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The Effect of Body Part-dependent Resistance Training on Lipid Profiles and Hormonal Levels in Young Males

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ABSTRACT

Background. The impact of movement pattern of resistance training on some factors related to cardiovascular diseases is not clear.

Objectives. Therefore, the purpose of this study was to investigate the effects of 8 week different resistance training patterns on lipid profile and hormonal responses in young males.

Methods. Forty untrained students in 23.8 ± 2.66 average years old and weight of 67.43 ± 4.96 kg were randomly selected, who participated volunteering in this investigation. They were randomly divided into practice groups including *upper-body*, *lower-body*, and *compound* for 3 sessions during 8 weeks (%60 to %80 of a maximum repetition) (control $n=10$). In order to assess lipid profile and hormone concentration, body composition and blood samples of subjects were measured in similar conditions in three stages: pre-test, end of the 4th week, and end of the 8th week.

Results. fat percentage ($P<0.002$) had a significant reduction and TG ($P<0.002$), HDL ($P<0.001$), and testosterone ($P<0.002$) had significant increases compared to the pretest in upper-body group. In lower-body group, however, a significant reduction in fat percentage ($P<0.006$) was observed, and HDL ($P<0.001$), VLDL ($P<0.002$), and testosterone ($P<0.000$) values had significant increases compared to the pretest. there was a significantly increase after 8 weeks in BMI ($P=0.006$), TG ($P<0.030$), and muscle mass ($P<0.007$), and a significant reduction in cortisol ($P<0.016$) compared to the pretest after a four-week exercise in compound group.

Conclusion. It seems that upper-body and lower-body resistance training optimal methods make desirable changes in some cardiovascular risk factors, for example reduction in fat percentage and increase in HDL, the facts which could leads about prevention of cardiovascular diseases in untrained individuals.

KEY WORDS: *Resistance Training, Movement Pattern, Lipid Profile, Hormonal Responses.*

INTRODUCTION

Cardiovascular diseases are one of the most deadly diseases in the world. Almost half of all mortality in industrial and 25 percent of deaths in developing countries are in some way related to heart coronary arteries (1). It seems that exercise and physical activity can modify this risk factor. Effects of resistance training and its

effect on the reduction of cardiovascular disease has been widely studied (2). Resistance training on the other hand can have a positive effect on cardiovascular issues and hormonal changes (3). According to some previous studies, testosterone has a potentially anti-diabetes function in men (4). Cortisol, as a catabolic hormone, is

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effectively the most vital stress-relief hormone in body. Increase of cortisol leads to symptoms including abdominal obesity, hypertension, impaired glucose tolerance or diabetes or dyslipidemia (the existence of abnormal lipid in blood) all of which are also insulin resistance symptoms (5). But a change in testosterone can be affecting the amount of blood glucose, cholesterol, and triglyceride (6). Theoretically, Low amount of Testosterone can cause changing to increase cholesterol and decrease arteries' elasticity which in turn can be leads coronary artery atherosclerotic (7, 8). In any case, the effect of resistance training on cardiovascular disease factor is not clear (1, 9). For example, Banz *et al.* (2003) observed that the resistance trainings led to significant decrease in waist-to-hip ratio while the level of TG and LDL was constant after 10 weeks of exercise (8). On the other hand, Brait *et al.* (2006) and Kevin *et al.* (2006) demonstrate that resistance exercises have a positive effect on hypertension and lipid profile. Yet, Vincent *et al.* (2003) concluded that resistance exercises have no effect on lipid profile (10). Whereas resistance exercise protocols mainly focus on upper body muscles and lower body muscles in separate sessions in different days. A protocol is utilized by the bodybuilders to prevent of overtraining (11). Therefore, since no study has ever focused on the effect of separate upper body exercise and lower body exercise and the whole body on lipid profile; and resistance exercise was considered as a physical activity for reduce the risk of cardiovascular diseases; and according to this fact that adolescents turn to this kind of exercise and also because of the role of resistance exercises have on hormones and changes in lipid profile and according to the inconsistencies of the results, lipid profile and hormonal responses and received less research attention. Researchers in this study were investigated effect of an eight-week differences resistance training pattern to determining of lipid profile, testosterone and cortisol in young men.

