Asian Exercise and Sport Science Journal

Vol.1 No.1

Received: March 2017 **, Accepted:** August 2017 **, Available online:** December 2017

Effect of eight weeks' resistance and endurance training on serum levels of vaspin and Anthropometric indicators in obese and overweight young men

Javad Rashki [1], Mehdi Mogharnasi [2], Seyed Amin Papoli Baravati [3*], Asiyeh Taji Tabas [4]

[1]*Rashki J, M.A in Exerccise Physiology, Islamic Azad University of Taft, Yezd, Iran. J.rashki@yahoo.com*
[2]*Mogharnasi M, Associate Professor of Exercise Physiology, Faculty of Sport Sciences, University of Birjand, Birjand, Iran. Mogharnasi@birjand.ac.ir*
[3*]*Papoli Baravati SA, M.A in Exerccise Physiology, Islamic Azad University of Kerman, Kerman, Iran. S.a.papoli@gmail.com*
[4]*Taji Tabas A, M.A in Exerccise Physiology University of Sistan and Baluchestan, Zahedan, Iran. Asiyeh.taji@yahoo.com*

DOI: 10.30472/aesj.v1i1.1

Abstract:

Vaspin is one of adipokines that is diverse biological roles with variables of BMI, diabetes and obesity. The goal of this research, Effect of eight weeks' resistance and endurance training on serum levels of vaspin and Anthropometric indicators in obese and overweight young men. Twenty-nine overweight and obese Physically young men (Age 30±5 year and BMI 30±2.5 kg/m^2) that had no a history of continuous exercise selected and divided in to 3 groups: resistance, endurance and control. Exercises for eight weeks, three sessions per week. 10 subjects in endurance training group (with intensity of 50% HRmax for 20 minutes and with the gradual increase to 70% HRmax for 30 minutes), 12 subjects in resistance training group (with intensity of 50% and with the gradual increase to 70% of repetition maximum) in the meetings ended, Participated and 7 Person in the control group during the study period did not have any sports activity. Serum levels before and after exercise, vaspin, BMI, Percent body fat and WHR Was calculated. The differences between groups for analyze One-way Anova and for intra-group Paired-Samples T-Test, Post Hoc LSD and by using software SPSS 20 the significance level of $\alpha<0.05$ is used. Eight weeks of resistance training and endurance, there were significant reductions levels of vaspin and Percent body fat ($P<0.05$). Endurance training was decreased body weight and body mass index ($P<0.05$). While the WHR and also the resistance training levels of BMI Significant changes were observed ($P>0.05$). Well as reviews significantly change between the groups of levels Vaspin in the experimental group compared with the control group ($P<0.05$). While was not significant changes in anthropometric variables ($P>0.05$). It seems that exercise training to reduce the Vaspin and anthropometric variables play an effective role in cardiovascular community health and improvement of obesity-related disorders in young men.

