Physical and Psychological Effects of a 12-Session Cancer Rehabilitation Exercise Program

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Background: The positive effects of regular exercise for cancer survivors are becoming increasingly apparent. However, comprehensive examination of the benefits of modest levels of physical activity is somewhat lacking.

Objectives: This study aimed to test the hypothesis that participating in a 12-session exercise program will improve depression, fatigue, aerobic endurance, muscular strength, and quality of life (QOL) in patients with cancer.

Methods: A group of 20 older adult women with a prior cancer diagnosis were evaluated during a 6- to 10-week exercise program that occurred twice weekly. The majority of patients had breast cancer (n = 14), but treatment status varied (11 were currently undergoing treatment, and 9 were post-treatment). Each patient completed initial and exit assessments, which consisted of three physical function tests and three psychosocial questionnaires. Patient charts contained the initial and final assessment scores and personal demographics.

Findings: Analyses of pre- and postprogram data using paired t tests revealed that 12 exercise sessions (each lasting about an hour) significantly improved six-minute walk test, 30-second sit-and-stand test, hand grip strength test (dominant and nondominant hand), and overall QOL scores in patients. As a result, moderate levels of exercise have a beneficial effect in this population.

All cancer treatments potentially have serious side effects, including fatigue, muscle or hair loss, nausea, pain, weakness, loss of appetite or ability to perform activities of daily living, depression, anxiety, and sleep disruptions (Hanna, Avila, Meteer, Nicholas, & Kaminsky, 2008). In addition, specific treatments and surgical procedures can lead to lymphedema, restricted range of motion, joint pain, and osteoporosis (Schwartz, Mori, Gao, Nail, & King, 2001; Segal et al., 2001). Together, these can lead to loss of physical function, weight management issues, depression, decreased cardiovascular health, and, ultimately, an overall decline in quality of life (QOL) (Adamsen et al., 2009; Campbell, Mutrie, White, McGuire, & Kearney, 2005; Sandel et al., 2005; Valiance, Courney, Plotnikoff, Yasui, & Mackey, 2007).

Compared to healthy, aged-matched controls, patients with cancer demonstrate multiple measures of impaired psychological and physical well-being during and after treatment. Aerobic endurance, muscular strength, depression, fatigue, and QOL are commonly assessed health and fitness components that are negatively affected by cancer (Gerritsen & Vincent, 2015).

Background

Aerobic Endurance and Muscular Strength

Aerobic endurance refers to the ability of the body to continuously transport oxygen throughout its various systems for extended periods of time (Adamsen et al., 2009; Segal et al., 2001). In addition, aerobic function and endurance are important during cancer rehabilitation to improve physical strength, adjust to a new lifestyle during or following treatment, and decrease the number of hospitalizations (Wu & McSweeney, 2004). Cardiovascular toxicity can occur from...
some cancer treatments, leading to direct heart damage, electrocardiogram abnormalities, decreased blood perfusion in tissue, and inflammatory responses in vessels (Segal et al., 2001).

Muscular strength refers to the amount of force that a muscle can produce in a single maximal effort. Maintenance and development of muscular strength is important during cancer rehabilitation because musculoskeletal alterations occur during cancer treatment (Courneya, Friedenreich, et al., 2003).

**Depression, Fatigue, and Quality of Life**

Depression is a mood disorder that causes a persistent feeling of sadness and loss of interest in usual activities (Blaney et al., 2010; Courneya, Mackey, et al., 2003). Cancer-related fatigue is an important side effect associated with cancer and its treatment (Cramp & Byron-Daniel, 2012; Pickett et al., 2002; Wolin, Schwartz, Matthews, Courneya, & Schmitz, 2012; Wu & McSweeney, 2004). Individuals who are undergoing treatment or recovering from cancer face adverse physical side effects, which may lead to decreased health-related QOL (Mock et al., 2001). The World Health Organization defines QOL as an individual's perception of the situation within his cultural context and set of beliefs in relation to his goals, expectations, values, and life interests (Hubanks & Kuyken, 1993). As patients go through cancer treatment and post-treatment rehabilitation, QOL is essential in maintaining a patient's positive attitude, feeling of self-worth, and ability to maintain independence (Sneeuw et al., 1999). Dealing with a diagnosis of cancer is daunting, and a patient will experience pain and physical changes during treatment. Consequently, finding ways to ensure QOL is enhanced is important, particularly following treatments.

