Effects of combined aerobic and resistance exercise on quality of life and fitness of individuals who are post cancer treatment; a pilot study

by

Meagan O'Neill MHSc, BSc, CEP, Reg. Kin

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Masters in Health Science

in

Kinesiology

in

The Faculty of Health Science

Program

University of Ontario Institute of Technology

July 2013

Certificate of Approval

CERTIFICATE OF APPROVAL

Submitted by **Meagan O'Neill**

In partial fulfillment of the requirements for the degree of

Master of Health Sciences

Date of Defence: **July 29, 2013**

Thesis title: Effects of combined aerobic and resistance exercise on quality of life and fitness of individuals who are post cancer treatment; a pilot study.

The undersigned certify that the student has presented her thesis, that the thesis is acceptable in form and content and that a satisfactory knowledge of the field covered by the thesis was demonstrated by the candidate through an oral examination. They recommend this thesis to the Office of Graduate Studies for acceptance.

Examining Committee

Dr. Otto Sanchez
Chair of Examining Committee

Dr. Erin McGowan
External Examiner

Dr. Manon Lemonde
Research Supervisor

Dr. Kevin Power
Co-Supervisor

Dr. Holly Jones Taggart
Examining Committee Member

Dr. Kirsten Burgomaster
Examining Committee Member

As research supervisor for the above student, I certify that I have read and approved changes required by the final examiners and recommend the thesis for acceptance:

Dr. Manon Lemonde
Research Supervisor

Abstract

Cancer Survivors are defined as any individual who has been diagnosed with cancer and completed treatment, who may or may not be free of the disease (Speck et al., 2010). Cancer survivors can experience numerous, debilitating and long lasting side effects. These side effects can occur during and following cancer treatment and can affect individuals' daily life. An overview of the literature on the outcomes that can be experienced from physical activity/exercise for cancer survivors will be presented.

This study evaluated an 8-week individualized combined aerobic and resistance training program on individuals post cancer treatment, through supervised bi-weekly exercise sessions. This study was constructed based on the review of the benefits of exercise for treatment of cancer and the side effects. The outcomes of the exercise intervention were evaluated through pre-, post and three-month follow-up assessments consisting of physical and psychological testing. Trends of improvements in muscular strength, endurance, reduction in fatigue levels and perceived Quality of Life (QOL) were identified. These outcomes further support current literature that, a comprehensive physical fitness program is important for this population in assisting them with reduction in their cancer related side effects.

Keywords

Cancer, Exercise, Rehabilitation, Personalized exercise program, post cancer treatment

This Master's Thesis is dedicated to

my cousin Rachel Anne Cecelia Higgins and

my uncle John Charles Cussons.

Thank you for showing me true dedication to your passion,

courage and strength to face what life sends your way,

and the beauty of love.

John I love you and miss you, thank you for your belief in me.

Rachel I love you and miss you every day,

I only wish to honor your memory with my work, and through making a difference

in the lives of people living with cancer.

Acknowledgements

It is here that I wish to provide my gratitude to the individuals that helped me along my path to completing my Master's Thesis.

To my supervisors, Drs. Kevin Power and Manon Lemonde, your support, guidance and enthusiasm through this process has allowed me to grow in my research abilities and enjoy my Masters experience. To my Master's Thesis Committee, thank you for your guidance. To Carolyn Brown and Brittany Lee thank you for all of your support, you are both wonderful individuals.

To my parents, thank you for your unwavering support, guidance and love throughout my life and specifically during the past two years. To my Mom, there are no words to express how **awesome** you are, but I wouldn't be here today without your constant assistance, helpful management and love, thank you. To my Dad, thank you for always asking the tough questions, for without those I would still be searching for the answers. To my siblings, Kailey and Ryan, thank you for always being there for me and supporting me, through any path I take. To my aunt Sheelagh thank you for your love and guidance.

I love you all.

Finally, I would like to express my gratitude to my cousin Rachel, where you are. Thank you for showing me courage, strength, determination, unwavering love and generosity. Your legacy of the RACH Fund continues to grow. Rachel you taught me to be strong and brave during tough times, laugh all the time, and love life, family and friends to the fullest.

Be Awesome

Live, Laugh, Love

Table of Contents

List of Tables

List of Figures

List of Appendices

Introduction

Overview

Being diagnosed with cancer can be a devastating experience. However since the awareness of cancer is high within our society, cancer survivors have an understanding of what to expect following this diagnosis. Both the nature of the disease, in addition to various cancer treatments can cause side effects, including changes to the individual's physical, psychological, social, and emotional well-being (Beisecker et al., 1997; Portenoy et al., 1994). Along with the increasing number of individuals surviving cancer, due to advances in early diagnosis and treatment of the disease (Schneider et al., 2002) side effects that occur due to treatment can be long lasting and devastating even following treatment. There is a range of physical and psychological side effects that an individual can experience; however cancer related fatigue is the most reported and disruptive side effect experienced (Schwartz et al., 2001). Additional side effects include physical changes; decreased muscular endurance, muscular strength, cardiovascular endurance, and changes in body composition, as well as, psychological changes; reduction in self-esteem, difficulty sleeping and depression. One or more physical side effects, can lead to overall general decrease in physical functioning. Also, if they do experience one or more psychological and physical side effects it can lead to a reduction in Quality of Life (QOL). QOL encompasses multiple areas of an individual's life including physical, psychological, emotional and social states or well-being (Burnham & Wilcox, 2002; Campbell et al., 2005). Due to the disease, its treatment and the side

effects, QOL may still be compromised months or years following treatment (Courneya et al., 2003c). There are treatment(s), support groups and guidance in place to assist individuals through their cancer experience. Additional therapy to consider is exercise. Exercise for the general healthy population has been known to have positive effects on improving physical functioning by: increasing muscular strength, muscular endurance, cardiovascular endurance and positively changing body composition. Benefits of improved self-esteem, reduction of fatigue levels, and improvements in depression levels have been associated with regular exercise (Courneya et al. 2003b; Pinto et al. 2003; Sprod et al. 2010)

Research in the field of cancer and exercise rehabilitation has also demonstrated that there are benefits of exercise therapy for individuals at any stage of their cancer journey, at diagnosis, through treatment, and post treatment (Burnham & Wilcox, 2002; Courneya et al., 2007; Schwartz et al., 2001; Sprod et al., 2010). Research completed by Mcneely et al. (2006) and Speck et al. (2010) have found positive effects from exercise therapy for individuals post cancer treatment on improvements in QOL, aerobic fitness, upper and lower body strength, and decreases in fatigue. The above systematic review and meta-analysis discussed research of varying exercise protocols including: aerobic only training, resistance only training and combined aerobic and resistance training. Positive relationships were identified between cancer related side-effect reduction and exercise therapy.

Therefore if we apply a combined aerobic and resistance exercise therapy, to individuals that have been diagnosed with cancer, specifically post cancer treatment providing them with an individualized exercise program, it is expected

that similar positive physical and QOL outcomes will occur (Sprod et al., 2010). As minimal research has focused on the benefits of individualized, combined aerobic and resistance training for this population, this study focuses on the benefits that an individualized exercise program can provide on the physical and psychological (QOL) side effects that occur in cancer survivors (for this thesis cancer survivors are defined as any individual who has been diagnosed with cancer and completed treatment, who may or may not be free of the disease (Speck et al., 2010)).

Statement of the Problem

Individuals diagnosed with cancer can experience side effects from the disease and its treatments. These side effects can have long-lasting devastating effects on the individual's physical functioning and QOL. Using a natural and holistic approach, such as exercise to reduce side effects can provide the individual with a sense of control over and potentially eliminate the need for additional medication or other therapy. Therefore the need to provide evidence-based exercise programs for these individuals at any stage of the cancer journey is very important. Research to evaluate what occurs when an individual post cancer treatment completes a supervised exercise program is needed. As the number of individuals surviving cancer continues to grow, there are many individuals that may still experience side effects following treatment. This research will help to provide evidence-based knowledge of a supervised exercise program.

Purpose of the Study

The purpose of this study was to determine whether an eight-week individualized aerobic and resistance exercise training program will improve the overall physical functioning and QOL of individuals following cancer treatment (surgery, chemotherapy, radiation or a combination). For the purpose of this thesis; physical functioning refers to: cardiovascular function, muscular strength, muscular endurance, and flexibility and QOL refers to: changes in their overall wellness including physical and psychological functioning.

Research Questions

1. Will an eight-week individualized aerobic and resistance exercise intervention, developed by a Certified Exercise Physiologist (CEP), improve an individual's physical functioning post cancer treatment (surgery, chemotherapy, radiation or a combination)?
2. Will an eight-week individualized aerobic and resistance exercise intervention, developed by a Certified Exercise Physiologist (CEP), improve overall quality of life in individuals who are post cancer treatment (surgery, chemotherapy, radiation or a combination)?

Research Hypothesis

It is hypothesized that an eight-week individualized aerobic and resistance exercise intervention in post-cancer treatment individuals will improve:

1. Physical functioning: increased muscular strength, endurance and flexibility, and improve cardiovascular functioning.

2. QOL, which includes but is not limited to: fatigue, self-esteem, satisfaction with life, anxiety, and depression.

Literature Review

Introduction

This review will provide an understanding of cancer through the statistics, biology and diagnosis, treatment and side effects that arise from it. It also provides a review of the health benefits that exercise poses in the general population, as well as, the benefits and/or potential drawbacks to exercise rehabilitation for the cancer population will be discussed. Gaps in the literature regarding cancer and exercise rehabilitation will be identified.

Cancer

Statistics

The prevalence of cancer has become a concern for all Canadians, as it has exceeded cardiovascular disease as the leading cause of death (Canadian Cancer Society, 2013). The Canadian Cancer Society reported that out of five Canadians, two will be diagnosed with cancer in their lifetime (Canadian Cancer Society, 2013). In 2007 the total number of new incidences of all cancers in Ontario was 63,492 and the total number of deaths from all cancers was 25,369 (Cancer Care Ontario, 2012). In Canada for 2012 the number of new incidences of all cancers was estimated at 186,400 and the estimated total number of deaths from all cancers was 75,700 (Canadian Cancer Society, 2012). The most common types of cancer in Ontario (in 2007) and Canada (in 2012) are prostate Cancer for males, breast cancer for females, followed by lung and colorectal cancers (Canadian Cancer Society 2012; Cancer Care Ontario, 2012).

Cancer Biology and Staging

Cancer develops from a genetic mutation that can corrupt any part of the cell cycle or prevent the natural process of cell death; it is the continuous additional mutations and proliferation of these cells that form a tumour or cancerous mass (Pardee & Stein, 2009). Cancer diagnosis is defined by four general stages (i.e. 0 to IV). Stage 0 refers to carcinoma in situ (early stage of cancer which does not have cells capable to invade the surrounding area) and stage IV refers to the most aggressive stage where cancer metastases to another location of the body (Almeida & Barry, 2010). Metastasis is a process whereby mutations have occurred in cancer cells which enable them to spread to other locations of the body (Pardee & Stein, 2009).

Cancer Treatment

With the diagnosis and staging of cancer, an optimal treatment protocol can be developed. Currently the main types of treatment for cancer are surgery, drug therapy (chemotherapy), radiation, integrative medicine, and palliative care (Pardee & Stein, 2009). The type of treatment(s) prescribed will depend on a number of elements including; location where cancer originated, type of cancer, stage of cancer, and other biological factors (Pardee & Stein, 2009). As briefly mentioned, cancer develops due to genetic mutations that effect the cellular pathways, therefore most treatments attempt to target or stop the defect in these pathways. New treatments being developed are attempting to pinpoint or individualize treatment. Unfortunately with treatments there can and will be side effects that can have a large impact on the physical and psychological well being

of an individual during treatment. These side effects can persist post treatment as a result of the consequences that occur on physical functioning and QOL during treatment (Avis et al., 2005; Burnham & Wilcox, 2002).

The following is a brief overview of the various treatments used to combat cancer.

Surgery

Surgery is used to remove the cancerous mass entirely, to debulk the mass, or as a diagnostic tool (i.e. biopsies). Surgery can be used as a precursor to chemotherapy or radiation to help reduce the size of the mass to give the other forms of treatment a chance to reduce the mass further. Surgery can also be used following chemotherapy or radiation after the initial treatments have reduced the size of the tumour (LeMura & von Duvillard, 2004). Following surgery symptoms that can occur include pain around the incision site, and/or potential loss of mobility at the affected site, both of which can affect the range of motion and use of the affected area (Lauridsen et al, 2008; Tasmuthl, 1996).

Chemotherapy

Chemotherapy is a type of systemic drug treatment. Chemotherapy is used to destroy the cancerous cell by preventing deoxyribonucleic acid (DNA) from replicating, stopping cancer cells from proliferating. However the drug works on all rapidly dividing cells, therefore non-cancerous normal cells can be affected, such as epithelial cells (Pardee & Stein, 2009). Side effects of the rapidly dividing epithelial cells can include hair loss (Beisecker et al., 1997). The dose of chemotherapy can be a single or combination of chemotherapeutic agents, which

may provide better treatment for the disease and/or prevent drug resistance. This type of treatment has a number of ways to be administered; the most prevalent are intravenously or orally. Chemotherapy is scheduled in cycles that occur between two and four weeks apart, and the length of the treatment can last up to six months (LeMura & von Duvillard, 2004; Pardee & Stein, 2009). Chemotherapy can cause side effects such as; weakness, nausea, lowering blood counts. These side effects can occur weeks to years following this treatment (Pardee & Stein, 2009).

Radiation

Radiation is considered a localized treatment. The most common type of treatment administration is by an external beam of radiation generated from a machine, however there are other ways to administer this treatment, such as brachytherapy and ingestion or injection of radioisotopes (Pardee & Stein, 2009). Radiation works to damage the cancer cells' DNA, thus preventing the cancer cells from proliferating by causing cell death. Radiation will also affect the surrounding normal cells, however they are able to heal at a faster rate than the cancerous cells (Pardee & Stein, 2009). There is the traditional treatment dose in which patients receive daily treatments for between five to seven or eight weeks (LeMura & von Duvillard, 2004; Pardee & Stein, 2009); however as advances continue to occur with all types of treatment for cancer, the radiation treatment dose could change in the future. Side effects that can occur due to radiation treatment will appear in the surrounding non-cancerous tissue and organs that have received radiation during the treatment (Bentzen, 2006). This can have

early or late effects on an individual, including nausea, skin redness, changes in the affected tissues such as reducing structure and flexibility, and atrophy of the surrounding tissues (Bentzen, 2006). These side effects could lead to decreases in range of motion and reduction of use to the affected area.

Side effects from cancer and its treatment

With the brief overview of the main types of cancer treatment, it is important to review their potential side effects. One of the predominant side effects of cancer treatment is fatigue; this has been shown to be the case in different cancer types, with chemotherapy treatment specifically causing the side effect of fatigue (Dikken & Sitzia, 1998; Feyer et al., 2008; Portenoy et al., 1994; Spichiger et al., 2011; Yamagishi et al., 2009). Cancer-related fatigue (CRF) can have detrimental consequences on an individual's ability to function and their overall QOL, as it is not relieved by rest or sleep and can be inconsistent with activity levels (Ryan et al., 2007; Wagner & Cella, 2004). The mechanisms of cancer related fatigue have yet to be fully elucidated and continued research is still evaluating the causes. A study completed by Okuyama et al (2000), suggested that fatigue is related to distress experienced due to physical and psychological aspects instead of the treatment received. However, a review completed by Wagner & Cella (2004) looked at the multidimensional causes of fatigue, which included: disease, treatment, psychosocial factors, comorbid symptoms, and comorbid medical conditions. Further Ryan et al. (2007) suggests that CRF may occur due to disruption within a multitude of systems, including the physiological, biomedical and psychological systems. These system disruptions

may occur as a result of the disease, but also could occur due to the treatment, such as the side effects of chemotherapy of all rapidly dividing cells. As the mechanisms of CRF are still being evaluated, for this literature review, fatigue can develop due to a myriad of factors from diagnosis and treatment of cancer.

A study completed by Beisecker et al (1997) administered two interviews with breast cancer patients who had received adjuvant chemotherapy (chemotherapy that occurs after other treatments for cancer) (Pardee & Stein, 2009). The first interview was one-month post chemotherapy and the second interview was completed six months later. Some of the side effects reported were: hair loss, fatigue, nausea, weight gain, and emotional problems. There were some differences in reported side effects at one-month post chemotherapy versus six months following first treatment. Patients had expected to experience some of the initial side effects reported, however did not expect them six months post-chemotherapy treatment (Beisecker et al., 1997). Another interesting finding was that one third of the women experienced fatigue and/or a decrease in energy six months after treatment was completed (Beisecker et al., 1997). Cancer related fatigue is a debilitating side effect of various treatments that can have severe effects on an individual (Schwartz et al., 2001).

A long-term study completed by Spichiger et al (2011), with a mixed cancer type (lymphoma, breast, lung or colorectal cancers) also showed fatigue or lack of energy as a prevalent side effect. Other side effects included but were not limited to: worrying, feeling drowsy, feeling sad, difficulty sleeping, nausea, and difficulty concentrating. This study assessed participants during the initial cycle of chemotherapy, and one week prior to both the third and fourth cycle of

chemotherapy. The scores showed patients most prominently experienced fatigue during the third and fourth cycle of chemotherapy (Spichiger et al., 2011). Another study of mixed cancer sites (breast, colon, prostate or ovary cancer), completed by Portenoy et al (1994) looking at both inpatient and outpatient populations, observed that overall QOL was negative associated with the number of symptoms reported; overall QOL included decrease in performance and psychological distress (Portenoy et al., 1994). Similar findings have been shown in other studies, where more symptoms are related to depression or severity of fatigue, which Portenoy et al (1994) describes as the most prevalent symptom (Feyer et al., 2008; Spichiger et al., 2011). Another devastating symptom of treatment can be weight loss, as seen in colorectal cancer or weight gain as seen in breast cancer (Beisecker et al., 1997; Dikken & Sitzia, 1998; Feyer et al., 2008), which cannot only affect their physical functioning, but can also cause issues with self-esteem and self-confidence which can cause psychological issues. There are trends seen from the research of impairments in physical and psychological well-being. After briefly reviewing the side effects noted above, if one or more of these side effects occurred within a participant, then one could attribute this combination of side effects to the decrease in the level of QOL.

Lymphedema can be a side effect of cancer, such as breast cancer; it will be a life-long side effect. Lymphedema occurs due to damage to the lymphatic system from treatment, such as axillary dissection or radiation (Bicego et al., 2006). This damage to the lymphatic system can cause the affected side's limb (i.e. arm for an individual diagnosed with breast cancer) to become enlarged due

to the accumulation of lymphatic fluids, causing the limb to be heavy, tight and may cause pain (Bicego et al., 2006).

There are clinical interventions available to help combat some of the side effects associated with cancer treatment. However, some of the side effects could also be due to the cancer itself. There is a substantial number of people, 22 million, worldwide who are cancer survivors that could be dealing with any number of side effects from their treatment or disease (Feyer et al., 2008). It is important to have interventions in place to assist the cancer survivors in treating their side effects, which would also assist them in returning to their normal activities. As noted in Beisecker et al (1997) having organized support groups for patients whom have finished treatment, including being physically active, may be helpful for the individual to cope with side effects such as weight gain. This would assist with both the physical and psychological side effects. Through the remainder of this literature review, the benefits of exercise to reduce side effects and improve health will be discussed. Exercise can be used as an additional intervention to current treatments/activities in place.

Exercise

Improvements in cardiovascular function and strength can greatly increase an individual's QOL, thereby allowing them to be able to complete their normal activities more easily. Aerobic exercise improves cardiovascular functioning, whereas resistance training increases muscular strength (Boreham, Wallace, & Nevill, 2000; Kraemer & Ratamess, 2004).

Cardiovascular Exercise

Cardiovascular exercise promotes improvements in cardio-respiratory health (Boreham et al., 2000). Through cardiovascular endurance training changes can occur throughout different systems, such as cardiovascular, respiratory, and metabolic (Jones & Carter, 2000). These changes can promote improvements in blood lactate concentrations, cholesterol levels, cardiorespiratory health, and fitness levels in individuals that have previously been sedentary (Boreham et al., 2000).

Resistance Exercise

Resistance training is used to build muscular strength, endurance, coordination, performance and balance. It is traditionally used for elite athletes and body builders as a tool for improvement. However, now for most populations, resistance training has been recommended by national health organizations (Kraemer & Ratamess, 2004). To ensure the most appropriate resistance-training program is developed for an individual, their personal goals must be considered regardless of age or fitness level.

Psychological Benefits of exercise

Cardiovascular and resistance training provides benefits for the physical body as indicated above, however being physically active and exercising can also provide psychological benefits. Through social support that may occur in group exercise formats and improvements in an individual's self-esteem from continued exercise, improvements in depression, stress, self-identity, and anxiety have been seen (DiLorenzo et al., 1999; King et al., 1993; McCann & Holmes, 1984).

However to maintain these benefits, such as with physical benefits, continued involvement in the physical activity is required (King et al., 1993). An interesting finding by Myers & Roth (1997) when evaluating the benefits and barriers to physical activity suggests individuals that are more active identify more health benefits than barriers, which is the opposite for individuals who are not active. Further promoting the fact that exercising provides benefits, physical and psychological.

