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The Effect of Endurance Exercise Training on Vaspin, Lipid Profile, and Anthropometric Indices in Young People

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ABSTRACT

Background: Exercise training affects the adipose tissue, which may lead to the secretion of adipokines. This study aimed to evaluate the effect of endurance exercise training on vaspin, lipid profiles, and some anthropometric indices among young people. **Methods:** The participants included 26 young men selected and categorized into the intervention and control groups randomly. The intervention group underwent the endurance activity (aerobic), while the control group had no exercises during the study. Anthropometric indices and dietary intakes were determined by standard and 48-hr recall methods, respectively. Before and after implementation of the exercise training, the participants' fasting blood samples were collected. Lipid profile (including cholesterol, triglyceride, LDL, and HDL) and vaspin levels were determined. **Results:** A significant difference was observed in body fat percentage of the intervention group after exercise training (P = 0.009). However, no significant differences were observed based on the means of anthropometric indices, lipid profile, and daily energy intake between two groups. With regard to the vaspin levels, a significant difference was observed between the participants' scores before (P = 0.001) and after (P = 0.04) the exercise training in intervention compared to the control group.
Conclusion: Endurance exercise program can lead to appropriate changes in some anthropometric indices, lipid profile, and vaspin adipokine in young people. So, exercise training can affect health promotion of people.

Keywords: *Vaspin; Endurance training; Anthropometric indices*

Introduction

Since 1990, several hormones (adipokines) have been identified in relation to obesity, type 2 diabetes, metabolic syndrome, cardiovascular disease (CVD), nervous, endocrine, and immune

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systems (Akbarzadeh *et al.*, 2012). Adipose tissue is an endocrine organ that secretes different components including hormones, growth factors, cytokines, and complement factors. These factors play role in fat cell differentiation and metabolism, regulation of vascular blood flow, and fat metabolism (Haider *et al.*, 2006). Physical exercise affects the adipose tissue and can influence the health process. Furthermore, adipose tissue secrets different adipokines such as vaspin. Vaspin seems to cause insulin sensitivity and metabolic homeostasis reactions. However, the mechanism of this process is unknown. Nevertheless, physical activity can cause a change of vaspin in the blood circulation (Seeger *et al.*, 2008). Vaspin plays role in different metabolic processes, such as fat tissue activity, changes in body mass index (BMI), blood glucose tolerance, metabolic syndrome, diabetes, and CVD (Chtara *et al.*, 2005, Klöting *et al.*, 2006, Youn *et al.*, 2008). Exercise training influences adipose tissue, which leads to release of vaspin. It was reported that 12 weeks of aerobic interval activity could decrease total cholesterol and low-density lipoprotein (LDL) (Pedersen et al., 2016). Moreover, physical fitness is determined by measuring indicators such as body composition, body fat percentage, BMI, and waist to hip ratio (WHR) (Saghebjoo *et al.*, 2011). Regular exercise training, including endurance and resistance activities, improves physical condition and health promotion. For example, endurance training increases energy expenditure and fat oxidation, while strength training increases body mass and muscle strength (Kang *et al.*, 2009). Increase of adipose tissue is related to the low level of serum vaspin and physical activity can increase serum levels of vaspin among non-athletes (Youn *et al.*, 2008). Furthermore, it was reported that modification of life style and increase of physical activity decreased the vaspin level, body weight, and resistance to insulin among the overweight and obese adolescents (Lee *et al.*, 2010). Another study demonstrated that the increase in serum vaspin was related to obesity and caused a decrease in insulin sensitivity. It was also reported that the association between increased serum levels of vaspin and weight gain were associated with decreased levels of insulin sensitivity in diabetic patients (Youn *et al.*, 2008). On the contrary, another study revealed that aerobic training did not change the vaspin level significantly (Khademosharie *et al.*, 2014). It seems that physiological beneficial changes can be achieved by endurance activities, resistance training, or a combination of them, which can balance the energy metabolism and fitness in body composition, insulin sensitivity, and regulation of energy metabolism to establish health (Youn *et al.*, 2008). Meanwhile, it is probable that combination of exercise training has more beneficial effect than individual training methods (Klöting *et al.*, 2006). Considering different results about the effect of exercise training on the levels of vaspin, body composition, and lipid profile, this study aimed to evaluate the effect of endurance exercise training on the serum vaspin, lipid profiles, and some anthropometric indices in young people.

