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Considerations for Training Cancer Survivors

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Lead Summary

The incidence of cancer development has reached a plateau while cancer survival rates have been increasing. Therefore, more cancer survivors are living with the negative effects of cancer and cancer treatments. Exercise can play a significant role in combating the negative effects of cancer and cancer treatments and improving quality of life during and following clinical treatment for cancer. However, exercise interventions must be individualized to optimally meet the needs of cancer survivors. This article provides valuable information for certified personal trainers regarding the modification of exercise interventions to meet the specific needs of the ever increasing population of cancer survivors.

Keywords

cancer; exercise; rehabilitation; conditioning; fatigue

Cancer

The progression from normal tissue to invasive cancer is driven by the accumulation of genetic mutations, or “hits” to the DNA, which eventually lead to uncontrolled cell growth (7). Exposure to certain dietary and environmental factors, such as ultraviolet radiation, some viruses, and tobacco can greatly increase the chance of genetic mutations (7). Stress, chronic disease, and advancing age impair immune function and leave a person much more likely to develop cancer (13,23). Lifestyle choices may decrease the risk of developing some cancers. Proper nutrition and exercise play a role in the prevention of cancer (9,22).

Although cancer is the leading cause of death among men and women under the age of 85, death rates have been decreasing at a greater rate in recent years. For all cancer sites, the mortality rate in men decreased by 2.6% between 2002 and 2004, compared to a 1.5% decline between 1992 and 2002. Similarly, for all cancer sites in women, the mortality rate between 2002 and 2004 decreased by 1.8% compared to a .8% decline between 1992 and 2002. An ever increasing number of Americans are living with a history of cancer (16). Improvements in five year survival rates are leaving more cancer survivors impacted by the long-term negative effects of cancer and cancer treatments. Exercise is a valuable tool for cancer survivors as the physiological adaptations that occur with exercise combat many of the common negative side effects of cancer and cancer treatments (27,28,29). The purpose of this article is to provide considerations and training recommendations to certified personal trainers who may work with the growing population of cancer survivors.

Cancer Treatments and Treatment Side Effects

The major treatments for cancer include surgery, chemotherapy, and radiation therapy. The treatment plan is dependent on many factors, including the stage and location of the cancer and whether the cancerous cells are confined to one area or have metastasized (7).

Surgery can negatively affect physical functioning by causing damage to muscles and nerves in the immediate area and the area surrounding the incision. Activity following surgery is often limited due to impaired movement near the affected area. The type and location of surgery must be considered when designing individualized exercise interventions for cancer survivors. If the surgery only affects one side of the body, it may be beneficial to perform resistance exercises with the muscles on the opposite side of the body until healing allows full use of bilateral muscle groups. Resistance training leads to muscular and neural adaptations and ultimately improvements in strength. A 'cross-training effect', also known as 'cross education', occurs when resistance training is performed unilaterally and improved strength is achieved in the trained muscle group as well as the same muscle group on the untrained, opposite side of the body (4,18,30). Although improvements in strength in the untrained muscle groups may only be evidenced by a 7 to 16 percent strength improvement (4,18), strengthening the healthy limb may minimize the atrophy associated with disuse of the limb affected by surgery and therefore speed recovery.

Surgical manipulation, as well as radiation of lymph nodes may lead to the development of lymphedema. Weekly circumference measurements of all limbs, taken at the same location, should be done in order to monitor swelling in cancer survivors who have undergone surgery or radiation treatments that involve the lymph nodes.

Chemotherapeutic drugs target cells that reproduce quickly, such as cancer cells. However, healthy cells with rapid turnover rates are also susceptible to the impact of cytotoxic drugs. Tissues such as the bone marrow are impaired during chemotherapy treatments. The bone marrow is the site of blood cell production. Red blood cells are necessary for oxygen transport and white cells are primarily involved in defending the body against infection. As a result, hematological toxicities such as anemia and suppressed immune function are the most common side-effects of chemotherapy treatments (26,34). Anemia leads to fatigue due to decreased blood oxygen carrying capacity. Therefore, cancer survivors undergoing chemotherapy treatments should exercise at lower intensities than disease free individuals. Chemotherapy can also lead to the development of low bone mineral density via chemotherapy induced premature menopause (7). Low bone mineral density can lead to an increased risk of fractures. Therefore, exercises utilizing cervical spine or trunk flexion must be performed with caution.