Exercise and other clinical populations

Aerobic and resistance training described above are very general concepts that are associated with a healthy population that can be transferrable to unhealthy or diseased populations. A study by Atlantis et al., (2004) on improving mental health and QOL through exercise and behavioural modifications, showed improvements in mental and physical health components of health-related QOL measures. This study used a combination of aerobic and resistance exercise over a 24 week period on employees of a casino. Inclusion criteria ensured participants did not have a clinically medical diagnosed psychiatric condition, or if they were on workers compensation (Atlantis et al., 2004). Although this study was a mixed treatment study, it still provides evidence that exercise can be a part of a program to improve mental health as well as physical health. When looking at sleep loss, a study on chronic primary insomnia, evaluating individuals diagnosed with insomnia, dealing with insomnia for more than six months and between 30 to 55 years of age, found that through exercise training there were improvements in sleep and QOL following a six-month aerobic

exercise intervention (Passos et al., 2011). Comparison of Passos' study with cancer patients, as a disruption in sleep can be a side effect reported (Feyer et al., 2008), could show the benefits in providing an exercise program to help combat this specific side effect, possibly limiting the amount of drugs used to improve sleeping habits. The above provides an insight as to how general aerobic and resistance exercise program can be transferred to a non-healthy or diseased population, such as a cancer population.

Cancer and Exercise

The side effects that occur due to cancer can drastically affect an individual. Many studies have shown there is a benefit to exercising during and after treatment for cancer. These benefits include but are not limited to; physical functioning, QOL, and reduction in fatigue (Courneya et al., 2007, 2003c; Ohira et al., 2006; Schwartz et al., 2001), which have been shown in both supervised exercise programs and home-based exercise programs. Through the literature reviewed, there was a mix of exercise protocols prescribed. The majority of studies reviewed prescribed only aerobic exercise, there were a few that looked at only resistance or weight-training exercises, and few that combined both exercise types. This trend of aerobic only training research reviewed is similar to findings from meta-analysis and systematic reviews where aerobic only training and combined aerobic and resistance training together are the majority of protocols prescribed, followed by resistance training and then non specified training protocols (Bicego et al., 2009; Speck et al, 2010). As can be seen within the research there are multiple exercise programs prescribed, which suggests

that an optimal exercise prescription for this population needs has yet to be determined (McNeely et al., 2006; Schmitz et al., 2005).

Bicego et al. (2009) found through a systematic review benefits of weight loss, decreased fatigue, improvements in QOL and mood were seen in nine studies, which were predominantly aerobic and combined aerobic and resistance exercise programs. De Backer et al. (2009) completed a systematic review on resistance training and found out of the 24 studies reviewed, 20 consisted of combined aerobic and resistance training program. Through these studies reviewed, benefits were seen in muscular and cardiopulmonary function, however as the majority of the studies consisted of a combined training program the amount of positive change due to the resistance training aspect of the program cannot be evaluated.

Aerobic Exercise

A three-week study that compared supervised aerobic exercise to a relaxation training group in individuals diagnosed with a solid tumour found that physical aerobic performance, evaluated based on an ergometer stress test, increased in the aerobic group. There was no difference between groups in the reduction of fatigue (Dimeo et al, 2004). This was the shortest study in duration reviewed (i.e. three weeks) and no control group was tested. This study provides an interesting perspective; there are multiple aspects to cancer-related fatigue therefore therapeutic treatments may need to be diverse (Dimeo et al, 2004). This could mean that exercise alone will not provide the best intervention to reduce fatigue. Schwartz et al (2001) study was the only one assessing the

benefits of exercise on fatigue on a daily basis; they showed that exercise has benefits in reducing fatigue on the day when exercise is completed and the following day. This was a home-based intervention for breast cancer patients lasting eight weeks (Schwartz, 2001). Courneya et al (2003c) studied the benefits of aerobic training on post menopausal females with early stage breast cancer that were post treatment for QOL and cardiovascular functioning. The authors found that the exercise training group compared to the control group saw benefits from the aerobic training of three sessions per week for 15 weeks on a cycle ergometer. Positive effects on QOL and cardiopulmonary function were also identified (Courneya et al, 2003).

Resistance Exercise

Resistance exercise has also shown to provide benefits. A study by Courneya et al (2007) comparing resistance training, aerobic training and usual care, showed an increase in muscular strength, lean body mass, as well as self-esteem for the resistance training group (Courneya et al., 2007). This study on breast cancer patients demonstrated trends of improvements in levels of anxiety, fatigue, depression and QOL (cancer-specific), however did not see significant improvements. However trends were seen in the exercise groups, aerobic and resistance training, for the above outcomes. One interesting finding that came from this study was that chemotherapy completion rates increased in the resistance training group (Courneya et al., 2007). As noted in the study, further testing is needed to ensure the validity and reliability of this finding. However, this could have major implications in assisting with treatment completion. Weight

training has also been shown to have a positive effect on QOL in a six-month weight training only intervention on breast cancer patients (Ohira et al., 2006). These positive effects on QOL were correlated with the increases seen in upper body strength and gains of lean muscle mass (Ohira et al., 2006). Weight or resistance training can also be effective in other cancer populations. In prostate cancer it has been shown to improve fatigue levels (Segal et al., 2003). In fact a 12-week supervised program for men with prostate cancer who received androgen deprivation therapy, showed improved fatigue levels, along with improved health-related QOL (Segal et al., 2003).

Combined Training

Combined aerobic and resistance training have been shown to provide benefits post cancer treatment. A randomized controlled trial studied the effect of combined aerobic and resistance exercise in breast cancer survivors, post treatments, over a 24 week time period. They compared two time points; immediate exercise group (IEG) and delayed exercise group (DEG).The IEG completed a supervised aerobic and resistance training exercise intervention within the first 12 weeks and the DEG was asked not to complete physical activity during that time. In the final 12 weeks the DEG completed the exercise intervention and the IEG was not provided with any instructions (Milne et al., 2008). Participants attended 3 sessions per week during their active intervention. Results of this study found that a combined aerobic and resistance training program implemented early after treatment completion can have positive effects on QOL, aerobic fitness, muscular strength and fatigue, however the starting

fitness level of the participants was not noted and therefore the degree of positive effect is unknown (Milne et al., 2008). The findings from this study promote the initiation of exercise rehabilitation soon after the completion of chemotherapy and can possibly be extrapolated to completion of all treatments. These findings not only suggest that starting an exercise intervention soon after completion of treatment is of benefit, but also that the combined aerobic and resistance program promotes the positive outcomes noted. These improvements were seen after 6 weeks of training and further improvements at 12-weeks (Milne et al., 2008), indicating an eight week intervention period can produce improvement within this population. De Backer et al (2007) reached the same conclusion as Milne et al (2008), and noted that within the first eight to 12 weeks of training was where the largest increase in muscular strength was observed. A pilot study completed by Kolden et al (2002) on Group Exercise Training (GET), studied a 16-week intervention with both aerobic and resistance training for individuals with breast cancer who were in treatment. Although this was a pilot study and further research on this specific methodology is needed; the authors found that participants increased their physical functioning through the intervention by increasing their aerobic capacity, strength and flexibility. Additional findings for this study included improvements in QOL, through improved well-being and reduction in mood/distress (Kolden et al., 2002).

Individualized Training

From all of the above studies regardless of exercise type, there have been positive benefits for the participants with the types of cancer researched.

However, the studies used set training programs, such as all participants completing the same activities, time component, and intensity level, for the exercise intervention compared to individualized exercise prescription, of both aerobic and resistance training. Combined training was used in a study by Sprod et al (2010) comparing three months to six months of individualized aerobic and resistance training in breast cancer survivors. Improvements were noted at both three and six months, with improved cardiovascular endurance, fatigue and symptoms of depression occurring for participants completing the three months of exercise earlier, and additional improvements in pulmonary function, and muscular endurance by participants following six months of exercise (Sprod et al., 2010). Individualized exercise prescription was completed to ensure the specific needs of the participants were met, however the range of aerobic intensity was from 30% - 55% HRR, developed from the initial assessment (Sprod et al., 2010), this intensity level is slightly below the American College of Sports Medicine (ASCM) guidelines for the cancer population (American College of Sports Medicine, 2010). When compared to other research in the cancer field, it is inline with moderate intensity (Burnham & Wilcox, 2002) and significantly lower then studies by Courneya et al (2007) and Dimeo et al (2004). This study served to demonstrate the importance of individualizing the exercise prescription for individuals who are post cancer treatment. This could allow for greater benefit obtained by the participant of the exercise program, as the exercise prescription will be focused on their specific goals/needs.

Intensity Level

As previously discussed, there is no general consensus regarding the optimal exercise prescription for the cancer population. The American College of Sports Medicine (ACSM) has set guidelines for exercise prescription for this population. Research evaluates the range of intensity (low, moderate and high) around the set guidelines to find the optimal protocol. A study completed by Burnham & Wilcox (2002) compared low intensity aerobic exercise, moderate intensity aerobic exercise and usual care on individuals post treatment for lung, breast, or colon cancer. They found that both low- and moderate- intensity groups showed improvements of QOL and aerobic capacity and body composition over the control group (Burnham & Wilcox, 2002). However they noted that there was no statistical difference between the exercise groups (low- and moderate-intensity) on any of the variables tested; physiological and psychological. There have been few studies reviewed on high-intensity exercise with individuals post cancer treatment. An 18-week high-intensity resistance training program with aerobic interval training found improvements in muscular strength, health related QOL, and maximum oxygen consumption (De Backer et al., 2007). The intensity level for resistance exercise started with a focus on strength during the initial 12 weeks, at an intensity level of 65% - 80% of their one repetition maximum, completing two sets of ten repetitions. During the final six weeks of the intervention the focus changed to muscular endurance with an intensity of 35% - 40% of their one repetition maximum and increasing the number of repetitions to twenty. As noted previously, this study also found no significant correlation of

time span from completion of treatment to the starting of exercise training. The authors of this study completed a long term follow-up study and established that the benefits experienced at the end of the intervention on QOL and fatigue extended to a year. This indicates that improvements obtained during high-intensity exercise in the post treatment cancer population may provide long term benefits (De Backer et al., 2008). Additional research is required to gain a better understanding of high-intensity training which may benefit the development of effective, safe, and correct exercise prescription (De Backer et al., 2007). Although additional research is needed to confirm the appropriate intensity level, research above suggests that there are benefits for exercise at multiple intensities for this clinical population.

Program Length

In the literature reviewed, the range in intervention length was three weeks to six months, with the most frequent length of 10 - 15 weeks and there was also a predominance of supervised exercise interventions. The majority of the studies identified a positive trend or statistical significance with exercise and treatment related side effects. It is important to note that the majority of these studies have been completed on breast cancer patients and covered both active treatment and post-treatment populations (Courneya et al., 2007; Milne et al., 2008; Ohira et al., 2006; Pinto et al., 2003, 2005).

Statistics

Most studies showed improvements in side effects associated with treatment, however there were a few studies that did not show statistical significance. A 16-week home-based aerobic exercise program for colorectal cancer patients found no changes in QOL, fitness or between group differences (Courneya et al., 2003a). Although this study was unable to find benefits for an exercise program for this population, they indicate that further research is needed as issues with adherence and exercise reporting may have swayed the results of the study.

Social Support and Behaviour

Using physical exercise as a means of alleviating some of the side effects experienced by an individual that has been diagnosed with cancer is a great nonpharmacological therapy (Barber, 2012). Along with the benefits experienced from the physical activity, the group aspect of exercise training may also provide social support within the exercise therapy. This aspect of peer social support may have additional improvements in their QOL and psychosocial needs compared to individual exercise only. In a group exercise training atmosphere individuals will be physically active with other individuals that have been diagnosed with cancer. Having this social support with individuals dealing with similar issues during exercise therapy can be beneficial in improving QOL (Floyd & Moyer, 2009), it can also help in working towards goals, which is beneficial during an exercise program (Barber, 2012). Individuals may be more likely to participate in physical activity if there is social support available and also if they feel they will enjoy the

activity (McGowan et al., 2013; Rodes & Courneya, 2003; Speed-Andrews et al., 2012).

Adverse Events

The only adverse events found in the review, occurred in a supervised 15-week aerobic exercise intervention for breast cancer survivors (Courneya et al., 2003c). Events occurred in both the intervention and control group, such as lymphedema, influenza and gynaecologic complications. However the most interesting event was the number of intervention participants that developed lymphedema, three in total. There was a strong risk factor in two of the three participants for lymphedema due to their treatment (Courneya et al., 2003c). This is the only article reviewed that showed lymphedema developing in exercise, and suggests that lymphedema should be monitored during any exercise trials in the future (Courneya et al., 2003c). However, it has been found that progressive resistance training or increased physical activity with the affected arm does not increase the chance of developing lymphedema (Sagen et al., 2009; Schmitz et al., 2010). One thought is that exercise provides stimulation to the skeletal muscular system, which in turn promotes lymphatic and venous fluid pump (Bicego et al., 2006). One recommendation that has been provided in the literature as a precautionary measure to individuals diagnosed with lymphedema or determined at risk from physicians, is to wear a prescribed compressive sleeve during exercise (Bicego et al., 2006).

Pilot Study Research

There were also a few pilot studies reviewed, aerobic only and combined training protocol, that showed positive trends towards reduction of fatigue, improvements of body image, and increase in physical functioning, to name a few (Campbell et al., 2005; Oldervoll et al.,2003; Pinto et al., 2005). However within some of these studies there were limitations, such as; small sample size, length of study, control group, and limited generalizability, that suggest that further research is required in order to validate the results (Oldervoll et al., 2003; Pinto et al., 2003, 2005).

Overall, there are studies that highlight benefits of exercise rehabilitation for cancer survivors. However, there is no definitive answer that exercise improves QOL or decreases levels of fatigue in cancer patients which, could be due to the individual nature of these symptoms. Nevertheless, positive relationships can be seen between exercise therapy and reduction of fatigue, improved body image or self-esteem, improvements in body composition, strength and functional capacity, as well as trends of improved QOL for these individuals (Burnham & Wilcox, 2002; Campbell et al., 2005; Courneya et al., 2007, 2003c; Dimeo et al., 2004; Ohira et al., 2006; Oldervoll et al., 2003; Pinto et al., 2003, 2005; Schwartz et al., 2001; Segal et al., 2003)

Gaps in the literature and future research

Continued research in the field of exercise therapy or rehabilitation is needed to provide evidence-based knowledge on exercise therapy for this population. Although there is a vast amount of research showing the positive

effects that exercise possesses, there is still more information that can be obtained to ensure the most appropriate, safe and effective individualized exercise protocols are developed for cancer survivors. This will relate to the dose-response relationship of exercise prescribed to reduce side effects, such as fatigue (Schwartz et al., 2001). One important area of research surrounds lymphedema; it is very important to study the effects that exercise poses on lymphedema to ensure minimized risk of development of lymphedema.

This literature review contained both supervised and home-based exercise interventions; additional research is needed to evaluate supervised and home-based programs to decide which intervention produces the most benefits and/or to develop the best protocols for both types of intervention. Developing the best protocols to ensure exercise adherence, safety, and benefits to the individual would allow individuals who do not want to participate in a supervised program (group or individual) to complete the therapy at home. As noted earlier there is an estimated 22 million long-term cancer survivors worldwide (Feyer et al., 2008), as of January 2009 there were 838,724 cancer survivors (diagnosed within the past decade) living in Canada (Canadian Cancer Society, 2013); it is important that this type of therapy be made available to everyone, therefore multiple types of exercise regimens may have to be developed. Since there are such a vast number of cancer survivors as well as newly diagnosed individuals every day (Canadian Cancer Society, 2013) it is important to study all cancer populations to evaluate if this therapy is effective across all cancer types and individual stage of their journey. Currently breast cancer is the most studied population. Branching out and studying the effects of exercise on various cancer diagnoses will allow for

an understanding of what occurs with exercise for different cancer types. This will allow a better understanding of how to individualize exercise protocols for the different cancer types.

There are current studies that assess aerobic exercise or resistance exercise on individuals with cancer (Dimeo et al., 2004; Ohira et al., 2006; Schwartz et al., 2001; Segal et al., 2003), however very few reviewed the effects of combined aerobic and resistance therapy on individuals with cancer. Further research is needed to assess the potential benefits of a combined aerobic and resistance exercise therapy program, versus aerobic or resistance exercise alone. This again will allow for the most optimal exercise protocol to emerge. The benefits of only aerobic exercise and only resistance exercise have been shown with great effect (Dimeo et al., 2004; Ohira et al., 2006; Schwartz et al., 2001; Segal et al., 2003), thus a combined approach, may result in health benefits for those with cancer.

Effects of combined aerobic and resistance exercise on quality of life and fitness of individuals who are post cancer treatment

O'Neill, M.E.[1], Lemonde, M.[1], Jones-Taggart, H.[1], Burgomaster, K.[3], Power, K.E.[2]

1 University of Ontario Institute of Technology, 2000 Simcoe St. N, Oshawa, ON, L1H 7K4
2 Memorial University of Newfoundland, St. John's, NL, A1C 5S7
3 R.S. McLaughlin Durham Regional Cancer Centre, Oshawa, ON, L1G 2B9

Abstract

Introduction

The number of cancer survivors is growing. Many treatments used to treat cancer have long-lasting, negative side effects. Exercise can be an intervention implemented following treatment to reduce side effects.

Purpose

This study evaluated the effects of an eight-week individualized aerobic and resistance exercise program on physical functioning and quality of life (QOL) in individuals post-treatment from breast, colon or adenoid cystic cancer.

Method

Participants were recruited through a local non-profit cancer support centre. Eight participants (eight women, mean age 58 years old) met the inclusion criteria and were approved to participate by physicians through a Physical Activity Readiness medical questionnaire (PARmed-X). All participants completed four assessments surrounding an eight-week exercise program. Pre-, post- and three month follow-up assessments consisted of an interview, related QOL questionnaires, and physical measures of body composition, cardiovascular and musculoskeletal health, using protocols outlined by the Canadian Society for Exercise Physiology. An additional questionnaire-only assessment was administered at the four-week point (mid-way) of the exercise program. The individualized exercises prescribed were based on results from the pre-assessment. Participants attended exercise training sessions bi-weekly for eight weeks. Training sessions included a warm-up, prescribed cardiovascular and resistance training and stretching.

Results

Results indicated trends of improved muscular strength, decreased levels of fatigue and improvements in perceived QOL.

Conclusion

A combined resistance and aerobic training program may be beneficial in mitigating the long-lasting, negative side-effects of cancer treatments. Future research should focus on the benefits of individualized exercise programs, for all cancer types at any stage, including improvements in QOL, fatigue and physical functioning.

Introduction

Overview

With the estimated 187,600 new cases of cancer within Canada in 2012, estimated 71,900 diagnosed in Ontario (Canadian Cancer Society, 2013), and with over 22 million long-term cancer survivors in the world (Feyer et al., 2008), there is a need to provide this population with assistance in alleviating side effects experienced. During and following cancer treatment individuals often experience negative side effects such as fatigue/decreased energy levels, weight loss/gain, and nausea, due to the treatment and disease. This could lead to a decrease in physical functioning and QOL. Not only do individuals with cancer deal with a significant life changing disease, but they must also endure the side effects of cancer treatment. Traditionally, these individuals receive support and guidance to assist with side effects such as medication and support groups (Beisecker et al., 1997). Comprehensive physical fitness programs can be a natural holistic therapy that can assist with reducing side effects of cancer and its treatment.

Exercise for the general population improves health and increase fitness. Exercise is also used in clinical populations such as assisting with sleep and mental health, such as depression, to improve overall health, and help reduce the associated symptoms (Atlantis et al., 2004; McCann & Holmes, 1984; Passos et al., 2011).

Currently research shows there are benefits of prescribing cardiovascular and resistance exercises to cancer survivors. A meta-analysis on randomized

controlled trials on exercise for cancer survivors found positive benefits on QOL and physical functioning, such as reduction in body weight, fatigue and depression and increases in grip strength (Fong et al., 2011). This was found through a variety of exercise protocols, predominately aerobic only, then resistance only and combined training, and one study using individualized exercise prescription. As see from the meta-analysis using a nonpharmacological therapy such as physical activity to improve some of the side effects from cancer and its treatment that has been demonstrated in the literature (Barber, 2012). What is important now is to determine the most appropriate exercise protocol to be implemented for this population. Improvements in fatigue levels, physical functioning and QOL have been seen in females post breast cancer treatment, following a 12-week, three sessions per week supervised combined aerobic and resistance training program, consisting of 12 resistance exercise and 20 minutes of aerobic exercise per session (Milne et al., 2008). Similarly a 15-week, three session per week supervised aerobic only training program where initial exercise intensity ranged from 70% to 75% of maximal oxygen consumption, improved QOL among post-menopausal breast cancer survivors (Courneya et al., 2003c). Resistance only 12-week three session per week supervised training program consisting of nine exercises, for men diagnosed with prostate cancer showed improvements in fatigue symptoms, as well as health related QOL (Segal et al., 2003). Current research indicates that there are numerous benefits to exercise therapy in cancer survivors. Although further research throughout this entire field is necessary to provide a greater understanding of the benefits of combined

aerobic and resistance training and how personalized exercise prescription plays a role in benefits experienced.

