group) and would recommend FITNET to other young adult cancer survivors. Despite receiving more minimal message content, SC group participants reported that accessing study information was easy and an effective way to get information about exercise. Given the limitations on formatting the appearance of Facebook messages, it is possible that the shorter, simpler messages were more appealing. Furthermore, the SC participants posted their own discussion questions, while both groups, on average, posted a similar number of Facebook comments to the respective group walls. Interestingly, the SC participants posted 188 comments without being prompted by the study administrator compared to 153 posts by FITNET participants, who received regular discussion prompts. Posts among both groups included a combination of participant introductions, comments related to PA, encouragement, support, accomplishments and PA resources; support may have been just as encouraging and acceptable when offered by a peer, as opposed to a study moderator. Frequency of Facebook posts did not appear to be related to changes in PA in either group. However, since over half of participants in both groups never posted or posted only once, it is unclear if access to a Facebook group and peer interactions influenced PA changes over time and to what extent Facebook functionalities were used and promoted participant engagement. The objective measure of posts is unable to account for those who read peer comments and resources posted by the moderator but did not interact with peers. These results among the SC group suggest that a minimal intervention delivered through Facebook may help promote behavior

change in young adult cancer survivors. Though, this should be interpreted with caution considering the small sample size of the current study and the lack of a true control group with which to compare the SC group. Other studies, however, have also found that a minimal intervention offered to the control group, such as a pedometer and/or standardized print materials, produced increases in physical activity [61, 62, 70]. Future studies should further evaluate how young adult cancer survivors use social networking sites and examine the potential for both moderated and self-directed Facebook group discussions to enhance behavior change in this population.

Findings from intervention dose analyses indicate that participants who logged the most PA entries and set more weekly goals reported greater MVPA minutes at 12 weeks compared to the middle tertile, suggesting that these self-monitoring behaviors may have led to MVPA increases over time in the most adherent FITNET participants. Previous home-based PA interventions among cancer survivors have produced increases in self-reported MVPA using exercise logs and pedometers as intervention strategies [61, 62]. As with many Internet-based interventions, adherence declined over time with only 24% of participants logging PA entries on the study website at 12 weeks. Unexpectedly, MVPA in the lowest tertile of participation was not different from that of the highest tertile, with participants in the middle tertile reporting the lowest mean MVPA. Since participants with the lowest adherence never, or only once, logged PA entries and/or set a weekly goal, the observed decreases in objective self-monitoring behaviors over time are likely attributable to participants in the middle tertile. FITNET participants were asked to access a separate website to record activity, which may have grown burdensome over time. Furthermore, though they occurred on only a few occasions, website outages due to weather and site maintenance may have discouraged participant use. It is conceivable that survivors in the lowest adherence tertile were using other tools to self-monitor their PA, but the current study is unable to explain why their levels of MVPA were comparable with survivors in the highest tertile of adherence. Future studies should examine strategies for self-monitoring PA that are more easily accessible and less time intensive (e.g., Facebook applications, phone accelerometers), as well as additional features that have been shown to be related to improved PA adherence (e.g., tailored feedback) [71] and increased exposure to Internet-delivered interventions (e.g., email/phone contact, website updates) [72]. Rather than accessing intervention components or functionalities within Facebook, it also is possible that other strategies might be better accessed through a different technology platform. For instance, perhaps a Facebook group is most beneficial as a discussion forum for an intervention that is otherwise delivered via email or text messages. This study provides initial insight into how delivering health information through Facebook can be useful to young adult cancer survivors interested in improving PA behaviors. Future research is needed to identify more effective intervention and engagement strategies to enhance MVPA among young adult cancer survivors within, or as a complement to, social networking site approaches. Additional testing of whether more minimal, but more frequent and less time-intensive strategies, like the simpler messages offered to SC group participants, and alternative self-monitoring techniques might be effective among young adult cancer survivors is warranted.

This study did not demonstrate enhanced QOL, as has been reported in other PA trials among survivors [52, 73]. A recent review of QOL outcomes in PA interventions for cancer survivors demonstrated that the more effective interventions focused on higher-intensity aerobic exercise and were longer in duration [74]. Given that PA gains were more demonstrable in lower-intensity PA, it is not surprising that increases in QOL were not realized. Furthermore, the FACT-G instrument may not have been sensitive to QOL issues affecting survivors that are further from diagnosis, as it was designed to assess concerns more proximal to diagnosis. Considering that both groups received active interventions, this

may have minimized differences in QOL between arms. The reported QOL among this sample of young adults was lower relative to QOL among cancer survivors participating in other PA studies that used the FACT-G [52, 68], suggesting that QOL may be lower in young adult survivors than those previously studied and is deserving of future research.

