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COMBINED HIGH INTENSITY STRENGTH AND AEROBIC TRAINING ENHANCES QUALITY OF LIFE OUTCOMES FOR INDIVIDUALS WITH CHF

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ABSTRACT

COMBINED HIGH INTENSITY STRENGTH AND AEROBIC TRAINING ENHANCES QUALITY OF LIFE OUTCOMES FOR INDIVIDUALS WITH CHF. **Ann M. Swank, Daniel C. Funk, Kerry L. Barnard, Kent J. Adams, D. Martin Denny**. **JEPonline**. 2002;5(2):36-41. This study evaluated quality of life outcomes following 8-weeks of combined high intensity strength and aerobic training for 18 males (age=67.0±12.5 yrs; ejection fraction=27.5±6.8) with congestive heart failure (CHF). Subjects performed 30 min of aerobic exercise three days per week and high intensity (80% of 1RM) strength training 2 days/week for 8 weeks. The Minnesota Living with Heart Failure Questionnaire was administered before and after training to determine the subjects' self-assessment of the impact CHF has on their lives and perceived benefits of exercise. Significant differences ($p<0.05$) were found with two of the questionnaire's sub-scales including performance of daily living activities and symptoms related to CHF. Subjects reported that their CHF had less of an impact on their performance of daily living activities and symptoms related to CHF were reduced after training. The changes in quality of life exceeded established criteria (greater than one standard error of the mean) for consideration as clinically relevant changes thus indicating the effectiveness of combined high intensity strength and aerobic training for enhancing quality of life for individuals with CHF.

Key Words: Exercise, Activities of Daily Living, Heart Failure

INTRODUCTION

Congestive heart failure (CHF) is a chronic form of heart disease characterized by ventricular dysfunction and exercise intolerance (1). Nearly five million Americans have CHF and over 400,000 new cases are diagnosed each year (2). The incidence of CHF is 10 per 1,000 for individuals over 65 years of age and is the most common cause of hospitalization for this age group (2). The Health Care Finance Administration spends nearly

5.5 billion dollars for CHF hospital admissions, an amount greater than the expenditure for all types of cancer (2.24 billion) and for myocardial infarction (3.18 billion) combined (2). With the "graying of America" interventions such as exercise that have potential to limit hospital re-admissions and subsequent costly procedures will be important for cost effective disease management.

Exercise intolerance is a defining characteristic of CHF, leading to the reduced muscle mass and strength of the musculo-skeletal system (1). Loss of muscle mass and strength results in an impaired ability to perform routine activities of daily living, thereby impacting quality of life. Combining strength training with aerobic training may be an effective strategy for increasing muscle mass, and muscular strength and endurance in individuals with CHF. Such improvements would help restore the ability to perform activities of daily living and improve quality of life.

Recently, our lab evaluated the impact of combining high intensity strength and aerobic training on muscular strength for individuals with CHF (3). Our results indicated that average strength was significantly increased ($p<0.05$, 29%) with no cardiovascular concerns or significant muscle soreness or injury. The present study evaluated quality of life outcomes following a combined high intensity strength and aerobic training program for individuals with CHF. The Minnesota Living with Heart Failure questionnaire (MLHFQ) was used to assess changes in quality of life consequent to the training program (4). MLHFQ evaluates five dimensions including performance of daily living activities, psychological, symptoms associated with CHF, socioeconomic and physical (4). We hypothesized that the sub-scale related to performance of daily living activities would be most significantly impacted by exercise.

METHODS

Subjects

All participants in this study were phase II cardiac rehabilitation patients from River Cities Cardiology Cardiac Rehabilitation Center in Jeffersonville, Indiana. Patients are generally from the Louisville, Kentucky and Southern Indiana geographic region. Patients include males and females referred by participating physicians to the clinic. Patient conditions include coronary artery bypass surgery, myocardial infarction, angioplasty, cardiomyopathy, and other heart-related conditions. The average age of patient population was 55±15 yrs. Most patients were of modest socioeconomic status. Relevance of the combined aerobic and strength training regimen is especially important in this geographic location, since many patients enrolled at River Cities Cardiology Cardiac Rehabilitation Center are employed in heavy industry (automobile and appliance manufacturing, package delivery industries) where lifting tasks are an essential job requirement.

All subjects signed a consent form to participate in the research study and had a physical exam and maximal graded exercise test performed by a cardiologist before entrance into cardiac rehabilitation. 18 males with CHF were enrolled and completed all phases of the study. Average age was 67.0±12.5 yrs, height=174.2±6.1 cm, weight=88.8±13.4 kg, and ejection fraction=27.5±6.8 %. Medications included: beta blockers-11, diuretics-14, cardiac glycosides-4, ACE inhibitors-13, anticoagulants-10.

