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Cancer Survivor Rehabilitation Program: Preliminary Results

Burnham T[1*], Peters J[1], Conner H[3], Kemble K[2] and Acquisto LD[1]

[1]*Exercise Science Laboratory, Central Washington University, Ellensburg, WA, USA*

[2] *Confluence Health Medical Center, Wenatchee, WA, USA*

[3] *Wenatchee YMCA, Wenatchee, WA, USA*

[*]**Corresponding author:** Tim Burnham, Central Washington University, Department of Nutrition, Exercise, and Health Sciences, 400 East University Way, Ellensburg, WA 98926-7572, USA, Tel: (509) 963-1764, (509) 860-1717; Fax: (509) 963-1848; E-mail: tim.burnham@cwu.edu

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Abstract

Cancer survivors in the U.S. now total over 12 million. The symptoms remaining posttreatment may lead to a decrease in quality of life. Often patients are left without guidance to rehabilitate themselves back to prior physical, emotional and psychosocial status. Rehabilitation for patients with cancer should be no different from rehabilitation for other diagnostic conditions, including both educational and functional components.

Purpose: To measure the effectiveness of a cancer survivor rehabilitation program.

Methods: Thirty post-treatment cancer survivors, (26 breast, 3 colon, 1 lung, 2 men, 28 women, 35-77 years) were subjects in a one group pre-post quasi-experimental design. The program consisted of two, 90 minute sessions per week for 12 weeks. Each meeting was divided into 3 sections: an educational activity, cardiovascular training, and a strength and flexibility session. The dependent measures included: aerobic capacity, body fat %, lower body flexibility, handgrip strength, quality of life, Schwartz fatigue scale, and the LASA scale (fatigue, anxiety, confusion, depression, energy and anger). A paired t-test was used to analyze pre-post measures.

Results: Aerobic capacity increased 20%, body fat decreased by 1.6 %, lower body flexibility improved 13.7%, and handgrip strength increased 11.3%. Quality of life increased 12.2%. Fatigue measured by the Schwartz scale decreased 28%, LASA scale results: fatigue decreased 50.3%, and depression decreased 63%, confusion decreased 55%, energy increased 47.8%, and anger decreased 62.2%. Anxiety decreased 27.5% but was not statistically significant. CONCLUSION: This program gave the participants the tools to change their lifestyles for the better. They developed a fundamental knowledge of the physiological and psychological changes that can occur with lifestyle choices and they had a support system with other participants. This combination of tools acquired in the cancer rehabilitation program proved effective at reducing symptoms often seen in post-treatment cancer survivors and improving overall quality of life.

Keywords: Cancer survivor; Rehabilitation

Introduction

The National Cancer Institute has estimated that about 66% of individuals diagnosed with cancer survive for greater than or equal to 5 years [1]. This increase in cancer survivorship is likely due to advances in biomedical technology that allow for early diagnosis and treatment of cancer. The Centers for Disease Control has defined a cancer survivor as a person who has been diagnosed with cancer and is still living [2]. As of 2012, the number of cancer survivors in the United States is estimated to be 13.7 million and predicted to be 18 million by 2022 [3]. With such a dramatic increase in cancer survivors on the horizon, methods for improving psychosocial wellbeing, quality of life, and physical capabilities will be in high demand.

Substantial evidence exists for utilizing exercise as an effective, well-tolerated interventional method in improving conditions related to cancer treatment [4-6]. Current cancer rehabilitation studies have focused on improving psychosocial components such as depression, fatigue, anger, confusion, tension, total mood disturbance, and quality of life [4,7-10], as well as improving physical components such as functional capacity [10], aerobic capacity [9,11], lower-body flexibility [9], and body composition [12]. These studies have determined that exercise participation can improve both psychosocial and physiological measures.