Notably, this study showed a reported 2-kg weight loss from baseline to 12 weeks in the FITNET group with no significant weight loss over time in the SC group, which was an unexpected finding. It should be noted that, while this outcome is not measured weight, self-reported weight has been shown to be strongly correlated with clinically measured weight in cancer survivors [70]. While dietary change is the likely mechanism, the groups were not different on MVPA and dietary intake was not measured; as such, this study does not provide evidence as to why FITNET participants' self-reported weight decreased over time. Previous exercise interventions among survivors have not demonstrated significant changes in body weight [62, 73]. A recent weight loss intervention using Facebook and text messaging produced a significant 2-kg weight loss in college-aged young adults after 8 weeks compared to Facebook only and wait-listed control groups [31]. Given that weight gain and declines in PA often occur during young adulthood, and young adult cancer survivors may be at higher risk for obesity-related chronic disease after treatment, these results suggest that weight control interventions might be feasibly delivered to young adult cancer survivors in part through Facebook. Future studies should examine the long-term effects of social networking site approaches to behavioral change among young adult cancer survivors.

A major strength of this study was that it was one of very few randomized controlled trials to evaluate a PA intervention among young adult cancer survivors. Furthermore, it used a popular and publicly available social networking site and was completely home-based. Both of these features facilitated the recruitment of young adult cancer survivors, a rare population of survivors relative to survivors of other age groups, across North America. The fact that the study was delivered through a popular social networking site improves the possibility for future dissemination. The SC group also received an active intervention, allowing for a more robust test of the effects of the goal-setting, self-monitoring and moderated group discussion components on PA outcomes.

Despite these strengths, there are a number of important limitations which may limit the generalizability of study outcomes. With both groups receiving an active intervention through Facebook, the multicomponent intervention and lack of a true control group limited our ability to isolate the effect of the social networking component on PA outcomes. The small sample size may have resulted in inadequate power to detect a significant difference between groups in the primary outcome of weekly minutes of MVPA. Additionally, the lack of objective measures for PA and BMI limit generalizability of study findings. Self-report measures may have led to over- or underreporting of PA minutes and other outcomes, resulting in biased estimates due to social desirability and recall errors; though, presumably these were equally distributed between groups through randomization. Furthermore, while the intervention encouraged lifestyle changes to incorporate PA into daily routines, the self-report measure assessed only leisure-time PA. The relatively short study duration was a limitation, which may not have allowed sufficient time for participants to gradually increase their PA intensity. The study reports on short-term outcomes and lacked long-term follow-up, and therefore was unable to demonstrate long-term effectiveness. Participants that enrolled earlier during the four-month recruitment period may have been motivated to start exercising prior to the 12-week intervention, which could have biased study findings. In addition, the study did not address the needs of young adult cancer survivors who are not on Facebook or lack Internet access, a population that may be most in need of health-related information [75]. It is important to note that recruiting a diverse study sample proved to be

challenging, and findings may have limited generalizability to the broader population of young adult cancer survivors. Future studies are necessary to determine more optimal ways to recruit diverse and larger sample sizes of young adult cancer survivors to behavioral interventions.

Given the limited availability of behavioral interventions for young adult cancer survivors and their interest in making lifestyle changes, results of this study suggest that Facebook may be a suitable delivery channel for behavioral interventions among young adult cancer survivors, and Facebook-based approaches hold potential for promoting PA in this population. Further research that is adequately powered to compare Facebook-based approaches and that includes additional objective data measures and more diverse samples of young adult cancer survivors is warranted. Our findings suggest that delivering health communication through an existing social networking site that is commonly used by cancer survivors may be beneficial and have future implications for young adult cancer survivors, health care professionals and organizations that serve young adult cancer survivors.

## Acknowledgments

This study was supported by a 2011 Society of Behavioral Medicine Distinguished Student Award for Excellence in Research, the UNC Lineberger Cancer Control Education Program (National Cancer Institute funded; R25 CA057726), the UNC Communications for Health Applications and Interventions Core (funded through Gillings School of Global Public Health Nutrition Obesity Research Center (National Institute of Diabetes and Digestive and Kidney Diseases funded; P30 DK56350) and the Lineberger Comprehensive Cancer Center (National Cancer Institute funded; P30 CA16086)), and the National Center for Research Resources (UL1 RR025747). At the time of the study, the first author was supported by a Multi-Year Royster Fellowship from the UNC Graduate School. The authors would like to acknowledge the memory of Dr. Marci Campbell, who made substantial contributions to the conception and design of the study and created a legacy that will live on. We also thank Dr. Dianne Ward for her expertise and insightful comments on a draft of this manuscript. We wish to acknowledge Dr. Carey Anders, Dr. William Wood, the community-based organizations, LIVESTRONG, and members of the LIVESTRONG Young Adult Alliance that graciously assisted with study recruitment. Finally, we are most grateful to the young adult cancer survivors who participated in the study.