The purpose of this study was to evaluate the benefits/drawbacks of an eight-week individualized aerobic and resistance exercise training program for post cancer treatment individuals. This study assessed whether a combined aerobic and resistance exercise training program elicits improvements in overall physical functioning and the QOL of individuals following cancer treatment (surgery, chemotherapy, radiation or a combination).

It was hypothesized that a combined personalized exercise-training program for individual's post-cancer treatment will improve their QOL and will enhance physical functioning following an eight-week intervention.

Methods

Recruitment/Subjects

Participants were recruited through a local non-profit organization that provides services for cancer survivors and their families. The initial week of recruitment consisted of pamphlets (see Appendix A) displayed at the non-profit organization. Informal information sessions were conducted during the second and third week of recruitment. During the informal information sessions, all questions from interested individuals were answered. Ethical approval was obtained from the Research Ethics Board form the University of Ontario Institute of Technology (UOIT) prior to start of recruitment. Approval letter can be found in Appendix J.

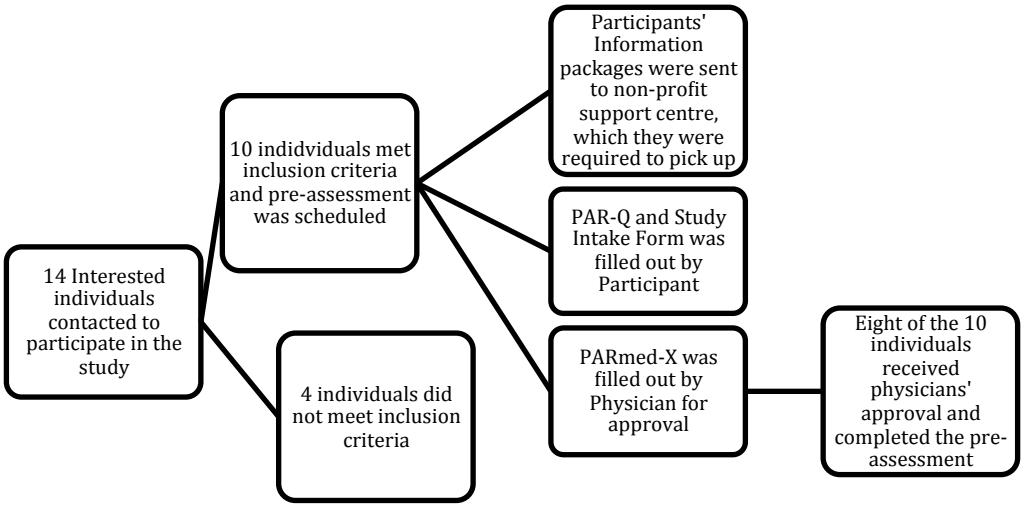


Fig. # 1 - Participant recruitment process

Figure 1 provides a description of the recruitment process participants completed in order to meet all of the inclusion criteria to be eligible to participate in the study. A full flow chart of the movement of the participants through the study is found in Appendix B.

During the initial call, 10 individuals answered questions to ascertain their eligibility to participate in the study. Eligibility to participate in the study included completion of cancer treatment, between 2 and 12 months post, diagnosed with a

solid tumour up to stage III, and physician's approval; participants were excluded from the study if they had a stage III diagnosis or metastasis. If participants met the eligibility criteria, they were briefed on their role in the study; if they still agreed to participate in the study they were provided with a participant identification number to ensure confidentiality. Participants were then informed that an information package would be left for them at the local non-profit organization. The information package contained a letter explaining the contents of the package, study intake form, Physical Activity Readiness – Questionnaire (PAR-Q), letter to a Physician explaining reasons to complete Physical Activity Readiness – Medical Examination (PARmex-X), pamphlet for physician, Parmed-X, and directions to the University of Ontario Institute of Technology (UOIT) with a map of the campus (as the assessments and exercise sessions occurred on campus). There was also contact information included for the Principal Investigator (PI)/Certified Exercise Physiologist CSEP® (CEP) (exercise leader) if the participant had any questions or concerns prior to the pre-assessment or if they needed further directions to the campus. Participants were then required to pick up their information package and visit with a physician for completion of the PAR-med-X prior to the pre-assessment.

Demographics

Participants (N=8) ranged in age from 49 – 75 years old. All participants were female, six participants were diagnosed with breast cancer, one was diagnosed with colon cancer, and one participant with adenoid cystic carcinoma.

All participants met the inclusion criteria. See baseline demographics for additional information (Tables 1 and 2).

Demographics	Pre-Assessment	Post Assessment	Follow-up Assessment
	Mean ± SD	Mean ± SD	Mean ± SD
Age, years	58 ± 7.6	58 ± 7.6	59 ± 7.5
Working/ Volunteering	50%	50%	75%
Medical			
Weight (kg)	68.4 ± 10.9	69.1 ± 12.7	70.1 ± 12.5
Body Mass Index (kgm^2)	25.4 ± 3.3	25.6 ± 3.8	25.8 ± 4.0
Sum of 5 skinfolds (mm)	98.7 ± 28.6	100.7 ± 30.0	111.0 ± 32.7
Months post treatment	6.4 ± 2.0	9.4 ± 2.0	12.4 ± 2.0

Table 1 - Demographics of participants at each assessment

Table 1 provides characterizes for each participant at baseline, post intervention and 3-month follow up.

Diagnosis	
Breast Cancer	75%
Colon Cancer	12.50%
Adnoid Cyctic Carcinoma	12.50%
Stage	
I	37.50%
II	25%
Unknown	37.50%
Treatment	
Surgery	87.50%
Radiation (RT)	87.50%
Chemotherapy (CT)	37.50%
Hormone Therapy (HT)	62.50%
Surgery Alone	1 out of 8
Surgery plus RT	6 out of 8
Surgery plus RT & CT	3 out of 8
Surgery plus RT, CT & HT	2 out of 8
Surgery plus RT & HT	3 out of 8

Table 2 - Baseline Demographics of participants

Table 2 provides information on the diagnosis, stage and type of treatment received by the participants.

Intervention

Assessment

	Pre - Assessment	Mid - Assessment	Post - Assessment	3-month Follow-up Assessment
Time of Assessment	1 week prior to exercise program	Midway through exercise intervention	Up to 1 week post exercise program	3-month following post exercise program
Eligibility to participate confirmed	✓			
Informed Consent Obtained	✓			
Interview Portion	✓		✓	✓
Pre-Test (Resting Heart Rate and Blood Pressure)	✓		✓	✓
Lymphedema measurement (both arms)	✓		✓	✓
Body Composition (CSEP® guidelines see Appendix C)	✓		✓	✓
Cardiovascular – YMCA cycle ergometer submaximal test	✓		✓	✓
Musculoskeletal testing (CSEP® guidelines)	✓		✓	✓
Questionnaires – SF-36, F.A.C.T., Fantastic lifestyle questionnaire, Healthy Physical Activity Participation, and Stages of Change	✓	✓	✓	✓

Table 3 - Outline of Assessments

Table 3 provides an outline of what testing occurred at each of the four assessments.

The above Table 3, Outline of Assessments, provides an overview of what occurred during each of the four assessments that the participants were asked to complete. For a full breakdown of each section of the assessment, interview

portion, cardiovascular testing, body composition and musculoskeletal testing, which followed the CSEP® guidelines, and copy of each questionnaire (Health and cancer related QOL, physical activity levels, lifestyle and stages of change) see Appendix C.

As shown above prior to the pre-assessment, eligibility to participate in the study was reviewed with the participant. In addition, the key aspects of the consent form were discussed with the participants, who were given ample time to review the consent form and asked any questions before providing their written informed consent.

The assessments consisted of an interview portion to obtain participants' diagnosis, stage and grade of cancer, treatment, medical history, concerns or issues, activities of daily living, functional limitations, barriers to physical activity and goals they would like to reach. Prior to any physical activity, the participants' resting heart rate and blood pressure were measured following the CSEP® cut off values. Participants that had the diagnosis of breast cancer had both limbs measured. Measurements were taken at four points; metacarpal-phalangeal joints, wrist, 10 cm distal to the lateral epicondyle, 15 cm proximal to the lateral epicondyle. Participants' body composition was evaluated through height, weight, waist circumference and skinfold measurement. They completed the YMCA cycle ergometer submaximal test to evaluate cardiovascular function. Testing of participants' muscular strength, endurance and flexibility was completed following the CSEP® guidelines. Test included; grip strength, push-ups, partial curl-ups, sit and reach, back extension test and predicted one repetition maximum (1RM) testing on the chest press and leg press machines. Finally participants completed

five questionnaires, Short Form 36 (Ware, 1993), Functional Assessment of Cancer Therapy (F.A.C.T) (FACIT, 2012), Health Physical Activity Participation Questionnaire (CSEP, 2003), Fantastic Lifestyle Checklist (CSEP, 2003) and Stages of Change (CSEP, 2003). For an expanded description of the assessment please see Appendix C.

During the pre-assessment participants were scheduled into their bi-weekly exercise session for the remainder of the eight-week exercise intervention (e.g. they would be participating in the Monday and Wednesday 5 – 6pm group). The post assessment was scheduled during the second last week of the exercise program, for one-week post intervention. Participants scheduled their three-month follow-up assessment during the post-assessment. At this time each participant was provided with an exercise guidebook developed by UOIT Faculty of Health Science Kintern student Brittany Lee, providing the participants with all of the exercises prescribed during the eight-week program. This guidebook included pictures and a description of each exercise. Finally the guidebook provided the participants with their final exercise session information including weights used, sets and repetitions of each exercise (see Appendix G).

Exercise Program

Individualized exercise program for each participant was prescribed based on the pre-assessment results. Although the exercise program was individualized, each program followed general guidelines set out by ACSM; cardiovascular exercise completed on the Monark® cycle ergometer at an intensity of 40% - 65% Heart Rate Reserve (HRR) and 10 resistance training

exercises started at an intensity of 40% - 70% one Repetition Maximum (1RM), adjustments to intensity occurred dependent on the equipment available, such as free weights and resistance tubing. The exercise program was eight weeks in length, with two exercise sessions per week. Participants completed the exercise program in small groups, up to five participants per session in the presence of a CEP and a Certified Personal Trainer CSEP® (CPT), who monitored exercises, technique, and provided motivation for the participants. The CEP followed up with each participant during the exercise session, on their previous session and any issues that may have arisen. The sessions took place on the UOIT campus in a Faculty of Health Science, Kinesiology Lab. Equipment used included free weights, resistance bands, Monark® cycle ergometers, stability balls, medicine balls and participants body weight.

During each exercise session participants completed a warm-up using the agility ladder prior to their prescribed aerobic and resistance exercises. As the participants progressed through the eight weeks, their individual exercise programs were modified and adjusted to prevent performance plateau. Progression of the exercises was done through a combination of increasing the time, number of repetitions, or resistance. Progression occurred through discussion between the exercise leader and participants during each exercise session to ensure they were completing the exercise correctly and adjustments were made as exercises became easier.

Statistics

Due to the small sample size of this study (N=8), non-parametric statistical testing was completed using Kruskal-Wallis test and the percent change between each assessment was evaluated.

Results

Although statistical significance was not observed in this study, trends in improved muscular strength and endurance, decreases in fatigue levels and clinical significance was identified. Percent change was completed on all pre-assessment to post-assessment, pre-assessment to three-month follow up assessment and post-assessment to three-month follow-up assessment. Standard deviation is not included in the figures due to the low sample size and high variation, however standard deviation is provided in text form.

Adherence

Throughout the eight-week intervention if participants missed a session, the session was rescheduled to the extent possible. There was a 96.8% adherence rate to attending sessions by the eight participants.

Physical Testing

Body Composition

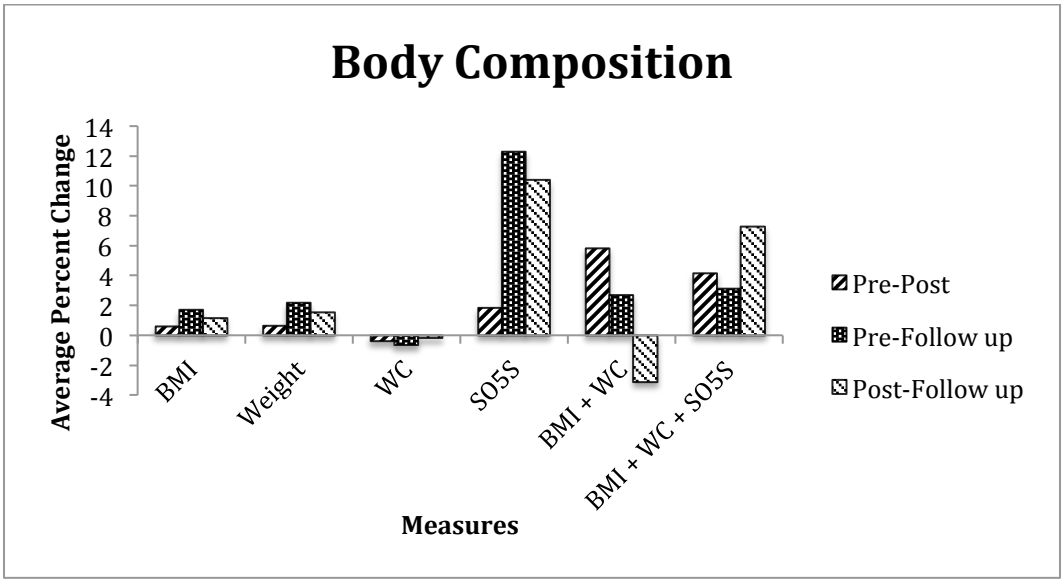


Figure 2 - Body Composition Average Percent Change

Figure 2 shows the average percent changes that occurred for body composition testing through comparisons of the assessment. No statistical significance or patterns were found within these results.

The average percent change of the Body Mass Index (BMI), weight, waist circumference (WC) and sum of 5 skinfold (SO5S) measurements indicate minimal change, during the exercise intervention and three-months post, as seen in Figure 2 (above). The percent change either positive or negative was minimal. However Healthy Body Composition scores of BMI + WC (5.83% ± 37.5) and BMI + WC + SO5S (4.16% ± 27.3) from pre-assessment to post-assessment time comparison indicates there was a positive change occurring in the participants' body composition Health Benefit Zones.

Cardiovascular

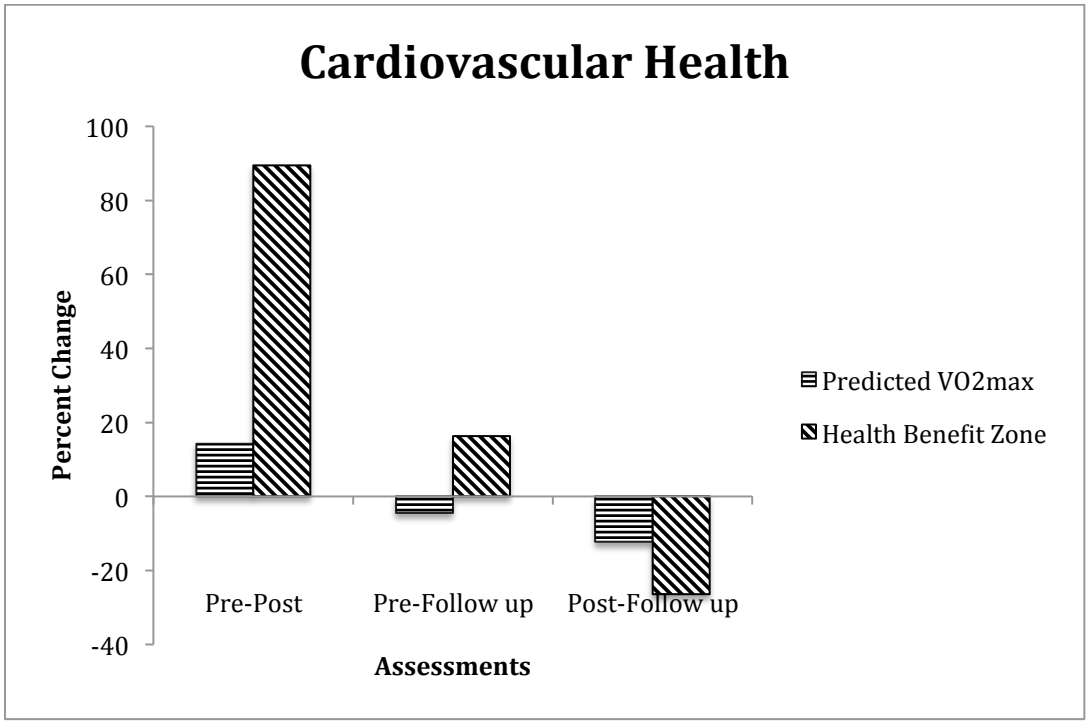


Figure 3 - Cardiovascular Percent Change

Figure 3 presents the average percent change that occurred for the Predicted VO_2max and health benefit zones for the participants through assessment comparisons. No statistical significance or patterns were seen.

The predicted $V0_2$max from the pre-assessment ranged from 26.9 ml/kg/min to 52.5ml/kg/min for the eight participants. For post assessment the range shifted to 31.5ml/kg/min to 49.16ml/kg/min. There was an average positive 14.3% ± 43.6 change from pre-assessment to post assessment comparison, indicating that there was an average improvement in cardiovascular function for the participants. The pre-assessment to follow-up assessment and the post assessment to follow-up assessment comparisons both show average negative percent change at 4.4% ± 34.7 and 12.3% ±20.4, respectively. The trend of improvement in predicted $V0_2$ max was also seen in participants' Health Benefit Zone (HBZ) as developed by CSEP, with an average positive percent change of 89% ± 179.8 at the pre-assessment to post-assessment time comparison. A decrease is also seen in average percent change at comparison of pre-assessment to follow-up assessment (16.3% ± 109.5), and post assessment to follow-up assessment (-26.5% ± 23.6) compared to pre-assessment to post assessment comparison. Again this indicated that there was a trend of improvement in cardiovascular function following the eight-week exercise intervention, however this improvement in cardiovascular function was not maintained during the three-months following the intervention, as seen in Figure 3 (above).

Musculoskeletal

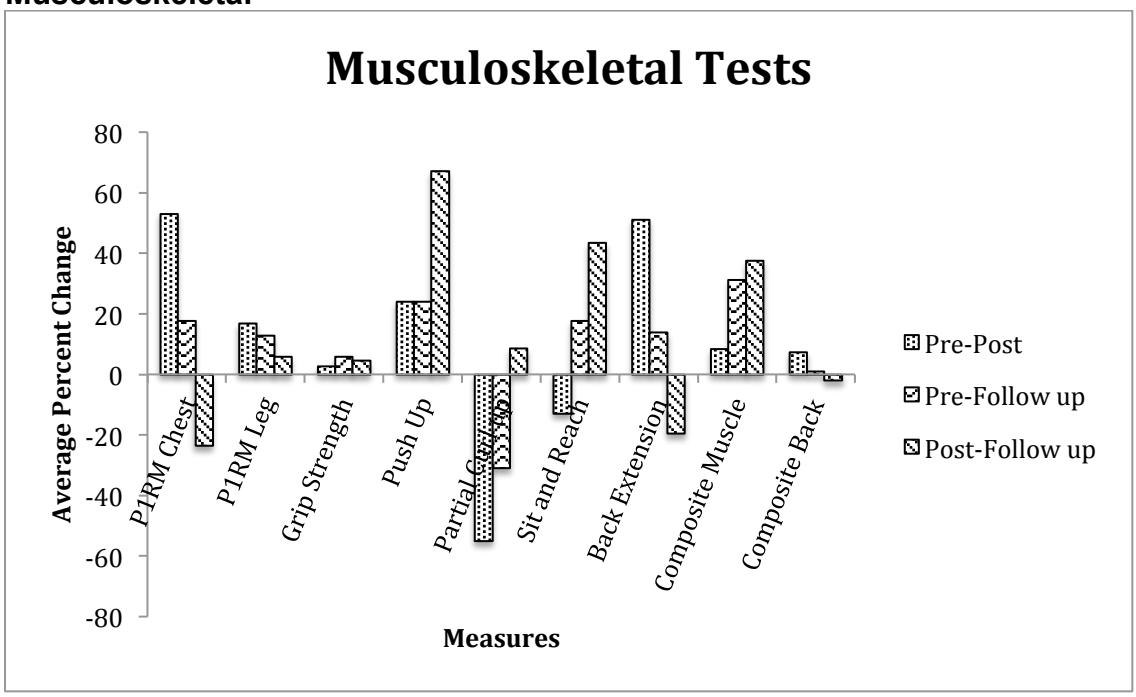


Figure 4 - Musculoskeletal Average Percent Change

Figure 4 provides a graphical representation of the average percent change that occurs for each of the musculoskeletal tests completed for the assessment comparisons. No statistical significance was found, however patterns of increases in upper body and lower body strength, and muscular endurance were seen.

Of the nine variables evaluated seven showed positive average percent change and two were negative. The greatest average percent change during the pre-assessment to post assessment comparison occurred with predicted one repetition maximum (RM) chest press, evaluating upper body muscular strength, with a 53% ± 38.9 positive change, indicating improvements in upper body strength. Compared to lower body strength, predicted 1 RM leg press, of average positive percent change of 16.7% ± 52.5 which when compared to upper body percent change is not as large of a change. However the trend of improvement in lower body strength was still seen. Both upper body and lower body, predicted 1 RM chest press and leg press respectively, show decreases in average percent change during pre-assessment to follow-up assessment and post assessment to

follow-up assessment comparisons in relation to the pre-assessment to post assessment average percent change value.

