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Effects of 12 weeks aerobic exercise on plasma level of TSH and thyroid hormones in sedentary women

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ABSTRACT

Thyroid hormones have significant effect on the metabolism of the body, so that the complete lack of thyroid secretion may cause decrease inthe basic metabolic rate and, on the other hand, the excessive secretion of it can increase the basic metabolism. Results of previous studies have shown that regular aerobic exercise is an important factor in the regulation of thyroid hormones; therefore, in this study, the effects of 12 weeks aerobic exercise on plasma level of TSH and thyroid hormones, have been investigated in sedentary women. Thirty inactive obese women were randomly selected though purposive sampling and divided into two groups: aerobic exercise and control. The training program consisted of 12 weeks moderate-intensity aerobic exercises with music. These exercises were performed three sessions a week and each session take 60-minute for three stages. The plasma level of TSH, triiodothyronine (T_3), and thyroxin (T_4) were measured before and after 12 weeks aerobic exercise. After 12 weeks of intervention, no significant change was observed in the plasma level of TSH and thyroid hormones (T_3 and T_4) in the exercise group (aerobic exercise). In general, it can be concluded that the aerobic exercise alone had no effect on plasma level of TSH, andthyroid hormones ofT_3 and T_4.

Keywords: Aerobic Exercise, Thyroid Hormones, TSH, sedentary Women

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INTRODUCTION

Having a healthy body and fitness may cause increase confidence and motivation to make other lifetime activities. On the other hand, they will retain the person from the dangerous cardiovascular diseases, diabetes, and etc. Obese persons may expose to the risk of many chronic diseases and endocrine and metabolic disorders. Most activities that are often used to reduce weight are tedious due to their high workloads and time requirements; therefore, finding a compact and versatile training method to improve the body composition and increase the fat oxidation, is necessary for today's society [1]. The rhythmic aerobic exercise is one of the most common sports in the recent years that have become popular among Iranian women. Muscles use oxygen in aerobic exercises. Aerobic exercise increases blood flow, improves muscle strength, and stimulates the heart and lungs [1].

Study of hormones, especially the metabolic thyroid hormones and their relationship with obesity is useful for individuals with thyroid disorders. Individuals, who have a thyroid disorder, suffer from weight-related problems [2]. Thyroid hormones have a significant impact in increasing the metabolism, so that the complete lack of thyroid secretion may decrease the basic metabolism rate up to about 45 to 50 percent less than the normal level, and the excessive thyroid secretion may increase the basic metabolism rate up to about 60 to 100 percent more than the normal level [3]. Thyroid secretion is mainly controlled by thyroid-stimulating hormone, thyrotropin (TSH), which is secreted by the anterior pituitary gland. TSH increases the secretion of thyroxine and triiodothyronine by the thyroid gland [3]. These hormones regulate the metabolism and also affect the growth and the performance of many systems in the body [4].

Unit now, a few studies have been done about the relationship between obesity and thyroid; however, some studies on euthyroid individuals have indicated a significant relationship between BMI and thyroid function [2]. The thyroid gland with help of the pituitary gland is the most important organ in the body for controlling the weight and obesity [3]. Triiodothyronine and thyroxine have important biological effects. They control the rate of energy burning and may create the protein [4].

Accelerating metabolism is important in individuals aged 40 years or older, because metabolism decreases in midlife. Therefore, exercise and regular physical activities play a crucial role in increasing metabolism and weight control and reduction programs [5]. Those who exercise regularly would have a better weight balance and a better metabolic as well as lower body fat percentage [6]. The rhythmic aerobic exercises, that have become popular in the recent years, include an integrated training group that executes regular and organized movements along with music and with a special tempo and rhythm and variable intensity and duration in the presence of a trainer [7]. These rhythmic exercises improve cardiovascular and respiratory endurance and strengthen the muscles and are the best method for weight reduction and control [8].

