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EFFECT OF ONE CIRCULAR RESISTANCE SESSION ON PLASMA MYOGENIN AND MYOSTATIN OF YOUNG FEMALE VOLLEYBALL PLAYERS

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Abstract:
The purpose of this study was to analyze the effect of one circular resistance training session on circular surface and plasma myostatin of young female volleyball players. This article was semi-experimental with pre-test and post-test design. The statistical population of this study included club female volleyball players of Zahedan city. In this study, a sample size of 24 was used, who were divided into two groups of 12. Age of subjects was between 23.9 and 24.5. Sampling was done using purposive sampling method from among qualified subjects. Measurement tools included a demographic questionnaire and consent form, digital scales, height gauge, stopwatch, syringes and blood samplers, free weights and training machine weights, laboratory kits, freezers and centrifuges, and microplate reader. To analyze the data, the descriptive statistics were used, including mean and standard deviation and for comparison between pre-test and post-test variables, paired t-test (dependent t) were used and independent t-test was used to compare the mean differences between the studied groups. All analysis operations were done at the significance level of $p \geq 0.05$ and statistical analysis was done using SPSS version 20. In this study, the following results were obtained: (1) a circular resistance training session had significant effect on increasing plasma concentrations in female volleyball players. 2. A circular resistance training session had no significant effect on plasma myostatin concentration in female volleyball players. The results showed for the first time that circular resistance training is a strong stimulus to increase plasma myogenin. So, this kind of activity can be a stimulus for muscle hypertrophy.

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Keywords: circular resistance training, myogenin, myostatin, female volleyball players

1. Introduction

Large number of people referring to sports and fitness and weight loss centers also shows the importance of this issue. This has made fitness experts, including sports physiologists to do many studies for discovering and providing suitable training methods, thus taking huge strides in this area. One of the important issues is that most people are looking for is muscle hypertrophy. The researchers have examined the effect of exercise training on a variety of factors involved in hypertrophy and provided training solutions to it. Given the importance of fitness and providing of appropriate training methods, it is necessary to have sufficient knowledge in the field of resistance training, in particular circular resistance training and its effects on muscle hypertrophy. Skeletal muscle is a dynamic tissue that is able to adapt to different physiological stimuli and external factors (Eschafeno et al, 1996). Repeated training sessions cause different physiological and biochemical adaptations in skeletal muscle. As a result of such adaptations, functional capacity and physical performance improve. Growth and muscle hypertrophy is a physiological adaptations that influence the myogenic regulatory factors (MRFs) and causes transforming growth factor beta (TGF-β). Myogenic transcription factors and myogenic regulatory factors play an important role in skeletal muscle cell differentiation processes by controlling the transcription of phenotype specific proteins (Kramere et al, 2004). MRFs are basic helix-loop-helix transcription factors specific for skeletal muscle, including myogenic differentiation factor (MYOD), muscular regulatory factor 4 (MRF4), myogenic factor 5 (MyF5) and myogenin (Saboren et al, 2000). MRFs are involved in the regulation of satellite cells differentiation, leading to transcription of specific genes involved in skeletal muscle, such as creatine kinase, myosin heavy and light chains, troponin one and desmin (Mosaro et al, 2000).

Another factor affecting muscle growth is myostatin or growth factor / differentiation 8 (GDF8). Myostatin falls within family of transforming growth factor beta (TGF-β) and functions as a regulator of negative muscle mass, and is strongly expressed in skeletal muscle and then secreted into the circulation (Hulmi et al, 2008). Myostatin deficiency is associated with increased muscle growth. Complete absence of myostatin in mice is associated with increased skeletal muscle mass 2 to 3 times both in the form of increased myofibrillar size (hypertrophy) and increase of the number of myofibrils (hyperplasia) (Hulmi et al, 2008). Laboratory studies suggest that myostatin prevents the proliferation of myoblasts during myogenesis and activity of satellite cells and protein synthesis in muscle cells in adult mice (18, 19). Myostatin transcription or protein expression differs in different physiological and pathological conditions such as muscle atrophy, heart failure, HIV, weightlessness, the load applied to the muscle, and affects the muscle mass (Matsakas et al, 2006). Recent evidence has shown altered mRNA and myogenin protein and myostatin in muscle in response to exercise. In this regard, Raue et al (2006) showed that the myogenic gene expression (myogenin, myostatin) at rest is higher in older women than younger women, and that 4 hours after a week of resistance exercise in young women, (MYOD) and myogenin increased while myostatin has been shown to have reduced. Bickel et al (2004) reported a three-fold increase in mRNA myogenin following resistance exercise. They concluded that some expressions of MRF increased 12-24 hours after a resistance exercise. On the other hand Yang et al (2005) reported that resistance exercise (three sets of 10 repetitions with 70% RM-1) increased three times myogenin after 8 to 12 hours. While a running session (30 minutes running on a treadmill at 75 percent Vo2max), made no changes in myogenin. The results of study suggest that the peak of gene expression occurs 4-8 hours after exercise and then at 24 hours post-workout it returns to pre-exercise levels.