Grip strength, which indicates overall strength, had minimal positive average percent changes at all time comparisons, suggesting that no change occurred in grip strength during intervention or during three months following intervention.

The push-up test evaluates upper body endurance. Only seven of the eight participants completed the push-up test due to wrist issues. Over all of the assessment comparisons there was a positive average percent change. Pre-assessment to post assessment 23.9% ± 24.5, then 23.9% ± 53.8 and finally 67% ± 227 at the post assessment to follow-up assessment.

Partial curl up test used to assess participants' abdominal muscular endurance had only two participants able to fully complete the test during all assessments, with an additional two participants able to complete the full assessment during at least one assessment. The test allows for participants to complete the test to the best of their ability, using distance curled in cm and total number of curls at the distance they are able to curl. Only four participants were able to fully complete the test at least one of the assessment, which provides a negative average percent change of 55% ± 45.5 in the pre-assessment to post assessment comparison. However evaluating all participants, comparing distances and number of curl-ups completed, pre-assessment to post assessment half of the participants (four of eight) had improvements in their abdominal muscular endurance, one participant maintained their abdominal muscular endurance and three participants had a decrease in their abdominal

muscular endurance. At the post assessment to follow-up assessment comparison half of the participants increased, while the other half saw a decrease of their abdominal muscular endurance.

One of the two variables that had a negative average percent changed from pre-assessment to post assessment was the sit and reach, which measures lower body flexibility. Compared to other variables measured, the sit and reach moved from a negative average percent change from pre-assessment to post assessment at -12.7% ± 13.1, increasing to 15.2% ± 24.0 pre-assessment to follow-up assessment, then 39.4% ± 59.2 post assessment to follow-up assessment. This indicates that lower body flexibility decreased during the eight-week intervention and increased during the three-months following the intervention, where participants tended to have reduced physical activity.

For back extension, only seven participants were used for the average percent change, as one participant was only able to complete the 3 month follow-up assessment test due to low back issues during the previous assessments. The average percent change for the pre-assessment to post assessment comparison was 50% ± 68.3, with a slow decrease towards the follow-up assessment. Back extension tested the muscular endurance of the extensor muscles of the back, indicating that there was a trend of improved extensor muscle endurance following the exercise intervention, which slowly decreased following the exercise intervention.

The composite muscle score and composite back score developed by CSEP provides an overall score for the muscle and back. Composite muscle score had average positive percent change at all assessment comparisons,

however again like sit and reach, the lowest average percent change occurred at the pre-assessment to post assessment comparison (8.3% ± 56.5), then 31.3% ± 65.8, and finally 37.5% ± 48.4 at post assessment to follow-up assessment. These results suggest that there was a greater change occurring following the three-months after the exercise intervention then immediately post exercise intervention. The composite back score pre-assessment to post assessment had an average positive change of 7.3% ± 21.8. There was a decrease following the intervention; pre-assessment to follow-up assessment average percent change 1% ± 36.5, and post assessment to follow-up -2.1% ± 40.1 change.

Quality of Life Questionnaire testing

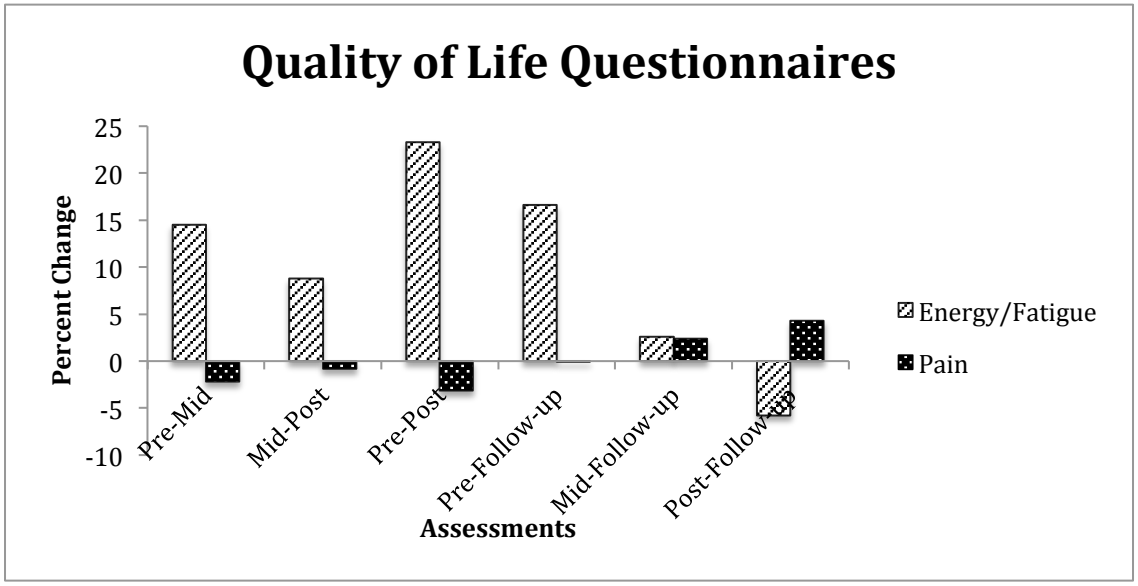


Figure 5 - SF-36 (Energy/Fatigue and Pain) Percent Change

Figure 5 displays two of the eight subcategories of the Short Form 36. The Energy/Fatigue subcategory shows patterns of improvements in energy levels following the exercise intervention, with no statistical significance found. The pain subcategory had no statistical significance or patterns found, however it is of interest to note that participants had minimal increase in pain levels during intervention and minimal decreases in pain levels after the intervention. A figure with all subcategories from the SF-36 can be found in Appendix H.

The questionnaires were completed four times throughout the study, pre-assessment, at the four-week point (half way) of exercise intervention, post

assessment and three-month follow-up assessment; there are six assessment comparisons evaluated.

Health Related QOL was evaluated using the Short Form 36 (SF-36) (Figure 5 (above)) and Functional Assessment of Cancer Treatment (F.A.C.T.) (Figure 6 (below)). SF-36 is broken down into eight subcategories; Physical Functioning, Role Limitations – Physical Health, Role Limitations – Emotional Problems, Energy/Fatigue, Emotional Well Being, Social Functioning, Pain and General Health.

Energy/Fatigue subcategory on average had the greatest average percent change over the assessment comparisons. Pre-assessment to post assessment Energy/Fatigue had the greatest percent change with 23.3% ± 34.1 change compared to a negative average percent change of -9.5% ± 38.6 for Role Limitation – Physical Health. The Energy/Fatigue subcategory percent change was in the top two positive percent change, except in the post assessment to follow-up assessment, among the subcategories. There was a decrease in Energy/Fatigue from post-assessment to three-month follow-up. The findings indicate that there was an improvement in energy or reduction in fatigue during the intervention, however following the three-months after the exercise intervention energy levels decreased or fatigue increased.

The pain subcategory, although minimal changes throughout all assessment comparisons, provides an interesting finding. All assessment comparisons except mid-exercise intervention assessment to follow-up assessment and post assessment to follow-up assessment, found there was a minimal negative average percent change, with a positive average percent

change occurring at comparisons mentioned above. This could indicate that during the intervention participants experienced additional pain, and had improvements in pain levels following the three months post intervention. However, since the amount of average percent change was minimal positive or negative, this suggests that no change was actually occurring.

The other six subcategories provide some change, however no subcategory has the same positive or negative average percent change as the Energy/Fatigue subcategory. Physical Functioning, Emotional Well Being and Social Functioning had the greatest percent change during the pre-assessment to post assessment comparison with the highest change at 6.9%. See results appendix (Appendix H) for a full figure of SF-36 subcategories average percent change and clinical significance word cloud.

The F.A.C.T. average percent change showed minimal positive and negative changes with the greatest positive change of 3.1% ± 4.6 and negative change of -2.7% ± 3.4, suggesting that minimal change occurred in disease related QOL.

The three additional questionnaires evaluated; Stages of Change, Fantastic Lifestyle Checklist and Healthy Physical Activity Participation Questionnaire (Figure 6 (below)) all had positive average percent change at the pre-assessment to post assessment comparison, however the Fantastic Lifestyle Checklist questionnaire's greatest percent change occurred Mid-assessment to three-month follow-up assessment comparison. A copy of the questionnaires used can be found in Appendix E.

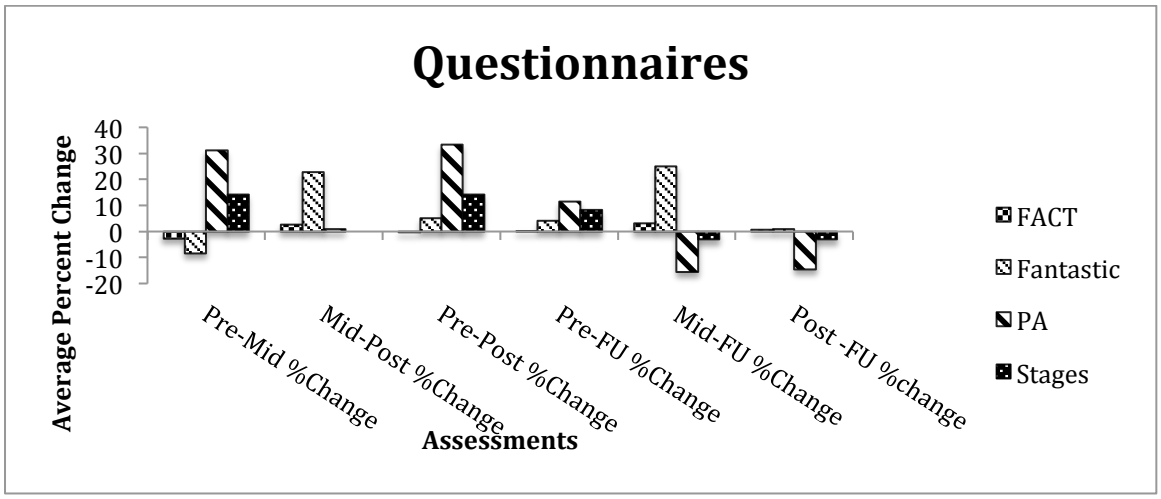


Figure 6 - Questionnaire Percent Change

Figure 6 provides an overview of the average percent change that occurred through the assessment comparisons for the Functional Assessment of Cancer Therapy (F.A.C.T), Fantastic Lifestyle Checklist, Health Physical Activity Participation Questionnaire, and Stage of Change Questionnaire. No statistical significance or patterns were found.

Participant Remarks

During each exercise session and the post-assessment participants were given an opportunity to provide comments on their experiences and feelings from the program. Participants commented on their improved balance, increases in energy levels and noticing they were feeling stronger. A list of all comments made can be found in Appendix I.

Discussion

Results in content

As it was hypothesized a combined personalized exercise eight-week training program for individual's post-cancer treatment suggests positive patterns of improvements in muscular strength, endurance and perceived QOL following the exercise intervention.

Similar to Courneya et al (2007) both studies identified trends of improvements in upper and lower body strength following a 17-week exercise intervention. This finding is in line with research conducted by De Backer (2007) and Ohira et al (2006), that identified improvements in strength after 8 to 12 weeks and six-months of exercise training, respectively. However, within this study, participants did not maintain their gains in strength at the three-month follow-up assessment, suggesting that the benefits experienced during the exercise intervention are only maintained with continued exercise.

Another trend identified within this study was a decrease in levels of fatigue and/or increase in energy levels. Along with results from questionnaires indicating changes in fatigue/energy levels, participants also verbally indicated noticing changes in their energy levels, throughout the intervention and during the post-assessment. Sprod et al (2010) also noticed a reduction in fatigue levels following both a three-month and six-month exercise intervention, suggesting that extended program length, beyond eight weeks, will further provide decreases in fatigue levels and/or improvements in energy levels. Again similar to the improvements in muscular strength, positive changes in fatigue/energy levels of

the participants were not maintained at the three-month follow-up assessment, suggesting that these benefits will also only be maintained with continued activity.

This current study provided participants with personalized exercise prescription to assist them in improving functional capacity and working towards their individual goals. Sprod et al (2010), compared to Courneya et al (2007), De Backer (2007) and Ohira et al (2006), was the only other study that completed personalized exercise prescription. Although similar improvements were seen across all of the studies noted, personalized exercise prescription during an eight-week or three- & six-month exercise intervention also provides benefits. This suggests that personalized exercise prescription will also provide improvements to this clinical population.

An interesting finding from this study was the improvements seen from pre-assessment to post assessment by the participants in the push-up test. Four of seven participants were able to complete the push-up test at pre-assessment, compared to the post assessment where seven out of seven participants were able to complete the test. One participant was unable to complete this test due to wrist issues. In addition to this improvement, all participants had positive changes in upper body strength (predicted 1 RM chest press) at the post assessment. What is interesting from these findings is that 75% of the sample population was diagnosed with breast cancer, and with this population changes to muscular strength, endurance and shoulder ROM could be affected from the disease and treatment. Although shoulder ROM was not measured in this study, and is a drawback from these findings, however these findings suggest improvements in

upper body strength and endurance, which can be an affected area within the breast cancer population.

Interesting findings

The most interesting and possibly most important finding of this study was that clinical significance occurred for the participants and was determined through improved physical functioning and perceived QOL. Clinical significance could imply many different aspects, however if there is a positive difference made in an individuals' daily activities, this should indicate clinical significance (Kazdin, 1999). Throughout the exercise intervention and at the post assessment, participants provided comments on how they felt following an exercise session and on the program as a whole. "Noticing more energy", "feel like I'm stronger", "feeling energized as (I) workout", "finding balance is increased" are among the remarks that participants provided. Additional comments can be found in Appendix I. These comments indicate that participants identified improvements in their strength, endurance, energy levels, and balance. Along with these improvements, participants enjoyed the group-training atmosphere and would have liked to continue on with this type of programing. The comments from the participants suggest that there was a positive change experienced, which affected their daily activities, indicating clinical significance occurred with the exercise intervention.

Strengths and Limitations

There are various limitations to this study such as the small sample size of eight participants and lack of control group, which may have reduced the ability to

detect statistical significance and limits our ability to interpret the results. Limited information can be obtained from average percent change experienced by the participants and also demographics of the sample size, as 3/4 of the participants had been diagnosed with breast cancer. Additional limitation includes the length of the intervention of eight weeks. Research has found benefits from exercise at the eight week mark, however from this study, it may prove to be too short of a time to obtain the full benefits of the program and engrain physical activity as a habit following intervention. The location and equipment used for the exercise sessions provided to emulate more of a home-gym atmosphere, as the program ran in a Kinesiology lab at UOIT and free weights, body weighted exercise, resistance bands and cycle ergometers were used. Although this provided participants with the understanding that physical activity can occur anywhere with limited equipment, it may not have fostered the correct motivation for continuation of physical activity, or for the participants to enter a gym setting. Review of the outcomes, using the YMCA cycle ergometer submaximal test may have provided more of a challenge and elicited local muscle fatigue, therefore affecting the outcome of the participants' cardiovascular results, compared to a walking or step test (Ebbeling single stage treadmill test or mCAFT). Additionally due to limited recruitment, this was a pre-post testing with no control group. Finally, the Principal Investigator (PI) was also the exercise leader that conducted all assessments, developed the personalized exercise programs, and supervised the exercise sessions, and additional unintentional bias could have influenced the outcomes of this study.

Although there are various limitations to this study, this is a pilot study that requires additional research. There are however great strengths to this study. The assessor and exercise leader was a Certified Exercise Physiologist (CEP) through CSEP, and Certified Kinesiologist. The participants received personalized exercise programs of both aerobic and resistance prescribed exercises. The prescribed exercise program was based on each participant's initial assessment physical testing results with a discussion of each participant's goals at an early stage. Along with the personalized exercise program, each exercise session was completed in a group exercise format, supervised by a CEP and CPT (Certified Personal Trainer through CSEP). Providing a group atmosphere for individuals to exercise, with other individuals dealing with similar issues allowed for additional social support to develop between group members. This was further confirmed by a participant's comment "good to be in a small group with others going through the same thing"; enjoyment of the group setting and being able to interact with peers. Finally providing supervision of the exercise program ensured that proper technique was being followed for exercises, especially if the exercises were new to the participant. It also ensured progression of the exercises to allow for greatest benefits to be received by the participant. Additionally having a supervised exercise program allowed the participant to be accountable for their physical activity to external individuals (other participants and exercise leader) and not just to themselves. Some participants found it difficult to be only accountable to themselves following the exercise intervention.

Implications

Although this current study did not provide statistical significance, trends and clinical significance were still experienced. For a clinical population such as cancer, clinical significance may be a better predictor of improvements, specifically in a functional capacity. Individuals with mixed cancer diagnosis, post cancer treatment will benefit from a personalized exercise intervention occurring within one year of treatment. Courneya et al (2003c) suggested that for breast cancer survivors, continued research needs to be completed on timing for implementation of an exercise intervention along the journey of cancer diagnosis to remission. However, research including this study, has shown that there are benefits of an exercise program post cancer treatment (Burnham & Wilcox, 2002; Campbell et al., 2005; Ohira et al., 2006; Schwartz et al., 2001).

Implications from this study suggest programming of exercise rehabilitation/therapy for individuals post cancer treatment should be developed in Ontario, specifically Durham Region area. Providing an individualized approach to exercise prescription allows the individual to work towards their goals, while still assisting them towards their physical functioning pre-diagnosis levels. Finally, the supervised group training atmosphere provides a safe, social support setting for this population, allowing not only improvements from the exercise prescribed, but the benefits of external motivation, accountability and enjoyment, allowing continued occurrence and participation of physical activity.

Conclusion

Positive patterns in reduction of fatigue, improved muscular strength and back extensor endurance following exercise intervention, and overall clinical significance, was seen following an eight-week personalized aerobic and resistance exercise program for individuals who are post cancer treatment.

Positive physical and QOL changes were experienced by participants, indicating clinical significance occurred within this study.

As mentioned, this is a pilot study and further research is needed specifically to confirm the results and reduce the limitations of this study. However, additional research is needed in general in the field of cancer and exercise rehabilitation. Program length, intensity of prescribed exercises, role of group dynamics during physical activity, heterogeneous versus homogenous group dynamics, exercise programs developed for specific cancer types or personalized exercise programs are factors which should be researched to provide a better understanding of what type of exercise program design will provide the most benefits for cancer survivors.

Summary Conclusion

This study provides an overview of the benefits of a personalized aerobic and resistance exercise program on individuals post cancer treatment. The benefits experienced include a reduction of fatigue levels, an increasing in physical functioning and an improvement in perceived QOL. This study, along with past and current research, should provide confidence in cancer health practitioners to recommend or refer their patients to become physically active or partake in an exercise program (Milne, 2008). This recommendation or referral should be to an exercise specialist, such as a Kinesiologist or Certified Exercise Physiologist, CSEP® with knowledge of the most appropriate exercise program for those living with illnesses. The hope is that cancer will be beaten in our lifetime, however individuals will still be diagnosed with cancer and experience side effects associated with the disease and treatment, therefore a nonpharmacological natural approach to reducing these side effects is necessary such as the comprehensive physical fitness program. A comprehensive physical fitness program developed by trained professionals is needed and should be a required step in treatment for this population.

Reference

Almeida, C.A., Barry, S. . (2010). *Cancer screening, detection, & diagnostic procedures & tests. Cancer - basic science and clinical aspects* (1st ed., p. 133). UK: Wiley-Blackwell.

American College of Sports Medicine. (2010). *ACSM's Guidelines for Exercise Testing and Prescription*. (L. S. Thompson, W.R., Gordon, N.F., Pescatello, Ed.) (8th ed.). Wolters Kluwer - Lippincott Williams & Wilkins.

Atlantis, E., Chow, C.-M., Kirby, A., & Singh, M. F. (2004). An effective exercise-based intervention for improving mental health and quality of life measures: a randomized controlled trial. *Preventive Medicine*, *39*(2), 424–34. doi:10.1016/j.ypmed.2004.02.007

Avis, N. E., Crawford, S., & Manuel, J. (2005). Quality of life among younger women with breast cancer. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *23*(15), 3322–30. doi:10.1200/JCO.2005.05.130

Barber, F. D. (2012). Social Support and Physical Activity Engagement by Cancer Survivors. *Clinical Journal of Oncology Nursing*, *16*(3), E84 – E98.

