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Research Paper

Effect of 8-Week Resistance Training on Hypertrophy, Strength, & Myostatin Concentration in Old and Young Men

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ABSTRACT

Objectives The decline in muscle mass and strength, which are associated with aging, is called sarcopenia. Resistance training is one of the effective methods to deal with sarcopenia. Correspondingly, this study aimed to investigate the effect of 8-week resistance training on muscle mass, strength, and myostatin concentration in old and young men.

Methods & Materials The present study included 14 old men (age range of 55 to 70 years) and 11 young ones (age range of 20 to 35 years) who were randomly chosen from the volunteers. They participated in a progressive resistance training (gradual increase in training load, 50% of one repetition maximum in the first week to 85% in the eighth week) for 8 weeks, 3 days a week. Daily calorie intake, strength, muscle mass, muscle cross-sectional area (by CT scan), and myostatin concentration were measured before and after the training.

Results The findings of the study indicated that after 8 weeks of training, muscle strength significantly increased in the old group in comparison with the young group ($P<0.05$); however, total muscle mass significantly increased in the young one ($P<0.05$). Daily calorie intake did not change in both groups ($P>0.05$). Quadriceps muscle mean (SD) cross-sectional area of the young group (pretest: 76.03[12.21] cm2 compared to posttest: 79.16[11.54] cm^2) significantly increased ($P<0.05$) compared to that in the old group (pretest: 60.03[10.57] cm^2 compared to posttest: 61.93[10.43] cm^2). The myostatin mean (SD) concentration significantly decreased in both groups ($P<0.05$), but there was no difference between the groups (3.86[1.89] ng/mL and 3.68[1.66] ng/mL in elderly and young group, respectively; $P>0.05$). Also, there was a significant correlation between myostatin concentration with muscle mass in old men ($r=0.73$, $P<0.05$).

Conclusion Resistance training was associated with a decline in myostatin level and increase in the muscle mass and cross-sectional area. Hence, the beneficial effect of resistance training may decrease age-related muscle atrophy and affect elderly health.

Key words:
Aging, Sarcopenia, Myostatin, Hypertrophy, Resistance training

Extended Abstract

1. Objectives

Reduction in muscle mass and strength occurs with the aging process, which is called sarcopenia. Resistance training is one of the most effective methods to counter the loss of muscle mass and strength. Several factors might play the role of mediation in resistance training to deal with the loss of muscle mass. Myostatin is an effective and negative factor to set the growth and maintain muscle mass,

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which may be dependent on the age of the individual [1]. Most previous studies evaluated mRNA myostatin in skeletal muscle. Before converting to myostatin protein or forming in circulation, mRNA myostatin bears adjustments and reforms so that it cannot represent the myostatin in blood circulation [2]. Therefore, monitoring changes in blood flow also becomes necessary. In this regard, this study aimed to investigate the effect of resistance training on strength and muscle mass and determine the concentration of myostatin.

2. Methods & Materials

Among the volunteers who participated in this research, 14 old men (age range 55-70 years) and 11 young ones (age range 20-35 years) were selected randomly for a progressive resistance training program (gradual increase from the first week of practice time with 50% of maximum one repetition up to the eighth week, with 85% of maximum one repetition) 3 days a week for 8 weeks. Exercise protocol included weight training for biceps, triceps, front thigh, back thigh, chest, belly, and shoulder muscle groups. For this purpose, front hip movements while sitting using the device, lying

Table 1. Anthropometric measurements, muscle mass, myostatin concentration with group separated