Various studies have shown the relation of reduced the transcription of mRNA myostatin in muscle in response to muscle activity under various loads, such as short-term activities, a short-term swimming training (Matasakas et al., 2006), running on a treadmill and running long on rotating wheel (Wehling et al, 2000), or isometric resistance training after atrophy due to load removal on the extremities (Haddad et al, 2006). Although the effect of loading on the expression of myostatin has been well studied, but in this case there is still disagreement among researchers. For example, in humans, decrease and increase of levels of mRNA and myostatin protein was observed during one resistance exercise while several weeks of heavy resistance training has been associated with decreased expression of mRNA myostatin (Kim et al, 2005) and reducing myostatin levels in the blood stream (Walker et al, 2004). Willoughby et al (2004) showed that heavy resistance training in healthy subjects for twelve weeks was associated with increased expression of mRNA and myostatin protein and therefore elevation of serum myostatin. In research by Hulmi et al. (2006), expression of mRNA myostatin was determined in men before and after 6 months of resistance training (5 bilateral leg press with 10% RM-1). Muscle biopsy in half an hour before and 1 and 4 hours of practice showed reduced myostatin and its receptor (activin). In research by Heinemeier et al (2007), 4 hours of resistance training eccentric, concentric, and isometric reduced muscle mRNA myostatin in female mice, but the impact of concentric training was more than concentric and isometric training. In Louis et al (2007), external vastus biopsy showed reduction of mRNA myostatin of 6 trained individuals 1-24 hours after a resistance exercise. The results of Jesnke et al (2010) showed that that 7 session intense eccentric resistance exercise with one leg and introspective for isokinetic knee extensor movements had no effect on the mRNA myostatin in 20 young women.

Myostatin (GDF-8) is a protein that is coded in humans by gene (MSTN). Myostatin is transforming growth factor of TGF β family, which inhibits muscle growth is through a process called myogenesis. Myostatin is the major product of skeletal cells that circulate in the body by the bloodstream and ultimately connects to receptors called muscle tissue (ACTIVIN type II) are connected. To understand the full statins peptide, we should first become familiar with myostatin. Myostatin or (GDF-8) or (MSTN) is a member of the (TGF- β) protein super family. Myostatin is primarily produced in the cells of skeletal muscle and circulates in the blood flows and connect it to its place in the muscle tissue (ACTIVIN type II) and inhibits the growth and differentiation of muscles. Myostatin prevents the proliferation and differentiation of muscle stem cells, weakens growth of muscle fibers resulting in the reduction of skeletal muscle mass. Myostatin control means an increase in size (hypertrophy and hyperplasia) in skeletal muscle, increases strength in the skeletal muscle, reduces fat without affecting smooth and cardiac U muscles without problems and side effects on longevity, increase of bone strength and repair strength of connective tissue.

Myogenin is one of important biochemical agents which modify muscle mass. Myogenin and (MYOD) are two important members of MRFs family, which are at the nucleus of muscle cells and are involved in muscle hypertrophy (Eshedo et al 2004). In response to stimulation by these transcription factors, differentiation of myoblasts and and transcriptional regulation of a lot of muscle specific genes occur (Bergstorm et al, 2002). Many studies have shown the role of MRFs in determining structural and metabolic phenotypes of skeletal muscle (12, 13). For example, Hogez et al (1993) found that the distribution of mRNA myogenin in slow-twitch oxidative fibers is more common. Given the importance of myogenin and myostatin in the regulation of skeletal muscle mass and the impact of resistance exercise on these factors, as well as the contradictory impact of resistance exercise on myostatin and given most studies have been focused on skeletal muscle adaptations and changes of myogenin myostatin versus resistance training and that so far neither locally and abroad, any research has been done on the impact of one session of circular resistance exercise on plasma myogenin and myostatin protein level, researchers sought the answers to these questions and considered the following hypotheses:

1. Does one circular resistance training session affect the plasma myostatin level among young female volleyball players?
2. Does one circular resistance training session affect the plasma myogenin level among young female volleyball players?

