EFFECTS OF INTENSIVE STRENGTH TRAINING ON CARDIOVASCULAR ENDURANCE

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Review paper

Abstract
Summary research on the topic: "Effects of intensive strength training on cardiovascular endurance", is selected to review the companion problems as the first in the world after death is not making a difference in age. We wish to contribute to clearing up the answer to the question of how intensive training of strength affecting changes the function of the cardiovascular system. Argues that we need knowledge and statistical data to what extent intensive strength contributes to transformation independently and in combination with some other type of training. It primarily thinks of the impact aerobic research out combined with strength training. Research interests include respondents of different age, different health problems, divided by sex. Various training programs can give us reliable data in a positive evaluation of training programs just applied to different categories of the population with all the differences (age, gender, health).

Key words: *training, strength, hearth, pressure and endurance*

Introduction

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Previous research

Rimmer, Riley, Creviston & Nicola (2000) research exercise training in a predominantly african-american group of stroke survivors. The results indicated that the exercise group improved significantly in peak [Vo.sub.2], time to exhaustion, muscular strength in the bench press and leg press exercises, hamstring flexibility, and skinfold measurement. These variables either remained unchanged or worsened in the lag control group during the first 12-week iteration. No significant differences were observed between the two groups in shoulder flexibility, handgrip strength, or waist-to-hip ratios. The authors concluded that people with stroke can make significant fitness improvements with a supervised exercise program. They also suggested that greater efforts should be made to involve people with stroke in fitness and physical activity programs and such programs may help reduce morbidity and disability in these people. Ferketich, Kirby & Alway (2002) research cardiovascular and muscular adaptations to combined endurance and strength training in elderly women. Chi-square analysis of fibre area data showed an increase in the frequency of larger type I fibres in the post-training data from the E & S group, but an increase in the frequency of smaller fibres in the E group post-training; however, mean fibre area was not significantly changed by training. These data suggest that greater improvements in sub-maximal time to fatigue and strength are achieved when resistance training is added to an aerobic training programme in healthy elderly women. Carvalho, Mota & Soares (2003) research strength training vs. aerobic training: cardiovascular tolerance in elderly adults. The aim of the present study was to evaluate cardiovascular tolerance to two different types of exercise (strength training vs. aerobic training) in healthy elderly subjects. The results showed no significant differences in heart rate (HR), sessions and by measuring systolic (SBP) and diastolic blood pressure (DBP) values between the two training types. Both sessions were performed at appropriate intensity without exaggerated cardiovascular response. In strength training, exercises that involved the legs presented higher rises in SBP and DBP values than those performed with the arms. These data suggest that, if appropriate techniques are used, strength training as well as gymnastics can be performed by healthy older subjects so long as basic rules for exercise in this population are followed. Furthermore, the data indicate a greater cardiovascular hemodynamic response after strength exercises with the legs than arms. Fröhlich, Schmidtbleicher & Emrich (2004) research metabolic and cardiovascular response in strength endurance training.