## References

- Howlander, N.; Noone, AM.; Krapcho, M.; Neyman, N.; Aminou, R.; Altekruse, SF.; Kosary, CL.; Ruhl, J.; Tatalovich, Z.; Cho, H.; Mariotto, A.; Eisner, MP.; Lewis, DR.; Chen, HS.; Feuer, EJ.; Cronin, KA., editors. SEER Cancer Statistics Review, 1975–2009 (Vintage 2009 Populations). National Cancer Institute; Bethesda, MD: [http://seer.cancer.gov/csr/1975\\_2009\\_pops09/](http://seer.cancer.gov/csr/1975_2009_pops09/), based on November 2011 SEER data submission, posted to the SEER web site, April 2012 [Accessed December 1, 2012.]
- Yabroff KR, Lawrence WF, Clauser S, Davis WW, Brown ML. Burden of illness in cancer survivors: findings from a population-based national sample. *J Natl Cancer Inst.* 2004; 96:1322–1330. [PubMed: 15339970]
- Hewitt, ME.; Greenfield, S.; Stovall, E., editors. *From Cancer Patient to Cancer Survivor: Lost in Transition*. Washington, DC: National Academies Press; 2006.
- Curtis, RE.; Freedman, DM.; Ron, E.; Ries, LAG.; Hacker, DG.; Edwards, BK.; Tucker, MA.; Fraumeni, JF., Jr, editors. *New malignancies among cancer survivors: SEER cancer registries, 1973–2000*. Bethesda, MD: National Cancer Institute; 2006.
- Demark-Wahnefried W, Aziz NM, Rowland JH, Pinto BM. Riding the crest of the teachable moment: promoting long-term health after the diagnosis of cancer. *J Clin Oncol.* 2005; 23:5814–5830. [PubMed: 16043830]
- National Cancer Institute (NCI). Report of the adolescent and young adult oncology progress review group. Bethesda, MD: NCI; 2006. LIVESTRONG Young Adult Alliance. Closing the gap: Research and care imperatives for adolescents and young adults with cancer.
- Tai E, Buchanan N, Townsend J, Fairley T, Moore A, Richardson LC. Health status of adolescent and young adult cancer survivors. *Cancer.* 2012;10.1002/cncr.27445

