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THE EFFECTS OF THE RESISTANCE TRAININGS OF UPPER-BODY, LOWER-BODY AND COMPOUND ON IL-6 AND CRP OF YOUNG WOMEN

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ABSTRACT

The purpose of the present study was investigation of the effects of the three types of upper-body, lower-body and compound resistance trainings on relaxation levels of IL-6 and CRP serums of young women, regarding to the shortage of studies about effects of various types of resistance trainings.

Forty examined subjects of this research were divided to four groups of upper-body resistance training, lower-body resistance training, upper + lower compound resistance training and control. The three exercises groups were participated in 8 weeks progressive resistance trainings. Blood samples were taken from the subjects, before (24 hr prior to the trainings beginning) and after (48 hr then the trainings ending) the trainings.

In order to investigate and compare variations of the variables, factorial analysis of variance with repeated measures was applied. IL-6 did not vary through resistance exercise ($P>0.05$), though C-reactive protein decreased through resistance exercise, significantly ($P<0.05$). Nevertheless, there was no difference between executions of upper-body, lower-body and compound resistance trainings ($P>0.05$).

Resistance trainings might probably cause desirable influences on inflammatory factors, regardless of whether type of resistance trainings (either upper-body or lower- body, or

compound). However, the issue should be deeper surveyed in future studies, accompany with measurement of other inflammatory indices.

Key words: IL-6, Resistance Trainings, CRP, Compound Training, Inflammation

INTRODUCTION

Resistance trainings have been attended by many people of the society for the sake of improvement and maintenance of healthiness, especially women. In the other hand, the resistance trainings have various types that can have their common and individual unique influences on physiological systems of the body and specifically the immune system. Therefore, special attention to cytokines and inflammatory factors can be important, for clarifying complicated questions of immunity response to exercise. Interleukin-6 (IL-6) is a cytokine that have vast various functions. This cytokine stimulates production of acute phase proteins (CRP) through hepatic cells, in inherent immunity, and associate I generation of an inflammation system, which is named the acute-phase. In addition, this cytokine stimulates growth of B-lymphocytes that differentiate to antibodies producer cells, in acquired (adaptive) immunity **[1,2].** IL-6 amount would remarkably heighten in response to exercise (up to a hundred times) and reduce after activity **[3].**

IL-6 can raise lipolysis and stimulate production of cortisol and other regulating cytokines such as IL-10 and IL-1Ra. Besides, IL-6 suppresses production of the pre-inflammatory cytokine TNF-α. Hence, its consequent insulin resistance would be reduced, which could be one of the positive benefits of exercise **[4].** Whereas level of IL-6 rises in muscle fibers following exercise, the level heightening of this cytokine could be due to anti-inflammatory activities, regarding to dual pre-inflammatory and anti-inflammatory hands of IL-6 and its recognition as a cytokine **[5,6].** Effects of moderate intensity exercises on enhancement of muscular levels are reported, yet **[7].**

In the other hand, Timmerman et al (2008) indicated that regular exercise trainings in duration of 12 weeks would lead to decreases in circulation level and production of IL-6 cytokine **[8].** In addition, CRP is mostly made in response to inflammatory cytokines by liver and adipose tissue, and has inflammatory property itself and is a strong risk factor to heart attack, hypertension and cardiovascular diseases **[9,10].** Increment of CRP amounts would lead to arthrosclerosis spread through three mechanisms, at least **[11,12].**

Donges et al (2010) studied effects of aerobic or resistance trainings on CRP and body composition of three groups of aerobic, resistance and control, during 10 weeks. Their results indicated significant reduction of CRP in both training groups **[10].** In addition, Stewart et al (2007) investigated effects of 12 weeks compound (aerobic and resistance) schedule on CRP among 29 young men (18 to 35 year old) and concluded that CRP decreased through exercise **[13].** Some other researches denoted exercise schedules do not effect on inflammatory markers (like CRP) **[14,15].** Nevertheless, comparison of effects of three types of upper-body, lower body and compound on these inflammatory factors have not been cleared, yet. Therefore, the aim of the present study was comparison of the effects of the three types of upper-body, lower-body and compound resistance trainings on IL-6 and CRP serums of non-athletic young women.

SUBJECTS AND METHODS

Subjects

Forty healthy 20 to 29 year old women were purposefully chosen and divided to four groups of upper-body resistance training, lower-body resistance training, compound resistance training and control (10 person for each group), randomly. The properties of the subjects of the three training groups were presented in table 1. In addition, the relative to independent one-way ANOVA P and F values, which have been summarized to compare the subjects' properties, have been presented in this table. The differences in properties of age, height and weight were not significant, between the three training groups (P>0.05). Hence, it could be stated that the subjects of the three exercise groups were homogeneous in properties of age, height and weight, with 95 percent certainty.

