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The effects of two types of pyramid and inverted-pyramid resistance trainings on GH and IGF-1 serums of active young men

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Abstract

In regard of researches shortage about effects of various types of resistance trainings on growth hormone (GH) and pseudo-insulin growth factor (IGF-1), the purpose of the present study was comparison of the acute and chronic effects of two types of pyramid and inverted-pyramid resistance trainings on levels GH and IGF-1 serums, among active young men. For this purpose, twenty men of the research divided to two pyramid and inverted-pyramid training groups, randomly (10 persons for each group). The both training groups participated in 8 weeks resistance trainings (pyramid and inverted-pyramid). Blood samples were taken from the subjects, before, immediately then, and two hr after the first test (48 hr before the trainings beginning) and the final one (48 hr after the trainings ending). Factor analysis of variance test was used to investigate changes of under study variables in both pyramid and inverted-pyramid groups. The results indicated that eight weeks both pyramid and inverted-pyramid trainings would cause increase in GH and IGF-1 serums, among active young men (P was 0.000 for both). In the other hand, there was not seen any significant difference about increments of GH and IGF-1 serums, between pyramid and inverted-pyramid types of resistance trainings (P was 0.474 and 0.463, respectively). It seems, resistance trainings create acute and chronic anabolic effects on the bodies of active young males, and these influences do not relate to pyramid or inverted-pyramid type of resistance trainings. However, further surveys with more subjects and measurements of other effective variables are required, for rather accurate conclusions.

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Introduction

Physical activity and sport accompany with physiologic consistencies. Recognition and investigation of these consistencies, especially in hormonal system that has a substantial role about vital reactions of the body, is very important and remarkable. By performing various sport exercises and activities, the hormones would expose different changes, which understanding of these variations is operative about interpretation of physiologic mechanisms of the body.

For the sake of healthiness, the resistance trainings have been noticed by many people. These trainings, which consist of various types like concentric, eccentric, isometric, and even pyramid and inverted-pyramid, cause generation of physiologic variations and consistencies. The most remarkable aspect of these variations and consistencies could appear in hormonal system.

Following muscular damages, consequent on resistance trainings or independent of them, different growth remedial changes would activate, which are being noticed about the topic of consistencies. Anabolic hormones and growth factors are considered, as some of these variations, which are effective about most growth aspects of the tissue (Rasaie *et al.*, 1994), and interpretation of their changes upon exercise induced physiologic responses is very substantial. IGF-1 (or somatomedin-C) and growth hormone (GH) are some of these growth factors, which have influences on growth aspects of the tissue (Charles, 2006).

Growth hormone that is called somatotropic hormone or also somatomedin is a small protein molecule and contained 191-amino acids in a single-chain with molecular weight of 22005 Dalton. This hormone would cause enlargement of the cells bodies and mitose increment companion with cells proliferations and exclusive separations of some kinds of cells, like; bone growth cells and primary muscle cells (Guyton and Hall, 2011).

Somatomedin-C or pseudo-insulin growth factor (IGF-1) that recognized as the positive stimulus for muscle growth is produced in liver and skeletal muscles, and has endocrine and autocrine-paracrine hands (Ohlsson *et al.*, 2000). Molecular weight of somatomedin-C is about 7500 Dalton. This hormone has a strong influence on increment of growth aspects. Plasma concentration of this hormone follows rate of GH secretion (Guyton and Hall, 2011).

It seems GH and IGF-1, have operational roles in responses to resistance trainings (Charles, 2006). Some studies have been carried out about variations of GH and IGF-1 levels following resistance trainings, which some of them showed increases in the levels of those hormones (Borst *et al.*, 2001; Cappon *et al.*, 1994; Weltman *et al.*, 2008; Weltman *et al.*, 2006) and some others did not indicate any variation (Kraemer *et al.*, 1995; Nindle *et al.*, 2001; Walker *et al.*, 2004). The resistance trainings have been paid attention by many men, and the number of persons who go to the gyms and register for resistance trainings is increasing, day by day.

So, the study about this field could be noticed by a vast range of people. As has mentioned previously, the resistance trainings have been contained different types and could be performed in various methods. In this way, selection of training execution in pyramid (from light to heavy, in the sets) and inverted-pyramid (from heavy to light, in the sets) figures could be one of the issues of the coaches and athletes of resistance trainings.

The aim of the present study was comparison of acute and chronic effects of two types of pyramid and inverted-pyramid resistance trainings on levels of GH and IGF-1 serums, among active young males.