The purpose of this empirical study was: 1st: To evaluate the strain in three specifically trained training groups (untrained, athletics and wrestler) by a constant stress (20-RM) in a typically strength endurance training. 2nd: To predict the strain in strength endurance training over six sets. The results are: The research load as an objective parameter decreased over the six sets and there was a significant difference between the three different groups. Lactic acid concentration increased in the same way over the sets and there was no statistic difference between the groups. The findings of heart rate, systolic blood pressure, double product and rating of perceived exertion remain clear. There was no health risk by usage rate in the set in the three groups. Wilborn, Greenwood, Wyatt, Bowden, & Grose (2004) research the effects of exercise intensity and body position on cardiovscular variables during resistance exercise. There were no significant ($p > 0.05$) differences in systolic blood pressure (SBP) or heart rate (HR) between body position or apparatus. A significantly higher HR and BP were found in the following conditions for hack squat (HS): 65% > 1 RM, 85% > 1 RM, 65% > 85%. Also, during the leg press (LP) condition, BP and HR were greater at 65% than during 1 RM. These findings suggest cardiovascular measures are influenced by intensity, rather than apparatus or body position, during resistance exercise. Izquierdo, Häkkinen, Ibáñez, Kraemer & Gorostiaga (2005) research effects of combined resistance and cardiovascular training on strength, power, muscle cross-sectional area, and endurance markers in middle-aged men. No significant differences were observed in the magnitude of the increases in research load (Wmax) between endurance training alone (cycling exercise) (E) (14%), endurance (once weekly) training on muscle mass (SE) (12%) and E (10%) during the 16-week training period. During the last 8 weeks of training, the increases in Wmax in E and SE were greater ($P<0.05–0.01$) than that observed in resistance training alone (S). No significant differences between the groups were observed in the training-induced changes in sub-maximal blood lactate accumulation. Significant decreases ($P<0.05–0.01$) in average heart rate were observed after 16 weeks of training in 150 W and 180 W in SE and E, whereas no changes were recorded in S. The data indicate that low-frequency combined training of the leg extensors in previously untrained middle-aged men results in a lower maximal leg strength development only after prolonged training, but does not necessarily affect the development of leg muscle power and cardiovascular fitness recorded in the cycling test when compared with either mode of training alone. Faulkner, Quinn, Rimmer & Rich (2005) research a cardiovascular endurance and heart rate variability in adolescents with type 1 or type 2 diabetes. This investigation explored the influence of type of diabetes, gender, body mass index (BMI) and metabolic control (HbA1c). Furthermore, exercise beliefs, physical activity on cardiovascular endurance (CE), and heart rate variability (HRV), too. Regardless of the type of diabetes, females and those with higher BMI, poorer metabolic control, and lower amounts of physical activity tended to have lower levels of CE. Exercise beliefs consistently predicted both frequency and time domain HRV measures. Measures of exercise beliefs, self-reported physical activity, CE (V0 (2peak)), and HRV were significantly lower in adolescents with type 2 DM (diabetes measures) in comparison to those with type 1 DM. Early findings of poor physical fitness, lower HRV, fewer positive beliefs about exercise, and less active lifestyles highlight the importance of developing culturally sensitive interventions for assisting youth to make lifelong changes in their physical activity routines. Females, those with poorer metabolic control, and minority youth with type 2 DM may be particularly vulnerable to later cardiovascular disease. Okamoto, Masuhara & Ikuta (2006) research cardiovascular responses induced during high-intensity eccentric and concentric isokinetic muscle contraction in healthy young adults.

The purpose of this study was to determine the differences in cardiovascular response between high-intensity eccentric (ECC) and concentric (CON) contractions, and to obtain the basic data applicable to resistance training in middle-aged and elderly individuals. ECC were significantly smaller compared with CON. It is clear that cardiovascular response by high-intensity contraction is smaller in ECC than in CON. High-intensity ECC has been suggested to exert only small stress to the cardiovascular system. Thus, being a contraction mode it may be applicable to resistance training. D’Assunção et al. (2007) research acute cardiovascular responses in strength training conducted in exercises for large and small muscular groups. The aim of this study was to compare the behaviour of the systolic blood pressure (SBP); diastolic blood pressure (DBP); heart rate (HR) and double product (DP) during the unilateral performance of three sets of 10RM in two exercises involving distinct muscular groups. The two-way ANOVA with repeated measurements, followed by the post-hoc test by Tukey did not find differences ($p > 0.05$) for intraexercises SBP. Therefore, at least in the present study, the muscular mass involved in the strength training did not influence the acute cardiovascular responses in trained normotensive subjects. Acute cardiovascular responses in strength training conducted in exercises for large and small muscular groups. Casey, Beck & Braith (2007) research progressive resistance training without volume increases does not alter arterial stiffness and aortic wave reflection. Results: there are no changes were observed in brachial flow–mediated dilation (FMD), plasma levels of nitrate/nitrite (NOx), norepinephrine (NE), or blood pressures. These results suggest that a resistance training (RT) protocol consisting of progressively higher intensity without concurrent increases in training volume does not increase central or peripheral arterial stiffness or alter aortic pressure wave characteristics in young subjects.