Beisecker, A., Cook, M. R., Ashworth, J., Hayes, J., Brecheisen, M., Helmig, L., Hyland, S., et al. (1997). Side effects of adjuvant chemotherapy: perceptions of node-negative breast cancer patients. *Psycho-Oncology*, *6*(2), 85–93. doi:10.1002/(SICI)1099-1611(199706)6:2<85::AID-PON247>3.0.CO;2-T

Bentzen, S. M. (2006). Preventing or reducing late side effects of radiation therapy: radiobiology meets molecular pathology. *Nature Reviews. Cancer*, *6*(9), 702–13. doi:10.1038/nrc1950

Bicego, D., Brown, K., Ruddick, M., Storey, D., Wong, C., & Harris, S. R. (2006). Exercise for women with or at risk for breast cancer-related lymphedema. *Physical Therapy*, *86*(10), 1398–405. doi:10.2522/ptj.20050328

Bicego, D., Brown, K., Ruddick, M., Storey, D., Wong, C., & Harris, S. R. (2009). Effects of exercise on quality of life in women living with breast cancer: a systematic review. *The Breast Journal*, *15*(1), 45–51. doi:10.1111/j.1524-4741.2008.00670.x

Boreham, C. a, Wallace, W. F., & Nevill, A. (2000). Training effects of accumulated daily stair-climbing exercise in previously sedentary young women. *Preventive Medicine*, *30*(4), 277–81. doi:10.1006/pmed.2000.0634

Brazier, E., Harper, R., Jones, N. M. B., Cathain, A. O., Thomas, K. J., Usherwood, T., & Westlake, L. (1992). Validating the SF-36 health survey questionnaire : new outcome measure for primary care. *British Medical Journal*, *305*(July), 160–164.

Burnham, T. R., & Wilcox, A. (2002). Effects of exercise on physiological and psychological variables in cancer survivors. *Medicine and Science in Sports and Exercise*, *34*(12), 1863–7. doi:10.1249/01.MSS.0000040995.26076.CC

Campbell, A., Mutrie, N., White, F., McGuire, F., & Kearney, N. (2005). A pilot study of a supervised group exercise programme as a rehabilitation treatment for women with breast cancer receiving adjuvant treatment. *European Journal of Oncology Nursing : the Official Journal of European Oncology Nursing Society*, *9*(1), 56–63. doi:10.1016/j.ejon.2004.03.007

Canadian Cancer Society. (2013). *Canadian Cancer Statistics Special topic : Liver cancer* (pp. 1–114). Toronto. Retrieved from cancer.ca/statistics

Canadian Cancer Society, Statistics Canada, ProvincialTerritorial Cancer Registries, P. H. A. of C. (2012). *Canadian Cancer Statistics 2012* (pp. 1–69). Toronto.

Cathrine Lauridsen, M., Overgaard, M., Overgaard, J., Hessov, I. B., & Cristiansen, P. (2008). Shoulder disability and late symptoms following surgery for early breast cancer. *Acta Oncologica*, *47*(4), 569–575. doi:10.1080/02841860801986627

Cella, D. (2000). Assessment methods for quality of life in cancer patients- the FACIT measurement system. *International Journal of Pharmaceutical Medicine*, *14*, 78–81.

Courneya, K S, Friedenreich, C. M., Quinney, H. a, Fields, a L. a, Jones, L. W., & Fairey, a S. (2003). A randomized trial of exercise and quality of life in colorectal cancer survivors. *European Journal of Cancer Care*, *12*(4), 347–57. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/14982314

Courneya, Kerry S, Friedenreich, C. M., Sela, R. a, Quinney, H. A., Rhodes, R. E., & Handman, M. (2003). The group psychotherapy and home-based physical exercise (group-hope) trial in cancer survivors: physical fitness and quality of life outcomes. *Psycho-Oncology*, *12*(4), 357–74. doi:10.1002/pon.658

Courneya, Kerry S, Mackey, J. R., Bell, G. J., Jones, L. W., Field, C. J., & Fairey, A. S. (2003). Randomized controlled trial of exercise training in postmenopausal breast cancer survivors: cardiopulmonary and quality of life

outcomes. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *21*(9), 1660–8. doi:10.1200/JCO.2003.04.093

Courneya, Kerry S, Segal, R. J., Mackey, J. R., Gelmon, K., Reid, R. D., Friedenreich, C. M., Ladha, A. B., et al. (2007). Effects of aerobic and resistance exercise in breast cancer patients receiving adjuvant chemotherapy: a multicenter randomized controlled trial. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *25*(28), 4396–404. doi:10.1200/JCO.2006.08.2024

CSEP. (2003). *The Canadian Physical Activity, Fitness & Lifestyle Approach* (3rd ed.).

De Backer, I C, Schep, G., Backx, F. J., Vreugdenhil, G., & Kuipers, H. (2009). Resistance training in cancer survivors: a systematic review. *International Journal of Sports Medicine*, *30*(10), 703–12. doi:10.1055/s-0029-1225330

De Backer, I C, Vreugdenhil, G., Nijziel, M. R., Kester, a D., Van Breda, E., & Schep, G. (2008). Long-term follow-up after cancer rehabilitation using high-intensity resistance training: persistent improvement of physical performance and quality of life. *British Journal of Cancer*, *99*(1), 30–6. doi:10.1038/sj.bjc.6604433

De Backer, Ingrid C, Van Breda, E., Vreugdenhil, A., Nijziel, M. R., Kester, A. D., & Schep, G. (2007). High-intensity strength training improves quality of life in cancer survivors. *Acta Oncologica (Stockholm, Sweden)*, *46*(8), 1143–51. doi:10.1080/02841860701418838

Dikken, C., & Sitzia, J. (1998). Patients' experiences of chemotherapy: side-effects associated with 5-fluorouracil + folinic acid in the treatment of colorectal cancer. *Journal of Clinical Nursing*, *7*(4), 371–9. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9830978

DiLorenzo, T. M., Bargman, E. P., Stucky-Ropp, R., Brassington, G. S., Frensch, P. a, & LaFontaine, T. (1999). Long-term effects of aerobic exercise on psychological outcomes. *Preventive Medicine*, *28*(1), 75–85. doi:10.1006/pmed.1998.0385

Dimeo, F. C., Thomas, F., Raabe-Menssen, C., Pröpper, F., & Mathias, M. (2004). Effect of aerobic exercise and relaxation training on fatigue and physical performance of cancer patients after surgery. A randomised controlled trial. *Supportive Care in Cancer : Official Journal of the Multinational Association of Supportive Care in Cancer*, *12*(11), 774–9. doi:10.1007/s00520-004-0676-4

FACIT. (2012). FACIT.org. Retrieved from http://www.facit.org/FACITOrg/Overview

Feyer, P., Kleeberg, U. R., Steingräber, M., Günther, W., & Behrens, M. (2008). Frequency of side effects in outpatient cancer care and their influence on patient satisfaction--a prospective survey using the PASQOC questionnaire. *Supportive Care in Cancer : Official Journal of the Multinational Association of Supportive Care in Cancer*, *16*(6), 567–75. doi:10.1007/s00520-008-0422-4

Floyd, A. & Moyer, A. (2009). Group vs. individual exercise interventions for women with breast cancer: a meta-analysis. *Health Psychology Review*, *4*(1), 22–41. doi:10.1080/17437190903384291.Group

Fong, D. Y. T., Ho, J. W. C., Hui, B. P. H., Lee, A. M., Macfarlane, D. J., Sharron, S. K., Cerin, E., et al. (2011). Physical activity for cancer survivors : meta-analysis of randomised controlled trials, (September), 1–14. doi:10.1136/bmj.e70

J.E., W. (1993). SF-36 Health Survey manual and interpretation guide. *Boston: The Health Institute, New England Medical Centre*.

Jones, a M., & Carter, H. (2000). The effect of endurance training on parameters of aerobic fitness. *Sports Medicine (Auckland, N.Z.)*, *29*(6), 373–86. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/10870864

Kazdin, A. . (1999). The Meanings and Measurement of Clinical Significance. *Journal of Consulting and Clinical Psychology*, *67*(3), 332–339.

King, a C., Taylor, C. B., & Haskell, W. L. (1993, July). Effects of differing intensities and formats of 12 months of exercise training on psychological outcomes in older adults. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association*. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/8404803

Kolden, G. G., Strauman, T. J., Ward, A., Kuta, J., Woods, T. E., Schneider, K. L., Heerey, E., et al. (2002). A pilot study of group exercise training (GET) for women with primary breast cancer: feasibility and health benefits. *Psycho-Oncology*, *11*(5), 447–56. doi:10.1002/pon.591

Kraemer, W. J., & Ratamess, N. a. (2004). Fundamentals of Resistance Training: Progression and Exercise Prescription. *Medicine & Science in Sports & Exercise*, *36*(4), 674–688. doi:10.1249/01.MSS.0000121945.36635.61

LeMura, L.M., & von Duvillard, S. P. (2004). *Clinical exercise physiology - applications and physciological principles* (1st ed., p. 389). Lippincott Williams & Wilkins.

McCann, I. L., & Holmes, D. S. (1984). Influence of aerobic exercise on depression. *Journal of Personality and Social Psychology*, *46*(5), 1142–7. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/6737208

McGowan, E. L., Speed-Andrews, A. E., Rhodes, R. E., Blanchard, C. M., Culos-Reed, S. N., Friedenreich, C. M., & Courneya, K. S. (2013). Sport participation in colorectal cancer survivors: an unexplored approach to promoting physical activity. *Supportive Care in Cancer : Official Journal of the Multinational Association of Supportive Care in Cancer*, *21*(1), 139–47. doi:10.1007/s00520-012-1501-0

Mcneely, M. L., Campbell, K. L., Rowe, B. H., Klassen, T. P., Mackey, J. R., & Courneya, K. S. (2006). a systematic review and meta-analysis.

Milne, H. M., Wallman, K. E., Gordon, S., & Courneya, K. S. (2008). Effects of a combined aerobic and resistance exercise program in breast cancer survivors: a randomized controlled trial. *Breast Cancer Research and Treatment*, *108*(2), 279–88. doi:10.1007/s10549-007-9602-z

Myers, R. S., & Roth, D. L. (1997, May). Perceived benefits of and barriers to exercise and stage of exercise adoption in young adults. *Health psychology : official journal of the Division of Health Psychology, American Psychological Association*. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/9152707

Ohira, T., Schmitz, K. H., Ahmed, R. L., & Yee, D. (2006). Effects of weight training on quality of life in recent breast cancer survivors: the Weight Training for Breast Cancer Survivors (WTBS) study. *Cancer*, *106*(9), 2076–83. doi:10.1002/cncr.21829

Okuyama, T., Akechi, T., Kugaya, A., Okamura, H., Imoto, S., Nakano, T., Mikami, I., Hosaka, T., Uchitmoi, Y. (2000). Factors correlated with fatigue in disease-free breast cancer patients : application of the Cancer Fatigue Scale. *Support Care Cancer*, *8*, 215–222. doi:10.1007/s005209900114

Oldervoll, L. M., Kaasa, S., Knobel, H., & Loge, J. H. (2003). Exercise reduces fatigue in chronic fatigued Hodgkins disease survivors--results from a pilot study. *European Journal of Cancer (Oxford, England : 1990)*, *39*(1), 57–63. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12504659

Ontario, C. C. (2012). Cancer Care Ontario Cancer Statistics. Retrieved July 28, 2013, from

https://www.cancercare.on.ca/cms/One.aspx?portalId=1377&pageId=8630#two-tab

Pardee, A.B. & Stein, G. S. (2009). *The biology and treatment of cancer*. (G. S. Pardee, A.B., Stein, Ed.). Hoboken, New Jersey: Wiley-Blackwell.

Passos, G. S., Poyares, D., Santana, M. G., D'Aurea, C. V. R., Youngstedt, S. D., Tufik, S., & De Mello, M. T. (2011). Effects of moderate aerobic exercise training on chronic primary insomnia. *Sleep Medicine*, *12*(10), 1018–27. doi:10.1016/j.sleep.2011.02.007

Pinto, B. M., Clark, M. M., Maruyama, N. C., & Feder, S. I. (2003). Psychological and fitness changes associated with exercise participation among women with breast cancer. *Psycho-Oncology*, *12*(2), 118–26. doi:10.1002/pon.618

Pinto, B. M., Frierson, G. M., Rabin, C., Trunzo, J. J., & Marcus, B. H. (2005). Home-based physical activity intervention for breast cancer patients. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *23*(15), 3577–87. doi:10.1200/JCO.2005.03.080

Portenoy, R. K., Thaler, H. T., Kornblith, a B., Lepore, J. M., Friedlander-Klar, H., Coyle, N., Smart-Curley, T., et al. (1994, June). Symptom prevalence, characteristics and distress in a cancer population. *Quality of life research : an international journal of quality of life aspects of treatment, care and rehabilitation*. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/7920492

Rodes, R. E., & Courneya, K. S. (2003). Investigating multiple components of attitude , subjective norm , and ... *British Journal of Social Psychology*, *42*, 129–146.

Ryan, J. L., Carroll, J. K., Ryan, E. P., Mustian, K. M., Fiscella, K., & Morrow, G. R. (2007). Mechanisms of cancer-related fatigue. *The Oncologist*, *12 Suppl 1*, 22–34. doi:10.1634/theoncologist.12-S1-22

Sagen, A., Kåresen, R., & Risberg, M. A. (2009). Physical activity for the affected limb and arm lymphedema after breast cancer surgery. A prospective, randomized controlled trial with two years follow-up. *Acta Oncologica (Stockholm, Sweden)*, *48*(8), 1102–10. doi:10.3109/02841860903061683

Schmitz, K. H., Ahmed, R. L., Troxel, A. B., Cheville, A., Lewis-Grant, L., Smith, R., Bryan, C. J., et al. (2010). Weight lifting for women at risk for breast cancer-related lymphedema: a randomized trial. *JAMA : the Journal of the American Medical Association*, *304*(24), 2699–705. doi:10.1001/jama.2010.1837

Schmitz, K. H., Holtzman, J., Courneya, K. S., Ma, L. C., Duval, S., & Kane, R. (2005). Controlled Physical Activity Trials in Cancer Survivors : A Systematic Review and Meta-analysis Controlled Physical Activity Trials in Cancer Survivors : A Systematic Review and Meta-analysis, 1588–1595.

Schneider, C. M., Dennehy, C. a, Roozeboom, M., & Carter, S. D. (2002). A model program: exercise intervention for cancer rehabilitation. *Integrative Cancer Therapies*, *1*(1), 76–82; discussion 82. doi:10.1177/1534735402001001006

Schwartz, A. L., Mori, M., Gao, R., Nail, L. M., & King, M. E. (2001). Exercise reduces daily fatigue in women with breast cancer receiving chemotherapy. *Medicine & Science in Sports & Exercise*, *33*(5), 718–723.

Segal, R. J., Reid, R. D., Courneya, K. S., Malone, S. C., Parliament, M. B., Scott, C. G., Venner, P. M., et al. (2003). Resistance exercise in men receiving androgen deprivation therapy for prostate cancer. *Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology*, *21*(9), 1653–9. doi:10.1200/JCO.2003.09.534

Speck, R. M., Courneya, K. S., Mâsse, L. C., Duval, S., & Schmitz, K. H. (2010). An update of controlled physical activity trials in cancer survivors: a systematic review and meta-analysis. *Journal of Cancer Survivorship : Research and Practice*, *4*(2), 87–100. doi:10.1007/s11764-009-0110-5

Speed-Andrews, a E., Rhodes, R. E., Blanchard, C. M., Culos-Reed, S. N., Friedenreich, C. M., Belanger, L. J., & Courneya, K. S. (2012). Medical, demographic and social cognitive correlates of physical activity in a population-based sample of colorectal cancer survivors. *European Journal of Cancer Care*, *21*(2), 187–96. doi:10.1111/j.1365-2354.2011.01290.x

Spichiger, E., Müller-Fröhlich, C., Denhaerynck, K., Stoll, H., Hantikainen, V., & Dodd, M. (2011). Prevalence of symptoms, with a focus on fatigue, and changes of symptoms over three months in outpatients receiving cancer chemotherapy. *Swiss Medical Weekly*, *141*(November), w13303. doi:10.4414/smw.2011.13303

Sprod, L. K., Hayward, R., & Schneider, C. M. (2010). Three versus six months of exercise training in breast cancer survivors. *Breast Cancer Research and Treatment*, *121*(2), 413–419. doi:10.1007/s10549-010-0913-0.Three

Tasmuthl, T. (1996). Pain and other symptoms during the first year after radical and conservative surgery for breast cancer, *2031*(March), 2024–2031.

Wagner, L. I., & Cella, D. (2004). Fatigue and cancer: causes, prevalence and treatment approaches. *British Journal of Cancer*, 822–828. doi:10.1038/sj.bjc.6602012

Yamagishi, A., Morita, T., Miyashita, M., & Kimura, F. (2009). Symptom prevalence and longitudinal follow-up in cancer outpatients receiving chemotherapy. *Journal of Pain and Symptom Management*, *37*(5), 823–30. doi:10.1016/j.jpainsymman.2008.04.015

Appendices

Appendix A

POSSIBLE BENEFITS

Improvements in:
- Cardiovascular functioning
- Muscular strength
- Self-esteem
- Flexibility

Decreases in:
- Fatigue
- Anxiety

POSSIBLE RISKS

Physical risks with exercise:
- Muscle strain/sprain
- Joint pain or discomfort
- Increased muscle soreness after an exercise session

Psychological
- Discouragement
- Embarrassment

Social
- Privacy

Cancer related risks with exercise:
- Lumphedema

CONTACT INFORMATION

Below are three ways to contact, if you are interested in participating or have any questions:

1) Meagan O'Neill - 905-447-7205
If you recieve Voice Mail please provide your name, number and best time for return call.

2) Meagan O'Neill - Meagan.O'Neill@uoit.ca
In your e-mail please provide your name, number, and the best time for you to be reached.

3) Meredith Shaw - Hearth Place
Provide Meredith with your name, number and best time for you to be reached.

UOIT UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

CANCER AND EXERCISE REHABILITATION STUDY

HEARTH PLACE Cancer Support Centre

STUDY PURPOSE

To determine whether an eight week combined aerobic and resistance exercise training program will improve overall physical functioning and quality of life of individuals following cancer treatment (surgery, chemotherapy, radiation, or a combination)

Background Cancer and Exercise

Through research exercise has been shown to help reduce some side effects associated with cancer and its treatment.

Benefits have been seen in improving muscular strength, cardiovascular functioning, self-esteem; as well as improving quality of life, through decreasing fatigue, anxiety and depression.

Research has been completed through aerobic only, resistance only and combined aerobic and resistance exercise training.

This current study will use combined aerobic and resistance exercise training during the eight week intervention

Study approved by UOIT Research Ethics Board File # 12-007. Ethics Compliance officer: compliance@uoit.ca or Tel: 905 721 8668 ext. 3693

Research Study

Location

Assessment and Exercise session will be located at UOIT, in the Science Building and Campus Recreation and Wellness Centre.

2000 Simcoe St. N. Oshawa, ON

Parking

There will be free access to parking during assessment and exercise sessions.

Timeline of Study

Middle of Sept – Middle of Oct:
Participant Recruitment

Middle of Oct:
Initial Assessment

Middle of Oct – Middle of Dec:
Eight week exercise intervention, two sessions per week

Nov:
Half way Questionnaire assessment

Middle of Dec: Final assessment

Participation

Who can participate?

Individuals who have been diagnosed with a solid tumor, 2 - 12 months post treatment, and are not pregnant.

What does participation entail?

Participating in this research study will be through two assessments consisting of both physical testing and questionnaires, as well as a half way questionnaire assessment. Also you will participate in an eight week individualized exercise program.

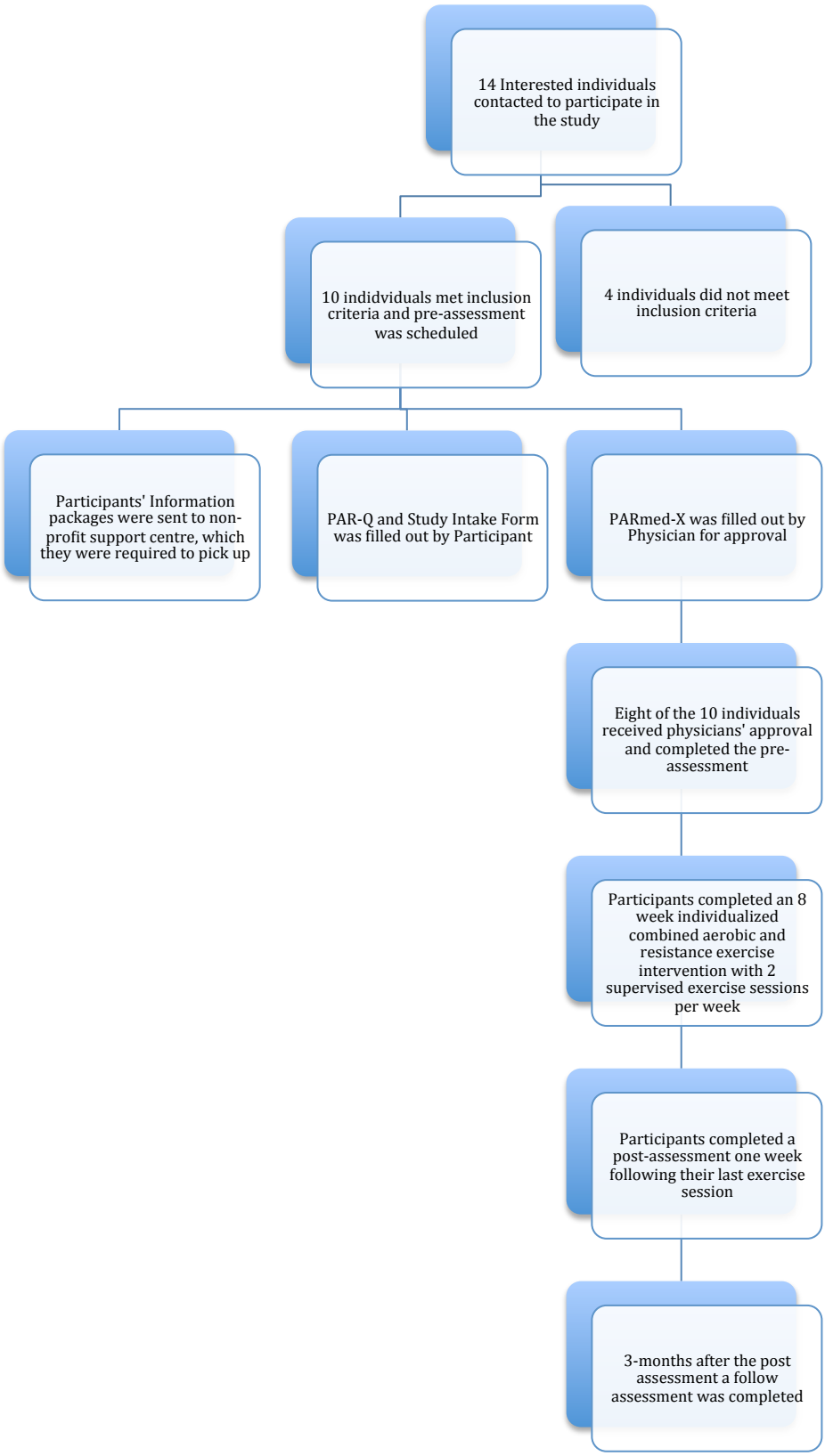
What do I receive from participating?

