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Physical Activity and Clinical Exercise Rehabilitation as a Primary and Secondary Preventative Measure Against Cancer

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Abstract

To reduce the risk of acquiring cancer in healthy populations and comorbidities associated with treatment in patients, clinical exercise rehabilitation has focused on improving their functional independence and overall quality of life. Evidence suggests that regular physical activity reduces the incidences of site-specific types of cancers. Regular physical activity leads to marked health benefits in individuals living with cancer, particularly in the early stages. The purpose of this review is to supplement an evidence-based knowledge translation video designed to educate the general population on the health-related benefits of physical activity in the context of cancer oncology. **Health & Fitness Journal of Canada 2017;10(3):61-67.**

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Introduction

Cancer encompasses a group of diseases that involve abnormal cell division with the potential to spread around the body leading to reduced organ function and overall health (Hanahan and Weinberg, 2000). The Canadian Cancer Society's Steering Committee on Cancer Statistics (2017) reported that nearly 1 in 2 Canadians will develop cancer in their lifetime, and that cancer contributes to 1 in 4 deaths in Canada.

Advancements in medical research and clinical practice continue to yield novel therapeutic measures to manage the complications associated with cancer. However, many of these conventional treatments can contribute to a decline in cardiovascular and musculoskeletal function (Jones et al., 2012). In fact, Jones and colleagues (2012) reported that chemotherapeutic agents such as Doxorubicin and Herceptin can lead to cardiotoxicity, leading to cardiomyocyte apoptosis and a subsequent decline in cardiorespiratory fitness. The reduction in cardiorespiratory fitness can have a negative impact on an individual's capacity to perform aerobic physical activity. Hence, exercise oncology interventions are integral to preserve cardiovascular fitness and prevent the vicious cycle of functional decline in patients undergoing chemotherapy.

Exercise intolerance can lead to the vicious cycle of functional decline, which is marked by physical inactivity, leading to a decline in physical conditioning, worsened body composition, and increased risk of chronic diseases (Dimeo et al., 1997; Jones et al., 2009). Since a reduction in physical conditioning typically constitutes a reduction in peak aerobic power (an independent predictor of premature mortality), current evidence suggests that clinical exercise intervention is prescribed to patients

undergoing therapy for cancer as a secondary prevention.

Regular physical activity in at-risk and healthy individuals has compelling evidence to support the notion that it reduces the incidence of specific types of cancer (Chan and Giovannucci, 2010; Lee, 2003). This finding highlights the important role exercise plays in the primary prevention of specific types of cancers.

The purpose of this narrative review is to supplement an evidence-based knowledge translation video designed to educate the general population regarding the health benefits of physical activity in the primary and secondary prevention of cancer. We hypothesized that there would compelling evidence to support the health benefits of routine physical activity participation in the primary and secondary prevention of cancer.

Key Findings

Role of Physical Activity in the Primary Prevention of Cancer

It is well known that regular physical activity confers many health benefits. There is irrefutable evidence that physical activity is a primary and secondary preventative strategy against more than 25 chronic conditions in both general and at-risk populations. (Warburton et al., 2006). A systematic review conducted by Lee (2003) revealed the finding that a regular exercise routine can lower the risk of developing site-specific cancers. In fact, it was revealed that physically active men and women reported a 30-40% reduction in developing colon cancer compared to inactive persons (Lee, 2003). Regarding recommended physical activity levels, Lee (2003) reported that there is a dose-response relationship such that higher levels of physical activity decrease the risk of developing colon cancer. The systematic review also revealed sparse data that 30-60 minutes of moderate to vigorous intensity per day is needed to decrease the risk of colon cancer. Colon cancer is one of the many site-specific cancers where the risk of developing the disease can be attenuated with regular physical activity.

