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COMPLEMENTARY THERAPIES IN THE MANAGEMENT OF CANCER TREATMENT-RELATED SYMPTOMS: THE INDIVIDUALIZED PRESCRIPTIVE EXERCISE INTERVENTION APPROACH

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Abstract

The immediate and residual side effects associated with cancer treatments have increasingly gained attention. The medical community is now recognizing the importance that complementary therapies play in mitigating side effects of cancer treatments. The prevalent side effects of fatigue, cachexia, depression, nausea, and dyspnea decrease the functionality of patients, prolong recovery time, and diminish the overall quality of life. The correlated decrease in metabolic, cardiovascular, pulmonary, neurological and musculoskeletal efficiency can account for such symptoms. While many of these symptoms are treated with pharmacological therapies, which provide in the majority of the cases only temporary relief to patients, prescriptive exercise is a promising therapy in complementing such strategies. Research has shown that when exercise is administered prior, during, and post cancer treatment, patients demonstrate significant decreases in fatigue, improvements in strength and endurance, conservation of muscle mass, improved metabolism, improved sleeping and eating patterns, and enhanced quality of life. The purpose of this article is to address the use of exercise as a complementary therapy in the management of cancer treatment-related symptoms. Also, a brief review on current empirical evidence on the benefits of exercise for cancer patients, a section on how to utilize exercise safely and effectively, the combination of exercise and recreation therapy as another promising approach, and recommendations for future research are included in this article. Exercise is widely accepted as a preventative, rehabilitative, and recuperative intervention for cardiovascular, pulmonary, orthopedic and endocrine diseases and it should now be considered so for cancer.

Key words: cancer, exercise, recreation therapy, side effects

Introduction

The prevalence and magnitude of cancer issues beyond that of prevention and treatment are notable. Approximately 8.4 million Americans or 3% of the population will require some form of care both during and following diagnosis, treatment, and recovery. Cancer most often strikes after middle age with approximately 6 of 10 new cancer cases occurring among those aged 65 and older. The number of cancer patients receiving treatment will increase threefold over the next 30 years, leading many to speculate that oncology may soon exceed cardiology as the most costly medical arena. Management of cancer-related symptoms and the need for follow-up care and pre- or post-operative checks are among the most common reasons for adults making cancer-related ambulatory visits to their physician or to the hospital (22%). Cancer survivors have difficulty conducting normal daily activities, with 69% being unable to perform house cleaning tasks, 56% unable to complete errands such as grocery shopping, 56% found it difficult to climb stairs, and 69% were unable to walk any appreciable distances. These often unnecessary declines in quality of life impact everyone directly or indirectly at some level. This article will address the significance of exercise therapy as a way to prevent de-conditioning and to advance the level of functionality that often wanes in the face of cancer and cancer treatments.

Plato to Socrates: "is not bodily habit spoiled by rest and illness, but preserved for a long time by motion and exercise?" Plato's insight has given foundation to advancing the use of therapeutic activities as sound principle for disease prevention as well as treating and managing disease processes. Specific exercise programs have long been accepted as therapeutic and rehabilitative interventions for cardiovascular, renal, neuromuscular, and metabolic/endocrine disease. Today, therapeutic exercise is being considered for the significant impact it can have for the cancer population to mitigate the chronic and acute side effects of treatment. A substantial body of literature supports the use of exercise as a promising complement to the

medical treatments used in fighting cancers. In healthy individuals, exercise training and recreational activities have been shown to promote a host of positive psychological and physiological adaptations. Investigations into the effects of exercise have demonstrated that cancer patients of varying ages can increase their individual levels of aerobic, muscular and metabolic fitness as well as achieve significant reductions in cancer treatment-related conditions, especially fatigue (1-7). These effects may serve to counteract or attenuate the onset of fatigue, a decline in functionality and decreased quality of life precipitated by the well known side effects of cancer treatments.

Cancer treatment-related side-effects

The side effects from cancer treatment can be debilitating and often leave the patient with the inability to function at their pre-cancer level. The most prevalent symptoms commonly observed in the majority of cancer patients that undergo cancer treatment are fatigue, worry, depression, pain, cachexia, dyspnea, and nausea. In patients receiving multi-modal treatments, the level of impact appears to be more profound (8, 9). The impairment can be manifested at any time along the cancer continuum from diagnosis to even years beyond the completion of treatment.