MATERIALS AND METHODS

Participants. 40 unexercised healthy men (with average age of 23.8 ± 2.66 years old and weight of 67.43 ± 4.96 kg) were volunteered of participation in this study (Table 1). They signed

the written consent form. Studied people didn't practice in any sport exercise at least for 2 years. All participators were healthy according to cardiac, respiratory, renal, and metabolic aspect and have no orthopedic damage preventing their body activity and their health should be proved by doctor. Participators were put in all four groups by simple random method.

Study Design. Resistance exercise protocol in the present study includes 8 weeks practice with weight. Three sessions of exercise in week was implemented every other day. Exercise duration with weight was about 65 min in each session. To reduce some confounding factors affecting results of the study and to reduce the effects of food type on lipid profile, testosterone and cortisol, subjects were asked at Three days before testing night, meals in every days were provided to remove effect of nutrition on studied variables (55% carbohydrates, 15% protein, and 30% fat). They were asked to sleep about 11 o'clock at night. Blood samples were collected before starting the protocol, at the end of the fourth week, and the day after the last exercise session of the eight week after 12 hours of fasting and 5cc blood samples were taken on completion of interventions. This study was approved by Ethical committee in Research Committee of Physical Education and Sports Science research center in accordance with the charter and norms of research ethnics of Ministry of Science, Research and Technology and approved with the code: SSRC.REC.1394,102.

Training Protocol. Exercise with weight for upper body parts include bench press, rowing, shoulder press, lat pull down, Biceps curl, and triceps curl and exercise for lower body parts include squat, launch, leg press, leg extensions, leg curl, and seated calf raise, and combined exercises include bench press, leg press, lat pull down, squat, biceps curl, seated calf raise that in each station one turn with 60% of maximum power with 8-12 repetition and 4 set with 6-8 repetition were conducted by 80-85% of maximum power. Rest time between sets was 2 minutes and between movements was 3 minutes. The intensity of exercise in the fourth week reduced for proper recovery and prevention from overtraining and participators continued their exercises after determining maximum power

with 80-85% of new maximum power. Participators did jogging and stretching exercises about 10 minutes at the beginning of each session for warm-up before starting training with weights. At the end of each session, they again did jogging and stretching exercises to slow down the repetition. Participators of exercise group were asked to prevent any exercise in research duration except the prescribed exercise. Participators of control group avoided any physical exercise extra of their daily life.

Measurements. Height of subjects was measured by a height meter with accuracy of 0.01 and weight was measured on scales with an accuracy of 0.1 kg. Body Mass Index (BMI) was obtained by dividing weight (kg) by height (m). Blood samples were collected before starting the protocol, at the end of the fourth week, and the day after the last exercise session of the eight week after 12 hours of fasting. Samples were analyzed according to serum level of lipid profile, testosterone and cortisol. Participators referred to laboratory after 12 hours fasting Blood samples were centrifuged at 3000 RPM for 10 minutes to separate serum and the obtained serum was distributed and immediately frozen at -80°C for later analysis. The plasma

lipid level (cholesterol, triglycerides in enzymatic method, colorimetry by photometric method using Pars Azmoon Company kits, HDL, LDL (by direct method)) was measured by mindray-bs200 Auto-analyzer machine made in China. VLDL was also gained by dividing the amount of triglycerides by five. Measuring overall testosterone level on Nano-gram basis per millimeter was performed by SIEMENS kit made in Germany. Cortisol was also measured according to microgram per deciliter using SIEMENS kit made in Germany by luminescence quantity method. In the first day of this study, participators referred to gym to evaluate and register BMI, body composition, 1 repetition maximum (1RM) for resistance exercises. Body composition of participators was analyzed using Body composition analyzer BC-418MA system by considering usage principles and values were reported as fat percentage and muscular mass. In order to measure 1RM, participators warmed up by light weights (about 50% of a predicted RM) then tried for a weight increase with 85% of RM. rest (3-5min) was between 2 exercises. The last lifted weight was considered as 1RM.