Participants will receive an individualized eight week exercise prescription from a Certified Exercise Physiologist.

Overall benefits of research

Additional research within the field of Cancer and Exercise Rehabilitation will assist with evidence based results

Appendix B


14 Interested individuals contacted to participate in the study
10 indidviduals met inclusion criteria and pre-assessment was scheduled
4 individuals did not meet inclusion criteria
Participants' Information packages were sent to non-profit support centre, which they were required to pick up
PAR-Q and Study Intake Form was filled out by Participant
PARmed-X was filled out by Physician for approval
Eight of the 10 individuals received physicians' approval and completed the pre-assessment
Participants completed an 8 week individualized combined aerobic and resistance exercise intervention with 2 supervised exercise sessions per week
Participants completed a post-assessment one week following their last exercise session
3-months after the post assessment a follow assessment was completed

Appendix C

Assessments

Interview

During the interview portion of the pre-, post-, and three-month follow-up assessments, information obtained from the participant included: diagnosis, stage and grade of cancer, treatment of the disease, any recent scans and outcomes, medical history, as well as any current concerns or issues. Finally information was obtained on activities of daily living, current and past exercise habits, any subjective functional limitations that would prevent them from being active, physically or during their daily lives, as well as goals the participant might have or barriers that have prevented them from achieving their goals and being physically active in the past. During the post and follow-up assessment, participants were asked about their additional activities of daily living.

Pre-test

Following the interview portion, the participant's resting heart rate and blood pressure were measured. For resting heart rate if the measurement from the 15 second test was 100 beats per minute (bpm) or greater, the participant was seated for 5 minutes and the resting heart rate was re-measured; if it was under 100 bpm (the cut off value) the assessment continued. Resting blood pressure was measured, if the systolic blood pressure was ≥144 mmHg or diastolic blood pressure was ≥94 mmHg (the cut off values), the participant rested for 5 minutes and the measurement was retaken. If it was below the cut-offs noted above, the assessment continued. If a participant had been diagnosed with breast cancer, lymphedema measurements of both affected limbs (arms)

were taken at four points; metacarpal-phalangeal joints, wrist, 10 cm distal to the lateral epicondyle, 15 cm proximal to the lateral epicondyle. The pre-assessment measurements were used as a baseline for each individual participant (CSEP, 2003).

Body Composition

During the body composition portion of the pre-, post-, and three-month follow-up assessments each participant's height was measured to the nearest 0.5 cm and weight to the nearest 0.1 kg, this was used to calculate the participant's body mass index (BMI = weight(kg)/height(cm)^2). Their waist circumference and skinfold measurement were taken: Waist circumference was measured to the nearest 0.5 cm. Skinfold measurements occurred at 5 locations; triceps, biceps, subscapular, iliac crest, and medial calf. The skinfold measurements were taken with Harpenden calipers and recorded to the nearest 0.2 mm. The measurements from the body composition were used to find the composite score and provide a baseline for each participant. At each assessment the same measurement tools were used (CSEP, 2003).

Cardiovascular

YMCA Cycle Ergometer Submaximal test

The cardiovascular testing was completed via the YMCA cycle ergometer submaximal test. This test consisted of a 3-4 minute warm-up at 0.5 kp (50 watts), throughout the cardiovascular test the heart rate was measured at the end of each minute. During the warm-up stage if the heart rate reached a steady state (heart rate ≤5 bpm) in the final two minutes, the steady state heart rate was

used to determine the resistance loading sequence for the subsequent workloads of the test as outlined in the YMCA cycle ergometer test (see end of Appendix D). If during the remaining workload(s) the heart rate reached a steady state, the resistance was adjusted to the subsequent workload until the participant reached within ten beats of their 85% predicted HR max. 85% predicted HR max was determined by finding the participant's age predicted HR max (220-age) and multiplying the value by 0.85%. Once the participant had reached their submaximal heart rate, within 10 beats of their 85% predicted max HR the test was complete. The resistance was lowered for the active recovery phase, which ranged from 2-5 minutes. Following the active recovery the participant's heart rate and blood pressure was measured at minutes 1, 3 and 5 (CSEP, 2003).

Musculoskeletal

The cardiovascular test was also a warm-up for the musculoskeletal testing. The following are the tests completed for the musculoskeletal section of the pre-, post- and three-month follow up assessments.

Grip Strength

Grip strength was assessed using a hand dynamometer to determine the upper-body strength of the participants. The hand dynamometer was adjusted to fit each participant so that the 2nd joint of the fingers fit under the handle and could hold the weight. Participants were instructed to hold the hand dynamometer with a straight arm with hand away from thigh, dial of dynamometer away from the body and to maximally squeeze the hand dynamometer. This was

done twice, alternating between both hands with measurements rounded to the nearest kilogram (CSEP, 2003).

Push-ups

Next, the participant completed the push-ups test, evaluating upper body muscle endurance. If any participant answered yes to having back issues this test was not completed. Participants were asked to complete their maximum number of push-ups consecutively with no time limit. Participants' start position was prone with legs together, hands under shoulders with fingers pointing forward. All participants were female so they completed this test from their knees with their toes maintaining contact with the ground. They had to push up from the mat to fully extended arms, and then return to starting position – chin to mat. As mentioned previously, participants had to complete the push-ups consecutively, any incorrect repetition was not counted and the test was stopped after two consecutive repetitions with incorrect technique. Participants were allowed one to two practice repetitions (CSEP, 2003).

Partial Curl up

The partial curl up test evaluated abdominal muscle endurance. The participant laid on a mat with their knees bent to 90°, with two taped lines 10 cm apart on the mat. Participants started with fingertips touching the first taped line and curled up using abdominal musculature to touch the second taped line. The participant was required to keep their feet on the ground and hands on the mat. Participants had to move to the beat of a metronome set at 50 beats per minute. With the first beat, they curled up to the second tapeline and the following beat

then returned to the start position and repeated until the test was terminated. This was a timed test of one minute; with a maximum of 25 curl ups for this test. To ensure proper technique, the participants returned their shoulder blades and head to the mat at the end of each curl up. If the participant was experiencing any discomfort, unable to maintain the cadence, or had improper technique on two consecutive repetitions, the test was terminated before the minute was up (CSEP, 2003).

Flexibility

To test the flexibility of the participants hamstrings and lower back, they completed a sit and reach test. Participants completed modified hurdle stretch twice on both legs for 20 seconds prior to completing the test. A flexometer was used to measure flexibility. The participant sat with legs straight, no shoes on and feet flat against the flexometer; their feet 6 inches apart. The participant placed their hands, one on top of the other. Keeping their knees extended, the participant bent forward pushing the slider forward and holding for 2 seconds at their farthest point. The movement was to be smooth with no jerky movements or the trial would not be counted. This was done twice and the maximum value was recorded. The measurement was recorded to 0.5 cm (CSEP, 2003).

Back Extension

Prior to the back endurance test, the participants completed a pre-test to ensure they did not experience pain/discomfort in the low back. The pre-test consisted of having the participant lie prone on a mat, they performed a single straight leg extension with both right and left leg, then leg extension left and right

with opposite arm. If there was any discomfort or pain in the participant's low back, the test was terminated. Equipment used to complete this test consisted of a step used for mCAFT test, mat and straps used to secure the participant's legs. The participant lay prone on the step with iliac crest positioned at the edge of the step, initially they supported their upper body weight with their hands. Straps were placed at middle of the calf and middle of the thigh and additional pressure on the back on their legs was provided if asked. To start the test, the participant raised their arms off the ground and crossed them over their chest. The participant was instructed to maintain the horizontal position of their body by contraction of their abdominals for as long as possible up to a maximum time of 180 seconds. During the test, they were not allowed any rotation or lateral shifting. This test allowed for one warning of incorrect technique and re-positioning. The total number of seconds was recorded. After the test was completed the participant recovered by lying on their back and bringing their knees to their chest to relax their back muscles, this was done for one minute (CSEP, 2003).

Health Benefit Zone

Health Benefit Zone was developed by the CSEP as a way to interpret results of the testing to individuals based on the health benefits associated with their results. Health Benefit Zone range from Needs Improvement, Fair, Good, Very Good and Excellent. With the higher zone indicating the individual has more health benefits from their results and the lower zones the individual has more health risks from their zones. Each test or fitness component Health Benefit

Zones indicate what level of benefit or risk their score is associated with and additional information on ways to improve the rating (CSEP, 2003).

Predicted One Repetition Maximum (1RM)

The final strength testing was a predicted one-repetition maximum, which was a submaximal strength test. This evaluated upper body strength and lower body strength. Participants warmed up on the weight machine, either chest press or leg press depending on which test was being conducted, using a light weight completing 10 repetitions with proper technique. If the participant was able to complete the warm-up stage completely with this weight after a minute of rest, the weight was increased. Participants again attempted 10 repetitions with correct form. If the participant was able to complete 6-10 repetitions and would not have been able to complete an additional repetition with correct form, then it was deemed they had completed the test. If however, they felt that they would be able to complete an additional repetition another attempt was completed until the participant was unable to complete a full 10 repetitions. Once the participant had completed 6-10 repetitions maximum, the number of repetitions and the weight lifted was used to predict the one Repetition Maximum, using the chart found in Appendix F and calculation (weight/%1RM).

Questionnaires

Short Form 36 (SF-36)

The Short Form 36 questionnaire is a health related QOL questionnaire, that evaluates QOL through eight subcategories; physical functioning, social functioning, role limitations – physical problems, role limitations – emotional problems, emotional well-being, pain, general health and energy/fatigue. This provides subjective health related QOL by the individual completing the questionnaire (Brazier et al., 1992).

Functional Assessment of Cancer Therapy

The Functional Assessment of Cancer Therapy (FACT) is a disease related QOL measurement. This questionnaire looks at four dimensions of health within the one questionnaire; physical, social, emotional and functional well-being (Cella, 2000).

Stages of Change

Questionnaire used to evaluate the individual's readiness to change their physical activity levels(CSEP, 2003).

Healthy Physical Activity Participation Questionnaire

A questionnaire used to evaluate an individuals health benefits from their physical activity level. The questionnaire evaluates three areas of physical activity; frequency, intensity and perceived fitness. With higher scoring of the questionnaire the individual is obtaining more health benefits from their physical activity levels, with lower scores their physical activity levels may be associated

with health risks. This is evaluated from the Health Benefit Zones developed by CSEP previously discussed (CSEP, 2003).

Fantastic Lifestyle Checklist

This is another questionnaire that is used to evaluate health benefits, through evaluation of the individual's attitudes and lifestyle habits. Having the individual subjectively answer questions on their habits and attitudes on family, nutrition, and stress to name a few, provides another factor to the health benefits of the participants. Again this questionnaire is evaluated with the Health Benefit Zones (CSEP, 2003).

Appendix D

Assessment Form

Assessment

Date:_____

Pre ☐ Mid-point (questionnaire only) ☐ Post ☐

Participant # ___

Name of Assessor: _____

Gender: M ☐ F ☐ Par-Q: Approved Y / N Parmed-X: Approved Y / N
F.A.C.T: Completed Y / N SF-36: Completed Y / N Healthy Physical Activity Participation: Score Rating
Fantastic Lifestyle Checklist: Score Rating Physical Activity Stages of Change Assessment: Completed Y / N

Diagnosis: _____ Stage: _____ Grade: _____
Age: _____

History of Current Condition:

_____
_____
_____
_____
_____
_____
_____
_____

Treatment:

_____
_____

Scans:

_____
_____

Medical History: (review intake form)

_____
_____
_____
__

Current Pain, how long, due to disease?

_____
_____

Employment (present and Past):

_____

_____

Daily Activities (work/home/leisure):

_____

_

Functional Limitations:_____

_____

Eating and Lifestyle habits:

_____

_____

Exercise:

Have you previously been a member at a fitness facility? Yes or No

Do you exercise regularly? Yes or No

What do you do?

_____

_____

Light Moderate Vigorous

Goals:

1)_____

_____

2)_____

_____

3)_____

_____

4)_____

_____

Barriers that previously prevented you from exercising, or barriers you feel will prevent you now:

1)_____

_____

2)_____

_____

3)_____

_____

Any other information you feel is relevant but you have yet to shared:

Resting Heart Rate and Blood Pressure

Heart Rate: _____ (15 sec) _____bpm
Blood Pressure: Systolic _____mmHG Diastolic _____mmHG

Continue on with Assessment: Yes ☐ Wait 5 minutes and retake ☐

Heart Rate: _____bpm Ok ☐

Blood Pressure: Systolic _____mmHG Ok ☐
Diastolic _____ mmHG Ok ☐

If Diagnosed with Breast Cancer:

Arm Measurements (centimeters) Affected side: Left or Right

Arm	MCPs	Wrist	10cm Below Lat. Epicondyle	15 cm Above Lat. Epicondyle
Right				
Left				

Body Composition

Height: _____feet &inches _____ cm (nearest 0.5 cm)
Weight: _____lbs _____kg (nearest 0.1kg)

BMI: _____kg/m^2

Waist Circumference _____ cm (nearest 0.5cm) Rating _____

Skinfold measurements (mm) (nearest 0.2mm, If greater than 0.4mm complete 3rd measurement)

Site	1st Measurement	2nd Measurement	3rd Measurement	Mean
Triceps				
Biceps				

Site	1st Measurement	2nd Measurement	3rd Measurement	Mean
Subscapular				
Iliac Crest				
Medial Calf				

Sum of 5 skinfolds: _____

Health Body Composition scores

	Score	Rating
BMI + WC + SO5S		
BMI + WC		

Cardiovascular Assessment

☐ Ebbeling Single-Stage Treadmill walking test Predicted VO_2 max _____

☐ YMCA Cycle Ergometer test Predicted VO_2 max _____

Musculoskeletal Fitness

Grip Strength (kg)
Right Hand 1_____ 2_____ Max _____ Combined Right and Left Max _____ Rating _____
Left Hand 1_____ 2_____ Max _____

Push-ups **Any low back issues: Yes or No**

Max number _____ Rating: _____

Partial Curl-Up (max 25)
Total number _____ Rating _____

Sit & Reach (cm) (complete stretching before – 20 sec 2x/leg, Hold test for 2sec, shoes off)
Trial 1 _____ Trial 2 _____
Max _____ Rating_____

Back Extension Pre-test complete: Yes or No, Continue with test: Yes or No
(max 180 sec) _____sec Rating _____

Predicted 1-RM

Predicted 1-RM exercise	wt (lbs or kg)	# of Reps	Predicted 1-RM
Bench Press			
Leg Press			

Composite musculoskeletal fitness
Age: _____yr Gender: Male or Female

Appraisal Items	Measurement	Rating	Weighted Score	Maximum Attainable Weighted Scores	
				Male	Female
Grip Strength (kg)				8	8
Push-ups (#)				8	4
Sit & Reach (cm)				4	8
Partial Curlups (#)				4	4
Leg Power (W)	--	--	--	4	4
Back Extension(s)				4	4

Total Maximum Attainable Weighted Score: ..... /32 /32
Total Weighted Score Achieved: ..... _____
Composite Musculoskeletal Fitness Score: _____ (out of 4)
Composite Musculoskeletal Fitness Rating:
NI F G VG E

Composite back fitness

Age: _____yr Gender: Male or Female

Appraisal Items	Measurement	Rating	Weighted Score	Maximum Attainable Weighted Scores	
				Male	Female
P.A. Participation				8	8
Waist Circumference (cm)				4	8
Sit & Reach (cm)				4	4
Partial Curlups (#)				4	4
Back Extension(s)				8	8

Total Maximum Attainable Weighted Score: ..... /28 /28

Total Weighted Score Achieved: ..... _____

Composite Musculoskeletal Fitness Score: _____ (out of 4)

Composite Musculoskeletal Fitness Rating:

NI F G VG E

Tool #16b **YMCA CYCLE ERGOMETER TEST**

Data Collection Form

Name:		**Date:**	
Resting HR:	bpm	**Resting BP:**	mmHg
Age: yrs	**Gender** M or F	**Body Mass:**	kg
85% predicted HR max (-10 bpm):	bpm	**Seat Height:**	

Time (min)		Resistance (kg or watts)	Cadence (rpm)	HR (bpm)	RPE
First Workload	1				
	2				
	3				
	4*				
Second Workload	1				
	2				
	3				
	4*				
Third Workload	1				
	2				
	3				
	4*				
Fourth Workload	1				
	2				
	3				
	4*				
Recovery** (reduce resistance)	1				
	2				
	3				
	4				
	5				

*4th minute for each workload only required if HR during 2nd and 3rd minute are not at steady state (within 5 bpm)
** An active recovery period of 2-5 minutes should immediately follow this test. Once client has completed the active recovery, then proceed to post-test HR and BP measurements. These can be taken in the seated position.

Post-Test Measurements

Time (min)	HR (bpm)	BP (mmHg)
1		
3		
5		

Equation to Predict VO_2max for YMCA Cycle Ergometer Test

1. **Determine power output for each workload using ACSM Metabolic Equation for Cycle Ergometry:**
   - *1 W = 6 kpm•min^{-1}*
   - *1 kg = 2.2 lbs*
   - *SM_1 = sub-maximal VO_2 at second-last workload*
   - *SM_2 = sub-maximal VO_2 at last workload*

$$VO_2 = \left(\frac{Workload\ (W)}{Body\ mass\ (kg)} \times 10.8\right) + 3.5 + 3.5$$

$$SM_1 = \left(\frac{\quad}{\quad} \times 10.8\right) + 3.5 + 3.5$$

$$= \_\_\_\_\_$$

$$SM_2 = \left(\frac{\quad}{\quad} \times 10.8\right) + 3.5 + 3.5$$

$$= \_\_\_\_\_$$

2. **Determine slope of the line of best fit using Multi-Stage Slope Prediction:**

$$b = \frac{SM_2 - SM_1}{HR_2 - HR_1}$$

$$= \frac{\_\_\_\_\_ - \_\_\_\_\_}{\_\_\_\_\_ - \_\_\_\_\_}$$

$$= \_\_\_\_\_$$

3. **Determine VO_2max**

VO_2max = SM_2 + [*b* x (HRmax - HR_2)]

= _____ + [_____ x (_____ - _____)]

Aerobic Fitness Score

= 10 x VO_2max

= 10 x _____ mL•kg^{-1}•min^{-1}

= _____

CPAFLA Health Benefit Zone: (See CPAFLA Figure 7-12)

- ❑ Excellent
- ❑ Very Good
- ❑ Good
- ❑ Fair
- ❑ Needs Improvement

Appendix E

Assessment Questionnaires

Fantastic Lifestyle Questionnaire

INSTRUCTIONS: Unless otherwise specified, place an 'X' beside the box which best describes your behaviour or situation in the past month. Explanations of questions and scoring are provided on the next page.

