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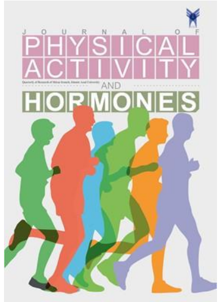

Effect of two types of resistance and functional training programs on myostatin and follistatin of young active men

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Keywords
Intense functional training, resistance training, follistatin, myostatin.

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Abstract

Introduction: The present study aimed at the effect of two types of resistance and functional training programs on myostatin and follistatin of young active men.

Material & Methods: In the study, 45 active young men with an age range of 18 to 28 years were selected as available and placed in three groups of intense functional exercises, traditional resistance exercises and control. Bleeding was done in two stages: pre-Test (24 hours before the start of the intervention period) and post-test (48 hours after the end of the intervention period). The plasma levels of myostatin and follistatin hormones were measured using the human kit of Zellbio, Germany. The training phase took place in eight weeks and three sessions each week. The data collected was analyzed by T-dependent method, covariance and benfronian tracking test.

Results: The results of the present study showed that intense functional training (P=0/0001) and traditional resistance training (P=0/011) had a significant effect on the reduction of myostatin in young active men. Participants in the intense performance training group were statistically lower in myostatin compared to participants in the traditional resistance training group (P=0/027). Intense functional training (P=0/0001) and traditional resistance training (P=0/0001) had a significant effect on the increase in follistatin in young active men. Participants in the intense performance training group were statistically higher than participants in the traditional follistatin resistance training group (P=0/012). Intense functional training (P=0/0001) and traditional resistance training (P=0/037) had a significant impact on increasing the strength of the lower and upper limbs of active young men. Participants in the intense performance training group had statistically higher lower and upper limb strength compared to participants in the traditional resistance training group (P=0/013).

Conclusion: Overall, the results of the present study showed that 8 weeks of traditional HIFT and resistance training improved protein synthesis factors and improved the performance of young athletes.