Table 1. Personal feature of control and exercise group (Mean+SD)

Exercise group	Age (year)	Height (cm)	Weight (kg)	Body fat, %	BMI (kg/m ²)
Upper body	24.15±2.77	170.70±6.76	70±3.32	15.6±4.83	23.00±1.49
Lower body	21.00±0.79	174.60±8.22	65.13±7.39	15.7±4.85	23.50±3.15
Combination	21.20±0.76	176.20±1.55	66.52±3.96	19.1±3.30	25.00±2.83
Control	22.26±2.23	175.20±5.07	68.10±3.96	15.7±4.88	23.90±2.13

BMI: Body Mass Index

Statistical Analysis. The data are presented in mean and SD. To analyze the research data after determining the normality of participants, ANOVA with repeated measures and its non-parametric equivalent, Friedman test (in case the data distribution is abnormal), and one-way ANOVA within groups and Kruskal-Wallis were utilized. In order to determine between groups differences, Post hoc Bonferroni and Scheffe test and Tukey and U-mann-Whitney with Benferroni correction and Wilcoxon's post hoc test (as post hoc test of Friedman method with Benferroni correction was utilized.

Statistical analysis was performed by software SPSS20at significant level $P<0.05$.

RESULTS

The results of the study showed that in upper body group: after eight weeks of exercise, fat percent ($p<0.002$), TG ($p<0.002$), HDL($p<0.001$), and testosterone had a significantly increase but VLDL ($p<0.002$) decreased ($p<0.002$) compared to pretest. In lower body group, there was a significantly decrease in the amount of Fat percent ($p<0.006$) and a significantly increase in VLDL ($p<0.001$), HDL($p<0.001$) and

testosterone level ($p<0.000$) compared to pretest. In mixed group, after eight weeks, BMI ($p<0.006$), TG ($p<0.030$) and muscle mass ($p<0.007$) had a significantly increase and cortisol ($p<0.016$) had a significantly decrease after four weeks of exercise compared to pretest. Following that, after eight weeks of exercise, the amount of triglyceride of the four groups had a significantly difference ($p<0.004$). The effect of upper body and mixed exercise had a significantly difference with lower body and control group ($p<0.05$). It seems that upper body and mixed exercises led to increase and lower body and control group led to decrease in triglyceride level. The amount of HDL change is diverse in different study groups after eight weeks ($p<0.006$) and mixed exercises had a significantly difference with lower body exercise effects ($p<0.008$). The lower body exercises increased HDL while mixed exercises decreased it. After eight weeks of exercise, the amount of change in VLDL for four groups showed a significantly difference and the amount of VLDL changes for upper body exercise group after eight weeks showed a significantly difference and increase with lower body exercise and control group ($p<0.05$). The amount of testosterone in study groups represent a significantly

difference after eight weeks ($p<0.025$) in a way that upper body and lower body exercises led to a significantly increase of testosterone compared to the control group ($p<0.008$). The amount of fat percent changes was different in different groups ($p<0.030$) and this difference was related to the fat percent of mixed exercise group with upper body exercise group ($p<0.008$). The amount of BMI is also different in different study groups ($p<0.007$) and the difference is only between mixed exercise and upper body exercise ($p<0.008$) (table2). Increases of 1RM in the upper body group were observed in the chest press and arm curl ($P<0.000$). Increases for each of the exercises were 20% in chest press and 30% in arm curl, On the other hand Increases of 1RM in the lower body group were observed in the squat, seated calf raise ($P<0.00$) Increases for each of the exercises were 15% in squat, 20% in seated calf raise. 1RM in the in combined group were observed in the chest press and arm curl ($P<0.00$). Increases for each of the exercises were 15% in chest press and 25% in arm curl, and increases of 1RM in the lower body group were observed in the squat, seated calf raise ($P<0.00$) Increases for each of the exercises were 12% in squat, 20% in seated calf raise.