While exercise has been shown to be beneficial, there are several barriers to participation, and it may not encompass all the components needed for a successful rehabilitation from cancer. Many cancer survivors lack the knowledge and skills to design exercise rehabilitation programs on their own. The majority of established exercise programs or fitness center facilities lack the leadership of experienced certified cancer exercise specialists who develop programs based on cancer diagnosis, treatments and current symptoms. Additionally, exercise programs are often short in duration, and participants have a tendency to retreat to previous lifestyle habits upon program completion [5,9,11]. Education is a key element that is often lacking in some rehabilitation programs. Education provides not only the knowledge of how to make a change, but more fundamentally why people should make that change, leading to greater adherence to program teachings. Cancer survivors need a complete understanding behind emotional, physical, and psychosocial challenges associated with cancer treatment and to be provided with the tools to manage

such changes through recovery and beyond in order to make substantive lifelong lifestyle changes that can improve quality of life.

Given the increasing numbers of cancer survivors and the negative side effects associated with cancer diagnosis and treatment, there is a substantial need for cancer survivor rehabilitation programs to bridge the gap between medical treatment and a return to pre-treatment functional status. There are a number of successful comprehensive rehabilitation programs for other medical conditions, such as cardiovascular disease and diabetes, however few programs of this type exist for cancer. Several mono-dimensional cancer rehabilitation programs have been developed to better assist cancer patients and survivors in recovering from treatment-related physical and psychological side effects and improving quality of life [13]. However, the question of utilizing a multidimensional rehabilitation program for cancer survivors, incorporating both educational and physical components, has not been addressed sufficiently in the literature [11,13-16]. The American College of Surgeons Commission on Cancer has released guidelines requiring all accredited cancer treatment centers to provide patients with treatment summaries and survivorship health care plans by the year 2015. In an effort to abide by these guidelines, a multidimensional, education and exercise, cancer rehabilitation program was designed and implemented. Therefore, the aims of this study were to evaluate the efficacy of a community based multi-component exercise and educational program, developed by an interdisciplinary team, on both physical and psychosocial outcomes in cancer survivors.

Method

Cancer survivor rehabilitation design

The cancer survivor rehabilitation program was developed with input from a number of people with a variety of backgrounds, including: several medical oncologists, a physical therapist, an occupational therapist/ lymphedema specialist, a registered dietician, a nurse manager, and exercise physiologists. This group met twice a month for several months, to establish the program requirements. Several institutions were also involved in program development including a local medical center (Confluence Health Medical Center), a local YMCA (Wenatchee Valley YMCA), a non-profit cancer foundation (EASE Cancer Foundation) and a university (Central Washington University). The aim of this project was to produce a comprehensive, multidimensional, exercise and education, cancer survivor rehabilitation program that would impact the quality of life of cancer survivors.

Recruitment and subjects

Participants were referred into the Cancer Survivor Rehabilitation Program by their primary care physician, primary oncologist, or oncology nurse practitioner. Both males and females, at least one week post-treatment (surgery, radiotherapy, immunotherapy, chemotherapy), regardless of age, race or cancer type were eligible to participate. All participants were cleared for involvement by their primary care provider, primary oncologist, or oncology nurse practitioner. If participants were surviving breast cancer, they were examined by an occupational therapist for lymphedema risk prior to beginning the program. The procedures for the study were approved by Central Washington University's Human Subjects Review Committee. All participants were informed of the risks and benefits and signed a consent form prior to participation.

Study design

This was a pre-post quasi-experimental study where all participants were assigned to the treatment group. Measurements collected at baseline (pre-program) and week 12 (post-program).

Study dependent variables

Participants completed three separate questionnaires pertaining to cancer and treatment related symptoms. The Linear Analogue Self-Assessment Scale (LASA) was utilized to measure fatigue, anxiety, confusion, depression, energy, and anger [17]. Participants indicated their perception of symptoms on a 100 mm analogue scale, indicating the magnitude of symptoms present. Reliability for the LASA is reported elsewhere [17]. Additionally, the Schwartz Cancer Fatigue Scale was utilized as a second tool to measure cancer related fatigue. Testing and reliability data for the SCFS have been reported elsewhere [18]. Lastly, the Quality of Life Index for Cancer Patients (QLI) was utilized. The QLI is a linear analogue scale including 14-items concerning general physical condition, normal activities, and personal attitudes on general quality of life [19]. The mean score for the 14-items were recorded. Testing reliability for QLI has been reported in previous research [20]. Height was measured and recorded to the nearest centimeter; body weight was measured and recorded to the nearest quarter kilogram using a digital scale (Health o'Meter). Skinfold fat thickness was measured by the same practioner from three sites with a Lang Skinfold Caliper (Lang Skinfold Calipers, Cambridge Scientific Industries Inc., Cambridge, MD) using standardized techniques for men and women according to the American College of Sports Medicine guidelines. Calculation of body fat percentage was determined by Jackson-Pollock Method [21].