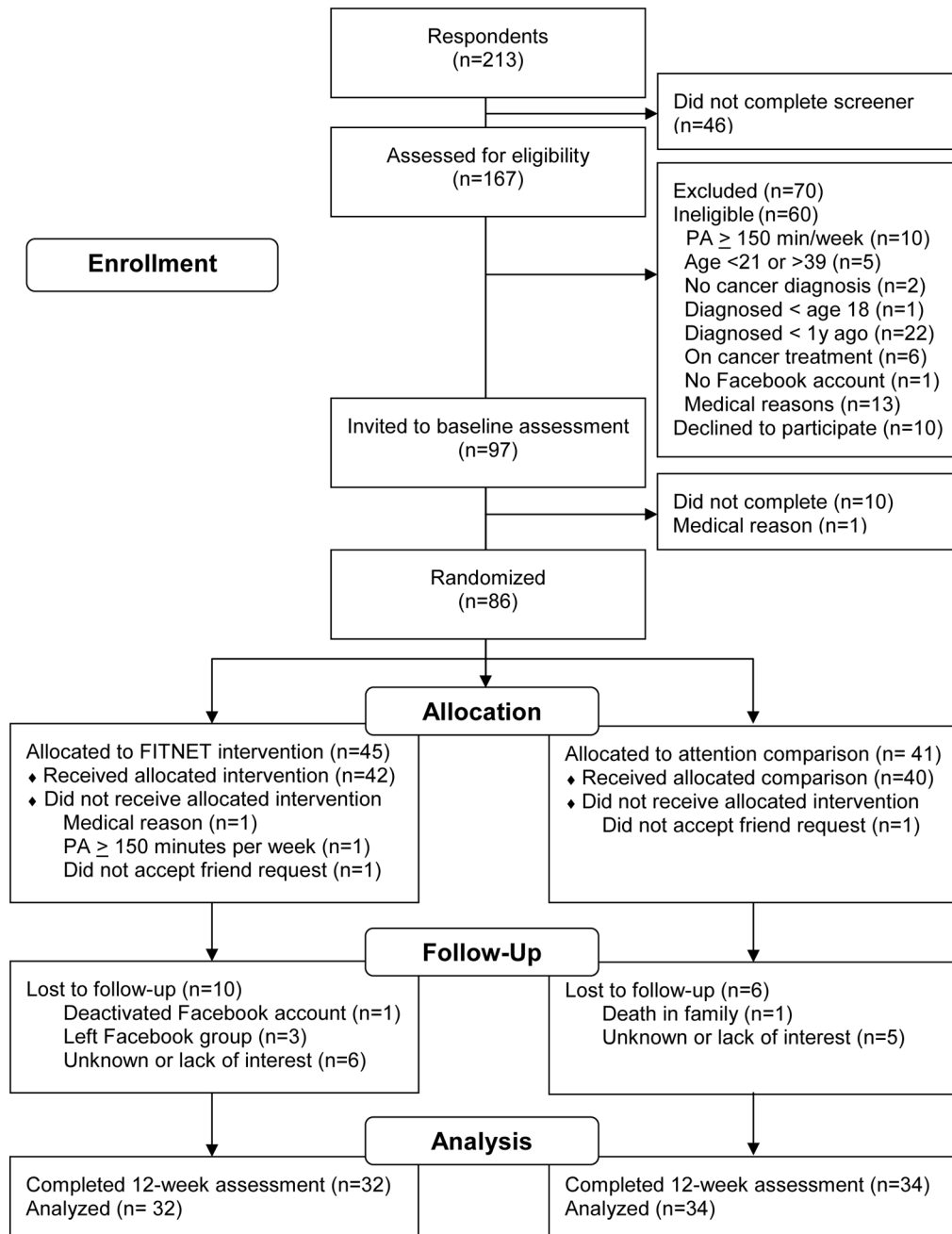
8. Stull VB, Snyder DC, Demark-Wahnefried W. Lifestyle interventions in cancer survivors: designing programs that meet the needs of this vulnerable and growing population. *J Nutr.* 2007; 137:243S–248S. [PubMed: 17182834]
9. World Cancer Research Fund / American Institute for Cancer Research. *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective.* Washington, DC: American Institute for Cancer Research; 2007.
10. Ballard-Barbash R, Friedenreich CM, Courneya KS, Siddiqi SM, McTiernan A, Alfano CM. Physical activity, biomarkers, and disease outcomes in cancer survivors: a systematic review. *J Natl Cancer Inst.* 2012; 104:815–840. [PubMed: 22570317]
11. Rock CL, Doyle C, Demark-Wahnefried W, et al. Nutrition and physical activity guidelines for cancer survivors. *Cancer.* 2012; 62:242–274.
12. Demark-Wahnefried W, Jones LW. Promoting a healthy lifestyle among cancer survivors. *Hematol Oncol Clin North Am.* 2008; 22:319–342. viii. [PubMed: 18395153]
13. American Cancer Society. *Cancer Treatment and Survivorship Facts & Figures 2012–2013.* Atlanta, GA: American Cancer Society; 2012.
14. Zebrack B. Information and service needs for young adult cancer survivors. *Support Care Cancer.* 2009; 17:349–357. [PubMed: 18543006]
15. Zebrack B. Information and service needs for young adult cancer patients. *Support Care Cancer.* 2008; 16:1353–1360. [PubMed: 18386075]
16. Zebrack BJ. Psychological, social, and behavioral issues for young adults with cancer. *Cancer.* 2011; 117(S10):2289–2294. [PubMed: 21523748]
17. Zebrack BJ, Block R, Hayes-Lattin B, et al. Psychosocial service use and unmet need among recently diagnosed adolescent and young adult cancer patients. *Cancer.* 2012; 1002/cncr.27713
18. Rabin C. Review of health behaviors and their correlates among young adult cancer survivors. *J Behav Med.* 2011; 34:41–52. [PubMed: 20683649]
19. Rabin C, Simpson N, Morrow K, Pinto B. Behavioral and psychosocial program needs of young adult cancer survivors. *Qual Health Res.* 2011; 21:796–806. [PubMed: 20705863]
20. Rabin C, Politi M. Need for health behavior interventions for young adult cancer survivors. *Am J Health Behav.* 2010; 34:70–76. [PubMed: 19663754]
21. Bélanger LJ, Plotnikoff RC, Clark AM, Courneya KS. Determinants of physical activity in young adult cancer survivors. *Am J Health Behav.* 2012; 36:483–494. [PubMed: 22488398]
22. Bélanger LJ, Plotnikoff RC, Clark A, Courneya KS. Physical activity and health-related quality of life in young adult cancer survivors: a Canadian provincial survey. *J Cancer Surviv.* 2011; 5:44–53. [PubMed: 20857227]
23. Bélanger LJ, Plotnikoff RC, Clark A, Courneya KS. A survey of physical activity programming and counseling preferences in young adult cancer survivors. *Cancer Nurs.* 2012; 35:48–54. [PubMed: 21558852]
24. Coups EJ, Ostroff JS. A population-based estimate of the prevalence of behavioral risk factors among adult cancer survivors and noncancer controls. *Prev Med.* 2005; 40:702–711. [PubMed: 15850868]
25. Bellizzi KM, Rowland JH, Jeffery DD, McNeel T. Health behaviors of cancer survivors: Examining opportunities for cancer control intervention. *J Clin Oncol.* 2005; 23:8884–93. [PubMed: 16314649]
26. Rabin C, Simpson N, Morrow K, Pinto B. Intervention format and delivery preferences among young adult cancer survivors. *Int J Behav Med.* 2012; 1007/s12529-012-9227-4
27. Zebrack B, Isaacson B. Psychosocial care of adolescent and young adult patients with cancer and survivors. *J Clin Oncol.* 2012; 30:1221–1226. [PubMed: 22412147]
28. Van Den Berg MH, Schoones JW, Vlieland TPMV. Internet-based physical activity interventions: a systematic review of the literature. *J Med Internet Res.* 2007; 9:e26. [PubMed: 17942388]
29. Vandelandotte C, Spathonis KM, Eakin EG, Owen N. Website-delivered physical activity interventions a review of the literature. *Am J Prev Med.* 2007; 33:54–64. [PubMed: 17572313]
30. Bennett GG, Glasgow RE. The delivery of public health interventions via the Internet: actualizing their potential. *Annu Rev Public Health.* 2009; 30:273–292. [PubMed: 19296777]