Material and Methods

Design and participants: This semi-experimental study was carried out on 40 male students (19.2 ± 2.1 y), who were selected using the randomize method. The participants were selected from physical education students in Sistan & Baluchistan University, Zahedan, Iran. Of the 40 students, 14 were excluded since they were not able to keep up with the study conditions and recommendations. The remaining 26 participants completed the study without any problem; so, they were randomly divided into the endurance or aerobic (n = 13) and control (n = 13) groups.

The inclusion criteria were having 18-25 years of age, using the university's self-service restaurant, having no professional training and physical illnesses, residing in dorms with no medical histories, having a stable weight for at least three months, and having confirmation certificate of public health provided by a physician from the university clinic. The

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exclusion criteria included smoking, failing to adhere to exercises regularly, not using the university's self-service restaurant, and consuming medications or supplements that affect the laboratory test results.

Exercise training program: Aerobic activities, which involved walking and running were supervised by an exercise physiologist in 60 min/d and 3d/wk for 10 weeks. At every training session, the participants completed the warm up activities during the first 6 min, performed stretching and flexibility exercises during the next 4 min (taking a total of 10 minutes). In the following, they conducted a 15–50 min walking-running at 55 - 85% of HRmax. Relaxation exercises were performed 10 min at the end of the period. The cold-up exercises, performed at the end of the process, lasted 3 to 4 minutes and included jogging and walking. After every workout session, 5 min of stretching were performed by all participants. This phase was considered to last less than 10 min. The participants' heart rates were checked and recorded by a manometer. Furthermore, all trainings and activities were performed and checked by an exercise physiologist.

Determination of anthropometric indices and body composition: Body weight and height were measured using standard methods by an athletic trainer. Body weight and height were measured by a Seca scale to the nearest 100 g and 0.5 cm, respectively. The waist circumference was measured between the lower border of the rib and the iliac crest by a non-stretchable tape. Body mass index was evaluated based on the calculation of body weight (kg)/height (m^2) (Mahan and Raymond, 2016, Ramírez-Vélez *et al.*, 2017). Percentage of body fat was calculated by skinfold thickness measurements (Skinfold Fat Caliper SAEHAN, SH5020; South Korea). The body fat was also calculated based on the following formula:

$$\text{Density body (DB)} = 1.1093800 - (0.0008267.(S) + [0.0000016\,(S^2) - 0.0002574].[\text{Age}(y)]$$

$$\%\ \text{Body fat} = (4.95/\ BD + 4.5).100$$

Where, S = Total fat under the skin in three points, including chest, abdomen, and thigh.

This formula was approved by Jackson and Pollock for men (Jackson, Pallock., et al., 1978). Three points of the participants' body were used for determination of the body fat, including pectoral, superailiac crest, and midthigh area of the body.

According to the standard, body fat of 24% or greater was considered as obesity (Jackson and Pollock, 1978). All skinfold thickness measurement was performed by the athletic trainer and supervised by a sports physiologist.

Nutritional assessment: Dietary intakes were evaluated using the 24-hr recall questionnaire. All consumed foods were recorded in the questionnaire for two days. The mean values of calorie and macro-nutrients intake were measured on one weekday and on week-end. Dietary intake data and the amount of daily food intake were recorded in 48-hr recall questionnaires. The calorie and macro-nutrients intake were analyzed using a computer software program developed for analyzing the Iranian foods (Mirmiran *et al.*, 2004). The participants were educated by a nutritionist and followed up regularly. According to the recall questionnaire, all participants mentioned the type and amount of different foods consumed in two days of week.

Blood sampling and determination of lipid profile: To conduct the study, 10 ml fasting blood was taken from all participants in pre- and post-training. In the intervention group, blood samples were taken 48 hrs after the last exercise session. Serum was analyzed for lipid profiles in two steps of cholesterol and triglyceride. Moreover, HDL levels were calculated by enzymatic method, and using commercial kits, Parsazmun, Tehran, Iran, RA- 1000 (Technical publication No, UBA- 7638 – 00/USA) (Richmond et al.,1973). The LDL value was calculated employing friedwald formula (Friedewald *et al.*, 1972). The remained samples were stored at -70 °C till analysis.

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Determination of adipokines; Vaspin: Serum levels of vaspin were measured by Enzyme-linked Immune-Sorbent Assay enzyme- linked immune-sorbent assay (ELISA) using the commercial kits: Human adipsin; Hangzhou Eastbiopharm Co, LTD, Cat.No : CK-E10968 ELISA kit).

Ethical considerations: The Ethics Committee of Zahedan University of Medical Sciences approved this study (Code number; 6992; 31. Jan. 2015).

