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A Pilot Study of a Physical Activity Intervention Targeted towards Women at Increased Risk for Breast Cancer

Sheri J. Hartman, PhD¹, Shira I. Dunsiger, PhD², and Bess H. Marcus, PhD¹

¹Department of Family and Preventive Medicine, University of California, San Diego

²Centers for Behavioral and Preventive Medicine, The Miriam Hospital and W. Alpert Medical School of Brown University

Abstract

Objective—To pilot test a physical activity intervention targeted towards women with a first-degree relative with breast cancer.

Methods—Sedentary women (n=27) with at least 1 first-degree relative with breast cancer but no personal breast cancer diagnosis received a print-based physical activity intervention. The intervention was a 12-week theory-based and individually tailored physical activity intervention targeted towards women with a family history of breast cancer. Participants' minutes of physical activity, worry about breast cancer, perceived risk of developing breast cancer and perceived control over breast cancer risk were assessed at baseline and 12-weeks.

Results—There was a significant increase in minutes of moderate to vigorous intensity physical activity from baseline to 12 weeks ($t=4.93$, $p<.001$), with a mean increase in physical activity of 130.56 min/week ($sd=137.50$). At 12 weeks, 41% met ACSM criteria of engaging in 150 minutes or more of moderate intensity activity. Regression models indicate that change in perceived risk of breast cancer was significantly associated with change in physical activity ($t=-2.36$, $p=0.03$, $r=.34$), with decreases in perceived risk associated with increases in physical activity over time.

Conclusions—Findings suggest that a targeted intervention can increase physical activity and decrease perceived risk of breast cancer.

Keywords

Physical activity; intervention; breast cancer risk; Cancer; Oncology

Among women, breast cancer is the second leading cause of cancer death[1]. Women with one first degree relative with breast cancer have a two to four times increased risk for developing breast cancer, compared to women with no family history[1]. Although women cannot modify some of their risk factors for breast cancer, including family history and age, other factors can be changed. One such modifiable factor is engaging in regular physical activity.

There is mounting evidence of the benefits of physical activity related to reduction of breast cancer risk. Epidemiological research has consistently found an inverse relationship between participation in regular physical activity and breast cancer risk[2–4]. Literature reviews have found that physical activity is associated with, on average, a 20% risk reduction in breast cancer[2–5]. Reviews of the literature support that there is a dose-response relationship for

physical activity and breast cancer risk[5, 6]. One review of epidemiological studies that examined the dose-response related to different intensities of physical activity reported a 22% risk reduction for moderate intensity physical activity and 26% risk reduction for vigorous intensity physical activity[6]. Another review[5] examining the dose-response related to time spent engaged in physical activity calculated that for every one-hour of physical activity per week there is an additional 6% breast cancer risk reduction. In addition to the direct benefits of physical activity on breast cancer, physical activity can also reduce adiposity[7–9], which is associated with increased risk of lifetime breast cancer in postmenopausal women [10–13]. Therefore, promoting regular physical activity may be extremely important for women at increased risk for breast cancer.

Physical activity may also address some of the psychosocial issues faced by women with a family history of breast cancer. First degree relatives of breast cancer patients have been found to have significant amounts of cancer related and general distress[14–17]. Some studies even suggest that relatives may experience levels of distress that are comparable to patients' distress[18–20]. However, other studies have found that first degree relatives did not report higher levels of distress than those with no family history of breast cancer[21, 22]. Some of the discrepancies in findings may be related to individual differences, with research suggesting that women who are younger, less educated, and have a higher perceived risk of breast cancer are at increased risk for distress[18, 23, 24]. Physical activity has been shown to decrease psychological distress and increase emotional well-being in non-patient populations[25, 26] as well as cancer patients[27, 28]. Since first-degree relatives of breast cancer patients are at increased risk for psychological distress they may benefit from engaging in physical activity.