1RM Testing

One repetition maximal strength (1RM) testing and exercise training was performed on a Trotter MG60 (Trotter Front/Cybex Medway, MA) multi-station weight system. The Trotter MG60 uses fixed weight selection and provides both concentric and eccentric muscular action. The 1RM was measured for the seated shoulder press, leg extension, lat pull down, two-arm biceps curl and horizontal squat. These exercises are primarily multi-joint movements and representative of lower and upper body strength needed to perform activities of daily living. Our lab has utilized the 1RM testing methodology of Kraemer and Fry (5) in a number of research investigations with special populations including individuals with stable heart disease, pulmonary disease, CHF, post-menopausal African American women and elite athletes (3,6,7,8). All strength measurements were made with identical equipment positioning and technique.

Exercise Program

All subjects participated in a combined high intensity strength and aerobic training. The subjects performed 30 minutes of aerobic exercise on Monday, Wednesday, and Friday; 15 minutes on a Schwinn Air Dyne (Schellers Fitness, Louisville, KY) and 15 minutes on a Burdick 165 treadmill (New York, NY). Intensity for cardiovascular exercise was 60% to 80% maximum heart rate reserve and was increased an average of 0.5 metabolic equivalents per week consistent with subject tolerance.

Following their aerobic training, subjects performed high intensity strength training on Monday and Friday for the entire 8-week period. During weeks 1 and 2, subjects used 60% of the 1RM for 2 sets of 12 repetitions. During weeks 3 and 4, subjects used 80% of the 1RM for 2 sets of 8 repetitions. During weeks 5 to 8, the weight was increased on an individual basis to ensure that eight repetitions were the maximum number of repetitions that could be performed. Individual weight adjustment allowed each subject to exercise within the strength development zone of the repetition maximum continuum. The exercises used for the strength program were the seated shoulder press, leg extension, lat pull down, two-arm biceps curl and horizontal squat.

Minnesota Living with Heart Failure Questionnaire (MLHFQ)

The MLHFQ was administered to determine the subjects' self-assessment of the impact of CHF on their lives and perceived benefits of exercise. The MLHFQ is a 21-item, self-administered questionnaire that comprehensively covers physical, socioeconomic, and psychological impairments that patients often relate to their heart failure. A single score based on how each person ranks each item on a common scale is used to quantify the extent of impairment and how the impairment is affected by the therapeutic intervention, in this case combined strength and aerobic training. The MLHFQ has been shown to be reliable with a weighted kappa of 0.84 (n=83) (4). Associations with the overall rating of how much their CHF prevented them from living as they wanted ($r=0.80$, $p<0.01$) and the NYHA classification of CHF scheme ($r=0.60$, $p<0.01$) suggests validity (4). Randomized, placebo controlled studies have demonstrated the responsiveness of the MLHFQ to short-term interventions (9). Subjects completed the MLHFQ before and after 8 weeks of training.

Statistical Analyses

For the MLHFQ, five sub-scales derived from items representing five dimensions, performance of daily living activities, psychological, symptoms associated with CHF, socioeconomic and physical were analyzed. The five sub-scales, associated questions from the MLHFQ and alpha values (reliability indicator) are outlined in Table 1. When the MLHFQ is administered each item is preceded by: "Did your heart failure prevent you from living as you wanted during the last month by".

Table 1. Sub-scales and associated items from MLHFQ

Performance of Activities of Daily Living: (alpha = 0.74)
2. Making your working around house or yard difficult? 7. Making your walking about or climbing stairs difficult? 11. Making your going places away from home difficult? ***13. Making your recreational pastimes, sport, hobbies, difficult?***
Psychological: (alpha = 0.81)
16. Making you worry? 17. Making you feel depressed? 19. Making you feel loss of self-control in your life? ***21. Making you feel you are a burden to family or friends?***
Symptoms: (alpha = 0.79)
1. Causing swelling in your ankle, legs etc.? 4. Making you sit or lie down to rest during the day? ***5. Making you tired, fatigued, or low on energy? 8. Making you feel short of breath?*** ***9. Making your sleeping well at night difficult? 10. Making you eat less of the foods you like?*** ***14. Difficult to concentrate or remember things? 15.Giving you side-effects from medications?***
Socioeconomic: (alpha = 0.71)
3. Making your relating to or doing things with your friends/family difficult? ***18. Costing you money for medical care? 20. Making you stay in a hospital?***
Physical: (alpha = 0.59)
6. Making your working to earn a living difficult? 12. Making your sexual activities difficult?

Analysis of the sub-scales in addition to the composite score was consistent with our directional hypothesis that combining strength training with aerobic training is most likely to effect performance of activities of daily living rather than other dimensions related to quality of life for the individual with CHF. Cronbach's alpha for four of the five sub-scales ranged from 0.71 to 0.81 indicating the items used to represent the sub-scales were reliable and above the 0.70 benchmark (10). The exception to this benchmark score was the physical dimension sub-scale and subsequently this sub-scale was deleted from further analysis. A Wilcoxon signed-ranks test was used to examine pre- and post-training composite score as well as the sub-scale scores for the remaining four dimensions. Significance level was set at $p<0.05$.

