Comparisons of Exercise Dose and Symptom Severity Between Exercisers and Nonexercisers in Women During and After Cancer Treatment

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Abstract

Context. Although numerous studies of the efficacy of exercise are reported, few studies have evaluated changes in characteristics of exercise dose in women with cancer both during and after cancer treatment.

Objectives. To describe the characteristics of exercise dose (i.e., frequency, duration, and intensity) and evaluate for differences in symptom severity (i.e., fatigue, sleep disturbance, depression, and pain) between women who did and did not exercise during and after cancer treatment.

Methods. In a sample of 119 women, two groups were classified: exercisers and nonexercisers. Exercisers were defined as women who met specific criteria for frequency (three times per week), duration (20 minutes/session), intensity (moderate), and mode (aerobic). Nonexercisers were defined as women who did not meet all these criteria. Evaluation of exercise dose was completed at baseline (T1: the week before chemotherapy cycle 2), at the end of cancer treatment (T2), and at the end of the study (T3: approximately one year after the T1 assessment) using self-report exercise questionnaires.

Results. Approximately 50% of the participants exercised during treatment and 70% exercised after treatment. At T1, exercisers had lower total fatigue, lower behavioral and sensory subscale fatigue scores, and lower depression scores (P = 0.038) than nonexercisers. No significant differences in sleep disturbance or pain were found between groups. At T2, exercisers had lower cognitive/mood subscale fatigue and depression scores than nonexercisers (P = 0.047). At T3, no significant differences were found between groups in any symptom severity scores.

Conclusion. Both during and after cancer treatment, achieving or maintaining exercise guideline levels were met by most patients. Further study is needed to...
examine the link between exercise dose and symptom severity. J Pain Symptom Manage 2012;43:842–854. © 2012 U.S. Cancer Pain Relief Committee. Published by Elsevier Inc. All rights reserved.

**Key Words**

Exercise dose, cancer, fatigue, sleep disturbance, pain, depression, cancer treatment

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**Introduction**

Based on a series of systematic reviews and meta-analyses, exercise interventions are known to improve physiologic and psychological outcomes in patients during and after cancer treatment. In addition, the most current systematic review and meta-analysis reviewed 82 studies and showed a large range of effects in upper and lower body strength from physical activity interventions during or after cancer treatment. However, a range of challenges are noted for individuals who are initiating and sustaining exercise doses and investigators who are conducting exercise intervention studies. The challenges for the individual include a need to change behavior and initiate exercise activities, which is especially difficult for a person who is sedentary. Once the exercise begins, the challenge shifts to sustaining this new behavior. Both these challenges are made more difficult when individuals experience distressing physical and psychological effects from cancer and its treatment. Challenges for investigators include not being able to control for participants’ previous exercise dose, specifically for those who exercised regularly before the start of the study, and not knowing participants’ exercise capabilities. Dealing with the wide range of exercise interventions and adherence with the exercise intervention are additional challenges.

An evaluation of cancer patients’ level of adherence with an exercise intervention is important because long-term maintenance of exercise activities is essential in maintaining the benefits of exercise over the course of the disease and its treatment. Many beneficial effects of regular physical activity fade within two weeks if physical activity is not maintained, and the effects will disappear within two to eight months without a return to regular exercise. Although most of the published exercise interventions include details about frequency, duration, and intensity, they differ widely (i.e., ranging from two to three times per week, from 10 to 60 minutes, and from 40% to 75% of maximum heart rate). Because of these variations, it is difficult to evaluate adherence across previous studies.

The American Cancer Society’s (ACS) guidelines for cancer patients state that they should exercise three to five times per week, for 20–60 minutes per session, at moderate intensity, and use aerobic exercise. However, no studies were found that evaluated the same cohort of cancer patients’ adherence with these recommended guidelines both during and after cancer treatment. Therefore, the aims of this study were to describe the characteristics of exercise dose (i.e., frequency, duration, and intensity) in a sample of women both during and after cancer treatment and evaluate for differences in symptom severity (i.e., fatigue, sleep disturbance, depression, and pain) in exercisers vs. nonexercisers at three time points.