31. Napolitano MA, Hayes S, Bennett GG, Ives AK, Foster GD. Using Facebook and text messaging to deliver a weight loss program to college students. *Obesity*. 2012;10.1038/oby.2012.107
32. Cavallo DN, Tate DF, Ries AV, Brown JD, Devellis RF, Ammerman AS. A social media-based physical activity intervention: a randomized controlled trial. *Am J Prev Med*. 2012; 43:527–32.10.1016/j.amepre.2012.07.019 [PubMed: 23079176]
33. Chou WYS, Hunt YM, Beckjord EB, Moser RP, Hesse BW. Social media use in the United States: implications for health communication. *J Med Internet Res*. 2009; 11:e48. [PubMed: 19945947]
34. Neiger BL, Thackeray R, Van Wagenen SA, et al. Use of social media in health promotion purposes, key performance indicators, and evaluation metrics. *Health Promot Pract*. 2012; 13:159–164. [PubMed: 22382491]
35. Bender JL, Jimenez-Marroquin MC, Jadad AR. Seeking support on Facebook: a content analysis of breast cancer groups. *J Med Internet Res*. 2011; 13:e6. [PubMed: 21252034]
36. PricewaterhouseCoopers Health Research Institute. [Accessed April 17, 2012.] Social media “likes” healthcare: From marketing to social business. Delaware: PricewaterhouseCoopers LLP. Apr. 2012 <http://www.pwc.com/us/en/health-industries/publications/health-care-social-media.jhtml>
37. Farmer AD, Bruckner Holt CEM, Cook MJ, Hearing SD. Social networking sites: a novel portal for communication. *Postgrad Med J*. 2009; 85:455–459. [PubMed: 19734511]
38. Facebook. [Accessed December 14, 2012.] Key facts. Available at <http://newsroom.fb.com/content/default.aspx?NewsAreaId=22>
39. Hampton, KN.; Goulet, LS.; Rainie, L.; Purcell, K. Social networking sites and our lives. Washington, DC: Pew Internet & American Life Project; Jun 16. 2011 Available at <http://www.pewinternet.org/Reports/2011/Technology-and-social-networks.aspx> [Accessed July 16, 2012.]
40. Prochaska JJ, Sallis JF, Long B. A physical activity screening measure for use with adolescents in primary care. *Arch Pediatr Adolesc Med*. 2001; 155:554–559. [PubMed: 11343497]
41. Thomas S, Reading J, Shephard RJ. Revision of the physical activity readiness questionnaire (PAR-Q). *Canadian J Sport Sci*. 1992; 17:338–338.
42. National Cancer Institute. [Accessed August 12, 2012.] Facing forward: life after cancer treatment. Available at <http://www.cancer.gov/cancertopics/life-after-treatment>
43. LIVESTRONG. [Accessed August 12, 2012.] Diet and exercise: a podcast series for young adults with cancer. Available at <http://www.youtube.com/watch?v=c53CzzdcFdQ>
44. American Cancer Society. [Accessed August 12, 2012.] Staying active. Available at <http://www.cancer.org/Treatment/SurvivorshipDuringandAfterTreatment/StayingActive/index>
45. Bandura, A. Social foundations of thought and action: A social cognitive theory. Upper Saddle River, NJ: Prentice Hall; 1986.
46. Campbell MK, Carr C, DeVellis B, et al. A randomized trial of tailoring and motivational interviewing to promote fruit and vegetable consumption for cancer prevention and control. *Ann Behav Med*. 2009; 38:71–85. [PubMed: 20012809]
47. Campbell MK, James A, Hudson MA, et al. Improving multiple behaviors for colorectal cancer prevention among African American church members. *Health Psychol*. 2004; 23:492–502. [PubMed: 15367069]
48. Ryan DH, Espeland MA, Foster GD, et al. Look AHEAD (Action for Health in Diabetes): design and methods for a clinical trial of weight loss for the prevention of cardiovascular disease in type 2 diabetes. *Control Clin Trials*. 2003; 24:610–628. [PubMed: 14500058]
49. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. *Can J Appl Sport Sci*. 1985; 10:141–146. [PubMed: 4053261]
50. Jones LW, Courneya KS, Fairey AS, Mackey JR. Effects of an oncologist’s recommendation to exercise on self-reported exercise behavior in newly diagnosed breast cancer survivors: a single-blind, randomized controlled trial. *Ann Behav Med*. 2004; 28:105–113. [PubMed: 15454357]
51. Rogers LQ, Hopkins-Price P, Vicari S, et al. A randomized trial to increase physical activity in breast cancer survivors. *Med Sci Sports Exerc*. 2009; 41:935–946. [PubMed: 19276838]
52. Von Gruenigen VE, Gibbons HE, Kavanagh MB, Janata JW, Lerner E, Courneya KS. A randomized trial of a lifestyle intervention in obese endometrial cancer survivors: quality of life

