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Does a Peer-Led Exercise Intervention affect Sedentary Behavior among Breast Cancer Survivors?

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Abstract

Objective—Sedentary behavior is recognized as an independent risk factor for chronic diseases. Cancer survivors report high levels of sedentary behavior. In secondary analyses, we examined the effects of an exercise intervention on sedentary behavior (sitting time) among breast cancer survivors.

Methods—Seventy-six breast cancer survivors (mean age=55.62 years, mean 1.1 years since diagnosis) were randomized to receive either a 12-week telephone-delivered exercise intervention from peer volunteers or a contact control condition. The intervention did not specifically address sitting time. Participants' sedentary behavior was assessed for 7 days at baseline, 12 weeks and 24 weeks via self-report and objective measurement (accelerometer).

Results—At baseline, our sample reported sitting for 7.75 hours/day (10.98 hours/day by accelerometer data). Spearman rank correlations showed significant positive correlations at baseline between sitting time measured by self-report and accelerometer (rho= 0.37; p=.002) in the entire sample. There were no significant changes over time within group nor were there significant intervention effects on sitting time (self-report and objective) at 12 and 24 weeks (all p's >.05).

Conclusions—An exercise intervention that did not focus specifically on sitting time did not affect sedentary behavior among breast cancer survivors. Intervention components that specifically target sitting behavior are needed to reduce this risk behavior among survivors.

Keywords

cancer; oncology; sedentary behavior; sitting; exercise interventions

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Conflict of Interest:
Bernardine Pinto, Shira Dunsiger and Kevin Stein declare that they have no conflict of interest.

BACKGROUND

There is growing support from national organizations such as the American College of Sports Medicine [1] and the American Cancer Society [2] for the role of moderate-to-vigorous physical activity (MVPA) to help cancer patients recover and regain physical functioning, improve fitness and reduce fatigue. What has more recently emerged is that the amount of sedentary behavior that an individual engages in has a large impact on health, regardless of his/her level of MVPA. Sedentary behavior is defined as any behavior with energy expenditure of ≤1.5 METs (metabolic equivalents) [3]. In the past, sedentary individuals were defined as those who did not meet MVPA guidelines. Currently, the new definition recognizes that a sedentary lifestyle is one characterized by high levels of sedentary behavior regardless of the individual's MVPA.

There is emerging interest in examining sedentary behavior among cancer survivors, many of whom spend less than 1% of their waking hours in the recommended MVPA [4,5]. In national surveys, cancer survivors were found to be more likely to engage in sedentary behavior compared to non-cancer participants [6]. Not only is sedentary behavior associated with an increased risk of specific cancers independent of MVPA [7–9], but cohort studies have shown a significant association of sedentary behavior with overall cancer mortality [10,11] and site-specific mortality [12]. It is important to note that sitting time (defined as TV watching time) was positively associated with metabolic risk variables among healthy adults who met public health guidelines for MVPA [13,14]. A few investigators have explored the relationship of sedentary behavior with quality of life (QOL) and fatigue. In a longitudinal study of colorectal cancer survivors, watching television for ≥5 hours/day (vs. ≤2 hours) was associated with a 16% lower total QOL score [15] and a mean increase in body mass index of 0.72 kg/m^2 over 2 years after adjusting for baseline MVPA [16]. The relationship between sitting time and fatigue among breast cancer survivors is unclear with one cross-sectional study suggesting a positive association [17] and a longitudinal study showing no significant association [18].

There have been numerous studies promoting the adoption of MVPA among cancer survivors (see review [19]). However, there have been few efforts to examine if these interventions impact sedentary behavior. Our previous work demonstrated that a peer-administered intervention significantly increased breast cancer survivors' MVPA assessed via self-report and objectively (using accelerometers) at 12 and 24 weeks [20]. In this randomized controlled trial, peer volunteers with the American Cancer Society's Reach to Recovery (RTR) program were trained and supervised in delivering a previously tested 12-week telephone delivered MVPA program [21]. There were no specific efforts to target participants' sitting behavior. However, we were interested to know if participants who received the MVPA program decreased sitting time while they adopted MVPA (i.e., does MVPA adoption serve as a "gateway" to decreasing sitting time in previously inactive survivors?). The present secondary analyses examined intervention effects on participants' sedentary behavior (sitting time) assessed for 7 days via retrospective recall and objectively (accelerometer data) at baseline, 12 and 24 weeks. Our hypothesis was that the intervention would have no significant effect on sitting time because the literature suggests that such behavior is independent of MVPA participation. We also examined the correlation between