	Group	Pretest	Posttest	Pt-Test
Weight (Kg)	Aged	79.51±6.14	79.56±5.12	0.165
	Young	75.06±4.23	77.01±6.74	
Body mass index (Kg/m^2)	Aged	26.6±32.09	26.34±2.23	0.102
	Young	23.9±63.66	24.12±3.14	
Body fat (%)	Aged	24.9±93.46	24.43±3.17	0.086
	Young	22.6±12.60	22.14±1.89	
Physical activity (score)	Aged	26.91±16.16	-	-
	Young	26.43±21.18	-	
Foot maximum power (w)	Aged	530.12±98	*642±109.10	0.419
	Young	[a]648.26±48.21	*751.1±99.47	
The maximum power (w)	Aged	410.18±101	*528.36±88	0.318
	Young	[a]512.2±76.11	*598.25±92.96	
Scott (Kg)	Aged	41.45±6.14	*59.14±9.28	**0.001
	Young	[a]56.43±8.99	*68.31±11.03	
Bench press (Kg)	Aged	43.09±15.12	*58.81±11.47	**0.004
	Young	[a]58.11±8.89	*69.36±9.56	
Total muscle mass (Kg)	Aged	30.84±8.86	31.08±8.71	0.065
	Young	[a]34.36±8.58	*35.39±8.63	
Quadriceps muscle cross-sectional area (cm^2)	Aged	60.03±10.75	*61.93±10.42	**0.001
	Young	[a]76.03±12.21	*79.16±11.54	
Myostatin (ng/ml)	Aged	4.23±1.91	*3.86±1.89	0.865
	Young	4.04±1.79	*3.68±1.66	
Myostatin to muscle ratio (ng/ml.Kg)	Aged	0.16	*0.14±0.11	0.740
	Young	0.14±0.10	*0.12±0.09	

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[a] Significant difference (t-test) compared to other groups in the pretest; * A significant difference (t-test) after the pretest compared to pretest; ** statistically significant (t-test) between the two groups after eight weeks of training; kg: kilogram, kg/m^2: kilograms per square meter; w: Watt, cm^2: square centimeter; ng/mL: nanogram per milligram

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leg curl with the machine, squats for the lower limbs, slept bench press with the machine, chest, abdomen, belly and wide-grip pull-down for the central trunk muscles and biceps with barbell, triceps and deltoid wide-grip pull-down with device for the upper extremities were used. Calories received by recalling three days of food, maximum one repetition (power), mass and muscle cross-sectional area (including CT scan machine Siemens models, Germany), thigh area before and after the training period were measured in both groups. Blood samples were taken from the brachial vein after 10 hours of fasting, 3 days before and after the training program to measure levels of myostatin obtained through ELISA method (Sets by R & D Company, America). The Independent t test (comparing the difference between pre-and post-test between the two groups) and the Pearson coefficient were used for data analysis.

3. Results

The results showed that maximum power up, maximum power of hand, and the strength of squat and bench press were higher in the younger group compared to old people before starting the training program ($P<0.05$). It was also found that the increase in power was significantly higher in the older group compared to young ones ($P<0.05$) while there was no significant difference between the two groups ($P>0.05$). After 8 weeks of training, both groups showed significant improvement in power and strength records compared to the pretest ($P<0.05$). Muscle mass and cross-sectional area of the quadriceps muscle in young people were significantly higher ($P<0.05$) compared to the aged group before starting the exercise program. But after 8 weeks of training, although cross-sectional area of quadriceps muscle had a significant increase in both groups, the increase in youth group was significantly higher ($P<0.05$). Increase in muscle mass was significant only in the youth group ($P<0.05$), but there was no change in muscle mass from pretest and posttest between two groups ($P<0.05$).

In this research, serum level of myostatin was evaluated as an indicator associated with hypertrophy. The serum concentration of myostatin was at the baseline in both groups, and after 8 weeks of resistance training, it did not show a significant difference ($P>0.05$), although both groups have demonstrated a significant reduction compared to pretest ($P<0.05$). Correlation of myostatin serum at the baseline state with muscle mass was not significant in youth group ($r=-0.59$, $P=0.053$). But there was a significant correlation between myostatin and muscle mass in the older group ($r=-0.73$, $P=0.003$) (Table 1).

4. Conclusion

One of the interesting findings of the study was a further increase in power in the aged group compared to the young one. It is generally accepted that the initial rise in power (sessions and weeks) results from neural adaptation such as the use of more motor units and a decrease in opposed muscle activation [3, 4]. Moreover, increased strength in the aged subjects can be the result of psychological factors such as increase in confidence, lack of movement [4], and maximum one repetition test. In this study, a standard protocol of familiarization was used to avoid the impact of the mentioned factors (self-confidence and unawareness of movement) and increase the accuracy of maximum one repetition test before starting the exercise program. Serum myostatin showed a significant reduction in two age groups following the workout, which may indicate the potential of this type of training in increasing hypertrophy through reductive myostatin serum regulation. It seems that hypertrophic compatibility between two age groups cannot be explained by changes in serum myostatin. In addition to reducing the number of Type II muscle fibers and their atrophy, myostatin can cause a loss of strength in the aged subjects as observed in the present study [5].

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Conflict of Interest

The authors declared no conflicts of interest.

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