Many studies have concluded that aerobic exercise may affects a group of metabolic and endocrine functions and change the human hormone levels [9]. Especially, the exercise itself can cause hemodynamic changes and change the hormone levels. Although, there are some data reported on the effects of exercise on thyroid hormone metabolism in the literatures, but they are inconsistent [9]. Some studies have observed that the resistance training does not lead to significant changes in thyroid hormones [10]. Fattahi and Nastaran (2014) examined the effect of 8 weeks aerobic exercise on thyroid hormones in female rats with polycystic ovary syndrome. They divided the female Wistar rats into two training groups including low intensity-group (LIG) and moderate-intensity group (MIG) and forced them to perform aerobic exercise. At the end of the eighth week, the changes in TSH between the low-intensity group (LIG) and the medium-intensity (MIG) were not significant. Their results showed that the aerobic exercises with different intensities and durations improve the thyroid hormones in rats with polycystic ovary syndrome. Hawamde et al. (2012) reported that the long-term exercises by athletes may have different effects on thyroid hormone levels in comparison with intensive training programs [11]. Boostani et al. (2012) studied the effects of one session taekwondo on TSH and thyroid hormones. They reported that the taekwondo with the reported intensity and duration, does not seem to place a disproportionate burden on the body, and the exercise can be used to improve cardiorespiratory fitness [12]. Other studies suggested that serum levels of thyroid-stimulating hormone and thyroid hormones are affected by the maximal aerobic exercises [4].

Shazad Saleem et al. (2011) examined the relationship between the thyroid stimulating hormone and the metabolic syndrome. They concluded that the high-normal TSH is associated with metabolic syndrome and its components which may increase the risk of cardiovascular disease with high-normal TSH levels [13]. Hackney and Dobridge (2009) studied the effect of prolonged exhaustive exercise on men. Their results showed that in exhaustive exercise, thyroid hormones decreased about 24 hours in the recovery, and the cortisol responses were inversely correlated with reduced thyroid while the (increased) prolactin responses were exactly correlated with TSH variations [14].

Bastmir *et al.* (2007) investigated the thyroid functions, independently. Their results showed contradictory evidence regarding the positive correlation between TSH serum levels and some degree of obesity and metabolic positive effects in the obese individuals with normal thyroid function [15].

A few attempts were made to examine the effects of aerobic exercise on body composition and thyroid hormone regulation. The present study evaluates the effect of aerobic exercise on body composition and the thyroid-stimulating hormone level and the thyroid hormones.

MATERIALS AND METHODS

In this semi-experimental trial, 30 overweight inactive women were recruited voluntarily and were randomly divided into two groups, including aerobic exercise (n=15) and control (n=15). The selection criteria were as follows: (1) not having metabolic diseases, such as diabetes, (2) not having hormonal problems such as hypothyroidism or hyperthyroidism, (3) not having orthopedic problems and prohibition from participation in physical activity, (4) lack of regular physical activity in the past two years, (5) not taking any medications, (6) lack of irregular menstruation. Before the training program, the participants underwent medical examinations. An informed consent was taken from them regarding the participation in physical activities.

Anthropometric Measurements

To measure the height of the individuals, they stand shoeless on a 200-cm height-measuring device mounted on the wall so that their heels, hips, shoulders be in contact with the wall. Then, their heights were recorded in a table (in centimeters). The minimum waist (abdomen) circumference and the maximum hip circumference were also measured using a tape meter to determine the waist-to-hip ratio (WHR= Waist/Hip).The IOI body composition analyzer was used to the measure the weight (kg), the body mass index (BMI), and the body fat percentage. The weights were measured in two stages: before the training program, and 48 hours after completion of the 12-week training. When measuring the body composition, all individuals were fasting, and their stomach and bladder were emptied. They stood motionless and shoeless with minimum clothing on the body composition analyzer. The measurements were performed according to the manufacturer's instructions. The measurement of the individual's subcutaneous fat was conducted using the SH 5020 caliper (SAEHAN) and the Yuhasz's six-point formula in two stages: before the training program, and 48 hours after completion of the 12-week training. A CASIO digital chronometer with a precision of hundredths of seconds was used to determine and record the heart rate before training (resting heart rate) and to control the exercise intensity (HRmax=220-age).

Blood analysis

In order to measure the plasma level of TSH (thyroid-stimulating hormone) and thyroid hormones (triiodothyronine and thyroxine), the blood samples were drawn from individuals 48 hours before the first training session and after 12 weeks training (72 hours after the last training session). Sampling was performed after 8 to 10 hours of overnight fasting in the morning between 8-9 am by a qualified technician in the sitting position. Six milliliters of venous blood was drawn from each person from the anticubital vein. The blood samples were drawn into tubes containing anticoagulant. All blood samples were frozen at -80° C and they were conserved until analysis process. All variables were measured using the Auto Bio laboratory kits with the precision of 0.936 ng/ml by the ELISA method.