**Impact of Exercise**

As in healthy populations, exercise has been shown to improve many psychological and physical components of well-being in patients with cancer ( Gerritsen & Vincent, 2015). Supervised exercise in patients with cancer has been shown to improve physical fitness and muscular strength during and after treatment (Battaglini et al., 2007; Courneya et al., 2007; Schmitz et al., 2010; Twiss et al., 2009). In addition, documented improvement has been noted in psychological functioning as a result of exercise—specifically, improved QOL and reduced depression (Midggaard, Rorth, Stelter, & Adamsen, 2006; Mock et al., 2001; Schwartz et al., 2001). Exercise and physical activity can reduce side effects of the disease process and improve a patient's functional ability and QOL, regardless of the stage of cancer (Blaney et al., 2010; Browall et al., 2008).

Given the burden of disease and previous studies showing the positive effects of exercise and physical activity in patients with cancer and survivors, a growing number of treatment centers now offer cancer rehabilitation exercise programs. These programs are often based on cardiovascular exercise programs and can use the same resources (e.g., staff, equipment, programming). Although cancer rehabilitation exercise programs differ, most are offered two to three days per week, with each session consisting of about one hour of cardiovascular and strength exercises. The daily exercise routine is also varied and can be individually adjusted according to patient fitness levels (Campbell et al., 2005; Hanna et al., 2008; Schwartz, Winters-Stone, & Gallucci, 2007).

Past studies have often focused on one variable, failing to gather data on multiple components of cancer-related health. In addition, many past studies have addressed only one cancer diagnosis and/or one point in the continuum of cancer care, which may not be reflective of general participants in a typical rehabilitation setting.

Accordingly, the purpose of this investigation was to test the hypothesis that a structured exercise program will have a positive impact on physical and psychological functioning in patients with cancer. This project explored changes in depression, fatigue, aerobic endurance, muscular strength, and QOL following a 12-session exercise-based cancer rehabilitation program.

**Methods**

**Design and Sample**

Participants consisted of individuals who attended a cancer rehabilitation exercise program offered at Miami Valley Hospital South, a regional medical hospital in Centerville, Ohio. Broad inclusion criteria regarding cancer type and treatment state were made to reflect the diversity of a typical cancer rehabilitation exercise program. The inclusion criteria were being aged older than 18 years, having a cancer diagnosis (all types), and completing all 12 exercise sessions, including clinical outcomes at intake and postprogram. However, given the low participation rates of men in the program (2 of 22 participants during the study period), data analyses were limited to females to avoid any potential gender-related differences in the response to exercise.

**Exercise Prescription**

Patients enrolled in this study attended the cancer rehabilitation exercise program two days a week (Tuesday and Thursday) until they completed all 12 exercise sessions within a 6- to 10-week time frame. Each session lasted for about one hour and included, but was not limited to, 30–40 minutes of aerobic activity and 20–30 minutes of light dumbbell exercises with stretching. At each session, heart rate, blood pressure, and oxygen saturation, along with rate of perceived exertion (RPE), were recorded during exercise. Heart rate and blood pressure were also recorded at rest before and after exercise. Heart rate and oxygen saturation were measured using a pulse oximeter, and blood pressure was manually taken by a trained staff member using a sphygmomanometer and stethoscope. Each patient was either given a target heart rate (40%–60% of their heart rate reserve [HRR]), or the RPE scale was used. A patient's HRR was calculated using the following equation: 40% (HR_{max} − HR_{rest}) + HR_{rest}, and 60% (HR_{max} − HR_{rest}) + HR_{rest}. HR_{max} is determined by subtracting the patient's age from 220, and HR_{rest} is the patient's measured heart rate while sitting at rest, taken at the primary intake appointment.
Progressive individual treatment plans and exercise prescriptions were mutually agreed on between patient and physician. These plans were based on patient goals and assessment findings. All exercise prescriptions were developed according to American College of Sports Medicine (2009) guidelines. Stage of treatment, medications, comorbidities, and a moving safety assessment, combined with the results of physical fitness testing, informed the exercise prescription. Each patient’s HR, blood pressure, oxygen saturation, and exercise metabolic equivalent levels were monitored during exercise by a cardiovascular nurse and an exercise physiologist.