Material and methods

Subjects

Statistical society of this study consisted of entire healthy male students of Azad universities of Tehran city. Twenty active male students from different majors and with ages of 20 to 30 years old announced their readiness to participate in the research, following the invitations in those universities. The

qualifications were no decease and surgery precedent, disuse of any medicine and tobacco, having physical healthiness and performing at least one weekly exercise session. The subjects were chosen purposefully and in access, and divided to two experiment groups (10 persons for each group). The whole subjects had perfect physical healthiness (physician approval). Impressibility probability of the dependent variables from the disruptive ones was reduced as possible, by homogenization of the subjects (except the hereditary matters). The subjects' properties have been represented in table 1.

Data Collecting Method

After selection of the subjects, they were become familiar with the study protocol, in a justification meeting, one week before the research execution. Besides becoming familiar with the resistance movements, the demographic characteristics including height, weight and BMI, and 1RM and 10RM were measured. Thereafter, the subjects attended in the test session, 48 hr before the trainings beginning, and blood samples were taken from the two training groups, before, immediately then and 2 hr after a pyramid or an inverted-pyramid resistance activity session. Then, the subjects were performing their trainings schedules, in duration of 8 weeks. They were executing three weekly sessions. After ending of the eight weeks trainings and then the proportional rest to the interval between the first day of samples collecting and the trainings beginning (48 hr), the final resistance activity session was held, just like the first day. Before, immediately then and 2 hr after this session, blood samples were taken, too.

Training Schedule

The resistance trainings schedule consisted of three weekly sessions, in duration of 8 weeks. The span of each session was 50 min, including 10 min warm up, 35 min main training and 5 min cold down. The training loads were the same, among pyramid and inverted-pyramid resistance trainings. The resistance trainings were designated in circular figures and two pyramid and inverted-pyramid ways. The trainings of both group had seven stations of bench press, legs press, biceps, forelegs, triceps, rear-legs and side stretch. Each movement contained three sets (10 repetitions in each set). One and two min rest intervals were considered between each two sets and movements, respectively. Each session involved one circle, too. Among the pyramid group (light to heavy system), the three sets of each movement were being carried out with 50, 75 and 100 percentages of ten maximal repetitions, respectively. In the inverted-pyramid group (heavy to light system), the three sets of each movement were also being done with 100, 75 and 50 percentages of 10 maximal repetitions, respectively.

Blood Samples Collecting and Hormonal Analysis

Blood samples were taken from the middle veins (basilic) of the subject in the amounts of 5 cc, before, immediately then and 2 hr after the first test (48 hr before the trainings beginning) and the final one (48 hr after the trainings ending). It should be mentioned, in order to compensate the lost liquids, enough beverages had been provided for the participants, after each exercise session. The gathered samples were poured into sterile containing K3EDTR tubes. The heparin tubes and EDTR were placed into an ice container, and then the container remained in the room temperature for few minutes. Thereafter, serum separated from plasma by centrifuge pump, in span of 10 min and radial velocity of 3500 RPM. All of blood samples were being preserving in frozen from and at -20°C, until the time of lab examination. It should be noticed, the subjects were demanded to avoid consuming caffeine and alcohol, at the nights of before samples collecting and generally during entire steps of the research. The whole stages of samples collecting were performed in the same conditions, for entire subjects. Growth hormone (GH) serum was measured by ELISA method utilizing LDN (Labor Diagnostica Nord GMBH2CO) kit with sensitivity amount of 0.2 (*ng/ml*). Pseudo-insulin growth factor (IGF-1) serum was gauged by ELISA method using IDS (Immunodiagnostic System) kit with sensitivity amount of 3.1 (*µg/ml*).

Statistical Approach

At first, values of under study variables were described by mean and standard deviation. The Smirnov -Kolmogorov test was implemented, to investigate naturalness of data distributions and selection of parametric or nonparametric tests. Since the data had natural distributions, factor analysis of variance test with repeated measurements was applied to survey changes of under study variables, among both pyramid and inverted-pyramid groups. The significance level was set as 0.05 for entire statistical tests. In addition, the statistical software SPSS v.16 was utilized for statistical calculations.