Training program

Training program consisted of 12 weeks moderate-intensity aerobic training (the maximum heart rate up to about 50-75%) three times a week in 60-minute sessions and was conducted in three stages. The first stage of training (warm-up) included jogging and dynamic stretching for 8-10 minutes with music. In the second stage of training, in the first week, the choreography consisted of simple movements without spinning and jumping and movement approaches. The duration of sessions began with 10 minutes and incrementally increased to 40 minutes in the last sessions. The last sessions included training and performing complex chains (after eight weeks). The exercise intensity increased from 60-75 percent of the maximum heart rate in the first weeks to 85 percent of the maximum heart rate in eighth week. During exercise, heart rate of individuals was measured by the trainer and the assistant. If the heart rate was increased over 160 bpm, the participants were requested to reduce their hand motions without stopping the feet to return to the desired heart rate range. The trainer then was used music with lower BPM (135-145) and dynamic stretching to slowly reduce the heart rate of individuals. At the third stage, the training session was terminated using static stretching, and in some sessions with ground movements (5-7 minutes) to return to the initial state.

Statistical analysis

In this study, the data for personal characteristics and research variables were classified and described by calculating the average and standard deviation as M±SD. The correlated t-test was used to examine the intragroup variations. To compare the intergroup variations, the pre-test values were subtracted from the post-test values, and the result was compared using the independent t-test. The Pearson correlation coefficient was used to examine the relationships between variables. The significance level was considered as $P \leq 0.05$.

RESULTS AND DISSCUSION

The average of desired indices in two studied group has been compared in table 1. Table 2 shows the intragroup variations in each group using the correlated t-test and middlegroup variations using independent t-test. As seen in these tables, the results of correlated t-test showed that 12 weeks aerobic exercise was no significant effect on the TSH level, ($t = -0.224$, $P \geq 0.828$), T_3($t = -1.153$, $P \geq 0.279$), and T_4 ($t = 0.301$, $P \geq 0.771$). The results also showed that the effect of this training program has not created a significant change in body weight ($t = 0.719$, $P \geq 49$), BMI ($t = 0.743$, $P \geq 0.476$), and WHR ($t = 0$, $P \geq 1.0$) (see fig. 1). While after 12 weeks aerobic exercise only skin thickness and body fat percentage have been significantly decreased. Table 1 shows the basic characteristics of individuals in each group. As seen, there were no significant differences between groups in any of the variables.

Table 1. The basic characteristics of individuals

Variable	Exercise group		Control group	
	Average	Standard deviation	Average	Standard deviation
Age (year)	41	7.21	42.5	5.12
Height (cm)	159.7	3.83	157	6.59
Weight (kg)	73.16	8.4	71.27	2.84