The exercise program consisted of multiple cardiovascular and strength exercises, along with stretching. Before beginning each exercise session, resting vitals (HR, blood pressure, oxygen saturation) were obtained, and patients completed a five-minute warm-up, which consisted of walking on the track. Specific cardiovascular aerobic exercises included using a treadmill, standing or seated elliptical, recumbent or spinning bike, upper body ergometer, and NuStep® machines. Patients started with 15–20 minutes on one or two machines at low resistance levels and worked their way up to 30–45 minutes at increased workloads. Patients were encouraged to stay at a moderate intensity (11–13 on RPE scale) for the entire 30 minutes. RPE, rather than HR, was emphasized to familiarize patients with this method of gauging intensity that requires no additional equipment. At the same time, nursing staff monitored HR to ensure it was between 40%–60% of their HRR. Strength exercises were performed using light hand weights and included a combination of bicep curl, shoulder press, tricep extension, calf raise, squat, and lateral raise movements. The strength exercises were conducted in two sets of 10–12 repetitions. Patients started with two-pound hand weights and gradually worked toward increasing the weight.

Data Collection

All data (questionnaires and measurements) were collected from July 2014 to August 2015 and were retrospectively reviewed in August 2015 for the current analysis. The initial and final assessments were conducted in the same sequence, beginning with demographic and self-reported information and then moving into the physical tests.

Self-reported questionnaires: To quantify depressive symptoms, the Patient Health Questionnaire-9 (PHQ-9) depression screening tool was used. The PHQ-9 allows individuals to self-report the frequency of nine depressive symptoms (e.g., little interest or pleasure in doing things, feeling bad about yourself—or that you are a failure or have let yourself or your family down) and how difficult these symptoms have made common activities. The maximal score is 27, where a higher score indicates a greater level of depression according to the following scale: 0–4 = minimal depression, 5–9 = mild depression, 10–14 = moderate depression, 15–19 = moderately severe depression, and 20–27 = severe depression. The PHQ-9 is a common and validated instrument (Kroenke, Spitzer, & Williams, 2001).

To determine fatigue, the six-item Schwartz Cancer Fatigue Scale was used. This tool allows individuals to self-report their tiredness, difficulty thinking, and feelings of being overcome, listless, worn out, and helpless. The maximal score is 30 points, where a higher score indicates a greater level of fatigue. This test has been shown to be valid and reliable for the population of patients with cancer (Schwartz et al., 2007).

The Dartmouth Cooperative Functional Assessment Charts (COOP) were used to assess overall QOL through six different selected components: physical fitness, feelings, daily activities, social activities, change in health, and overall health. When using the COOP in this manner, the maximal score is 30 points, where a lower score indicates a greater QOL. The COOP is a valid and reliable self-reported questionnaire (Eaton, Young, Ferguson, Garrett, & Kolbe, 2005).

Fitness measurements: The six-minute walk test was conducted using the track in the exercise room; each lap was 90 feet. The patients walked around the track for six minutes, and the laps were tallied and the total distance calculated. Patients could stop and rest at any time if needed, but the time was not stopped. The six-minute walk test assessed the patient’s aerobic endurance, and the distance was used to calculate an approximate speed that the patient would be able to walk on the treadmill (Rikli & Jones, 1998).

The 30-second sit-and-stand test was conducted using a chair without arms to assist the patient. The clinician counted the total number of chair squats the patient could do in 30 seconds without assistance. One repetition involves the patient starting in a seated position, standing up from the chair until his knees are fully extended, and returning to the seated position. The 30-second sit-and-stand test assessed the patient’s muscular endurance (Millor, Lecumberri, Gómez, Martínez-Ramírez, & Izquierdo, 2013).

The hand grip strength test was conducted using a hydraulic dynamometer that measures the total kilograms each patient could squeeze in his dominant and nondominant hands. Each patient completed three single squeezes on each hand, and the average was taken for each hand. The hand grip strength test assessed the patient’s muscular strength (Hamilton, McDonald, & Chenier, 1992).