Organ system dysfunctions, loss of energy, muscular weakness, a decrease in lean mass with concurrent increase in adiposity, abnormal blood profiles, and a reduction in total body flexibility and agility, commonly observed during and post treatment, all contribute to the decrease in general activities of daily living and are likely to impact patient's overall quality of life. For example, various chemotherapies have been determined to cause direct myocyte injury, degeneration, and death (10). Skeletal muscle edema and necrosis are also reported (11). Radiation has been linked to disruption in muscle cell membranes and a decrease in neuromuscular efficiency (12). Degeneration of muscle fibers (13), negative alterations in skeletal muscle mitochondria (13), and an overall decrease in the number of intact skeletal muscle capillaries (14) have also been shown to occur.

Radiation and chemotherapy have profound direct cardiovascular effects. Radiation therapy has been implicated in the occurrence of interstitial myocardial fibrosis (15) and coronary and carotid artery arteriosclerosis (16, 17). Both chemotherapy and radiation have been linked to left ventricle impairments, such as a decrease in size, abnormal pressure/volume relationships, and decreased ejection fraction (18, 19). Various cancer treatments also cause direct negative effects to the pulmonary, urinary, gastrointestinal, immune, and neurological systems (20, 21).

Despite the prevalence of these widespread effects, treatment to address these issues is often unavailable or underutilized. Several strategies currently used by oncology physicians to combat side-effects commonly developed during cancer treatments include Erythropoietin Alfa (Prednisone or Dexamethasone) for the treatment of anemia, Neulasta to address mylosupression (Pegfilgastim), selective serotonin re-uptake inhibitor (SSRI) to alleviate nausea, and Methylphenidate to combat depression. Some of these strategies however, provide only temporary relief.

As cancer treatment-related symptoms have increasingly become a concern in the oncology arena, patient de-conditioning and possible long-term disability have become an important focus of cancer research. Many cancer patients and survivors are at risk for developing late and long term physiological and psychosocial effects of cancer treatment that may potentially lead to premature morbidity and mortality. Therefore, a greater understanding of the efficacy of complementary alternative therapies designed to manage the side effects of cancer treatment and impact overall treatment outcomes and survivorship, is greatly needed.

Cancer treatment-related fatigue

The American Cancer Society reports that cancer-treatment-related fatigue is experienced in varying degrees of severity by 72 to 95% of all cancer patients receiving or recovering from treatment (22). In patients receiving multi-modal treatments, the level of impact appears to be more profound (8, 9), causing the patient to decrease participation in routine activities or experience exhaustion after only minimal activity. Fatigue can be manifested at any time along the cancer continuum from diagnosis to even years beyond the completion of treatment.

The magnitude and variability of the alterations found in multiple organ systems suggest that cancer treatment-related fatigue is likely the resultant effect of a myriad of factors. Initial research appears to suggest that the severity of cancer treatment-related symptoms may be treatment-dependent (8, 9) and therefore differences in treatment effect may be partially responsible for the variance in reported fatigue levels. Regardless of the treatment type, some of the possible mechanisms that influence the development of fatigue in cancer patients are presented in Table 1.

Cancer patients who receive a combination of chemotherapy and radiation seem to experience higher levels of fatigue and a decreased functional capacity than those patients receiving either radiation or chemotherapy exclusively (9). The majority of cancer patients often described themselves as not having enough energy or not feeling well enough to conduct normal routine activities (1). Cancer fatigue should be viewed as a multidimensional phenomenon because of the diverse bio-behavioral symptoms expressed before, during, and following the treatment process (2). These symptoms

Table 1. *Possible mechanisms that may be involved in the development of fatigue in cancer patients due to treatment*

Mechanism	Causes
Altered ability to process nutrients	Impaired glucose, lipid, and protein metabolism
Increased energy requirements	Tumor consumption of and competition for nutrients, necrosis (cellular/ molecular component uptake, conversion, and removal)
Decrease intake of energy sources	Anorexia, nausea/vomiting, diarrhea
Loss of lean tissue	Decrease muscular strength
Decreased cardiovascular efficiency	Reduction in cardiac contractility, compromised ability to transport oxygen and nutrients to tissues and organs
Decrease in musculoskeletal integrity	Loss of muscle cell integrity, change in connective tissue integrity, bone loss, and decreased muscle cell capillarity
Psychological distress/ Social impact	Cancer disease, depression, decreased self-esteem, decreased social interaction

can be categorized into 4 domains: subjective fatigue, physiological fatigue, emotional impact, and social impact. Subjective fatigue represents expressions of weariness, tiredness, and lack of energy. The physiological domain consists of measures of an individual's physical performance and ability to carry out normal daily functions. The emotional impact represents the manifestations of depression and psychological distress and the social impact encompasses those factors that limit or impede social interactions (23).