Peak aerobic capacity (VO_{2peak}) was measured using a metabolic cart (Parvo-medics TrueMax 2400, Sandy, Utah) during a walking test on the treadmill. Participants were fitted with a heart-rate monitor (Polar AccurexPlus, Polar Electro Inc., Port Washington, NY) before initiation of testing and monitored the entire duration of the test. Participants were encouraged to walk on the treadmill prior to testing, allowing for familiarization with the equipment. The walking speed used for testing was individually determined based on the participant's fitness and comfort level and utilized for both the initial and post-treatment testing. During the test, the grade was elevated one degree every minute. Heart rate and rating of perceived exertion (RPE) (Borg Scale; 6-20) were recorded each minute. The peak aerobic test was terminated when participants could no longer keep pace with the treadmill, estimated maximal heart rate was reached, respiratory exchange ratio (RER) reached 1.0 or participants requested to stop the test. Lower body flexibility was assessed with a sit and reach test during which the participant sits on the floor with their shoes off, they reach out as far as possible with both arms and the distance (cm) reached past the feet is measured. Strength was assessed with a hand dynamometer to measure grip strength in the dominant hand, the result was recorded in kilograms.

Rehabilitation program specifics

The Cancer Survivor Rehabilitation Program participants met two days a week for a period of 12 weeks, for 90-minutes per session. Each meeting consisted of the following three components: (a) an educational activity, (b) cardiovascular endurance training, and (c) strength and flexibility training. The choice of a group-oriented program was based on prior research that indicates peer contact may

provide emotional support effecting participants attitude and expectations about cancer and group discussion may strengthen the effects of education through facilitated rehearsal, reinforcement, and clarification of the educational material [22].

The educational component entailed primarily lecture material presented by two exercise physiologists, in which main topic handouts were distributed, followed by a question and answer session. Educational topics included the following: physical and psychosocial benefits of exercise, basic nutritional concepts, nutritional supplements, exercise prescription, sleep hygiene, benefits of dance, physiology and benefits of aquatic exercise, motivational interviewing, cognitive behavioral therapy, weight management, lymphatic management, blood pressure and cholesterol management, stress reduction and "chemo-brain" information. Educational topics did not include specific mechanisms of cancer or information about types of treatment (related to all cancer types).

Physical training sessions were closely monitored by two exercise physiologists and specifically aimed at improving cardiovascular fitness, movement skills, strength and flexibility. Each physical training session was performed at a YMCA and consisted of primarily aerobic machine training. Aerobic training sessions utilized the following exercise machines: cycle ergometers, treadmills, and elliptical trainers. Dance, aquatic exercise, Pilates, and gentle yoga were also incorporated in conjunction with the aerobic machine training sessions and conducted by licensed professionals per specialty. Strength and flexibility sessions were structured to include a stretching warm-up followed by a resistance training circuit, concluding with a stretching cool-down. The resistance circuit utilized dumbbells and elastic bands, incorporating upper and lower body strength moves and modified accordingly per participant.

At beginning, the educational component focused on lecture and discussion for 45-minutes, utilizing the majority of time allotted per session. The cardiovascular endurance training incorporated 20-minutes of exercise, followed with 15-minutes of strength training. Sessions were concluded with 10-minutes of flexibility training. The initial exercise intensity for the aerobic session was based on 40-60 % of heart rate reserve, calculated by the Karvonen target heart rate method. As participants improved in physical function, the cardiovascular training sessions were extended an additional two minutes each week. During the last six weeks, the educational component lasted 30-minutes in duration to allow for 40-minutes of cardiovascular training. Sessions were concluded with 20-minutes of resistance and flexibility training.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) (International Business Machines Corporation SPSS, release version 21; IBM Inc., Armonk, New York, USA). Paired T-tests to compare the mean difference of scores pre- and post-program. Significance was established at the $p< 0.05$ level.