In a healthy population, exercise in moderation has been shown to improve immune function. However, excessive exercise, either in intensity or duration, may impair immune function (20). Immune function is already weakened as a result of chemotherapy treatments, therefore moderate exercise, in both intensity and duration, is necessary to prevent further immunosuppression.

Maintaining a clean facility, given the susceptibility to infection in cancer survivors undergoing chemotherapy, it is imperative. Equipment must be disinfected after every use in order to prevent the possibility of disease transmission to individuals with immune systems unable to combat infectious agents.

Second to hematological toxicities, chemotherapy treatments often cause neurotoxic side effects. These side effects, manifesting as peripheral neuropathies, typically progress as the cumulative dosages increase. With the cessation of most chemotherapy, neurologic damage halts. However, the extent of neurologic impairment resulting from platinum chemotherapy compounds, such as cisplatin and carboplatin, may not be fully elucidated until several months have passed following chemotherapy (34). Peripheral neuropathy commonly results in numbness, pain, or weakness in the extremities. Therefore, proprioception and balance may be impaired. Autonomic neuropathy may also result in heart rate and blood pressure abnormalities, dizziness, and heat intolerance, all of which impact the ability to exercise (33).

Chemotherapeutic agents such as the anthracyclines, and trastuzumab, a monoclonal antibody, may lead to cardiomyopathy during treatment or in the years following treatment completion. Impaired cardiac function is therefore a serious concern for cancer survivors treated with cardiotoxic chemotherapeutic agents (36). Treatments with methotrexate and bleomycin may lead to pulmonary toxicity and therefore impaired lung function (5). Singularly, or in combination, chemotherapy drugs can result in impaired cardiorespiratory function, making exercise a valuable tool during and following treatment as a means to combat the physiological decrements that may result from treatment.

Radiation treatments can lead to blistering, decreased skin elasticity, pain, necrosis, fibrosis, and damage to organs in the immediate vicinity near the targeted area (5). Receiving chest irradiation and chemotherapy including anthracyclines for the treatment of breast cancer can synergistically result in greater damage to cardiac tissue than either treatment alone (6). Damage resulting from radiation may last years after the completion of treatment. Choose modes of aerobic and resistance exercise that will not exacerbate the pain in the affected area. Dehydration is also a common side-effect of radiation treatment; therefore, emphasize hydration before, during, and after each training session.

Cancer-related fatigue is the result of both the disease process and the side-effects of cancer treatment and can lead to psychological distress, depression, sleep disturbances, and reduced functional capacity (35). Cancer-related fatigue usually begins before treatment and is further exacerbated as treatment progresses. The overwhelming fatigue is the most common and persistent side effect of cancer treatment, not only negatively impacting quality of life during cancer treatment but also months and even years after treatment completion (1,3,8,17). Cancer-related fatigue differs from fatigue in a healthy individual in magnitude and persistence, remaining despite adequate rest and impairing the ability to perform activities of daily living (12,31). Researchers have found that a combination of treatments results in greater fatigue than a single treatment and that fatigue peaks during treatment (3,15). Training sessions must be altered as fatigue levels fluctuate throughout treatment and following treatment completion. It is important to monitor objective and subjective measures of exercise intensity, such as both heart rate and rating of perceived exertion. Cancer-related fatigue may not result in an increased heart rate. However, a higher than recommended rating of perceived exertion may be evidence of increased fatigue and the resultant need to decrease exercise intensity.

Cancer and cancer treatments impact cancer survivors in a somewhat predictable manner yet the severity of side effects varies due to individual characteristics. Exercise interventions for cancer survivors should be specifically designed for each individual, based on the results from an initial assessment. Progressive adjustments may be made throughout the exercise intervention to offer the greatest benefit.

Assessment

A physician referral is an important step prior to implementing a training program designed for a cancer survivor. Similarly, a thorough assessment is recommended prior to implementing any exercise intervention. Obtain a complete medical and cancer history, including the type and stage of cancer, the previous and/or current treatment/s, and other physical limitations. Assessment of cardiorespiratory endurance, muscular strength and endurance, flexibility, range of motion, body composition, fatigue, and depression may be done initially and at predetermined intervals throughout the exercise intervention. The assessment results will enable the trainer to prescribe an individualized exercise intervention based on current health status and realistic short and long-term goals. Modification of the assessment is warranted in cancer survivors who are plagued by severe cancer-related fatigue or limited mobility. In either

case, choosing alternative tests or eliminating tests that are inappropriate for the client or your facility is advisable.