Although physical activity may reduce risk of breast cancer and psychological distress, women generally do not spontaneously make changes in their physical activity following a diagnosis of breast cancer in a first-degree relative. Therefore, they could benefit from participation in a physical activity intervention designed to increase their physical activity and potentially lower their risk of breast cancer. While physical activity interventions have been developed with a focus on a variety of populations including healthy adults and cancer patients, no interventions to our knowledge have been developed with a focus on first-degree relatives of cancer patients.

Although first-degree relatives of breast cancer patients may be healthy themselves, they may have concerns and motivations for engaging in physical activity that differ from those of other healthy adults. These women may benefit from a physical activity intervention that addresses specific concerns about their health related to their increased risk for breast cancer and possible increased distress surrounding their cancer risk or family member's cancer diagnosis. These women may also not be aware of ways to decrease their breast cancer risk. For example, one study of sisters of breast cancer patients found that these women had lower perceived response efficacy for physical activity than they had for mammography screenings, meaning that they did not believe physical activity would decrease their breast cancer risk or morbidity but did believe that mammography screenings would increase early detection and decrease morbidity. Teaching women about the relationship between physical activity and breast cancer risk may be a motivating factor to engage in physical activity.

The Social Cognitive Theory (SCT), a theoretical framework commonly used to explain behavior change, including physical activity, states that behaviors are determined by personal factors, environmental influences, and behavioral attributes, and that behaviors occur within a dynamic interaction between these factors [29–31]. Teaching women about breast cancer risk, and using concerns about breast cancer to motivate behavior can help to influence expectancies (i.e., environmental cues, outcome expectations, and self-efficacy)

and incentives (value of the outcome), two major concepts of SCT. If a woman is concerned about getting breast cancer and she feels that being sedentary poses a threat to her risk of getting breast cancer (environmental cues), then she is likely to become more physically active if she also believes that engaging in physical activity would decrease that threat (outcome expectations), and that she is able to increase her physical activity (self-efficacy) [31]. Therefore, incorporating breast cancer risk information into a physical activity intervention could be influential in promoting behavior change.

The current study pilot tested a 12-week theory-based physical activity intervention that was targeted towards women with a first-degree relative with breast cancer. The primary aim was assess changes in physical activity from baseline to the end of the intervention. A secondary aim was to explore the association between breast cancer worry, perceived breast cancer risk, and perceived control over breast cancer risk with reported physical activity.

Methods

Sample

Women with at least one first-degree relative who was diagnosed with breast cancer were recruited through the internet and radio ads. In order to be eligible to participate, women had to be engaging in less than 90 minutes per week of at least moderate intensity physical activity. Exclusion criteria included: personal diagnosis of any type of cancer except basal cell carcinoma; currently pregnant or intention to get pregnant in the next 3 months; presence of a known medical condition that would make it difficult/dangerous for them to exercise (e.g., CVD); history of a severe psychiatric illness; plans to move from the area in the next 3 months; or unable to read and speak English. Written informed consent was obtained, and the protocol was approved by the institutional review board of The Miriam Hospital.

Intervention

Participants were enrolled in a 12-week physical activity intervention. The physical activity materials were individually-tailored based on the SCT [30] and Transtheoretical Model (TTM) [32]. Based on focus group feedback, the overall intervention was targeted to address questions and needs of women with a family history of breast cancer. This is an extension of an intervention that was developed for healthy men and women and has previously been shown to be efficacious [33–38].

At the baseline visit, participants met with a PhD level psychologist experienced with health behavior change, to set a personalized exercise goal and plan. Participants were told the studies' goal to engage in 150 minutes of moderate intensity or greater physical activity each week, based on the ACSM recommendations, but participants were allowed to set any personal goal. Participants were also instructed on how to self-monitor their physical activity.

