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Research Paper

The Effect of 8 Weeks Resistance Training With Low Load and High Load on Testosterone, Insulin-Like Growth Factor-1, Insulin-Like Growth Factor Binding Protein-3 Levels, and Functional Adaptations in Older Women

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Low-load resistance training, High-load resistance training; Testosterone, Insulin-like Growth Factor 1 (IGF-1), Insulin-like Growth Factor Binding Protein-3 (IGFBP-3)

ABSTRACT

Objectives The loss of muscle mass in older adults is attributed to the impaired ability of the skeletal muscle in response to anabolic stimuli and the increased activation of the proteolytic signaling pathway. With increasing age, plasma concentrations of circulating anabolic hormones and growth factors, e.g. testosterone, Insulin-like Growth Factor-1 (IGF-1) and Insulin-like Growth Factor Binding Protein-3 (IGFBP-3) are also diminished. Resistance Training (RT) promotes positive adaptations that attenuate the harmful effects of aging. The aim of this investigation was evaluation the impact of RT with Low Load (LL) and High Load (HL) on the testosterone, IGF-1, IGFBP-3 levels and functional adaptations in older women.

Methods & Materials A total of 28 older women (Mean±SD age: 63.14±2.51 y) eligible to participate in this study were randomly assigned into three groups of RT with Low Load (RT-LL) (30٪ 1RM [one repetition maximum test]), RT group with High Load (RT-HL) (80٪ 1RM) and control group. Both training groups performed the exercise until fatigue. The minimum number of repetitions for the RT-LL group was 20 and for the RT-HL group 8. The RT program was executed three sessions per week for 8 weeks. Testosterone, IGF-1, IGFBP-3, lower body muscular strength, and muscular endurance of the subjects were measured before and after the intervention.

Results No significant changes were observed in testosterone, IGF-1, and IGFBP-3 levels after 8 weeks of RT (P>0.05). Both training groups significantly increased the lower body muscular strength and muscular endurance (P<0.05), and there was no significant difference between the two RT groups (P>0.05).

Conclusion Based on the study findings, RT-LL until the fatigue may affect performance adaptations resulting from exercise and provide an appropriate alternative to RT-HL in older people.

Extended Abstract

1. Introduction

Decreased muscle mass in older people is attributed to impaired skeletal muscle ability to respond to anabolic stimulation and to increase the activity of proteolytic signaling pathways [1]. According to studies, low exercise intensities like 30% of 1-Repetition Maximum (1RM) to voluntary fatigue are effective in stimulating muscle protein synthesis and hypertrophy [2]. In other words, in fatigue conditions, increased activity of the motor unit leads to increased activity of high-threshold motor units that innervate type II fibers and in-

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creases stimulation for hypertrophy and muscle strength [3-5]. Since hormone changes and growth factors are involved in the effect of resistance training with different loads on muscle hypertrophy, this study aimed to investigate the impact of 8-week resistance training to volitional fatigue with 30% and 80% of 1RM on testosterone, Insulin-like Growth Factor 1 (IGF-1), IGF Binding Protein-3 (IGFBP-3), and functional adaptations in older women.

2. Materials and Methods

The study participants were 28 older women living in Mashhad City, Iran who were randomly assigned into three groups of resistance training with low load (RT+LL), 30% 1RM (n=12), resistance training with high load (RT+HL), 80% 1RM (n=8), and control (n=8). The training was conducted 3 sessions per week for 8 weeks. The training protocol included warming up, training to fatigue with low and high loads (30% and 80% of 1RM), and cooling down. The minimum number of repetitions was 20 for the RT+LL group and 8 for the RT+HL group.

To estimate the maximum strength of the participants, we used a weight by which the subject could perform training correctly up to 10 times. Using the Brzeski Equation (Formal 1), the maximum strength of the subjects was achieved in performing bench press and knee flexion to determine the maximum upper and lower body muscle strength [6].

1. *1RM= weight / [1.0278- (0.0278×number of repetitions)]*

The Shapiro-Wilk test was used to check the normality of the data distribution. The paired t test was used to examine within-group differences, and one-way ANOVA and Bonferroni post hoc test were used to determine the differences between groups. The significance level was set at P<0.05.

3. Results

Five milliliters of blood samples were taken from the vein of subjects in the fasting time before the intervention and eight weeks after training to measure their biochemical factors. All factors were measured by Enzyme-Linked Immunosorbent Assay (ELISA) method (Table 1).

The results showed that the resistance exercise had no significant effect on testosterone, IGF-1, and IGFBP-3 levels (P>0.05). Both types of low-load and high-load training significantly increased lower body muscle strength and endurance (P<0.05), and there was no significant difference between the two groups (P>0.05) (Table 2).

4. Conclusion

The results showed that eight weeks of low- and high-load resistance training to fatigue had no significant effect on IGF-1, IGFBP-3, and testosterone, but both types of exercise increased muscle strength and endurance in older women. Low-load resistance training significantly improved muscle function; also, it had a positive but not significant effect on some biochemical factors related to muscle strength and muscle hypertrophy. Although higher intensity resistance exercises may have more beneficial results, they can put too much pressure on the musculoskeletal and cardiovascular system, and besides their potential unpleasant consequences, they can make the elderly feel tired and drained [8]. Therefore, it is recommended to use low-load resistance training where it is not possible to use high-load resistance training (e.g. in rehabilitation, chronic diseases, or physical disability).

Ethical Considerations

Compliance with ethical guidelines

This study received its ethical approval from the Research Ethics Committee of Hakim Sabzevari University.

Table 1. ELISA kits used for measuring biochemical factors

Factor	ELISA kit	Sensitivity, ng/mL
IGF-1	Mediagnost (Germany)	0.09
IGFBP-3	Mediagnost (Germany)	0.03
Testosterone	LBL International (Germany)	0.18

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ELIZA: Enzyme-linked Immunosorbent Assay; IGF-1: Insulin-Like Growth Factor 1; IGFBP-3: Insulin-Like Growth Factor binding Protein-3

Table 2. The inter nad between group changes of the variables

Variables	Stage	RT+LL	RT+HL	Control	P*
IGF-1 (ng/mL)	Pre-test	141±56.93	180.75±49.63	157±124.78	0.86
	Post-test	183±70.88	165.75±35.15	184±113.72	
	P	0.06	0.33	0.26	
IGFBP-3 (ng/mL)	Pre-test	3177.5±650.88	3421.9±651.46	3235±707.46	0.75
	Post-test	3156.2±629.31	3409.4±893.78	3196.9±786.16	
	P	0.88	0.93	0.71	
Testosterone (ng/mL)	Pre-test	0.28±0.10	0.34±0.21	0.37±0.05	0.17
	Post-test	0.29±0.09	0.27±0.07	0.35±0.07	
	P	0.36	0.37	0.50	
Two-min walk test (No)	Pre-test	124.50±26.34	152.88±39.76	93.62±23.69	0.001
	Post-test	168.17±29.20	195±28.94	103.38±25.30	
	P	0.001*	0.004*	0.26	
Chair stand test (No)	Pre-test	11.25±1.60	11.37±3.33	9.12±2.10	0.001
	Post-test	16.08±3.14	17.25±3.61	10.87±2.79	
	P	0.001	0.001	0.021	

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IGF-1: Insulin-Like Growth Factor 1; IGFBP-3: Insulin-Like Growth Factor Binding Protein-3; RT+LL: Resistance Training With Low Load; RT+HL: Resistance Training With High Load

* Significant difference at P<0.05

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Authors' contributions

All authors contributed in preparing this article.

Conflicts of interest

The authors declared no conflict of interest.