The generalized bodily fatigue expressed in cancer patients should be addressed differently than fatigue related to exercise in a healthy population. When athletes demonstrate chronic fatigue symptoms, increase in rest time between training sessions and reduction in exertional levels is recommended (24). Cancer patients who display fatigue symptoms following therapy often self impose diminished physical and social activity as well. However, in this population, physical and social inactivity actually can intensify fatigue, provoking a further diminished capacity for performing even simple daily activities. The following model (Fig.1) presents the potential mechanism on how side effects produced by cancer treatment

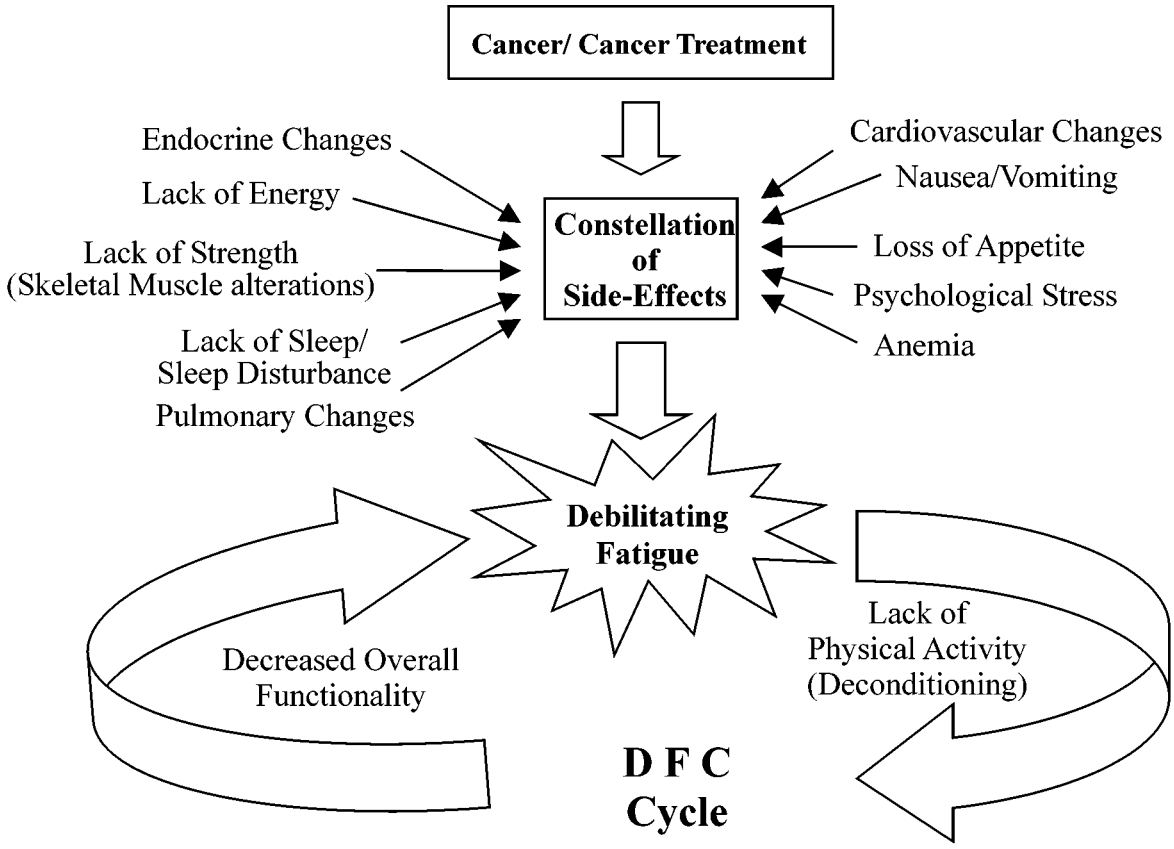

Fig. 1. *Debilitating Fatigue Cycle (DFC)*

lead to a debilitating fatigue cycle (DFC), that if not treated, could lead to decreases in the patients overall functionality. Cancer and cancer treatments cause physiological and psychological resistance to physical activity. This decrease in activity causes further decline in key physiological and psychological facets which initiates a downward spiral into disability. By breaking the DFC cycle, further decrease in physical de-conditioning and decrements in functionality are ameliorated, which can positively impact the debilitating fatigue experienced by the majority of cancer patients that undergo cancer treatment.

Cancer rehabilitation

Given the significant impact that cancer causes, it is evident that the cancer care continuum should include evidence based supportive and therapeutic services to help the patient prevent fatigue and subsequent deconditioning during and following treatment. Cancer rehabilitation should provide well-designed and orchestrated therapeutic methods for cancer patients to regain control and confidence within their lives, to restore function, and to address the emotional and social needs each faces throughout the cancer experience. The key focus of these types of therapeutic interventions is on the practical day-to-day issues; including maximizing strength and adjusting to temporary or permanent changes that directly impact work, home, and leisure life. The functional, emotional, and social needs of the cancer patient are complex issues. These needs are usually dependent on such factors as the extent of disease state, tolerance for and success of treatment, pre-existing medical conditions, and the patient's physical condition, support systems, and coping skills.

Cancer rehabilitation should offer a comprehensive approach addressing the multidimensional needs of cancer patients. It is preferential that cancer rehabilitative services should be recommended by oncologists or primary care physicians, especially if the patients are undergoing treatment or just completing treatment. This insures full attention is being paid to the health and well-being of each patient. Medical evaluations performed prior to initiation of rehabilitation can rule out contraindications that might exacerbate symptoms. When limitations are noted or recommendations made, specific modifications can be made to insure safety and enhance the success of the interventions.