In addition to colon cancer which applies to all genders, there is evidence to support that regular physical activity can decrease the risk of developing breast and endometrial cancer, where the incidence is reported primarily in the female sex. A systematic review conducted by Holmes and colleagues (2005) reported that high levels of physical activity have been linked to a 20-40 % lower risk of developing breast cancer. Noteworthy in the report is that this statistic is controlled for menopausal status, type, and intensity of activity. Furthermore, there is accumulating evidence to suggest that adequate physical activity attenuates the risk of the development of colon, breast, and endometrial cancers by regulating the metabolism of endogenous hormones such as estrogen and insulin (Bianchini et al., 2002). Thus, it seems that regular exercise contributes to physiological changes in the body leading to a reduction in the risk of developing site-specific cancers.

There is a general understanding that regular physical activity reduces the risk of developing factors that lead to mortality. Additionally, there is a near-consensus agreement that routine physical activity plays an effective role in the primary and secondary prevention of obesity (Warburton et al., 2006). However, there is a growing body of evidence supporting the association between obesity and cancer risk. A population-based, case-control study conducted by Pan and colleagues (2003)

reported that subjects who were overweight with a body mass index (BMI) of 25-29.9 kg/m^2 or obese (BMI > 30.0 kg/m^2) conferred a significantly greater risk for 19 cancers compared with subjects with a BMI of less than 25. Conclusively, there is evidence to suggest that being overweight or obese can lead to increased risk of site-specific cancers. Therefore, incorporating regular physical activity is imperative in the primary prevention of cancer.

Role of Physical Activity in the Secondary Prevention of Cancer

There is a large body of evidence advocating for physical activity and its positive role in the secondary prevention of cancer which has ultimately led to changes in clinical practice settings. Exercise during and post-treatment reduces physical and psychological problems associated with cancer and its associated therapy (Knols et al., 2005). Additionally, improvements in health and specific markers of quality of life were reported including psychological well-being, increased energy, greater functional capacity, and healthier body composition in response to regular physical exercise (Courneya and Friedenreich, 1999; Mock et al., 2001). Although the primary goal of cancer treatment is the elimination of cancerous cells, mental health is often overlooked throughout the treatment plan. Regular exercise is encouraged as participation can positively contribute to an individual's physical and mental well-being.

In addition to the negative somatic and psychological symptoms reported by patients undergoing cancer therapy, there is evidence to suggest that regular physical activity reduces mortality risk. A longitudinal investigation by Hu and colleagues (2004) reported that physically inactive middle-aged women showed a 29% increase in mortality from cancer in comparison to individuals of the same demographic living a physically active lifestyle. In this study, physical inactivity was defined as less than one hour of exercise per week. A systematic review conducted by Holmes and colleagues (2005) reported that an increase in weight post-diagnosis is linked to poorer survival from breast cancer in many studies. Since cancer therapies often contribute to an increase in exercise intolerance eventually leading to increased body weight, an exercise intervention would help by breaking the physical inactivity cycle and increasing survival in cancer patients.

Evidence-Based Clinical Exercise Guidelines

Although a definitive blueprint for exercise oncology is currently not fully elucidated, evidence suggests a significant correlation between physical activity and improvements in both cardiorespiratory fitness and quality of life in individuals living with cancer (Jones et al., 2012; Knols et al., 2005) and survivors. A study by Jones and colleagues (2011) reported that supervised physical activity is associated with improvements in aerobic fitness and marked health benefits in early-stage cancer patients. This report also asserted that the risks for adverse exercise-related events were remarkably low in this population. Therefore, patients in the early stages of cancer progression are strongly encouraged to participate in physical activity while undergoing treatment.

A systemic review conducted by Jones and colleagues (2012) revealed a significant improvement in peak aerobic power (VO_2peak) in cancer patients. One of the recommendations stated by Jones

and colleagues (2012) for patients during adjuvant therapy is to participate in physical activity for 3 days per week at 60-75% of the individual's heart rate reserve or 20-45 minutes per day. Furthermore, they also revealed that an exercise program combining both aerobic and resistance training led to a greater effect on improving cardiorespiratory fitness compared to a single-modality intervention. Therefore, it is encouraged that individuals should engage in a variety of exercise modalities to gain the greatest physiological improvements. This systematic review provided compelling evidence for the establishment of clinical exercise prescriptions for cancer survivors.