After the initial meeting all other intervention components were sent through the mail. The intervention consists of three types of print material that were mailed: stage-matched manuals, tailored feedback report, and tip sheets. The stage-matched manuals are booklets with messages matched to the participants' readiness (stage) for physical activity based on the TTM which states that individuals move through a series of stages (i.e., Precontemplation, Contemplation, Preparation, Action, and Maintenance) when starting and maintaining physical activity. The individually tailored feedback reports are based on SCT constructs including decisional balance, self-efficacy, and outcome expectancies. The reports are generated from a computer-based expert system in response to the participant's answers to monthly questionnaire items. These prewritten counseling messages were created

by Ph.D. level psychologists experienced in health behavior change. They provide feedback on: 1) how the participant compares to profiles of individuals who have successfully adopted and maintained physical activity (normative feedback); and 2) following the baseline assessment, feedback regarding progress made on specific topic areas and changes in minutes of physical activity participation since the individual's prior assessment (progress feedback). The topics that feedback is provided on include stage of change, physical activity decisional balance, and self-efficacy for physical activity. The physical activity tip-sheets are on a variety of topics from exercising safely to tips to stay motivated.

In order to modify the original intervention to target women with a first-degree relative with breast cancer, seven daughters of breast cancer patients were individually interviewed. All of these women had previously participated in a research trial using the original physical activity intervention[33]. Tape-based structured reviews of the audio files were conducted and executive summaries were developed to identify the key findings. Based on the findings from the interviews, additional materials related to breast cancer risk were created and incorporated into the intervention. Topics of the new material included information on modifiable and non-modifiable risk factors for breast cancer, details on how physical activity can influence breast cancer risk, how family history, including genetic risk, influences breast cancer risk, and more general breast cancer information such as the importance of breast cancer screening. In the development of these materials we were cognizant to provide accurate information, especially with regard to the risk factors for breast cancer. For example, the information on how physical activity relates to breast cancer risk clearly stated that most of the benefits have been found in postmenopausal women and with higher levels of physical activity. In addition to incorporating breast cancer related information, the appearance of the materials were modified by using a pink color scheme and incorporating a pink ribbon into the study's logo and throughout the materials, again, targeting the materials to this population.

Participants received the materials through the mail for 12 consecutive weeks. For the first 4 weeks, participants received each week either the expert report, stage-matched manual, or the physical activity and breast cancer information sheets. For the next 8 weeks, materials were mailed out every other week with participants receiving either a stage-matched manual with the physical activity tip sheet or the tailored feedback reports with the breast cancer information sheet. Participants also received the questionnaire packet, that assessed factors including the TTM stage of change, self-efficacy, and outcome expectations, which was used to generate the tailored physical activity materials through the mail at week 6 and week 10.

Measures

Demographic information was obtained through a self-report measure including date of birth, race, marital status, income, and familial relation to breast cancer patient. At baseline participants came to the research center to have their height and weight measured and to complete assessment measures. Participants provided self-reported information about the relative(s) who was diagnosed with breast cancer including, the breast cancer patients' age at diagnosis, date of diagnosis, types of treatment, number of recurrences, and whether the relative died from breast cancer.

Physical activity was assessed with the Seven Day Physical Activity Recall (7 Day PAR) [39]. The 7 Day PAR is an interviewer-administered measure of occupational and leisure-time physical activity. This measure has consistently demonstrated acceptable reliability ($r = .93$), and congruent validity with other more objective measures of activity levels ($r = .54$) [40–43], as well as sensitivity to changes in moderate intensity physical activity over time [44, 45].

Cancer worry was assessed with the Cancer Worry Scale[46], which is a 4-item measure of the extent to which breast cancer specific worry interferes with daily functioning rated on a 4-point Likert scale (1=not at all or rarely; 4=a lot). This measure has been used in many studies measuring women's worries and concerns about breast cancer and has demonstrated good internal consistency reliability and test-retest reliability (Bowen, et al., 2003; Rees, Fry, Cull, & Sutton, 2004). The internal consistency in the current study was $\alpha = .084$.