KEY WORDS: Vaspin, resistance training, endurance training, obese, overweight

INTRODUCTION

Obesity is the biggest challenges of public health in the current century, and most of the country's health sector are involved in issues and complications caused by growing of obesity [1]. According to the World Health Organization (WHO) in 2005, the population suffering from overweight and obesity in the world were estimated 937 and 396 million people, respectively. This figure has doubled over the past 25 years [2]. It is expected that by 2020, 3.1 billion people worldwide will be overweight and 573 million will be obese [3]. Obesity is not only associated with the development of adipose tissue, but also is linked to chronic low-grade inflammation and hypoxia due to the loss of tissue function [4]. Increase in the amount of Adipose tissue leads to obesity and related diseases like insulin resistance that results in releasing of several protein adipokine that has different biological effects [5]. Adipose tissue plays a key role in regulating the body's metabolism. This metabolic function is performed by mediums called adipokines, which are secreted by adipose tissue [6]. Adipokines establish a connection between adipose tissue with the main metabolic organs such as the liver, muscle, pancreas and also CNS. Consistent with this notion, impairment in messaging of adipokines often leads to metabolic abnormalities in various tissues [7]. Vaspin (serpin protease inhibitor derived from visceral adipose tissue) is a molecule from adipokines family which is newly introduced and described and seems to be related to risky metabolic factors [8] and also has the effect of insulin sensitivity [9]. As insulin in blood and obesity increase, Vaspin levels decreases [10]. Despite the close relationship between serum Vaspin and some anthropometric parameters such as weight, Safarzadeh et al (2012) showed that four weeks of resistance training significantly decreased levels of Vaspin in male Wistar rats (18). In another study Soori et al (2014) body fat percentage and body mass index, obese people due to a larger volume of body fat, have higher vaspin levels [11,12]. Accordingly, there is a significant correlation between the Vaspin and anthropometric indices and gender, insulin sensitivity and glucose metabolism [13]. In a comparative study, the researchers examined the relationship between Vaspin and anthropometric parameters; they reported that people with high physical fitness and less percentage of fat (especially visceral fat as the main source of Vaspin production) had lower levels of Vaspin in serum than those who had a lower physical fitness [12]. One of the most important indexes of physical fitness related to health is anthropometric components that are measured by body weight, body fat percentage, body mass index and waist-to-hip ratio which are known as factors related to obesity [14]. Low levels of physical activity and intake of extra calories are considered of the main causes of obesity and related metabolic disorders [15]. Adjusted lifestyle through increased physical activity and diet control is considered as appropriate and effective methods of control and treatment of obesity and its related disorders. Various factors, including physical activities affect the secretion of adipokines that the response of every adipokines, separately depends on the intensity, duration and type of exercise [16]. In this regard, according to the desired cardiovascular disease and obesity, researchers examined the effects of different forms of exercise on Vaspin. In a study by Kim et al (2011) conducted on elderly subjects and after 10 months modification of lifestyle, they did not observe significant changes in serum levels of Vaspin [17].

concluded that endurance and resistance training in obese middle-aged men reduced the levels of serum Vaspin [19]. Further identifying of adipokin can help to further

understanding of the complications of obesity. As a result, according to the function of vaspin hormone and its excessive relationship with the diseases associated with obesity, and due to the fact that studies on the effect of exercise training are very low on vaspin levels and limited researches have achieved conflicting results and since no study has been conducted on this case, the aim of this study was to investigate the effect of eight weeks of endurance and resistance training on the amount of vaspin in serum and some anthropometric variables in overweight and obese men.

METHODS

The methodology of the present study is quasi-experimental and the study design included pretest and post-test with a control group and two experimental groups. At first, by hanging announcement posters obese and overweight men of Zahedan province who were willing to perform exercises to adjust their weight and improve physiological condition of their body were registered. Under the inclusion terms, the participants were male, aged around 25 to 45 years, BMI 25 to 35 kg per square meter and no drugs users. Then, after explaining the method, informed consent was obtained from the subjects participating in the study, they were evaluated according to the medical history and readiness to start physical activity questionnaire (PAR-Q) [20]. people who have the disease (cardiovascular, renal, pulmonary, diabetes, etc.), took medicines, smoke tobacco, engaged in regular physical activity at least 6 months and the implementation of less than 80 percent of training sessions were discarded. Then, based on the plan, the subjects were divided into groups consisting of a control group (n = 7) and two experimental groups (endurance (10) and resistance (n = 12)). During the training period, participants were asked to refrain from other sport activities, and have one kind of sports diet designed by an exercise nutritionist, and during the study, control their diet and avoid changing diet. In order to remove the effects of circadian rhythm on hormonal changes, all testing and sampling was performed at a specified time for all group.

Anthropometric measures

In order to measure Anthropometric indices, first the weight with light clothing and no shoes was measured using a digital scale (with 0/1 of accuracy) and the height of the subjects using the height measuring device (with accuracy of 0.5 cm) was measured. Body Mass Index (BMI) was calculated by dividing body weight (kg) by the square of height (m2). The waist to hip ratio (WHR) was measured by inflexible tape and without bearing any pressure on the body and with an accuracy of one centimeter by measuring the waist circumference at the narrowest area between the gear down and the crest of the pelvis, and when the slimmest lumbar Available was not detectable, measurements were carried out in the smallest horizontal circumference in this area and dividing it by the pelvic in the area of loose hips and Relax. Skin fold thickness in chest, abdomen and thigh of the body was measured by calipers model made in South Korea. Body fat percentage was calculated using the ternary equation.