RESULTS

Changes in muscular strength consequent to high intensity strength and aerobic training for the individual with CHF have been published previously (3). Significant improvements in strength were as follows: horizontal squat (18.3%), leg extension (31.6%), shoulder press (32.6%), lat pull-down (23.2%), and the biceps curl (25.5%). Overall compliance for the study was 89.5%, representing attendance of 451 visits out of a possible 504 sessions. Table 2 presents the mean pre- and post-sub-scale scores and the associated standard error of the mean (SEM) with four dimensions of the MLHFQ. Significant differences were found for the sub-scale of performance of activities of daily living ($p<0.05$). Subjects reported that their CHF had less of an impact on preventing them from performing activities of daily living after training ($p<0.05$). In addition, subjects reported they experienced significantly fewer symptoms associated with their CHF ($p<0.05$) following training. Shepherd and Franklin (11) have established a critical threshold, one SEM for changes in quality of life consequent to a specific intervention to be considered clinically relevant. The differences following training exceeded one SEM for both performance of activities of daily living (2.0 SEM) and symptoms associated with CHF (1.5 SEM) indicating changes in quality of life were clinically relevant.

Table 2 Mean pre and post exercise training quality of life scores with standard errors and alpha values (n=18).

Sub-scales for MLHFQ	***Pre-test***		***Post-test***	
	Alpha	***Score***	***Alpha***	***Score***
Performance of Activities of Daily Living	0.74	2.53±0.27	0.81	2.00±0.29*
Psychological	0.81	1.52±0.29	0.92	1.68±0.33
Symptoms	0.79	1.95±0.24	0.81	1.60±0.23*
Socioeconomic	0.71	1.77±0.31	0.67	1.64±0.3

* Post value significantly lower than pre ($p<0.05$) using Wilcoxon Signed Ranks Test

DISCUSSION

This study evaluated the impact of combining high intensity strength training with aerobic training on quality of life for individuals with CHF. Results indicate that subjects perceived the exercise program as decreasing the limitations that their CHF had on performing activities of daily living. Specifically, activities of daily living related to working around the house, climbing stairs, participating in recreational pastimes and daily tasks related to leaving one's residence. In addition, subjects perceived the combined exercise regimen as decreasing the symptoms associated with CHF such as fatigue, loss of energy and shortness of breath. These differences were considered to be clinically relevant based on the change score exceeding one SEM (12).

To date, only one study has used the MLHFQ to evaluate quality of life changes associated with exercise training and their impact on individuals with CHF. Keteyian and co-workers (12) randomly assigned 51 males with CHF to either an aerobic training or a control group. The investigators found improved exercise capacity as

measured by VO_2peak, however no significant differences were found for quality of life as measured with the MLHFQ. Furthermore, VO_2peak was not related to the total score or the physical sub-scale score of the MLHFQ. The authors stated that these findings might be related to the limited sensitivity of the MLHFQ instrument to detect changes in peak exercise performance (12). In contrast, the present study found significant increases in quality of life due to combining high intensity strength training with aerobic training, a protocol that may impact a primary exercise limitation of CHF, that is reduced muscle mass and strength.

Tyni-Lenne and associates have assessed quality of life changes for individuals with CHF as a result of skeletal muscle endurance training (13,14). Eight weeks of knee extensor endurance training on a cycle ergometer was determined to improve the overall, physical, and psychosocial dimensions of the Sickness Impact Profile (13,14). Specific items showing improvement included ambulating, home management and recreational pastimes. These results are consistent with those found in the present study, where the combined exercise regimen demonstrated clinically relevant improvements of quality of life related to activities of daily living specifically, working around the house, climbing stairs, participating in recreational pastimes and daily tasks related to leaving one's residence.

Keteyian and associates (12) evaluated the impact of aerobic exercise on quality of life for individuals with CHF while Tyni-Lynne and colleagues (13,14) studied low intensity muscular endurance training. To date, only one previous study evaluated the impact of high intensity strength and aerobic training on quality of life. Beniamini and associates (15) studied 38 low and intermediate risk cardiac rehabilitation patients assigned to either a high intensity (up to 80% of 1 RM) strength training group or flexibility group with each group participating in an identical aerobic program. The strength group demonstrated significantly enhanced self-efficacy, improved mood, and well being scores compared with the flexibility group. Specifically, the strength group increased their self-efficacy scores for lifting, push-ups, climbing and jogging when compared with the flexibility group. Self-efficacy was measured using the scale developed by Ewart and Taylor (16). The primary differences between Beniamini and associates (15) study and the present study is the risk of the populations evaluated (high risk in comparison to moderate and low risk) and questionnaires used to assess quality of life changes.

Conclusions

These results suggest strength training is an important and meaningful addition to traditional CHF exercise programs. It is difficult to directly compare the findings of currently available studies evaluating quality of life with heart patients due to use of different scales and different heart disease conditions. However, the important and consistent finding with addition of strength training (15) or muscular endurance training (13,14) is an increase in the quality of life scores for performing activities of daily living. In conclusion, this investigation found that subjects with CHF perceived combined high intensity strength and aerobic training as decreasing the limitations that their heart condition had on the activities of daily living. In addition, the subjects perceived their symptoms related to CHF to be less after the exercise intervention.

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