FAMILY FRIENDS	I have someone to talk to about things that are important to me	almost never		seldom		some of the time		fairly often		almost always
	I give and receive affection	almost never		seldom		some of the time		fairly often		almost always
ACTIVITY	I am vigorously active for at least 30 minutes per day e.g., running, cycling, etc.	less than once/week		1-2 times/week		3 times/week		4 times/week		5 or more times/week
	I am moderately active (gardening, climbing stairs, walking, housework)	less than once/week		1-2 times/week		3 times/week		4 times/week		5 or more times/week
NUTRITION	I eat a balanced diet (see explanation)	almost never		seldom		some of the time		fairly often		almost always
	I often eat excess 1) sugar, or 2) salt, or 3) animal fats, or 4) junk foods.	four of these		three of these		two of these		one of these		none of these
	I am within ____kg of my healthy weight	not within 8 kg		8 kg (20 lbs)		6 kg (15 lbs)		4 kg (10 lbs)		2 kg (5 lbs)
TOBACCO TOXICS	I smoke tobacco	more than 10 times/week		1 - 10 times/week		none in the past 6 months		none in the past year		none in the past 5 years
	I use drugs such as marijuana, cocaine	sometimes								never
	I overuse prescribed or 'over the counter' drugs	almost daily		fairly often		only occasionally		almost never		never
	I drink caffeine-containing coffee, tea, or cola	more than 10/day		7-10/day		3-6/day		1-2/day		never
ALCOHOL	My average alcohol intake per week is (see explanation)	more than 20 drinks		13-20 drinks		11-12 drinks		8-10 drinks		0-7 drinks
	I drink more than four drinks on an occasion	almost daily		fairly often		only occasionally		almost never		never
	I drive after drinking	sometimes								never
SLEEP SEATBELTS STRESS SAFE SEX	I sleep well and feel rested	almost never		seldom		some of the time		fairly often		almost always
	I use seatbelts	never		seldom		some of the time		most of the time		always
	I am able to cope with the stresses in my life	almost never		seldom		some of the time		fairly often		almost always
	I relax and enjoy leisure time	almost never		seldom		some of the time		fairly often		almost always
	I practice safe sex (see explanation)	almost never		seldom		some of the time		fairly often		always
TYPE of behaviour	I seem to be in a hurry	almost always		fairly often		some of the time		seldom		almost never
	I feel angry or hostile	almost always		fairly often		some of the time		seldom		almost never
INSIGHT	I am a positive or optimistic thinker	almost never		seldom		some of the time		fairly often		almost always
	I feel tense or uptight	almost always		fairly often		some of the time		seldom		almost never
	I feel sad or depressed	almost always		fairly often		some of the time		seldom		almost never
CAREER	I am satisfied with my job or role	almost never		seldom		some of the time		fairly often		almost always

STEP 1 Total the X's in each column → ☐ ☐ ☐ ☐ ☐

STEP 2 Multiply the totals by the numbers indicated (write your answer in the box below) → 0 × 1 × 2 × 3 × 4

STEP 3 Add your scores across the bottom for your grand total → ☐ + ☐ + ☐ + ☐ = ☐ **Grand total** (see explanation)

Adapted with permission from the "Fantastic Lifestyle Assessment" ©1985 Dr. Douglas Wilson, Department of Family Medicine, McMaster University, Hamilton, Ontario, Canada L8N 3Z5

▼ A BALANCED DIET:

According to Canada's Food Guide to Healthy Eating (for people four years and over):

Different People Need Different Amounts of Food

The amount of food you need every day from the 4 food groups and other foods depends on your age, body size, activity level, whether you are male or female and if your are pregnant or breast feeding. That's why the Food Guide gives a lower and higher number of servings for each food group. For example, young children can choose the lower number of servings, while male teenagers can select the higher number. Most other people can choose servings somewhere in between.

Grain Products	Vegetables & Fruit	Milk Products	Meat & Alternatives	Other Foods
Choose whole grain and enriched products more often.	Choose dark green and orange vegetables more often.	Choose lower fat milk products more often.	Choose leaner meats, poultry and fish, as well as dried peas, beans and lentils more often.	Taste and enjoyment can also come from other foods and beverages that are not part of the 4 food groups. Some of these are higher in fat or calories, so use these foods in moderation.
recommended number of servings per day:				
5-12	5-10	Children 4-8 years: 2-3 Youth 10-16 years: 3-4 Adults: 2-4 Pregnant and breast-feeding women: 3-4	2-3	

▼ ALCOHOL INTAKE:

1 drink equals:

		Canadian	Metric	U.S.
1 bottle of beer	5% alcohol	12 oz.	340.8 ml	10 oz.
1 glass wine	12% alcohol	5 oz.	142 ml	4.5 oz
1 shot spirits	40% alcohol	1.5 oz	42.6 ml	1.25 oz.

▼ SAFE SEX:

Refers to the use of methods of preventing infection or conception.

WHAT DOES THE SCORE MEAN?

85-100	70-84	55-69	35-54	0-34
EXCELLENT	VERY GOOD	GOOD	FAIR	NEEDS IMPROVEMENT

NOTE: A low total score does not mean that you have failed. There is always the chance to change your lifestyle — starting now. Look at the areas where you scored a 0 or 1 and decide which areas you want to work on first.

TIPS:

1. Don't try to change all the areas at once. This will be too overwhelming for you.
2. Writing down your proposed changes and your overall goal will help you to succeed.
3. Make changes in small steps towards the overall goal.
4. Enlist the help of a friend to make similar changes and/or to support you in your attempts.
5. Congratulate yourself for achieving each step. Give yourself appropriate rewards.
6. Ask your physical activity professional (CSEP-Professional Fitness and Lifestyle Consultant), family physician, nurse or health department for more information on any of these areas.

Healthy Physical Activity Questionnaire

DETERMINING THE HEALTH BENEFITS OF YOUR PHYSICAL ACTIVITY PARTICIPATION IS AS EASY AS A, B, C ...

A. Answer the following questions:

#1 Frequency

Over a typical seven-day period (one week), how many times do you engage in physical activity that is sufficiently prolonged and intense to cause sweating and a rapid heart beat?

- ☐ At least three times
- ☐ Normally once or twice
- ☐ Rarely or never

#2 Intensity

When you engage in physical activity, do you have the impression that you:

- ☐ Make an intense effort
- ☐ Make a moderate effort
- ☐ Make a light effort

#3 Perceived Fitness

In a general fashion, would you say that your current physical fitness is:

- ☐ Very Good
- ☐ Good
- ☐ Average
- ☐ Poor
- ☐ Very Poor

B. Circle your score for each answer and total your score.

Scoring of Questionnaire Responses

Item	Male	Female	Male	Female	Male	Female
#1 Frequency	Rarely or never		Normally once or twice		At least three times	
	0	0	2	3	3	5
#2 Intensity	Light effort		Moderate effort		Intense effort	
	0	0	1	2	3	3
#3 Perceived Fitness	Very Poor or Poor		Average		Good or Very Good	
	0	0	3	1	5	3

Total Score = _____

C. Determine your health benefit rating based on your score from B.

Health Benefit Zone	Total Score
Excellent	9–11
Very Good	6–8
Good	4–5
Fair	1–3
Needs Improvement	0

Stages of Change Questionnaire

STAGES OF CHANGE QUESTIONNAIRE

Physical activity can include such activities as walking, cycling, swimming, climbing the stairs, dancing, active gardening, walking to work, aerobics, sports, etc. Regular physical activity is 30 minutes of moderate activity accumulated over the day, almost every day OR … vigorous activity done at least three times per week for 20 minutes each time.

1. Here are a number of statements describing various levels of physical activity. Please select the one which most closely describes your own level:

(Please tick one)

I am not physically active and I do not plan on becoming so in the next six months.	☐ 1
I am not physically active, but I have been thinking about becoming so in the next six months.	☐ 2
I am physically active once in a while, but not regularly.	☐ 3
I am currently physically active, but have only begun doing so within the last six months.	☐ 4
I participate in regular physical activity and have done so for more than six months.	☐ 5

2. (Answer if not currently active)

I was physically active in the past, but not now. ☐ YES ☐ NO

Functional Assessment of Cancer Therapy (F.A.C.T)

Below is a list of statements that other people with your illness have said are important**. Please circle or mark one number per line to indicate your response as it applies to the <u>past 7 days</u>.**

	<u>PHYSICAL WELL-BEING</u>	**Not at all**	**A little bit**	**Some -what**	**Quite a bit**	**Very much**
GP1	I have a lack of energy	0	1	2	3	4
GP2	I have nausea	0	1	2	3	4
GP3	Because of my physical condition, I have trouble meeting the needs of my family	0	1	2	3	4
GP4	I have pain	0	1	2	3	4
GP5	I am bothered by side effects of treatment	0	1	2	3	4
GP6	I feel ill	0	1	2	3	4
GP7	I am forced to spend time in bed	0	1	2	3	4

	<u>SOCIAL/FAMILY WELL-BEING</u>	**Not at all**	**A little bit**	**Some -what**	**Quite a bit**	**Very much**
GS1	I feel close to my friends	0	1	2	3	4
GS2	I get emotional support from my family	0	1	2	3	4
GS3	I get support from my friends	0	1	2	3	4
GS4	My family has accepted my illness	0	1	2	3	4
GS5	I am satisfied with family communication about my illness	0	1	2	3	4
GS6	I feel close to my partner (or the person who is my main support)	0	1	2	3	4

Q1	*Regardless of your current level of sexual activity, please answer the following question. If you prefer not to answer it, please mark this box* ☐ *and go to the next section.*					
GS7	I am satisfied with my sex life	0	1	2	3	4

Please circle or mark one number per line to indicate your response as it applies to the <u>past 7 days</u>.

	<u>EMOTIONAL WELL-BEING</u>	**Not at all**	**A little bit**	**Some -what**	**Quite a bit**	**Very much**
GE1	I feel sad	0	1	2	3	4
GE2	I am satisfied with how I am coping with my illness	0	1	2	3	4
GE3	I am losing hope in the fight against my illness	0	1	2	3	4
GE4	I feel nervous	0	1	2	3	4
GE5	I worry about dying	0	1	2	3	4
GE6	I worry that my condition will get worse	0	1	2	3	4

	<u>FUNCTIONAL WELL-BEING</u>	**Not at all**	**A little bit**	**Some -what**	**Quite a bit**	**Very much**
GF1	I am able to work (include work at home)	0	1	2	3	4
GF2	My work (include work at home) is fulfilling	0	1	2	3	4
GF3	I am able to enjoy life	0	1	2	3	4
GF4	I have accepted my illness	0	1	2	3	4
GF5	I am sleeping well	0	1	2	3	4
GF6	I am enjoying the things I usually do for fun	0	1	2	3	4
GF7	I am content with the quality of my life right now	0	1	2	3	4

Short Form 36 (SF-36)

SF-36(tm) Health Survey

Instructions for completing the questionnaire: Please answer every question. Some questions may look like others, but each one is different. Please take the time to read and answer each question carefully by filling in the bubble that best represents your response.

Patient Name: _____

SSN#: _____ Date: _____

Person helping to complete this form: _____

1. In general, would you say your health is:

- ☐ Excellent
- ☐ Very good
- ☐ Good
- ☐ Fair
- ☐ Poor

2. Compared to one year ago, how would you rate your health in general now?

- ☐ Much better now than a year ago
- ☐ Somewhat better now than a year ago
- ☐ About the same as one year ago
- ☐ Somewhat worse now than one year ago
- ☐ Much worse now than one year ago

3. The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

a. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

b. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

c. Lifting or carrying groceries.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

d. Climbing several flights of stairs.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

e. Climbing one flight of stairs.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

f. Bending, kneeling or stooping.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

g. Walking more than one mile.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

h. Walking several blocks.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

i. Walking one block.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

j. Bathing or dressing yourself.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all.

4. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

a. Cut down the amount of time you spent on work or other activities?
☐ Yes ☐ No

b. Accomplished less than you would like?
☐ Yes ☐ No

c. Were limited in the kind of work or other activities
☐ Yes ☐ No

d. Had difficulty performing the work or other activities (for example, it took extra time)
☐ Yes ☐ No

5. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

a. Cut down the amount of time you spent on work or other activities?
☐ Yes ☐ No

b. Accomplished less than you would like
☐ Yes ☐ No

c. Didn't do work or other activities as carefully as usual
☐ Yes ☐ No

6. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?
- ☐ Not at all
- ☐ Slightly
- ☐ Moderately
- ☐ Quite a bit
- ☐ Extremely

7. How much bodily pain have you had during the past 4 weeks?
- ☐ Not at all
- ☐ Slightly
- ☐ Moderately
- ☐ Quite a bit
- ☐ Extremely

8. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

- ☐ Not at all
- ☐ Slightly
- ☐ Moderately
- ☐ Quite a bit
- ☐ Extremely

9. These questions are about how you feel and how things have been with you during the past 4 weeks. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the past 4 weeks.

a. did you feel full of pep?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

b. have you been a very nervous person?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

c. have you felt so down in the dumps nothing could cheer you up?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

d. have you felt calm and peaceful?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

e. did you have a lot of energy?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

f. have you felt downhearted and blue?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

g. did you feel worn out?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

h. have you been a happy person?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

i. did you feel tired?
- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

10. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting friends, relatives, etc.)?
- ☐ All of the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

11. How TRUE or FALSE is each of the following statements for you?

a. I seem to get sick a little easier than other people
- ☐ Definitely true
- ☐ Mostly true
- ☐ Don't know
- ☐ Mostly false
- ☐ Definitely false

b. I am as healthy as anybody I know
- ☐ Definitely true
- ☐ Mostly true
- ☐ Don't know
- ☐ Mostly false
- ☐ Definitely false

c. I expect my health to get worse
- ☐ Definitely true
- ☐ Mostly true
- ☐ Don't know
- ☐ Mostly false
- ☐ Definitely false

d. My health is excellent
- ☐ Definitely true
- ☐ Mostly true
- ☐ Don't know
- ☐ Mostly false
- ☐ Definitely false

Appendix F

Predicted 1-RM

Predicted 1-RM Exercise	Weight (lbs or kg)	# of Reps	Predicted 1-RM
Flat Bench Press			
Inlined Leg Press			
Preacher Barbell Curl			

Table 6.12 Average Number of Repetitions and %1-RM Values

Repetitions	%1-RM[a]
1	100
2	95
3	93
4	90
5	87
6	85
7	83
8	80
9	77
10	75

[a]These values may vary slightly for different muscle groups and ages.

Data from Baechle, Earle, and Wathen 2000.

Example: If your client was performing a predicted 1-RM on the bench press and was able to lift 100lbs for 6 reps, their predicted 1-RM would be: (100 lbs/0.85) = 118lbs

NOTE: Use the number of reps completed from the predictive test and look on the table above to determine the %1-RM to use in your calculation. I.e. 6 reps = 85% or 0.85 in the calculation.

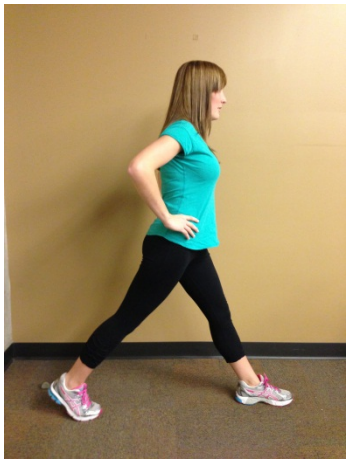
Appendix G

Exercise Guidebook
Completed by Brittany Lee – Kintern student

Squats

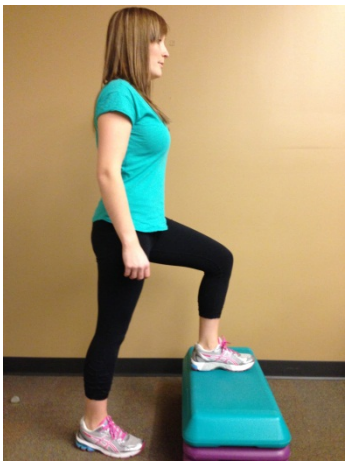
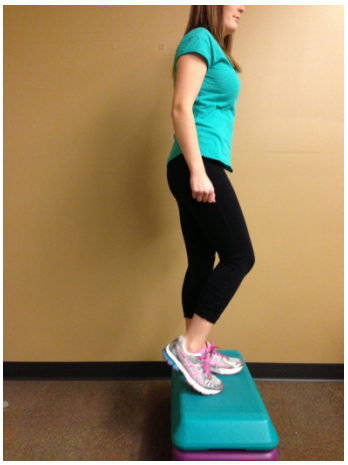

Technique: Stand with feet hip width apart. As you inhale sit back into a seated position until your knees are 90 degrees while maintaining a straight back. As you return to starting position push your weight up through your heels.
Primary muscles used: Quadriceps, Gluteus medius and maximus

Lunges



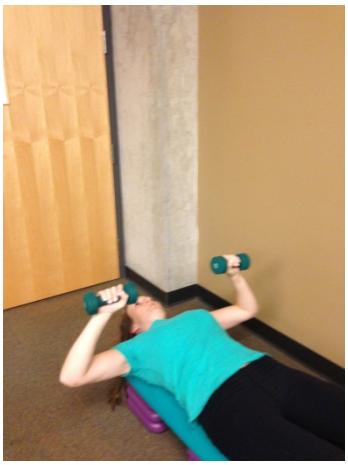
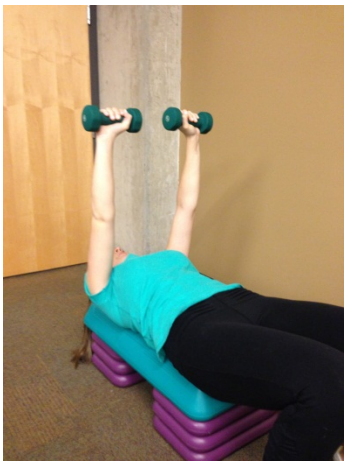

Technique: Begin standing with legs slightly apart. Inhale and take a big step forwards while maintaining an upright torso. Drop your back knee to the ground until both legs are at 90 degree angles while still maintaining an upright torso. As you return to start position push your weight up through the heel of the foot in front.
Primary muscles used: Quadriceps, Gluteus maximus

Step Ups

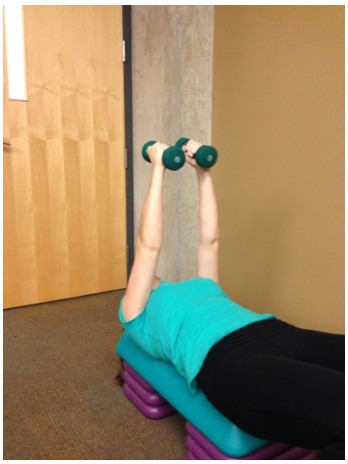
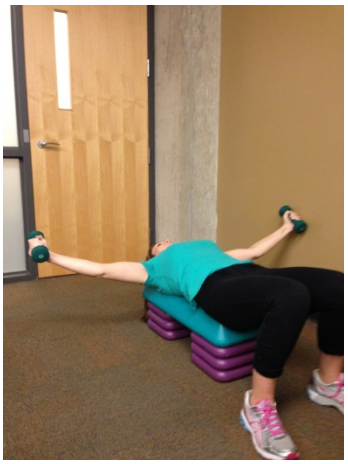



Technique: Begin with the left foot on the step. Push up through the left heel to bring your right foot to the top of the step. *Avoid bouncing off of the right foot to lift yourself up; the effort should be in the left leg quadricep muscles*. Tap the right foot and return to starting position. Repeat on the right leg.
Primary muscles used: Quadriceps, Hamstrings, Gluteus maximus

Dumbbell Chest Press

Technique: Ensure your shoulders and hips are supported on a bench. If using an exercise ball, ensure the shoulders are supported on the ball and the hips are held high, parallel to the ground. In starting position, palms are facing forwards and elbows at 90 degree angle. As you exhale, push the dumbbells straight up over the chest. Inhale as you return to start position.
Primary muscles used: Pectoralis major, Anterior Deltoid, Triceps
Dumbbell Chest Fly

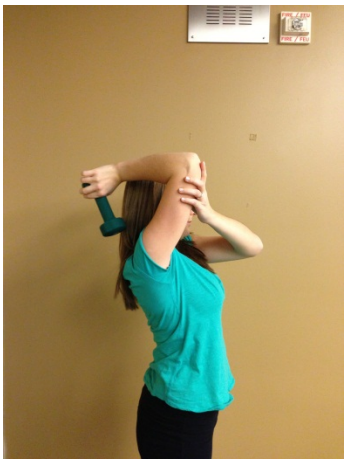



Technique: Begin in starting position with palms facing towards each other and arms extended straight up above the chest. As you inhale open the arms to horizontal above the floor. Exhale as you bring your arms together back to starting position.
Primary muscles used: Pectoralis major

Lying Dumbbell Tricep Extensions


Technique: Ensure shoulders and hips are supported on a flat bench. Begin with arms vertical above the chest while holding a single dumbbell with both hands, palms facing the ceiling. Inhale as you lower your forearms towards your forehead. Exhale as you extend your arm back to starting position.
Primary muscles used: Triceps brachii, Aconeus

Overhead Dumbbell Tricep Extension

Technique: Stand with a slight bend in the knees. In starting position hold a dumbbell with the arm extended vertically. Using your other arm to guide the movement, inhale as you lower the arm holding the dumbbell behind the head. Exhale as you extend your arm to return to starting position.
Primary muscles used: Triceps brachii, Aconeus

Tricep Kickbacks


Technique: Stand with feet hip width apart and knees slightly bent. Bend forwards at the hips while maintaining a straight torso, hold your upper arms in line with the angle of your back and elbows flexed. Holding a dumbbell in each hand with your palms facing towards each other, extend your arms behind you in a "kickback" motion.
Primary muscles used: Triceps Brachii, Aconeus