Jackson- Pollock three-point equation (J-P) for men (21).

$$\text{Body}=1.10933800- (0.0008267 \times \text{sum of the three points}) + (0.0000016\times \text{ sum of the three points}^2) - (0.0002574 \text{ subjects age})$$

Then, the percentage of body fat was calculated using the satiety formula (21).

Percentage of body fat= (body density/495)-450

All measurements were carried out one step before training and the other step after ending training period.

Exercise plan

As mentioned, the subjects were divided purposefully into three resistances, strength, and control groups. The training practices were held eight weeks, three sessions a week. The control group during the study did not participate in any exercise program.

The endurance training program Subjects for eight weeks

The subjects participated for the eight-week of training program consisting of running, the training program at first with 50 percent of maximum heart rate (MHR) for 20 minutes was carried out gradually with the progress of the training program reached up to 70 percent of maximum heart rate (MHR) and 30 min (Table 1). To determine the intensity of the exercise, the maximum heart rate (220-age) was calculated by the (age-220) relationship. Also, the intensity of practices in each session was controlled using a heart-rate measure made in Finland.

Table 1. Endurance training protocol

The number of sessions	Warm up (10 min)	Time based on minutes	The maximum Heart rate	Cool down
First-second session (acquaintance with program)	Slow jogging , stretching and softening	20	50 %	Jogging and walking, stretching without pressure
Third to seventh sessions		20	55 %	
Eighth to twelfth session		25	60 %	
Thirteenth to eighteenth session		25	65 %	
Nineteenth session to the end		30	70 %	

Resistance training program

In this group before working with the subjects, the Safety Tips related to practicing with weight and how to use bodybuilding devices were explained. In this group, in order to learn the right movements, the subjects did the two training sessions with a minimum of sub maximal weights and some maximum reps. After that, evaluation of power using one maximum repetition (1RM) was estimated by the Brzycki formula (1993) [22].

$$\text{a maximum repetition} = \frac{\text{moved weight kg}}{[\ 1/0278 - (\text{nimber of repetition till exhuastion} \times 0/0278)]}$$

The Resistance training program was performed including practice with 5 devices (underarm stretch, leg press, shoulder barbell from behind, tripped and bench press). The training program with a 50 % of intensity began with a maximum repetition with 15 to 20 times of repetition, and by the gradual increase of exercise intensity reached to 70 % of a maximum repetition with 10 to 12 times of repletion till the overload principle be considered. The rest time between each set of exercises was 60 seconds and rest time between stations was 90 seconds (Table 2).

Table 2. Resistance training protocol

The number of sets	The overload additional intensity and gradual pressure and rest						
	Warm up (10 min)	Number of sets	break time between the sets	percent repetition maximum	number of repetitions at each station	rest time between sets	Cool down
Session 1 to 2 (familiarizing)	Slow jogging, stretching and	3	60"	50 %	15 - 20	90 "	Jogging and walking, stretching without
Session 3 to 7		3	60"	55 %	12	90 "	
Session 8 to 12		3	60"	60 %	12	90 "	
Session 13 to 18		3	60"	65 %	10 - 12	90 "	
Session 19 to the end		3	60"	70 %	10 - 12	90 "	

Measuring Biochemical variable

To measure the biochemical variables, all test in 12 hours of fasting 48 hours before the start of the training program and 48 hours after the last session, in order to eliminate the effects of acute exercise, 10 ml of blood was taken from anti-cubital vein, by laboratory expert. All samplings in the same condition, was performed at 8 to 10 am. Samples of blood after clotting and centrifugation and separation of serum were frozen at -70 ° C to be analyzed along with post-test blood samples. In this study, changes in Vaspin of serum of the samples in the stages (pre-test, post-test) were analyzed by Vaspin kit, vaspin-Elisa-Human-96t EASTBIOPHARM company made in America by ELISA method.