sitting time assessed by self-report and accelerometers because such data would be helpful in selecting valid approaches to assessing sitting time. Finally, we explored the association between baseline sitting time (self-report and objective) with fatigue and QOL at 12 and 24 weeks. Because the results of prior work have been inconclusive, we hypothesized that there was no significant association between sitting time with fatigue and QOL.

METHODS

Study Design. A randomized controlled trial was conducted wherein 76 breast cancer survivors were randomized to receive either a 12-week exercise intervention (PA Plus RTR, N=39) or a contact control condition (RTR Control, N=37) delivered by 18 Reach to Recovery volunteers. The study received approval from the Institutional Review Boards at The Miriam Hospital (RI) and Women & Infants Hospital (RI). A full description of the study method is seen in the main outcomes publication [20].

Recruitment and Training of ACS RTR Volunteers

We partnered with ACS offices in 6 NE states and recruited RTR volunteers (who had completed RTR training and had been a volunteer for at least a year) to serve as exercise coaches. Additional eligibility criteria included willingness to: a) participate in group training, b) provide coaching to 4–5 participants, c) be supervised by telephone, and d) audiotape telephone contacts with study participants. Volunteer coaches completed informed consent procedures and were asked to complete questionnaires at the start of the study, at post-training and at the end of study participation. ACS staff in four states approached 335 RTR volunteers through email, informational mailings, and personal contact. Thirty one volunteers expressed interest in the study, 28 were screened for eligibility, 18 completed the four-session training (64%) (mean age = 54.89 years, SD=7.76, mean 7.00 years post-diagnosis, mean years volunteering with RTR=4.47 years).

As described previously [20], coaches were trained in small groups either in-person or via video-conference. The training program (4 sessions, 2 hours per session) focused on the research goals, intervention theory, and intervention components. Coaches were trained to deliver the PA counseling as well as the RTR Control condition. To monitor participant safety, coaches were required to ask participants about physical symptoms such as chest pain that required a temporary suspension of the program until medical evaluation was conducted by the patient's physician. Coaches reviewed the participants' MVPA weekly logs that included pulse rates and rates of perceived exertion to ensure that participants were exercising at least at moderate-intensity.

Participants

Women aged ≥21 years with Stage 0–3 breast cancer (diagnosed in the past 5 years) were eligible if they: a) had completed surgery (patients receiving on-going chemotherapy, radiation or hormone treatment were eligible); 2) were able to read and speak English; 3) were able to walk half-mile without stopping; 4) were sedentary (i.e., < 30 minutes/week of vigorous exercise or < 90 minutes/ week of moderate-intensity exercise for the past six months); and 5) were willing to receive telephone calls. Women with medical or psychiatric

problems (e.g., stroke, substance abuse, etc.) that might interfere with protocol adherence were excluded. The study was powered to detect effects on MVPA at 12 and 24 weeks. [20]

Participant Recruitment

From January 2010 to April 2012, we recruited participants from informational mailings to breast cancer constituents on lists maintained by the ACS in 6 states (n=8111), electronic newsletters sent by the ACS to their constituents in NE, recruitment at ACS-sponsored events in RI, and referrals from RTR coordinators (n=26). Other recruitment avenues included informational mailings by three hospitals in three states (mailing size = 2425) and three private practices to breast cancer patients in two states (mailing size = 321), and in-person recruitment at a hospital in RI [20].

Potential participants were phone screened for eligibility, informed consent was obtained and baseline assessments were conducted. Physician consent was obtained for all study participants. A total of 595 potential participants were contacted, 304 were ineligible at initial contact or phone screen (51.1%), 123 were not interested (20.7%) and 168 were eligible at phone screen (28.2%). Of the 168 potential participants, 31 were no longer interested, 61 became ineligible and the remaining 76 were eligible and randomized (76/168=45.2%). See study flow chart [20].