- outcomes and mediators of behavior change. *Health Qual Life Outcomes*. 2009; 7:17. [PubMed: 19243603]
53. Jacobs DR, Ainsworth BE, Hartman TJ, Leon AS. A simultaneous evaluation of 10 commonly used physical activity questionnaires. *Med Sci Sports Exerc*. 1993; 25:81–91. [PubMed: 8423759]
  54. Miller DJ, Freedson PS, Kline GM. Comparison of activity levels using the Caltrac accelerometer and five questionnaires. *Med Sci Sports Exerc*. 1994; 26:376–382. [PubMed: 8183104]
  55. Sallis JF, Buono MJ, Roby JJ, Micale FG, Nelson JA. Seven-day recall and other physical activity self-reports in children and adolescents. *Med Sci Sports Exerc*. 1993; 25:99–108. [PubMed: 8423762]
  56. National Cancer Institute. [Accessed August 12, 2012.] Health Information National Trends Survey. Available at [hints.cancer.gov](https://hints.cancer.gov)
  57. National Institutes of Health (NIH). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults: the evidence report. Bethesda, MD: NIH; 1998.
  58. Cella DF, Tulsky DS, Gray G, et al. The Functional Assessment of Cancer Therapy scale: development and validation of the general measure. *J Clin Oncol*. 1993; 11:570–579. [PubMed: 8445433]
  59. Overcash J, Extermann M, Parr J, Perry J, Balducci L. Validity and reliability of the FACT-G scale for use in the older person with cancer. *J Clin Oncol*. 2001; 24:591–596.
  60. Winstead-Fry P, Schultz A. Psychometric analysis of the Functional Assessment of Cancer Therapy-General (FACT-G) scale in a rural sample. *Cancer*. 1997; 79:2446–2452. [PubMed: 9191537]
  61. Vallance JK, Courneya KS, Plotnikoff RC, Yasui Y, Mackey JR. Randomized controlled trial of the effects of print materials and step pedometers on physical activity and quality of life in breast cancer survivors. *J Clin Oncol*. 2007; 25:2352–2359. [PubMed: 17557948]
  62. Pinto BM, Frierson GM, Rabin C, Trunzo JJ, Marcus BH. Home-based physical activity intervention for breast cancer patients. *J Clin Oncol*. 2005; 23:3577–3587. [PubMed: 15908668]
  63. Tabachnick, B.; Fidell, LS. *Using Multivariate Statistics*. 3. New York, NY: Harper Collins Publishers; 1996.
  64. Thorogood A, Mottillo S, Shimony A, et al. Isolated aerobic exercise and weight loss: a systematic review and meta-analysis of randomized controlled trials. *Am J Med*. 2011; 124:747–755. [PubMed: 21787904]
  65. Jones LW, Courneya KS. Exercise counseling and programming preferences of cancer survivors. *Cancer Pract*. 2002; 10:208–215. [PubMed: 12100105]
  66. Karvinen KH, Courneya KS, Campbell KL, et al. Exercise preferences of endometrial cancer survivors: a population-based study. *Cancer Nurs*. 2006; 29:259–265. [PubMed: 16871091]
  67. Vallance JKH, Courneya KS, Jones LW, Reiman T. Exercise preferences among a population-based sample of non-Hodgkin's lymphoma survivors. *Eur J Cancer Care*. 2006; 15:34–43.
  68. Brucker PS, Yost K, Cashy J, Webster K, Cella D. General population and cancer patient norms for the Functional Assessment of Cancer Therapy-General (FACT-G). *Eval Health Prof*. 2005; 28:192–211. [PubMed: 15851773]
  69. Schmitz K, Courneya K, Matthews C. American College of Sports Medicine roundtable on exercise guidelines for cancer survivors. *Med Sci Sports Exerc*. 2011; 43:1409–1426.
  70. Demark-Wahnefried W, Clipp EC, Lipkus IM, et al. Main outcomes of the FRESH START trial: a sequentially tailored, diet and exercise mailed print intervention among breast and prostate cancer survivors. *J Clin Oncol*. 2007; 25:2709–2718. [PubMed: 17602076]
  71. Krebs P, Prochaska JO, Rossi JS. A meta-analysis of computer-tailored interventions for health behavior change. *Prev Med*. 2010; 51:214–221. [PubMed: 20558196]
  72. Brouwer W, Kroeze W, Crutzen R, de Nooijer J, de Vries NK, Brug J, Oenema A. Which intervention characteristics are related to more exposure to Internet-delivered healthy lifestyle promotion interventions? A systematic review. *J Med Internet Res*. 2011; 13:e2. [PubMed: 21212045]
  73. Taylor CLC, deMoor C, Smith MA, et al. Active for Life After Cancer: a randomized trial examining a lifestyle physical activity program for prostate cancer patients. *Psychooncology*. 2006; 15:847–862. [PubMed: 16447306]



74. Ferrer RA, Huedo-Medina TB, Johnson BT, Ryan S, Pescatello LS. Exercise interventions for cancer survivors: a meta-analysis of quality of life outcomes. *Ann Behav Med.* 2011; 41:32–47. [PubMed: 20931309]
75. Fox, S.; Purcell, K. Chronic disease and the Internet. Washington, DC: Pew Internet & American Life Project; Mar 24. 2010 Available at <http://pewinternet.org/Reports/2010/Chronic-Disease.aspx> [Accessed August 12, 2012.]