Bottaro et al. (2007) demonstrated that a high-velocity power resistance training program can be performed safely in older men and appears to be more effective in improving muscular power, and more importantly, functional performance, compared with a low-velocity traditional resistance training program. Compared to baseline, heart rate (HR) and double product (DP) were significantly ($p < 0.05$) higher after the third set of both upper and lower body exercise in of all the protocols. HR and DP were significantly ($p < 0.05$) lower in the two discontinuous rep protocols compared with the continuous rep protocol for upper body exercise.

However, HR and DP were significantly ($p < 0.05$) lower only in the discontinuous (5 second rest) protocol for lower body exercise. It appears that discontinuous high-velocity resistance exercise, otherwise known as power training, may have a lower cardiovascular demand than continuous resistance exercise in older women. These findings may help exercise scientists to prescribe high velocity resistance exercise in a safety manner. Also, help encourage long term adherence to power training in the elderly population. Da Silva et al. (2007) research high-velocity resistance exercise protocols in older women: effects on cardiovascular response. Acute cardiovascular responses to different high-velocity resistance exercise protocols were compared in untrained older women. Compared to baseline, heart rate (HR) and rate pressure product (RPP) were significantly ($p < 0.05$) higher after the third set in all protocols. HR and RPP were significantly ($p < 0.05$) lower in a pause of five (DP5) and 15 (DP15) compared with continuous protocol (CP) for the bench press (BP) exercise. Compared to baseline, Rating of Perceived Exertion (RPE) increased significantly ($p < 0.05$) with each subsequent set in all protocols.

Blood lactate concentration during DP5 and DP15 was significantly lower than CP. It appears that discontinuous high-velocity resistance exercise has a lower cardiovascular demand than continuous resistance exercise in older women. Resnik et al. (2007) research the resistance training as important component of cardiac rehabilitation; however, there are concerns about orthopaedic and hemodynamic complications. The purpose of our study was to evaluate the effects of resistance training on muscle strength and hemodynamic response in patients with coronary heart disease (CHD). All patients completed the weightlifting exercises without dysnea and/or chest pain, increasing their muscle strength in P 34.34%, D 15.51%, B 16.75% and C 18.72%. These values were statistically significance ($P < .05$), in comparison to hemodynamic variables: heart rate, systolic and diastolic blood pressure (NS). Resistance training has demonstrated to be safe, using appropriated research loads, improving upper and lower body strength with an adequate cardiovascular response. Vincent et al. (2007) research strength training and hemodynamic responses to exercise. Post-training, time to peak systolic and diastolic blood pressures and heart rate was increased in the low-intensity exercise (LEX) and high-intensity exercise (HEX) groups by 22.9% and 44.5%, respectively ($p<0.05$). Diastolic blood pressure, heart rate, and mean arterial pressure during the graded exercise test (GXT) were significantly decreased ($p<0.05$) in the high-intensity exercise group HEX group following training. Post-GXT heart rate was lower in the HEX and LEX groups compared to control ($p<0.05$) indicating a more rapid recovery. Resistance exercise prolongs the onset of peak cardiovascular responses, decreases the cardiovascular response to exertion, and improves recovery from maximal exertion. Polito et al. (2008) research discontinuous sets of knee extensions induce higher cardiovascular responses in comparison to continuous ones. To compare the acute cardiovascular responses of systolic arterial pressure (SAP), diastolic arterial pressure (DAP), heart rate (HR) and double product (DP) during the unilateral knee extension (four series of 8 maximum repetitions) performed continuously or discontinuously. The discontinuous series showed significantly higher values when compared to the protocol of the continuous series. The discontinuous protocol promoted higher increase in pressure responses when compared to the continuous one. The strength training can promote significant cardiovascular responses during its performance and it is interesting to devise strategies to reduce them, without compromising the strength production.