Results

Patient characteristics and physiological variables

Of the 33 participants enrolled, three individuals did not complete the program. Reasons given for the failure to complete the program included lack of time (2 participants) and health reasons (1 participant, not associated with cancer). Thirty participants (age 64.4 ± 10.6 years, 28 females and 2 males, 26 breast, 3 colon, 1 lung cancer) completed the program. The participants were predominantly female (93%) and the majority of participants were diagnosed with breast cancer (86.7%). All participants had undergone treatment which included but not limited to the following: chemotherapy, surgery, radiation therapy or a combination of these. All participants were within one year post-treatment for cancer.

Table 1 shows the physiological changes recorded over the program period. Participants significantly increased both relative and absolute aerobic capacity, dominant hand grip strength, and lower body flexibility, while body fat percentage significantly decreased. Body weight decreased slightly but the result was not significant

Dependent Variables	Pre-Treatment	Post-Treatment	Mean Difference & 95% CI	Pre to Post Percent Change (%)	p Value
Body Weight (lbs)	177.0 ± 46.9	175.7± 46.0	1.3 (-.16, 2.88)	-0.7 %	P=0.79
Body Composition (% fat)	30.2 ± 7.0	28.6 ± 6.7	1.6 (.86, 2.39)	-1.6 %	P< 0.00*
VO2peak (mL/kg/min-1)	17.7 ± 3.3	21.3 ± 3.9	3.5 (2.8, 4.3)	20.1 %	P< 0.00*
VO2peak (L/min-1)	1.3 ± 0.3	1.6 ± 0.4	.27 (20, .33)	20.0 %	P< 0.00*
Hand grip strength (kg)	10.4 ± 2.6	11.5 ± 2.3	1.1 (70, 1.6)	11.3%	P=0.01*
Lower body flexibility (cm)	22.9 ± 6.6	26.0 ± 6.0	3.0 (1.9, 4.3)	13.7%	P=0.01*

Table 1: Physiological variables.

*Significant differences between pre- and post-treatment, $p< 0.05$. Means + SD.

Psychosocial measures

Means and standard deviations for psychosocial variables including the Linear Analogue of Self-Assessment, Schwartz Cancer Fatigue Scale, and Quality of Life Index for Patients with Cancer (LASA, SCFS, QLI respectively) are presented in Table 2. With the LASA and SCFS measure, a lower score is more desirable, indicating less fatigue with exception to the energy measurement on the LASA, in which a higher value is more desirable. With the QLI measure, a higher value is more desirable, representative of a higher quality of life.

Participants significantly increased quality of life, and a measure of energy, while significantly decreasing fatigue (reported by two independent measures), depression, confusion and anger. The measure of anxiety decreased but did not reach statistical significance.

Dependent Variable	Pre-Treatment	Post-Treatment	Mean Difference & 95% CI	Pre to Post Percent Change (%)	p Value
Quality of Life	76.4 ± 17.9	85.8 ± 10.1	9.3 (2.8, 15.8)	12.2%	P=0.008*
Linear Analogue Self-Assessment Scale (LASA) (mm)					
Fatigue	48.6 ± 32.0	24.1 ± 21.4	24.5 (10.3, 38.6)	-50.3%	P=0.001*
Anxiety	27.4 ± 28.1	19.8 ± 20.3	7.5 (3.1, 18.2)	-27.5%	P=0.160
Confusion	21.4 ± 24.7	09.6 ± 08.9	11.8 (2.2, 21.5)	-55.3%	P=0.018*
Depression	34.3 ± 29.9	12.7 ± 15.4	21.6 (10.6, 32.5)	-63.0%	P< 0.000*
Energy	40.3 ± 24.9 37	59.7 ± 24.0	19.3 (7.7, 30.9)	47.8%	P=0.002*
Anger	16.4 ± 20.3	06.1 ± 07.5	10.2 (2.0, 18.3)	-62.2%	P=0.016*
Fatigue (SCFS)	13.6 ± 5.9	9.8 ± 3.6	3.8 (1.7, 5.9)	-28.2%	P=0.001*

Table 2: Psychosocial Variables.