**Methods**

**Study Design**

This study was part of a longitudinal, randomized, controlled trial that tested the effectiveness of a systematic exercise intervention on fatigue (i.e., PRO-SELF®: Fatigue Control Program). In this randomized controlled trial, participants were randomly assigned to one of three groups: Group 1 (EE) received their exercise prescription throughout the study period (both during and after cancer treatment), Group 2 (CE) received their exercise prescription after having completed cancer treatment, and Group 3 (CC) received usual care throughout the study period (during and after cancer treatment). No differences were found among the three groups for changes in
fatigue over time. However, fatigue severity increased and decreased over time regardless of group assignment. In addition, no significant differences were obtained among groups in symptoms of sleep disturbance, depression, or pain. Therefore, for the current analysis, all patients were combined to examine their exercise doses. This analysis evaluated three exercise dose characteristics (i.e., frequency, duration, and intensity) at three time points: baseline (the week before the second chemotherapy [CTX] treatment [T1]), at the completion of cancer treatment (T2), and at the end of the study (T3: approximately one year after T1) and compared fatigue, sleep disturbance, depression, and pain between exercisers and nonexercisers.

Settings and Participants
Participants were recruited from six outpatient oncology clinics in the San Francisco Bay area. All participants were women who were 18 years or older with a confirmed diagnosis of breast, colorectal, or ovarian cancer; beginning their first cycle of CTX; able to read, write, and understand English; had a Karnofsky Performance Status (KPS) score of 60 or more; and were able to provide written informed consent. Participants were excluded from the study if they were receiving concurrent radiation therapy (RT) or bone marrow transplantation or had uncontrolled hypertension or diabetes mellitus, a pain intensity rating of three or more on a zero to 10 numeric rating scale (NRS), a lytic bone lesion or orthopedic limitations, a history of major depression or sleep disorders, CTX within the past year, a diagnosis of AIDS-related malignancies or leukemia, or absolute contradictions to exercise testing as established by American College of Sports Medicine guidelines.

Procedures
The study was approved by the Committee on Human Research at the University of California, San Francisco, and at each recruitment site. Participants who met the study criteria and were scheduled to begin CTX were told about the study by the referring oncologists and nurses at each recruitment site and then approached by the research staff. After written informed consent was obtained, participants completed a packet of questionnaires in the clinic or in their home. Questionnaires were returned when patients came in for exercise testing. Participants were classified as exercisers if their actual exercise doses measured at each time point corresponded to the minimum criteria recommended by the ACS guidelines for frequency (three times per week), duration (20 minutes/session), intensity (moderate), and mode (aerobic). Aerobic exercise included activities, such as walking, jogging/running, swimming, and cycling. Nonexercisers were defined as individuals who did not fulfill these criteria.

Measures
A demographic profile form, completed by the participants at T1, obtained information on age, income, ethnicity, and gender. In addition, at T1, T2, and T3, participants provided information on occupational status, KPS score, menopausal status, and symptoms. Three items from the demographic profile form were used to evaluate exercise dose at the three time points. To measure frequency, participants were asked, “How often do you exercise per week?” Possible answers ranged from once a week to more than five times per week. To measure duration, participants were asked, “On average, how long do you exercise at each session?” Possible answers ranged from once a week to more than five times per week. To measure intensity, participants were asked, “How hard do you exercise at each session?” and the choices ranged from easy to very hard.

The KPS scale measures the physical abilities of the patient based on the definitions provided on a scale of zero to 100. Since its development, the scale has been used extensively in oncology to evaluate performance status. A score of 100 indicates that the individual is able to carry on normal activities and that there is no decrease in performance status. A score of 30 indicates that the individual is severely disabled and needs to be hospitalized. The KPS has well-established interrater reliability, concurrent validity, and criterion validity.

The medical record review form was used to obtain medical and treatment-related data. Information was obtained on diagnosis, CTX...
protocol, treatment goals, and response to CTX, and/or RT.34,36

The Piper Fatigue Scale is a 22-item instrument41 that evaluates subjective fatigue (i.e., behavioral, affective, sensory, and cognitive/mood). Each item is rated on a zero (none) to 10 (a great deal) NRS. Total and subscale scores are calculated, which can range from zero to 10. It was originally developed to measure fatigue in persons with cancer and has excellent reliability and validity estimates.42 Fatigue scores are categorized as mild (1–3), moderate (4–6), and severe (7–10).41 In the present study, the Cronbach’s α for the Piper Fatigue Scale ranged from 0.96 to 0.97.

The General Sleep Disturbance Scale consists of 21 items that evaluate various aspects of sleep disturbance (i.e., quality, quantity, sleep latency, waking up during sleep, daytime sleepiness, and medication use).47 Items are rated on a zero (never) to 7 (every day) NRS. The 21 items are summed to yield a total score that ranges from zero (no disturbance) to 147 (extreme disturbance). A score of 43 or more reflects sleep disturbance.48 The General Sleep Disturbance Scale has well-established reliability and validity in cancer patients.49 In the present study, Cronbach’s α ranged from 0.83 to 0.86.

