Kermanshah University of Medical Sciences

Journal of Kermanshah University of Medical Science

Journal homepage: Htpp://journals.kums.ac.ir/ojs/index.php/jkums

Original Article

Effects of Eight-Weeks of Aerobic Training on Resistin Levels and Insulin Resistance in Sedentary Middle-Aged Women

Bahram Abedi[1]*, Mehri Karimi[1], Abbas Mehranpour[1], Mansour Sayyah[2]

1. Dept. of Physical Education, Mahallat Branch, Islamic Azad University, Mahallat, Iran
2. Trauma Research Center, College of Medicine, Kashan University of Medical Sciences, Kashan, Iran

Article Info

Keywords: aerobic exercise; resistin; insulin resistance; sedentary middle-aged females

***Corresponding Author**: Islamic Azad University, Daneshgah Street, Ayatollah Khamenei Boulevard, Mahallat, Markazi Province, Iran. Post Code: 3781958514
Phone: +98 918 866 7662

Email: abedi@iaumahallat.ac.ir

Received: 25 September, 2017
Accepted: 05 December, 2017

J Kermanshah Univ Med Sci. 2017; 21(3): 91-95

Abstract

Introduction: Resistin is an adipocyte-specific hormone secreted from adipose tissue which plays a significant role in the energy homeostasis and regulation of energy metabolism. The purpose of this study was to examine the effects of eight weeks of aerobic training on the resistin levels and insulin resistance in sedentary middle-aged women.

Methods: In this quasi-experimental research, 20 sedentary women were randomly selected and assigned to two groups: experimental group, n=10, aged 47.70±5.35; and control, n=10, age 41.30±3.02, respectively. The participants in the training group performed an exercise protocol three times per week with the goal of 55 to 65 per cent of maximum heart rate. Before and after the completion, the resistin, insulin, glucose and insulin resistance levels were measured after 12 h of overnight fasting. Data were analyzed before and after the intervention by t-test. The significant level was defined as $P \leq 0.05$.

Results: Aerobic training in compared with the control group showed significant effect in decreasing resistin levels (P=0.012), BMI (P=0.01), insulin resistance (P=0.01), and increasing VO2 max (P=0.004).

Conclusion: It appears that eight weeks of aerobic training significantly changes the level of resistin and the insulin resistance index in sedentary middle-aged women. Plasma resistin may be associated with insulin resistance in sedentary women.

In general, according to the results, we may say that an eight-week aerobic training with a significant reduction in plasma resistin has a preventive effect as a new and effective training method on insulin resistance in middle-aged sedentary women.

Introduction

Adipose tissue plays an important role in insulin resistance through an abnormal production and secretion of several proteins such as leptin, adiponectin and resistin. The new resistin hormone is secreted from adipocytes and belongs to the group of proteins with the carboxyl terminus rich in cysteine. Evidence shows that increased secretion of resistin impairs insulin action and glucose metabolism, while the injection of antibodies against this protein into diabetic mice improves glucose homeostasis and insulin sensitivity [1]. Further studies have shown that increasing resistin gene expression in the livers of mice causes insulin resistance and reduces fasting glucose levels in mice lacking this gene, thus, it was concluded that this protein inhibits insulin action in the liver by interfering in insulin signaling pathway [2]. The result of research has indicated that high level of resistin impairs glucose tolerance, increases insulin resistance in the liver, and impairs insulin activity. Based on these results it has been concluded that resistin levels are highly correlated with inflammation [2]. A further research report has indicated that exercise can improve insulin sensitivity through metabolic adaptations with regard to insulin resistance [3]. However, effect of exercise on levels of resistin and insulin resistance adaptation have remained controversial. For instance, Jorge et al. (2010) demonstrated that resistin and insulin resistance did not change significantly after 12 weeks of aerobic training [4]. In addition, Giannopoulou et al. (2005) found no significant change in the levels of resistin and in insulin resistance after 14 weeks of an aerobic training program [5], whereas Jones et al. (2006) demonstrated a significant decrease in serum resistin and no change in insulin resistance in obese adolescents after eight months of aerobic exercises [6]. On the contrary, Abedi et al. (2015) observed a significant decrease in insulin resistance in overweight women after 10 weeks of concurrent (aerobic and resistance) training [7].

Despite abundant research of protocols examining the effects of acute exercise on resistin levels, there is a lack of unanimity with regard to the effect of exercise on resistin. Such a condition is partly due to the different types of exercise protocol and to overweight or fat participants; in addition, while there is sufficient research showing the effectiveness of regular exercise in increasing serum insulin levels and preventing type II diabetes, there are insufficient research findings with regard to the effect of exercise on resistin level and insulin sensitivity in the sedentary population. Therefore, this research was designed to examine the effect of aerobic training on resistin levels and insulin resistance in sedentary middle-aged women.

Materials and Methods

This quasi-experimental pre-test and post-test design was conducted in 2015 in Saveh City. The participants were sedentary middle-aged women who were involved in their daily activities with no history of regular sport activities. Following advertising in public places in the city, women who were interested in the exercise protocol (based on the inclusion and exclusion criteria), volunteered to participate. After a thorough explanation of the purpose and procedures, the sedentary women (sedentary: defined as less than 30 min of physical activity per day based on the International Registration Score Questionnaire) candidates completed a physical activity questionnaire [8]. Then, 20 volunteers with sedentary life styles were selected. Exclusion criteria consisted of smoking, past medical history of any diseases, any medication use, and also participation in regular physical activity in the past six months.

All the participants signed formal consent forms. A week before the first session, the participants were required undergo a physical examination by a physician for their public health and cardiovascular health, control of medication, lack of specific diseases and lack of mobility. Three days before the start of the exercise programs, the anthropometric and physiological measurements including age, height, weight, body fat percentage, waist to hip ratio and maximum oxygen consumption were evaluated. Then, they were randomly assigned to two groups; experimental (n=10) and control group (n= 10).

Aerobic training was done in three sessions per week for eight weeks. Each exercise session included eight minutes for warming up through walking, stretching and movements and some minutes for running, with the goal of 55 to 65 per cent of maximum heart rate. The running time was 8 min in the first session, and 1 min for running time was added to each of the two sessions. After eight weeks, running time was 20 min and the last five min was to cool off. Also, during this period the control group did not participate in any exercise program. Heart rate monitors were controlled by Polar watch model (RC3).

To check the biochemical variables blood samples were taken after 12 to 14 h of fasting in two separate steps, before and after eight weeks of exercise. In the first step, two days before the test, the participants were asked not to participate in any severe physical activity. Then, the participants were present in the laboratory between 8 and 10 am. Blood samples (5 ml blood) were taken through the veins of the right hand of each participant in sitting position and resting mode. The blood sample was left at room temperature for 10 min and then was centrifuged at 4,000 rpm for 10 min. Where necessary, serum was stored at 24 °C to identify indicators. After this stage, the experimental group participated in the aerobic exercise for eight weeks. Twenty-four hours after the last training session, all participants were also asked to go to the laboratory. The blood samples were taken from them under the same conditions as for the previous step.

Insulin and serum resistin levels were assessed by ELISA assay kit (Demeditec insulin ELISA DE2935, Germany, and Biovendor-Laboratoria Medicine as Czech, respectively). Serum glucose was measured by the Pars Azmoon kit (made in Iran), with sensitivity of 5 mg/dl and interrater coefficient of variation % 6/5 and enzymatic method. Insulin resistance index was determined by measuring fasting glucose and insulin by a specific formula: HOMA-IR=fasting glucose (mg. dl-1)×fasting insulin (μIU.ml-1)/405 [9].

Three days before and three days at the termination of the exercise protocol, a 24-h dietary recall questionnaire was employed to assess the dietary energy consumption. Maximum oxygen consumption (VO2 max) was calculated by performing Rockport Walking Test. Body fat per cent was calculated by using skinfold method (calipers model SAEHAN- SH5020 Made in England) and Jackson and Pollock formula [10].

Data Analysis

Kolmogorov-Smirnov test was used to test the normality of the data. Descriptive statistics including mean and dispersion index were calculated. Independent *t*-tests were applied to compare the means, and significant level was set to alpha = 0.05. The SPSS version 20 was employed to analyze the data.

Results

Kolmogorov-Smirnov test showed that data were normally distributed. The result of *t*-test showed that there were significant differences between the serum insulin index scores (P=0.045), glucose (P=0.012), body mass index (BMI) (P=0.000), maximum oxygen consumption (P= 0.011) (Table 1), resistin (P= 0.02) (Fig. 1) and insulin resistance index (P = 0.000) (Fig. 2) in pre and post-test state of the experimental group. But, there was no significant difference between these values in the pre- and post-test condition of the control group (P>0.05).

In addition, there were significant differences between the resistin index scores (P=0.012), BMI (P= 0.03), maximum oxygen consumption (P= 0.004) and insulin resistance index (P= 0.01) of the experimental and control groups.

Discussion

The results of this research showed that eight weeks of aerobic exercises significantly decreased plasma resistin levels of middle-aged sedentary women. This decrease was also associated with a decrease in body fat percentage and weight. The results of this study showed a decrease in resistin levels. These findings are in agreement with the findings of Botero et al. (2013), who showed a decrease in resistin levels of older post-menopaused women after 12 weeks of resistance training [11], or Prestes et al. (2009), who reported that 16 weeks of resistance training decreased the resistin levels of older post-menopaused women [12]. In addition, Hasson et al. (2012) examined the effect of eating alone and together with resistance training in

Table 1. Total demographic characteristics of the experimental and control groups (mean ± SD).

Variable	Group	Aerobic training (mean ± SD)	*P* (Intra-Group Aerobic training)	Control group (mean ± SD)	*P* (Intra-Group Control)	*P* (Inter-Group)
Age (y)	---	47.70 ± 5.35	---	41.30 ± 3.02	---	0.54
Height (cm)		160 ± 6.71		158.20 ± 6.33		
Weight (kg)	Pre-test	71.48 ± 13.45	0.032	69.84 ± 9.65	0.27	0.02
	Post- test	69.68 ± 10.65		70.68 ± 8.15		
Body Fat (%)	Pre-test	27.41 ± 0.74	0.031	28.17 ± 0.55	0.37	0.001
	Post- test	26.16 ± 0.81		27.99 ± 0.85		
VO2 max(mL/kg/min)	Pre-test	36.41 ± 0.34	0.011	36.17 ± 1.55	0.772	0.004
	Post- test	37.96 ± 0.41		35.99 ± 1.82		
Body mass index (kg/m2)	Pre-test	25.08 ± 0.652	0.000	25.02 ± 1.23	0.465	0.03
	Post- test	23.68 ± 0.65		24.61 ± 1.26		
Glucose (mg/dl)	Pre-test	94.93 ± 3.46	0.012	96.07 ± 3.88	0.084	0.06
	Post- test	92.73 ± 2.69		95.47 ± 3.68		
Insulin (µIU/ml)	Pre-test	14.57 ± 0.62	0.045	14.54 ± 0.41	0.094	0.04
	Post- test	13.89 ± 0.58		14.21 ± 0.52		

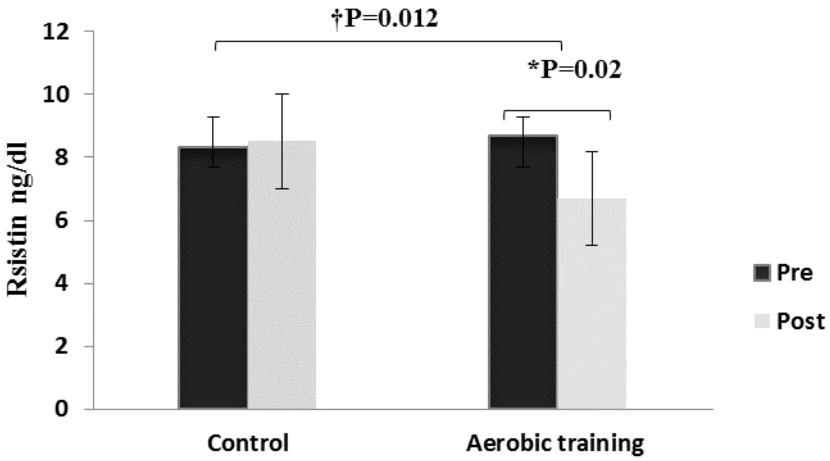

Fig 1. Resistin activity shows significant decrease in intervention and control groups after aerobic training (**P* = 0.02) and between the groups (†*P* = 0.012).

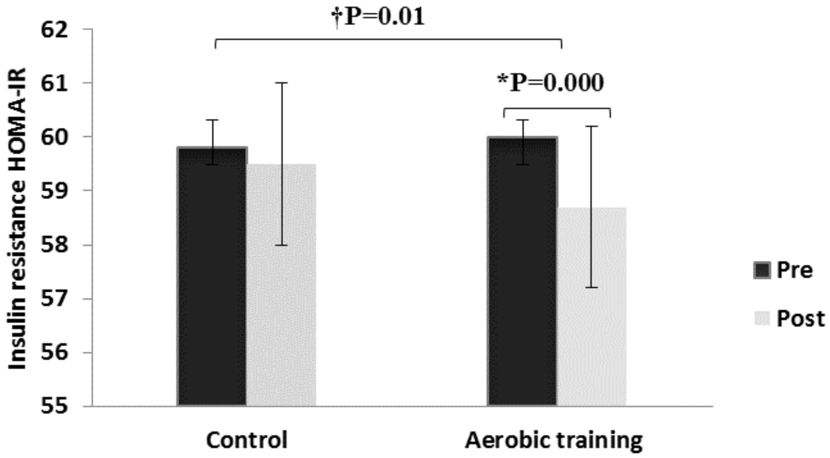

Fig 2. Insulin resistance activity shows significant decrease in intervention and control groups after aerobic training (**P* = 0.000) and between the groups (†*P* = 0.01).

obese teens and concluded that the resistin levels in the exercise group were reduced as compared with the group that ate alone [13]. The results of this study were in disagreement with those of the study by Jorge et al. (2011), who found that the variety of exercises (aerobic, resistance or combined) made no changes in the resistin levels in patients with diabetes mellitus type II [14-17].

These different results can be attributed to the difference between the studies in defining training features (type, intensity and duration) and also the study subjects (age, gender, health status, obesity and level fitness). So, in line with this, several mechanisms have been referred by researchers as the confirmation of their theories. Several researchers have claimed that weight loss and fat mass decrease are necessary to reduce the level of circulating resistin [18], whereas some others have purposed that it is independent of weight loss [19]. Prestes et al. proposed that decrease in production of pro-inflammatory cytokines is a possible mechanism by the innate immune system [12], for the reason that the macrophages and adipocytes are the main sources of resistin secretion [20]. Due to the effect of nutritional status on resistin levels, Haghighi et al. reported that resistin levels were not changed after 10 weeks of aerobic training for lack of diet control by the participants during this period [21]. Samadian and Tofighi also claimed that changes in the anthropometric indices and pro-inflammatory cytokines such as interleukin-1 and interleukin-6, and tumor necrosis factor-alpha [22], caused an increase in the resistin levels after 12 weeks of aerobic and resistance training.

However, by summarizing these findings, it may be concluded that the changes in weight, fat mass, anthropometric indices, and pro-inflammatory cytokines are the likely mechanisms; however, it seems more research is needed to identify the exact mechanism involved in the effect of exercise training on resistin levels. This study showed that eight weeks of aerobic training decreased insulin resistance significantly. Due to the possible relationship between resistin and insulin resistance in humans, the decrease in insulin resistance may be attributed to the decrease in resistin levels. However, there is contradictory evidence with regard to the relationship between concentrations of serum resistin and the insulin resistance index since some studies have shown a positive correlation between resistin with body fat mass and insulin resistance, whereas others have failed to observe such correlation between the resistin gene and body weight or insulin sensitivity [24, 23]. Medeiros et al. (2015) observed an improvement in insulin sensitivity in 25 obese participants after 26 sessions of aerobic training for 70 min with intensity of 50%-75% of maximum oxygen consumption performed five days per week [25]. After six and nine weeks of aerobic exercise, Friedenreich et al. (2011) also observed decreases in insulin resistance in postmenopausal women [26]. Kasumov et al. (2015) observed an increase in insulin sensitivity in young obese participants after 12-weeks of a training program at 80%-85% of maximum heart rate five times per week during an hour session per day [27].

Poehlman et al. examined the effects of endurance and resistance training on insulin sensitivity in non-obese young women for six months. The endurance and resistance training programs caused an increase in insulin sensitivity [28]. In contrast, Hasson et al. did not observe any changes in insulin resistance index in obese children based on resistance training, whether they had food together or alone [29]. It would appear that the characteristics of the training modalities (type, intensity and duration) and the study population (age, sex, healthy or sick, obesity, eating control) determined the effects of exercise on insulin resistance. Both endurance and resistance training programs improve access to glucose for young women through different mechanisms [28, 30]. The likely increase in the amount of lean mass as a result of resistance training through a mass effect and no change in the internal capacity of muscle to respond to insulin, causes increase in the availability of glucose. On the other hand, contrary to these findings, Ahmadizad et al. in their study found that the mechanisms responsible for the effects of resistance training on glucose homeostasis and insulin sensitivity are similar to those of endurance training [30, 31] because the increase in protein content of GLUT4, the insulin receptors, the amount of glycogen synthase and protein kinase B was shown after strength training without an increase in muscle mass [32].

In summary, the conflicting results discussed above could be a result of the various sources and may be attributed to the racial differences, differences in the methods of measurement, type and duration of the training program and so on. Therefore, the need for better-designed research protocols in the future seems necessary to determine the relationship between insulin resistance and resistin in humans, as well as to determine the impact of a variety of exercise programs on the levels of these factors.

Conclusion

Based on the findings of this research and with regard to the effective role of training intensity in the desired changes of resistin, it has been recommended that the implementation of various training programs with different intensities be examined.

In conclusion, according to the results, we can say that an eight-week aerobic training as a new and effective training method with a significant reduction in plasma resistin has a preventive effect on insulin resistance in middle-aged sedentary women

Acknowledgment

This article is a part of a MSc. thesis in 2016 in fulfillment of the degree, with the code 20021404922034 and supported by the research deputy of the Islamic Azad University of Mahallat Branch. The researcher wishes to express his gratitude for the full cooperation of the participants.

Conflict of Interest: No conflict

References

1. Jamurtas AZ, Stavropoulos-Kalinoglou A, Koutsias S, Koutedakis Y, Fatouros I. Adiponectin, Resistin, and Visfatin in Childhood Obesity and Exercise. Pediatr Exerc Sci. 2015; 27(4):454-62.
2. Zaidi SI, Shirwany TA. Relationship of serum resistin with insulin resistance and obesity. J Ayub Med Coll Abbottabad. 2015; 27(3):552-5.
3. Kasumov T, Solomon TP, Hwang C, Huang H, Haus JM, Zhang R, et al. Improved insulin sensitivity after exercise training is linked to reduced plasma C14:0 ceramide in obesity and type 2 diabetes. Obesity (Silver Spring). 2015; 23(7):1414-21.
4. Jorge M, Olireira V, Resende N, Paraiso L, Calixto A, Diniz A, et al. The effects of aerobic, resistance and comlined exercise on metabolic control, inflammatory markers, adipocytokines and muscle insulin signaling in patients with type 2 diabetes mellitus. Metabolism Clinical and Experimental. 2011; 60 (9): 1244-52.

5. Giannopoulou I, Fernhall B, Carhart R, Weinstock R, Baynard T, Figueroa A, et al. Effects of diet and/ or exercise on the adipocytokine and in flammatory cytokine levels of postmenopausal women with type 2 diabetes. Metabolism. 2005; 54(7): 866-75.
6. Jones T, Basilio J, Brophy Rm, Mccammon M.R, Hickner Rc. Long-term exercise training in over weight adolescents improves plasma Peptide yy and resistin. Obesity. 2009; 17(6): 1189-95.
7. Abedi B, Abbasi-Bakhtiari R. The effect of a 12-week combined training program on serum leptin, C- reactive protein and the insulin resistance index in overweight men. Feyz. 2015; 19(4) :293-301.
8. Stewart AL, Mills KM, King AC, Haskell WL, Gillis D, Ritter PL. CHAMPS Physical Activity Questionnaire for Older Adults: outcomes for interventions. Med Sci Sports Exerc. 2001;33(7):1126-41.
9. Jackson AS, Pollock ML. Generalized equations for predicting body density of men. Br J Nutr. 1978; 40:497–504.
10. Wallace TM, Levy JC, Matthews DR. Use and abuse of HOMA modeling. Diabetes Care. 2004; 27 (6): 1487–95.
11. Botero JP, Shiguemoto GE, Prestes J, Marin CT, Do Prado WL, Pontes CS, et al. Effects of long-term periodized resistance training on body composition, leptin, resistin and muscle strength in elderly post-menopausal women. J Sports Med Phys Fitness. 2013; 53(3):289-94.
12. Prestes J, Shiguemoto G, Botero JP, Frollini A, Dias R, Leite R, et al. Effects of resistance training on resistin, leptin, cytokines, and muscle force in elderly post–menopausal women. J Sports Sci 2009; 27(14):1607-15.
13. Hasson RE, Adam TC, Davis JN, Kelly LA, Ventura EE, Byrd- Williams CE, et al. Randomized controlled trial to improve adiposity, inflammation, and insulin resistance in obese African- American and Latino youth. Obesity (Silver Spring). 2012; 20(4):811-8.
14. Jorge ML, de Oliveira VN, Resende N, Paraiso LF, Calixto A, Diniz AL, et al. The effects of aerobic, resistance and combined exercise on metabolic control, inflammatory markers, adipocytokines and muscle insulin signaling in patients with type 2 diabetes mellitus. Metabolism 2011; 60(9):1244-52.
15. Perseghin G, Burska A, Lattuada G, Alberti G, Costantino F, Ragogna F, et al. Increased serum resistin in elite endurance athlete with height insulin sensitivity. Diabetologia. 2006; 49(8):1893-900.
16. Zelber-Sagi S, Nitzan-Kaluski D, Goldsmith R, Webb M, Zvibel I, Goldiner I, et al. Role of leisure-time physical activity in nonalcoholic fatty liver disease: A population-based study. Hepatology. 2008; 48(6):1791-8.
17. Jamurtas AZ, Theocharis V, Koukoulis G, Stakias N, Fatouros IG, Kouretas D, et al. The effects of acute exercise on serum. Adiponectin and resistin levels and their relation to insulin sensitivity in overweight males. Eur J Appl Physiol. 2006; 97(1):122-6.
18. Davoudi B, Zilaei BS, Ahangarpour A, Zilaei BM. [Effects of two different physical exercises on plasma levels of adiponectin and resistin in obese and overweight young girls (Persian)]. Arak Medical University Journal. 2014; 17(4):27-37.
19. Balducci S, Zanuso S, Nicolucci A, Fernando F, Cavallo S, Cardelli P, et al. Anti-inflammatory effect of exercise training in subjects with type 2 diabetes and the metabolic syndrome is dependent on exercise modalities and independent of weight loss. Nutr Metab Cardiovasc Dis. 2010; 20(8):608-17.
20. Lehrke M, Reilly MP, Millington SC, Iqbal N, Rader DJ, Lazar MA. An inflammatory cascade leading to hyperresistinemia in humans. PLoS Med. 2004; 1(2):e45.
21. Haghighi AH, Yarahmadi H, Ildarabadi A, Rafieepour A. [Effect of a period of aerobic training on serum resistin level in obese men (Persian)]. Med J Mashad Univ Med Sci. 2013; 56(1): 31-8.
22. Tofigh A, Samadian Z. [Comparison of 12 weeks aerobic with resistance exercise training on serum levels of resistin and glycemic indices in obese postmenopausal women with type 2 diabetes (comparison of two exercise protocols) (Persian)]. Jundishapur Sci Med J. 2013; 12(6): 665-76.
23. Banerjiee RR, Rangwala SM, Shapiro JS, Rich AS, Rhoades B, Wang J, *et al.* Regulation of rich fasted blood glucose by resistin. Science. 2004; 303 (5661):1195-8.
24. Janke J, Engeli S, Gorzelniak K, Luft F, Sharma A. Resistin gene expression in human's adipocytes is not related to insulin resistance. Obes Res. 2002; 10 (1): 1–5.
25. Medeiros NS, Abreu FG, Colato AS, Lemos LS, Ramis TR, Dorneles GP, et al. Effects of concurrent training on oxidative stress and insulin resistance in obese individuals. Oxid Med Cell Longev. 2015;2015:697181
26. Friedenreich C, Neilson H, Woolcott C, Tiernan A, Wang Q, Ballard-Barbash R. Changes in insulin resistance indicators, IGFs, and adipokines in a year-long trial of aerobic exercise in postmenopausal women. Endocr Relat Cancer. 2011; 18 (3): 357-369.
27. Kasumov T, Solomon TP, Hwang C, Huang H, Haus JM, Zhang R, Kirwan JP. Improved insulin sensitivity after exercise training is linked to reduced plasma C14:0 ceramide in obesity and type 2 diabetes. Obesity (Silver Spring). 2015; 23(7):1414-21.
28. Poehlman ET, Dvorak RV, DeNino WF, Brochu M, Ades PA. Effects of resistance training and endurance training on insulin sensitivity in nonobese, young women: a controlled randomized trial. J Clin Endocrinol Metab. 2000; 85(7):2463-8.
29. Hasson RE, Adam TC, Davis JN, Kelly LA, Ventura EE, Byrd- Williams CE, et al. Randomized controlled trial to improve adiposity, inflammation, and insulin resistance in obese African- American and Latino youth. Obesity (Silver Spring). 2012; 20(4):811-8.
30. Ahmadizad S, Haghighi AH, Hamedinia MR. [Effects of resistance versus endurance training on serum adiponectin and insulin resistance index (Persian)]. Eur J Endocrinol. 2007; 157(5):625- 31.
31. Castaneda C, Layne JE, Munoz-Orians L, Gordon PL, Walsmith J, Foldvari M, et al. A randomized controlled trial of resistance exercise training to improve glycemic control in older adults with type 2 diabetes. Diabetes Care. 2002; 25(12):2335-41.
32. Barnett JB, Woods MN, Lamon-Fava S, Schaefer EJ, McNamara JR, Spiegelman D, et al. Plasma lipid and lipoprotein levels during the follicular and luteal phases of the menstrual cycle. J Clin Endocrinol Metab. 2004; 89(2):776-82.