Intervention Delivery

Following baseline assessments, the Intervention Coordinator opened the sealed envelope that contained the randomization status and informed the participant. Per RTR protocol, each participant was assigned to a coach based on scheduling availability and similarity of cancer treatment(s). Each coach contacted her participant in PA Plus RTR or RTR Control once a week over 12 weeks and audio-taped the calls.

PA Plus RTR group

This group received the telephone-based PA intervention that had been previously tested [21]. The goal was to encourage participants to gradually increase the amount of aerobic PA (e.g., brisk walking) over 12 weeks to meet recommendations of ≥ 30 mins. of moderate-intensity PA on most days of the week [1, 22]. Counseling focused on building a supportive relationship with participants, assessing motivational readiness, monitoring PA, identifying health concerns, and identifying and problem solving barriers to PA. All participants received a pedometer (Digiwalker) and a heart rate monitor and were provided logs to monitor PA. Coaches reviewed the logs during the telephone calls. There was no specific focus on getting participants to monitor or change their sitting time. Participants were provided RTR print materials, 12 exercise tipsheets and a PA feedback report at Week 2, 4, 8 and 12 [20]. As is typical of RTR, coaches responded to questions about breast cancer and its treatment.

RTR Control Group

Participants received 12 weekly calls to equate for frequency of contact with the PA Plus RTR group. During each call, the coach administered the Weekly Symptom Questionnaire [23] that assesses general health problems such as headaches. Participants were also

provided RTR print materials. Coaches responded to participants' concerns about breast cancer and provided support. Participants were asked not to join a structured PA program during the 12-week intervention phase. At 24 weeks, they were sent the same exercise tipsheets that had been provided to the PA Plus RTR group [20].

Measures

At baseline, participants provided demographic information. Data on their cancer diagnosis and treatment were obtained from the patients' healthcare provider. Participants were sent accelerometers (Actigraphs) with instructions to wear the unit for 7 days and a packet of questionnaires assessing psychosocial variables such as fatigue and QOL. Participants were asked to mail back the Actigraph and the completed questionnaires. A Research Assistant (blind to the participant's group assignment) conducted a PA interview (described below) by telephone and was responsible for collecting all data following the same procedures at 12 and 24 weeks. A description of the measures follows:

a. Seven Day Physical Activity Recall (7 Day PAR) [24], a widely used, validated measure of PA was administered by telephone. It assesses hours spent in sleep, sitting, moderate activity, hard and very hard activity. Participants were queried (per administration protocol) about their sitting time during each of the previous 7 days. This was the self-reported measure of sedentary behavior.

b. Accelerometer. Participants were asked to wear a tri-axis accelerometer (Actigraph GT3X) for seven days at each assessment point. The Actigraph monitors activity counts, energy expenditure and steps taken. Software is available for categorizing the counts into light, moderate, hard or very hard categories of MVPA. The cut-points for sedentary behavior were defined as <100 counts per minute [25]. We considered only activity counts associated with sedentary behavior for these analyses.

c. Functional Assessment of Cancer Therapy Scale-Fatigue (FACIT-F) [24]. This 13-item scale is a brief, reliable and valid measure of the physical and functional effects of fatigue [26]. The range of scores is 6 (high fatigue) to 52 (low fatigue).

d. Functional Assessment of Cancer Therapy Scale for Breast Cancer (FACT-B) is a 55-item scale that assesses QOL and is reliable and valid [27]. The range of scores is 0 to 144, with higher scores indicating a better QOL.

Analyses

Descriptive data of the sample including between group differences have been tested and presented elsewhere [20]. Correlations between self-reported and objectively assessed sitting time at baseline was examined using Spearman rank correlations, as they are less sensitive to outlying values, particularly in small samples.

Using a series of mixed effect longitudinal models, we tested intervention effects on mean sitting duration obtained via self-report and accelerometer, while controlling for participants' baseline sitting time, chemotherapy use and occupation (physically active – defined as skill/craft, machine operator or manual labor - vs. other). Covariates that were

included were those significantly correlated with the outcome (those listed above). Models included subject-specific intercepts to account for repeated measurements within participant over time.