*Significant differences between pre- and post-treatment, p<0.05. Mean + SD.

Discussion

The principal aims of this study were to describe the design, implementation and effects of a multidimensional, exercise and education, cancer survivor rehabilitation program on (1) physiological functioning, aerobic capacity, body composition, strength, and flexibility, and (2) psychosocial functioning; quality of life, fatigue, anxiety, depression, confusion, and anger. The results revealed significant improvement in aerobic capacity, body composition, strength, flexibility, quality of life, fatigue, depression, confusion and anger.

This program was designed with input from medical oncologists, a nurse practioner, a nurse manager, an occupational therapist, a Registered Dietician, and exercise physiologists. Each professional had input into the structure and educational components of the program. The final program format was decided on by this group after several bi-monthly discussion periods. Differences among this group were resolved either by consensus or a majority vote. Additionally, the following four institutions were involved: a medical center, a YMCA, a non-profit cancer foundation, and a university. We realize that not every community would have these resources and personnel available to them to develop such a program. Further, the majority of the people involved donated their time, so an estimate of program costs for this venture would require further review. The majority of the program activities took place at the YMCA, while the physiological testing took place at the medical center. Participants did pay a registration fee to cover the cost of the YMCA membership and help defer the costs of utilizing the facility. Cooperation among people and entities was essential in designing and implementing this program.

This program showed significant improvements in physiological measures including aerobic capacity (VO2peak), body composition, strength and flexibility. Aerobic capacity increases of about 20% found in this study are comparable to those of Spina et al. [23] on cardiovascular adaptations in elderly men and women. These researchers reported endurance exercise training to increase VO2max by 19 and 20% in healthy women and men, respectively. Improvements in aerobic capacity are in agreement with prior research and indicative that exercise training can improve VO2max in cancer survivors [6,9,24].

The improvement in VO2peak in this study is noteworthy because it suggests an enhanced physical functional capacity. On a practical note, this implies that our participants should be able to perform physical daily tasks of living at a reduced relative physiological load. It should be noted that participants varied the mode of aerobic activity depending on their preference, some participants walked on a treadmill, utilized the elliptical or used a stationary bike, however, the minutes of aerobic activity remained the same for all participants. Participants were also introduced to alternative forms of physical activity during some sessions. These activities included water exercise, aerobic dance, Pilates, and gentle yoga. These activities not only provided variety but also exposed the participants to other forms of exercise that they may want to engage in after the program ended. Improving aerobic fitness is important to many cancer survivors as the stress of treatment often causes a reduction in physical activity as well as a decrease in muscle mass and an increase in body fat that may contribute to fatigue and a decrease in quality of life.

Interestingly, as percent body fat significantly decreased over 12-weeks, body weight, on average, was maintained among the participants. A change in body composition may be caused by an overload to the working musculature, as provided by lower body aerobic exercise and resistance training, thus increasing lean body mass. If lean body mass was increased while fat mass decreased, overall body weight would be maintained. These results are similar to those of Irwin et al. [12] who examined the effects of aerobic exercise on body composition in breast cancer survivors. This investigation revealed a significant decrease in body fat as well as a significant increase in lean body mass. Body weight among participants, however, did not significantly change. As research suggests, cancer survivors typically lose weight during cancer treatments which is followed by weight gain

beyond baseline measures once primary treatment is completed [9,25]. Previous research has shown that exercise can help maintain, if not decrease, body weight in breast cancer patients [24,26]. This is particularly important, for there is a positive relationship between weight gain and decreased quality of life in cancer survivors [27,28].

Grip strength (a marker for general muscular strength) and lower body flexibility significantly improved for participants over the program period. Improvements in these areas may allow cancer survivor to perform activities of daily living with greater ease, thereby suggesting a greater fatigue threshold. Additionally, increases in muscular strength may contribute to weight management and may improve bone health [29].