**Figure 1.**  
Study enrollment and retention

**Table 1**

Overview of differences between study groups in the Fostering Improvement Through Networking and Exercising Together trial

Concept Targeted	FITNET	Self-help Comparison
Overall goal	Meet PA recommendation for cancer survivors: 150 minutes of moderate- intensity PA per week	Meet PA recommendation for cancer survivors: 150 minutes of moderate- intensity PA per week
Behavioral capability	Links to publicly available websites related to PA and/or cancer survivorship 12 weekly Facebook messages with expanded behavioral lessons on PA topics and behavioral strategies	Links to publicly available websites related to PA and/or cancer survivorship 12 weekly Facebook messages with basic information on PA
Self-efficacy	Pedometer provides feedback on daily walking Website with weekly goal- setting and charts providing feedback on performance relative to weekly exercise goal, previous weeks and overall intervention goal	Pedometer provides feedback on daily walking
Self-monitoring	Pedometer to monitor steps Website with diary to record walking steps and PA type, duration and intensity	Pedometer to monitor steps
Social support	Facebook group with moderated discussion prompts to encourage support, links and weekly reminders	Facebook group with unmoderated discussion

*PA* physical activity

**Table 2**

Baseline characteristics of participants in the Fostering Improvement Through Networking and Exercising Together trial

Characteristics	FITNET (n=45)	Comparison (n=41)
Age (y), mean (SD)	30.8 (5.7)	32.7 (4.2)
Female sex, n (%)	41 (91.1)	37 (90.2)
Race/ethnicity, n (%)		
Non-Hispanic White	42 (93.3)	36 (87.8)
Black / Other	3 (6.7)	5 (12.2)
Marital status, n (%)		
Married or living as married	21 (46.7)	22 (53.7)
Single, divorced, separated	24 (53.3)	19 (46.3)
Education Level, n (%)		
Some college, vocational/trade school	9 (20.0)	10 (24.4)
College graduate	26 (57.8)	19 (46.3)
Postgraduate	10 (22.2)	12 (29.3)
Annual Income \$50,000, n (%)	25 (55.6)	23 (56.1)
Employment Status, <sup>a</sup> n (%)		
Full-time	20 (44.4)	20 (48.8)
Part-time	7 (15.6)	6 (14.6)
Full-time student	10 (22.2)	7 (17.1)
Living arrangements, n (%)		
Live with others	38 (84.4)	34 (82.9)
Responsible for children <18y	17 (37.8)	16 (39.0)
Body mass index (kg/m <sup>2</sup> ), mean (SD)	28.4 (8.2)	29.1 (8.9)
Months postdiagnosis	63.2 (7.8)	53.7 (5.1)
Cancer type, n (%)		
Hematologic	14 (31.1)	13 (31.7)
Breast	8 (17.8)	9 (22.0)
Gynecologic	5 (11.1)	8 (19.5)
Head and neck	7 (15.6)	3 (7.3)
Gastrointestinal	4 (8.9)	5 (12.2)
Other (musculoskeletal, genitourinary, lung)	7 (15.6)	3 (7.3)
Stage of cancer, n (%)		
Not staged / Don't know	7 (15.6)	7 (17.1)
I-II	20 (44.4)	20 (48.8)
III-IV	18 (40.0)	14 (34.1)
Treatment, <sup>a</sup> n (%)		
Chemotherapy	31 (68.9)	32 (78.0)
Surgery	33 (73.3)	30 (73.2)
Radiation	24 (53.3)	22 (53.7)
Bone marrow transplant	8 (17.8)	6 (14.6)

Characteristics	FITNET (n=45)	Comparison (n=41)
Other	10 (22.2)	8 (19.5)
3 h daily Internet use, n (%)	25 (55.6)	27 (65.9)
Daily Facebook use, <sup>b*</sup> mean (SD)	2.6 (1.4)	2.0 (1.0)

<sup>a</sup>Check all that apply.