Data Analysis and Statistical Approach

Paired Student’s t tests were made on pre- and postprogram data. Microsoft Excel® was used to calculate and analyze the data. Sample size was estimated a priori using G*Power software, and sufficient power (0.8) was found in post hoc analyses. Significance was set a priori at p < 0.05.

Results

Sample

Sample characteristics are presented in Table 1. All 20 participants were women. Participants’ ethnicity and race were not collected. All physical function tests improved significantly at the completion of the program. The outcome of the six-minute assessment findings. All exercise prescriptions were developed according to American College of Sports Medicine (2009) guidelines. Stage of treatment, medications, comorbidities, and a moving safety assessment, combined with the results
TABLE 1. Sample Characteristics (N = 20)

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<th>Characteristic</th>
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<td>12.6</td>
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<td>Body fat (%)</td>
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<td>11</td>
</tr>
<tr>
<td>Postprogram</td>
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<td>10.7</td>
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<td>Weight (pounds)</td>
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<tr>
<td>Preprogram</td>
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<td>35.1</td>
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<tr>
<td>Postprogram</td>
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<table>
<thead>
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<th>Characteristic</th>
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<td>Cancer type</td>
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walk test improved from a mean of 427 meters (SD = 99) to a mean of 502 meters (SD = 114) (p < 0.001). The 30-second sit-and-stand test outcome improved as well, from 9 repetitions (SD = 2) to 12 repetitions (SD = 3) (p < 0.001), as did the outcome of the hand grip strength test, from 51 pounds (SD = 11.7 pounds) to 57 pounds (SD = 10.8) in the dominant hand and from 49.7 pounds (SD = 13.6) to 54 pounds (SD = 14.3) in the nondominant hand (for the both the dominant and nondominant hand, p < 0.001). In addition, patients’ overall QOL scores, as measured by the COOP, improved significantly, from 15 (SD = 2) to 12 (SD = 3) (p < 0.001). Patients’ depression scores as measured by the PHQ-9 (preprogram mean score of 5 [SD = 4] versus postprogram mean score of 4 [SD = 3]) and self-reported fatigue scores, as measured by the Schwartz Cancer Fatigue Scale (preprogram mean score of 11 [SD = 4] versus postprogram mean score of 9 [SD = 3]), did not change significantly. See Table 2 for additional data.

Discussion

This study demonstrates that exercise has a positive impact on physical function and QOL for people with cancer during and after treatment. The results indicate that exercising twice a week for about one hour each time has a positive impact on various physical and psychological factors in this population. The current authors also found that the benefits are relatively consistent across a heterogeneous population, reflecting those who may enroll in a rehabilitation program. This study is unique in that it incorporated multiple cancer diagnoses, included patients at various stages in their cancer journey, and assessed psychological and physical factors within a single study. A number of studies, including randomized, controlled trials, have established the benefits of exercise in patients with cancer over the standard treatment (Gerritsen & Vincent, 2015). The results of this study support these general findings and stem from a fairly low investment, minimal time rehabilitation program. The improvements in the psychological and physical measures examined should provide motivation for implementing such programs in the cancer care process.

Aerobic Endurance

In this study, aerobic endurance was measured with the six-minute walk test. On average, a patient’s six-minute walk distance improved about 70 meters following completion of the program. Previous studies have used a 12-minute walk test and saw an increase of 150–300 feet (45.7–91.4 meters) from initial to final testing (Campbell et al., 2005; Hanna et al., 2008). The greater magnitude of improvement observed in this study may have been attributable to the shorter duration of the test.

Muscular Strength and Endurance

Muscular strength was measured with the hand grip strength test and muscular endurance with the 30-second sit-and-stand test. The outcomes of both tests significantly improved from the first assessment to the end of the program. A variety of tests of strength can be performed, and the results of these functional tests correlate with previous studies that used a test of maximal weight lifted (Courneya, Mackey, et al., 2003; Courneya et al., 2008). Improvements in muscular strength, rather than simple prevention of a decline, deserves mention, particularly for the 11 patients currently undergoing cancer treatment.