Participants

Research on the topic: "Effects of intense strength training on cardiovascular endurance", were selected in four ways, namely: by age (5 categories), research on gender of respondents (men, women, both sexes), based on health status (ill and healthy), based on the training program (strength and aerobic) and it all finally summarized in obtaining the sum of positive or negative results.

Table 1. Basic information

Year	25-35	35-45	45-55	55-65	65-75>	∑
M	3	/	/	/	1	4
W	/	1	1	1	3	6
B	1	1	/	1	2	5
∑	4	2	1	2	6	15
Se	/	/	/	2	1	3
H	4	2	1	/	5	12
∑	4	2	1	2	6	15
St	4	1	1	/	4	10
St+At	/	1	/	2	2	5
∑	4	2	1	2	6	15
+	2	1	/	2	6	11
-	2	1	1	/	/	4
∑	4	2	1	2	6	15

Legend: M–men, W–women, B-both (M&W), Se-Seek (ill), H-health, St-strength training, At-aerobic training.

Discussion and conclusion

Total researches subjects include age from 25 to 35 years were 4 (3 men and 1 of both sexes). All four studies were conducted of subjects who were healthy. Strength training program is the only program in the experimental treatment in all studies in this category. Positive research results showed that the two researches are positive and other two researches are negative. Total research subjects include age from 35 to 45 years was 2 (1 with women and 1 of both sexes). The survey was conducted of the respondents who were healthy. Strength training program was in one experimental treatment, and the program of aerobic training with strength in the second experimental treatment.

Positive result shows one research, and a negative result also shows one research. Total research subjects include age from 45 to 55 years was 1 with women. Both studies were conducted of subjects who were healthy. The program was in force only in the experimental treatment. The experimental program is given a negative result. Total research subjects include age from 55 to 65 years was 2 (1 with women and 1 of both sexes). The survey was conducted of the respondents who were healthy. The strength program with aerobic training was present in both experimental treatments. Positive results show both researches. Total research subject include age of 65 years and over was 6 (1 with men, 3 women and 2 with both sexes). Five studies were conducted with healthy, and one with the sick respondents. The strength training program has been in four researches, and a program of strength with aerobic training was represented in the two experimental treatments. Positive research results show all researches in this category. From a total of 15 researches included in this, 4 were with men, 6 women and 5 with both sexes. The health aspect of researches has 3 sick and 12 with healthy subjects. The training program of strength training was concerned with 10 researches, and the combined strength training with aerobic training 5 researches. The positive result of research on the topic: "Effects of intense strength training on cardiovascular endurance", gave 11 researches, and statistically negligible results gave 4 researches. From this we can to conclude the integrity of intensive strength training can cause a positive effect on the cardiovascular system.

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UTJECAJ INTENZIVNOG TRENINGA SNAGE NA KARDIOVASKULARNU IZDRŽLJIVOST

Sažetak

Predmet istraživanja je kardiovaskularna izdržljivost ispitanika starosti od 25 do 75 godina. Problem istraživanja su efekti trenažnog procesa na kardiovaskularnu izdržljivost. Cilj istraživanja je da se utvrdi efekat intenzivnog treninga snage na kardiovaskularnu izdržljivost. Za rješavanje zadataka postavljenih u radu upotrebljene su metode teorijske analize kojom se proučava teorija i analiza sadržaja radova stranih autora. Istraživanja koja su prikupljana, obrađena i sagledavana morala su zadovoljiti slijedeće uvjete i to: da su provedena na ispitanicima starosti od 25 do 75 godina, različitog spola, zdravstvenog i psihofizičkog stanja. Proučavani radovi nisu stariji od deset godina. Istraživanjem se želi pokazati statistički značajan efekt intenzivnog treninga snage na kardiovaskularnu izdržljivost u odnosu na starost, spol i zdravstveno stanje ispitanika. Značaj istraživanja je u razumijevanju funkcioniranja i prilagođavanja kardiovaskularnog sistema uslijed treninga snage. Prikupljeni, obrađeni i klasificirani podaci se mogu iskoristiti kao baza za neka nova istraživanja.

Ključne riječi*: trening, snaga, srce, tlak i izdržljivost*

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