1. Introduction

Skeletal muscle growth (muscular hypertrophy) is characterized by an increase in the volume or mass of muscle fibers, which is associated with an increase in protein synthesis in muscle fibers. Despite this, there are many mechanisms that control protein synthesis and myofibril growth. One of the most important physiological adaptations is skeletal muscle growth and hypertrophy, which is characterized by an increase in protein synthesis in muscle fibers followed by an increase in the volume or mass of muscle fibers. However, there are many mechanisms that control protein synthesis and myofibril growth. One of the most important message transmission pathways regulating protein synthesis in skeletal muscle fibers is the myostatin-Smad signaling pathway, which is regulated by two agents, myostatin and follistatin (1) myostatin protein or growth/differentiation factor (GDF8) 8 members of It is the transforming growth factor-beta (TGF-β) family - the largest family of secreted growth factors - that inhibits skeletal muscle growth. Myostatin is produced in skeletal muscle; After synthesis in the muscle, it enters the blood and binds to its receptor (activin IIb) in the muscle fibers and leads to the activation of the myostatin-smad signaling pathway and inhibits the growth of skeletal muscle (2). Another mechanism of inhibiting the growth, preservation and regeneration of skeletal muscle caused by myostatin occurs by inhibiting the activation and proliferation of satellite cells (3). It has been shown that the complete knockout of myostatin in mice increases two It is accompanied by three times the mass of skeletal muscle, which occurs as a result of the increase in the size of myofibrils (4), despite this, the effects of myostatin can be influenced by other interactive factors such as follistatin (5). Follistatin is a monomeric secreted binding protein of the family of transforming growth factor beta. Follistatin is secreted from almost all tissues of the body, and as the strongest myostatin antagonist, it can inhibit the activity of myostatin by binding to the myostatin receptor (activin IIb). Deletion of the follistatin gene in muscle causes a decrease in muscle mass, while overexpression of its gene causes excessive muscle growth. The combination of removing myostatin with overexpression of follistatin increases muscle mass by four times (4, 5). However, myostatin and follistatin protein gene expression is affected by various physiological and pathological conditions, including muscle atrophy, heart attack, weightlessness, and sports activity. Various studies have investigated the effect of various types of sports activity on myostatin and follistatin. and (6-8) researches have shown that myostatin increases in response to various loads, including a short-term swimming training period (6), long-term pedaling on a rotating wheel, running on a treadmill (9) and isometric resistance training. After atrophy caused by removal of organ load, it decreases (10), despite this, some studies have reported no change (7) or an increase in myostatin (3). For example, Jenski et al.'s research (7) shows that seven sessions of intense extroversion resistance training with one leg and introversion in the form of isokinetic knee extension movements had no effect on myostatin mRNA in young women. On the other hand, Willegby (8) shows that heavy resistance training in healthy people for twelve weeks was associated with an increase in mRNA and protein expression of myostatin, and as a result, an increase in its serum level. (8) About follistatin, quantitative researches have investigated its changes due to sports activity. Despite this, Hansen and his colleagues reported that the release of plasma follistatin increases during sports activities such as cycling, knee flexion and one hour swimming (3), while Jenski and his colleagues showed that outdoor resistance training and severe introversion did not have an effect on follistatin mRNA in young women. (7) It seems that these discrepant findings are rooted in the difference in the type and intensity of exercise, the sampling time and the method of measuring the target proteins. Despite this, the study on the effect of training methods such as high intensity interval training (HIIT) on myostatin and follistatin is very limited. Also, so far no study has been conducted regarding the effect of high functional training (HIFT) on the hormonal factors of hypertrophy. Despite this, recent studies have reported that HIIT, unlike traditional endurance exercises, causes skeletal muscle hypertrophy (11, 12). It has been shown that long-term HIIT increases the synthesis of muscle proteins. The mechanism by which HIIT causes muscle hypertrophy is not fully understood. It seems that the repetition of short periods and intense work of HIIT can affect muscle growth by stimulating the expression of growth factors (13, 14). , using the whole body and performing a series of strength and endurance exercises together is less common. Therefore, it is necessary to have a study that shows the special exercise intervention of the whole body in human athletes. High functional training (HIFT) is a relatively new training model that has recently been seen in the fitness industry. Attention to HIFT may be largely due to the participants' strong empathy, which increases adherence to the exercise program compared to traditional resistance training methods (15-17). Physiologically, current research suggests that HIFT may improve body composition and increase aerobic capacity, while also increasing absolute and relative strength (18).The hallmark of HIFT is high-intensity dynamic resistance training. It is combined with repetitive endurance programs with little or no rest between exercise activities, resulting in a high caloric expenditure similar to intense circuit training. Despite the popularity of HIFT, it is surprising that very few studies have investigated the adaptations of HIFT exercise chronically. While recent advances in HIFT have provided a glimpse into the physiological and social characteristics of this type of exercise, more research is needed to better characterize HIFT exercises. Therefore, the main question of the current research is whether there is a difference between traditional resistance training and intense performance on the amount of changes in the serum levels of follistatin and myostatin in active youth? As far as we know, the effective cellular mechanism in hypertrophy caused by intense training has not been investigated. It is assumed that one of the mechanisms of hypertrophy refers to the regulation of myostatin and follistatin expression after HIFT. To confirm this hypothesis, in this study, we investigated the effect of eight weeks of HIFT and traditional resistance training on serum levels of myostatin and follistatin in active youth.

2. Materials and methods

Considering that the present research was conducted on a human sample and due to the lack of control over all research conditions on human samples, the present study method is semi-experimental and practical in terms of applying the results. In this research, the dependent variables were pre-test-post-test and double-blind. Data was collected in the field and laboratory. In this study, 45 active young men with the age range of 18-28 years volunteered to participate in this random study. In this study, 45 subjects with the age range of 18-28 years volunteered to participate in this random study. All participants had at least three HIFT and traditional resistance training sessions per week in the last six months and were free from any physiological restrictions that may affect and limit their performance. In addition, all the participants are deprived of any clinical or performance-enhancing drugs, and through the health questionnaire, they are not allowed to consume any food supplements (including creatine, beta-alanine, amino acids) before the intervention and in They were prohibited for the duration of the intervention. The usual caffeinated drinks (coffee and tea) will be consumed during the intervention period as before and there is no prohibition for them. After explaining all the research methods, potential risks and possible benefits, each of the participants gave their informed consent before participating in this study. The supervisory board of academic institutions and the relevant ethics committee approved the research protocol before applying it to the subjects. The research design of the present study is shown in Table 1.