The Center for Epidemiological Studies Depression Inventory (CES-D) is a 20-item self-report instrument that measures the clinical syndrome of depression.52 Each item is rated on a four-point scale (0–3). Scores can range from zero to 60, with higher scores reflecting more depressive symptoms. A score of 16 or more indicates the need for a clinical evaluation.52 The CES-D has well-established reliability and validity across samples of persons with cancer receiving surgery, CTX, or RT.46,49,51,53 In the present study, Cronbach’s α for the CES-D ranged from 0.80 to 0.89.

The Worst Pain Intensity Scale is a single-item zero (no pain) to 10 (worst pain imaginable) NRS that patients used to rate their worst pain in the past 24 hours. A descriptive NRS is a valid and reliable measure of pain intensity.54

Data Analyses

Data were analyzed using SPSS, version 15 (SPSS Inc., Chicago, IL). Before the analysis of the specific study aims, appropriate descriptive statistics were calculated for all variables at each point in time. Descriptive statistics were used to characterize the sample demographically and clinically. Chi-squared tests were used for categorical variables. Independent sample t-tests were used to compare continuous variables between exercisers and nonexercisers at each time point. In addition, Mann-Whitney U tests were used to evaluate for differences in exercise doses (i.e., frequency, duration, and intensity) between exercisers and nonexercisers because of the expectation of skewness in their distributions. Two-tailed tests were used at an alpha of 0.05. Comparisons were made between patients who dropped out to those who did not to determine if differential bias existed on the outcomes because of dropout.

Results

Demographic Characteristics

Of the 252 women initially approached and screened, 119 women were eligible to participate. Detailed information of individuals who did not participate is described elsewhere.18 Major reasons for refusal included not interested, not eligible, or too busy. No significant differences were found in any demographic variables between participants who completed and dropped out of the study.18

As shown in Table 1, 44.1% (n = 52) of the participants were classified as exercisers at T1. No differences were found at any time point in demographic and clinical/treatment characteristics between exercisers and nonexercisers. At T1, participants were asked if they were involved in a regular exercise program. A significantly higher number of participants in the exerciser group responded “yes” to this question (P < 0.005). This pattern continued at T2 and T3. No difference was found in the proportion of exercisers and nonexercisers who received RT after their initial course of CTX.