Table 2. anthropometric (physiological) measures

Variables	Group	Weeks of Training			p	
		Pretest	Fourth week	Eighth Week	Within Group	Between Group
		Mean±SD	Mean±SD	Mean±SD		
BMI	Upper E.	2.76±24.15	23.78±3.09	23.91±2.73	0.006*	0.007**
	Lower E.	21.10±0.79	21.10±0.54	21.16±0.49		
	Combined	21.38±0.76	21.72±0.66	†21.79±0.61		
	Control	22.26±2.23	21.18±0.92	21.17±1.04		
Body fat %	Upper E.	18.58±2.25	17.87±1.78	†17.30±1.86	0.002*	0.030**
	Lower E.	13.53±0.84	13.61±0.65	†12.63±0.79	0.006*	
	Combined	12.78±2.41	12.63±2.02	12.83±1.59		
	Control	17.26±5.54	17.16±5.23	17.24±5.07		
Muscle Mass	Upper E.	53.73±1.24	53.93±1.86	54.64±1.62	0.007*	0.173
	Lower E.	49.79±6.31	49.94±5.98	50.51±5.88		
	Combined	54.91±1.33	56.11±1.72	†56.17±1.29		
	Control	50.55±4.46	50.18±5.81	50.17±6.11		

*: significant difference three test steps ($p<0.05$), †: significant difference from pre-test (for BMI and muscular mass) and significant difference from amounts of 4 weeks for fat% ($p<0.025$), **: significant difference among four groups ($p<0.05$).

DISCUSSION

The results of the present study showed that resistance training of upper body and lower body leads to increase in testosterone after eight weeks. Research results show that this hormone improved growth and Muscle hypertrophy was associated with biochemical changes such as lipid profile that may be to factors affecting on prediction of cardiovascular disease (12, 13) It seems that resistance training with upper body leads to a significant increase in testosterone even after four weeks of exercise because it has work out with more muscles (13). On the other hand, high intensity training may be Explanation of as a part of results. In this regard, Goto et al. showed that making resistance training with the intensity of 80% one repetition maximum increases testosterone (14). Several mechanism were suggested by researchers to increase serum testosterone in responding to exercise training including Increased testicular blood circulation, activation of the sympathetic nervous system, increased plasma in the volume changes, increased secretion and testicular testosterone production in responding to vasodilator (15) . Findings of the present study are inconsistent with findings of some other research. Resistance exercise increases rest level of testosterone (16, 17). In addition, findings of other researchers demonstrated activity with manual ergometer makes more muscular stress in comparison to activity on bicycle ergometer so Type II fibers were used mostly in manual ergometer. However, Type II fibers have high glycolytic capacity and low oxidation, more lactate produced (18). Although in the present study the concentration of lactate was not measured but several studies have support the relationship between testosterone increases in line with increased lactate. On the other hand, there are higher number of androgenic receptors in upper extremities (chest) compared to the muscles in lower extremities (Vastus lateralis muscle) and androgenic receptors a-in upper extremities muscles show less response to strength training exercises compared to the lower extremities muscles (19) Therefore, combining the upper and lower extremities may not result in significant changes that is contradicts the

findings of some researchers who showed exercise with all the body muscles involved result in more hormonal response (20, 21). On the other hands, the combined exercise condition resulted in significant BMI increase after eight weeks of training. It seems like there is an inverse association between BMI and testosterone level. . in addition, while the Muscle mass increased in all the exercise groups, however, the increase was only significant in the combined group, therefore, it seems like at least prolonged adaptation in neuroendocrine is related to the volume and intensity of training (13). Eight weeks of exercise group performed by the upper and lower extremities groups decreased body fat percent significantly. . Research results have indicated that 1 to 9 percent of body fat percent decrease because of participating in resistance training with different duration time may occur (22). But, after eight weeks, there was a slight and in significant increase in body fat and Muscle mass in mixed group and as it seems, BMI increase in mixed group is the result of slight increase in body fat and Muscle mass. Epidemiological studies have shown that there is a two-way relationship between obesity and serum's testosterone level (23). On the other hand, there was an increase in testosterone and body fat decrease in upper and lower body groups. Therefore, based on these explanations, it may be conclude that these two type of exercise models may have effect on fat percent and testosterone level. The combined training program resulted in significant decrease in Cortisol after four weeks but in other training group no significant change was found Goto *et al.* (2009) demonstrated that intensive resistance training (80 percent in 1RM) and speedy movement did not result in any significant change in Cortisol (24). This result is partly similar to what was found in the present research (upper and lower extremities conditions). Different factors including individual differences, nutrition status, and training conditions play a role in cortisol response to exercise (13) the mild and insignificant decrease of Cortisol concentration of serum in the end of eight weeks of training in upper and lower extremities groups may be attributed to the nerve