Results

Statistical descriptions of GH and IGF-1 serums have been presented in table 2. The values have been reported as mean and standard deviation. The results of factor analysis of variance test with repeated measurements have been represented in tables 3 and 4, to compare changes of the variables between the two groups of pyramid and inverted-pyramid. Time operation was significant (P=0.000) but group operation and time and group cooperation were insignificant (P were 0.745 and 0.474, respectively), about GH serum. Overall, GH serums of the two training groups increased, significantly (P=0.000), though there was not any difference between pyramid and inverted-pyramid groups (P=0.474). Time operation was significant (P=0.000) but group operation and time and group cooperation were significant (P were 0.500 and 0.463, respectively). Generally, IGF-1 serums of the two groups increased, significantly (P=0.000), though there was not any difference between these two groups (P=0.463).

Table 1. The subjects' properties.

Variable	Pyramid Group	Inverted-pyramid Group	Overall
Number of Subjects	10	10	20
Age (years old)	26.50±2.27	25.10±2.68	25.80±2.52
Height (cm)	175±4.37	175.70±6.09	175.35±5.17
Weight (kg)	75±3.82	71.70±5.77	73.35±5.06
BMI (kg/m^2)	24.04±1.39	23.90±1.38	23.97±1.35

Discussion

According to the results of the present study, there was not observed any significant difference in levels of GH serum of active young men, between effects of eight weeks resistance pyramid and inverted-pyramid trainings. Indeed, both training groups made significant increment of GH serum among active young men, though the difference was not significant between the two groups.

Table 2. Statistical results of GH and IGF-1.

Variables	Sampling Times	Delorme Groups	Oxford Groups
GH (ng/ml)	Pre	2.99±0.65	3.07±0.52
	Post 1	3.48±0.53	3.44±0.58
	Post 2	3.92±0.69	3.92±0.65
	Post 3	4.21±1.02	3.75±1.008
	Post 4	4.63±0.83	4.56±0.81
	Post 5	4.77±0.86	4.72±0.83
IGF-I (mg/l)	Pre	124.40±25.61	122±22.40
	Post 1	139.90±25.73	151.20±25.80
	Post 2	154.10±22.63	165.90±26.68
	Post 3	166±28.05	175.60±24.51
	Post 4	180.60±24.01	186.10±25.16
	Post 5	195.50±22.87	199.90±24.76

Generally, the present results showed the research groups did not follow any different variations pattern, which was statistically significant. The previous founds are very few about this field and they are mostly concerned to the researches that have investigated various kinds of trainings, not the two types of resistance trainings. Therefore, different results should also be expected, and an accurate conclusion could not be earned without accomplishment of further researches. However, it has been observed in the present study, which has investigated the acute and chronic effects of the two types of pyramid and inverted-pyramid trainings on levels of GH serums among active young men, that the levels of this hormone were not significant between the two training groups.

Table 3. Statistical results of factor analysis of variance with repeated measurements to compare variations of GH serum in the two groups.

Factor	Sum Square	of df	Mean Square	F	P	Effect Size	Observed Power
Time	42.849	1.720	24.914	34.239	0.000 *	0.655	1
Group	0.250	1	0.250	0.109	0.745	0.006	0.061
Time*Group	0.902	1.720	0.525	0.721	0.474	0.039	0.153

* The mean difference is significant at the 0.05 level.

The only way to achieve accurate results and dissolve the existing ambiguities is accomplishment of rather controlled researches in this field. The intensity of exercise is one of the most substantial variables of hormonal response, and thereafter the training duration would be another effective and important parameter (Kraemer, 1988). Indeed, intensities and spans of the both types of resistance trainings were the same, and their differences appeared in pyramid (from light to heavy) and inverted-pyramid (from heavy to light) executions of similar trainings of the subjects' both groups.

Table 4. Statistical results of factor analysis of variance with repeated measurements to compare variations of IGF-1 serum in the two groups.

Factor	Sum of Square	df	Mean Square	F	P	Effect Size	Observed Power
Time	71509.367	2.396	29842.945	81.477	0.000 *	0.819	1
Group	1346.700	1	1346.700	0.473	0.50	0.026	1
Time*Group	725.600	2.396	302.814	0.827	0.463	0.044	0.195

* The mean difference is significant at the 0.05 level.

The nonbeing difference of GH serums between the pyramid resistance trainings and those of inverted-pyramid was observed in the present study. Because of the lack of adequate accomplished studies about this interested field, further researches are required to achieve an accurate conclusion and declare a clear statement and can then insist on a certain understanding. Based on the results of the present study, GH serum levels of the group of pyramid resistance trainings increased significantly, during the research period. Similarly, GH serum levels of the group of inverted-pyramid resistance trainings increased significantly, during the study period.