Data analysis: The SPSS 16 was used for statistical analysis. Data were reported in mean ± SD. Kolmogorov Smirnov test was used to test normal distribution of the data. Independent sample *t-test* and paired sample *t-test* were also applied to compare means between and within the two groups with normal distribution, respectively. In the case that the data were not distributed normally, nonparametric test such as Mann-Whitney U and Wilcoxon were used between or within groups respectively. P-value < 0.05 was considered as the significant level.

Results

The general characteristics of participants in the two groups are shown in **Table 1**. At baseline, the mean of anthropometric indices was normal in the two groups and no significant difference was observed between them in terms of BMI, WC, and WHR ($P > 0.05$).

However, with regard to the body fat percentage, the intervention group's scores were significantly different before and after the exercise training ($P = 0.02$). However, this difference was not significant in the control group ($P = 0.3$, **Table 2**). Significant difference was also observed in the body fat percent before and after the exercise training in the intervention group compared to the control group ($P = 0.009$).

No significant difference was observed in the intervention group in terms of lipid profile levels before and after the exercise training. However, except to the HDL level, all other changes were significant compared to the control group ($P < 0.05$, **Table 3**).

According to vaspin level, no significant difference was observed before and after the exercise training between the study groups ($P = 0.1$, **Table 4**). Furthermore, the amount of blood vaspin reduced one month after the aerobic exercise training, but no significant difference was observed in the two groups ($P = 0.1$). Moreover, a significant difference was seen in the level of vaspin in the intervention group before ($P = 0.01$) and after ($P = 0.05$) the endurance exercise training intervention compared to the control.

Dietary analysis showed no significant variation in the daily calorie intake between two groups. It was found that mean of the daily calorie intake was 2383.7 ± 265.7 and 2412.7 ± 285.2 kcal/d in the intervention and control groups, respectively, which was near the recommended dietary allowances. In addition, the ratio of macronutrients is similar in providing the total daily energy intake in the intervention and control groups. The average ratio of the daily calorie intake of the macronutrients in the case group included carbohydrates, proteins, and fats were 59.3 ± 1.5%, 17.6 ± 2.7%, and 23.1 ± 4.1%, respectively. These levels had no significant difference compared to the control group ($P > 0.05$).

Table 1. The general characteristics of participants before and after 10 weeks of training

Groups	Age (y)	Weight (kg)	Height(cm)	BMI (kg/m^2)[c]	WC(cm)[d]	WHR[e]
Intervention	20.0 ± 0.9[a] (19 - 22)[b]	63.7 ± 9.6 (55 – 102)	175.5 ± 0.6 163 - 184	21.8 ± 3.4 (19 – 34)	76.7 ± 12.6 (61 - 69)	0.82 ± 0.1 (0.6 - 0.9)
Control	19.9 ± 0.95 (18 - 22)	70.9 ± 12.9 (58 – 101)	177 ± 0.6 (163 – 184)	22.4 ± 3.4 (19 –32)	73.1 ± 8.2 (63 – 91)	0.80 ± 0.06 (0.7- 0.9)
P-valuef	0.5	0.8	0.5	0.6	0.4	0.4

[a] : Mean ± SD, [b]: Range, [c]: Body Mass Index, [d] : Waist circumference, [e]: Waist to Hip Ratio, [f]: Student *t-test*

Table 2. Comparison of percentage of body fat in the studied groups

Groups	Before	After	P-value[b]
Intervention	14.0 ± 1.6[a]	13.0 ± 2.2	0.02
Control	11.2 ± 2.6	10.9 ± 6. 2	0.3

[a]: Mean ± SD, [b]: Paired *t-test*

Table 3. Mean serum levels of lipid profile levels in the studied groups

Groups	Intervention		P-value[b]	Control		P-value[b]
	Before	After		Before	After	
Cholesterol (mg/dl)	137 ± 21[a]	133.0 ± 26.0	0.4	117 ± 29.0	124.0 ± 28.0	0.04
Triglyceride (mg/dl)	82 ± 22	71.0 ± 23.0	0.6	60.0 ± 23.1	67.0 ± 16.9	0.1
Low density lipoprotein (mg/dl)	95.3 ± 24.5	96.3 ± 18.9	0.8	84.5 ± 24.2	93.1 ± 17.4	0.03
Hgih density lipoprotein (mg/dl)	23.4 ± 4.1	24.0 ±5.6	0.5	21.4 ± 7.0	24.9 ± 4.1	0.09