1. One circular resistance training session does not affect the plasma myostatin level among young female volleyball players.
2. One circular resistance training session does not affect the plasma myogenin level among young female volleyball players.

2. Literature

2.1 Domestic Literature

Asgarpour et al (2015) studied effects of resistance training methods and lack of training on serum myostatin levels, cortisol, testosterone and male non-trained muscle strength. 34 male non-trained were assigned three groups: experimental (a) (four training sessions), experimental (b) (three sessions per week) and control. The results, analyzed using ANOVA Mix and Tukey follow-up test, showed that resistance training increases muscle strength, lean body mass, decreases testosterone and cortisol and myostatin in both groups. The increase and decrease in the experimental group A was higher than the experimental group B. Also, a detraining period increased serum myostatin levels and cortisol in the experimental group b.

Tavassoli et al (2014) studied impact of a circular resistance training on plasma levels of acylated ghrelin, insulin and growth hormone in males 17 to 19 years old with overweight. A total of 20 students with an average age of 18 years, 174.5 cm height, body mass index of 27.48 were randomly divided into two groups: control and resistance training. The results showed that growth hormone significantly increased but the insulin levels did not show a significant difference.

Bagheri et al (2014) did a study entitled the effect of combined training (strength and endurance) on serum levels of myostatin, follistatin and follistatic ratio on myostatin of elderly women. 11 elderly women were randomly assigned to one of four groups: training of endurance + strength (E + S) (n = 9), strength + endurance (S + E) (n = 10), rotation combined (ACT) (n = 12) and control (n = 9). The results showed levels of follistatin and myostatin did not significantly change after three types of training. Rahimi et al (2014) studied the influence of Ginseng supplements on serum levels of IGF-1 and myostatin among Karate players after one-round race simulation.

So 16 of the club karate players were divided to Ginseng and placebo groups by double-blind, pre-and post-test quasi-experimental design and for a month before and after taking the supplement and after simulated race round, blood sampling was performed. The results showed that in the group receiving ginseng supplements, serum myostatin levels and serum IGF-1 levels was affected by ginseng supplements and activity simulated. Serum myostatin levels and serum IGF-1 levels after consumption had increased compared to before supplementation.

Mohammadi et al (2014) did a research titled study and proliferation of myostatin gene regulation zone and determining sequence of it in native cattle (Najdi) of Khuzestan. Blood samples of 12 cattle were taken at Najdi cattle support station. The results showed that mutations had no significant effect on the boxes and promoter components.

Zakavi (2014) did a study entitled effect of 12 weeks of combined training (aerobic and resistance) on serum myostatin levels in obese adolescents, in which 30 obese adolescents were randomly divided into experimental and control groups. The results showed that the weight (P = 0.004), body fat percentage (P = 0.013), BMI (P = 0.006) and myostatin (P = 0.000) fell significantly pursuant to performing 12 weeks of combined training.

Pakdel et al (2013) studied effect of carcinoembryonic antigen solution on cell myogenic enterocytic differentiation. The results showed that pure conventional CEA trade and environment collected from LS-180 cells had inhibitory effects on Caco-2cell differentiation, but this effect was observed in the control groups.

Saghebjoo et al (2013) studied the effect of eight weeks of high-intensity circular resistance training on plasma chemerin levels and glycemic control in male patients with diabetes type 2. Eighteen overweight inactive men with type 2 diabetes (mean age 48.5 years, weight 79.41 kg and body mass index 27.29 kilograms per square meter) were randomly divided into two groups (n = 10) and control (n = 8). The results showed that chemerin levels fell significantly in the resistance training group. Also significant decreased in plasma levels of insulin and glucose was observed. Resistance training reduced insulin resistance index.

