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**THE EFFECTS OF THE RESISTANCE TRAININGS OF UPPER-BODY, LOWER-BODY AND COMPOUND ON IL-4 AND IFN- $\gamma$  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-4 and IFN- $\gamma$  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-4 increased through resistance exercise, which had greater increment in the compound group ( $P < 0.05$ ). IFN- $\gamma$  though decreased through resistance exercise, but this reduction was not significant, in the aspect of statistics ( $P > 0.05$ ).

Resistance trainings might probably cause activity enhancement of humoral immunity in young women, by increase in IL-4. This increment is greater through compound (upper-body and lower-body) trainings. However, the issue should be surveyed in future studies, deeper.

**Key words: Humoral Immunity, Resistance Trainings, Cellular Immunity, Cytokines, Young Women**

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## 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 can be important, for clarifying complicated questions of immunity response to exercise. Immune system of the body associates in many activities such as inflammatory activities, allergy heightening and erasing pathogens (bacterial and viral) [1,2].

The inflammatory activity is based on production of cytokines like Interleukin-4 (IL-4) and Interferon- $\gamma$  (IFN- $\gamma$ ). The produced cytokines of T-lymphocytes have remarkable part in development and enhancement of immune system performance against pathogens. Differentiation of T-lymphocytes to the type I indices (Th1/Tc1) are determined by IFN- $\gamma$  production [3]. Outer membrane pathogens, which generate response of humoral immune system, would also lead to the differentiation of these cells to the type II indices (Th2/Tc2) and production of IL-4 [4,5].

It has been shown in a study, 8 weeks resistance trainings would lead to decrease in IFN- $\gamma$  levels [6]. In contrast, some researchers have shown nonbeing increment and change of these indices, during and following the exercise [7]. Nurtjahja-Tjendraputra et al (2007) reported 16 weeks resistance training would lead to decrease in concentrations of pre-inflammatory cytokines and increase in concentrations of anti-inflammatory cytokines [8]. In overall, research results indicate that exercise and physical activity, and especially regular endurance trainings would affect various factors of the immune system. These influences are apparent about both performance improvement and the number of components of immune system [2,9,10].

In the past, since it was thought the women did not adequately benefit from the resistance exercises, they did rarely perform such exercises. Nevertheless, it has been proven in recent years that the women benefit from the resistance exercises, as same as the men. Because of the tendency of nowadays women to healthiness improvement and fitness, they attentions draw to such trainings. The purpose of the present study was comparison of the three types of upper-body, lower body and compound resistance trainings on the levels of IL-4 and IFN- $\gamma$  serums in young women,

regarding to properties of cytokines and effects of resistance trainings.

## 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<sup>th</sup> 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-4 of each sample was gauged by means of ELISA method utilizing eBioscience kit. IFN- $\gamma$  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 $\times$ 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-4 and IFN- $\gamma$  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. Significant differences were observed between the four groups, in variations patterns of IL-4 ( $P=0.02$ ). In a manner that the IL-4 increased in the three training groups, but there was not observed any specific change in the control

group. Nevertheless, the results of Toki post-hoc test indicated that only the compound group had significant difference to the control one ( $P=0.015$ ). There was no difference in variations patterns of IFN- $\gamma$ , between the four groups ( $P=0.22$ ). However, reduction amount of IFN- $\gamma$  in the three exercise groups were further than that of control group.

**Table 2: Statistical descriptions of the variables (mean  $\pm$  standard deviation)**

Variables	Sampling Times	Upper Body Groups	Lower Body Groups	Combination Groups	Control Groups
IL-4	Before Training	4.71 $\pm$ 0.57	3.93 $\pm$ 1.05	4.26 $\pm$ 1.13	4.74 $\pm$ 1.13
	After Training	6.52 $\pm$ 2.33	5.91 $\pm$ 1.48	7.03 $\pm$ 2.06	4.72 $\pm$ 1.31
IFN- $\gamma$	Before Training	17.76 $\pm$ 3.25	16.88 $\pm$ 2.71	18.43 $\pm$ 3.11	15.72 $\pm$ 2.11
	After Training	14.32 $\pm$ 1.88	13.76 $\pm$ 1.55	14.79 $\pm$ 1.82	14.84 $\pm$ 1.33

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

Variables	Factor	F	P
IL-4	Time	28.05	0.001*
	Group	1.78	0.16
	Time $\times$ Group	3.64	0.021*
IFN- $\gamma$	Time	28.86	0.001*
	Group	1.46	0.24
	Time $\times$ Group	1.53	0.22

\* The mean difference is significant at the 0.05 level

## DISCUSSION

According to the results of the present study, IL-4 would heighten through resistance trainings. This increment was greater through compound (both upper-body and lower-body muscles) trainings. In the other hand, IFN- $\gamma$  did not show any variation. 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. A research has shown that eight weeks gradual resistance trainings relate to the decrease in levels of IFN- $\gamma$ , during rest [6]. In contrast, some researchers indicated variation and increment of this index, during and following the exercise [7].

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 [8]. 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. Physical activity has dual influences on the immune system, in such a way that long and intense periods of physical activities would lead to decrease in performance of the immune system and consequently might raise the probability of affliction with inflammation and infection [11].

Indeed, the inflammations of various tissues are the immunity response to tissue wounds, which involves complicated reactions via immune cells and dissolved proteins, including cytokines, at location of inflammation [12]. Hence, oxidation damage and generated inflammation, following different training scheme, could expose performances of various systems of the body, such as the immune one, to variation that consequences to heightening of inflammatory cytokines in serum and active muscles [13]. The tissue damages caused by physical exercises would lead to intensify inflammatory cascades. Release of these

cytokines would trigger inflammatory responses and stimulate release of IFN- $\gamma$ , which exert its anti-inflammatory effect through secretion enhancement of IL-10 and IL-2 [4]. Exercise would cause decreases in levels of inflammatory cytokines [15,16,17].

IFN- $\gamma$  production is vital for the sake of anti-viral defense, and several studies reported reduction of the concentration of IFN- $\gamma$ , in tumors [18,19]. Researchers believe that suppression of IFN- $\gamma$  production is serious mechanism for increment of infection risk in tumors [18]. The immune system of the body associates in many activities such as inflammatory ones, allergy raising and erasing pathogens (bacterial and viral) [1,2]. The inflammatory activity is based on production of cytokines like IL-4, IFN- $\gamma$  and variation of ratio of CD4 to CD8 lymphocyte cells. Researchers believe that production amount of lymphocyte cells and in addition regulation of CD4 to CD8 ratio are dependent to existence of appropriate signals such as IFN- $\gamma$ . The relative increment of IFN- $\gamma$ , which is the activator of cellular immunity (production enhancements of Tc1 and Th1), and production reduction of IL-4, which is the activator of inflammatory and humoral immunity (production decreases in Tc2 and Th2), would lead to increase in activity of cellular immunity and affect on this ratio [5].

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, it has been clarified in the present study that further increment of IL-4 occurred through the compound trainings and insignificant decrease in IFN- $\gamma$  happened through the three types of resistance trainings.

### CONCLUSION

According to the results of the present study, it has been concluded that the resistance trainings would lead to activity enhancement of humoral immunity in young women, if they are performed with both upper-body and lower-body muscles (compound figure). However, further studies are required, yet.

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