Table 1. *Schematic of the current research plan*

Group	Subjects under investigation	pre-exam	After the test
High Intensity Functional Training	Active young people aged 18-28	T1 (initial blood draw)	T2 (secondary blood draw)
Traditional resistance training	Active young people aged 18-28	T1 (initial blood draw)	T2 (secondary blood draw)
Control	Active young people aged 18-28	T1 (initial blood draw)	T2 (secondary blood draw)

2.1. High Functional Training Protocol (HIFT)

After the familiarization sessions, the subjects will be measured at the desired sports club for the initial body composition test. In order to eliminate the potential effect of diet on muscle structure and body composition, the subjects were fasting for 10 hours. The subjects were fully hydrated 24 hours before the intervention and the beginning of the test process, but they did not have the right to use alcoholic substances, caffeine and intense sports activities. Very intense activity was considered as intense activities (such as anaerobic activity, speed activity, resistance training) than slow running, stretching or calisthenics. Functional tests were performed in a Crossfit club, so that all subjects performed a one-repetition maximal strength (1RM) squat and chest press test. Before performing the 1RM test, each subject performed two warm-up sets using strength training at about 40% to 60% and 60% to 80% of their maximum capacity, respectively. 1RM squat and chest press tests were performed. For each exercise, 4-5 consecutive attempts were performed to obtain 1RM. At least 3 minutes of rest between each attempt was a maximum repetition. During the 8-week intervention of each HIFT training session, an international CrossFit trainer controlled the volume and intensity of the training workload. All training sessions included a strength training session followed by a metabolic bodybuilding session. The strength training session consisted of progressive overload with an intensity of 60 to 100% of 1RM for each activity. Metabolic bodybuilding sessions include a series of Olympic and strength movements (cleans, snatches, body weight activities (squats, Swedish swimming and barfix), non-traditional training methods (kettlebell rotation, medicine ball throwing) and activities Anaerobic exercises (jump rope, row ergometer, sprinting) (19).

2.2. Traditional resistance training protocol

Exercises on the upper and lower limbs were performed in separate sessions. 8 movements and each movement is in 4 sets with 10 repetitions and the intensity of Hurst's performance is based on 10 RM or 75% of 1RM. The rest interval between each set of performing each movement in order to obtain muscle hypertrophy (30-90 seconds) and rest between each movement was considered 3 minutes. This group will perform 24 training sessions three times a week with an interval of 48 hours during 8 weeks. The lower body movements included front lunges, dog squats, leg presses, deadlifts, dumbbell deadlifts, hip thrusts, leg crunches, and reverse crunches. Upper body movements including chest press, dumbbell chest press, chest of the machine, underarm cable pull machine from the front, T-bar with reverse hand, cable puller, lying back fillet, forearm and inner abdomen in one session and another session including shoulder press movements The machine was dumbbell side press, bent press with machine, chest, front arm standing cable pull, hammer front arm, lying dumbbell back arm, standing cable back arm, abdominal crunch machine (20).

2.3. Measurement of blood variables and biochemical evaluations

In order to measure biochemical variables in all 3 study groups, blood sampling was done in two phases: pre-test (24 hours before the intervention period) and post-test (48 hours after the end of the intervention period). To measure MyoD and Myf5 levels in the subjects' blood, after at least 12 hours of overnight fasting, 7 milliliters of blood was taken from the brachial vein of each person and the blood sample was immediately poured into EDTA containing tubes.

The samples were centrifuged at a temperature of 4 degrees Celsius, at a speed of 3000 rpm for 20 minutes. Then, plasma and serum were poured separately into marked tubes and kept in a freezer at minus 30 degrees Celsius to measure blood variables in the future. At this temperature, the samples can be kept for a maximum of one year. In order to minimize the effects of exercise on blood samples, subjects did not have any exercise for 72 hours before. Blood sampling was done between 8-10 in the morning so that the circadian rhythm of protein secretion was observed. Samples were collected at Noor Laboratory located in Fatemi Crossroads and the measurement steps were performed at room temperature (18-25 degrees Celsius). The plasma levels of myostatin and follistatin hormones were measured using a 96-piece human myostatin and follistatin kit from Zellbio, Germany.