[a]: Mean ± SD, [b]: Paired *t-test*

Table 4. Mean serum levels of vaspin (ng/ml) in the studied groups

Groups	Before (ng/ml)	After (ng/ml)	P-value[b]
Intervention	10.2 ± 8.4[a] 1.5 - 25.2[d]	8.3 ± 8.2 0.8 - 20.6	0.1
Control	2.1 ± 3.1 0.5 - 10.9	2.2 ± 3.4 0.7 - 11.9	0. 1
P-value[c]	0.01	0.05	

[a]: Mean ± SD, [b]: Paired *t-test*, [c]: Student *t-test*, [d]: Range

Discussion

The results revealed no significant difference in general characteristics between the case and control groups at the baseline. In general, all indices were at the normal level according to the standards. Although some indicators were at extensive range, for example BMI, WC, WHR, and Body weight. The results revealed that BMI, WC, and WHR were normal at first and one month after the exercise training with no significant changes. Body mass index can represent general obesity, not body composition, and fat distribution (Etchison *et al.*, 2011, Kruschitz *et al.*, 2013). In addition, body weight consists of two parts including adipose

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tissue and lean body mass such as muscles and bones. If the exercise training program does not lead to reduction of fat and improvement of cell function, physical activity cannot reduce insulin resistance and inflammation (Šenolt *et al.*, 2009).No significant difference was observed between the two groups with regard to the BMI, waist circumference, and WHR at the baseline. However, the values of these variables were in normal range. In this study, aerobic exercise reduced fat deposition and changed fat tissue cells, which could cause the release different adipokine such as vaspin. If physical activity is severe and prolonged, it will have a greater impact on fat tissue. It also had an impact on calorie restriction. However, physical activity can cause dynamic changes in adipose tissue, improve respiratory capacity, and create effective oxidative stress (Khademosharie *et al.*, 2014, Thompson *et al.*, 2012). The lack of weight loss or body fat in aerobic training may be related to increase of energy intake or energy expenditure, or both (Church et al., 2010). The results showed that the percentage of body fat decreased significantly one month after the exercise training (P = 0.02). In a similar study, the effect of an eight-week endurance activity was more than the resistance activity effect on BMI (P = 0.03), adipose tissue (P = 0.4), and WHR (P = 0.02) among the overweight and obese females (Jafari *et al.*, 2015). Increase in physical activity caused reduction in body weight, vaspin, and insulin resistance in obese teenagers (Lee *et al.*, 2010). In a similar study, eight weeks of aerobic exercise decreased somatic indices including waist circumference, WHR, and subcutaneous fat compared to the baseline and the control group (Mazurek *et al.*, 2014). Unlike our findings, the results of another study showed that 5 and 10-weeks aerobic exercise training did not have a significant effect on body weight, body fat percentage, BMI, lipid profiles, and vaspin in diabetic patients. In order to have more effective physical activity in the patients, they were recommended to continue exercise training according to severity, duration, type, and number of training sessions (Khademosharie *et al.*, 2014). It was reported that both light and moderate aerobics developed body composition and lipid profile in obese females. At first, they can start with light activities and gradually increase to more intensive activities (Marandi *et al.*, 2013). It was also observed that interval aerobic exercise for at least 12-16 weeks improved health anthropometric indices in obese participants (Mazurek *et al.*, 2014). In the present study, except for the LDL and HDL, endurance training program decreased blood cholesterol and triglyceride levels in the participants although these changes were not significant. It is mentioned that levels of the lipid profile were in normal range before and after exercise training. It was reported that if the level of lipid profile was normal, the improvement of these indices would be limited after aerobic exercise training. A significant reduction in body mass or improvement in body composition can create beneficial changes in the lipid profile levels. In a similar study, only moderate aerobic exercise could reduce blood triglycerides in young people compared to the control group (Mazurek *et al.*, 2014). Therefore, there is no need to implement intervention program based on the participants' normal lipid profile. Nevertheless, metabolism and physiological aspects of sport, for example reduction of fat as somatic and vaspin adipokine in the body should be emphasized. It was also reported that decrease in vaspin or increase of insulin sensitivity is due to exercise-induced oxidative stress (Hida *et al.*, 2005). Unlike the elderly, physical activity in young people causes consumption of energy in body mass and body fat, which confirms the performance of physical activity to prevent weight gain and promoting health (Ekelund *et al.*, 2005).

