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SM Journal of Clinical Medicine

Research Article

Individualized Exercise Improves Fitness and Psychological Measures to a Greater Extent than Group Exercise during Cancer Treatment

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Article Information

Received date: Jan 15, 2018
Accepted date: Feb 02, 2018
Published date: Feb 07, 2018

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Keywords Exercise; Rehabilitation; Fitness

Abstract

Introduction: Exercise rehabilitation has previously been reported effective in attenuating numerous cancer treatment-related toxicities and enhancing the QOL of patients. Many cancer centers have responded to this by initiating group-based exercise instruction to cancer survivors. However, research from other chronic diseases indicates that an individualized approach is most effective at attenuating treatment related toxicities and maximizing quality of life. Therefore, the purpose of this investigation was to compare a group-based exercise program to individualized exercise on fitness parameters, QOL, and psychological measures.

Methods: 573 individuals who were currently undergoing cancer treatment participated in this investigation. Each group underwent a comprehensive fitness assessment and completed McGill QOL questionnaires at the start of their exercise training, and after 12-weeks of training. Compliance data was also measured for each group. Data was analyzed at the 0.05 level of significance using descriptive statistics.

Results: Exercise has a positive impact on fitness parameters for both groups. On average, the one-on-one exercise group experienced greater improvements in all measured parameters. Likewise, QOL improved for both groups, but to a greater extent in the group exercisers ($p<0.05$).

Conclusions: Based on these data, it appears as though exercise can improve fitness parameters during cancer treatment. The individualized, one-on-one approach was the most effective at improving fitness.

Introduction

As research into chronic disease rehabilitation broadens, exercise is becoming a standard component in many treatment plans. Studies over the past 25 years have specifically shown that patients who have received a cancer diagnosis greatly benefit from some form of exercise training. In response to this, cancer exercise programs have sprouted across the country. What seems to be missing from a majority of these programs, however, is an element of individualization. This study aims to address this gap in cancer care, and make the case for its necessity in standard treatment plans.

The positive effects of exercise within the realm of chronic disease have been well documented. A literature review published in 2006 by Bente Pedersen and Bengt Saltin assessed exercise therapy studies performed in patient populations presenting with 18 different chronic diseases. Diagnoses included metabolism, heart, pulmonary, muscle and bone pathology. Numerous studies were reviewed and ultimately hundreds cited in the finished publication. Regardless of the difference in mechanism or approach to exercise, the evidence overwhelmingly found that exercise prescription created positive change in patient health status, with a wide range of different variables assessed. It was, however, noted that certain modes of training may be more beneficial in light of the differences of each disease pathology [1]. In 2015, the same review was updated to include 26 different pathologies, this time including psychiatric and neurological diseases and cancer [1]. With each affliction, the efficacy of exercise training in patient quality of life, disease, and symptom treatment is reaffirmed. The analysis also notes that physical training in accordance with cancer treatment should be personalized to each patient first. This makes the case for not only exercise prescription in disease treatment, but also the necessity for individualization. This type of intervention is so important in chronic disease management, that the American College of Sports Medicine, a leader in exercise program development, even published a book titled, ACSM's Exercise Management for Persons with Chronic Diseases and Disabilities. The publication has an entire chapter explaining why "exercise is medicine," and also makes suggestions and provides detail on the role of exercise in 49 specific conditions. Another chapter is dedicated expressly to cancer, containing evidence-based exercise practices beneficial to the specific needs of cancer patients [2]. Dr. Carolyn Rochester, of the Yale University School of Medicine, posits that, "The clinical benefits of exercise rehabilitation last

How to cite this article Wonders KY and Ondreka D. Individualized Exercise Improves Fitness and Psychological Measures to a Greater Extent than Group Exercise during Cancer Treatment. SM J Clin Med. 2018; 4(1): 1032s.

up to 2 years following 8 to 12 weeks of training" [3]. This industry shift to disease management and treatment through exercise is now backed by years of research, and is solidifying the role of physical activity in modern medicine.