Quality of Life

Physical exercise in patients with cancer has been shown to improve overall health, as well as enhance mood and QOL (Schwartz et al., 2001; Sneeuw et al., 1999). A study by Meneses-Echávez, González-Jiménez, and Ramírez-Vélez (2015) found that improved QOL from exercise can be observed in as few as six weeks. In the current study, overall QOL significantly improved after the completion of all 12 exercise sessions (p < 0.001), and this finding compares favorably with previous studies (Browall et al., 2008; Mock et al., 2001).

Depression

In the current study, no significant change was noted in reported depression levels. One reason for this may be that, on average, the patients were not severely depressed when they started the program. Consequently, a basement effect may have been observed that limited the current authors’ ability to effect change in this group of patients. In a study by Burnham and Wilcox (2002), patients’ depression scores improved 4–6 points after completion of a 10-week exercise program that involved exercising three times a week at a moderate to high intensity. Given the current design of the cancer rehabilitation exercise program, including modest levels of exercise, a greater change in depression scores may have been observed with additional exercise (frequency or intensity).
Health-Related Fatigue

No changes in fatigue scores were observed in this study. Prior studies focused on whether exercise could combat undesirable conditions of cancer treatment, such as fatigue (Dimeo, Thomas, Raabe-Menssen, Pröpper, & Mathias, 2004; Dodd et al., 2010; McNeely et al., 2006; Meneses-Echávez et al., 2015). These studies evaluated different parameters but concluded that exercise did not improve the overall well-being of patients with cancer. Other studies used mood scales to evaluate individual fatigue levels and found an improvement of 2–3 points after completion of the exercise program (Mock et al., 1997, 2001). The current study differed from previous studies because all types of cancer and various treatment statuses were included, and the population of women was older. Patients may have also become more active, given their improved physical function; this increase in activity may have mitigated any detectable change in self-reported fatigue.

Limitations

This study was limited to a small sample of only female participants who were either currently undergoing treatment or had completed all their treatments for cancer. Most were patients with breast cancer, but a few patients had other cancers. No statistical comparisons of cancer type, stage or type of treatment, or gender were done because of low participation rates in the program. Any of these factors may have moderated the observed improvements (or lack thereof).

Exercise habits or physical activity of the patients outside of their rehabilitation sessions were not assessed in this study. Whether patients were exercising outside of the twice-weekly sessions is unknown. In addition, given the improvements observed, patients likely became more physically active in their daily lives, standing more and walking farther distances. This is beneficial to the overall health and well-being of the patients, even if it may minimize the independent effects of the exercise rehabilitation program.

Conclusion

The overall goals of the outpatient cancer rehabilitation exercise program studied are improved quality of life, completion of treatment, minimized cancer-related side effects, enhanced survivorship, and reduced recurrence. This study has provided a basis for the success of the first and third of these goals. After the completion of 12 group exercise sessions, significant changes were noted regarding patients’ aerobic capacity, muscular strength and endurance, and overall QOL. These results suggest that incorporating exercise into the routine of a patient with cancer is important for physical and QOL changes.

Future studies are needed to build on the findings of the current study. Outside activity levels should be tracked to detect and account for changes that may result during participation. This study was small and comprised of women at various points along the continuum of cancer care. Additional studies can be appropriately powered to determine what, if any, effect gender, type of cancer, and stage of treatment have on the improvements observed. In addition, a fairly conservative approach to the intensity of exercise was taken in this study (moderate, with 40%–60% HRR). High-intensity exercise may provide additional benefit, and studies are needed to further the limited evidence-based exercise prescription guidelines that exist (Schmitz et al., 2010).

Although it may seem challenging at times, exercise can be a vital portion of a patient’s treatment and survivorship. Even moderate levels of supervised exercise (about two hours per week), as occurred in the current study, can provide beneficial physical and psychological outcomes. These types of findings are key for the cancer care team member when attempting to motivate patients with cancer to exercise.
Implications for Practice

- Realize that a cancer rehabilitation exercise program is feasible for many institutions using current resources and collaboration among departments.
- Understand that modest levels of exercise are beneficial to physical function and quality of life.
- Emphasize the multifaceted benefits of modest levels of exercise to patients and providers to increase participation and referral rates, respectively.

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References


