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A study of Effect of Endurance Training and Resistance on Injury Heart Disease Factors

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ABSTRACT: *Patients with chronic heart failure (CHF) report trouble performing exercises of everyday living. As far as anyone is concerned, on the other hand, no study has specifically measured execution in exercises of everyday living in these patients to methodically evaluate their level of physical incapacity. Patients and controls were surveyed for execution in exercises of everyday living, self-reported physical capacity, top high-impact limit, body structure and muscle quality previously, then after the fact a 18-wk resistance preparing system. To evacuate the frustrating impacts of a few malady related variables (muscle neglect, hospitalization, intense ailment), we enlisted controls with comparable movement levels as CHF patients and tried patients >6 months taking after any sickness intensification/hospitalization. Execution in exercises of every day living was 30% lower (P<0.05) in CHF patients versus controls and was identified with both lessened vigorous limit (P<0.001) and muscle quality (P<0.01). In addition, resistance preparing enhanced (P<0.05 to <0.001) physical capacity and muscle quality in patients and controls also, without changing oxygen consuming limit.*

Keywords: Body structure; chronic heart failure (CHF); exercises; muscle quality.

INTRODUCTION:

Is there any effect of endurance and resistance training on heart disease and factors related**.** At the advent of the 21st century, infectious diseases became relatively less of a concern, while chronic diseases continue to plague the global populace. Antibiotics and many other drugs help to treat acute diseases, whereas the biomedical model is limited when dealing with the health crisis resulting from chronic diseases, which develop over a prolonged period of time and persist for lengthy durations. As opposed to their acute disease counterparts, most chronic diseases are largely related to lifestyle factors, and can be minimized or prevented, for the most part, by lifestyle changes. Chronic diseases have one or more of the following characteristics: they are persistent and leave residual disability; they are caused by nonreversible pathological conditions; and they require special training of the patient on rehabilitation, or may be expected to require prolonged medical supervision, observation or health care. Among the most common chronic diseases that afflict humans worldwide are diabetes, cardiovascular diseases (CVDs), osteoporosis, arthritis, obesity, chronic obstructive pulmonary disease, inflammatory bowel disease, central nervous system degenerative diseases and some cancers. CVDs and chronic obstructive pulmonary disease not only contribute largely to morbidity and mortality but also put a heavy economic burden on the health care system at both a global and a national scale. CVDs caused 78,942 deaths (36% of all deaths) in India in 1999, and in 2000, CVDs were responsible for 18% of the total hospital costs in India. Therefore, it is important that CVD-related causes and concerns be addressed.

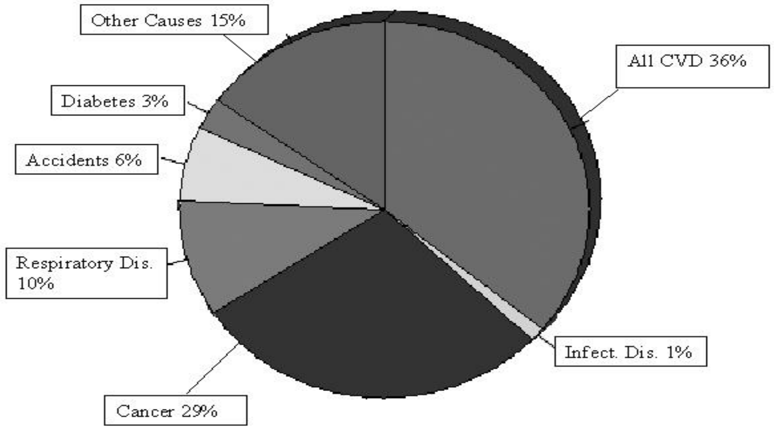

Figure 1: Leading causes of death in India in 1999. Percentages represent data combined from males and females of all ages. CVD Cardiovascular disease; Dis Diseases; Infect Infectious

Chronic heart failure (CHF) is a common condition with poor prognosis. CHF is characterized by the inability of heart muscle to meet tissue energy demand that results in symptoms of fatigue or dyspnoea initially on exertion and then later on progressing to even at rest. Actually, ventricular dysfunction is usually the major component of the CHF syndrome, which occurs in conjunction with skeletal muscle structural and functional abnormalities. There is also a perception that the underlying mechanisms are largely dependent on oxidative energy production and control of energy fluxes.