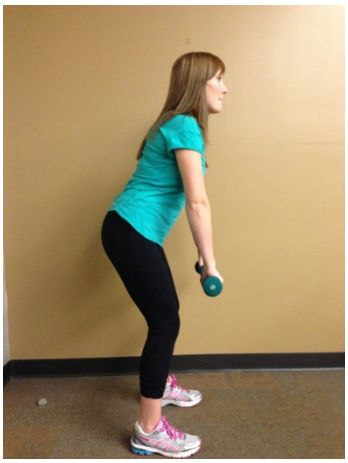
Bicep Curls


Technique: Stand with feet slightly apart and a slight bend in the knees. Holding a dumbbell in each hand with palms facing forwards, inhale and flex your arms and lift your forearms up towards your shoulders. Exhale as you lower your arms back to starting position.
Primary muscles used: Biceps brachii, Brachialis, Brachioradialis, Anterir deltoid

Hammer Curls


Technique: Stand with feet slightly apart and a slight bend in the knees. Holding a dumbbell in each hand with palms facing inwards towards the body, inhale and flex your arms to lift your forearms towards your shoulders. Exhale as you lower your arms back to starting position.
Primary muscles used: Biceps brachii, Brachialis, Brachioradialis

Bent-Over Dumbbell Row

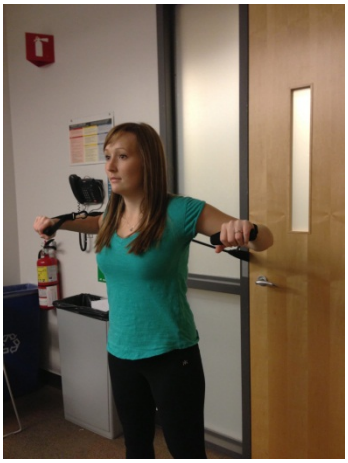



Technique: Stand with feet hip width apart, knees bent, and torso bent forwards at the hips while maintaining a straight back. Hang your arms by your sides with a dumbbell in each hand with palms facing your body. Inhale and contract your core, while pulling the dumbbells into your abdomen keep your elbows tucked into your body and focus on squeezing your shoulder blades together. Exhale as your lower your arms back to starting position.
Primary muscles used: Posterior Deltoid, Trapezius, Infraspinatus, Rhomboid, Teres minor, Teres Major, Latissimus Dorsi, Erector Spinae

Back Row with Therabands

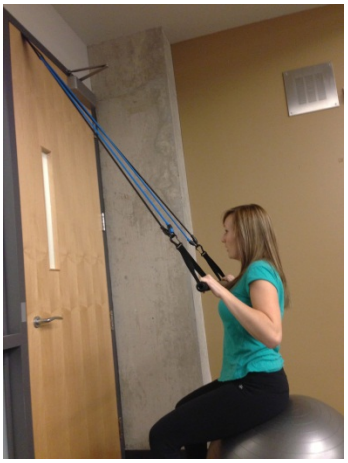

Technique: Using an exercise ball, sit with feet flat on the floor, hip width apart, and maintain an upright torso. Begin with arms extended in front of the body, hands holding the therabands with palms facing inward towards each other. Inhale, contract the core, and pull your elbows back as far as you can, focusing on squeezing your shoulder blades together. As you exhale, extend your arms back to starting position in a controlled manner.
Primary muscles used: Posterior deltoid, Trapezius, Rhomboid, Teres major, Latissimus dorsi, Erector Spinae

Chest Press with Therabands



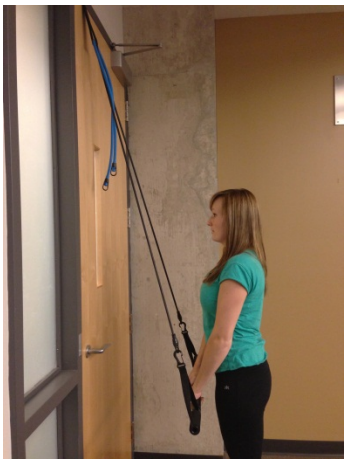

Technique: Stand with feet hip width apart, knees slightly bent, with elbows held horizontal in line with the shoulders above the ground. Your palms should be facing the ground as you hold the therabands. As you exhale extend your arms straight out in front of your body. Inhale and return to starting position in a controlled manner.
Primary muscles used: Pectoralis major, Triceps brachii, Anterior deltoid

Lat Pull-Downs

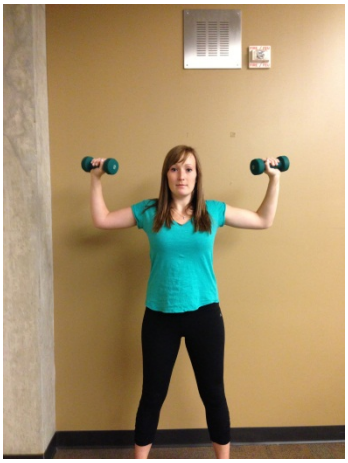
Technique: Using an exercise ball, sit with feet flat on the floor, hip width apart, and torso in an upright position. Inhale and pull the bar down towards your chest while pulling the elbows back. Exhale as your return to starting position in a controlled manner.
Primary muscles used: Latissiums dorsi, Teres major, Biceps brachii, brachialis

Tricep Extension with Therabands

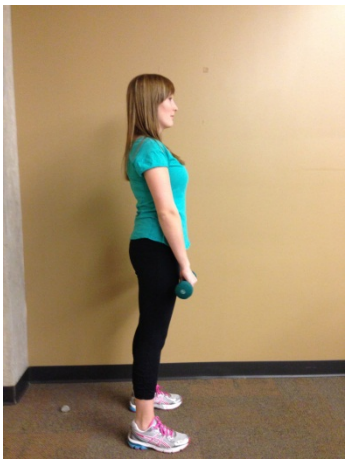
Technique: Stand with feet hip width apart and knees slightly bent. Begin holding the bar with your palms facing the ground and elbows bent to 90 degrees. Exhale as you extend your arms towards the ground. Inhale as you return your arms to starting position. *Remember that your upper arms do not move throughout the exercise*.
Primary muscles used: Triceps brachii, Aconeus

Dumbbell Shoulder Press



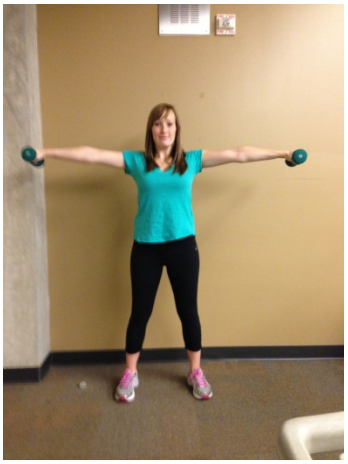

Technique: Stand with feet hip width apart and knees slightly bent. Hold a dumbbell in each hand with palms facing forwards and arms held at 90 degree angles. Exhale and push the dumbbells straight up above your head. Inhale as your lower your arms back to starting position.
Primary muscles used: Triceps brachii, Deltoids (Anterior, middle, posterior)

Front Shoulder Dumbbell Raises



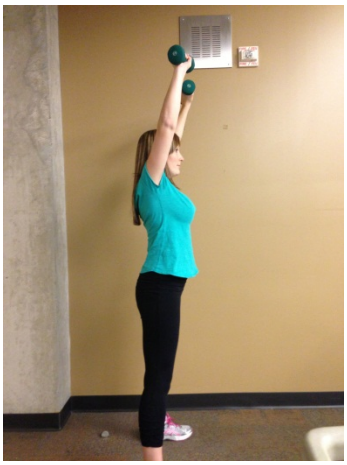

Technique: Stand with feet hip width apart, knees slightly bent, with arms at your sides. Hold a dumbbell in each hand with palms facing the ground. As you exhale, raise arms straight out in front of your body. Inhale as you lower your arms back to starting position.
Primary muscles used: Pectoralis major, Deltoids (Anterior, middle)

Lateral Dumbbell Raises

Technique: Stand with feet hip width apart, knees slightly bent, and arms at your sides. Hold a dumbbell in each hand with your palms facing your body. Exhale and raise your arms until they are horizontal. *Do not raise your arms any higher than shoulder level*. Inhale as you lower your arms back to starting position.
Primary muscles used: Deltoid (Anterior, middle, posterior), Trapezius

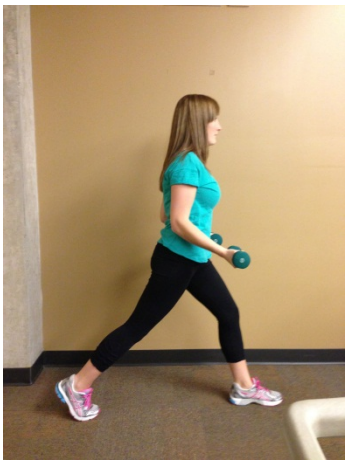
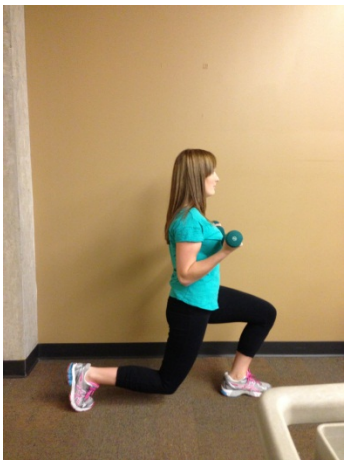
Squats with a Shoulder Press

Technique: Stand with feet hip width apart. Holding a dumbbell in each hand with palms facing forwards, arms should be held at a 90 degree angle. As you inhale sit back into a seated position until your knees are 90 degrees while maintaining a straight back. Exhale as you and push your weight up through your heels while simultaneously extending the dumbbells directly above your head.

Primary muscles used: Quadriceps, Gluteus maximus, Gluteus medius, Triceps brachii, Deltoid (Anterior, Middle, Posterior)

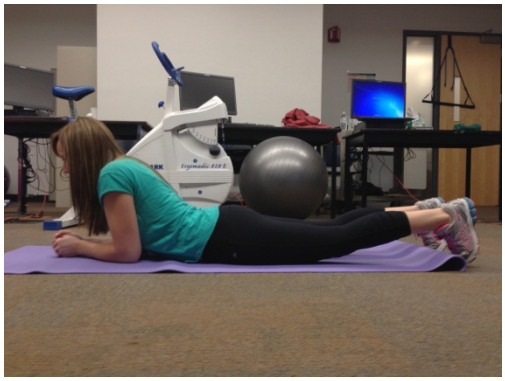
Lunges with a Bicep curl

Technique: Begin standing with legs slightly apart with a dumbbell in each hand and palms facing forwards. Inhale and take a big step forwards while maintaining an upright torso. Drop your back knee to the ground until both legs are at 90 degree angles, while simultaneously flexing your arms towards your shoulders. As you return to start position push your weight up through the heel of the foot in front while lowering your arms.

Primary muscles used: Quadriceps, Hamstrings, Gluteus maximus, Biceps Brachii, Brachialis, Brachiordialis, Anterior Deltoid

Plank




Technique: Begin lying on your stomach and rise up on your toes using your forearms to support you. Your body should be one line from your shoulders to your feet. Be sure that your hips are not too high. Hold for as long as possible.

Primary muscles used: Transverse abdominus, Erector spinae, Rectus abdominus

Side Plank

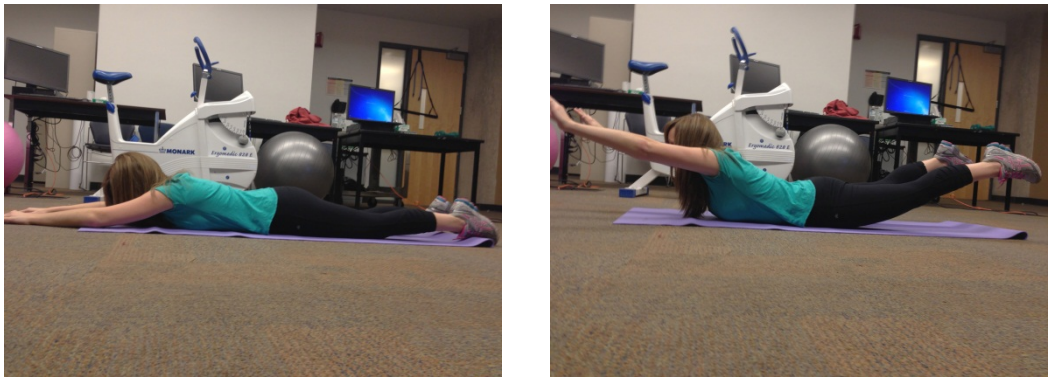

Technique: Lay on one side using your forearm for support directly under your shoulder. Place on foot in front of the other and lift your hips off the ground so that your body is a line from your shoulders to feet. Hold for as long as possible.

Primary muscles used: transverse abdominus, gluteus medius, gluteus minimus,adductors of the hip, external and interbal obliques

Up and Down Planks

Technique: Start in a plank position in which your weight is supported by your toes and forearms. Transition your weight to your left forearm and place your right hand on the mat. Continue to transition your weight to your right hand and place your left hand on the mat. Return to starting position by returning your weight to your right forearm, followed by your left.
Primary muscles used: Pectoralis major and minor, Triceps brachii, Deltoids (Anterior, Middle), Transverse abdominus, Erector spinae, Rectus abdominus

Supermans



Technique: Begin by lying on your stomach with your arms straight out in front and legs straight out behind you. When ready lift both your legs and arms as high as possible to lift your chest and legs off the ground. Hold this position for as long as possible.
Primary muscles used: Erector spinae, Quadratus lumborum, Multifidi, Transverse abdominus, gluteus maximus, Hamstrings, Deltoids

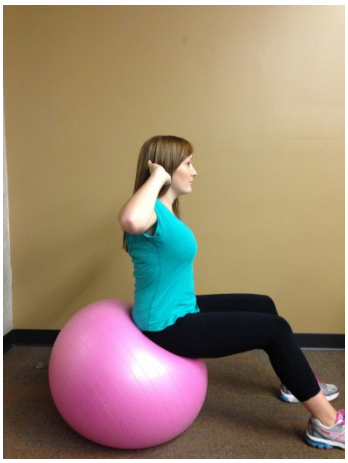
Crunches


Technique: Lie on your back with hands touching the side of your head, knees bent with feet flat on floor. Inhale and raise shoulders towards the knees until they are off the ground while contracting the core musculature. Exhale as you return to starting position.
Primary muscles used: Rectus abdominus, External oblique, Tensor fasciae latae

Pull Throughs


Technique: Lie on your back with knees bent, feet flat on floor and hands on top of one another straight out in front of you. Inhale and as you raise your shoulders up off the group reach with your hands between your knees while contracting the core musculature. Exhale as you return to start position.
Primary muscles used: Rectus abdominus, External oblique, Tensor fasciae latae

Crunches with an Exercise Ball




Technique: Begin sitting upright with hands touching the sides of your head, knees bent at a 90 degree angle and feet flat on the floor. Exhale, lean back on the exercise ball and contract your core musculature to return to starting position.
Primary muscles used: Rectus abdominus, Transverse abdominus External oblique, Tensor fasciae latae

Reverse Crunches


Technique: Lying on your back, flex your knees to 90 degrees, with hands at your sides. Extend your legs out in front of you and contract core musculature to return to starting position.
Primary muscles used: Rectus abdominus, Transverse abdominus, External oblique, Quadriceps, Tensor Fasciae latae

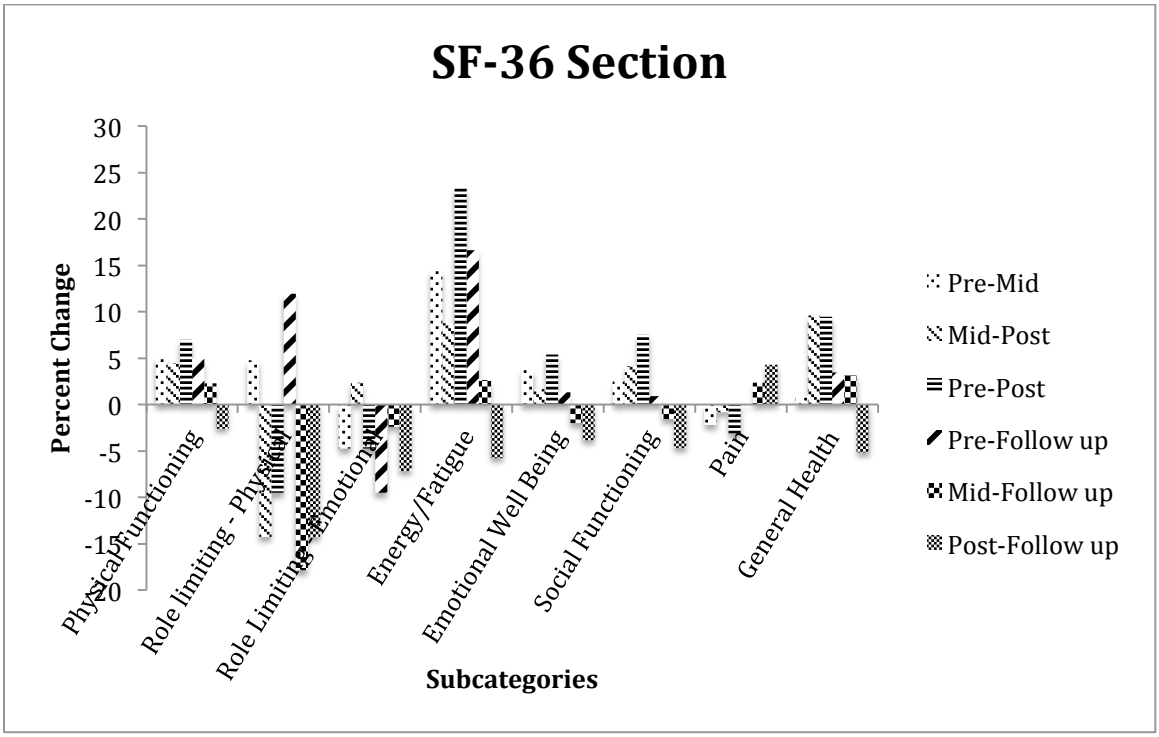
Mountain Climbers

Technique: Place hands on floor, slightly wider than shoulder width. On forefeet, position one leg forward bent under body and extend other leg back. While holding upper body in place, alternate leg positions by pushing hips up while immediately extending forward leg back and pulling rear leg forward under body, landing on both forefeet simultaneously

Primary muscles used: Rectus abdominus, Transverse abdominus, Gluteus maximus, medius, and minimus, Quadriceps, Hamstrongs

Appendix H

Results



Remarks Word Cloud

Appendix I

Discussion
Comments made by participants at the three-month follow-up assessment and during some exercise sessions

“Noticing more energy”
“less tired, Stairs, bending down, lifting easier”
“more strength in arms”
“good to be in a small group with others going through the same thing”
“Really enjoyed program”
“thought it was very worth while”
“Thought it was great”
“It was fun”
“Would like to continue”
“Program was great “
“improved balance”
“Worked specific core”
“Found exercise challenging”
“Would have preferred to have had a program that was supervised over last three months”
“Good Program”
“Feel made an improvement “
“feels stronger”
“Able to run with front of group with last clinic, normally runs at back of group”
“Ok”
“Exercises great”
“Feeling energized as workout”
“Feeling good”
“Feeling good”
“wants to be more active. “
“feel like I'm stronger”
“Arms are much stronger”
“endurance increased”
“Raking leaves - felt able to do more and work faster”
“Finding balance is increased”
“notice a difference in arms”
“Stronger!”
“Really helped the arms/shoulder”

Appendix J

Research Ethics Board Approval Letter

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

RESEARCH ETHICS BOARD
OFFICE OF RESEARCH SERVICES

Date: September 12th, 2012

To: Meagan O'Neil (PI), Manon Lemonde (Faculty Supervisor), Kevin Power (Faculty Supervisor)

From: Amy Leach, REB Chair

REB File #: 12-007

Project Title: Effects of combined aerobic and resistance exercise on quality of life and fitness of individuals who are post cancer treatment

DECISION: APPROVED

START DATE: September 12th 2012 **EXPIRY: September 12th, 2013**

The University Of Ontario Institute Of Technology Research Ethics Board has reviewed and approved the above research proposal. The application in support of the above research project has been reviewed by the Research Ethics Board to ensure compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2) and the UOIT Research Ethics Policy and Procedures.

Please note that the Research Ethics Board (REB) requires that you adhere to the protocol as last reviewed and approved by the REB. **Always quote your REB file number on all future correspondence.**

Please familiarize yourself with the following forms as they may become of use to you.

- **Change Request Form:** any changes or modifications (i.e. adding a Co-PI or a change in methodology) must be approved by the REB through the completion of a change request form before implemented.
- **Adverse or unexpected Events Form:** events must be reported to the REB within 72 hours after the event occurred with an indication of how these events affect (in the view of the Principal Investigator) the safety of the participants and the continuation of the protocol. (I.e. un-anticipated or un-mitigated physical, social or psychological harm to a participant).
- **Research Project Completion Form:** must be completed when the research study has completed.
- **Renewal Request Form:** any project that exceeds the original approval period must receive approval by the REB through the completion of a Renewal Request Form before the expiry date has passed.

All Forms can be found at http://research.uoit.ca/EN/main/231307/Research_Forms.html

REB Chair Dr. Amy Leach, SSH amy.leach@uoit.ca	Ethics and Compliance Officer compliance@uoit.ca

University of Ontario, Institute of Technology
2000 Simcoe Street North, Oshawa ON, L1H 7K4
PHONE: (905) 721-8668, ext. 3693