Ideally, the assessment process should begin with an examination by a physician. Potential comorbidities, limitations, and current medications that may contraindicate certain exercise intensities or modes must be established (14,26). A physician supervised symptom-limited graded exercise test can be used to establish functional capacity and results can be used to develop the optimal heart rate training zone. A physician trained in clinical exercise testing must be present during testing in participants who are at an increased risk for cardiovascular complications, such as cancer survivors with comorbidities such as coronary artery disease or cancer survivors who have been treated with cardiotoxic chemotherapy drugs (2,26). Peak treadmill testing can be implemented in the presence of a qualified physician when using a graded treadmill protocol. Field tests, such as the six-minute walk test, may be used to establish baseline functional capacity as well. Field tests are beneficial because minimal equipment is needed but valuable information may be obtained. As well, individuals using assistive devices or those with low fitness levels may be more able to perform field tests rather than functional tests using the strict speed and grade guidelines of a treadmill protocol (2,14). However, field tests are not as reliable as controlled testing so if at all possible, set controlled protocols to assure testing within and between clients is similar.

Muscular strength and endurance can be assessed via grip strength using a handgrip dynamometer (2,14), a crunch test to establish muscular endurance of the abdominal wall, (2) and by using a battery of muscular endurance tests to determine the muscular endurance of the major muscle groups (14,26). The crunch test may be difficult for individuals suffering from impairments such as low back or knee pain, frailty, or autonomic neuropathy, as the client will have to move to and from the floor to perform the test.

If tolerated, upper body muscular endurance can be established using weight machines and free weights while performing exercises such as biceps curls, the bench press, lat pull-down, triceps push-down, and shoulder press. Lower body muscular endurance can be determined using the leg extension, leg curl, and the leg press machines. Choose a weight for each of the exercises that will likely elicit volitional fatigue in 15 repetitions or less and have clients maintain a slow, controlled, and constant pace (26). In order to establish an appropriate weight, communicate with the participant following the first repetition attempt at a particular weight. If the participant anticipates being able to perform more than 15 repetitions, increase the amount of weight and allow the participant to rest for several minutes prior to starting again. By using the same amount of weight during the initial and post assessment, it is possible to establish improvements in muscular endurance. Also, the amount of weight lifted prior to reaching muscular fatigue can be used to guide the training program. One repetition maximum testing is not recommended (26).

The modified sit and reach test can be used to measure flexibility of the low back and hamstrings. However, this test may also be inappropriate for individuals suffering from low back or knee pain, frailty, or autonomic neuropathy. A hand-held or wall mounted goniometer can be used to assess range of motion at the shoulder and hip joints (14,26). Body composition can be estimated using a skinfold test. Sum of skinfolds during the initial and post assessment can be compared to determine changes that have occurred during the training period (2,14, 26).

Cancer-related fatigue and depression are also important parameters to assess initially and track throughout the exercise intervention. The Revised Piper Fatigue Scale (24) can be used to assess fatigue and depression can be measured with the Beck Depression Inventory (25). Higher scores represent greater fatigue and depression, respectively. Using the Beck Depression

Inventory, scores of 31 or greater indicate a severe level of depression (25). Those who are severely depressed as well as individuals who indicate they are a potential threat to themselves or others should be referred to a mental health profession for psychological counseling.

The assessment process should occur prior to prescribing exercise and at predetermined intervals in order to assess improvement and guide the modification of the exercise prescription. The exercise prescription should be a controlled plan based on the results of the assessment, used to formulate the training program.

Training protocol

A “whole body” exercise intervention that includes moderate intensity aerobic, resistance, and flexibility training should be performed on two or three non-consecutive days per week. Additional aerobic exercise should be encouraged on days when resistance training is not performed. The American Cancer Society recommends performing at least 30 minutes of moderate to vigorous physical activity five or more days per week to aid in the prevention of cancer development. Although less research has been conducted to determine the ideal exercise dosage to prevent cancer recurrence, the American Cancer Society recommends the same guidelines for cancer survivors (6). As cancer survivors move through the cancer continuum, progression from diagnosis, cancer treatment, and finally treatment completion, attempt to increase the exercise session to 60 minutes in duration, if increasing exercise duration does not exacerbate fatigue.