Boroujeni (2012) studied the effect of 8 weeks of resistance training on signal factors affecting the satellite cells in male Wistar rats. A total of 20 adult male Wistar rats of weight of 150 to 250 g were divided were randomly divided into two groups: control and resistance training. Resistance training group was trained for 8 weeks, 5 sessions per week on special stairs with a height of 1 meter and 26 escalators by carrying a weight of 30 percent of their body weight attached to their tail. This level reached increasingly 200% of body weight in the last seven weeks. The exercise included 4-interation sets with 3 minutes rest between sets. The results showed that the levels of 2FGF- significantly increased in the RT group.

Assad, MR, Vakili, J. (2012) studied effect of resistance training program on plasma myostatin level of untrained obese men. For this purpose, 19 obese men untrained volunteers participated in the study and divided into two groups:

experimental (n = 8) and control. The results showed that serum myostatin levels in the experimental group were significantly reduced compared with the control group. Rashidlamir et al (2011) studied the effect of intensity of circular resistance training on ghrelin and GH plasma concentration among young women.

For this purpose, 20 young adult women were voluntarily selected and randomly divided into 4 experimental and control groups. The experimental groups consisted of three group: group 1 with intensity of 40% RM-1, group 2 with intensity of 60% RM-1 and group 3 with intensity of 80% RM-1 performed exercise protocol and the control group had no training. Before and immediately after exercise, blood samples were collected. The results showed that in all three exercise intensity, ghrelin increased. This increase in the experimental group 2 was higher than other groups, it increased in all three groups but it was higher in the experimental group 3 than other groups.

Saremi and Bahrami (2011) studied the effect of resistance training on serum levels of myostatin and skeletal muscle mass among male smokers and non-smokers. In this quasi-experimental study with a pretest – posttest design, fifteen male smokers and fourteen male non-smokers were included. The results showed that, after leg press resistance strength training, chest press strength and skeletal muscle mass increased significantly in both groups, while the index of body fat (including BMI and fat mass) did not change in response to resistance training at the same time, serum myostatin levels decreased in both groups in response to resistance exercise.

Arazi and Hosseini (2010) compared the effect of different intensities of circular resistance training on appetite level of female and male student trained. The study population included all student, male and female, athlete of Guilan University, of whom 45 male subjects (3 groups of 15 each) and 45 females (3 groups of 15 each) were selected at random, and the results showed that circular training with intensity of 50% and 65% RM-1 had a significant impact on increasing appetite of male and female students.

Saremi and Gharaati (2010) studied the effects of resistance training on serum myostatin and insulin resistance in overweight men. The subjects were 17 overweight obese men who were randomly assigned to two groups: resistance training (n = 9) and control (n = 8). The results showed that after resistance training, lean mass and muscle strength significantly increased. At the same time serum levels of myostatin significantly decreased in response to resistance training.

Saremi, A. (2009) studied effects of resistance training on bone mineral density and serum levels of myostatin among male adolescents. In this quasi-experimental research, 30 young men were selected and randomly divided into two groups: resistance training (n = 15) and control (n = 15). The results showed that resistance training significantly increased the chest press strength, leg press strength, lean body mass and bone density in the femoral neck, whereas myostatin were decreased.

Gharakhanlou et al (2008) studied effect of resistance training on levels of myostatin GASP-1, IGF-I and IGFBP-3 in young men. 16 young men were divided into two groups: resistance training (n = 8) and control (n = 8). The results showed that resistance training increases muscle strength, and lean body mass and reduces myostatin.

2.2 Foreign literature

Souza et al. (2014) showed that in response to a set of combined training, myostatin and regulatory genes associated with it ACTIVIN IIb, FLST-3, FOXo-3a, GASP1 remained unchanged after eight weeks of combined training, though strength increased found in both groups.

Ryan et al (2013) also stated that aerobic training associated with weight loss reduce the expression of myostatin in skeletal muscle and also improves insulin resistance in obese older men and women.

Ahalt et al (2011) studied serum levels of myostatin, before and after 6 months of interventional training in lifestyle of 57 obese children and adolescents aged 6 to 16 years. They concluded that serum myostatin levels are higher than before after six months training intervention.