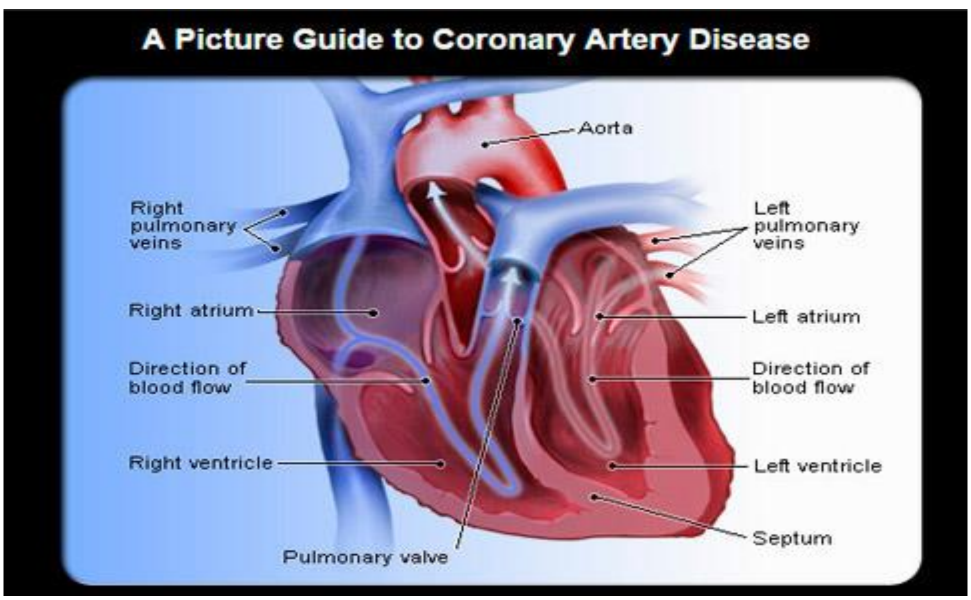

Figure 2: Heart disease

Physical inactivity is a modifiable risk factor for cardiovascular disease and a widening variety of other chronic diseases, including diabetes mellitus, cancer (colon and breast), obesity, hypertension, bone and joint diseases (osteoporosis and osteoarthritis), and depression. The prevalence of physical inactivity (among 51% of adult Canadians) is higher than that of all other modifiable risk factors. In this article we review the current evidence relating to physical activity in the primary and secondary prevention of premature death from any cause, cardiovascular disease, diabetes, some cancers and osteoporosis. We also discuss the evidence relating to physical fitness and musculoskeletal fitness and briefly describe the independent effects of frequency and intensity of physical activity. In a companion paper, to be published in the Mar. 28 issue, we will review how to evaluate the health-related physical fitness and activity levels of patients and will provide exercise recommendations for health.

HEART DISEASES:

The term "heart disease" refers to several types of heart conditions. The most common type is coronary artery disease, which can cause heart attack. Other kinds of heart disease may involve the valves in the heart, or the heart may not pump well and cause heart failure. Some people are born with heart disease. Anyone, including children, can develop heart disease. It occurs when a substance called plaque builds up in your arteries. When this happens, your arteries can narrow over time, reducing blood flow to the heart. Smoking, eating an unhealthy diet, and not getting enough exercise all increase your risk for having heart disease. Having high cholesterol, high blood pressure, or diabetes also can increase your risk for heart disease. Ask your doctor about preventing or treating these medical conditions.

METHODOLOGY

Patients with chronic heart failure (CHF) have high rates of physical disability, based on self-reported difficulty in performing of activities of daily living. An impaired ability to perform simple everyday tasks reduces patients' quality of life, increases health care costs by increasing the need for supportive services and is an independent predictor of mortality. Knowledge of the factors that determine physical function in CHF patients, therefore, has implications for improving quality of life and prognosis.

The ability to perform daily activities involves a complex interaction of physiological and psychological factors. In CHF patients, to our knowledge, no study has directly assessed disability by measuring performance in a range of common activities of daily living that encompass the physical skills required to function independently. The one exception is that many studies have evaluated 6 minute walk distance, a surrogate of aerobic fitness, as an index of functional capacity in daily activities. Arguably, this historical focus on indices of cardiorespiratory fitness is reasonable considering that the hallmark symptoms of CHF--dyspnea and fatigue --are emblematic of a reduction in aerobic capacity. Walking endurance, however, is only one aspect of physical function in daily activities. Moreover, performance in many daily activities has been shown to be poorly correlated to aerobic fitness in some cardiac disease populations, arguing that factors other than aerobic fitness likely contribute to physical disability.

Compared to the number of studies that have measured indices of aerobic fitness, the relative paucity of studies examining muscle

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strength is surprising considering evidence for marked muscle weakness in CHF patients and the fact that many common daily activities (eg, lifting objects, rising from a seated position, climbing stairs, etc) are strongly dependent on muscle strength. Despite the importance of muscle strength, its role in determining physical function in real-world activities of daily living in CHF patients has not been examined.