system adaptation to exercise. On the other hand It seems like the mild decrease of Cortisol level in upper and lower extremities conditions is proportional to the increase in testosterone increase in these groups- an indication for hormonal interactions (13). In lower body and control groups there was not a significant difference regarding triglyceride between pretest and eighth week while there was an increase in upper body and mixed group. According to the findings of Tran and Weltman (1985) people with TGs lower than 120 milligram per deciliter cannot normally decrease it to a significant level (25). In the present study, the primary TG of participants was about 81 milligram per deciliter. Therefore, it did not change significantly under lower body resistance training. On the other hand, the amount of triglyceride has increased significantly for upper body and mixed group after eight weeks of training therefore more study was needed to justify it. The results of the present study show that total cholesterol and LDL have no significant changes in different exercise groups after four and eight weeks. The present study can be considered as consistent with findings of Donovan *et al.* (2005) and Benz *et al.* (2003) which showing that resistance exercises have no effect on LDL (26,8). Contrary to LDL, HDL carries cholesterol from Peripheral tissues to the liver; therefore can reduce cholesterol that can cause a increase HDL (27). Some studies have reported that HDL-c is a simple and repeatable lipid variable for predicting cardiovascular diseases in type 2 diabetes (28). Results of the present study show, HDL increased in the upper and lower body groups. On the other hand, the increase of VLDL hydrolyze in liver can cause a increase in HDL-c synthesis(29) while VLDL did not have any significant change in the participants of the group except upper body group but there has been an increase in HDL-c synthesis. On the other hand, Research results show that increased of HDL in lower body group was associated with a mild decrease of VLDL in lower body group after four weeks of exercise. Therefore, the eight week intervention may stimulate cholesterol reverse-transfer (29). Findings of the present study were inconsistent with the results reported in Kevin *et al.* (2006), Braith *et al.* (2006), and Slentz *et al.* (2007). The mechanism that causes

HDL increase is yet unknown (1,9,27), but it is possible that increase in HDL is as a result of increase in ApoA, LDL enzymes, cholesterol lecithin transferase and decrease in liver lipase enzyme (30). In the present study, some changes in lipid levels can be considered as a result of hormonal changes. Inadequate of testosterone may have caused coronary arteries diseases which may lead to Atherosclerosis (31). Present study shows an increase in testosterone in upper and lower body group that findings of the present study are consistent with findings of some other research. , it may be conclude that these two type of exercise models may have increase of HDL. Rosano *et al.*(1999) reports that there is a significant relationship between plasma testosterone level and Optimal heart function (32). It must be noted that reduction in testosterone can be a determining factor for cardiovascular diseases in men (33). Although some studies have shown that high concentration of testosterone correlates with HDL-C decrease (34). Some Research results show that increase in physiological levels of testosterone was associated with decrease in HDL (35). It was also observed that levels of HDL decrease in patients who are under testosterone oral treatment (36). It is also likely that inconsistent the results of this study with other findings are the type of participants. It is said that following exercise, endocrine system increases oxidation of fat by increasing hormones such as testosterone, growth and cortisol for need to provided energy by increasing Consumption of free fatty acids and reduces body fat (35, 36).

CONCLUSION

Also, upper and lower body exercises reduce body fat , increase HDL-c and reduce risk factors of lipid profile and create a protective effect against cardiovascular diseases. Increase of testosterone and increase of HDL-c can probably prevent sudden mortality and cardiovascular disorders. In general, this study can be applied for this group of society, for improve effective factors on cardiovascular system and body composition. The results of this research can be clarified further with more tests to evaluate the effects long-term and under different training intensities as well as nutrition control on changes in rest levels of the index.

APPLICABLE REMARKS

- 8-weeks upper and lower body Resistance Training could be an appropriate method for increase in HDL-c in young Men.
- Upper and lower body Resistance Training could be a reliable effective method in decreasing body fat%.

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