Statistical method

To analyze the data based on the objectives of the study descriptive statistics were used and the results were shown in table format. Normality of the data was determined using Kolmogorov–Smirnov test (K-S). Paired t-test were used to investigate the within group changes in the pre and post-test of each variable in the experimental and control groups, the comparison of the effects of

between groups exercise using single sided analysis of variance of changes was conducted pre and post-test and the post hoc LSD tests was used to test the significance. In all of the tests the rate of error was considered in 0.05 level; the data was investigated using SPSS 20 software.

Findings

Dk8emographic characteristic of subjects at baseline was shown in Table 2. A normal distribution of data was determined by (K-S) test and Table 3 showed paired t-test comparisons between data before and after training in various subjects.

Table 3. Profile of participants and the comparison between the variables before and after trainings for experiment and control groups

Variables	Groups	Weight (kg)	Body mass index (kg/m^2)	Around waist basin (WHR)	Percentage of body fat (%F)	Vaspin (μu/ml)	Age (year)	Stature(cm)
Resistance (n=12)	Pre test	90.75±8.36	30.57±2.64	0.94±0.02	29.49±3.25	4.87±3.13	26.16±3.63	172.33±5.82
	Post test	89.91±7.72	30.30±2.49	0.93±0.02	28.83±3.25	2.58±2.70		
	P value	0.07	0.08	0.19	0.03*	0.00*		
Endurance (n=10)	Pre test	101.9±24.15	33.89±8.61	0.96±0.03	33.74±4.89	2.63±2.91	27.6±5.03	173.60±4.11
	Post test	99.80±24.44	33.19±8.64	0.96±0.01	33.03±5.67	0.50±0.58		
	P value	0.03*	0.03*	0.89	0.01*	0.05*		
Control (n=7)	Pre test	88.14±14.96	28.8±4.07	0.94±0.01	29.37±4.53	2.88±3.42	29.5±3.82	174.57±5.06
	Post test	88.14±12.26	28.8±3.15	0.94±0.02	29.95±4.10	0.81±0.85		
	P value	0.18	0.09	0.52	0.36	0.18		

The values were shown as mean ± standard deviation.
*Paired t-test (between pre and post-test for each group) is significant at 0.05 ($p \leq 0.05$)

Using dependent t-test in experimental groups in the values for weight of the endurance group (P=0.03), body mass index of the endurance group (P=0.03), percentage of body fat, for endurance group (P=0.01) and resistance group (P=0.03) and Vaspin in the endurance group (P=0.05) and resistance group(P=0.00) a significant reduction was observed ($P \leq 0.05$). Amounts of weight and body mass index in resistance group and waist to hip ratio was significantly decreased in all practice groups ($P \geq 0.05$). In control group all values of the variables were more than 0.05 and the control group was not in significant level ($P \geq 0.05$). This result was expected, since the members of control group did not have any sport activities.

Table 4- the results of analysis of the variance to compare changes between groups

Variables	Sum of square	Degree of freedom	Mean square	F statistics	p-value
Weight (kg)	741.316	2	370.685	1.389	0.267
Body mass index	86.186	2	43.093	1.400	0.265
Waist round-hip (WHR)	0.004	2	0.002	3.223	0.056
Fat percentages of body (%f)	99.328	2	49.664	2.544	0.098
Vapsin (µu/ml)	27.263	2	13.632	4.017	0.030

One-way analysis of variance Test (ANOVA) significant at 0.05 level (p≥0.05)

The results of between groups one-way ANOVA was indicated in Table 4, that between there WAS NO significant relationship difference training and controls groups on average of body weight (P=0.267), body mass index (P=0.265), the waist-to-hip ratio (P=0.056), body fat percentage (P=0.098) in the pre-test and post-training workout groups (P>0.05). But a significant reduction is observed in the serum vaspin (P=0.03) (P≤0.05).

Table 5- the post hoc LSD test results in the comparison of eight weeks of training on serum Vaspin (µu/ml)

groups		**Mean difference(groups)**	**Standard deviation**	**p-value**
Resistance training	Endurance training	2.083	0.788	0.014**
	control	1.769	0.876	0.054
Endurance training	control	-0.314	0.907	0.732

** The mean difference in LSD tests is significant in 0.05 (p<0.05)

The results of LSD post hoc test in Table 5 showed that, there is a significant difference between resistance training group with endurance training group (P=0.014) at eight weeks of training (P≤0.05) in values of serum vaspin. And there was not a significant reduction between other groups (P>0.05).