Perceived risk of developing breast cancer was assessed with two questions modeled from previous research[47, 48] assessing absolute and relative risk. The first question, "How likely do you think that you are to have breast cancer during your lifetime?" is rated on a 6-point Likert scale ranging from 1 = extremely unlikely to 6 = extremely likely. The second question, "What do you think your chances are of having breast cancer in your lifetime compared to other women your age?" These two items were converted to a common metric and summed. The internal consistency in the current study was $\alpha = .075$.

Perceived control over breast cancer risk was assessed with two items assessing absolute and relative control. Participants reported the extent to which they agree or disagree with each statement on a 6-point Likert scale (1 = strongly disagree to 6 = strongly agree). The internal consistency in the current study was $\alpha = .086$.

Analyses

Baseline demographic characteristics of participants and their first-degree relative with breast cancer, baseline physical activity levels and psychosocial constructs were summarized using means (standard deviations) for continuous variables and percentages for categorical variables. Analysis was conducted on the intent to treat sample, such that all participants who entered the study at baseline were included in the analysis (N=27). We imputed missing physical activity outcomes at 12 weeks (n=2) using baseline value carried forward and compared these results to a completers-only analysis.

Changes in physical activity were coded as change scores (12 weeks minus baseline) and a t-test was used to test for changes in reported activity over 12 weeks.

Using linear regression models, we examined the association between baseline psychosocial measures (specifically, breast cancer worry, perceived risk of breast cancer, perceived control over breast cancer and mood) and changes in physical activity over time. Mean change scores were regressed on the construct under consideration and controlled for baseline levels of activity. Residual diagnostics were used to assess model assumptions (e.g., testing Normality using plot of residuals vs. predicted values). We also assessed whether any observation or group of observations were unduly influential on estimates of regression coefficients. We fit similar models to test the association between changes in the psychosocial variables over 12 weeks (coded as change scores) and changes in physical activity over time, while adjusting for baseline levels of activity.

Finally, in order to determine whether there were moderators of the association between breast cancer worry at baseline and changes in physical activity over time, we used linear regression models which included an interaction between the potential moderator and breast cancer worry. Models also adjusted for the main effect of the moderator and baseline levels of physical activity. Model assumptions were tested as well as potential influence of each individual case.

All analyses were conducted in SAS Version 9.2.

Results

Participants

Twenty-seven women participated in the study. Of the 143 women who contacted us regarding the study, 51 (35.66%) were eligible, 72 (50.35%) were ineligible, 10 (6.99%) were unable to be contacted, and 10 (6.99%) were not interested in the study once contacted. The most frequent reasons for being ineligible included not having a first-degree relative who was diagnosed with breast cancer ($n=29$), already engaging in more than 90 minutes of physical activity a week ($n=15$), medical contraindication ($n=13$), and having a personal diagnosis of cancer ($n=6$). Of the 51 women who were eligible 30 (58.82%) showed for an orientation meeting, 18 (35.29%) no-showed for the orientation meeting and were unable to be rescheduled, and 3 (5.88%) became ineligible at the orientation meeting. Reasons for being ineligible were too physically active ($n=2$) and plan to move from the area in the next 6 months ($n=1$). Of the 30 that attended the orientation, 27 (90.00%) were enrolled in the study and 3 (10.00%) did not show for measurements and were unable to be re-scheduled. Of the 27 enrolled, 2 (7.40%) were lost to follow-up and 25 (92.59%) completed the 3 month follow-up.

The 27 women enrolled were 38.52 years old ($SD=11.40$) on average, most identified as white (93%), non-Hispanic (89%), married (41%) and had some college education (89%). One person reported having two first-degree relatives diagnosed with breast cancer; all other participants reported having only one first-degree relative diagnosed with breast cancer. Of the 28 breast cancer patients, 24 were mothers of the participants and 4 were sisters of the participants (See Table 1)

Changes in Physical Activity—There was a significant increase in minutes of moderate to vigorous intensity physical activity from baseline (25.00 mins/week, $SD=30.45$) to 12 weeks (155.56 mins/week, $SD=127.52$), $t=4.93$, $p<.001$, with a mean increase in physical activity of 130.56 mins/week ($sd=137.50$). At 12 weeks, 41% met American College of Sports Medicine recommendations of engaging in at least 150 minutes of at least moderate intensity physical activity. No significant difference was found between the ITT analysis and a completers-only analysis.

