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Physical Activity Behaviors in Women with Newly Diagnosed Ductal Carcinoma-In-Situ

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Abstract

Epidemiological evidence suggests that physical activity may affect breast cancer risk and other health outcomes. Little information is available regarding changes in activity after diagnosis and treatment of in-situ cancer. We enrolled 487 women with newly diagnosed ductal carcinoma-in-situ (DCIS) in a longitudinal cohort study. Exercise behaviors were assessed at enrollment and at 18 months. Changes in exercise frequency over time were compared, and the impact of demographic and treatment-related variables was evaluated. Enrollment and 18-month exercise data were available for 391 women (80%). At enrollment, most women performed strenuous physical activity infrequently, and only half engaged in any type of exercise more than twice a week. Overall activity patterns did not change greatly over the course of the study. However, logistic regression modeling of changes in exercise revealed that women who underwent unilateral or bilateral mastectomy (hazard ratio [HR], 2.4; 95% confidence interval [95% CI], 1.3–4.4) and those who were anxious at enrollment (HR, 2.1; 95% CI, 1.1–4.1) were statistically significantly more likely to decrease exercise levels, and women who worked were significantly more likely to increase exercise over the course of the study (HR, 1.9; 95% CI, 1.1–3.3). Nonsignificant variables included age, reconstructive surgery, depressive symptoms, financial status, education, and tamoxifen use. A large proportion of women with newly diagnosed DCIS were inactive and remained so over time. Women who underwent mastectomy, as well as women who were more anxious, were more likely to decrease their level of physical activity. Women with DCIS might benefit from targeted interventions to increase physical activity.

The number of women diagnosed with ductal carcinoma-in-situ (DCIS) each year has risen dramatically with the widespread use of screening mammography.^{1,2} Survival after DCIS diagnosis is generally excellent with appropriate local management. Patients with DCIS are at increased risk of subsequent breast cancer events, but most of these patients will not die from breast cancer—related causes. In this setting, it is important to understand the impact of DCIS diagnosis and treatment on lifestyle factors associated with breast cancer risk and other health outcomes. Observational studies have demonstrated that physically active women are at lower risk of developing invasive and in situ breast cancers, and emerging data suggest that women who are physically active after diagnosis of invasive breast cancer have

a lower risk of cancer recurrence and cancer-related death compared with sedentary women.^{3–5} Physical activity after cancer diagnosis may also help prevent weight gain, which has been associated with high rates of second cancers and other health complications in breast cancer survivors.

Studies demonstrate that patients often become less active after diagnosis of invasive breast cancer,^{6–9} likely as a result of fatigue and side effects of adjuvant therapy.¹⁰ There are currently few data regarding postdiagnosis physical activity patterns in women with DCIS, who generally receive less intensive adjuvant therapy than women with invasive breast cancer. In this study, we measured physical activity patterns over time in a cohort of women with newly diagnosed DCIS and explored the impact of demographic, treatment-related, and psychological variables on changes in activity after diagnosis.

PATIENTS AND METHODS

Study Subjects

Potential participants were identified through the Rapid Case Registry at Dana-Farber/Harvard Cancer Center. Eligibility criteria included a new diagnosis of DCIS with no evidence of invasion or microinvasion, last surgical procedure within 3 months of study enrollment, and ability to speak and read English or Spanish. Participants were ineligible if they had a history of invasive breast cancer.

Once a potential participant was identified, the treating physician was contacted to obtain permission to approach the patient. After permission was obtained, women were mailed invitations to participate in the study. Informed consent was obtained from all participants before enrollment, and the study received local institutional review board approval.

Study Design

This physical activity research was conducted as part of a prospective longitudinal cohort study designed to assess health behaviors, risk perceptions, and psychosocial concerns in women with newly diagnosed DCIS.¹¹ Women were mailed questionnaires at enrollment, 9 months, and 18 months. Data were collected through telephone interviews with study staff.

Measures

Baseline and follow-up surveys were composed of questions regarding demographic and medical factors, health behaviors, and perception of subsequent breast cancer risks, as well as validated instruments to assess anxiety and depression. The Center for Epidemiologic Studies Depression Scale was used to measure depressive symptoms, with a score of 16 or more indicating a high level of depression. The anxiety subscale of the Hospital Anxiety and Depression Scale was used to assess anxiety, with a score of 8 or more indicating anxiety.¹³ For the baseline assessment of both instruments, women were asked to indicate their depression and anxiety symptoms in the month before their DCIS diagnosis. Disease and treatment-related information was obtained from the Rapid Case Registry Core records and from review of medical records at individual sites. Because of concern that some treatment-related information might not have been contained reliably in the available medical records,

participants were asked to verify surgical procedures (including reconstruction), receipt of radiation, and use of tamoxifen on the 9-month survey.