2.4. Information analysis method

After collecting the data and refining it, it was analyzed using descriptive and inferential statistics. At the descriptive level of the mean and standard deviation, as well as drawing diagrams, and at the inferential level before testing the hypotheses, the normality of the dependent variables was determined by using the Shapiro-Wilk test. In order to compare the average of the research variables during the pre-test and post-test phases, the dependent t-test was used. Analysis of covariance (ANCOVA) was used to find differences between experimental interventions on hormonal changes, and Bonferroni's post hoc test was used for changes between groups. All this analysis was done using SPSS software version 24 and at the level of 0.05.

3. Results

Table No. 2 shows the average and standard deviation indicators related to the age, height and weight of the subjects in different groups.

Table 2. *Anthropometric parameters of participants (mean ± SD) of the subjects*

group	Number	age (years)	height (cm)	weight (kg)
High Intensity Functional Training	15	3.75±22.93	6.48±186.70	4.73±76.60
Traditional resistance training	15	3.44±23.86	5.85±176.80	5.92±75.53
Control	15	3.25±24.20	6.40±175.73	5.56±77.40

Figure No. 1 shows the content of myostatin in the studied groups before and after the intervention, as can be seen, eight weeks of intense functional training has a significant effect on the myostatin of young men (P=0.0001). The results indicated that myostatin levels increased significantly from pre-test (62.06) to post-test (89.66) as a result of eight weeks of intense functional training. Other results indicate that eight weeks of traditional resistance training has a significant effect on myostatin in young men (P=0.011). The results indicated that myostatin levels increased significantly from pre-test (59/40) to post-test (73/73) as a result of eight weeks of traditional resistance training. Other results indicated that the effect size of intense functional training (1.67) was higher compared to traditional resistance training (0.75). The results of the covariance test indicated that there was a difference between the groups with an effect size of 0.415 in myostatin. There is significance (P=0.0001). The results of the Benferroni follow-up test indicate that there is a significant difference between intense functional training and traditional resistance training with a mean difference of 15.44 ng (P=0.027). Also, the results indicated a significant difference between intense functional training and control with a mean difference of 30.24 ng (P=0.0001). In addition, a significant difference was found between traditional resistance training and control with a mean difference of 14.79 ng (P=0.036).

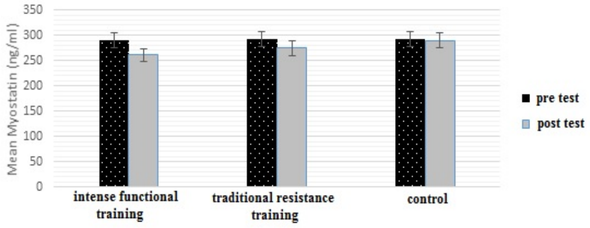

Fig 1. *The average of myostatin in the pre-test and post-test of the study groups*

Figure No. 2 shows the average content of follistatin in the studied groups before and after the intervention. As can be seen, eight weeks of intense functional training has a significant effect on follistatin of young men (P=0.0001). The results indicated that the levels of follistatin decreased significantly from pre-test (289.87) to post-test (261.00) due to eight weeks of intense functional training. Other results indicate that eight weeks of traditional resistance training has a significant effect on follistatin in young men (P=0.0001). The results indicated that the levels of follistatin decreased significantly due to eight weeks of traditional resistance training from pre-test (292/27) to post-test (274/33). Other results indicated a greater effect size of intense functional training (1.58) compared to traditional resistance training (1.29). The results of the covariance test indicate that there is a significant difference between the groups with an effect size of 0.518 in follistatin (P=0.0001). The results of the Benferroni follow-up test indicate that there is a significant difference between intense functional training and traditional resistance training with a mean difference of 13.26 ng (P=0.012). Also, the results showed a significant difference between intense functional training and control with a mean difference of 28.91 ng (P=0.0001). In addition, a significant difference was found between traditional resistance training and control with a mean difference of 15.64 ng (P=0.002).