Discussion

The main finding of this study was that, after eight weeks of resistance and endurance training levels of serum Vaspin significantly reduced in young obese and overweight men. these results consistent with the findings of Cheng et al. (2010) (12) Lee et al (2010) (23), Safarzadeh et al (2012) (18) and Suri et al (2014) (19), that observed a significant reduction in vaspin levels after exercise and it was not consistent with the findings of

Hejazi et al. (2014) (24) and Khademosharie et al (2014) (25) that showed no change in Vaspin levels after exercise. The differences observed between the results could be due to differences in age and gender of subjects, differences in the type, duration, and intensity and duration of the exercise. Vaspin is a new indicator of obesity and insulin sensitivity problem (26). There is less information on the effect of Sports activities on the levels of circulating Vaspin and the results of existing research is also flawed. One of The possible mechanisms to justify a reduction of vaspin levels in this study can be weight loss, body mass index and body fat percentage. Researchers in a comparative study reported that people with high physical preparation and low percentage of fat (especially visceral fat) as the main center of Vaspin production have lower levels of serum Vaspin than those with lower physical preparation (11). Chu and colleagues, Cheng and colleagues showed that despite the close relationship between serum Vaspin and anthropometric indices such as weight, body fat percentage and body mass index in obese subjects has higher Vaspin levels due to the more volume of body fat (11, 12). In another study Safarzadeh and colleagues also showed that a significant reduction of Vaspin in the endurance group compared to the resistance group has been due to the improvement of physical indexes and more reduction of fat percentage that is likely to explain the reduction of the amount of fat as disease mechanisms in the secretion of Vaspin (18). As a result, it is possible to consider can b weight loss and body mass index and body fat percentage as one of the reasons for the decline in Vaspin levels. In addition to changes in weight, body mass index and body fat percentage, other factors such as exercise, insulin resistance, diet and lifestyle may be effective in regulating the levels in circulating Vaspin. In a study by Veda in 2008 showed that in a level of high physical preparation, vaspin activity decreases while sport practices result in increase of vaspin concentration of serum in non-athletes (27). In a study Cheng and colleagues demonstrated that levels of Vaspin are associated with changes in daily food (12). In another study HIDA et al (2005) showed that changes in the Vaspin levels can affect insulin levels. Circadian changes of serum Vaspin, is dependent on diet (16). sharafati Moghaddam and colleagues also reported that due to the high levels of Vaspin in obese patients, sports programs and other programs, including modification of diet and educating lifestyle can be compensation structures in response to decreased insulin sensitivity and decreased glucose metabolism, thus reducing vaspin levels due to reduced adipose tissue along exercise, is a very useful structure for people with overweight and physical activity can have a supporting role for diseases associated with obesity, and they concluded that the effect of exercise on the adipose tissue and, consequently Vaspin production, is considered as prevention role in obesity(28).

According to the results, anthropometric variables decreased by 8 weeks of resistance and endurance training. This reduction was significant in weight, body mass index and body fat percentage, of the endurance group. But it was not significant in waist to hip ratio. Variables of body weight, body mass index

and waist to hip ratio in resistance group had not a significant reduction, but it had significant decrease in body fat percentage. In this study, a significant reduction in weight and body mass index was in line with the results of a study by Assad and vakili (2012) (29) and was not consistent with the results of Saidi, Miabaran et al (2014) (30). Inconsistent results may be due to differences in subjects' age, type, duration, intensity and duration of the exercise. Indeed, the study also had limitations that could affect the results of this study. Of the limitations of the research was subject's diet in both experiment and controlled. For this reason, the participants were advised during the research period to control their diet based on the recommendations, and avoid diet changes. But because experimental research is with human models, the precise control of diet was not possible by the researcher. Other limitations include the inability to control the precise placement, psychological stress, motivation levels of the subjects, lifestyle, endocrine secretions and genetic characteristics. Totally implementation of eight weeks of endurance training in the experimental group decreased levels of serum vaspin and the amount of weight and body mass index and body fat percentage, but no significant changes was observed in the ratio of waist to hips. Vaspin values in the resistance training experimental group and body fat percentage significantly decreased, but no significant change was observed in body weight, body mass index and waist to hip ratio. Also between-group Reviews showed significant changes in Vaspin values in the experimental group compared with the control group.