It is reported that improving lipid profile is limited among healthy participants with normal values of lipid indices. It was also reported that improving blood lipid profile was limited among healthy participants with normal values of lipid indices; on the other hand, regular physical activities reduced concentration of triglycerides by cycle exercises of moderate intensity, but the level of changes was not related to the type of exercise training program. Besides, it was shown that aerobic interval cycle exercise training (AIT) could improve HDL-cholesterol after eight weeks of training. The AIT causes a significantly greater improvement in VO2 max and VO2max is related to body mass. Eight weeks of aerobic interval training was more effective in improving body composition and cardiorespiratory fitness than continuous moderate exercise and regular physical education in participants (Mazurek *et al.*, 2014).

A nutritional assessment showed that the levels of calorie intake in the intervention group was appropriate (2472.3 ± 725 kcal/d). The results showed that the percentage of macronutrients intake including carbohydrates (59.3%), proteins (17.6%), and fats (23.1%) were in acceptable macronutrient distribution ranges for providing daily total energy intake in the participants (Mahan and Raymond, 2016). In another study, the percentage of daily energy intake was estimated for carbohydrates (60%), proteins (15%), and fats (31%) (Iwayama *et al.*, 2015). Therefore, it can be said that exercise regulates the appetite and improves satiety responses in overweight and obese individuals, but this issue needs further studies (Martins *et al.*, 2010). Energy intake does not increase in response to resistance exercise or aerobic activity. In fact, energy intake reduces slightly between the beginning and end of the exercise, which indicates an increase in energy intake in people who have sedentary life style and are involved in long exercise activities. Physical activity causes weight loss, which can be related to physiological condition. It seems to make balance between an improved satiety response to a food intake and developed sensitivity of the appetite (Bales *et al.*, 2012).

The research showed that the serum vaspin decreased significantly after aerobic exercise training compared to the control group. However, this difference was not significant due to the small sample size and high standard deviation in vaspin values during, before, and after exercise training. Youn et al. observed decreased amounts of vaspin and increased insulin sensitivity in overweight children whose intake was 1800 kcal/d with various aerobic activities such as dance, golf, swimming, basketball, football, and running. Exercise training in untrained participants increased vaspin serum levels, but low circulating vaspin was related to a high fitness level (Youn *et al.*, 2008).

Increased central fat causes secretion of Pro-inflammatory adipokines. On the other hand, aerobic or resistance exercise can decrease adipose tissue and secretion of adipokines (Chang *et al.*, 2010). Furthermore, serum vaspin levels are not associated with indicators of insulin sensitivity and glucose metabolism including fasting glucose, fasting insulin, and adiponectin. The results do not support the theory that vaspin is a major insulin-sensitizing adipokine in humans (Seeger *et al.*, 2008).

Program of aerobic exercise every day and every other day did not affect the vaspin level and lipid profile in diabetic patients. Therefore, it is supposed that training courses affect glucose and lipid metabolism in diabetic patients by increasing the secretion of vaspin as a compensatory mechanism in the body. It seems that for the effectiveness of aerobic training, these patients should perform these trainings within a prolonged duration (Khademosharie *et al.*, 2014).

It is reported that serum vaspin levels are reduced by exercise-induced oxidative stress mechanism and have no association with increasing sensitivity to insulin (Oberbach *et al.*, 2010). On the other hand, vaspin had a direct correlation with insulin sensitivity and glucose uptake (Wada, 2008). Vaspin secretion seems to be affected by the low-to-high-intensity exercise. Apparently, more studies are needed to achieve certain results. In the present study, a reduction of vaspin serum was observed in the intervention group compared to the baseline values in the control group. Aerobic exercise training is probable to cause optimal status on body composition and increase daily calorie intake in the participants. The results suggest that as the exercise training programs are appropriately designed, they can affect anthropometric measurements, lipid profiles, and serum vaspin. In the present study, findings revealed that exercise improved the anthropometric, biochemical, and

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adipokines indicators. The results also showed a significant difference in the intervention group before and after the training based on percentage of body fat. Furthermore, no significant reduction was observed in triglyceride and cholesterol levels after exercise training in the intervention group.

The limitations of the present study included participants missing, psychological stress, and endocrine hormones. Moreover, age, duration and intensity of exercise, and food intake of participants were checked by food self-service of the university. To analyze food intake, we tried to reduce the possible errors by educating participants. Nevertheless, further studies are needed to understand factors affecting the level of serum vaspin during exercise.

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Authors' Contribution

Karajibani M and Dehghani K contributed equally and performed the conception and design of research; Mogharnasi M and Mosavi Gillani SR performed experiments and prepared tools and facilities for field study; Dashipour AR performed statically analysis; Karajibani M and Montazerifar F drafted and revised the manuscript.

Conflict of interests

No potential conflict of interest was reported in this article.

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