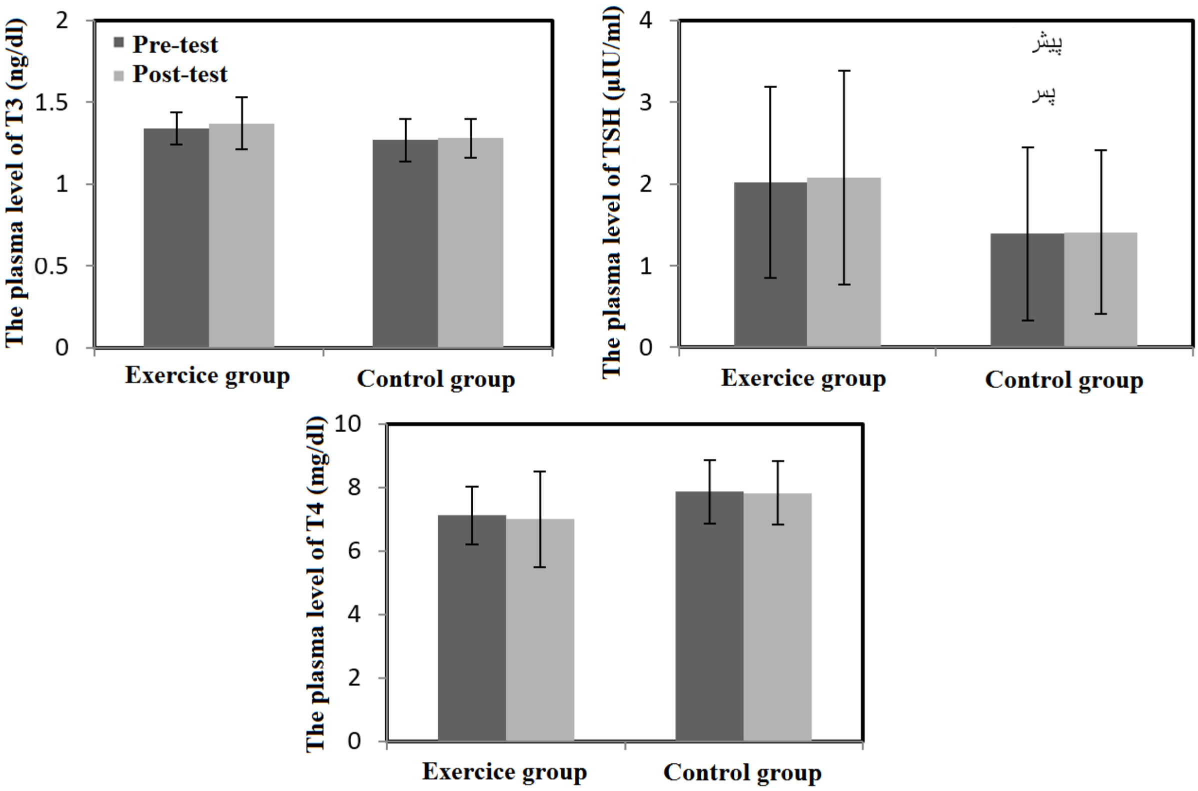

Figure 1. Comparison of pre- and post-test in exercise and control groups

Table 2. the average and standard deviation of individual's characteristics

Variable	Exercise group				Control group				P value
	Pre-test		Post-test		Pre-test		Post-test		
	mean	sd	mean	sd	Mean	sd	mean	sd	
Weight	73.16	8.4	72.83	8.6	71.27	2.84	71.65	3.5	0.615
BMI	28.63	3.4	28.5	3.4	29.06	2.89	29.24	3.06	0.627
WHR	0.87	0.03	0.87	0.05	0.87	0.03	0.86	0.05	0.344
Subcutaneous fat thickness	1.99	34.26	1.56	23.93	2.03	19.95	1.94	23.58	0.002
Body fat percentage	34.41	5.3	27.72	3.7	38.41	3.09	38.07	3.65	0.002
Thyrotropin	2.02	1.18	2.08	1.32	1.4	1.07	1.41	1	0.87
Triiodothyronine	1.34	0.1	1.37	0.16	1.27	0.14	1.28	0.13	0.348
Thyroxine	7.12	0.9	7	1.5	7.87	1.1	7.83	1.2	0.853

DISCUSSION

In summary, the results of the present study showed that no significant change occurred in the plasma levels of TSH and thyroid hormones (T_3 and T_4) after 12 weeks aerobic exercise. The TSH and T_3 levels was slightly increased after the training, however, the change was not significant. Also the T_4 levels showed a slight reduction after the training compared to those before training; however, these changes were not significant, too. The results are consistent with the previous studies [4, 9-12, 14, 16, 17]. Most of these studies did not report a significant change in TSH levels after exercise. Sullo *et al.* (2003) showed that maximal and submaximal aerobic exercise does not affect TSH and thyroid hormones in active young men [16]. Fattahi and Nastaran (2014) examined the effect of 8 weeks aerobic exercise on thyroid hormones in female rats with polycystic ovary syndrome and showed that the TSH and T_3 levels did not significantly change in both low-intensity and moderate-intensity training groups [17]. Rahimi *et al.* (2013) examined the effect of 8 weeks resistance training on men and reported no significant change in TSH and thyroid hormones levels [10]. Boostani *et al.* (2012) reported no significant change in TSH and T_3 and T_4 levels in

16 taekwondo athletes during a training session [12]. The findings of Hawamde *et al.* (2012) showed that 6 months of aerobic and anaerobic exercises did not change the TSH and thyroid hormones levels in Jordanian men [11]. Consistent with these finding, Hackney and Dobridge [14] and Sheng Huang et al. [9] reported the lack of significant change in TSH and thyroid hormones levels in men after a running session on treadmill. In this regard, the findings of the present study are inconsistent with those of Neto et al. [18], Shazad Saleem et al. [13], Ciloglu et al. [19], and Beyleroglu [4]. Neto et al. showed that a single session of high-intensity running significantly increases the TSH levels and reduces the T3 levels [18]. The inconsistency between our results and those of Neto et al. (2013) may be attributed to the exercise intensity, and in general, to its protocol [18].

In general, it can be concluded that moderate-intensity aerobic exercise with 50-75% of maximum heart rate does not significantly change the plasma concentration of TSH.

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