The purpose of this study was two-fold: 1) to compare performance in activities of daily living in CHF patients and healthy controls of similar age and habitual physical activity level to evaluate the extent of physical disability and its relationship to aerobic capacity and muscle strength; and 2) to determine the effects of 18 weeks of resistance training on muscle strength and performance of activities of daily living. We hypothesized that CHF patients would be characterized by considerable physical disability and that this would be related to both diminished aerobic capacity and muscle weakness. Additionally, resistance exercise training effectively increases muscle strength and the ability to perform activities of daily living independent of alterations in aerobic fitness. To isolate the effects of CHF, we recruited patients to limit the confounding effects of age, muscle disuse and acute disease exacerbation. In light of these considerations, our results likely reflect the unique effects of CHF on physical disability, muscle strength and their response to training, rather then the effects of age, muscle disuse or acute illness.

Thirteen patients (9 men, 4 women) with CHF were recruited. Ten patients (7 men, 3 women; mean ± SEM; age: 73.4 ± 2.4 yrs; height: 170.0 ± 2.7 cm; weight: 95.6 ± 9.4 kg) completed the trial and were included in the analyses. Of these ten patients, 7 were characterized by systolic failure with diminished ejection fraction (EF; 32 ± 2%, range = 28 to 38%), while 3 subjects had preserved systolic function (EF>40; 50 ± 3%, range = 44 to 53%). One patient was classified as Indian Heart Association class I, 6 as class II and 3 as class III.

The etiology of CHF was ischemic in 4 patients and idiopathic in 6. Patients were excluded if they had: 1) aute myocardial infarction or unstable angina within 3 months, 2) atrioventricular block greater than first degree without a functioning pacemaker, 3) severe hepatic or renal disease, 4) exercise-limiting peripheral vascular disease or orthopedic problems that limit their ability to perform exercise, 5) inflammatory arthritis or autoimmune disease or 6) an active neoplastic process or history of cancer within 5 yrs. To limit any effects of acute disease exacerbation/hospitalization on muscle performance and physical function, we included only patients who were clinically stable and had not been hospitalized for at least 6 months prior to study. Medications were maintained unchanged during the study and included: angiotensin-converting enzyme (ACE) inhibitors (100%), beta-blockers (90%), diuretics (50%) and HMG CoA reductase inhibitors (40%) and one female patient was receiving levothyroxine. The population included 3 patients with non-insulin dependent diabetes mellitus. Plasma creatine kinase levels were normal in all patients. All were weight-stable (± 2 kg during the prior 6 months), non-smokers and were not taking sex steroid replacement therapy.

All eleven (6 men, 5 women; age: 72.1 ± 2.1 yrs; height: 167.3 ± 3.4 cm; weight: 85.5 ± 5.4 kg), healthy volunteers self-reported being sedentary to minimally-active (≤2 sessions of ≥30 min of exercise/week) and were not participating in any exercise or weight loss programs. This recruitment criteria was included to obtain a control group with habitual activity levels that match the reduced level of physical activity in the CHF population. Controls were non-smokers, weight-stable and not taking sex steroid replacement therapy and had no signs or symptoms of heart failure, coronary heart disease or diabetes.

Left ventricular EF (>55%) was normal (62 ± 4%; range= 57 to 70%), as were blood counts/biochemical values. Five controls had hypertension. Three were treated with diuretics (27%) and two with ACE inhibitors (18%). All were normotensive at testing and showed no evidence of left ventricular hypertrophy or atrial enlargement by echocardiography. Three controls were on stable doses of HMG CoAs (27%) and one female was on levothyroxine. Plasma creatine kinase levels were normal in all controls.

Written informed consent was obtained from all volunteers and the protocol was approved by the Committees on Human Research at the University of Vermont. Baseline, pre-training data from a sub-set of volunteers in this study have been published in reports of the effects of CHF on whole muscle and single fiber protein content and contractile performance and myosin-actin cross-bridge kinetics.

Body composition

Total and regional body composition was assessed by dual energy x-ray absorptiometry (GE Lunar, Madison, WI), as described previously. Body composition measurements were not performed on one CHF patient because he exceeded the weight limit of the machine.

Exercise Protocol

Approximately 1 week following baseline evaluations, volunteers entered an 18-week resistance training program (3 X/wk). The resistance exercise training program was designed to improve whole body skeletal muscle strength with the goal of determining whether improvements in muscle strength can improve functional performance in activities of daily living. The training intensity was set to 80% of 1RM commensurate with guidelines for improving muscle strength and inducing hypertrophy. The range of exercises, the progression of exercise volume and intensity and the length of the program were derived from our previous studies in healthy elderly and those with cardiac disease, and are supported by data from others. Subjects were asked to not undertake any additional exercise during the study period. Compliance with the protocol was excellent (91%) and was similar between CHF and control groups (47.6 ± 2.1 vs. 48.9 ± 0.9 sessions/patient, respectively, P=0.55). The original CHF cohort consisted of 13 patients. Three heart failure patients did not complete the training study: one because he became injured in a motor vehicle accident, another because of acute worsening of his heart failure and the last for personal reasons.