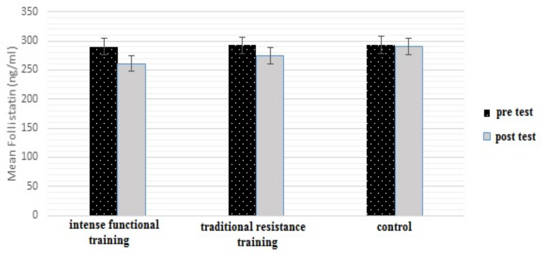

Fig 2. *Average follistatin in the pre-test and post-test of the study groups*

Figure No. 3 shows the changes in the average muscle strength of the lower limbs in the studied groups before and after the intervention. As can be seen, eight weeks of intense functional training has a significant effect on the strength of the lower limbs of young men (=0.0001). P). The results indicated that the strength of the lower limbs increased significantly from the pre-test (85.73) to the post-test (95.93) after eight weeks of intense functional training. Other results indicate that eight weeks of traditional resistance training has a significant effect on the strength of the lower limbs of young men (P=0.037). The results showed that the strength of the lower limbs increased significantly from pre-test (86.93) to post-test (91.26) as a result of eight weeks of traditional resistance training. Other results indicated that the effect size of intense functional training (1.60) was higher compared to traditional resistance training (0.59). The results of the covariance test indicated that between the groups with an effect size of 0.589 in body strength. there is a significant difference (P=0.0001). The results of the Benferroni follow-up test indicate that there is a significant difference between intense functional training and traditional resistance training with a mean difference of 4.42 kg (P=0.013). Also, the results showed a significant difference between intense functional training and control with an average difference of 11.18 kg (P=0.0001). In addition, a significant difference was found between traditional resistance training and control with a mean difference of 6.76 kg (P=0.0001).

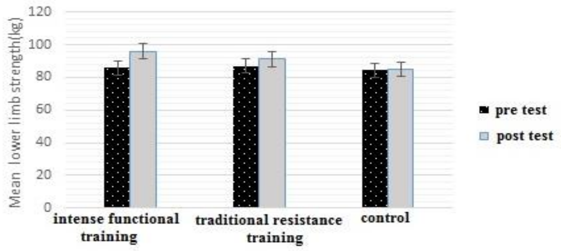

Fig 3. *The average strength of the lower limbs in the pre-test and post-test of the study groups*

Figure No. 4 shows the changes in the average muscle strength of the upper limbs in the studied groups before and after the intervention. The results of the dependent t test showed that eight weeks of intense functional training has a significant effect on the strength of the upper limbs of young men (0.0001). =P). The results indicated that the strength of the upper limb increased significantly from the pre-test (81.33) to the post-test (87.93) kg as a result of eight weeks of intense functional training. Other results indicate that eight weeks of traditional resistance training has a significant effect on the upper limb strength of young men (P=0.014). The results indicated that the strength of the upper limb increased significantly from the pre-test (79.86) to the post-test (82.93) kg as a result of eight weeks of traditional resistance training. Other results indicated a greater effect size of intense functional training (1.36) compared to traditional resistance training (0.72). Also, the results of the covariance test showed that there is a significant difference between the groups with an effect size of 0.593 in upper limb strength (P=0.0001). The results of the Benferroni follow-up test indicate that there is a significant difference between intense functional training and traditional resistance training with a mean difference of 4.90 kg (P=0.0001). Also, the results indicated a significant difference between intense functional training and control with an average difference of 8.67 kg (P=0.0001). In addition, a significant difference was found between traditional resistance training and control with a mean difference of 3.77 kg (P=0.006).