Exercise

Exercise frequency was assessed at the enrollment and 18-month surveys. Participants were asked to respond to the following two questions regarding their exercise frequency in the 30 days before completing the questionnaire:

How often do you do moderate exercise for at least one half-hour, such as golfing, bowling, walking, or gardening?

How often do you do strenuous exercise for at least one half-hour, such as running, swimming, bicycling, tennis, or aerobics?

Each question had five possible responses: (1) rarely/never, (2) a few times a month, (3) once or twice a week, (4) three to five times a week, and (5) every day.

Statistical Analysis

Descriptive statistics were used to evaluate the number of times per week that participants engaged in at least 30 minutes of moderate and strenuous physical activity at enrollment and 18 months. Analyses included all patients for whom both enrollment and 18-month survey responses were available.

To evaluate whether exercise behaviors changed over time, participants were grouped into three exercise categories at enrollment and at 18 months on the basis of the highest frequency of exercise performed (either strenuous or moderate): infrequently (includes responses “rare” and “1–2 times/month”), 1 or 2 times/week, 3 or more times/week. Women who performed strenuous exercise once or twice a week *and* moderate exercise once or twice a week were assumed to be exercising three or more times a week and were categorized in the highest group. The proportion of participants who increased, decreased, and maintained exercise behavior over time was then calculated from this combined measure of moderate and strenuous activity.

A step-down, unordered, polychotomous logistic regression model was used to identify whether change in exercise behavior over time was associated with demographic characteristics, treatment received, or emotional factors. The model used demographic information obtained at enrollment, treatment-related information obtained from the 9-month survey, and enrollment survey scores from psychological measures. All covariates were entered into the model. Predictors were removed from the model by backward elimination if the log-likelihood ratio test was not significant at a *P* value of .10 or greater. Models were used to generate risk ratios and 95% confidence intervals.

RESULTS

Eight hundred fifteen women with newly diagnosed DCIS were identified in eastern Massachusetts between April 2000 and May 2004. Forty-five women were found to be ineligible because they were unable to speak English or Spanish, or they had a concomitant

diagnosis with invasive or microinvasive breast cancer. Six additional patients could not be contacted. Of the remaining 764 eligible patients, 487 (64%) enrolled and responded to the enrollment questionnaire, 414 patients completed the 9-month questionnaire, and 395 patients completed 18-month questionnaire. Baseline characteristics for the participants completing both enrollment and 18-month questionnaires are presented in Table 1. The average age of participants was 53 years, and most were white (94%), employed full-or part-time (59.4%), and had at least a college degree (61.0%). The average time between DCIS diagnosis and enrollment was 3.8 months. Most women also reported having “money for special things” (72.4%), an indicator of higher socioeconomic status.

Physical Activity Patterns Over Time

Baseline and 18-month exercise frequency data are reported in Table 2. At baseline, most women (67.4%) reported that they performed strenuous physical activity infrequently, and only half engaged in any type of exercise more than twice a week. There was no relationship between baseline physical activity and type of surgical procedure or time between last surgical procedure and completion of the exercise questionnaire (data not shown). At 18 months, overall physical activity patterns remained largely unchanged, with 44.7% of women exercising twice a week or less.

Table 3 presents the changes in activity patterns over the 18 month follow-up period. Most participants maintained baseline levels of physical activity over the 18-month follow-up period, with 64.6% of patients reporting similar activity at baseline and at 18 months. Approximately 21% of patients reported an increase in activity, while 14.6% of patients reported a decrease.

Modifiers of Change in Exercise Frequency

Logistic regression modeling was used to explore the relationship between a variety of demographic, treatment-related, and psychological factors and changes in physical activity over time (Table 4). The strongest predictor of a decrease in exercise frequency between baseline and 18 months was mastectomy, with women who underwent this procedure being almost two and a half times as likely to decrease exercise compared with women who underwent a lumpectomy or excisional biopsy (hazard ratio [HR], 2.4; 95% confidence interval [95% CI], 1.3–4.4). Among women who underwent unilateral or bilateral mastectomy, 24% decreased exercise over the 18-month follow-up period and 16% increased exercise. In comparison, 10% of women who underwent a lumpectomy or excisional biopsy reported a decrease in exercise, and 23% reported an increase in exercise frequency. Further modeling analyses demonstrated that among women who underwent mastectomy, reconstructive surgery was not associated with either an increase or a further decrease in exercise frequency (χ^2 P values of .56 and .95, respectively).

