EFFECTS OF HEAVY RESISTANCE TRAINING ON MORPHOLOGICAL CHARACTERISTICS OF YOUNG ADULTS

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Abstract
Strength training can improve neuromuscular function in athletes. Most of previous researches have shown that heavy resistance training (55 – 80% of 1RM) influence morphological characteristics of adolescents. The goal of this study was to examine if 12 weeks of heavy resistance training (80 – 95% of 1RM) affects morphological characteristics of adolescents, in particular, voluminosity, body mass and subcutaneous fat tissue. Fifteen males participated in this study. Anthropometrics (body height, body weight, chest circumference, abdominal circumference, relaxed upper arm circumference, flexed upper arm circumference, upper leg circumference, abdominal skin fold thickness, m.tricepsbrachii skin fold thickness) and body composition(fat mass, fat free mass, muscle mass, intracellular and extracellular water) were measured before and after training program. Results has shown that there was significant differences ($p<0.05$) in variables: body weight, 4 circumferences, m. triceps brachii skin fold thickness and extra cellular water. From this study, it can be concluded that submaximal resistance training affects some morphological characteristics on anthropometrical level: voluminosity and skin fold, but have no effect on cellular level, except on extracellular water.

Key Words: *hypoalgesia, ischemic pain, exercise, aerobic, pain rating*

Introduction

There are many reasons why adults should do a regular program of resistance training. Research has shown that resistance training is effective for retaining muscle, recharging resting metabolism, reducing fat, reducing resting blood pressure, increasing insulin sensitivity/glycemic control, facilitating physical function, enhancing self-concept, increasing cognitive abilities, and reversing cellular aging factors (Westcott, 2012).

Resistance training is a modality of exercise that has grown in popularity over the past two decades, particularly for its role in improving athletic performance by increasing muscular strength, power and speed, hypertrophy, local muscular endurance, motor performance, balance, and coordination (Kreamer, et all, 2000). It act as an integral part of a total strength and conditioning programme for the enhancement of athletic programme and also prescribed by major health organizations, recreational and clinical communities for improving health, fitness and also in rehabilitation. Strength should not be considered a product of only muscular contractions. It is, in fact, a product of voluntary muscle contractions caused by the neuro-muscular system (Singh, 1991).Some studies have reported that loads of 60 – 80% of 1 repetition maximum (1RM) in adults, young men and women, has led to changes in morphological characteristics following 6- 12 weeks of resistance training at a rate of 3 days per week (Stone & Coulter, 1994 & Weiss et al., 1999). One study investigates effects of 18 weeks of strength training on body composition of 125 high – school students. Results showed significant decrease of body weight, BMI and body fat and increase of muscle mass (Jing, et al., 2009). The main goal of this study was to investigate effects of high load resistance training on morphological characteristics and body composition of young male adults.

Methods

Subjects
Fifteen young males (age 22 ± 0.5years; body height 181.94 ± 3.98; body weight 78.92 ± 6.58), participated in this study. They were all students of Faculty of Sport and Physical Education, University of Novi Sad. All of them were healthy and informed about study design and they volunteered for study.

Testing protocols
Subjects were tested before and after training program. For assessment of morphological characteristics following variables were used: body weight (kg), chest circumference (cm),abdominal circumference (cm), relaxed upper arm circumference (cm), flexed upper arm circumference (cm), upper leg circumference (cm), abdominal skin fold thickness (mm), m.tricepsbrachii skin fold thickness (mm).All measurements were perfomedby protocol of IBP (International Biology Program). For assessment of body composition five variables was selected: fat mass (%), fat free mass (%), muscle mass (kg), intracellular water (%) and extra cellular water (%). Body composition was measured by MaltronBioscan 920 – 2. Patients were lying on a non-conductive surface in supine position for at least 10 min.

They were instructed to relax completely, not to cross or bend the legs and arms, and to remain still during the measurement. Four electrodes, two on the right hand (directly below the third knuckle of the middle finger and on the crease of the wrist) and two on the right foot (centrally above the meeting of the second and third toe and at the crease of the ankle in line with shin bone), were attached.

Training program

Training program contained 4 training sessions per week and lasted 12 weeks. In the first four weeks was conducted familiarization with training program, with activation of all major muscle groups. The purpose of this familiarization period was to prepare participants for heavy resistance training and improve improper techniques. The remaining eight weeks load was 80 – 95% of 1 repetition maximum (1RM). Table 1.shows number of sets and repetitions for every muscle group.

Table 1. Training program

First training	Primary exercises	No.s	Load	Secondary exercises	No.s	Load
Chest	Bench press	4	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM 4 – 80%1RM	Incline dumbbell flies Pull over	3	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM
Biceps	Scott bench biceps curls	4	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM 4 – 80%1RM	Seated dumbbell biceps curls Single-arm preacher curls	3	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM
Second training						
Back	Pull-ups	4	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM 4 – 80%1RM	Deadlift Seated row	3	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM
Triceps	Barbell lying triceps extensions	4	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM 4 – 80%1RM	Triceps push-downs One-arm triceps dumbbell extensions	3	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM
Third training						
Shoulder	Seated barbell shoulder press	4	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM 4 – 80%1RM	High pull Dumbbell shoulder press	3	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM
Legs	Squat	4	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM 4 – 80%1RM	Leg curls Dumbbell lunge	3	1 – 80%1RM 2 – 90%1RM 3 – 95%1RM

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (v20.0, SPSS Inc., Chicago, IL, USA).