In the present study, the effect of endurance and resistance training was studied on Vaspin levels of serum and anthropometric variables and the results showed that both training methods leads to reduction of body mass index, weight and body fat percentage, eventually vaspin levels also decreases. Accordingly, it can be said, endurance and resistance training, by Vaspin reduction and obesity related factors, have an effective role in improving cardiovascular health and obesity-related disorders in obese and overweight men. Thus, although, according to the findings of the present study, these two types of exercises have been effective in reducing Vaspin levels, but more researches are recommended.

ACKNOWLEDGEMENT

Of all those to accomplish this research is a companion have done sincerely and gratefully.

References:

1. Kelly T, Yang W, Chen CS, Reynold K, He J., *Global burden of obesity in 2005 and projections to 2030*. International journal of obesity, 2008. 32(9): p. 1431-1437.
2. World Healt Organization., *Obesity: report of a WHO consultation.* World Health Organ Tech Rep ser, 2000. 894: i-xii. p. 1- 253.
3. World Health Organization., *Chronic diseases are the major cause of death and disability worldwide*. Available from: http//www.who.int/chp/chronic disease report/media/factsheet/pdf.
4. Sell H. and J. Eckel, *Adipose tissue inflammation: novel insight into the role of macrophages and lymphocytes*. Current Opinion in Clinical Nutrition & Metabolic Care, 2010. 13(4): p. 366-370.
5. Fasshauer M, Klein J, Lossner U, Paschke R., *Interleukin (IL)-6 mRNA Expression Is Stimulated by Insulin, Isoproterenol, Tumour Necrosis Factor Alpha, Growth Hormone, and IL-6 in 3T3-L1 Adipocytes*. Hormone and Metabolic Research, 2003. 35(03): p. 147-152.
6. Hasanzadeh Kafshgari, M, Harding, F, Voelcker N., *Insights into Cellular Uptake of Nanoparticles.* Current drug delivery, 2015. 12(1): p. 63-77.
7. Sahay G, Alakhova D, Kabanov A., *Endocytosis of nanomedicines*. Journal of control release, 2010. 145(3): p. 182-195.
8. Auguet T, Quintero Y, Riesco D, Morancho B, Terra X, Crescenti A, et al., *New adipokines vaspin and omentin. Circulating levels and gene expression in adipose tissue from morbidly obese women.* BMC medical genetics, 2011. 12(1): p. 60.
9. Teshigawara S, Wada J, Hida K, Nakatsuka A, Eguchi J, Murakami K, et al., *Serum vaspin concentrations are closely related to insulin resistance, and rs77060950 at SERPINA12 genetically defines distinct group with higher serum levels in Japanese population.* The Journal of Clinical Endocrinology & Metabolism, 2012. 97(7): p. E1202-E1207.
10. Blüher M., *Vaspin in obesity and diabetes: pathophysiological and clinical significance*. Endocrine, 2012. 41(2): p. 176-182.
11. Cho JK, Han TK, Kang HS., *Combined effects of body mass index and cardio/respiratory fitness on serum vaspin concentrations in Korean young men.* European journal of applied physiology, 2010. 108(2): p. 347-353.
12. Chang HM, Park HS, Park CY, Song YS, Jang YJ., *Association between serum vaspin concentrations and visceral adipose tissue in Korean subjects*. Metabolism, 2010. 59(9): p. 1276-1281.
13. Kaisar OM, Johnson DW, Prins JB, Isbel N., *The role of novel biomarkers of cardiovascular disease in chronic kidney disease: focus on adiponectin and leptin.* Current cardiology reviews, 2008. 4(4): p. 287-292.
14. Heyward VH. and A. Gibson, *Advanced fitness assessment and exercise prescription 7th edition*. Human kinetics, 2014. p. 1-7.
15. Lau DC, Douketis JD, Morrison KM, Hramiak IM, Sharma AM, Ur E., *members of the Obesity Canada Clinical Practice Guidelines Expert Panel. 2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children [summary]*. Canadian Medical Association Journal, 2007. 176(8): p. S1-S13.
16. Hida K, Wada J, Eguchi J, Zhang H, Baba M, Seida A, Hashimoto I, et al., *Visceral adipose tissue-derived serine protease inhibitor: a unique insulin-sensitizing adipocytokine in obesity.* Proceedings of the National Academy of Sciences of the United States of America, 2005. 102(30): p. 10610-10615.
17. Kim SM, Cho GJ, Yannakoulia M, Hwang TG, Kim IH, Park EK, Mantzoros CS. *Lifestyle modification increases circulating adiponectin concentrations but does not change vaspin concentrations*. Metabolism, 2011. 60(9): p. 1294-1299.
18. Safarzade A R, Gharakhanlou R, Hedayati M, Talebi-Garakani E., *The Effect of 4 Weeks Resistance Training on Serum Vaspin, Il-6, CRP and TNF-A Concentrations in Diabetic Rats.* Iranian Journal of Endocrinology and Metabolism, 2012. 14 (1): p. 68-74.
19. Soori R, Ranjbar K, Ravasi AA., *The comparison of between endurance and resistance training on vaspin and adiponectin in obese middle-age men.* Sport Physiology, 2014. 5(20): p. 97-114.
20. Thomas S, Reading J, Shephard RJ., *Revision of the Physical Activity Readiness Questionnaire (PAR-Q). Canadian journal of sport sciences.* 1992 Dec.