Women who were anxious at baseline were also more likely to decrease exercise frequency compared with women who were not anxious (HR, 2.1; 95% CI, 1.1, 4.1). Employment status was the only predictor statistically significantly associated with an increase in exercise frequency, with women who were employed outside the home full-or part-time almost twice as likely to increase weekly exercise compared with women who were retired, disabled, or

homemakers or who had another employment status (HR, 1.9; 95% CI, 1.1–3.3). Education level, socioeconomic status, age, use of tamoxifen, and depressive symptoms were not statistically significantly associated with change in exercise frequency.

DISCUSSION

An estimated 60,000 new cases of DCIS are diagnosed each year, accounting for 20% of all new breast cancers.^{1,14} Although the natural history of untreated DCIS is not completely clear, historical case series suggest that 11% to 60% of DCIS cases will progress to invasive breast cancer,^{2,15–17} and thus treatment guidelines recommend complete surgical excision.^{1,2} Historically, DCIS was often diagnosed as a result of the presence of a palpable mass, and most patients had marked breast involvement at diagnosis. Most patients were treated with mastectomy, with or without axillary lymph node dissection. Since the widespread adoption of mammographic screening, however, patients often manifest much less extensive DCIS.^{18,19} In this setting, several trials have demonstrated relatively low rates of local recurrence with breast-conserving surgery, generally followed by breast irradiation.^{20–22} Despite these studies, however, up to 59% of women with newly diagnosed DCIS will undergo mastectomy, and some series suggest that these rates have not changed greatly over time.^{18,19} Some data suggest that mastectomies are more common in women with multifocal or larger tumors, but a proportion of women even with small areas of DCIS are treated with mastectomy rather than breast-conserving surgery.^{19,23}

Regardless of surgical approach, prognosis after a diagnosis of DCIS is generally good. Historically, less than 2% of patients with DCIS have developed distant breast cancer metastases, and breast cancer-specific survival is close to 99%.^{24–26} These rates may be even higher in the current era when most patients have smaller DCIS lesions¹⁹ and therefore a lower likelihood of having undetected invasive cancer. Thus, most patients diagnosed with DCIS die of causes other than breast cancer.²⁷

Studies have demonstrated that many women gain weight after breast cancer diagnosis, putting them at higher risk of developing diabetes, heart disease, and other health problems.^{28–31} Data also suggest that overweight breast cancer survivors are more likely to develop additional breast cancers and other malignancies.³² Weight gain is most common in women treated with chemotherapy and in those who go through menopause as a result of cancer therapy,^{28–30} but studies also demonstrate weight gain in patients treated for DCIS and those who undergo surgery alone for early stage invasive cancers.³¹ It is not completely clear why women gain weight after breast cancer diagnosis, but several trials have suggested that reductions in physical activity may be at least in part to blame. The Healthy Eating and Living study demonstrated an association between weight gain and reductions in physical activity after diagnosis in 514 patients with stage 0–IIIa breast cancer taking part in a prospective cohort study.³¹ Demark-Wahnefried et al. also demonstrated a marked association between decreased physical activity and weight gain in 34 premenopausal women receiving chemotherapy for early stage breast cancer,¹⁰ and Herman et al. demonstrated a strong association between obesity and decreased physical activity in a cohort of 441 women with stage 0–II breast cancer.³⁰

target this group in future trials of exercise interventions in an effort to improve quality of life, and possibly disease outcomes and overall survival.

Several limitations of our trial should be acknowledged. First, we did not collect information about body weight at enrollment or changes in weight over time. It is possible that weight or weight changes affected physical activity patterns over time. Second, women were enrolled onto the study an average of 3.8 months after diagnosis, at a time when many women were still undergoing surgical treatment and radiation. These ongoing treatments may have affected baseline physical activity patterns; however, we did not see any relationship between physical activity levels at baseline and type of surgical procedure or the length of time between the last surgical procedure and study enrollment. Finally, although several instruments have been developed and validated for the measurement of physical activity in cancer patients over the last few years, few of these data were available at the time of this study's inception. Thus, a novel, unvalidated measure was used to measure physical activity. This measure did not allow for the calculation of metabolic task equivalents of physical activity per week, and it is therefore possible that we were not able to detect small changes in physical activity that occurred over the course of the study. It is also likely that we underestimated physical activity in participants who exercised for longer periods less frequently and overestimated activity in participants who engaged in shorter bouts of activity more frequently. Our method of grouping patients into three categories of physical activity on the basis of the highest frequency of either moderate or strenuous activity was also imprecise, again making it more difficult to detect small changes in exercise patterns over time. Despite these limitations however, we were able to detect a strong association between mastectomy and decrease in exercise frequency, as well as weaker associations between employment and anxiety and changes in exercise patterns over time. Additional work evaluating physical activity patterns in patients with DCIS will be needed that uses well-validated instruments to assess exercise frequency and intensity to more accurately reflect small changes in activity levels.