The resistance training intervention was individually designed based on 1-repetition maximum (1 RM; maximum weight an individual can lift once), as described in detail. At baseline, 1 RM was determined on each of 7 exercises, including: 1) leg extension; 2) leg press; 3) leg curls; 4) shoulder press; 5) bench press; 6) bicep curls; and 7) lateral pull-downs. A “composite 1 RM” was calculated by tallying the 1 RM for each of the 7 different exercises to provide an index of whole body muscle strength. Each session was supervised by an exercise physiologist or physical therapist. The progression of the program was gradual in both intensity and volume of exercise to orient the volunteers to the resistance training stimulus. The intensity of exercise began at 50% 1RM for 1 set of 10 repetitions during the first week. On week 2, the intensity was increased to 60% for 2 sets of 8 repetitions. On week 3, the intensity was increased to 70% for 3 sets of 8 repetitions. By week 4, all volunteers were exercising at 80% of 1RM for 3 sets of 8-repetitions. This ensured that the volunteers were exposed to the 80% 1RM stimulus for at least a 3 month period. 1RM was reassessed every 2 wks to account for improvements in strength. At the completion of the training program, all baseline evaluations were repeated, including 1 RM measurements. The only exception was echocardiography, which was repeated in CHF patients, but not controls.

PHYSICAL EXERCISES:

Physical exercises are generally grouped into three types, depending on the overall effect they have on the human body:

- Aerobic exercise is any physical activity that uses large muscle groups and causes your body to use more oxygen than it would while resting.[8] The goal of aerobic exercise is to increase cardiovascular endurance.[9] Examples of aerobic exercise include cycling, swimming, brisk walking, skipping rope, rowing, hiking, playing tennis, continuous training, and long slow distance training.
- Anaerobic exercise is also called strength or Resistance training and can firm, strengthen, and tone your muscles, as well as improve bone strength, Balance, and Coordination. Examples of strength moves are pushups, lunges, and bicep curls using dumbbells. Anaerobic exercise also include weight training, functional training, eccentric training, Interval training, sprinting and high-intensity interval training increase short-term muscle strength.

While high intensity interval exercises accomplish greater benefits in a fraction of the time compared to slow, endurance-type exercises like jogging, I don't recommend limiting yourself to that alone. Of equal, if not greater importance, is to avoid being too sedentary in general. Compelling research now tells us that prolonged sitting can have a tremendously detrimental impact on your health even if you exercise regularly. The reason for this is because your body needs to interact with gravity in order to function optimally. Therefore, make sure to get out of your chair every 10 minutes or so, as suggested below.

STRETCHING AND WARM-UP:

Weight trainers commonly spend 5 to 20 minutes warming up their muscles before starting a workout. It is common to stretch the entire body to increase overall flexibility; however, many people stretch just the area being worked that day. The main reason for warming up is injury prevention. Warming up increases blood flow and flexibility, which lessens the chance of a muscle pull or joint pain. Warm up sets are also important. For example, the same lifter working on his chest would also be advised to complete at least two warm up sets prior to hitting his "core tonnage." Core tonnage refers to the heavier lifts that actually strain your muscles. For example, if the lifter's main sets were at 205 lbs, 225 lbs and 235 lbs on the bench, then a warmup of 5 reps of 135 and 5 reps of 185 would be advisable. When

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properly warmed up the lifter will then have more strength and stamina since the blood has begun to flow to the muscle groups.

Figure 3.1: Stretching and Warm-Up Exercise

BREATHING:

Breathing shallowly or holding one's breath while working out limits the oxygen supply to the muscles and the brain, decreasing performance and, under extreme stress, risking a black-out or a stroke by aneurysm. Most trainers advise weight trainees to consciously "exhale on effort" and to inhale when lowering the weight. This technique ensures that the trainee breathes through the most difficult part of the exercise, where one would reflexively hold one's breath.