21. Jackson AS, Pollock ML. *Generalized equations for predicting body density of men.* British journal of nutrition, 1978. 40(03): p. 497-504.
22. Brzycki M. *A practical approach to strength training. McGraw-Hill*. Chicago. 1998.
23. Lee MK, Jekal Y, Im JA, Kim E, Lee SH, Park JH, Chu SH, et al., *Reduced serum vaspin concentrations in obese children following short-term intensive lifestyle modification*. Clinica chimica acta, 2010. 411(5): p. 381-385.
24. hejazi M, nezamdoost Z, Saghebjoo M., *Effect of Twelve Weeks of Aerobic Training on Serum Levels of Leptin, Vaspin and Some Indicators of Oxidative Stress in Obese Middle-Aged Women*. Iranian Journal of Endocrinology and Metabolism, 2014. 16(2): p. 111-118
25. Khademosharie M, Amiri Parsa T, Hamedinia MR, Azarnive MA, Hosseini-Kakhk SAR., *Effects of two aerobic training protocols on Vaspin, Chemerin and lipid profile in women with type 2 diabetes*. Iran South Med J, 2014. 17(4): p. 571-581
26. Li Q, Chen R, Moriya J, Yamakawa J, Sumino H, Kanda T, Takahashi T. *A novel adipocytokine, visceral adipose tissue-derived serine protease inhibitor (vaspin), and obesity*. Journal of International Medical Research, 2008. 36(4): p. 625-629.
27. Wada J. *Vaspin: a novel serpin with insulin-sensitizing effects.* Expert opinion on investigational drugs, 2008. 17(3): p. 327-333.
28. Sherafati Moghadam M, Daryanoosh F, Mohammadi M, Koushki Jahromy M, Alizadeh Palavani H., *The effect of eight-week intense sprint exercise on plasma levels of vaspin and chemerin in female Sprague-Dawley rats.* Daneshvarmed, 2013. 21(107): p. 31-38
29. Asad MR. and J. Vakili, *Effect of 8 weeks' resistance training on myostatin serum level in overweight nonathletic women.* Applied Research of Sport Management and Biology, 2012. 1(1): p. 75-80
30. Saeidi Ziabari T, Mohebbi H, Hedayati Emami MH. *The effect of 8 weeks moderate intensity aerobic exercise on plasma Apelin level and insulin resistance in women with type 2 diabetes.* Sport Physiology, 2014. 5(20): p. 115-