Subsequently, we tested whether baseline sedentary time (assessed as a continuous variable) was a significant predictor of changes in QOL and fatigue from baseline to 12 and 24 weeks, using a series of longitudinal mixed effects models with subject specific intercept. Models adjusted for group assignment, chemotherapy use and occupation and were run separately using self-reported and objectively measured sedentary time as the predictor.

We adjusted mixed effect models for Actigraph wear time, but it did not significantly change effect estimates, nor did it improve model fit, and thus was not included in the final model.

All analyses were carried out using SAS 9.3 and significance level was set at 0.05.

RESULTS

Participants (N=76) were 55.62 years of age on average (SD=9.55), predominantly partnered (82.89%), Caucasian (98.68%) with at least some college level education (89.47%). Mean years since diagnosis was 1.11 (SD=1.05). Ten percent had a physically active job (Table 1). There were no significant group differences at baseline.

Unadjusted mean minutes/week of sedentary time (self-report and objective assessment) are presented in Table 2. Overall, 84.30% of participants were considered sedentary (sitting ≥9 hours/day on average) at baseline when measured via accelerometer. This percentage remained stable over time (82.50% at both 12 and 24 weeks). When sedentary time was self-reported, percentages dropped to 43.20% at baseline, 27.90% at 12 weeks and 34.30% at 24 weeks.

There were no significant changes over time in self-reported or objectively measured sitting time within group, nor were there significant intervention effects across groups at 12 or 24 weeks. Specifically, the mean group difference (PA Plus RTR vs. RTR Control) in self-reported sitting duration was 159.90 minutes/week at 12 weeks (t=−0.66, p=0.51) and 66.63 minutes/week at 24 weeks (t=−0.27, p=0.79). The mean group difference (PA Plus RTR vs. RTR Control) in objectively assessed sitting time was 221.64 minutes/week at 12 weeks (t=1.06, p=0.29) and 251.47 minutes/week at 24 weeks (t=1.21, p=0.23).

Results suggest significant positive correlations between self-reported and objectively measured sedentary time at baseline, rho=0.37, p=0.002.

Examination of the relationship between sitting time and QOL showed that those with greater baseline self-reported sitting time reported higher QOL at 24 weeks (t=2.48, p=.01). For example, if we compare participants at the 25^{th} and 50^{th} percentile of sitting time at baseline (2558 vs 3226 min/week of self-reported sitting time), mean QOL at 24 weeks was higher for those with greater time spent sitting (3.11 vs. 3.92). It should be noted that although the time by sitting time interaction was significant in the case of objectively assessed sitting time (at 12 weeks), when combined with the main effects as a measure of

the overall effect of sitting time on QOL at follow up, the effects were no longer significant. Baseline sedentary time (self-report and objectively assessed) was not associated with fatigue at follow-up (see Table 3).

CONCLUSIONS

Promoting exercise among cancer survivors is becoming widespread and interventions have helped to increase exercise adoption after cancer diagnosis and treatment [19, 28]. We explored, as post-hoc analyses, whether our peer-led MVPA intervention had an effect on sitting time among the cancer survivors who received the intervention. Results showed that the intervention did not significantly affect sitting time within participants over time. Although the intervention significantly improved participants' MVPA at 12 weeks and 24 weeks (self-report and objective) [20], there were no group intervention effects on sitting time at 12 weeks and 24 weeks, confirming our hypothesis. Our results also showed that there was a significant positive association between self-reported and objectively assessed sitting time at baseline. Finally, baseline sitting time (self-reported) was associated with better QOL at 24 weeks, contrary to our hypothesis.

Researchers have pointed out that there are multiple opportunities to integrate sedentary behavior intervention elements in MVPA intervention trials [29]. Peer coaches in our study did not specifically instruct participants to reduce the time they spent sitting but did encourage participants to find ways to fit exercise into their daily routine (e.g., walking instead of driving). Hence, we hypothesized that our intervention would not affect sitting time. The results confirmed our hypothesis and suggest that specific interventions are needed to break up long periods of sitting with standing and/or light activity.