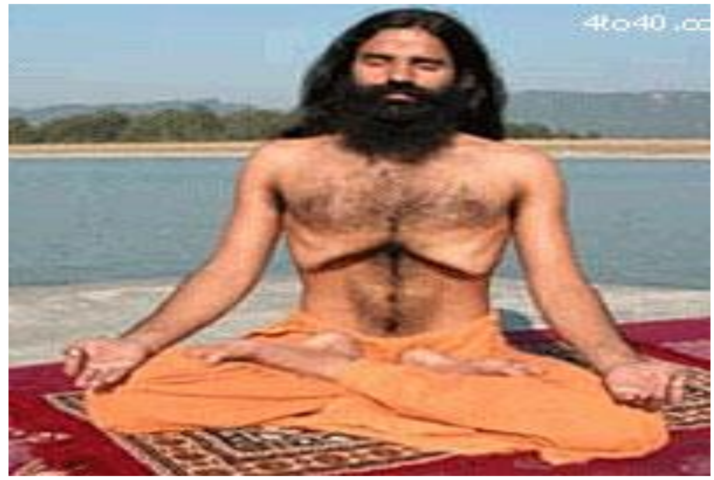

Figure 3.2: Breathing Exercise

Figure 3.3: Yoga Exercise

Free weights include dumbbells, barbells, medicine balls, sandbells, and kettlebells. Unlike weight machines, they do not constrain users to specific, fixed movements, and therefore require more effort from the individual's stabilizer muscles. It is often argued that free weight exercises are superior for precisely this reason. For example, they are recommended for golf players, since golf is a unilateral exercise that can break body balances, requiring exercises to keep the balance in muscles.

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BASELINE DATA:

At baseline, study groups were similar by age, sex distribution, body size and composition and physical activity; whereas, as expected, CHF patients had lower EF and peak VO_2, and greater left ventricular end systolic volume (all P<0.001; Table 1).

Table 1: Physical and clinical characteristics, aerobic capacity and physical activity levels and their response to resistance exercise training.

	Control		Heart Failure		P Value		
	Pre	Post	Pre	Post	Group	Training	Group x Training
Age (years)	72.1 ± 2.1		73.4 ± 2.4				
Sex (Male/Female)	6/5		7/3				
Height (cm)	167.3 ±3.4		170.0 ± 2.7				
Weight (kg)	85.5 ± 5.4	85.0 ± 5.1	95.6 ± 9.4	96.0 ± 9.1	0.32	0.94	0.44
Fat mass (kg)	31.7 ± 2.1	30.8 ± 2.0	35.3 ± 4.6	35.6 ± 4.5	0.38	0.58	0.32
Fat free mass (kg)	51.0 ± 4.3	50.9 ± 4.4	51.9 ± 5.0	53.2 ± 5.2	0.81	0.06	0.03
Fat (%)	38.9 ± 2.4	38.1 ± 2.5	39.5 ± 2.6	39.5 ± 2.7	0.78	0.11	0.13
Leg fat free mass (kg)	15.7 ± 1.4	15.7 ± 1.3	14.3 ± 1.5	14.4 ± 1.3	0.50	0.95	0.72
Arm fat free mass (kg)	5.5 ± 0.6	5.7 ± 0.6	4.7 ± 0.6	5.0 ± 0.6	0.39	0.001	0.44
Appendicular muscle mass (kg)	21.3 ± 1.9	21.4 ± 1.9	19.1 ± 2.1	19.4 ± 1.9	0.47	0.24	0.57
Ejection fraction (%)	62.3 ± 1.2 ‡	NP	37.7 ± 3.2	37.9 ± 4.5			
Left ventricular end diastolic volume (mL)	87.0 ± 13.7	NP	118.4 ± 9.4	122.7 ± 14.9			
Left ventricular end systolic volume (mL)	34.6 ± 6.1 ‡	NP	75.2 ± 8.3	79.9 ± 13.8			
Stroke volume (mL)	52.4 ± 7.8	NP	43.2 ± 4.0	42.8 ± 5.6			
Peak VO_2 ($mLO_2 * kg^{-1} * min^{-1}$)	23.4 ± 1.3 ‡	23.6 ± 1.0	14.6 ± 1.4	15.6 ± 1.1	0.0001	0.24	0.47

Accelerometer (kcal/day)	248.6 ± 40.3	285.8 ± 55.0	269.5 ± 41.4	214.5 ± 33.7	0.63	0.80	0.19

Data are mean ± SEM for n=11 controls and 10 and patients, except body composition measures, which reflect n=9 CHF patients. NP = not performed.
‡= P<0.001, differences between groups for pre-training values.

When composite 1RM was statistically controlled for body mass, whole body muscle strength was significantly reduced by 24% in CHF patients vs. controls (222.9 ± 20.2 vs. 293.5 ± 19.3 kg; P=0.023). Similarly lower (25%) muscle strength was found in CHF patients when leg extension measurements were adjusted for body mass (38.0 ± 4.1 vs. 50.6 ± 3.9 kg; P=0.042), in keeping with our prior report examining knee extensor strength in a sub-set of this cohort using dynamometry. Additionally, after adjustment for body weight, 1RM for bench press (−28.9%; P=0.031), shoulder press (−34%; P=0.05) and leg press (−15%; P=0.05) were lower in CHF patients; whereas, there was a strong trend towards a lower 1RM for leg curl (−37%; P=0.061). Although no differences were found for 1RM values for lat pull down (P=0.125) or arm curl (P=0.172). CHF patients had a lower (P<0.01) total PFP-10 score at baseline (Table 3), because of reduced (P<0.05 to P<0.01) lower body strength, balance and endurance; whereas, upper body strength and flexibility were similar between groups. Additionally, baseline 6 min walk distance was reduced (P<0.001) in CHF patients.