The initial assessment is used to establish a baseline fitness level, limitations resulting from cancer treatment or co-morbidities, and realistic short and long-term goals. Whole body conditioning should be the focus of the exercise intervention. Aerobic conditioning, resistance training, balance, and flexibility should all be addressed during each exercise session. Additionally, individual limitations, such as impaired shoulder range of motion following surgery for breast cancer, should be addressed. It is recommended that training sessions begin with a warm-up followed by aerobic exercise. Resistance training should be performed after the aerobic exercise. Balance training may be integrated into the resistance training portion of the session or specific balance exercises can be integrated into the program. Lastly, the session should end with a warm-down and stretching.

Aerobic conditioning should be prescribed at a moderate level in both intensity and duration. Aerobic exercise can improve cardiorespiratory fitness, reduce fatigue and improve psychological distress in cancer survivors (8,28,29,35). However, in excess, aerobic exercise can lead to impaired immune function (20). Initial cardiorespiratory fitness should be used to determine the optimal exercise intensity. The Karvonen formula can be used to calculate target heart rate (THR) based on estimated maximal heart rate (MHR), resting heart rate (RHR), and the desired exercise intensity (%HRR) (14,26):

$$\text{THR} = (\text{MHR} - \text{RHR}) \times \% \text{HRR recommended} + \text{RHR}$$

Maximal heart rate can be estimated using the equation (11):

$$\text{MHR} = 207 - (0.7 \times \text{age})$$

Rating of perceived exertion (RPE) should also be monitored throughout each exercise session. The Borg scale, ranging from 0–10 can be used to monitor RPE, with lower scores representing less exertion (21). Cancer survivors who have been sedentary, are in poor health, or have a low fitness level should begin exercising at an intensity of 30–45% of HRR and maintain an RPE

of one to three, a low exercise intensity (26). Active cancer survivors who are in good health may begin an individualized exercise intervention at 50–60% of HRR and can maintain an RPE of four to five during the aerobic conditioning portion of the exercise intervention, a moderate exercise intensity (26).

The duration of a single bout of aerobic exercise may be limited in cancer survivors suffering from fatigue. Accumulating shorter bouts of exercise throughout the day, for example, 6 minutes of exercise, 5 times per day, has been shown to elicit similar improvements in fitness as seen when sedentary participants perform a single 30 minute bout of exercise each day (19). In cancer survivors suffering from severe fatigue, performing multiple bouts of exercise, shorter in duration, is realistic and beneficial. On training days that include resistance training, 20 to 30 minutes of aerobic exercise is ideal. On non resistance training days, 30 to 60 minutes of aerobic exercise is appropriate, as recommended by the American Cancer Society (10). See Table 1 for common modes of cardiorespiratory training, including pros and cons for each (26).

Although many factors lead to the development of cancer-related fatigue, skeletal muscle wasting resulting from cancer cachexia is a contributing factor in some cancer survivors (32). An exercise intervention that focuses on resistance training to stimulate protein synthesis is especially valuable for individuals experiencing cancer cachexia (1). Resistance training also attenuates the common age-related decrease in muscle protein synthesis (1). Researchers have found resistance training to be very beneficial in improving muscular endurance in cancer survivors (27). Improving strength and endurance of all of the major muscle groups should be the focus of resistance training. The assessment results will guide the trainer in determining the areas that need additional attention. For example, the inability to perform even one shoulder press repetition during the initial assessment will elucidate the need to devote additional time to improving shoulder strength and/or shoulder range of motion. Cancer treatments may lead to deficiencies in proprioception and balance; therefore it is always necessary to “spot” closely and provide assistance if needed. A variety of resistance training exercises should be implemented as neuromuscular adaptations allow progression. Resistance bands, weight machines, and free weights are all recommended while progressing from single joint to multi-joint exercises of increasing difficulty (26). Figure 1 demonstrates a quarter squat using a physioball for support. This exercise requires the use of the core muscles for balance as well as the large muscles of the lower body and requires very little equipment.