In linking our results to other MVPA interventions, workplace programs aimed at increasing walking at work did not show that sitting decreased significantly vs. the comparison condition [29, 30]. However, studies among non-cancer populations that targeted increases in daily walking by using pedometers as motivational tools showed reductions in sitting time along with increases in walking [31, 32]. To the best of our knowledge, there has been only one intervention study conducted among colorectal cancer survivors that focused on multiple health behaviors including sedentary behavior. In that study, between group differences in sedentary behavior at 12 months were non-significant [33]. The researchers suggested that a specific intervention may be required to achieve robust changes in cancer survivors' sedentary behavior.

We found that baseline self-reported sitting time was significantly positively correlated with the objective assessment. However, sitting time assessed objectively was approximately 1000 minutes/week greater than self-reports. These discrepancies may have been because participants found it difficult to recall the time they spent sitting and may have been likely to under-report (social bias). Hence, accurate estimates of sitting time may require more reliance on objective rather than subjective reports. In collecting accelerometer data, additional information on the type of sedentary behavior and correlates would be required to develop appropriate interventions given the specificity of such behavior.

We found that our survivor sample appeared to be more sedentary than non-cancer populations. For example, in national studies, Matthews and colleagues [5] found that women aged 50–59 years (mean age of our sample=55.6 years) spent an average of 7.82 hours/day in sedentary behavior (assessed by accelerometer). In our sample, baseline objectively-assessed sitting time was 4612.07 minutes/week (10.98 hours/day) and these data are similar to the findings of Phillips and colleagues [34] who found that breast cancer survivors spent 9.26 hours/day in sedentary behavior (assessed by accelerometer) and were more sedentary than non-cancer controls.

The association of higher baseline sitting time with higher QOL at 24 weeks seems paradoxical (it should be noted that the differences in QOL scores between those with high vs. less sitting times is not clinically significant). Nonetheless, it is possible that those reporting more sitting were engaged in enjoyable activities while sitting such as watching television/computer programs, reading, etc. Our self-report measure of sitting time did not document activities concurrent with sitting and the context in which the behavior occurred. The task of breaking up sitting time when participants are engaged in enjoyable tasks can be as challenging as breaking up long periods of sitting while at work, but the intervention strategies may be quite different. Hence, understanding the context in which sitting occurs will become key to identifying effective ways to reduce such behavior.

The strengths of this study are the longitudinal design and the use of both self-reported and objective measures of sitting time for a week (including weekdays and weekends) at baseline, 12 weeks and 24 weeks. We also analyzed sitting time as a continuous variable as recommended [35]. A study limitation is that our self-report and objective measure did not capture the context of sitting time (e.g., work, leisure, transit, etc.). Experts have recommended against efforts to assess sedentary behavior as the absence of MVPA or without behavioral specifics [35]. Hence, identifying the contexts for such behavior among cancer survivors is a necessary prerequisite for the development of appropriate interventions. Another limitation is that our participants were a fairly homogenous sample of inactive breast cancer survivors.

In considering recommendations for future work, it is important to assess the context (and related variables) for sitting time among cancer survivors. If self-report measures are to be used, information on the type and the context of sitting should be elicited using standardized measures (e.g., [36–38]. Second, we recommend the use of objective measures and include an assessment of wear time [5], if the objective measure is an instrument that needs to be worn each day. Third, breast cancer survivors in this study spent more time sitting than the general population, when such behavior was objectively assessed. These data underscore the need to develop targeted interventions appropriate for the various contexts in which survivors engage in sedentary behavior. Fourth, while it continues to be important to encourage survivors to become physically active, the health risks associated with excessive sitting highlights the need to integrate sedentary behavior reduction components appropriate to the specific type of sitting in interventions.