Table 2: Muscle strength measures and their response to resistance exercise training.

	Control		**Heart Failure**		**P Value**		
	Pre	**Post**	**Pre**	**Post**	**Group**	**Training**	**Group x Training**
Bench press (kg)	47.9 ± 9.6	73.8 ± 12.0	44.1 ± 9.9	72.7 ± 7.3	0.89	<0.001	0.72
Arm curl (kg)	18.9 ± 3.5	29.1 ± 5.2	17.0 ± 3.5	24.5 ± 4.3	0.60	<0.001	0.29
Lateral pulldown (kg)	37.8 ± 7.3	52.9 ± 5.9	37.5 ± 5.8	50.0 ± 4.5	0.85	<0.001	0.42
Shoulder press (kg)	34.2 ± 13.7	51.5 ± 10.1	30.7 ± 8.5	47.7 ± 8.0	0.78	<0.001	0.96
Leg curl (kg)	18.0 ± 5.9	32.0 ± 4.3	13.8 ± 4.0	25.5 ± 5.2	0.36	<0.001	0.61
Leg press (kg)	66.1 ± 6.9	80.0 ± 3.8	63.9 ± 3.6	73.9 ± 5.8	0.64	<0.001	0.43
Leg extension (kg)	47.9 ± 9.7	70.2 ± 4.7	40.9 ± 7.3	59.1 ± 3.5	0.32	<0.001	0.45
Composite 1 RM (kg) [*]	271 ± 35	361 ± 40	248 ± 46	333 ± 58	0.69	<0.001	0.79

Data are mean ± SEM. No group differences were found between pre-training values for any measure. Composite 1 RM represents the sum of 1 RM values from each of the 7 different exercises.

*Lower composite 1RM values were found in CHF patients after statistical adjustment for differences in body size (ie, see text in *Results* section).

Table 3: Directly measured physical function (Physical Functional Performance Test, PFP-10) and their response to resistance exercise training.

	Control		**Heart Failure**		**P Value**		
	Pre	**Post**	**Pre**	**Post**	**Group**	**Training**	**Group x Training**
Total PFP-10 Score	69.6 ± 3.9	73.5 ± 4.2	48.5 ± 6.9	53.9 ± 6.8	0.01	0.001	0.47
Upper body strength	62.6 ± 6.9	74.0 ± 6.0	53.9 ± 9.5	59.3 ± 10.1	0.32	0.001	0.15
Lower body strength	64.3 ± 4.6 *	70.4 ± 4.7	43.7 ± 6.8	48.9 ± 7.2	0.02	0.001	0.65
Upper body flexibility	71.8 ± 4.2	72.5 ± 4.6	59.9 ± 6.3	65.7 ± 6.0	0.20	0.20	0.31
Balance	73.0 ± 3.8	74.7 ± 4.4	48.1 ± 7.0	53.8 ± 6.6	0.01	0.02	0.20
Endurance	72.7 ± 3.6	74.7 ± 4.1	47.4 ± 6.6	52.6 ± 6.4	0.01	0.15	0.24
6 min walk (meters)	536 ± 23	554 ± 21	361 ± 33	389 ± 32	0.001	0.05	0.64

Table 4: Self-reported quality of life measures (MOS SF-36) and the response to resistance exercise training.

	Control		**Heart Failure**		**P Value**		
	Pre	**Post**	**Pre**	**Post**	**Group**	**Training**	**Group x Training**
Physical Function	82.3 ± 5.3	90.9 ± 1.9	62.0 ± 5.7	67.0 ± 6.2	0.01	0.06	0.61
Role-Physical	95.5 ± 3.1	86.4 ± 7.8	50.0 ± 11.7	55.0 ± 12.8	0.01	0.77	0.32
Bodily Pain	83.9 ± 5.0	71.5 ± 5.7	67.6 ± 6.3	65.9 ± 8.3	0.18	0.11	0.22
General Health	75.5 ± 3.0	79.6 ± 4.1	56.4 ± 5.6	61.6 ± 5.1	0.01	0.19	0.89
Physical Component							
Summary Score	84.3 ± 2.4	82.1 ± 3.8	59.0 ± 5.1	62.4 ± 6.2	0.001	0.86	0.69