Schifero et al (2011) studied the effect of 12 weeks of strength training with an intensity of 70-80% RM 1 and strength endurance training at 80% MHR on myostatin gene expression and found no difference in terms of the myostatin gene expression between combined training, strength and endurance training.

Hitel et al (2010) reported decreased mRNA myostatin pursuant to an aerobic exercise while resistance training has been used in this study. Raue et al. (2006) studied myogenic gene expression in resting and after a session of resistance exercise in young and elderly women. In this study the expression of mRNA myogenin, MyoD, myostatin, Myf5, MRF4 and MEF2 during the resting and four hours after one resistance exercise set were studied in young women and older. 8 young woman (23 ± 2 years, 67 ± 4 kg) and 6 elderly women (85 ± 1 years, 67 ± 4 kg) participated in a bilateral resistance exercise comprising knee extension with 10 repetitions in 3 sets with 70% RM-1. Muscle biopsies of lateral vastus were performed before resistance exercise and 4 hours after it. The results showed that MyoD, MRF4, Myf5, myogenin and myostatin in elderly subjects at rest was higher than in young subjects. Resistance exercise increases MyoD (2 times) and MRF4 and myogenin and reduce myostatin (2.2 times) in both groups.

Kosk et al. (2006) studied the effects of resistance training three days a week for 16 weeks on myofibrillar hypertrophy and myogenic mechanism in young and elderly people. 12 elderly women and 13 elderly men as well as 11 young women and 13 young men participated in this study and myofibrillar distribution and its cross-sectional area were measured before and after the training period.Transcription and protein level of MRFs were evaluated as restorative markers before and 24 hours after the first session and was also evaluated after the sixteenth session. The results showed that the cross-sectional area of first type fibers increased by 18% only in young group. Myogenin mRNA and MyoD increased in young people and old people while Myf5 only increased in young people. Overall, the survey results show that resistance training 3 days a week causes more hypertrophy in young people than older people.

Yang et al (2005) reported that resistance exercise (three sets of 10 repetitions with 70% RM-1) increased three times myogenin after 8 to 12 hours. The number of participants of this study was 12, with 6 in the resistance exercise group and 6 in running group. Muscle biopsy was performed in 8 stages, before, immediately after, and 24,12,8,4,2,1 hours after the exercise for of lateral vastus (resistance group) and gastrocnemius muscle (endurance running group).

Resistance exercise group participated in an activity with three sets of 10 repetitions and 70 percent RM-1 and endurance group participated in 30 minutes treadmill running at 75 percent Vo2max. The results showed that, after resistance training, mRNA myogenin increased 5.3 times after 8-12 hours, MyoD 8.5 times after 8 hours, MRF4 3.7-4.5 times after 2 to 4 hours. In endurance mRNA MyoD increased 5 to 8 times after the activity for 8 to 12 hours. While no change in myogenin and MRF4 and Myf5 before and 24 hours after the activity was observed. The findings suggest that gene overexpressed time is variable and generally it reaches its peak after 4 to 8 hours after activity and 24 hours after the exercise, it returns to its original state.

Bickel (2005) studied the period of molecular response of the human muscle to resistance exercise. The number of participants of this study were 9 (3 women and 6 men) and at times before and 96,48,24,12 hours after electrical stimulation and maximal voluntary contraction of the lateral vastus muscle. The results showed that resistance exercise increases the level of mRNA myogenin (3 times), MyoD (83 percent) and 4 protein attached to IGF (46 percent).

Matsakas et al (2006) studied the effects of swimming on the expression of myostatin in white and red gastrocnemius muscle and cardiac muscle of rats. Subjects were divided into three groups (1- group swimming second sets of 3 hours, 2- group swimming intensely for 4 week, 3- control group). The results showed that the expression of myostatin in the white fibers in all three groups was higher than fibers and during two swimming sets of 3 hours, no change in the expression of myostatin occurred while the 4-week intense training caused a significant decrease in both mRNA myostatin content of white and red fibers, as that the reduction was more significant in the white fibers. In general, the results of this study showed that that intense exercise reduced the expression of mRNA myostatin in the white and red fibers in skeletal muscle but increases occurred in case of cardiac muscle.