Exercise rehabilitation in chronic disease

Chronic disease rehabilitation sees substantial benefit from personalized training programs. A French study on patients with Chronic Obstructive Pulmonary Disease, showed a significant increase in exercise tolerance after just 3 weeks of individualized exercise training [4]. In a 6-month cardiac rehabilitation study, 27 heart transplant patients participated in post-surgical rehab. 14 patients were assigned to a personalized program, based on their individual needs and fitness levels, and received supervised coaching to master their respective program design. The other 13 participants were sent home with a written generic program, but no explicit training or guidance. Both groups saw increases in cardiac output, but the supervised exercise group had significantly higher increases in cardiopulmonary functioning; most notably, peak oxygen consumption and workload [5]. A year-long exercise study involving 146 males with coronary heart disease examined cardiac function changes between a supervised exercise group, and non-exercise (usual care) group. At its conclusion, the exercise group saw significant change in cardiovascular efficiency, including increased ventricular function and aerobic capacity [6]. Exercise intervention in patients with Parkinson's Disease have also benefited positively from personalized training. A 4-week study compared an individual physical therapy group with group class and at-home program testing groups. The experiment concluded that the individualized training was the most effective way for the subjects to exercise, and saw the most significant improvement within the Physical Performance Test variables measured [7]. Each of these studies showed that one-on-one or more supervised personal training, increased physical fitness parameters more than their counterpart groups not involved in individualized training.

Specific to cancer

The Rocky Mountain Cancer Research Institute, a pioneer in the field of exercise and cancer, found success in an exercise intervention study performed with breast cancer patients. Each training session was personally engineered based upon the patient's initial fitness assessment performance, as well as Exercise and Cancer Recovery guidelines from the American College of Sports Medicine. Differences in both lean body mass and percentage of body fat were not considered statistically significant throughout the experiment, but significant differences were seen in each value between the control and exercise groups upon analysis at the conclusion of the study. The exercise group saw an increase of almost 10% muscular strength and over 4% lean body mass over the 16 weeks, while the control group's muscular strength actually decreased over the course of the experiment. The percentage of body fat in the exercise group also decreased by just fewer than 11% compared to a 3.52% gain by the control group [8]. The personalized program development created significant positive change throughout the study, and allowed the researchers to really consider the needs of each patient and their diagnosis. Therefore, the purpose of this investigation was to compare a group-based exercise program to individualized exercise on fitness parameters, QOL, and psychological measures.

Methods

This randomized controlled trial evaluated the effects of a group exercise intervention versus individualized exercise therapy in 573 newly diagnosed cancer survivors. An ethical committee of the recruiting cancer center approved this study prior to the onset of any data collection. Consenting men and women who were undergoing cancer treatment were included in this study. Patients were excluded if they had (i) a concurrent medical condition likely to interfere with the treatment, (ii) any major psychiatric, neurological illness, and/or autoimmune disorders, and (iii) secondary malignancy.

Baseline assessments were done on 296 patients at the start of the group exercise (GEx) intervention and on 308 patients prior to the start of individualized exercise training (IEx). At the conclusion of the 12-week group exercise intervention, the same fitness parameters were measured again. On the follow-up test, 282 patients in the GEx group and 291 patients in the IEx group were measured. Non-compliance was attributed to lack of interest, time constraints, and other concurrent illnesses.

Comprehensive fitness assessment

Initially, all participants underwent a comprehensive fitness assessment. All pertinent demographic information, medical history, clinical data, intake of medications, investigative notes, and conventional treatment regimen were determined. A subjective symptom checklist was utilized to assess treatment-related side effects and relevant psychological and somatic symptoms related to cancer. The checklist consisted of 31 items each evaluated on two dimensions; severity graded from 'no' to 'very severe' (0–4), and distress from 'not at all' to 'very much' (0–4). These scales measured the total number of symptoms experienced, total/mean severity and distress score, and were evaluated previously in a similar breast cancer population [9]. Additionally, quality of life (QOL) was measured using McGill QOL Questionnaire.

For the fitness assessment, cardio respiratory endurance was measured with the 6-minute walk test. Muscular strength was determined using the hand grip dynamometer. Upper body range of motion was measured via goniometer, and lower body range of motion was assessed via modified sit and reach. Muscular endurance was assessed via partial curl up test. Finally, body composition was measured with skin fold calipers. All participants were re-assessed following the conclusion of the 12-week program.

Group exercise intervention

The GEx class met once a week and was led by a certified Cancer Exercise Instructor. Each class consisted of range of motion, strengthening exercises, and interval cardiovascular training [10]. The sessions began with a guided warm up (10 min), followed by an exercise phase (40 min) which consisted of interval training with aerobic and strength exercises. Therabands were utilized at a starting weight of 2.5 pounds (light resistance). Patients completed a whole body workout that targeted all major muscle groups. Subjects were encouraged to remain active at home at least 2 additional days a week between classes. Instructors monitored home exercise through weekly telephone calls, text messages, and daily logs.

Table 1: Subject Characteristics.