Table 1: The subjects' properties

Variable	Upper-body group	Lower-body group	Compound group	Overall	F	P
Number	10	10	10	30		
Age (Y.O.)	24.50±3.02	25.90±2.60	26.50±1.90	25.63±2.60	1.617	0.217
Height (cm)	164.50±3.02	166.20±3.76	163.90±2.99	164.87±3.31	1.321	0.284
Weight (kg)	61.50±2.27	61.20±5.07	62.10±3.95	61.60±3.82	0.135	0.874

Data Collecting Method

The subject became familiar with the trainings protocol in justification meeting, one week before the research execution. Beside of introducing resistance movements to the subjects, their properties and their 1RM for each movement were measured. The subjects held in the test session and the blood samples

were taken from the four groups, 24 hr before trainings beginning. Thereafter, the subjects performed their trainings schedule progressively, in duration of 8 weeks. Relaxation blood samples were taken from the four groups again, 48 hr after the last exercise session.

Training Schedule

The resistance trainings schedule was held during 8 weeks (three weekly sessions, one day on-one day off), and each session was in span of 68 min and consisted of 10 min warm up, 52 main exercise and 6 min cold down. A percentage of a maximum repetition and execution speed was considered as intensity and mass of exercise. Exercise load was the same for upper-body, lower-body and compound trainings. The resistance trainings were designated in circular figure and in three manners of upper-body, lower-body and compound. Each circle involved chest press, thorax press, biceps, triceps, shoulder, lateral stretch (or length) and paddle stretch, for upper-body exercises. In addition, each circle consisted of leg press, forefoot, rear-foot, Scott, ankle, long jump and foot abduction, for lower-body workouts. Moreover, for compound exercises, each circle included chest press, leg press, biceps, forefoot, shoulder, rear-foot and lateral stretch (or length). The subjects performed their exercises with 20, 25, 30, 35, 40, 45, 50 and 55 percentages of a maximum repetition for the first to the 8^{th} weeks, respectively. Span of each station is considered as 2 min and 30 sec. The rest interval between each two successive stations and each two successive circles are considered as 1 min and 2 min, respectively. Two circles were considered for each exercise session. The three training group performed each of their stations with speed of V (V was assigned as 75 BPM). Execution speed of each movement was controlled by metronome.

Blood Sampling and Cytokines Analysis

Blood sampling were taken from the middle vein (the basilic vein) of the subjects, in amounts of 5 cc. The gathered samples were poured over sterilized tubes, containing K3EDTR.The heparin tubes and EDTR were settled inside ice and then remained at the room temperature, for some minutes. Thereafter, serum separated from plasma, by means of centrifuge in span of 10 min and with revolution speed of 3500 RPM. The whole blood samples were maintained in frozen state and at temperature of -20˚C, and were used at the time of lab examination. IL-6 of each sample was gauged by means of ELISA method utilizing eBioscience kit. CRP

of each sample was done by method of Turbidimetric utilizing Cobas Integra 400 device at wavelength of 552 nm.

Statistical Method

At first, values of every under study variables were described by implementing mean and standard deviation, and Kolmogorov-Smirnov test was applied to examine data natural distribution and selection of either parametric or non-parametric test. It was clarified that the data had natural distribution. Factorial ANOVA with repeated measures in a scheme of 4×2 (four groups at two times) was used, to compare variations of under study variables, in the four groups if upper-body, lower-body, compound and control. Significance level was assigned as 0.05, for entire statistical tests. In addition, the statistical software SPSS ver.16 was utilized to carry out statistical calculations.

RESULTS

Statistical descriptions of IL-6 and CRP have been presented in table 2. The values have been reported as mean and standard deviation. In order to compare variations of variables between the four groups, the results of factorial ANOVA with repeated measures have been shown in table 3. There was not observed any significant difference between IL-6 variations patterns of the four groups (P=0.07). Significant differences were observed between CRP variations patterns of the four group (P=0.001). In a manner that CRP of the three training groups decreased significantly, in comparison to that of control group (P=0.001), though the differences between the training groups were not significant (P>0.05).