Relationship between psychosocial variables and changes in physical activity—Results indicate that there was a significant association between changes in perceived risk of breast cancer and changes in physical activity over 12 weeks ($t=-2.36$, $p=0.03$), when controlling for baseline levels of activity. This corresponded to a medium effect size ($r=.34$), with decreases in perceived risk associated with increases in physical activity over time. The association between baseline perceived risk and changes in physical activity over time suggested a trend ($t=1.61$, $p=.12$) with medium effect size ($r=.26$). The direction of the association was positive, suggesting that higher perceived risk was associated with increased changes in physical activity over time. Baseline breast cancer worry and change in breast cancer worry were not significantly associated with a change in physical activity. See Tables 2 and 3 for parameter estimates. Residual diagnostics did not suggest any significant departures from model assumptions or potential outliers.

Moderators of the association between breast cancer worry and physical activity—There was a trend with medium effect size ($t=1.67$, $p=0.11$, $r=.35$) for baseline perceived risk of breast cancer to moderate the relationship between breast cancer worry at baseline and changes in physical activity, such that among those with higher perceived risk of breast cancer at baseline, more worry was associated with greater changes in physical activity over time. There was also a trend with medium effect size ($t=1.68$, $p=0.11$, $r=.30$)

for perceived control over breast cancer risk ($t=1.68$, $p=.11$) to moderate the relationship between breast cancer worry and changes in physical activity, such that among those with higher perceived control over risk at baseline, more baseline worry was associated with greater changes in physical activity over time. See Tables 4 and 5. Residual diagnostics did not suggest any significant departures from model assumptions or potential outliers.

Discussion

This study assessed a physical activity intervention targeted towards women with a first-degree relative with breast cancer. Results showed that women significantly increased their self-reported minutes per week of moderate to vigorous intensity physical activity from 25.00 minutes to 155.56 minutes, corresponding to a mean increase of 130.60 minutes. With regards to perceived risk of breast cancer, there was a trend for greater baseline perceived risk to be associated with increasing physical activity. This finding suggests that a physical activity intervention that is targeted towards concerns about developing breast cancer can provide motivation to increase physical activity. The results also indicated that increases in physical activity were associated with decreases in perceived risk of breast cancer. From these results it is not clear what impact this decrease in perceived risk may have. It could empower women to feel that they have some control over their breast cancer risk and potentially encourage other health promoting behaviors. Alternatively, it could give women a false sense of security about their breast cancer risk and impact important behaviors such as breast cancer screenings. This issue highlights the importance of providing women with accurate information so that they can be encouraged to engage in all of the behaviors to benefit their breast cancer risk. Although the focus in the current intervention was on physical activity, participants were still provided with information about other risk factors, the importance of breast cancer screening, and speaking with a health professional about their breast health. While the current study cannot answer this question, this is an important question for future research to find ways to encourage multiple health behaviors in a complimentary way.

While changes in physical activity were not related to changes in breast cancer worry, there were trends for both perceived risk of breast cancer and perceived control over breast cancer to moderate the relationship between breast cancer worry and physical activity. These findings suggest that more breast cancer worry may be associated with greater changes in physical activity when women have higher perceived risk or higher perceived control over breast cancer. This may indicate that worry about breast cancer alone is not enough to promote greater changes in physical activity and that a targeted intervention may be more beneficial when focusing on women who perceive themselves to be at increased risk for breast cancer. The findings are consistent with the SCT in that these factors work together to promote behavior change.

The lack of direct relationship between perceived control over breast cancer risk and changes in physical activity could suggest that focusing on increasing women's perceptions about their ability to control their breast cancer risk may not be as helpful for promoting behavior change.