Frequency, Duration, and Intensity of Exercise Dose at Three Time Points

In the total sample, in terms of frequency of exercise dose, more than 80% of the sample exercised more than three times a week. The frequency of exercise decreased in most participants to twice a week during cancer treatment (T2), and then it increased in most participants to three times a week after completion of cancer treatment (T3) (Fig. 1).
<table>
<thead>
<tr>
<th>Demo/Clinical Characteristics</th>
<th>All Patients (N = 119)</th>
<th>T1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>T2&lt;sup&gt;b&lt;/sup&gt;</th>
<th>T3&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Nonexercisers, n = 56</th>
<th>Exercisers, n = 46</th>
<th>Nonexercisers, n = 32</th>
<th>Exercisers, n = 70</th>
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<tr>
<td>Age, years</td>
<td>50.5 (9.4)</td>
<td>50.54 (9.51)</td>
<td>50.63 (9.34)</td>
<td>50.53 (10.24)</td>
<td>49.76 (8.81)</td>
<td>51.63 (11.13)</td>
<td>49.66 (8.89)</td>
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<tr>
<td>Education, years</td>
<td>16.2 (2.8)</td>
<td>16.2 (2.9)</td>
<td>16.2 (2.8)</td>
<td>16.4 (2.8)</td>
<td>16.2 (2.9)</td>
<td>16.3 (3.1)</td>
<td>16.3 (2.7)</td>
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<tr>
<td>Study period, days</td>
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<tr>
<td>T1–T2</td>
<td>169 (64.6)</td>
<td>165.3 (64.7)</td>
<td>172.8 (65.2)</td>
<td>164.4 (61.8)</td>
<td>173.2 (66.2)</td>
<td>166.0 (48.7)</td>
<td>153.93 (43.87)</td>
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<tr>
<td>T2–T3</td>
<td>164.8 (60.8)</td>
<td>159 (61.3)</td>
<td>171.63 (60)</td>
<td>155.6 (54.3)</td>
<td>174.6 (66.7)</td>
<td>167.1 (68.4)</td>
<td>169.9 (65.7)</td>
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<td>Karnofsky Performance Status</td>
<td>87.63 (9.4)</td>
<td>85.5 (9.9)</td>
<td>90.5 (7.9)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>84.4 (9.2)</td>
<td>85.4 (9.4)</td>
<td>87.8 (11.6)</td>
<td>89.1 (9.6)</td>
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<td>Marital status</td>
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<td>Married</td>
<td>80 (68.4)</td>
<td>43 (66.2)</td>
<td>36 (70.6)</td>
<td>36 (65.5)</td>
<td>34 (73.9)</td>
<td>20 (62.5)</td>
<td>51 (73.9)</td>
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<tr>
<td>Ethnicity</td>
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<tr>
<td>White</td>
<td>88 (75.2)</td>
<td>45 (69.2)</td>
<td>42 (82.4)</td>
<td>41 (74.5)</td>
<td>35 (76.1)</td>
<td>24 (75)</td>
<td>55 (79.7)</td>
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<td>Employed</td>
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<tr>
<td>Full or part time</td>
<td>50 (44.2)</td>
<td>25 (39.1)</td>
<td>24 (50)</td>
<td>39 (69.6)</td>
<td>31 (73.4)</td>
<td>26 (83.9)</td>
<td>52 (75.4)</td>
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<td>Income (≥$40,000)</td>
<td>94 (83.2)</td>
<td>48 (77.4)</td>
<td>45 (90)</td>
<td>43 (82.7)</td>
<td>38 (84.4)</td>
<td>24 (80)</td>
<td>56 (82.4)</td>
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<td>Menopausal status</td>
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<tr>
<td>Premenopausal</td>
<td>40 (36.7)</td>
<td>23 (37.1)</td>
<td>17 (37)</td>
<td>5 (9.4)</td>
<td>4 (9.5)</td>
<td>2 (7.1)</td>
<td>7 (10.8)</td>
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<td>Perimenopausal</td>
<td>19 (17.4)</td>
<td>13 (21)</td>
<td>6 (13)</td>
<td>23 (43.4)</td>
<td>20 (47.6)</td>
<td>6 (21.4)</td>
<td>16 (24.6)</td>
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<tr>
<td>Postmenopausal</td>
<td>50 (45.9)</td>
<td>26 (41.9)</td>
<td>23 (50)</td>
<td>25 (47.2)</td>
<td>18 (42.9)</td>
<td>20 (71.4)</td>
<td>42 (64.6)</td>
<td></td>
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<tr>
<td>Sequential chemotherapy then radiation therapy</td>
<td>59 (49.6)</td>
<td>27 (40.9)</td>
<td>32 (61.5)</td>
<td>30 (53.6)</td>
<td>26 (56.5)</td>
<td>17 (53.1)</td>
<td>38 (54.3)</td>
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<tr>
<td>Participate in regular exercise program</td>
<td>75 (64.7)</td>
<td>28 (43.8)</td>
<td>47 (92.2)&lt;sup&gt;e&lt;/sup&gt;</td>
<td>27 (49.1)</td>
<td>39 (84.8)&lt;sup&gt;e&lt;/sup&gt;</td>
<td>11 (35.5)</td>
<td>52 (72.4)&lt;sup&gt;e&lt;/sup&gt;</td>
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<tr>
<td>Cancer stage</td>
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<td>I</td>
<td>40 (36)</td>
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<td>22 (40.7)</td>
<td>17 (41.5)</td>
<td>11 (36.7)</td>
<td>12 (42.2)</td>
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<tr>
<td>II</td>
<td>52 (46.8)</td>
<td>24 (38.7)</td>
<td>27 (56.3)</td>
<td>26 (48.1)</td>
<td>16 (39)</td>
<td>13 (42.3)</td>
<td>27 (42.2)</td>
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<tr>
<td>III</td>
<td>19 (17.1)</td>
<td>11 (17.7)</td>
<td>8 (16.7)</td>
<td>6 (11.1)</td>
<td>8 (19.5)</td>
<td>6 (20)</td>
<td>10 (15.6)</td>
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</table>

<sup>a</sup>T1: the week before second chemotherapy treatment.
<sup>b</sup>T2: four to six months after T1.
<sup>c</sup>T3: approximately one year after T1.
<sup>d</sup>P < 0.05.
<sup>e</sup>P < 0.01.
In terms of duration of exercise per session at T1, about 80% of the sample exercised for more than 20 minutes/session and approximately 36% did more than 45 minutes/session. At T2, similar percentages were reported for duration, and more than 45 minutes/session was still the highest percentage. At T3, about 90% of the sample exercised more than 20 minutes/session, and 37% exercised 31–45 minutes/session (Fig. 2).