Subject Characteristics			
		Gex	**IEx**
Age (yr)		64± 3.4	66 + 2.2
Gender	Male	55	117
	Female	227	174
Type of cancer	Prostate	37	52
	Breast	164	184
	Colon	32	22
	Lung	12	16
	Brain	1	3
	Other	36	14
Current Course of Treatment	Radiation	89	**77**
	Chemotherapy	146	149
	Surgery	42	58
	Other	5	7

Individualized Exercise Intervention

The IEx group consisted of 12 weeks of prescribed, individualized exercise that included cardiovascular exercise, strength training, and flexibility components. Following the comprehensive fitness assessment, an exercise program was created and individualized according to each patient's strengths, weaknesses, and goals. Patients exercised with a Cancer Exercise Instructor once each week for 60 minutes each session. The intensity level for the cardiovascular exercise ranged from 30-45% of the individual's predicted VO2max. The strength training involved a full body workout, with emphasis on all major muscle groups. Machines, free weights, and tubing were all employed. Patients completed 3 sets of 10 repetitions for each exercise. Flexibility training involved static stretching of all major muscle groups for 15-20 seconds at the completion of each workout. Patients were also given an at-home workout program and Therabands, and were encouraged to exercise two additional times each week at home. Their trainers monitored exercise compliance through telephone calls, texts, and daily logs.

Statistical methods

Data were analyzed using Statistical Package for Social Sciences version 20.0 for PC windows 2000. Mean scores for fitness parameters and QOL measures were calculated for the complete sample.

Table 2: Fitness Parameters. Values are mean scores ± SE.

	GEx (Percent change ± SE)	IEx (Percent change ± SE)
Cardiovascular Endurance	2.7± 0.4	7 ± 0.4*
Muscular Strength	23± 0.3	34± 0.1*
Muscular Endurance	26± 0.8	64.5± 0.2*
Flexibility	22± 0.6	23± 0.7
Body Composition	-7± 0.4	-6.3± 0.6

*P<0.05 between groups.

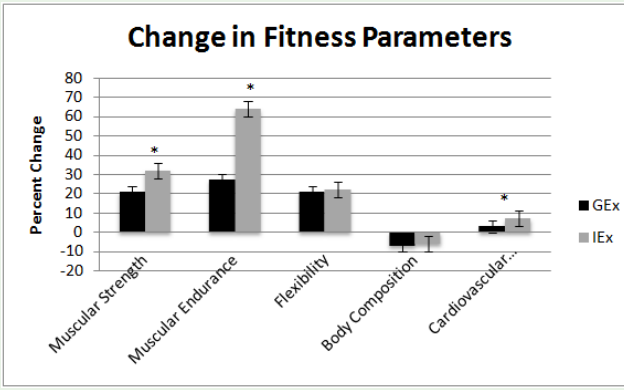

Figure 1: GEx and IEx Improvements in Fitness Parameters. Values are mean scores ± SE. *P<0.05 between groups.

Compliance data was also measured for each group. The data were averaged and analyzed using a one-way ANOVA test. All data was analyzed at the 0.05 level of significance.

Results

A total of 573 men and women completed the study, 282 participants comprised the GEx group and 291 comprised the IEx group. There were no dropouts due to injuries. The GEx and IEx groups were similar with respect to medical characteristics, and heterogeneous in treatment regimen (Table 1).

Exercise had a positive impact on fitness parameters for both groups (Figure 1). Muscular strength, muscular endurance, and flexibility significantly improved from baseline levels in both the GEx and the IEx groups ($p<0.05$).The IEx exercise group experienced greater improvements in cardiovascular endurance, muscular strength, and muscular endurance ($p<0.05$) than the GEx counterparts. There were no significant differences between groups for flexibility and body composition. Table 2 presents the mean values from pre- to post-assessment for both groups.

Two questions on the McGill Quality of Life questionnaire were also analyzed. Patients were asked to indicate on a scale of 1-10 the level of depression and anxiety they have experienced over the last 2 d. Mean depression and anxiety scores improved in both groups, but to a greater extent in the GEx group (Table 3). It was determined that individuals in the GEx group experienced significantly lower levels of depression (GEx = 2.25 ± 0.3, IEx = 5.4 ± 0.4; $P< 0.05$) and anxiety (GEx = 3 ± 0.25, IEx = 4.2 ± 0.6; $P< 0.05$) than their NR counterparts. Finally, the GEx had the highest compliance rate (87% vs. 76% in the IEx group) ($p<0.05$).

Table 3: Depression and Anxiety Scores.

	GEx	IEx
Depression	Pre: 7 ± 1.7 Post: 2.25 ± 0.3*	Pre: 7.4 ± 1.4 Post: 5.4 ± 0.4*
Anxiety	Pre: 8 ± 0.5 Post: 3 ± 0.25*	Pre: 7.7 ± 2.1 Post: 4.2 ± 0.6*

Scores are mean values representing change in score from baseline to post-intervention ± SE. P<0.05 from baseline.

