



CLINICAL EXERCISE SPECIALIST MANUAL

A Fitness Professional's Guide
to Training People with
CHRONIC DISEASE

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**A FITNESS PROFESSIONAL'S GUIDE TO
EXERCISE AND CHRONIC DISEASE**

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CHAPTER 14

CANCER

By the end of this chapter you will understand:

- Types and pathophysiology
- Classification
- Pharmacology
- Side effects
 - Lymphedema
 - Cancer-related fatigue
- Comorbidities
- Modifiable factors
 - Nutrition
 - Activity
 - Exercise guidelines
 - Considerations to exercise

Chances are you or someone you know has, or has had cancer, as it is a leading cause of death worldwide. There are almost 2 million new cases of cancer diagnosed each year in the United States and more than 600,000 people die from cancer annually (National Cancer Institute, n.d.b). In 2016, there were over 15 million cancer survivors; a number that is expected to increase to more than 20 million by 2026. Because there are more than 100 types of cancer, direct medical expenses are difficult to determine, but

in 2015 it was estimated in addition to direct medical expenses, over \$94 billion was lost in wages and productivity (Baxter, 2019; Cooper, 2000).

Pathophysiology

The most common cancers are breast cancer, lung and bronchus cancer, prostate cancer, colon and rectum cancer, melanoma of the skin, bladder cancer, non-Hodgkin lymphoma, kidney and renal pelvis cancer, endometrial cancer, leukemia, pancreatic cancer, thyroid cancer, and liver cancer. Cancer is the result of a mutation, at the cellular level, which alters DNA and leads to uncontrolled cell proliferation (Cooper, 2009; San Juan, Fleck, & Lucia, 2018). The mutation leads to a tumor that is either benign or malignant. A benign tumor is noncancerous and can be classified by location or cell type. Benign tumors usually do not spread to other sites of the body and do not invade surrounding tissue. Examples of benign tumors are lipomas which grow from fat cells, myomas grow from muscle or in the walls of blood vessels, fibroids grow in fibrous tissue, moles grow on the skin, and polyps grow in or on the liver. Although these are considered benign tumors, some, such as moles and polyps, can grow into cancer (Cooper, 2009).

Only malignant tumors are referred to as cancer. Malignant tumors invade surrounding tissue and spread thorough out the body via the lymphatic or circulatory system. The spreading of cancerous cells is known as metastasis. It is the spread of malignant cells in the body that makes cancer dangerous and difficult to treat (Cooper, 2009).

Classification

The classification and staging of cancer are used as a factor for diagnosis and treatment. One of the most widely used codifying systems is tumor-node-metastasis (TNM), as maintained by the American Joint Committee on Cancer and the International Union for Cancer Control (Edge & Compton, 2010). Tumor (T) describes the size and location of the main, or primary tumor, and if it has invaded surrounding tissue or organs. Node (N) indicates if cancer has infected nearby lymph nodes, and metastasis (M) indicates if cancer has spread to other parts of the body (National Cancer Institute, n.d.a). Ranking is as follows:

- T_x indicates the tumor cannot be measured T_0 indicates no tumor; T_4 indicates invasion of a vital organ.
- N_x indicates the spread cannot be determined; N_0 indicates the tumor has not spread to any lymph nodes; N_3 indicates extensive spreading.
- M_x indicates metastasis cannot be measured; M_0 indicates no metastasis; M_1 indicates metastasis.

TNM definitions are used to stage a cancer. Stage 0 indicates abnormal cells that have not spread. Stages I-III indicate the presence of cancer; the higher the number, the larger the cancer tumor and the more it has spread into nearby tissues. Stage IV indicates a cancer has metastasized to other parts of the body (National Cancer Institute, n.d.a).

Pharmacology

Once TNM and/or stage is determined, a treatment plan is developed. Treatments usually consist of pharmacological therapy or surgery (San Juan et al., 2018). Radiation therapy attacks mutated cells by

delivering high energy particles to break apart the DNA of the cell. Radiation treatments can be very precise, and target just the tumor leaving the surrounding, healthy tissue undamaged. Chemotherapy drugs involve powerful chemicals that aggressively kill cells and interfere with tumor growth by inhibiting DNA or RNA, or interfering with cell replication. Unlike other treatments, chemotherapy does not differentiate between mutated and healthy cells, and therefore often damages fast-growing healthy cells such as skin, hair, intestines, and bone marrow. Chemotherapy can be used to cure cancer, prevent recurrence of cancer, shrink tumors in preparation for other therapies, or ease symptoms. Immunotherapy and biotherapy use protein molecules to disrupt cancer cell growth while encouraging growth of healthy cells. Immuno- and biotherapies are used to fight cancer, slow the growth of mutated cells, and repair damage caused by other forms of treatment (San Juan et al., 2018). Bone marrow transplant is usually used to treat cancer of the blood. Bone marrow transplants involve destroying infected bone marrow, and replacing it with healthy marrow from a donor, or marrow taken at a time of remission. Hormone treatment is used to disrupt the growth of hormone receptor positive tumors. Hormone treatment is most thought of for breast and prostate cancers but can also be used for other cancers (San Juan et al., 2018).

Unfortunately, all of the treatments have side-effects based on the type, length, and intensity of treatment. Early side effects are nausea, vomiting, hair loss, and fatigue. More severe complications can include blood and lung embolisms, allergic reactions, and infections. Long-term side effects mostly involve toxicity that result in anemia, immunity complications, cardiovascular complications, and musculoskeletal problems that include atrophy, range of motion limitations, and osteoporosis. Neurological disorders, kidney, renal, and gastrointestinal dysfunction, and thyroid and pituitary alterations can also occur (San Juan et al., 2018).

Lymphedema

Lymphedema is a pathological dysfunction of the lymphatic system caused by damage or removal of lymph nodes allowing fluids to build and cause a harmful and painful swelling in the extremities. Some treatments, such as radiation, can cause blockage, and if cancer had spread via the lymphatic system, some nodes may need to be removed. Upper extremity lymphedema is particularly common with breast cancer, while lower extremity lymphedema is common in uterine and prostate cancers. The severity of lymphedema is dependent on how many nodes have been damaged or removed and can occur days to years after treatment or surgery.

Historically, cancer patients have been cautioned against exercise while experiencing bouts of lymphedema, however, this is not necessarily supported by research. Conversely, self-reported studies suggest resistance training may actually reduce the incidence and severity of lymphedema (San Juan, et al., 2018). It is thought physiological adaptations brought about resistance training such as increased muscle contraction and increased ventilation may be beneficial for the reduction of lymphatic fluid buildup (San Juan, et al., 2018).

Cancer Related Fatigue

Cancer-related fatigue (CRF) affects almost every cancer patient, and is defined as “a persistent, subjective sense of physical, emotional, or cognitive tiredness or exhaustion related to cancer and cancer treatment that is not proportionate to activity and interferes with normal functioning” (Blaney et al., 2010, p. 1136). CRF is the most disturbing side effect, as it can be caused by a cancer, or its treatment, or both, and can continue long term. Factors related to CRF are anxiety and depression, poor sleep and eating habits, anemia, and pain. All of these factors lead to a low level of physical activity, which leads

to muscular and cardiorespiratory deconditioning, an even greater level of fatigue, and exacerbation of comorbidities.

Comorbidities

Comorbidity is the existence of a disorder or dysfunction in addition to a primary disease (Sarfati, Koczwara, & Jackson, 2016). Cancer patients with a comorbidity have higher healthcare costs, reduced survival rates, and a reduced quality of life. The most common comorbidities associated with cancer are cardiovascular disease (CVD), metabolic conditions including obesity and diabetes, and musculoskeletal dysfunction (Sarfati et al., 2016). Because of the prevalence of chronic disease associated with cancer, it is prudent a CXS understands the implications while working with a client who, in addition to cancer, has one or more chronic diseases.

There is emerging evidence suggesting cancer may be as much, if not more of a metabolic disease than a genetic disease (Coller, 2014; Seyfried, Flores, Poff, & D'Agostino, 2014). Obesity is known to increase systemic inflammation causing DNA abnormalities, as well as changes in insulin and insulin-like growth factors resulting in a favorable environment for the growth of cancer cells, particularly in adipose tissue (Doerstling, O'Flanagan, & Hursting, 2017). Obese cancer patients are also at an increased risk for CVD, secondary infection and malignancy, lymphedema, and sickness from treatments, as well as lower treatment effectiveness because of interferences with systemic delivery systems (Ligibel et al., 2014). The *Warburg effect* suggests the proliferation of some cancer cells is based on the consumption of glucose, glutamine, and glycogen that increases the circulation of insulin and promotes cellular proliferation, directly linking the biological pathway of diabetes to cancer (Coller, 2014; Sarfati et al., 2016). Combined, obesity and diabetes are linked to over a dozen types of cancer including liver, pancreas, endometrium, colorectal, breast, bladder, thyroid, and ovarian (Centers for Disease Control and Prevention, 2017; Giovannucci et al., 2010).

Modifiable Factors

Modifiable behaviors associated with cancer are weight control, diet, physical activity, exposure to tobacco products, and alcohol consumption. All except exposure to tobacco products relate directly to energy balance. Energy balance, while optimally maintained has been associated with primary prevention of cancer and increased survival rates following treatment. Obesity is second only to smoking as a modifiable risk factor for cancer (Ligibel et al., 2014). Additionally, because diabetes and obesity are two of three risk factors needed for diagnosis of metabolic syndrome (MetS) (see Chapter 13 for more information on MetS), it is important for a CXS to understand the intricacies of working with clients who have diabetes, are obese, or have the risk factors for MetS.

Similar to other chronic conditions, staying active and eating well can reduce the lifetime risk for developing cancer (Kushi et al., 2012). Due to the complexity of cancer and the intricacies of nutrition, developing healthy eating guidelines is difficult. Accordingly, the type of study, the length and scope of the study, the type of cancer, nutrient and pharmacological interaction, and dose and timing of nutrient consumption need to be considered. Individuals who want to maintain a healthy weight should consider a 50-100 calorie/day deficit, while individuals who want to lose weight should strive for a 500 calorie/day deficit (Kushi et al., 2012).

Nutrition

The American Cancer Society Guidelines for Nutrition are below (Kushi et al., 2012), and Table 14.1 lists specific nutrients that can significantly modify cancer risk and progression.

- Be as lean as possible throughout life.
- Avoid excess weight gain.
- Individuals who are currently overweight should consider losing a small amount for health benefits.
- Limit high calorie food and beverages.
- Consume a healthy diet emphasizing on plant food.
- Limit consumption of processed meat and red meat.
- Eat at least 2.5 cups of vegetables per day.
- Choose whole grains over refined grains.
- Limit alcohol consumption (1 drink/day for women, 2 drinks/day for men).

Table 14.1

Nutrients that can significantly modify cancer risk and progression

Nutrient	Effect/Benefits	Sources
Capsaicin	Helps the TRPV1 receptor, anti-inflammatory, and may induce apoptosis in non-small cell lung cancer cells, T-cell leukemia cells, esophageal carcinoma cells, astrogloma cells, and prostate, colon, and gastric cancer cells	
Ellagic Acid	May slow tumor growth	Pomegranates, grapes, walnuts, cranberries, strawberries, raspberries
Green Tea Catechins	Antioxidant capacity, anti-angiogenic, anti-mutagenic, anti-inflammatory, induction of apoptosis and cell cycle arrest that interfere with multiple signaling cascades	Green Tea
Omega 3 fatty acids	Anti-inflammatory that may slow the growth of various types of cancers including lung, colon, mammary, and prostate, and may help improve the effectiveness of various pharmacological interventions	canola oil, flaxseed, soybean, green vegetables, various fish, and fish oils
Isothiocyanates (ITCs)	Certain ITCs may help in the prevention of breast, lung, and prostate cancers. Some may also contain chemotherapeutic properties that may target cellular pathways to inhibit growth, induce apoptosis, and prevent migration	Broccoli, cauliflower, garden cress, watercress, and cabbage

Resveratrol	May inhibit the growth and development of some cancers including pancreatic, prostate, brain and esophagus	Red wine (by far the highest concentration), peanuts, blueberries
Retinoid (Vitamin A)	Inhibits cellular proliferation, induces apoptosis, cell cycle arrest, and differentiation	Cod liver oil, eggs, orange and yellow vegetables and fruits, broccoli, spinach, and most dark green, leafy vegetables

Kushi et al., 2012; Niles, & Claudio, 2012

It is beyond the scope of practice for a CXS to offer a prescriptive diet or meal plan.

Physical Activity

Physical activity is one of the modifiable risk factors in the prevention and treatment of cancer, and should be considered as part of an overall behavior modification plan, and as a cost effective means in the primary prevention of cancer (Brown, Winters-Stone, Lee, & Schmitz, 2012). The goal of exercise for cancer patients and survivors is to regain and improve physical function, aerobic capacity, strength, and flexibility. The purpose is to improve cardiorespiratory, endocrine, neurological, muscular, cognitive, and psychosocial outcomes, to reduce or delay recurrence. While it is not possible to address all of the details associated with each kind of cancer, and is well beyond the scope of this text, understanding general guidelines is essential for a CXS who works with clients who have or have had cancer. Due to the number of variables involved with a cancer diagnosis, there is no consensus for exercise recommendations. However, the American College of Sports Medicine recommends maintaining or increasing muscle mass for cancer patients; decreasing body fat and weight loss is dependent on the current status of a patient, and the type and location of cancer (Schmitz et al., 2010). The FITT guidelines for cancer (Table 14.2) are compiled from the most current data available. Each client needs to be independently evaluated and an exercise program should be based on current ability, the type and location of cancer, and the type of treatment. Furthermore, a CXS who works with cancer patients is strongly encouraged to research the specifics of the type of cancer, as well as the diagnosis and treatment plan of a client.

Table 14.2

FITT guidelines for cancer prevention, treatment, and recovery

	Frequency	Intensity	Type	Time
Aerobic exercise	Starting at 3 days/week Progressing to 5-4 days/week	40% HRR progressing to 70-85% HRR	Start with walking and add in different modalities as tolerated	10-15 min progress- ing to 30-45 min, or 150 min/week
Resistance training	Start at 2x/week and progress to 3x/week	30% 1RM progressing to 70-80% 1RM	Start with bands, progress to machines, dumbbells, and free weights	Begin with one set and one exercise for each major muscle groups and progress to 8-10 exercises and 2-3 sets
Flexibility	Stop before discomfort or pain	As many days as possible	2-4 sets/muscle group	10-30 second static stretch

Considerations

The following are precautions and considerations to exercise for cancer patients (San Juan et al., 2018):

- For each of the following conditions avoid or postpone exercise, but encourage performing ADLs:
 - o Temperature of > 104
 - o Anemia
 - o Low white blood cell count (neutropenia)
 - o Low platelet count (thrombocytopenia)
 - o Extreme weight loss or atrophy (cachexia)
 - o Cardiotoxicity
- Avoid high impact or contact exercise for a client who has bone cancer or is at risk for hemorrhaging (thrombocytopenia).
- Be aware of clients who experience ataxia, dizziness, or neuropathy who may be at an increased risk for falls and fractures.
- Breast cancer patients should be cautious of lymphedema in the arm or shoulder.
- Prostate cancer survivors should be perform pelvic floor exercises.

Discussion and application

1. What are the side effects of cancer treatments and how does exercise minimize side effects?
2. What are precautions to keep in mind when working with a client who has cancer?

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