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Table 1

Baseline Demographic between and across Groups

	PA Plus RTR (N=39) Mean(SD)/%(n)	RTR Control (N=37) Mean(SD)/%(n)	All (N=76) Mean(SD)/%(n)
Age, years	55.64 (8.59)	55.59(10.59)	55.62(9.55)
Marital Status, partnered	79.49%(31)	86.49%(32)	82.89%(64)
Race, Caucasian	97.44%(38)	100%(37)	98.68%(75)
Ethnicity, Hispanic/Latino	10.26%(4)	2.70%(1)	6.58%(5)
Education, At least Some College	94.87%(37)	83.78%(31)	89.47%(68)
Employment, Full-time	30.77%(12)	48.65%(18)	39.47%(30)
Occupation			
Skill/Craft	0%(0)	17.2%(5)	8.9%(5)
Manual Labor	3.7%(1)	3.4%(1)	3.6%(2)
Scientific	3.7%(1)	3.4%(1)	3.6%(2)
Service Work	14.8%(4)	10.3%(1)	12.5%(7)
Clerical	3.7%(1)	6.9%(2)	5.4%(3)
Professional	70.4%(19)	41.4%(12)	55.4%(31)
Sales	3.7%(1)	17.2%(5)	10.7%(6)
Disease Stage			
0	7.69%(3)	5.41%(2)	6.58%(5)
1	41.03%(16)	35.14%(13)	38.16%(29)
2	41.03%(16)	48.65%(18)	44.74%(34)
3	10.26%(4)	10.81%(4)	10.53%(8)
Mean Years Since Diagnosis	1.05 (0.98)	1.16 (1.14)	1.11(1.05)
Treatment, Chemotherapy	78.38%(29)	64.86% (24)	71.62% (53)
Fatigue (FACIT-F)	37.33(8.93)	34.70(12.53)	36.05(10.84)
Quality of Life (FACT-B)	109.47(13.85)	103.40(22.19)	106.52(18.52)

FACIT-F: Functional Assessment of Cancer Therapy Scale-Fatigue

FACT-B: Functional Assessment of Cancer Therapy Scale for Breast Cancer

Table 2

Unadjusted Mean Minutes/week (and Standard Deviations) of Sedentary Time as collected via Accelerometer amd 7-day PAR

Objective	PA Plus RTR (N=39)	RTR Control (N=37)	All (N=76)	P
Baseline Sitting	4644.28 (765.70)	4577.97(765.40)	4612.07(760.72)	0.72
12 Week Sitting	4603.32(1048.89)	4299.22(569.38)	4480.61(893.50)	0.21
24 Week Sitting	4633.16(913.02)	4434.72(699.73)	4546.12(825.33)	0.37
Subjective				
Baseline Sitting	3286.72(1002.73)	3320.68(1124.65)	3258.08(1030.33)	0.73
12 Week Sitting	3195.64(1000.08)	3337.19(1095.40)	3262.25(1040.53)	0.58
24 Week Sitting	3322.50(919.47)	3399.74(943.70)	3358.24(924.47)	0.74

Table 3

Regression Results: Baseline Sedentary Time as Predictor of Fatigue and QOL

	FACIT-F	FACT-B
Self-Reported Sedentary Time	$b=6.8 \times 10^{-4}$($SE=1.0 \times 10^{-3}$), p=0.50	$b=3 \times 10^{-5}$($SE=5.9 \times 10^{-4}$) p=.96
Sitting × 12 week	$b=4.2 \times 10^{-4}$($SE=1.0 \times 10^{-3}$), p=0.68	$b =6.0 \times 10^{-4}$($SE=4.9 \times 10^{-4}$) p=.22
Sitting × 24 Week	$b=2.8 \times 10^{-4}$($SE=1.1 \times 10^{-3}$), p=0.79	$b=1.2 \times 10^{-3}$($SE=5.0 \times 10^{-4}$), p=.01
Objectively Measured Sedentary Time	$b=1.1 \times 10^{-3}$($SE=1.5 \times 10^{-3}$), p=0.43	$b=1.4 \times 10^{-3}$($SE=8.7 \times 10^{-4}$), p=0.11
Sitting × 12 week	$b=5.2 \times 10^{-6}$($SE=1.4 \times 10^{-3}$), p=0.99	$b=1.6 \times 10^{-3}$($SE=6.9 \times 10^{-4}$), p=0.02
Sitting × 24 Week	$b=3.5 \times 10^{-4}$($SE=1.5 \times 10^{-3}$), p=0.81	$b=-6.2 \times 10^{-6}$($SE=7.1 \times 10^{-4}$), p=0.38

Estimates are unstandardized regression coefficients. Main effects of sitting time are presented first in each cell followed by the interaction between time and sitting time. Models adjust for group, chemotherapy and occupation.