Therapeutic exercise

It is not surprising that most cancer patients find it difficult to deal with the level of discomfort that accompanies most cancer treatments. Until recently however, most patients were advised to rest and avoid strenuous activity that might further deplete their energy levels. Thanks to the work of many scientists (2, 3, 23, 25-28) exercise therapy has been shown to combat fatigue, malaise, nausea, pain, and a host of other routine symptoms.

Investigations into the effects of exercise have demonstrated that cancer patients of varying ages can increase their individual levels of aerobic and muscular fitness as well as achieve significant reductions in cancer treatment-related fatigue (1-7). For cancer patients these same effects may serve to counteract or attenuate the effects of treatments that contribute to the onset of fatigue, a decline in functionality, and decreased quality of life.

Enhancement of energy production, improved mobilization, and removal of cellular metabolites and toxins, stimulation of erythrocyte, thrombocyte, and leukocyte production, and increases in protein synthesis and muscle regeneration are just a few of the possible benefits of exercise used as a complementary alternative medicine to traditional cancer treatments (7). While there is considerable evidence as to the value of exercise for the apparently healthy population, exercise specific to the cancer patient has now become an increased focus of many researchers in the exercise sciences. Most of the previous studies have indicated that low to moderate aerobic exercise intervention has proven to be a successful and well-tolerated treatment toward decreasing fatigue, nausea, and the decline in normal functioning experienced by many cancer patients (6, 27). Cancer patients, both during and following treatment, can tolerate various exercise modalities, dosages, and progressions (26).

In recent articles, Galvao and Newton (28) and Courneya (25) conducted thorough reviews of the literature illuminating the benefits of exercise both during and following cancer treatments. In both articles, significant beneficial effects of exercise were observed. While many of the included studies suffer from methodological limitations such as sample size, sample representation, and randomization, enough evidence has been provided to clearly recognize the potential role that exercise has in improving quality of life by mitigating many of the debilitating side effects of cancer and cancer treatments. Reported improvements in exercise capacity (4, 6, 7), neutropenia, thrombocytopenia, diarrhea, pain, platelet transfusions (27), natural killer cell cytotoxic activity (29), fatigue (9), depression (2), length of hospitalization (3), and many psychosocial parameters must be viewed with interest. Table 2 is a summary of some possible benefits that exercise may have in the management of cancer treatment-related side effects.