The intensity rating of “somewhat hard” had the highest percentage among all the participants at all three time points (54%–64%). At T1 and T2, a similar pattern was found, with 30% of the sample at the “fairly light” level and 52% at the “somewhat hard” level of intensity.
intensity. At T3, the rate increased to 64% of the sample exercising at the “somewhat hard” intensity level (Fig. 3).

As to the mode or type of aerobic exercise, various types of aerobic exercises were reported: walking (72%–88%), bicycling (14%–26%), jogging (8.5%–16.5%), and swimming (6%–16%). Walking was the most popular mode of aerobic exercise in the total sample at all three time points. Approximately 50% of the participants at each time point (44%–57%) were involved in additional “other” types of exercise on a regular basis during the study period. These various “other” exercises included aerobic exercises, the elliptical trainer, the Stairmaster® (Tri-Tech Inc., Tulsa, OK), or a combination of aerobic exercise with yoga.

As a total sample, a one-group t test was used to evaluate each of the exercise dose characteristics against the minimum criteria of ACS recommendations (three times per week, 20 minutes/session, and moderate intensity). The study participants exercised significantly more frequently (P ≤ 0.019) and longer (P < 0.0005) than the recommended levels (more than three times per week and 20 minutes/session) but less than the recommended level regarding intensity (“moderate”). They exercised significantly less hard at T1 and T2 (P < 0.0005). No significant differences in intensity were found at T3 (P = 0.48).

A description of exercise doses of the exercisers and nonexercisers at each time point is shown in Table 2. Most exercisers exercised more than three times a week, for more than 30 minutes/session, at a moderate intensity level at each time point. Most nonexercisers exercised twice a week, less than 20 minutes/session, and at a mild intensity level at each time point.

Comparison of Symptom Severity Between Exercisers and Nonexercisers
At T1, the exercisers had significantly lower total fatigue scores as well as lower behavioral and sensory fatigue subscale scores than the nonexercisers (P = 0.037, 0.018, 0.04, respectively) (Table 3). The exercisers reported significantly lower depression scores than the nonexercisers (P = 0.038). However, the depression scores for both groups were lower than the cutoff score of 16 for being at risk for depression. No significant statistical differences in sleep disturbance or pain (P = 0.49, 0.88, respectively) were found between exercisers and nonexercisers. In both groups, the mean sleep disturbance score was above the cutoff of 43 or more for a clinically significant level of sleep disturbance.

Fig. 3. Intensity of exercise behavior per week over time for the entire sample.
At T2, the exercisers reported significantly lower cognitive/mood fatigue subscale scores than the nonexercisers \( (P = 0.047) \). The exercisers had significantly lower depression scores than the nonexercisers \( (P = 0.047) \), and both groups' depression scores were lower than the cutoff score of 16. No significant differences were found in sleep disturbance \( (P = 0.28) \) and pain \( (P = 0.91) \) scores between the exercisers and nonexercisers.

At T3, no significant differences were found in any symptom severity scores between the two groups. Participants in both groups reported mild fatigue, pain, and sleep disturbance at each time point but were not at risk for depression at any of the three time points.

### Discussion

Few studies have examined the characteristics of exercise dose longitudinally in the same women both during and after cancer treatment. Of note, at each time point, the women who were categorized as exercisers exceeded ACS exercise guideline levels. In addition, the average fatigue score at the beginning of cancer treatment (T1) in this group was significantly lower as were the behavioral and sensory fatigue subscale scores. However, this difference was not maintained at the completion of cancer treatment (T2) or six months after completion of cancer treatment (T3). In addition, the difference in fatigue scores between the exercisers and nonexercisers at T1 may not represent...
a clinically meaningful difference. Piper et al. suggested that a one-unit change in fatigue score (e.g., from three to four on a zero to 10 scale) represented a clinically significant change in fatigue.