Descriptive statistics were calculated for initial and final testing.

Changes in anthropometrics and body composition after training period was compared using t-test with level of significance set at $p \leq 0.05$ and all data reported as means ± SD.

Results

Anthropometrics

Table 1.shows descriptive parameters of anthropometrics from initial and final testing. There were significant differences ($p \leq 0.05$) in variables: body weight, chest circumference, abdominal circumference, relaxed upper arm circumference, flexed upper arm circumference, m. triceps brachii skin fold. No significant differences were found in variables: upper leg circumference and abdominal skin fold ($p > 0.05$).

Table 1. Anthropometric parameters from initial and final testing

Variable	Initial	Final	p
Body weight	78.93±6.59	80.41±6.24	,00*
Chest circumference	98.59±6.45	101.69±5.70	,00*
Abdominal circumference	86.05±5.21	84.63±5.14	,02*
Upper leg circumference	57.73±3.27	58.11±2.88	,36
Relaxed upper arm circumference	31.27±2.30	33.03±1.92	,00*
Flexed upper arm circumference	33.90±2.38	36.15±1.90	,00*
Abdominal skin fold	10.61±2.92	9.92±1.75	,21
m. triceps brachii skin fold	7.86±1.57	6.95±1.22	,00*

*significant difference $p \leq 0.05$ between initial and final testing

Body composition

Table 2. shows changes in descriptive parameters of body composition before and after training program. There were significant differences ($p \leq 0.05$) only in variable extracellular water.

Table 2. Body composition parameters from initial and final testing

Variable	Initial	Final	P
Fat free mass %	84.60±6.42	86,72±5.09	,16
Fat mass %	12.13±2.14	12.10±2.09	,94
Extracellular water %	41.79±1.72	42.57±1.11	,04*
Intracellular water %	57.33±2.23	56.92±1.00	,38
Muscle mass (kg)	35.36±3.21	35.62±2.81	,10

*significant difference $p \leq 0.05$ between initial and final testing

Discussion and conclusions

This study investigates the effects of heavy resistance strength training on morphological characteristics of young males. Results showed that 12 weeks of heavy resistance training affects morphological characteristics. Significant increasing was observed in body weight, chest circumference, relaxed upper arm circumference and flexed upper arm circumference. We can also notice significant decreasing of abdominal circumference and m. triceps brachii skin fold. By analyzing body composition variables significant changes was observed only in extracellular water. One study showed that 10 weeks of resistance training affect morphological characteristics of young males, by analyzing body composition, they found significant changes in fat free mass (+5.0+/- 0.3) and fat mass (-1.5+/- 0.5) (Cribb, et al, 2006). However, this was not case in our study. Rahimi (2006) found significant decrease of body fat, percent of body fat and body weight and increase of muscle mass after 12 weeks of strength training, however the participants in this study was overweight. Similar results found in study on sample of 125 high-school students. Results in this study showed significant decreasing of body weight, BMI, body fat and significant increasing of muscle mass (Jing, et al, 2009). Furthermore, one study that investigate effects of 8 weeks of strength training report increasing of body weight, upper arm circumference and chest circumference (Weiss, et al, 2010), same like results found in our study. However, in one study there were no significant changes in body composition after five weeks of strength training (Tomljanovic, et al, 2011). Possible reason for these result could be found in short duration of training program. The results of this study showed that submaximal resistance training affects some morphological characteristics. Changes were observed on six of eight anthropometrical variables. However, only significant changes in body composition were observed in extracellular water. Therefore, it can be concluded that 12 weeks of heavy resistance training affects morphological characteristics of young males.

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EFEKTI TRENINGA SNAGE NA MOFOLOŠKE KARATERISTIKE MLADIH ODRASLIH LJUDI

Sažetak

Trening snage može poboljšati neuromuskularne funkcije u sportaša. Većina dosadašnjih istraživanja su pokazala da trening opterećenjem (55 - 80% od 1RM) može utjecati na morfološke karakteristike adolescenata. Cilj ovog istraživanja bio je ispitati utječe li 12 tjedana treninga sa opterećenjem (80-95% od 1RM) na morfološke karakteristike adolescenata, posebice voluminoznost, tjelesnu masu i potkožno masno tkivo. Petnaest muškaraca sudjelovalo je u ovom istraživanju. Antropometrija (visina tijela, tjelesna težina, opseg prsa, opseg abdomena, opseg opuštene nadlaktice, opseg nadlaktice u fleksiji, opseg natkoljenice, kožni nabor trbuha, kožni nabor nadlaktice) i tjelesni sastav (masno tkivo, bezmasna masa, mišićna masa, unutarstanična i izvanstanična voda) mjereni su prije i nakon programa obuke. Rezultati su pokazali da je bilo značajne razlike (p <0,05) u varijablama: tjelesna težina, 4 obujma, m. triceps brachii i debljina nabora kože i izvanstanične vode. Iz ovog istraživanja, može se zaključiti da trening sa submaksimalnim otporom utječe na neke morfološke karakteristike na antropometrijskoj razini: voluminoznost i kožne nabore, ali nema učinka na staničnoj razini, osim na izvanstaničnu vodu.

Ključne riječi: *antropometrija, submaksimalni otpor, tjelesni sastav*

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