Regarding exercise prescription, Holmes et al. (2005) reported that women engaging in 9 or more MET hours per week resulted in approximately a 50% reduction in breast cancer-related mortality and a 30% reduction in all-cause mortality in comparison to inactive women. To build and extend upon this assertion, Jones and colleagues (2012) recommended engaging in physical activity for 3-5 days per week at 60-75% HRR for 20-45 minutes per day. This finding is consistent with the observations made by Meyerhardt and colleagues (2009), reporting that individuals engaging in 18 or more MET hours per week resulted in approximately a 50% reduction in colorectal cancer-related mortality and 30% reduction in all-cause mortality. Although there is evidence and opinion-based guidelines regarding the level and modality of exercise in cancer patients and survivors, Courneya and colleagues (2002) asserts that the individual's initial motivation and adherence to their program is a crucial consideration when planning physical activity programs.

Although physical activity is a primary and secondary preventative strategy against cancer, it is imperative that patients living with cancer complete the Physical Activity Readiness Questionnaire for Everyone (PAR-Q+) and (if necessary) the electronic Physical Activity Readiness Medical Examination (ePARmed-X+) (Bredin et al., 2013; Warburton et al. 2011b). These evidence-based, pre-participation screening tools are endorsed by the medical community to assess an individual's risk level for exercise-related adverse events (Bredin et al., 2013). Based on the risk algorithm on the ePARmed-X+, participants are categorized in one of three groups on a risk continuum including "low", "intermediate", and "high" (Bredin et al., 2013). Any patient receiving chemotherapy as part of their current cancer treatment or past treatment in the past will be placed at the intermediate risk" category at the very least. This is due to the potential cardiac injuries associated with chemotherapy such as myocardial injury, pericardial thickening, and increased risk for arrhythmias (Khakoo et al., 2011). Individuals in this "intermediate" risk category are advised to exercise under the guidance of appropriately trained, qualified exercise professionals who typically have advanced university training (Bredin et al., 2013; Warburton et al. 2011a; 2013). Patients with lung cancer, bronchogenic carcinoma, multiple myeloma, head and neck cancer with abnormal clinical tests are placed in the "high" risk category due to the increased risk and potential side effects of their respective treatments. Therapies such as anthracyclines and/or trastuzumab may lead to cardiotoxicity, cardiomyocyte apoptosis, heart failure, or cardiomyopathy which will increase the risk of exercise-related adverse events

(Jones et al. 2011; 2012). Because of their "high" risk profile, they are advised to exercise in medically supervised settings that include qualified exercise professionals (Bredin et al., 2013). The importance of risk stratification procedures and supervision by qualified personnel help ensure that patients living with cancer can reap the health-related benefits of physical activity.

Clinical Implications of "More is Better, But Every Little Bit Counts"

The message "more is better, but every little bit counts" is an evidence-based knowledge translation tool that should be used to assist all individuals in reaping the health-related benefits of physical activity (Lai and Warburton, 2017). Recognizing that many of the oncological therapies can contribute to increased exercise intolerance, some individuals may not be able to exercise at the recommended guidelines reported in this review. Nevertheless, the health benefits of physical activity are clear (Warburton et al., 2006). Despite the recommended guidelines in exercise oncology programs, it is of clinical importance to note that health benefits can still be accrued with a dosage and/or intensity of physical activity below the recommended guidelines (Hupin et al., 2015). Thus, every little bit of physical activity contributes to improving the health status of individuals living with cancer.

Conclusion

The evidence supports regular physical activity in their role as a primary and secondary prevention of cancer. Healthy and at-risk individuals can reduce their risk of developing site-specific cancers through an individualized physical activity program. Although there is no one-size fits all blueprint for exercise oncology programs, evidence suggests that an individualized, progressive exercise prescription is a recommended approach for healthcare professionals.

Authors' Qualifications

The authors' qualifications are as follows: Phillip Do, BKin; Henry Lai, BSc, BKin, HFFC-CEP; Darren Warburton, MSc, PhD, HFFC-CEP.

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