Even though empirical evidence supports the use of exercise for some cancer patients during and post cancer treatment, many questions remain unanswered regarding the use of exercise for the cancer population. As mentioned previously in this article, methodologi-

Table 2. *Cancer treatment-related side effects and the possible benefits of exercise*

Cancer Treatment Side-Effects	Benefits of Exercise
Loss of appetite	Increase appetite
Low blood cell count (anemia)	Stimulation of erythrocyte production
Loss of lean tissue	Increase in protein synthesis/ muscle regeneration
Decreased range of motion	Improve connective tissue integrity, decrease pain
Increased cellular debris	Improve mobilization and removal of cellular metabolites and toxins
Decreased energy metabolism efficiency	Enhancement of energy production and improve energy utilization
Cardiomyopathy	Improve cardiovascular efficiency
Neuropathy	Improve mobility, reduce pain, improve proprioception
Decreased psychological well being	Increase in self-esteem, body self-perception, and increase social interaction

cal limitations presented in previous studies (which also includes differences in research protocols and lack of larger randomized clinical trials) still make it quite difficult for medical community to completely accept that exercise can be used a complementary therapy. Questions on appropriate mode, intensity, frequency, and appropriate exercise prescription for the different cancer populations have yet to be completely answered.

The individualized prescriptive therapeutic exercise approach

Cancer rehabilitation therapies provide clinically efficacious services for cancer patients to regain control and confidence within their lives, to restore function, and to address the emotional and social needs each faces throughout the cancer experience. The key is to focus on the practical day-to-day issues; including maximizing strength and adjusting to temporary or permanent changes that directly impact work, home, and leisure life. The functional, emotional, and social needs of the cancer patient are complex issues. These needs are usually dependent on such factors as the extent of disease state, tolerance for and success of treatment, pre-existing medical conditions, and the patient's physical condition, support systems, and coping skills.

Cancer rehabilitation centers should provide a comprehensive intervention program addressing the multidimensional needs of cancer patients during treatment and recovery. Optimally this involves the integration of the medical community, the scientific community, exercise and dietary specialists, health professionals, and health management personnel. These individuals are best qualified to provide continuity for the patient, assuring a seamless integrative approach that works synergistically for the best treatment and recovery outcomes.

It is preferential for patients to be referred by physicians for cancer rehabilitation especially if they are undergoing treatment or just completing treatment. Medical evaluations performed prior to initiation of rehabilitation can rule out contraindications to changes in exercise and diet. This is both reassuring to the patient and to the exercise therapist. When limitations are noted or recommendations made, specific modifications can be made in the assessment process and in the exercise prescription to insure safety and enhance the success of the intervention.

As with any exercise program, a comprehensive cancer exercise therapy program should consist of a thorough fitness assessment that includes a cardiovascular evaluation using a protocol to assess functional levels of exertion and tolerance for aerobic activities, spirometry to assess pulmonary function, muscular strength and endurance assessments on specific muscle groups, and flexibility, balance and range of motion. The data from these tests should be compiled and utilized to quantify and qualify the present functional capacity of the patient. An individualized therapeutic exercise plan with goals and benchmarks should then be constructed.

The therapeutic plan should specify the type, modality, duration, frequency, intensity, and progression of physical exercises and activities that should be utilized to accomplish these goals. The plan does not identify specific exercises that should be conducted, but helps the patient and exercise therapist to select activities that will accomplish the prescribed effects. Even though the fitness assessments administered prior to the beginning of the exercise program for cancer patients assists cancer exercise therapists in the development of an individualized exercise prescription, the approach of implementing the exercise intensities and types of exercises should include a day to day evaluation prior to each exercise session. Due to the fact that the patient's physical and psychological condition fluctuates often during treatment, regular evaluations of physical and mental status become an important tool in the success of the exercise program designed for cancer patients. Contrary to cardiac rehabilitation where a more linear approach of progression

for volume and exercise intensity is applied, our experiences lead us to believe that this same methodology for cancer patients may not be appropriate. During days of compromised physical function due to cancer treatment-related side effects, the dosage and modality of activities should be modified to accommodate the patient's capabilities for that particular exercise session. Reductions in volume of training and even the implementation of different types of activities involving less physical exertion are relevant to the success of an exercise program developed for cancer patients. One technique that exercise therapist can use to accommodate the needs of clients throughout the treatment and recovery process is to complement the range of exercise interventions offered with other therapies. Contrary to what many see as "exercise", there are many activities that are both fun and functional that can be used effectively to promote the necessary physical and psychosocial adaptations needed to meet the needs of many cancer patients.