Focused balance training is especially important for individuals who have undergone chemotherapy treatments that have resulted in peripheral neuropathy. Initially, balance training can be the primary focus of a portion of the training time but should eventually be integrated into other resistance training exercises to shift the focus to functional, dynamic balance. A trainer must always be ready to “spot” the client. Figure 2 demonstrates balance disc walking which can be performed with or without the assistance of walking poles. Using walking poles will decrease the difficulty of this exercise and may be a good way to begin balance training. Once balance disc walking with walking poles becomes relatively easy, have the client walk across the balance discs without the assistance of walking poles. Figures 3 and 4 demonstrate a more advanced balance exercise, lateral and anterior toe taps while standing on a Bosu™ Balance Trainer, which combines balance training with lower body strength training. Lateral and anterior toe taps are more challenging than balance disc walking and can be integrated into the training program once balance disc walking without walking poles is no longer challenging. Begin by having the client use walking poles while performing the lateral and anterior toe taps. As this becomes easier, the client may use only one walking pole for assistance. Finally, the client may progress to lateral and anterior toe taps as seen in Figures 3 and 4, without walking pole assistance. Figure 5 is another advanced exercise, consisting of throwing and catching a light medicine ball while seated on a stability ball. If the client is stable while sitting on a

stability ball, begin tossing a light medicine ball from a close distance. Moving farther apart will make this exercise more difficult. To integrate balance training into resistance training exercises that require standing on the floor, the exercises can be performed on a balance pad, balance discs, or a Bosu™ Balance Trainer. Performing biceps curls (Figure 6) on the Bosu™ Balance Trainer not only targets the biceps muscles but also improves balance and kinesthetic awareness. Progression from a balance pad, to balance discs, to the Bosu™ Balance Trainer will increase the difficulty of the exercise. Similarly, performing a chess press exercise with dumbbells while laying on a physioball requires the integration of the core musculature for balance (Figure 7). Finally, training sessions should end with a low intensity warm-down and stretching.

Throughout the assessment and training process, it is important to note any changes in the cancer related symptoms of each client as well as changes in physical health and well-being. When concerns arise, encourage clients to make an appointment with their physician to establish any relevant changes in cancer and health status.

Summary

Cancer and cancer treatments can result in severe physiological decrements. Being familiar with the common side effects of surgery, chemotherapy, and radiation treatments allows trainers to safely and effectively prescribe exercise that potentially minimize or reverse the physiological decrements resulting from treatment. Prescribing exercise based on individual assessment results and the short and long term goals of the client plays a key role in helping cancer survivors recover from the negative side effects of cancer and cancer treatments. Exercise can ultimately help cancer survivors regain their ability to perform activities of daily living and improve quality of life.

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Biography

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Figure 1.
Quarter Squat with Physioball.

Figure 2.
Balance Disc Walking.

Figure 3.
Lateral Toe Tap.

Figure 4.
Anterior Toe Tap.

Figure 5.
Ball Toss on Stability Ball.

Figure 6.
Biceps Curls on Bosu^{TM} Balance Trainer.

Figure 7.
Chest Press on Physioball

Table 1

Cardiorespiratory Fitness Training

Type	Pros	Cons	Intensity	Duration
Treadmill	- Specific training for activities of daily living - Common in health clubs and clinical settings	- Challenging with balance impairments - Elderly may experience difficulties keeping pace with the belt	Low fitness → 30–45% HRR. Active → 45–60% HRR.	Low fitness → short bouts accumulating 30 min throughout the day. Moderate-high fitness → 30 min. at one time.
Outdoor walking	- Specific training for activities of daily living - No additional equipment needed	- Weather dependent - Uneven surfaces may increase chance of falls in unstable clients		
Walking with poles	- Greater energy expenditure than walking without poles - Improved muscular endurance of the upper body	- Requires additional coordination - Avoid immediately following upper body surgery		
Stationary bike	- Non-weight bearing - Common in health clubs and clinical settings	Avoid if concurrent or immediately following lower body radiation that may be irritated by seat		
Recumbent stepper	- Non-weight bearing - Requires little coordination	- Potential low back pain from stepping movement - Avoid if concurrent or immediately following lower body radiation that may be irritated by seat - Uncommon in health clubs		
Hydrotherapy pool	Reduced pressure on joints	Avoid if undergoing radiation or chemotherapy		

Table 2

Resistance Training Example

Exercise	Muscle group/s trained	Initial volume
Quarter squat with physioball	Quadriceps, hamstrings	2 sets 8–12 repetitions
Hamstring curl with physioball	Hamstrings, gluteus maximus	
Chest press on physioball	Pectoralis major and minor, anterior deltoid	
Standing or seated row using resistance bands	Latissimus dorsi, posterior deltoid, rhomboids	
Internal and external rotation using dumbbells	Rotator cuff muscles	
Biceps curls with dumbbells	Biceps	
Triceps pushdown using resistance bands	Triceps	
Crunches on physioball	Abdominals	
Calf raises	Soleus, gastrocnemius	