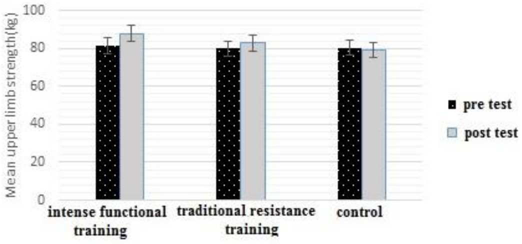

Fig 4. *The average upper limb strength in the pre-test and post-test of the study groups*

4. Discussion

The results of the present study showed that eight weeks of simple resistance training had a significant effect on the reduction of myostatin and the increase of follistatin in active young men. One of the mechanisms for regulating muscle volume and strength is myokine myostatin. Myostatin is a member of the TGF-β family as growth factors that are specifically expressed in skeletal muscle (21). The cellular effects of myostatin in an autocrine/paracrine manner are the main regulators of skeletal muscle growth, so that its activation leads to the inactivation of the hypertrophy pathway and its increased expression leads to muscle atrophy (22). Myostatin inhibits the proliferation and differentiation of myoblasts, as well as the mTOR/Akt pathway, which regulates muscle protein synthesis. This finding is in line with the findings of Sarmi et al. (2010). Creatine reduces the serum level of myostatin (23) Willegby (2004) had previously shown that following resistance training, the expression of myostatin in skeletal muscle and its level in the blood decreases (8). In another parallel study, Fortes et al. (2015) showed that the expression of myostatin in slow-twitch and fast-twitch muscles decreases with increasing load in a diabetic sample. while follistatin levels increased. These researchers attributed the changes of follistatin and myostatin in diabetic samples to hypertrophy responses. Follistatin improves muscle hypertrophy by inhibiting the suppressive effects of myostatin on the differentiation and growth of myogenic progenitor cells. (24) Also, follistatin increases protein synthesis from the mTOR-p70S6K1 pathway through a Samd-3-dependent mechanism (25), on the other hand, myostatin is a negative regulator of muscle growth by reducing the regulation of the mTOR, Akt signaling pathway and decreasing phosphorylation. rpS63, P70S6K, Akt and E4 binding protein act in stopping muscle hypertrophy (26) Contrary to these studies, Isazadeh et al (2020) investigated the effect of the sequence of combined exercises (aerobic-resistance group, resistance-aerobic group) on the serum levels of myostatin and follistatin in elderly women. The results showed an insignificant effect on the levels of myostatin and follistatin (27). The reason for the contradiction can be the method of measuring myostatin levels, most previous researches have evaluated myostatin mRNA in skeletal muscle. Myostatin mRNA undergoes changes and corrections before converting to myostatin protein or changing its form in circulation, so that it cannot represent myostatin in circulation (28). Therefore, it is necessary to monitor myostatin changes in circulation. In contrast to these findings and the results of the present study, an increase in myostatin levels in response to acute and chronic exercise has also been reported. However, this increase in myostatin did not affect the increase in muscle mass and strength. Skeletal muscle is the main source of myostatin expression, and according to the studies conducted, it seems that the release rate of myokines and muscle growth regulatory factors depends on the volume of the involved muscles. and the intensity of sports activity, which is probably part of the contradiction between studies as a result of different training intensities and different volumes of muscles involved. The inconsistency of the results in different studies can be caused by the sampling time, the sampling method (blood sample or muscle sample with biopsy), the duration, the intensity of training and the use of supplements during the training period (29). Myostatin protein in a negative feedback loop and through a signaling pathway dependent on smad-7 reduces the transcription, translation and expression of the myostatin gene in muscle cells, which subsequently reduces the amount of plasma protein. This mechanism is activated in several hours after the exercise stimulus is applied to the skeletal muscle (30). Another possible mechanism is the increasing effect of training on folatestatin (31). The present study showed that intense functional training has increased folatestatin. Follistatin plays an important role in reducing myostatin signaling (32). Follistatin glycoprotein, as one of the important inhibitors of myostatin expression, can act as a competitive inhibitor for myostatin and by binding to circulating myostatin and activin B type receptor, it prevents myostatin from binding to its receptor and neutralizes (33, 34) In the presence of follistatin, myostatin is not able to bind to its receptor and its atrophic activity is reduced (35). In this regard, twelve weeks of high-intensity resistance training has increased the homolog of follistatin and as a result inhibits myostatin. Another result of this research was the superiority of the intense performance group compared to the resistance training group in decreasing myostatin and increasing follistatin. (32) It can be stated that the improvement of follistatin factor as a result of intense functional training is significant due to the imposition of metabolic pressure on the subjects; Exercises using explosive movement patterns and higher loads for the lower body and moderate loads for the upper body (such as high-intensity functional training) have been shown to be more beneficial because the goal is to exert maximal strain during exercise (36). Therefore, it is possible that training programs that use high-intensity interval training (HIFT) and explosive exercises