Results revealed statistically significant improvements in many areas of psychosocial functioning including depression, anger, confusion, and energy. In previous research, depression has been found to interfere with the ability to integrate new information as well as work productively [30]. A 63% reduction in depression and a 55% reduction in confusion found with this program may be helping individuals integrate and utilize educational components of provided by the program. Potentially this could affect a person's quality of life as well as work productivity. The design of the present study does not allow for conclusions to be drawn concerning the amount of contributions from the educational, exercise, or group dynamic aspect of this program. Nevertheless, a reduction in depression, confusion, and anger may allow participants to feel more in control of their current situation and function more effectively in several domains of life.

This study also found a significant decrease in cancer related fatigue. Cancer related fatigue has been reported as the most prevalent side effect affecting as many as 76-99% cancer patients, and expressed as an extreme, persistent, and overwhelming form of fatigue [31]. Cancer related fatigue is a multifaceted phenomenon that potentially includes both physical and psychological components. Mechanisms may not be fully understood; however, physical side effects associated with cancer related fatigue may include anemia, muscle deconditioning, and disuse atrophy. Mechanisms pertaining to psychological symptoms may include depression, which has been reported as two to three times higher in cancer survivors when compared to the general public [32]. Depression can be associated with both physical and emotional symptoms, making it difficult to separate from cancer related fatigue, as fatigue may be an indication of depression. A vicious cycle of several factors including fatigue, reduced activity, an even further impaired physical capacity followed by an increase in depression may appear and contribute to the persistence of physical and emotional problems. This disuse cycle is common amongst survivors after primary treatment and may continue for months, or year's post-treatment.

The positive effects of exercise on breaking this cycle of cancer related fatigue have been reported [7,8,31]. As observed in Schwartz et al.'s study [31], exercise consistently reduced fatigue not only on the day of exercise but in addition to one day afterward. Exercise was also shown to greatly decrease four levels of fatigue including: fatigue at its worst and fatigue at its least in the past 24 hours, fatigue on average over 24 hours and fatigue experienced right now [31]. In the present study, cancer related fatigue decreased an average of 28% over 12 weeks. The contributions from the educational, or exercise components and potentially group dynamics cannot be determined with the present study design.

As more cancer patients survive the process of detection, treatment and management of side effects, it is important to acknowledge the impact of cancer on long-term health and overall quality of life [33]. As survivors are living longer lives, there is a need for new concepts, procedures and interventions to maximize this outcome. This study found that the overall QOL was significantly improved by 12% for a mixed group of cancer survivors, which is in agreement with other reports who have shown an improvement of 4-15% in QOL for cancer patients and survivors [7,9,15,22,33,34]. Overall quality of life pertains to psychological, physical, emotional and social function. Improvements in aerobic capacity and psychosocial functioning coupled with support from individuals with similar serious health concerns may substantially increase overall quality of life. Psycho educational interventions have been shown to improve overall QOL immediately following primary treatment, and improvements have been maintained for at least 3-months post-intervention [33]. Our study educated participants on life after treatment, eliminating disease specific mechanisms, and focused on improving overall QOL through various educational topics in conjunction with exercise. Improvements were observed in all domains associated with QOL over a 12-week period.

Limitations of Study

One limitation to this study is that it is difficult to determine if the improved QOL and psychosocial domains were enhanced due to exercise, educational components, group dynamics or a combination of the three. In order to determine the effectiveness of each treatment, a study treating each component is warranted. Secondly, a limitation to this study was the lack of a control group, which made it impossible to determine if improvements were solely due to program participation or an effect due to natural recuperation after primary treatment. Thirdly, the long-term effects of participation in a multidimensional program were not analyzed and are important for future research.

Conclusions

The results of this study demonstrate that this 12-week, multidimensional program had positive effects on psychosocial and physiological functioning in a mixed group of cancer survivors. This program gave cancer survivors the tools to change their lifestyles for the better. They were exposed to a variety of different exercise modes, to allow them to make an informed choice on the physical activity modality to employ. They were provided with fundamental knowledge, through the educational aspect, of the physiological and psychological changes that could occur with lifestyle choices. They also had a support system with other participants and the providers of the program. Taken in its entirety, this program significantly affected cancer survivor's quality of life for the better. Lastly, the program, as described here, is a safe and cost effective care plan that is in agreement with the American College of Surgeon's Commission on Cancer recommendations for cancer survivor rehabilitation programs.

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