<sup>b</sup>0 = less than 10 minutes, 1 = 10–30m, 2 = 31–60m, 3 = 1–2 hours, 4 = 2–3 hours, 5 = more than 3 hours

\* $p < 0.05$

PA physical activity

Table 3

Baseline means and estimated mean changes in physical activity, body mass index, body weight, and quality of life from maximum likelihood repeated measures mixed models

Outcome	Baseline			12 weeks			Unadjusted Mean Change			Adjusted <sup>d</sup> Mean Change			Group x Time		
	Mean (SD)	Mean (SD)	P	Mean (SD)	Mean (95% CI)	P	Mean (95% CI)	Mean (95% CI)	P	Mean (95% CI)	Mean (95% CI)	P	Mean (95% CI)	Mean (95% CI)	P
MVPA (min/week)															
FITNET	109.3 (125.0)	165.1 (196.9)	0.009	67.0 (13.6, 143.4)		0.009	67.9 (17.4, 136.8)		0.005						0.832
Comparison	118.4 (126.3)	164.4 (171.1)	0.045	46.3 (0.8, 109.0)		0.045	55.0 (-1.2, 133.9)		0.056						
Light PA (min/week)															
FITNET	78.3 (91.8)	232.6 (610.0)	0.001	163.6 (47.2, 387.9)		0.001	97.8 (18.4, 252.7)		0.007						0.070
Comparison	81.0 (78.5)	101.5 (107.1)	0.115	28.5 (-5.7, 78.3)		0.115	20.6 (-11.0, 66.0)		0.232						
Total PA (min/week)															
FITNET	187.6 (171.1)	397.7 (778.4)	0.001	237.0 (74.0, 501.7)		0.001	178.5 (45.4, 387.7)		0.004						0.154
Comparison	199.3 (151.5)	265.9 (228.1)	0.015	75.7 (12.6, 157.6)		0.015	77.7 (8.5, 167.1)		0.025						
Body mass index (kg/m <sup>2</sup> )															
FITNET	28.4 (8.2)	26.6 (6.7)	0.014	-0.6 (-1.1, -0.1)		0.014	-0.6 (-1.0, -0.1)		0.017						0.112
Comparison	29.1 (8.9)	28.7 (8.2)	0.961	0.01 (-0.6, 0.6)		0.961	0.03 (-0.5, 0.6)		0.924						
Body weight (kg)															
FITNET	79.5 (24.5)	73.3 (18.6)	0.004	-2.1 (-3.6, -0.7)		0.004	-2.0 (-3.4, -0.7)		0.003						0.083
Comparison	80.3 (25.6)	78.8 (23.7)	0.904	-0.1 (-1.9, 1.7)		0.904	-0.1 (-1.8, 1.7)		0.916						
FACT-G (0-108)															
FITNET	73.9 (18.1)	76.7 (17.5)	0.113	2.9 (-0.7, 6.6)		0.113	2.7 (-0.6, 6.2)		0.114						0.732
Comparison	72.1 (19.6)	76.9 (18.3)	0.039	3.4 (0.2, 6.8)		0.039	3.3 (0.2, 6.6)		0.036						
Physical well-being (0-28)															
FITNET	20.9 (5.6)	20.9 (5.4)	0.195	0.5 (-0.3, 1.3)		0.195	0.5 (-0.3, 1.3)		0.201						0.621
Comparison	19.4 (6.4)	20.5 (5.9)	0.080	0.7 (-0.1, 1.5)		0.080	0.7 (-0.04, 1.5)		0.065						
Social well-being (0-28)															
FITNET	18.6 (6.9)	19.7 (6.2)	0.277	0.9 (-0.7, 2.5)		0.277	0.8 (-0.6, 2.4)		0.274						0.711
Comparison	18.9 (6.3)	19.8 (6.3)	0.596	0.4 (-1.0, 1.9)		0.596	0.4 (-1.0, 1.9)		0.567						
Emotional well-being (0-24)															
FITNET	15.8 (4.2)	16.6 (5.1)	0.171	0.9 (-0.4, 2.2)		0.171	0.7 (-0.4, 2.0)		0.227						0.655

Outcome	Baseline		12 weeks		Unadjusted Mean Change		Time		Group x Time		Adjusted <sup>a</sup> Mean Change		Time		Group x Time	
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (95% CI)	P	P	P	P	Mean (95% CI)	P	Mean (95% CI)	P	P	P	
Comparison	15.7 (5.0)	17.1 (4.4)	17.1 (4.4)	17.1 (4.4)	1.1 (-0.1, 2.5)	0.080	0.080			1.1 (-0.1, 2.5)	0.074	1.1 (-0.1, 2.5)	0.074			
Functional well-being (0–28)																0.492
FITNET	18.6 (5.9)	19.4 (5.6)	19.4 (5.6)	19.4 (5.6)	0.8 (-0.6, 2.2)	0.271	0.271			0.7 (-0.6, 2.1)	0.301	0.7 (-0.6, 2.1)	0.301			
Comparison	18.0 (5.5)	19.5 (5.5)	19.5 (5.5)	19.5 (5.5)	1.3 (0.1, 2.5)	0.027	0.027			1.2 (0.1, 2.4)	0.029	1.2 (0.1, 2.4)	0.029			

Mean and SD at 12 weeks are based on available data. Number of participants for all models was: FITNET, Baseline=45, 12 weeks=32; Comparison, Baseline=41, 12 weeks=34.

<sup>a</sup> Adjusted models include marital status, months since diagnosis and baseline Facebook use as covariates.

FITNET Fostering Improvement Through Networking and Exercising Together intervention, MVPA moderate to vigorous physical activity, PA physical activity, FACT-G Functional Assessment of Cancer Therapy-General survey