can be effective in developing metabolic stress. and increasing growth factors to improve the level of follistatin. Considering that various mechanisms can play a role in the expression of myostatin as a result of functional training and one of the pathways can be attributed to the increase of insulin-like growth hormone caused by exercise (37), it can be stated that the decrease of myostatin in The effect of intense functional training is due to the increase of these factors; As Klisizovic et al. (2021) showed that the average level of growth hormone increased from 68.4 to 106.5 pg/ml in the short period of HIFT training, and in the long period of HIFT training, the average GH level increased from 38.5 to 286.4 picograms per milliliter has increased. (38) Other results of the current research showed that intense functional training had a significant effect on increasing the strength of the lower and upper limbs of active young men. Also, traditional resistance training had a significant effect on increasing the strength of the lower and upper limbs of active young men. The participants of the intense functional training group had statistically higher lower and upper limb strength compared to the participants of the traditional resistance training group. This finding of the present study is consistent with the study of Behramand et al. (2020). Behra-Mand et al. (2020) in a study compared CrossFit exercises and combined exercises (aerobic + resistance) in the field of myonectin, insulin resistance and physical performance in healthy young women. The results showed that the strength of the upper limbs improved more due to CrossFit exercises than combined exercises (39). The improvement of muscle strength of the participants of the intense functional exercises group is in line with other researches in this field. For example, Podivision et al. (2021) in a study investigated the effect of intense functional training on the physical and physiological factors of overweight and obese firefighters. The results showed that the factors of agility, muscle strength and physical fitness of firefighters also improved significantly. (40) But the findings of the present study are inconsistent with the findings of the study of Sobro et al. (2017). Sobrero et al. (2017) in a study compared intense functional exercises and circular exercises in functional variables and health in women. The results showed that both training groups increased upper body strength and lower body strength. But no change in upper and lower body strength was observed between the two training groups. (41) In another discordant study, McWhinney et al. (2020) showed a significant improvement in muscle strength for both types of traditional resistance training groups and intense functional training, but no significant difference was found between the two training groups. (42) One of the reasons for the discrepancy The results of the present study are similar to the results of the studies of Sobrero et al. (2017) and McWhinney et al. (2020) regarding the gender of the subjects. So that in both studies, the same subjects were used. But in general, the results of the present study are interesting, although the chest press (upper limb strength) was prescribed as an exercise for the resistance training group, the HIFT participants only performed this test in the pre-test and post-test. It is likely that the body weight and Olympic exercises performed by the HIFT group resulted in greater muscle strength gains. These findings are consistent with the results reported by Alcaraz et al. (2008) and Graber et al. (2011), which show that participants who trained with high resistance cycles as well as body weight cycles, have had a similar increase in strength as people participating in traditional strength training (43, 44) The ability of HIFT to increase strength in active young people in the current research shows that HIFT may be a suitable alternative to resistance training when the goal is to improve muscle strength. Also, in addition to the possible benefits of aerobic and anaerobic systems, HIFT sessions can also improve what is called "general exercise capacity" (Crawford et al., 2018), leading to increased work capacity. to be (45) In fact, these improvements represent the most reported effects of HIFT interventions to date (46) and are the result of functional tasks that are part of the programs and integrate and improve the efficiency of many body systems. They challenge at the same time (19) Improvements in overall exercise ability and work capacity, especially during off-seasons, can increase the general fitness of athletes to the extent that they may be able to withstand sport-specific training loads during the preseason, possibly leading to better results. It gets better. Due to conducting the current research during the corona epidemic, the use of masks during exercises and tests was one of the uncontrollable limitations of the research.

5. Conclusion

In general, the results of the present study showed that both resistance training and intense functional training have a significant effect on reducing the serum level of myostatin and increasing follistatin in active young men. Other results indicated the superiority of intense functional training compared to resistance training in these two factors in young active men.

6. Acknowledgment

This article is a part of the results of the master's degree thesis and also of the author's research.

Conflict of interests: The authors declare that there is no conflict of interest in the research.

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