Walker et al (2004) concluded that intense resistance exercise comprising bending of the elbow (2 times per week for 10 weeks with 80% RM-1) reduces serum myostatin of six healthy male and intense resistance exercise involving main groups of the whole body leads to no change in resting plasma myostatin in 11 healthy men (86). In research by Hulmi et al. (2006), expression of mRNA myostatin was determined in men before and after 6 months of resistance training (5 bilateral leg press with 10% RM-1). Muscle biopsy in half an hour before and 1 and 4 hours of practice showed reduced myostatin and its receptor (activin) and nd also reduction of catabolic action of myostatin.

In research by Heinemeier et al (2007), 4 hours of resistance training eccentric, concentric, and isometric reduced muscle mRNA myostatin in female mice (7-9 mice in each group), but the impact of concentric training was more than concentric and isometric training.

In Louis et al (2007), external vastus biopsy showed reduction of mRNA myostatin of 6 trained individuals 1-24 hours after a resistance exercise. The results of Jesnke et al (2010) showed that that 7 session intense eccentric resistance exercise with one leg and introspective for isokinetic knee extensor movements had no effect on the mRNA myostatin in 20 young women. In Louis et al (2007), external vastus biopsy showed reduction of mRNA myostatin of 6 trained individuals 1-24 hours after a resistance exercise. While muscle biopsy was done before exercise, immediately after exercise as well as 1, 2, 4, 8, 12 and 24 hours after the activity.

The results of Jesnke et al (2010) showed that that 7 session intense eccentric resistance exercise with one leg and introspective for isokinetic knee extensor movements had no effect on the mRNA myostatin in 20 young women, while the muscle biopsy at baseline was done 8 hours after the first session and 8 hours after the seventh session.

Barr Roth et al (2003) showed that myostatin may also play a role in skeletal muscle adaptations to exercise. They found that nine weeks of resistance training in eight young men and women, and seven elderly men and women who were trained and healthy, led to a 37% reduction of mRNA myostatin in human subjects.

3. Methodology

3.1 Statistical population & Sample

The population consisted of female club volleyball players of Zahedan city. In this study, the sample size was 24, which was divided to two groups of 12. Samples were selected using purposive sampling method; those who qualified in terms of conditions of inclusion in the study were selected voluntarily as follows.

After coordination and obtaining the permission of the Physical Education Department and relevant authorities, notification was done using statements inviting female volleyball players to participate in the research project. To determine the level of health and physical activity, they were asked to fill in the health and physical activity questionnaire. Through information obtained from the questionnaires, people with a history of cardiovascular disease, hypertension, diabetes or certain drug use were identified and were barred from participating in the research. The participants were asked to avoid extreme physical exertion foods containing caffeine 24 hours before the sports test. At the end, the subjects were asked to sign the consent form after reading the full details of its.

3.2 Research Tools

1. Personal and medical information questionnaire and consent form (Appendix A and B)
2. Seca digital scale with an accuracy of 0.1 kg for the measurement of body weight
3. Height gauge for measuring height with precision of 0.01 cm
4. Stopwatch (Qiu Qiu models HS43) to control resting time between sets
5. Syringes and blood collection equipment (20 cc syringes, needle no. 20 or 18, test tubes, alcohol, medical cotton and medical white glue)
6. Free weights and machine weights
7. ELISA and EIA laboratory kits for measuring myogenin and ELISA Kit for Myostatin (MSTN)
8. Freezer and centrifuges for maintenance and isolating plasma of blood samples
9. Microplate reader devices model Elx800 for laboratory measurements of hormones

3.3 Data analysis method

In this study, descriptive statistics such as mean and standard deviation was used and for comparison between difference of pre-test and post-test of variables of research, the paired t-test (dependent t) were used and independent t test was used to compare the mean differences the study groups. All analyses were performed at the significance level of p ≤ 0.05 using SPSS version 20.

4. Results

H1: One circular resistance training session does not affect the plasma myostatin level among young female volleyball players.

First, using the Kolmogorov-Smirnov test, normality condition of data was test to ensure that data were statistically normal. Therefore, the use of parametric statistical analysis is permitted.

