Study of changes in leptin and body mass composition with overweight and obesity following 8 weeks of Aerobic exercise

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Abstract

Introduction:
Obesity causes diseases such as coronary artery disease, mellitus diabetes, hypertension, cancer and stroke. The purpose of this study is to investigate changes in leptin and body mass composition in women with overweight and obesity after 8 weeks of aerobic exercise.

Method: The research method is semi-experimental. 34 women with overweight and obesity (40 ± 10 years, 25 ≤ BMI) volunteered and were randomly divided into experimental (17) and control (n = 17) groups. The training group started an 8-week training session with three sessions per week (51 minutes for each session) with 66% maximum heart rate in the first week and gradually reached 86% of the maximum heart rate with the progression of the training program. Each training session included warming up; the main part of the exercise included the implementation of low impact and high impact aerobic movements, in the standing position and back to the original sitting position. The control group was asked to maintain their normal life during the study period. Blood samples were taken in two phases: one was taken 48 hours before the tests and the other was taken 48 hours after the last aerobic training session. Serum leptin concentration was calculated using ELISA method using special kit. Shapiro-Wilk test was used to determine the consistency and normality of the information about the subjects in the research groups. For analyzing the data and considering the intra-group differences, the paired t-test was used and covariance test was used at the significance level of P≤0.05 to investigate the inter-group differences between the groups. SPSS 21 was used to perform statistical calculations.

Results: Data analysis showed that 8-weekly sport exercises had a significant effect on BMI (P = 0.001), body weight (P = 0.000), and leptin (P = 0.001).

Conclusion: Aerobic exercise can lead to weight loss and leptin. This exercise can be used as a non-invasive way to treat obesity and prevent its complications.

Key words: Leptin, Body Mass Index, Aerobic exercise, overweight

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Introduction

The global spread of obesity is seen in all age groups, so that about 250 million people who are about 7% of the world's current population are obese and two to three times of this amount are overweight (1). According to the World Health Organization reports, the number of obese and overweight people will increase by about 1.5 billion in 2015 (2). The prevalence of abdominal obesity in Brazil, France and the United States is reported to be 39.2%, 33.3% and more than 50 % respectively (3.1). Studies in different cities of Iran indicate a high prevalence of abdominal obesity in the population, so that the prevalence of abdominal obesity in these cities is as below: Tehran (over 76%), Rafsanjan (54.7%), Isfahan (84.6%), Arak (66.8%), Najaf Abad (82.2%) and Mazandaran province (82.2%) (4-6). Published statistics by the Institute for Endocrine Sciences and Metabolism of Shahid Beheshti University of Medical Sciences and Health Services showed that the prevalence of abdominal obesity increased from from 67.1% to 83.1% in the years 2002- 2009 (7).

The discovery of leptin hormone in 1995 has led to advances in obesity research. Leptin that is produced by the ob-gene is a protein hormone that is composed of 129 amino acids with a molecular weight of 16 kDa (8-9). This hormone is mainly secreted from adipose tissue and plays an important role in regulating body weight and energy homeostasis in the body. Leptin is actually an alert mechanism for regulating body fat. The higher adipose tissue contains more leptin and the lower adipose tissue secretes less leptin (8).

Laboratory studies are under way to better understand the function of leptin. Part of this research is the study of the effects of exercise on leptin levels. Several studies have shown that low-fat diet and physical exercise lower blood levels of leptin (9) and since regular body exercises play a crucial role in losing weight and body fat, if leptin levels are affected by exercise, it can explain how exercise affects obesity. Also, those who exercise regularly achieve better weight stability and metabolic fitness (1). Individuals who perform a particular exercise receive better results in reducing bodily mass than those who do not follow specific exercise (11). Leptin is associated with increased energy intake, reduced appetite and increased body temperature (12). In addition, leptin density significantly correlates with body mass index (BMI) and body fat percentage (12).

Limited studies have been conducted on leptin and have reported different outcomes. Azizi (2011) examined 8 weeks of running on a treadmill with an intensity of 65-85% maximum heart rate and reported that the leptin level significantly decreased in the training group but this decrease was not significant in comparison with the control group (13). Also, Akbarpour (2013) showed that 12 weeks of aerobic training on obese men with cardiovascular disease resulted in a significant decrease in leptin in the experimental group compared to the control group (14). Hejazi et al. (2014) investigated the effects of leptin changes after 12 weeks of aerobic training, which was performed 3 days a week and with an intensity of 75-65% of the heart rate in obese middle-aged women. They reported that exercise significantly decreased leptin (15). While Weltman et al. (2000) noted that a high intensity exercise session does not change the amount of leptin in the blood (16).

This contradiction in research results can be influenced by various factors such as the amount of fat and its distribution, inflammatory conditions, hormones and other factors, including the type and intensity of exercise. Therefore, more research is needed for understanding the mechanisms that control the synthesis and release of leptin and in clarifying the role of leptin better. Thus, according to little research done on the effect of long-term exercise on serum leptin levels and also given the importance of examining this new adipokin in obese people and the increasing interest of women in aerobic exercise, the aim of this study is to evaluate the effect of 8 weeks of aerobic exercise on resting levels of leptin and lipid profiles in overweight and obese women.

Materials and Methods

After distributing recall papers, among women, 34 overweight and obese women were selected voluntarily and available from Zahedan on the basis of entry and exit criteria. The criteria for entering the study were: having overweight and obesity of BMI 25≥ and a minimum age of 30 years and a maximum age of 50 years. Also, the criteria for leaving the research were: 1- Cardiovascular disease, severe hypertension, type 1 diabetes mellitus, thyroid-related diseases, 2- drug use, 3- smoking and alcohol consumption 4. Non-participation in any regular exercise during past 6 months. Samples should not have any particular diet at the time of the research. Due to the experimental nature of research and observance of ethical issues, at first, the consent form of participation in the research and the medical records questionnaire were completed by the subjects. Then subjects were randomly divided into two groups of training (17 people) and control (17 people). The training group participated in an 8-week training program and three sessions per week, while the control group was asked to maintain their normal life during the study period.

Aerobic exercise program included 8 weeks aerobic training, 3 sessions per week and 51 minutes each session which started with 66% of maximum heart rate in the first week and gradually increased to 86% of the heart rate with the progression of the exercise program. Each training session consisted of warming up (stretching and running slowly for 11 minutes), the main part of the exercise included performing low impact and high-impact aerobic exercises (41 minutes) in standing position and returning to the initial state in sitting position (11 minutes). It should be noted that the control group did not attend any regular exercise at any time during the course of the research. The maximum heart rate of the participants in the exercise group was calculated using the Pollard pulse rate. The exercise protocol was carried out in a covered

sports hall with proper ventilation and it was the same for all 8 weeks in terms of temperature and operating hours.

Blood samples were taken in two stages; one was taken 48 hours before the tests, and the other was taken 48 hours after the last aerobic exercise session in order to eliminate the effect of the exercise, in the laboratory between 5:00 and 8:00 am in a fasting state. Serum vaspin concentration and lipid profile was measured by ELISA method and by using a special kit of Human LEPTIN of EASTBIOPHARM Company according to the manufacturer's instructions.

Shapiro-Wilk's test was used to determine the consistency and normality of the information about the subjects of the research groups. In order to analyze the data, paired t-test was used to examine the intra-group differences and to examine the inter-group differences between research groups; covariance test was used at a significant level of P≤0.05. SPSS 21 was used to perform statistical calculations.

Findings

As shown in Table 1, subjects prior to the implementation of the research protocol did not have a significant difference in terms of age, weight, and composition of the body. Data analysis showed that 8-weekly exercise had a significant effect on BMI (P = 0.001), body weight (P = 0/000), and leptin (P = 0.001).

Discussion and Conclusion

The main findings of this study were significant reduction in serum leptin levels, BMI and weight in overweight and obese women. Exercise affects body composition, and carbohydrate and fat metabolism, and considering the effect of exercise activities on serum leptin levels in energy balance and glucose hemostasis is very important (17). In confirmation of the present study findings, some studies that have improved body readiness level and have an effect on body composition, have reduced serum leptin (17). The size of the fat mass, especially the abdominal fat, plays a special role in the level of blood leptin. In obese people, elevation of adipose tissue was associated with increased leptin and increased leptin resistance (18). Of course, in one study, after 60 minutes of aerobic exercise activity for 7 weeks, no significant changes were observed in the level of blood leptin (19). These findings were also observed in some other studies with different intensity and duration of training periods (16). Fataru et al. (2005) stated that 6 months of exercise (3 days a week) would lead to a decrease in blood leptin, with a decrease in subcutaneous fat and body mass index which is consistent with the findings of the present study (18). Gökbel et al. (2009) indicated that leptin concentration significantly decreased in long term aerobic exercise immediately after exercise, 24 and 48 hours after exercise, and in the re-initiation period (20). Oazaki et al. (2010) also investigated the effect of moderate-intensity aerobic exercise (50% maximal oxygen consumption) and diet for 1 week on fat loss and leptin concentrations in non-active obese and non-obese middle-aged women. Based on these findings,

Table 1: The average variables for the control and experimental groups in the pre and post-test

Variable	Phase	control group	experimental group
Height (cm)	Pre-test	161.1±*5.1	160.2±6.6#
Age (year)	Pre-test	39.7±6.2	37.1±7.3
Weight (kg)	Pre-test	75.6±9.2	80.7±9.7
	Post-test	75.6±8.9	78.8±9.7#*
BMI (2kg / m)	Pre-test	29.1±2.4	31.4±2.8
	Post-test	29.1±2.3	30.7±2.9#*
LEPTIN (ng / dl)	Pre-test	35.83±26.74	39.53±23.89
	Post-test	38.12±25.25	28.21±21.65#*

a Data are shown as mean ± standard deviation.

T test for dependent samples is significant (significant difference in the experimental group before and after 8 sessions) ($p < 0.05$).

* Covariance test is significant (significant difference of groups' post-test after eliminating the effect of pre-test) ($p < 0.05$).

leptin concentration and fat mass decreased, but decrease in leptin concentration was not associated with weight loss (21).

However, Bijeh et al. (2009) did not observe significant changes in body weight and body mass index and blood leptin levels by assessing the effect of 6 months of aerobic exercise on leptin level, cortisol, and insulin and serum glucose in middle-aged lean women. The reason for this discrepancy can be that regular physical activity is likely to reduce serum leptin levels if the body mass index is significantly reduced. In short, the decrease in the concentration of leptin after long-term exercises (more than 60 minutes) is assigned to overnight leptin reduction and hormonal changes due to exercise. Extremely long exercises that caused significant energy imbalances, affected periodical and overnight Leptin changes (23). However, the effect of leptin on physical activity and the return period to initial state is still unknown. There are some reasons that can explain the changes in the response of leptin to physical activity (17). Regarding all of these, it is believed that sports activities can play an important role in energy costs due to several factors, including weight loss and also can alter the response of leptin by effecting on hormonal concentrations (insulin, cortisol, growth hormone, catecholamine and testosterone) and metabolites (free fatty acid, lactic acid, and triglycerides)

Type of exercise is one of the factors influencing leptin levels (24). Long-term mild activity that consumes 900 kilocalories of energy, reduces leptin concentrations for more than 2 days after exercise, while high-intensity short-term activity with an energy consumption of approximately 200 kcal has no effect on leptin levels (24). The amount of exercise activity can have a significant effect on the levels of leptin, which is independent of the effects of exercise on the balance of energy (24).

The duration of exercise is one of the important determinants of severity that affects serum leptin levels (25). Studies are focused on leptin and short-term exercise. The severity and duration of activity, the nutritional status of individuals, the hours of blood transfusion, the caloric imbalance, the cyclic rhythm of leptin, etc. are affected by exercise (26). People with higher degrees of obesity are more resistant against leptin and therefore require a greater amount of exercise to affect leptin levels (27).

In summary, it may be said that aerobic exercise may be a suitable treatment for obesity and additionally if diet is used properly, it will have more beneficial effects.

References

1. Speiser PW, Rudolf MC, Anhalt H, Hubner CC. On Behalf of the Obesity Consensus Working Group: Childhood Obesity. J Clin Endoc Metab 2005;90:1871-7.
2. Kumanyika SK, Obarzanek E, Stettler N, Bell R, Field AE, Fortmann SP et al. Population based prevention of obesity the need for comprehensive promotion of healthful eating, physical activity, and energy balance. A scientific statement from American Heart Association council on epidemiology and prevention, interdisciplinary committee for prevention. Circulation 2008;118:428-64.
3. Holcomb CA, Heim DL, Loughin TM. Physical activity minimizes the association of body fatness with abdominal obesity in white, premenopausal women. Results from the Third National Health and Nutrition Examination Survey. J Am Diet Assoc 2004; 104:1859-62.
4. Heshmat R, Fakhrzadeh H, Pourebrahim R, Nouri M, Pajouhi M. [Evaluation of Obesity and Overweight and Their Changes Pattern Among 25-64 Aged Inhabitants of Tehran University of Medical Sciences Population LAB Region.] Iran J Diabetes Lipid Disord 2004; 3: 63-70. (Persian)
5. Akhavan Tabib A, Kelishadie R, Sadri G, Sabet B, Toluei HR, Baghaei A. [Heathy heart program: obesity in center of Iran.] J Qazvin Uni Med Sci 2003; 7: 27-35. (Persian)
6. Hajian K, Hiedari B. [Prevalence of abdominal obesity in a population aged 20 to 70 years in urban Mazandaran (Northern Iran, 2004).] J Clin Endoc Metab 2006; 8:147-56. (Persian)
7. Azizi F, Azadbakht L, Mirmiran P. [Trends in overweight, obesity, and central
obesity among adults residing in district 13 of Tehran: Tehran Lipid and Glucose Study.] J Facult Med 2005; 29: 129-32. (Persian).
8. Pérusse L, Collier G, Gagnon J, Leon AS, Rao D, Skinner JS, et al. Acute and chronic effects of exercise on leptin levels in humans. Journal of Applied Physiology 1997;83(1):5-10.
9. Kraemer RR, Durand RJ, Acevedo EO, Johnson LG, Synovitz LB, Kraemer GR, et al. Effects of high-intensity exercise on leptin and testosterone concentrations in well-trained males. Endocrine. 2003;21(3):261-5.
10. Volpe SL, Kobusingye H, Bailur S, Stanek E. Effect of diet and exercise on body composition, energy intake and leptin levels in overweight women and men. J Am Coll Nutr 2008; 27(2): 195-208.
11. Olive JL, Miller GD. Differential effects of maximal- and moderate-intensity runs on plasma leptin in healthy trained subjects. Nutrition 2001; 17(5): 365-9.
12. Irandoost KH, Rahmaninia F, Mohebi H, Mirzaei B, Hassannia S. The effect of aerobic exercise on plasma gherlin and leptin in obese and with normal weight women. Olympic J 2010; 18(2): 87-99.
13. Masoumeh Azizi, The effect of 8-weeks aerobic exercise training on serum LEPTIN in un-trained females. Procedia Social and Behavioral Sciences 15 (2011) 1630–1634.
14. M. Akbarpour, THE EFFECT OF AEROBIC TRAINING ON SERUM ADIPONECTIN AND LEPTIN LEVELS AND INFLAMMATORY MARKERS OF CORONARY HEART DISEASE IN OBESE MEN, Biol Sport. 2013 Mar; 30(1): 21–27.

15. Mahmdou Hejazi, Zeynab Nezamdoost, Dr Marziyeh Saghebjoo, Effect of Twelve Weeks of Aerobic Training on Serum Levels of Leptin, Vaspin and Some Indicators of Oxidative Stress in Obese Middle-Aged Women, IJEM, Volume 16, Number 2 (7-2014).
16.Weltman A., Pritzlaff C.J., Wideman L., Considine R.V., Fryburg D.A., Gutgesell M.E., Hartman M.L., Veldhuis J.D. (2000) Intensity of acute exercise does not affect serum leptin concentrations in young men. Medicine and Science in Sports and Exercise 32, 1556-1561.
17. Bouassida A, Zalleg D, Bouassida S, Zaouali M, Feki Y, Zbidi A, et al. Leptin, its implication in physical exercise and training: a short review. J Sports Sci Med 2006; 5: 172-81.
18. Fatouros IG, Tournis S, Leontsini D, Jamutas A, Sxina M, Thomakos P. Leptin and adiponectin responses in overweight inactive elderly following resistance training and detraining are intensity related. J Clin Endocrinol Metab 2005; 90: 5970-7.
19. Essig D, Alderson N, Ferguson M, Burtoli W, Durstine L. Delayed effects of exercise on the plasma leptin concentration. Metabolism 2000; 49: 395-9.
20. Gökbel H, Baltaci AK, Uçok K, Okudan N, Mogulkoç R. Changes in serum leptin levels in strenuous exercise and its relation to zinc deficiency in rats. Biol Trace Elem Res 2005; 106: 47-52.
21. Okazaki T, Himeno H, Nanri H, Ogata M, Ikeda M. Effects of mild aerobic exercise and a mild hypocaloric diet on plasma leptin in sedentary women. Clin Exp Pharmacol Physiol 1999; 26: 415-20.
22. Bijeh N, Moazami M, Ahmadi A, Samadpour F, Zabihi A. Effect of 6 months of aerobic exercise training on serum leptin, cortisol, insulin and glucose levels in thin middle-aged women. Olympic 2012; 16: 53-9.
23. Fisher JS, Van Pelt RE, Zinder O, Landt M, Kohrt WM. Acute exercise effect on post absorptive serum leptin. J Appl Physiol (1985) 2001; 91: 680-6.
24. Lowndes J, Zoeller RF, Caplan JD, Kyriazis GA, Moyna NM, Seip RL, et al. Leptin responses to long-term cardiorespiratory exercise training without concomitant weight loss: A prospective study. J Sports Med Phys Fitness. 2008;48:391-7.
25. Kohrt WM, Landt M, Birge SJ. Serum leptin levels are reduced in response to exercise training, but not hormone replacement therapy, in older women. J Clin Endocrinol Metab. 1996;81:3980-5.
26. Hayase H, Nomura S, Abe T, Isawa T. Relation between fat distribution and several plasma adipocytokines after exercise training in premenopausal and postmenopausal women. J Physiol Anthropol Appl Human Sci. 2002;21:105-13.
27. Hickey MS, Considine RV, Israel RG, Mahar TL, Mc Cammon MR, Tyndall GL, et al. Leptin is related to body fat content in male distance runners. Am J Physiol Endocrinol Metab. 1996;271:938-40.