West *et al.*, (2009) investigated two types of resistance trainings (involved biceps movement as the first, and biceps + forelegs movements as the other) among twelve 21 years old men, in duration of 15 weeks. There was not observed any significant increase in GH by means of the first type of trainings, though the second one caused significant increments of GH serum, 15-30 min after the training. Cross

sections of the muscles increased 12 and 10 percentages by the first and second types of trainings, respectively. Marx *et al.*, (2001) surveyed consistencies to light-mass resistance trainings versus those of heavy-mass ones, among women and in duration of 4 weeks. Hormonal variations results indicated nonbeing change of GH. Nicklas *et al.*, (1995) investigated response of GH, among thirteen 60 years old men and during 16 weeks resistance trainings. They showed GH would not change after trainings execution. Their trainings schedule caused 37 and 39 percentages increases in powers of trunk and haunch, respectively. Despite reduction of body fat percentage, pure mass of the body increased, remarkably. Their founds showed an acute resistance training would lead to GH response among elder people, but 16 weeks resistance trainings hadn't any effect on basic concentration of this anabolic hormone. McCall *et al.*, (1999) investigated acute and chronic influences of resistance trainings on hormones. Eleven male students had practiced, during 12 weeks. The results indicated that GH had not any variation, among their subjects. A remarkable correlation was observed between average GH rising and increment of the first and second types of muscle tissues. Their understandings showed the resistance trainings have not any influence on serum and relaxation concentrations of hormones.

Perhaps, some of the reasons of the disagreement among these founds were because of various trainings protocols and/or different durations of trainings protocols. In addition, the differences between under study societies should not be neglected. Beside the general influences of GH on growth generation, this hormone has several specific effects.

Some of these exclusive influences are the increment of protein synthesis level in entire body cells through intensification of RNA translation for protein synthesis by means of rybosoms and increment of RNA formation through increase in DNA copying and reduction of protein catabolism, increment of fatty acids for energy production, and decrease in glucose level throughout the body. In this manner, growth hormone actually increases the body protein and consumes fat storages, and preserves carbohydrates (Guyton and Hall, 2011). Therefore, it seems both pyramid and inverted-pyramid would cause desirable metabolic and growth effects among active young men. Hence, this group of athletes could use these kinds of trainings. However, further researches should still accomplish to present a sure conclusion in various research terms. There are enormous unclear details about GH response to various kinds of resistance exercises, yet.

According to the results of the present study, there was not observed any significant difference between the effects of 8 weeks pyramid and inverted-pyramid resistance trainings on the levels of IGF-1 serums of active young men. Indeed, both training groups would lead to significant increment of IGF-1 serums of active young men, though the difference between the two groups was not significant.

Generally, the present results showed that the research groups did not follow different variations patterns that are statistically significant, over time. As has been mentioned about GH, there are not enough researches about this field. By the way, further accomplished investigations are required, for better determination of the results. Nevertheless, there was not observed any significant difference on IGF-1 serum concentrations between pyramid (from light to heavy) and inverted-pyramid (from heavy to light) resistance exercises when intensities and spans of exercises were kept the same, in the present study. In a similar way, levels of IGF-1 serum increased significantly, among the group of inverted-pyramid, during the research period.

West *et al.*, (2009) investigated two types of resistance training (containing biceps as the first and biceps + forelegs as the other) among twelve 21 years old men, in duration of 15 weeks. The first type of training did not increase IGF-1 level, though that of the second significantly increased it, 15 to 30 min after the training. Cross sections of the muscles increased 12 and 10 percentages by the first and

second types of trainings, respectively. Walker *et al.*, (2004) surveyed effects of 10 weeks strength trainings on IGF-1 and myostatin. Their volunteers performed two weekly sessions of intense strength trainings, in two groups of large muscles of the body and elbow flexor muscles. Their outcome did not show any variation in IGF-1. Usro *et al.*, (2005) investigated effects of 10 weeks resistance trainings on muscle plasticity markers and IGF-1 receptors densities. Muscle biopsies of five males and females of their training group showed that IGF-1 receptors densities of the muscles would increase following the training period.