In summary, a large proportion of women with newly diagnosed DCIS reported infrequent exercise, and although most of these women did not substantially change physical activity patterns over time, women who underwent mastectomy and those who were anxious were far more likely to experience further decreases in activity in the months after diagnosis. Given that decreased physical activity after breast cancer diagnosis is associated with weight gain^{10,30,31} as well as increased risk of cancer recurrence in women with invasive breast cancer^{3,36} women with newly diagnosed DCIS may benefit from targeted interventions to increase physical activity with particular attention to women who undergo mastectomy and those with significant anxiety after diagnosis. Randomized trials will be needed to determine whether changes in physical activity affect rates of subsequent cancers and other health outcomes in women with DCIS.

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TABLE 1Patient characteristics ($n = 391$)

Characteristic	Value
Age (year)	
>50	37.3%
50–65	46.8%
<65	15.9%
Household socioeconomic status	
Money for special things	72.3%
Can pay bills with little/no spare money	24.5%
Difficulty paying bills	3.1%
Employment status	
Full/part-time	59.1%
Unemployed/homemaker	14.6%
Disabled/retired/other	26.3%
Highest education level	
Less than high school	1.3%
High school graduate/technical/vocational or some college	37.8%
College graduate	29.7%
Postgraduate	31.2%
Type of surgery	
Excision/biopsy	67.4%
Unilateral mastectomy	25.6%
Bilateral mastectomy	7.0%
Radiation	
No	49.3%
Yes	50.7%
Reconstructive surgery	
No	74.3%
Yes	25.7%
Tamoxifen	
No	55.8%
Yes	44.2%
Time between enrollment and diagnosis (mo)	
Median [25th, 75th percentile]	3.8 [2.6, 5.0]

TABLE 2Exercise frequency at baseline and 18 months ($n = 391$)

Exercise frequency	Baseline		18 Months	
	Moderate (%)	Strenuous (%)	Moderate (%)	Strenuous (%)
Rarely	16.6	57.0	13.3	47.2
Few times/month	13.5	10.5	13.8	13.0
1–2 times/week	23.3	12.5	22.4	15.3
3–5 times/week	31.7	15.6	36.2	19.4
Daily	14.8	4.3	14.3	5.1

TABLE 3Change in exercise ($n = 391$)

Exercise frequency	Baseline exercise		
	Decreased	Stayed the same	Increased
Rare/1–2 per month	NA	57 (14.5%)	50 (12.8%)
1–2/week	17 (4.3%)	24 (6.1%)	31 (7.9%)
3+/week	41 (10.5%)	171 (43.7%)	NA
Total	58 (14.6%)	252 (64.4%)	81 (20.7%)

NA, not applicable

TABLE 4

Effect of modifiers on exercise frequency

Characteristic	Risk ratio	
	Decrease vs. no change	Increase vs. no change
Age		
<50 vs. >65	1.32	.90
50–65 vs. >65	1.04	1.36
Household socioeconomic status		
Little spare money vs. money for special things	1.78	1.09
Difficulty paying bills vs. money for special things	1.06	.52
Employment status		
Full/part-time vs. other	1.19	1.91 (95% CI 1.1–3.3) *
Highest education level		
Vocational/some college vs. high school	1.32	.76
College graduate vs. high school	.71	1.62
Postgraduate vs. high school	1.18	1.56
Type of surgery		
Excision/biopsy vs. mastectomy	2.42 (95% CI 1.3–4.4) **	1.39
Reconstructive surgery		
Yes vs. no	1.23	1.25
Tamoxifen use		
Yes vs. no	.78	1.17
Anxiety		
Yes vs. no	2.10 (95% CI 1.1–4.1) ***	.90
Depression		
Yes vs. no	1.28	1.10

95% CI, 95% confidence interval

*
 $P = .02$ **
 $P = .004$ ***
 $P = .03$