Discussion

This study aimed to examine the difference between group exercises versus individualized exercise instruction. Our data found that both forms of exercise improved fitness parameters during cancer treatment, however, individualized, one-on-one approach was determined the most effective at improving fitness.

As knowledge of cancer pathology has grown, the medical community has developed ways to more accurately predict the progression of the disease. In order to learn more about an individual's cancer, testing Circulating Tumor Cells (CTC's) in the blood has become popular [11]. Testing the blood for these markers can indicate important tumor components that may help identify a more beneficial treatment, and can also show tumor movement earlier than other testing procedures. Genetic testing has shown promising results by allowing physicians to label markers on specific genes, in order to glean information about the individual disease pathology [12]. Because cancer arises from a genetic malfunction, it stands to reason that testing genes could help reveal how to counteract the disease. According to the American Cancer Society, cancer therapies aren't "one size fits all," so our treatment approach shouldn't be either [13]. Researchers continue to make strides in these areas with the goal of individualizing each patient diagnosis and cancer treatment. Typically, cancer diagnosis and treatment plans surface through investigation of physical symptoms. Searching for a chemical marker could give physicians information about certain cancers before symptoms even become apparent This approach is already used with a few genetic markers, as seen in prescription of Herceptin as a more focused therapy for patients found with increased HER-2. It is also common practice to now screen for BRCA1 and 2 gene mutations in order to direct treatment more specifically in breast cancer patients [14]. These more targeted types of treatment produce increased success in tumor management and eradication. By knowing more about the cancer's inception, and any specific genetic markers associated with it, medical professionals hope to more proactive and accurate when planning correlated treatments. These systems aren't perfect, and they both face challenges moving forward in the realm of cancer diagnosis and treatment, but show promising advantages in modern medicine's goal of personalized cancer treatment. Researchers hope to advance to a place where disease detection, diagnosis, and therapy can all be tailored to a patient's genetic profile, and thus, are as individualized as possible.

Programs already in existence

Cancer Exercise Rehabilitation is a field that is rapidly growing, and rehab programs are emerging all over the country to meet this demand. One of the most popular programs is Live strong, a 12-week cancer survivorship program sponsored by local YMCA's [15,16]. The program states that it is individualized; however, most YMCA's that facilitate Livestrong only offer small group training as opposed to personal training. Many cancer rehabilitation programs follow this trend. Local facilities like TriHealth and the Ohio State University's Comprehensive Cancer Center, The James, also offer small group exercise classes for those with cancer. The TriHealth Cancer Wellness Program [17] is a 12-week, small group program, similar to Livestrong, while classes at the James [18] are taken in 10-12-week series', and each series may not be completed more than once. With each of these previously mentioned outpatient programs, cancer treatment must already be completed at the time exercise begins, and there is no opportunity for a one-on-one experience with a personal trainer. Indiana University offers a Cancer Exercise Program through Ball Memorial Cancer Center [19] with a slightly higher level of supervision. New program participants meet for a one-on-one consultation with an exercise physiologist upon starting the program, and receive follow-ups and peer support throughout the program's 8-week duration. The program requires a monthly fee, unlike many others of its kind, and is currently not eligible for insurance reimbursement; this represents a treatment barrier for many patients already burdened by the costs of cancer. Finally, Maple Tree Cancer Alliance is an emerging national exercise oncology program that partners with hospitals to offer individualized exercise instruction at no cost to the patients. They presently operate out of seven offices in Dayton, and have satellite locations opening in Wisconsin and Pennsylvania.

As the health industry makes its move toward personalized medicine, exercise rehabilitation should likewise follow the same model. Individualized medicine keeps the patient in mind at all times, removes unnecessary procedures and medications, and uses proactive testing to be sure the correct treatment is prescribed. As an important part of the care team, exercise rehabilitation specialists should also have the ability to offer individualized care through the form of personal training. This one-on-one interaction allows for an exercise program design that perfectly aligns with patient needs, fosters trust between the patient and trainer, and allows the trainer to focus all their attention onto the patient. In this type of environment, the trainer has the opportunity to tailor their patients program to their patient's functional limitations, symptoms and side effects they may experience from treatment, as well as adaptation based on the specific form of cancer. Attending to one client at a time allows for the flexibility to adjust the program as necessary to provide for any changes throughout its extent. A few group classes are not enough to provide a patient with the rehabilitation and exercise skills required to recover efficiently. They must be afforded the same level of care in their exercise rehabilitation program, as they are with the rest of their oncology team.

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Citation: Wonders KY and Ondreka D. Individualized Exercise Improves Fitness and Psychological Measures to a Greater Extent than Group Exercise during Cancer Treatment. SM J Clin Med. 2018; 4(1): 1032s.

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