Vitality	73.2 ± 4.1 *	77.7 ± 3.5	59.0 ± 3.2	55.5 ± 6.6	0.005	0.85	0.14
Social Function	100.0 ± 0.0	100.0 ± 0.0	82.8 ± 5.8	86.1 ± 5.8	0.01	0.59	0.59
Role-Emotional	91.0 ± 4.6	84.9 ± 9.4	70.1 ± 10.5	73.4 ± 10.9	0.11	0.87	0.58
Mental Health	85.5 ± 2.9	86.9 ± 3.4	81.6 ± 2.9	86.8 ± 3.4	0.56	0.08	0.31
Mental Component							
Summary Score	87.4 ± 2.0	87.4 ± 2.6	73.3 ± 4.1	75.4 ± 4.6	0.01	0.71	0.70

Correlation analysis evaluated which physiological and psychological factors predict reduced physical function (Table 5). We examined both measured (i.e., PFP-10) and self-reported physical function (i.e., MOS SF-36 sub-domain) as indices of true physiological capacity for daily activities and self-perceived functional capacity, respectively, and also evaluated predictors of 6-minute walk performance, because it is a commonly used index of functional capacity in CHF populations. For directly measured functional capacity (ie, PFP-10 total score), peak VO_2 ($P<0.001$), 1 RM composite ($P<0.01$) and MOS SF-36 mental component score ($P<0.05$) were significant correlates. For 6 min walk distance, the correlates were similar to PFP-10 total score, but also included EF ($P<0.01$). For self-reported physical function, peak VO_2, measured physical functional capacity (ie, PFP-10 total score), MOS SF-36 Mental Component Score and ejection fraction (all, $P<0.01$) were significant correlates, whereas 1RM composite was not.

Table 5: Baseline correlates of directly-measured physical function (PFP-10), 6-minute walk distance and self-reported physical function.

	PFP-10	**6 minute walk distance**	**Self-reported physical function**
Peak VO_2	0.78 ‡	0.89 ‡	0.59 ‡
Composite 1 RM	0.64 †	0.46 *	0.02
Mental component score (MOS SF-36)	0.44 *	0.49 *	0.69 ‡
Ejection fraction	0.38	0.59 †	0.57 †
PFP-10	----	----	0.63 †

Data represent Pearson correlation coefficients for n=21. Composite 1 repetition maximum (1 RM) reflects the sum total of 1 RM data from 7 different exercises and self-reported physical function represents the physical function sub-domain of the MOS SF-36.

Resistance training data

No training or group by training effects were observed for body weight, adiposity, appendicular skeletal muscle mass or peak VO_2 (Table 1 and Figure 1). Resistance training increased ($P<0.01$ training effect) arm fat free mass and there was a trend toward an increase in fat free mass ($P=0.057$). CHF patients showed a greater increase in fat free mass with training when compared to controls ($P=0.03$ group X training effect). For CHF subjects, there were no changes in LV volumes or EF with training.

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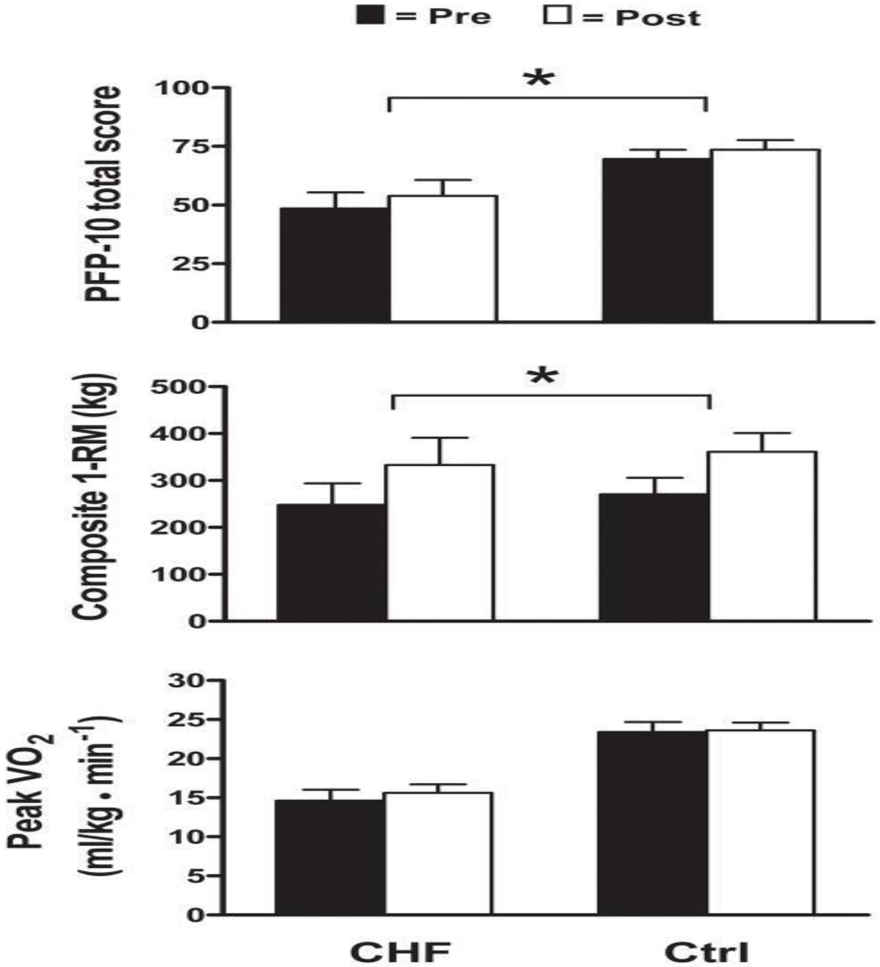
Figure 1:



Baseline (ie, pre; closed bars) and post-training (open bars) data for performance in activities of daily living (PFP-10 total score), composite 1 RM and peak VO_2 in chronic heart failure (CHF) patients and controls (Ctrl). Data were analyzed by 2 × 2 repeated measures analysis of variance to examine group, training and group by training interaction effects. Note that baseline PFP-10 and peak VO_2 were lower in CHF patients compared to controls (P<0.01 and P<0.001, respectively) and that composite 1RM was lower in CHF patients compared to controls (P<0.05) when statistically adjusted for body size. *, P<0.01 for training effect.

Resistance training resulted in significant improvements in all 1 RM measures, including composite 1 RM (all, P<0.001 training effect.

Total PFP-10 score improved with training in both groups (P<0.001 training effect; Table 3 and Figure 1), as a result of improvements in upper and lower body strength and balance scores (P≤0.02 to 0.001); whereas, no improvements in upper body flexibility or endurance were noted. Training-induced increases in performance of activities of daily living were similar between groups (ie, no group X training effect). Training increased 6 minute walk distance in both groups similarly ($P<0.05$). Conversely, there was no training effect on MOS SF-36 scores (Table 4), although there were trends toward improvement in the physical function and mental health sub-domains ($P=0.06$ and $P=0.08$, respectively).

CONCLUSION

In conclusion, exercise training in CHF patients has some merits and as discussed in this review, the changes induced by exercise at molecular level are well documented. However, how these changes translate into symptom improvement and QOL transformation is still not clear; in part due to lack of standardisation of the different ET protocols used. But before such patients can participate in a training programme, it is important to clarify the pathophysiology of their heart failure and thus identify their limiting factors. Finally the patient's individual profile requires definition: the training programme must be tailored to the patient's specific limitations and desired level of activity. Nevertheless, with the existing pool of evidence ET may safely be advocated to patients by health professionals keeping in view of their HF pathophysiology; whilst awaiting results from more robust large randomised studies. As discussed earlier, cardiac failure itself is a syndrome of circulatory failure, secondary to ventricular dysfunction. This primarily ventricular dysfunction is followed by a variety of neurohumoral, peripheral circulatory, skeletal muscle, and respiratory adaptations which determine the syndrome's clinical presentation and prognosis more than the primary ventricular dysfunction itself. Traditionally, avoidance of exercise was thus advocated in all forms and stages of heart failure. However, there is now evidence that inactivity leads to a further deterioration of remaining functional capacity. Published data so far on one hand is difficult to interpret with regard to the benefits of exercise duration and intensity on the outcome in chronic heart failure patients. Yet, more recently it has been shown that selected patients with compensated stable CHF can safely follow a training programme, thereby improving exercise tolerance and functional status.

Further research is thus necessary to confirm the role of ET as a treatment for patients with CHF, and to determine the most appropriate intensity, mode, and duration of training. Training can comprise overall endurance training monitored by heart rate, interval training based on percentage of maximum exercise level, or strength training. It has been suggested that muscle groups can be trained simultaneously or consecutively. For training to be effective, the intensity should be sufficiently high, and the frequency should be at least three times a week. Initial training, lasting for at least six weeks, should be followed by a maintenance training regimen, since all improvements are reversible. An active lifestyle should be promoted.

RECOMMENDATION

- Don’t get disheartened – science has made significant progress .
- Just monitor risk factors much more aggressively
  - ✓ Eat healthy
  - ✓ Walk regularly
  - ✓ Watch your weight
  - ✓ Quit smoking immediately
  - ✓ Keep your weight under control
  - ✓ In addition to improving your heart-healthy these measures are sure to your appearance.

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