Table 2: Statistical descriptions of the variables (mean ± standard deviation)

Variables	Sampling Times	Upper Body Groups	Lower Body Groups	Combination Groups	Control Groups
IL-6	Before Training	4.06 ± 0.86	3.96 ± 0.98	4.01 ± 1.17	3.98 ± 0.95
	After Training	4.08 ± 0.72	3.18 ± 0.34	4.33 ± 1.48	4.09 ± 0.95
CRP	Before Training	0.70 ± 0.44	0.81 ± 0.37	0.64 ± 0.41	0.73 ± 0.39
	After Training	0.53 ± 0.36	0.64 ± 0.33	0.48 ± 0.35	0.73 ± 0.40

Table 3: Statistical results of factorial ANOVA with repeated measures to compare variations of the variables in the groups

Variables	Factor	F	P
IL-6	Time	0.32	0.57
	Group	0.96	0.41
	Time*Group	2.52	0.073
CRP	Time	116.33	0.001*
	Group	0.49	0.68
	Time*Group	13.18	0.001*

*** The mean difference is significant at the 0.05 level**

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DISCUSSION

According to the results of the present study, IL-6 did not show any significant change, but the resistance training would lead to significant decrease in CRP, whereas there was not observed any significant difference between the three training groups, about this variable. The literature has spare results about effects of resistance trainings on serum levels of inflammatory related cytokines, and no study could find about the issue. Therefore, previous results about this matter are negligible, and no accurate conclusion can draft, before accomplishment of further studies.

Furthermore, intensity of exercise might be the most substantial variable of training in response to inflammatory factors, and span of training is another important variable, after exercise intensity. Actually, intensity and span of the three types of resistance trainings of the present study were the same, and their distinctions were in different muscles that were engaged through different training types. Based on the results of Nurtjahja-Tjendraputra et al (2007) 16 weeks resistance trainings would lead to decrease in concentrations of pre-inflammatory cytokines and increase in concentrations of anti-inflammatory cytokines **[16].**

Cytokines different responses of various studies could be ascribe to physical situations of subjects, implementing different training schemes and methods (training protocol types), subjects training precedence, span and intensity of pressing stimulant, exercise habits and consistency to trainings. Keller et al (2005) stated IL-6 level increases in comparison to pre-test situation, after 10 weeks trainings **[17].** In the other hand, Conraads et al (2002) indicated that compound endurance-resistance trainings did not have any influence on plasma amount of IL-6 among people with vascular disease **[18].** In addition, Nicklas et al (2004) investigated effects of an aerobic and resistance trainings schedule, among aged fat men and women with signs of knee osteoarthritis. They noted the exercise trainings did not have any significant influence on IL-6 **[19].**

In contrast, Ryan et al (2004), reported that a weight loss program and aerobic and

resistance trainings would lead to decrease in IL-6 of obese women **[20].** Furthermore, Haghighi et al (2005) showed execution of circular type resistance trainings have led to decrease in IL-6 plasma level, among obese men **[21].**

Olson et al (2007) surveyed CRP concentration after one-year execution of resistance trainings among 16 over-weighted women (with ages similar to the subjects of the present study), and their resistance trainings led to decreases in BMI, body fat percentage and CRP plasma concentration of their participant **[22]**, which is in agreement with the results of the present study. Improvement in endothelial structure and reduction of blood mononuclear cells are some of post-exercise CRP decrease mechanisms **[23].** There are still many investigation and discussion blank spaces about improvement mechanisms of CRP level. A main potential way can be the interleukins. Regarding the evidences, IL-6 and TNF-α factor are remarkably released from adipose tissue, especially visceral fat. Their release from adipose tissue would increase through sympathetic stimulation. Since regular exercise would cause reductive adjust of sympathetic stimulation, it might probably lead to decrease in TNF-α excretion (that means decrease in strong stimulant of IL-6 production) and IL-6 reduction (which means decrease in strong stimulant of CRP production) **[24].** By the way, IL-6 did not show any significant change, in the present study. However, exercise, in an appropriate model for study of inflammatory responses, could be effective in variations of CRP serum values. Most researchers have agreed with probable reduction of CRP relaxation concentration, and in addition, the relative consistencies to long-term physical trainings, in such a way **[25].**

Nevertheless, the results about the three resistance trainings types of upper-body, lower-body and compound are not voluminous, and accordingly interpretation of the results should be performed, cautiously. However, nonbeing variation of IL-4 and significant decrease in CRP through the resistance trainings (regardless the type of trainings) has been clarified in the present study.

CONCLUSION

According to the results of the present study, it has been concluded that the 8 weeks resistance trainings would lead to inflammation improvement. There may no difference that the resistance trainings would be performed by either upper-boy muscles of

those of lower-body or their compound, but in the same mass.

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