**Past Exercise Experience**

One of the study findings of past exercise experience is that women who participated in a regular exercise program before the beginning of CTX were likely to continue their exercise activities during and after cancer treatment. At T1, approximately 65% of participants were engaged in a regular exercise program. As would be expected, a significantly higher percentage of women who were participating in a regular exercise program were classified in the exerciser group at all three time points (\(P < 0.0005\)). This finding is consistent with the work by Courneya et al. who found that one of the strongest independent predictors of exercise contamination in a wait-list control group was past exercise experience. In addition, in another study, baseline physical activity predicted mean number of steps per week over the 12 weeks of a home-based exercise program in 43 breast cancer survivors. Taken together, these findings suggest that patients who are engaged in physical activity before cancer treatment are more likely to continue to exercise both during and after cancer treatment. Additional research is warranted to determine how and why previous exercise experience facilitates behavior changes, especially during a stressful time, such as receiving cancer treatment.

**Exercise Doses and Adherence to Exercise Interventions**

The use of various definitions of exercise adherence, and different operational definitions of exercise adherence, makes direct comparisons across studies difficult. However, the exercise adherence rates during or after cancer treatment in this study are similar to previous reports for both home-based and supervised exercise that ranged from approximately 60% to 98%. Using the ACS exercise guidelines, 50% of the patients in this study adhered to these guidelines during cancer treatment. Of note, 70% of these patients adhered to these guidelines after cancer treatment, similar to percentages reported in previous studies that followed patients for a much shorter period of time. Although the nonexercisers did not meet all three minimum exercise dose characteristics, most of them performed some physical activities.

**Exercise Doses and Symptom Severity**

Several studies have demonstrated that increased levels of physical activity during and after cancer treatment are associated with decreased fatigue severity, increased physical performance, and improved quality of life. In this study, improvements in fatigue and depression at the beginning (T1) and completion of the cancer treatment (T2) were found in the exercisers. It is still not entirely clear why the exercisers who had exercised more than the ACS recommendations both during and after cancer treatment did not differ significantly from the nonexercisers at T3. In all patients, fatigue severity remained in the mild range throughout the study. One explanation may be the “floor effect” of low fatigue and other symptom severity levels at the beginning of the study. Namely, a limited opportunity existed for the exercise dose to demonstrate a significant reduction in fatigue or other symptoms in this sample.

According to McNeely’s meta-analysis, the pooled results of the six studies that examined the effect of exercise on fatigue showed statistically significant improvements in this symptom in only two studies. Both studies evaluated the effects of exercise after primary cancer treatment. During adjuvant cancer treatment, exercise had no effect on fatigue severity. The evidence suggests that exercise does not decrease fatigue in women undergoing adjuvant cancer treatment. Although the effects were nonsignificant in four studies, all point estimates were in favor of exercise, which suggests the need for more research on the optimal dose and timing of exercise before this approach to reducing fatigue severity is rejected. Because fatigue is reported to be associated with sleep, depression, and pain, one can intuitively consider that improving fatigue might result in reductions in other symptoms.

Several study limitations are worth noting: self-report of exercise activities, demographic
characteristics, and data collection time points. These study data were obtained through self-report, without a supplemental objective measure of exercise (e.g., pedometer). Several demographic characteristics were reported as the determinants of physical exercise in cancer patients, such as higher education level, lower body mass index, and women with breast cancer. These characteristics in our sample limit the generalizability of the study findings. Furthermore, the exercise data were collected at only three time points over 12 months and not continuously.

The use of a self-report exercise dose supplemented with an objective measure was reported recently. Swenson et al. described a physical activity protocol for 36 patients with breast cancer receiving CTX. This study used a pedometer that captured home-based exercise and daily chores. The participants were asked to complete 10,000 steps daily. The mean (standard deviation) number of steps per day for the initial six weeks period was 7363 ± 2421 and increased after each CTX cycle. The adherence rate with this protocol was 74%. As might be expected, participants who reported more fatigue and hours spent sleeping/reclining at baseline were less adherent with the study protocol.

Although a considerable amount of research on exercise in cancer patients exists, several issues remain to be investigated, including a need to incorporate more frequent and thorough measures of physiological and psychological outcomes, analysis of changes in exercise dose and their causes during and after cancer treatment, the relationship between duration of regular exercise dose and symptoms, and optimal dose and timing of exercise during and after cancer treatment. Additional research is warranted on the barriers to exercise not only during but also after cancer treatment.

Last, because participation in a regular exercise program at baseline and all three time points was almost universal in the exercise group, it is important to consider a number of issues related to an exercise prescription. These issues include initial assessment of individual patients, monitoring and ensuring the safety and efficacy of the exercise program, and encouraging maintenance of the exercise program during and after cancer treatment.

Different intervention strategies may be needed for the previous exercisers to maintain their activities during cancer treatment and for the previous nonexercisers to initiate and sustain their activities during cancer treatment.

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