Recreation therapy as a complementary therapy to combine with exercise

Recreation therapy (RT) is a systematic process that utilizes recreation and other activity based interventions to improve or maintain the physical cognitive, social, emotional and spiritual functioning of individuals with illness and or disabling conditions (30). The interventions are based upon the assessed needs of clients and have as their ultimate goal to improve quality of life and facilitate full participation in life. A variety of interventions are commonly used in RT to accomplish treatment goals including but not limited to: adventure therapy, animal assisted therapy, biofeedback, behavior modification, community reintegration, creative writing, drama, exercise/fitness, expressive arts, family interventions, humor therapy, leisure education, relaxation training, social skills training, stress management, guided imagery, music, pain management, therapeutic games, and values clarification (31). While some of these activities may not be appropriate for all cancer patients in various stages of treatment and recovery, they represent the scope of activities that can promote the type of stimulus needed to positively impact factors that contribute to diminished quality of life for the cancer patient.

Although several practice models exist to guide recreation therapy practice, the most recent thinking draws upon psychosocial theory to explain the relationship between RT and well-being (32). The Leisure and Well-Being Model (32) focuses on individuals' problems, deficits and negative experiences, as well as their strengths, capacities, and positive experiences. When each of these factors are considered simultaneously, they provide a description of clients' resilience, well-being and quality of life. This model is founded on the theory that RT positively impacts one's psychological well-being by enhancing an individuals leisure experiences and developing their resources and capacity to engage in life activities. The five guiding principles that form a foundation for therapeutic interventions are: savoring leisure, authentic leisure, leisure gratification, mindful leisure, and virtuous leisure (32). Resource development is also focused on five areas including: psychological resources, social resources, cognitive resources, physical resources, and environmental resources (32).

Although theoretically promising, there is very limited empirical research that has explored the impact of RT on individuals with cancer. Recreation therapy is however, a part of a comprehensive cancer rehabilitation program in hospitals around the country providing patients' outcome-oriented treatment that is believed to be necessary to make good adjustment to illness and treatment (33). Shannon and Shaw (34) found through in-depth interviews followed by a focus group, that in the presence of this life threatening illness, women with breast cancer made leisure a priority in life. Leisure activity became more important because of the opportunity it provided women to engage in a desired and meaningful activity as well as activity that promoted positive physical and mental health. Indeed for many women, having breast cancer was a catalyst for them to restructure and reprioritize their lives with leisure taking on a more central role aimed at maintaining and improving health.

Despite the potentially valuable role of leisure in the lives of women with breast cancer, Shannon (35) found that health care professionals seldom discussed leisure with patients and the women in her study were never offered or received RT services. In her interviews, Shannon discovered that these woman in the study felt that they experienced constraints to their leisure participation as a result of having breast cancer. They further identified that if they had been provided an opportunity to discuss their interests and adaptations to various activities, leisure and recreation may have helped them mitigate the fear, anxiety, and anger they felt as a result of having cancer. While some of the women intuitively turned to walking, meditation and journaling as tools to help them cope with these psychological effects, many of the women described how they struggled to find effective coping mechanisms and how their health care providers generally ignored leisure as a tool to assist in recovery. Indeed, the only times that professionals mentioned recreation and leisure activity during their treatment was to discuss what they were "not to do" (e.g., no tennis or golf after surgery, avoid crowded malls during chemotherapy because of compromised immune systems).