Table 1: The results of paired t-test to compare pre-test and post-test plasma levels of myogenin

Variable	groups	pre-test	post-test	t	P
Myogenin (pg/ml)	**Circular training**	53/10±43/75	61/12±43/152	-241/15	000/0
	Control	01/11±86/73	55/10±71/73	162/0	887/0

Table 2: The results of the independent t-test to compare changes in plasma levels of myogenin

Variable	groups	pre-test – post-test	t	P
Myogenin (pg/ml)	**Circular training**	+37/13±30/77	04/15	000/0
	Control	-34/2±14/0		

According to the findings of Table 1, it can be seen a significant increase (P<0.001) existed in the plasma myogenin of subjects in the circular resistance exercise group, but the control group showed no significant difference in plasma concentration of myogenin (P = 0. 887). Comparison of the difference between the values generated between the groups (Table 2), significant differences (P<0.001) between the two groups was observed. Given significant difference, the first null hypothesis was rejected and the first hypothesis was confirmed, in other words, a circular resistance training session has significant effect on increasing plasma myogenin concentrations in female volleyball players. Thus, the first research hypothesis is rejected.

The findings were consistent with Bickel et al (2004) and Yang et al. (2005). Bickel et al (2004) reported a three-fold increase in mRNA myogenin following resistance exercise. They concluded that the expression of some MRFs 12-24 hours after a resistance exercise increases. Yang et al (2005) reported that resistance exercise (three sets of 10 repetitions with 70% RM-1) increased three times myogenin after 8 to 12 hours. The results of this study were inconsistent with Raue et al. (2006), Louis et al

(2007). Raue et al. (2006) studied myogenic gene expression in resting and after a session of resistance exercise in young and elderly women. The results showed that myogenin decreased. Louis et al (2007) showed that 24 hours after a resistance exercise, myostatin level reduced.

H2: One circular resistance training session does not affect the plasma myogenin level among young female volleyball players.

Table 3: The results of the paired t-test to compare pre-test and post-test plasma levels of myostatin

Variable	groups	pre-test	post-test	t	P
Myostatin (Ng/ml.)	**Circular training**	76/0±29/9	95/0±71/9	-121/2	078/0
	Control	98/0±43/9	98/0±43/9	000/0	000/1

Table 4: The results of the independent t-test to compare changes in plasma levels of myostatin

Variable	groups	pre-test – post-test	t	P
Myostatin (Ng/ml.)	**Circular training**	+54/0±43/0	441/1	175/0
	Control	-58/0±00/0		

According to the findings of Table 4-7, no significant difference was seen in terms of plasma myostatin of subjects between the circular resistance exercises and control groups (P = 0. 078, P =0.001). Comparing the difference of values between the groups (Table 4-8), no significant differences were seen between control group and circular resistance training group (p = 0.887). Given the lack of significant difference, the second null hypothesis was confirmed and the second hypothesis was rejected; in other words, one circular resistance training session has no significant effect on the plasma concentrations of myostatin in female volleyball players. Therefore, the second research hypothesis was confirmed.

The findings of this research were consistent with Bagheri et al (2014), Zakavi (2014), Assad and Vakili (2012), Saremi and Bahrami (2011), Saremi and Qaraati (2010), Saremi (2009), Gharakhanlou et al (2008), Souza et al. (2014), Ryan et al. (2013), Schefiro et al (2011).

Overall, the results showed that one session of circular resistance exercise is a strong stimulus to increase plasma myogenin but does not affect myostatin. So, this kind of activity can be a stimulus for muscle hypertrophy.

5. Suggestions

5.1 Suggestions derived from the research

Given the findings of this study that circular resistance exercise increases the amount of myogenin, it is suggested that people who are looking for fitness and muscle hypertrophy use the benefits of this type of circular resistance exercise.

5.2 Suggestions for future researches

1. Given the importance of myogenin and myostatin in muscle tissue growth and body composition, it is suggested that further research be conducted on the effects of acute training protocols or different circular resistance training on gene expression of myogenin and myostatin plasma levels of its.
2. Given the effects of gender and aging on muscle hypertrophy capacity, it is suggested that response of myogenic factors to sports training be examined in different groups.
3. Given the increased myogen is a treatment method to reduce diseases such as muscular dystrophy and muscle weakness, it is suggested further research be conducted to examine the impact on the myogenin and myostatin of activity or circular resistance training among these patients, to measure the impact of this type of training as a non-pharmacological method for the treatment or prevention of the progression of these disease.

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