Parkhouse *et al.*, (2000) investigated the possibility of increment of gain in IGF-1 resting status through long-term resistance trainings, among elderly women with low bone mineral density. The resistance trainings would lead to significant increases in maximal repetitions of the whole sports. The resting status IGF-1 was significantly increased through the resistance trainings, whereas there was not observed any significant change in amounts of IGFBP1 and IGFBP3. Hence, IGF-1 achievement increased through resistance trainings. These researchers concluded IGF-1 might have a role in significant gain of power, which was achieved through resistance trainings, among their under study society. Borst *et al.*, (2001) studied effects resistance trainings o IGF-1 and IGFBP3. Their major target was determination of influences of resistance trainings on circulating IGF-1 and its two attached proteins. Their schedule involved three weekly sessions, in duration of 25 weeks. Their results indicated that the circulating IGF-1 increased almost 20 percentages, during 13 weeks resistance trainings. There was not any further increase between the thirteenth to fifteenth weeks. The mentioned researchers concluded that the increment of circulating IGF-1 might least mediate in a part of power enhancement, which had been generated through resistance trainings, and had affected on that power rising, indirectly.

Marx *et al.*, (2001) surveyed the consistencies to light-mass resistance trainings versus those of heavy-mass ones, among women and in duration of 4 weeks. Their results indicated IGF-1 enhancement. Nicklas *et al.*, (2001) investigated the IGF-1 responses to 16 weeks resistance trainings among thirteen 60 years old men and showed IGF-1 did not change, after trainings execution. Nevertheless, their trainings schedule would cause 37 and 39 percentages increases in trunk and haunch, respectively. In addition, despite of decrease in body fat percentage, pure mass of the body increased, remarkably. Their found indicated that the 16 weeks resistance trainings had not any influence on basic concentration of this anabolic hormone. Kraemer *et al.*, (1999) compared the consistency of the endocrine system to resistance trainings among young men to that of elder males, and drew a conclusion that after 10 weeks trainings, IGF-1 had not any variation, and IGFBP3 would increase among the young men, unlike the elder ones. McCall *et al.*, (1999) investigated acute and chronic effects of the resistance trainings on hormones. In their research, eleven male students had practiced, in duration of 12 weeks. Their results indicated IGF-1 had not any change. Their understandings showed resistance trainings had not any influence on serum and relaxation concentrations of IGF-1.

Further investigations are needed to clarify the reasons of incongruous results. However, the expectation of observation of the anabolic responses following the resistance trainings, could not be simplistic, and it has been cleared IGF-1 is the most important hormone about appearance of hypotrophy, which resulted from the resistance trainings. The result might not probably be the same, in difference research conditions. The trainings protocols might play important roles about sighting different results. Kraemer (1988) stated a collection of several variables influence on hormonal acute and chronic responses. He considered the intensity, mass, span and rest period of training, and besides engaged muscular mass in company with his subjects' characteristics like age, healthiness level and training situation as substantial parameters.

In the present study, both groups of pyramid and

inverted-pyramid showed increments of IGF-1, during the 8 weeks research period. The growth hormone has a weak linkage to blood plasma proteins. Hence, this hormone would rapidly release from blood to tissues and its half-life is less than 20 min, in blood. In contrast, IGF-1 would build a firm linkage to a carrier protein of blood. This carrier protein is produced in response to GH, like somatomedin C. Therefore, somatomedin C would slowly release from blood to tissues, and some references have mentioned a half-life about 20 hr for it. The recent matter would greatly elongate the progressive effects of discontinuous growth of GH (Guyton and Hall, 2011).

Pseudo-insulin growth factors attach to the carrier protein and circulate in the bloodstream. This issue would create some variations in their half-life and would elongate it. Those factors have the anabolic effects. Some of these effects are amine acid transition, RNA and DNA synthesis, proteins synthesis, chondroitin sulfate production, collagen synthesis to stimulate the cartilage. Some effects in muscles tissues are amine acid transition, proteins synthesis, glucoses transitions, glycogen production (pseudo-insulin activity). Moreover, some effects in adipose tissues are glucoses transition, inhabitation of lipolysis, and stimulation of cells copying (Rasaie *et al.*, 1994).

Therefore, it seems the resistance trainings could be paid attention by young man, for anabolic consistencies and responses. However, since the mentioned researches were limited to pyramid and inverted-pyramid resistance trainings, further studies are required to reach a conclusion with confidence.

Conclusion

According to the results of the present study, it appears the anabolic processes are the dominant procedures of the body, regardless to the type of the resistance exercise (whether pyramid or inverted-pyramid. However, the shortage of researches about the field of the present study, make drawing a firm conclusion without further investigation and insisting on it, rather simplistic. It seems further researches are required, for comparing the effects of pyramid and inverted-pyramid resistance trainings.

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