The underutilization of RT as a complementary therapy to help manage the side effects of cancer

treatment is particularly troublesome given that several interventions recreation therapists commonly use with hospitalized patients have positive outcomes. McKinney (36) found that the administration of guided imagery and music with individuals with cancer led to decreased depression and stress, decreased "intrusive" thoughts and avoidance behaviors, increased social and family well-being, and increased quality of life. Music therapy can also improve mood disturbances, reduce fatigue, and reduce cortisol levels in individuals (37). Relaxation therapy and biofeedback are also mind-body therapies that have shown promise in helping individuals reduce anxiety and stress and manage pain (38). Finally, the application of adventure programs with cancer patients has been shown to help patients rediscover their strengths, practice problem solving, and learn about support resources needed to manage cancer symptoms (39). Several studies have also demonstrated that adventure programs help individuals come to view life differently and accept their bodies more fully (40), more easily identify external resources (41), and experience feelings of support, control, and a renewed sense of self (42).

While the research examining the interaction between cancer and RT is promising thus far, well controlled clinical research to support the use of RT practice in oncology is lacking (43). Therefore, a research agenda that begins with the use of pilot studies to test initial ideas and further develop and substantiate funding of larger projects is needed. Following the results of these initial studies, large-scale clinical random trials are needed to determine the type, amount, and duration of RT interventions and the specific impacts they have on client functioning and well-being. Only then can specific practice guidelines be written that detail the type, intensity and duration of activity needed to invoke a specific response.

Conclusion and recommendations for future research

The design of specific cancer exercise program should include a comprehensive functional assessment, specific goals and objectives, and personalized exercise interventions. This should occur in a controlled setting under the supervision of an exercise science professional with experience working with cancer patients. Important to the success of any cancer exercise program is the specificity of the individualized therapeutic design.

Since treatment type and regimen, stage and type of cancer, presenting co-morbidities, and response to treatment vary from case to case, each prescribed exercise regimen should be individualized. Because cancer patients are more susceptible to periods of lower immunological function, reduced metabolic efficiency, compromised mobility, and nutritional imbalances, the intensity, frequency, duration, progression, variability and modality of the exercise therapy must be routinely evaluated and closely monitored to insure effective outcomes.

The present body of literature on cancer and exercise strongly advances the use of exercise as a complementary therapy for cancer patients. However, these studies present dramatic variability in the way exercise has been administered. The use of non-prescriptive and generic exercise programs has limited researchers to include only the "healthier" cancer populations. Due to these limitations, generalizations across all cancer populations should be viewed with caution. Individualized prescriptive exercise interventions will safely bring the benefits of exercise to the entire spectrum of cancer patients, especially when such interventions are done in orchestration with medical treatment.

Even though exercise is a promising approach toward mitigating the psychological and physiological changes that are commonly observed in cancer patients post diagnosis, what remains of question is how to best maximize the benefits of exercise for cancer populations. The idea of implementing RT techniques targeting the psychosocial aspect of the disease in combination with exercise may prove to be a more comprehensive approach toward alleviating symptoms experienced throughout various stages of the cancer experience. Unfortunately, empirical evidence to support the effectiveness of these combined therapies for cancer patients is lacking. The implementation of a well designed line of research in this area is needed to determine the best possible approach toward delivering complementary therapies aimed at reducing the side effects of cancer treatment.

Current exercise programs presented in the literature include participation of patients twice or at the most three times a week. This is usually because a minimum of 24 hours of recovery time between exercise sessions seems necessary for patients to tolerate exercise. The idea of including recreation therapy techniques within an exercise program as part of each exercise session, or during those days that patients are physically recovering from exercise, may improve physical cognitive, social, emotional and spiritual functioning of individuals living with cancer, potentially improving the benefits already seen in the literature with the administration of exercise.

While significant improvements in prevention, diagnosis, and treatment of cancers have decreased mortality rates, the need to address the management of side effects for cancer survivors should now be a focus in oncology. The present intervention models utilized in cardiac, renal, pulmonary, and musculoskeletal diseases and disorders have incorporated the benefits of therapeutic exercise as a routine part

of treatment and/or recovery. Physicians and cancer exercise therapists should begin to work together to provide sound therapeutic interventions concomitant with treatment and recovery so that a comprehensive treatment and care continuum can be made available for cancer patients and survivors. Hopefully, future research can further validate the reasons why exercise, and the combination of exercise with various therapies including recreation therapy, will help to mitigate cancer side effects. While physicians should be encouraged by the evidence we have thus far to support exercise for cancer patients during treatment and recovery, additional support from medical specialists in the oncology community is critical if we hope to provide comprehensive services to patients and expand research efforts in this area.

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Author's contribution
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection