Original Article

The effect of an 8-week selected aquatic aerobic training period on plasma Leptin and insulin resistance in men with type 2 diabetes

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ABSTRACT

Introduction: leptin is proposed to be an important factor in energy balance and metabolism to influence body weight.The purpose of this endeavor was to investigate the effect of an 8-week selected aquatic aerobic training period on plasma Leptin and insulin resistance in men with type 2 diabetes. Material and Methods: : 20 types 2 diabetic men selected as subjects and were randomly divided into experimental (n=10) and control groups (n=10). Both groups were similar regarding their age and body mass indexes. The training program for the experimental group included three weekly sessions of aquatic aerobic exercise for a period of eight weeks with an intensity of 55-70% of maximal heart rate. The control group had no participation in any regular training program. The blood samples were analyzed for plasma Leptin and insulin resistance. Independent and dependent t-tests were implemented to compare parameter averages at α=0.05. Results: The results showed that in the experimental group, leptin (P=0.049) and insulin resistance (P=0.001) levels decreased significantly. The comparison of the differences between the two groups showed that the changes in leptin (P=0.52) not significant and insulin resistance (P=0.001) levels was significant. Conclusion: the results of this study showed that aquatic aerobic training can be effective in preventing and treating diabetes by reducing levels of leptin and insulin resistance.

Keywords: aquatic exercise, platelet indexes, retired athletes

Introduction

The balance of physiological factors maintains body stability and its problems can lead to the incidence of various diseases, such as obesity, cardiovascular problems, and diabetes. In today society, the prevalence of obesity has alarmingly increased [1]. Obesity by disturbing energy balance increases the received energy and reduces its consumption. In the recent years, the statistics have shown the ever-increasing number of obese people and obesity-induced illness. In Iran, about 71% of men and women are suffering from obesity and overweight [2]. Since obesity and inactivity result in mitochondrial function change and also cause common diseases such as type 2 diabetes, obesity and overweight have been a matter of interest to researchers in sports sciences [3]. Diabetes is the most common metabolic disease in the world, and its prevalence increases with age. Insulin resistance is recognized as the most important factor in the development of type 2 diabetes and the development of its related complications, which is defined as a reduction of optimal muscle cell function to absorb glucose in response to secreted insulin [4]. In recent years, a number of Adipocyte or adipokine-derived hormones have been identified, including leptin, applein, resistin, and lipocalin. These adipokines play an important role in physiological settings for fat storage, metabolism, nutritional behavior, and obesity-related disorders such as type 2 diabetes [5]. Leptin is a protein with 164 amino acids, which predominantly synthesized by adipose cells that helps to regulate energy balance, weight, and fat deposits [6]. The main role of leptin is to increase the consumption calorie and reduction of ATP production and inhibit hunger. Therefore three changes in leptin cycle result in obesity including inability to produce leptin, decrease in leptin secretion, and partial or total insensitivity of leptin receptors [7]. In obese people, the activity mechanism of adiponectin and leptin is damaged and the concentration of leptin is increased, however, the leptin function in reducing food intake and

Access this article online

Website: www.japer.in	E-ISSN: 2249-3379

How to cite this article: Davar Rezaeimanesh, Parisa Amiri Farsani. The effect of an 8-week selected aquatic aerobic training period on plasma Leptin and insulin resistance in men with type 2 diabetes. J Adv Pharm Edu Res 2019;9(S2):121-124.
Source of Support: Nil, Conflict of Interest: None declared.

increasing energy consumption is eliminated. Since the results of many studies showed that received energy regulates the expression of the leptin gene positively or negatively, a change in energy expenditure can affect the amount of leptin through exercise. Among the various adipokines, leptin is a new adipokine that the effect of exercise on it has been less studied [8]. Azarbayjani et al. evaluated the effect on one-session combined aerobic resistance exercise on inactive men and reported that leptin concentration and insulin resistance index were significantly reduced [9]. However, in another study, after eight weeks of training, no significant difference in subjects' levels of leptin and adiponectin and body mass index (BMI) was observed, but insulin resistance improved significantly [10]. Many studies have been conducted on the effects of various types of physical activity on insulin resistance in patients with type 2 diabetes and reported different results. However, most studies have shown that exercise plays an important role in improving insulin function and reducing hyperglycemia in these patients [11]. Leptin studies and its role in regulating weight are still not well known; maybe leptin receptors become more susceptible by decreasing leptin levels in a variety of ways, including aerobic activity. On the other hand, body exercises that increase the skeletal muscle capacity to use fat (endurance activity in water) play a vital role in weight control. Therefore, aerobic swimming exercises may have an important role in regulating weight and treating diabetes with effect on fat weight and subsequent plasma leptin levels. In most of previous studies, exercises have been conducted on a dry land. Because of the difficulties caused by dry land exercises and damage caused by it, most people are more interested in aquatic exercise. In water, due to reduced weight bearing, probably the weight of the body on the lower limbs and joints decreases. Although there are various reports about the efficiency of physical activity on level of leptin and insulin resistance, as well as its effect on energy homeostasis, metabolism, and weight changes in individuals, no reports have been found about evaluation of swimming effect on leptin level in men suffering from type 2diabetes. Therefore, the present study aimed at evaluating the effect of 8-week aquatic aerobic exercise on the plasmatic level of leptin and insulin resistance in men suffering from type 2 diabetes.

Methodology

The present quasi-experimental and field study was conducted on 20 men suffering from type 2 diabetes with the ability to participate in exercises programs. Based on inclusion criteria participants were randomly divided into exercise (10 people) and control group (10 people). The most important inclusion criteria were to have no side effects of diabetes, no specific disease, such as heart disease, kidney, liver, or metabolic disease, irregular exercise in regular exercise for more than 2 hours a week and over the past 6 months, no blood pressure above 140/190 Millimeters of mercury, have more than a year of diabetes history, body mass index of 25 to 35 kg/m^2, and take only one type of anti-diabetic tablet overnight. The insulin resistance index was also calculated by HOMA-IR[1] equation. All interventions were performed under the supervision of diabetes specialist and patient satisfaction.

In order to determine the leptin, insulin, and blood glucose, 5ml blood samples were taken from Vein arthritis of each subject (between 8 to 10 o'clock in the morning under doctor supervision) a day before exercise program under 12-hour fasting condition. Then the exercise group participated in the exercise protocol. The exercise protocol included aerobic exercises (marching) in water for 8 weeks, 3 sessions per week with an intensity of 55-70% HRmax. To measure heart rate and determine the intensity of training, polar watches were given to subjects. The maximum heart rate of subjects was determined by the equation (220-age = HR). The aerobic exercises program included 10 minutes low-speed walking, exercise and stretching to warm up, walking faster as the main workout, and at the end 5-minute slow walk and stretching exercises to cool down. The severity and duration of the exercise gradually increased so that in the first and second week the intensity was 55% HRmax for 30 minutes and every two weeks, 5% was added to the intensity and 10 minutes for the duration. The control group did not participate in any regular sporting activities during the study period. To prevent the possibility of acute exercise effect (post-test), all subjects participated in blood sampling in the same pre-test conditions 48 hours after the last exercise session. Measurement of variables was done in two groups of exercise and control simultaneously. At each stage, blood samples were immediately poured into EDTA-containing tubes. After centrifugation for 10 minutes and 3000 rpm, the blood plasma was isolated and stored in special microtubes and kept at -80 ° C. The Shapiro-Wilk test showed that the studied parameters had a normal distribution. To compare the mean of the parameters, dependent and independent t-test was used at a level of $\alpha = 0.05$.

Findings

Anthropometric and aerobic fitness characteristics were presented in Table 1 by groups. As seen in Table 1, body weight and BMI decreased significantly in the exercise group. In control group, although body weight and BMI decreased, it was not significant. Also, the results of Table 1 showed that the maximum amount of consumed oxygen in the exercise group was significantly increased.

Table 1. Mean and SD of a general profile and VO2 max in subjects

Variables	Control group			Exercise group		
	Pre-test	Post-test	P	Pre-test	Post-test	P
Age (year)	42.7± 5.5	-	-	43.1± 4.1	-	-
Height (cm)	176± 4.5	-	-	177±5.8	-	-

[1] Homeostasis Model Assessment of Insulin Resistance

Weight (kg)	90.02± 11.4	89.6± 10.7	0.059	92.5± 12.7	89.9± 12.3	0.001
BMI (Kg/m^2)	28.5± 2.6	28.3± 2.4	0.062	29.3± 2.7	28.4± 2.6	0.001
$VO_{2\,max}$ (ml.kg/min)	36.82± 3.21	37.22± 3.14	0.104	37.34± 2.91	40.2± 3.71	0.001

The results of Table 2 shows in-group comparison that after 8 weeks, leptin (P = 0.049), insulin (P = 0.001), glucose (P = 0.001), and insulin resistance (P = 0.001) had a significant decrease in exercise group. Besides, variation of insulin (P = 0.001) and insulin resistance (P = 0.001) were significantly different between exercise and control groups, but there was no significant difference between the two groups in terms of leptin (P = 0.521) and glucose (P = 0.207).

Table 2. a comparison of intergroup and within group variations of biochemical indexes in subjects

Variables	Group	Pre-test Mean and SD	Post-test Mean and SD	P In-group	P intergroup
leptin (ng/ml)	Exercise	8.17±1.08	7.83±0.8	0.049=P*	0.521=P
	Control	8.12±0.69	8.05±0.7	0.137=P	
insulin (µU/ml)	Exercise	10.27±1.17	8.23±0.68	0.001=P*	0.001=P¥
	Control	10.38±1.16	10.24±0.91	0.524=P	
glucose (mg/dl)	Exercise	139.8±19.8	129.1±16.3	0.001=P*	P=0.207
	Control	140.3±14.7	138.4±15.5	0.104=P	
Insulin resistance	Exercise	3.54±0.67	2.63±0.48	0.001=P*	P=0.001¥
	Control	3.6±0.61	3.5±0.47	P=0.262	

*In-group Statistical significance; ¥ intergroup Statistical significance

Discussion and Conclusion

Physical activity and sport are the most important factors in energy consumption. Since received energy can positively or negatively regulate the leptin gene expression, variation in energy consumption can affect the amount of leptin through exercise and physical activity. Therefore, physical activity is an important determinant factor in the amount of leptin [12]. Based on the results of present research, aerobic exercise in water led to a significant leptin decrease in the exercise group, however, no difference was observed in control group. The most conducted studied reported that exercise reduces leptin concentrations, but some research has failed to achieve its effect. There is less paradox in research that uses long-term exercise protocols, and most researchers confirm the significant reduction in serum leptin levels as a result of exercise sessions [13]. In this study, the reduction in leptin was in agreement with those of Koga et al. [14] and was in contrast with the findings of Leite et al. [15]. The mechanism that regulates the level of leptin is still unclear. However, severity, volume, and duration of exercise are among the factors influencing leptin levels [16]. Other possible effects of exercise on leptin levels are related to differences in the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis [17]. Some researchers believe that exercise can lead to a greater reduction in visceral fat than subcutaneous fat; therefore the reduction in serum leptin cannot be attributed to diminishing the size of adipose cells [18]. In general, the results of most studies indicate that a balanced diet and physical activity reduce the leptin levels in the blood. In leptin response to physical activity, several related mechanisms have been reported. Physical activity can reduce fat mass and play an important role in energy consumption. Also, it can affect the concentration of hormones such as insulin, cortisol, growth hormone, catecholamines, sex hormones, and metabolism. The findings of this study showed that the implementation of 8-week aquatic exercises improved insulin resistance index in diabetic men, but did not change the control group. In this study, the reduction of insulin resistance was consistent with [9, 10, 19] and in contrast with those of Jion et al. [20]. Several mechanisms have been proposed to reduce insulin resistance after exercise. These mechanisms include increase of insulin signaling and available receptors [21], an increase of glycogen synthase and hexokinase activity [22], a decrease of free fatty acid release and an increase of their clearance [23], and an increase of glucose delivery to muscle and changes in its composition. In diabetics, physical activity increases insulin sensitivity and glucose tolerance and reduces blood glucose levels in these patients [24]. Moreover, physical activity also increases glucose uptake by active muscle. This mechanism is performed through the stimulation and transfer of GLUT-4 to the cell membrane and the rapid removal of glucose by active muscle through protein carriers [25]. It should be noted that the most important point in these types of exercises is the improvement of maximum oxygen intake, which can be considered as an important indicator in promoting health, along with weight loss due to the effect of aerobic exercise in the water on body fat.

Conclusion

The results of the present study showed the positive effect of a period of swimming practice on serum leptin concentration and insulin resistance in type 2 diabetic patients. Accordingly, it can be concluded that performing swimming exercises is a good way to reduce the risk of type 2 diabetes through the development of glucose transfer into muscle cells. Also swimming by regulating the leptin secretion can be a good prevention method for postponing type 2 diabetes in men.

Acknowledgment

This article is subtracted from the results of the executed research project under Contract No. 142 dated 2017/10/24 from the research credits of Khorramshahr University of Marine Science and Technology.

References

1. Johnson NA, and George J. (2010). Fitness versus fatness: moving beyond weight loss in nonalcoholic fatty liver disease, Hepatology. 52:370-381.
2. Zhou L, Yu X, Meng Q, Li H, Niu C, Jiang Y, et al. (2013). Resistin reduces mitochondria and induces hepatic steatosis in mice by the protein kinase C/protein kinase G/p65/PPAR gamma coactivator 1 alpha pathway. Hepatology. 57(4):1384-93.
3. Yue P, Hong Jin, Aillaud M, Alicia C. (2010). Thomas Quertermous and Philip S.Tsao. Apelin are necessary for the maintenance of insulin sensitivity. Am J Physiol Endocrinol Metab. 298:59.
4. Rayalam S, Della-Fera MA, Krieg PA, Cox CM, Robins A, Baile CA. (2008). A putative role for apelin in the etiology of obesity. Biochem Biophys Res Commun. 368:815-9.
5. Kraemer RR, Chu H, Castracane VD. (2002). "Leptin and exercise". Exp Biol Med (Maywood). 227; PP:701-8.
6. Zhang, Y, Proenca. R. Maffei. M. Baroue . M., Lepold M, Friedman, JM. (1994). "Positional cloning of the mouse obese gene and its human homologue". Nature 374; PP:425-432.
7. Polyzos SA, Kountouras J, and Mantzoros CS. (2015). Leptin in nonalcoholic fatty liver disease: a narrative review, Metabolism. 64: 60-78.
8. Abbassi Daloii, A., Abdi, A., & Fani, F. (2016). The effect of 8 weeks endurance training with L-NAME on apelin in myocardial tissue and plasma glucose in elderly male rats. Razi Journal of Medical Sciences, 23(145), 22-29.
9. Mohammad-Ali Azarbayjani, Lale Behboudi, H Aghaalinejad, M Salavati. (2011). Comparative effects of aerobic training and whole body vibration on plasma adiponectin and insulin resistance in type 2 diabetic men. Ann Biol Res, 2(5), 671-80.
10. Ahmadizad S, Ghorbani S, Ghasemikaram M, and Bahmanzadeh M. (2014). Effects of short-term nonperiodized, linear periodized and daily undulating periodized resistance training on plasma adiponectin, leptin and insulin resistance, Clinical Biochemistry. 47: 417-422.
11. McGinley, S. K., Armstrong, M. J., Boulé, N. G., & Sigal, R. J. (2015). Effects of exercise training using resistance bands on glycaemic control and strength in type 2 diabetes mellitus: a meta-analysis of randomised controlled trials. Acta diabetologica, 52(2), 221-230.
12. Haqiqi A, Hamedi Nia M. [The effect of 13 weeks of aerobic exercise on serum leptin in obese men] Olympic Journal 1387, sixteenth year (Persian).
13. Shahidi F, Taghi Khani M, Aminian T, Kurdi M, Saghiri R, Arjomand M. [Long-term effects of aerobic exercise and increased concentration of selected hormones and leptin levels in women with excess weight] Sports science research Journal. 1387, No. 21(Persian).
14. Koga S, Kojima A, Ishikawa C, Kuwabara S, Arai K, and Yoshiyama Y. (2014). Effects of diet-induced obesity and voluntary exercise in a tauopathy mouse model: Implications of persistent hyperleptinemia and enhanced astrocytic leptin receptor expression, Neurobiology of Disease. 71: 180-192.
15. Leite JC, Forte R, De Vito G, Boreham CAG, Gibney MJ, Brennan L, and Gibney ER. (2015). Comparison of the effect of multicomponent and resistance training programs on metabolic health parameters in the elderly, Archives of Gerontology and Geriatrics. 60(3): 412-417.
16. Ghadiri B, Abadi Ne, Marandi Mo, Mojtahedi Ho, Asfrjany F. [Effects of aerobic exercise on serum leptin in obese and overweight] Isfahan Medical School Journal 1391, Year 30, No 183(Persian).
17. Piri, M, Bqrabady V, Amirkhani Zo, Hijazi Ma. [Impact of aerobic training on cortisol, testosterone levels in obese and lean men] Sports Science Research Jounal 1388, NO 22(Persian).
18. 18. Tomofusa I, Tetsuya Y, Keiko Y, Tsunehiko Y, Masafumi M, Koichi K, et al. Effect of Exercise Training on Serum Leptin Levels in Type 2 Diabetic Patients, Metabolism, 2001; 50(10): 1136-1140.
19. Inoue DS, De Mello MT, Foschini D, Lira FS, De Piano Ganen A, Da Silveria Campos RM, et al. (2015). Linear and undulating periodized strength plus aerobic training promote similar benefits and lead to improvement of insulin resistance on obese adolescents, Diabetes and its Complications. 29: 258-264.
20. Jeon JY, Han J, Kim HJ, Park MS, Seo DY, and Kwak YS. (2013).The combined effects of physical exercise training and detraining on adiponectin in overweight and obese children, International Medicine Research. 2: 145–150.
21. Henriksen EJ. (2002). Invited review: Effects of acute exercise and exercise training on insulin resistance, Journal of Applied Physiology. 93: 788-96.
22. Gilardini L, McTernan PG, Girola A, Da Silva NF, Alberti L, and Kumar S, et al. (2006). Adiponectin is a candidate marker of metabolic syndrome in obese children and adolescents, Atherosclerosis. 189:401–407.
23. Wadden T, Stunkard A. (2004). Handbook of obesity treatment. New York: Guilford Press (1st Ed): 19.
24. Castaneda C, Orians LM, Gordon PL, Walsmith J, Foldvari M. (2002). A randomized controlled trial of resistance exercise training to improve glycemic control in older adults with type 2 diabetes Diabetes Care;. 25(12):2335-41.
25. Arora E, Shenoy S, Sandhu JS. (2009). Effects of resistance training on metabolic profile of adults with type 2 diabetes. Indian J Med Res. 129(5):515-9.