Several limitations of this study should be noted. First, this is a small pilot study with no comparison group which limits the ability to interpret the significant findings. However, the base intervention that was used for the study has been tested in a randomized controlled trial [33–38] and had similar findings to the current study. Second, because of the small sample size, our focus was on estimates of effect and not on statistical significance testing (and thus was not focused on p-values). We would need a fully-powered trial in order to test whether associations hold in a larger sample. Third, we were unable to assess how their relative's

breast cancer's clinical information related to the outcomes. Although participants were asked about the age at which their relatives were diagnosed and the time since diagnosis, only a subset reported data on this, some of which was partially incomplete. Thus we were unable to control for these potential confounders of the association between perceived control, risk, worry and physical activity outcomes. Another limitation is that this sample may represent a highly motivated group of women and these results may not be generalize to less motivated populations

For women who have a first-degree relative with breast cancer, a physical activity intervention that incorporates breast cancer related information, was successful in helping these women increase their physical activity. When examining perceived risk of breast cancer, breast cancer worry, and perceived control over breast cancer, only perceived risk of breast cancer was directly related to physical activity. Both baseline perceived risk and changes in perceived risk were related to changes in physical activity. While breast cancer worry did not directly relate to changes in physical activity, results suggest that perceived risk and perceived control over breast cancer each moderated the relationship between breast cancer worry and physical activity. The medium effect sizes found for these significant relationships and trends in this small pilot study warrant conducting a fully powered randomized controlled trial to more fully examine the role that perceived risk of breast cancer, breast cancer worry, and perceived control over breast cancer have in increasing physical activity. These results also suggest that future studies could benefit from using a multi-prong approach to address these women's worry about breast cancer while motivating them to make important lifestyle changes.

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Table 1**Baseline Participant Characteristics, Physical Activity and Psychosocial Constructs**

	Intervention Arm (N=27) % or Mean (SD)
Age, years	38.52 (11.40)
Education (At least some College)	88.90%
Married	40.70%
White	80.95%
Non-Hispanic or Latino	88.90%
Number of First-Degree Relatives with Breast Cancer	
1	96%
2	4%
Breast Cancer Patient's Relationship to the Participant	
Mother	86%
Sister	14%
Baseline Physical Activity (minutes/week)	25.00 (30.45),
Baseline Perceived Risk of Breast Cancer	44.04 (10.25), Range 11–60
Baseline Breast Cancer Worry	1.93 (0.65), Range 1–3.5
Baseline Perceived Control over Breast Cancer	3.19 (0.52), Range 2–4

Table 2

Association between Changes in Psychosocial Predictors and Changes in Physical Activity

	Parameter Estimate	Standard Error	t-value	p-value
Changes in Perceived Risk of BC	−8.69	3.69	−2.36	0.03

* Model adjusts for baseline physical activity.

Table 3

Baseline Psychosocial Predictors of Changes in Physical Activity

	Parameter Estimate	Standard Error	t-value	p-value
Baseline Perceived Risk of BC	3.91	2.43	1.61	0.12

* Model adjusts for baseline physical activity.

Table 4

Perceived Risk as a Moderator of the Association between Breast Cancer Worry and Changes in Physical Activity

	Parameter Estimate	Standard Error	t-value	p-value
Baseline Perceived Risk of BC	-5.85	6.20	-0.94	0.36
Baseline BC Worry	-243.82	159.07	-1.53	0.14
Perceived Risk *BC Worry	5.67	3.39	1.67	0.11

* Model adjusts for baseline physical activity.

Table 5

Perceived Control as a Moderator of the Association between Breast Cancer Worry and Changes in Physical Activity

	Parameter Estimate	Standard Error	t-value	p-value
Baseline Perceived Control of BC	−191.00	121.18	−1.58	0.13
Baseline BC Worry	−271.83	187.27	−1.45	0.16
Perceived Control *BC Worry	95.36	56.71	1.68	0.11

* Model adjusts for baseline physical activity.