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The effects of Moderate intensity Aerobic Training on Serum Levels of Thyroid Hormones in Inactive Girls

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Abstract

Propose: The thyroid hormones (T3, TSH, T4, and FT4) play a role in energy balance and regulation of energy expenditure. The aim present study to investigate the effect of moderate intensity aerobic training on thyroid hormone levels in inactive girls. **Method:** A total 30 inactive girls students were randomly selected and divided to training group (n=15) and control group (n=15). The training group doing research protocol for four week (three session per week of 70% maximal heart rate), also the control group was not intervened during the study. However, elevation anthropometric index before protocol training study. Blood samples were collected 24 hours before the first and after the last training session .For analysis data used T-test at significant level $p<0.05$. **Results:** Results showed a significant reduction of T3 ($P<0.05$), but no significant change were observed at T4, TSH, FT4 levels after training ($P>0.05$). **Conclusions:** Our results showed that moderate aerobic training of 70% maximal heart rate have minimum effect on thyroid hormones in inactive adolescent girls.
***Keywords**:* Aerobic exercise, Thyroid hormones, Triiodothyronine, Inactive girls

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INTRODUCTION

According to research adolescent is a critical period in development for acquiring societal contribution values, because it involved the transition between childhood characterized by strong dependent on parents. Thus, adolescent can be defined as the period 10 and 24 year (Crone, & Fuligni, 2020). According to Iran Statically Center, this age group constitutes 21 percent of the country population (Tolouei Azar, Tofighi, & Motab Saei, 2018). However, about 80% of students (11 to 17 years) were not physically active in 2010 according to the World Health Organization and adolescent girls (84%) have less sufficient physical activity in comparison to 78% of boys (WHO, 2018). Low levels of exercise are particularly associated with a prevalence of obesity in children and adolescent (Bellamy et al., 2020) which disorder homeostasis and hormone levels in the body.

Thyroid hormones have significant roles in regulating metabolism, growth and tissue differentiation, the fatty acids oxidation and temperature regulation (Hackney and Gulledge, 1994; Nicoll, Hatfield, Melanson, & Nasin, 2018). Remarkably, thyroid hormones circulating levels decreases by increased exercise training, which is induced by negative energy imbalances and reduced energy availability (Loucks & Heath, 1994).

The thyroid gland secretes thyroxin (T4) more than triiodothyronine (T3) and T4 is converted to T3 by the iodized T4 in the liver. T4 is less active than T3 in biological conditionsbecause of its lower affinity for binding to thyroid hormone receptors. Thyroid hormone level's affected by many factors, including diet, smoking, medication, environmental conditions, pregnancy, obesity, and body mass index, age and exercise (Graves, Marteniuk, Refsal, & Nachreiner, 2006; Jonklaas and Razvi 2019). T3 and T4 thyroid hormones are altered by various exercises modality, depending on the type, time, frequency and intensity of exercise intervention (Hackney, Davis, & Lane, 2016). Regular exercise plays an essential role in regulating metabolism and weight reduction programs (Pantelić, Milanović, Sporiš, & Stojanović-Tošić, 2013). Those who exercise regularly have better metabolism and lower lipid percentages (Volpe, Kobusingye, Bailur, & Stanek, 2008). Those people with a higher body mass index have higher levels of thyroid-stimulating hormone and lower thyroxin levels than normal individuals and also, decreasing the levels of the thyroid causes weight loss (Jonklaas and Razvi, 2019).

Aerobic training can be any physical training that depends primarily on the aerobic energy – generation process, on the condition that it is of sufficient intensity to maintain or improve physical fitness (MacKay-Lyons et al., 2020). Aerobic training is usually performed at target heart rate between 50 – 85 % of heart rate reserve for at least 20 min per session (Brouwer, Wondergem, Otten, & Pisters, 2019). According studies Aerobic exercise can have beneficial effects on the metabolic process, endocrine function, and circulating hormones level. In particular, exercise can lead to hemodynamic changes and also, changes in the levels of the hormone in the body. On the other hand, some studies have shown that resistance exercise does not significantly change thyroid hormones (Onsori and Galedari, 2015). Fattahi and Nastaran (2014) showed that there was no difference in TSH levels after eight weeks of low and moderate aerobic exercise and they concluded that various intensity and duration of aerobic exercise led to improved thyroid hormones (Fathei & Nastaran 2014). Humad et al. (2012) demonstrated that there is no difference in levels of thyroid hormones in aerobic and anaerobic athletic regards higher TSH and fT3 levels in compare with non-athletes (Hawamdeh, Baniata, Mansi, Nasr, & Aburjai, 2012). Hackney and Dobridge (2009) evaluated the effect of exhaustive activity on male thyroid hormone levels and they concluded that exhaustive activity causes the reduction of thyroid hormones during 24 hours recovery period (Hackney & Dobridge 2009).

Overall, studies show inconsistent results about training methods on thyroid hormones, as well as the conflict in the findings of the effect of aerobic training in adolescent. The propose of the study present investigate the effect of moderate aerobic training on thyroid hormone levels in inactive girls.

METHOD

The present study was semi-experimental with pre-post testing. The statistical population of the study consisted of high schoolgirls' students in the Saleh Abad section in Tehrancity. The student-parent completed an informed consent form. The research process was approved by the Ethics Committee of the Baqiyatallah University of Medical Sciences with code IR.BMSU.REC.1396.642. The sample size of 11 person calculated per groups by G*Power (Version 3.1.9.2, Dusseldorf, Germany) with an alpha levels of 0.05, power (1-β) 0.95, an effect size (dz) of 1.65 which generated from changes in thyroid hormone serum levels in response to aerobic exercise by Altaye et al. (2019). In present research, 30 subjects were selected by available sampling method with a mean weight of 57 ± 6.15 kg and mean height of 159 ± 3.26 cm and mean age of 16 ±1 years and divided randomly with online sample randomizer (https://www.randomizer.org/#randomize) into two groups (n= 15) of exercise and control, without exercise group with online randomizer tool. And after parental satisfaction, explanations were given to their parents for familiarizing them with exercise intervention and research protocol. Inclusion criteria were: (1) no history of cardiovascular disease, (2) high blood pressure, (3) not taking medicine,(4) diabetes, (5) normal sleep. Exclusion criteria were: (1) lack of regular participation in the protocol training, (2) BMI more than 25 kg/m2, being athletes (3) thyroid disease.

Protocol training

At first, samples were called to the gym for familiarization of study protocol which the study process explained and exercise training modality to students. Heart rate measurement was done using a T31 Polar pulse sensor monitor (Komple Fland). Then students performed training protocol that included 5 minutes warm-up and cool down (walking, jogging and static and dynamic stretching) and main parts of the, first week of training 10 minutes, second week of training 15 minutes, third week of 25 minutes and fourth week of training 30 minutes for four week (three session per week) of 70% maximal heart rate moderate aerobic training. The total time of each training session lasted between 20 and 45 minutes.

Anthropometric measuring

At first, sample were called to the gym to measure anthropometric indices. Height was measured with a stadiometer (Seca, model 707, Hamburg, Germany), and body weight to the nearest 0.1 kg was measured using a digital balance (Seca, model 707, Hamburg, Germany).

Biochemistry test

Blood sample (3 CC) was taken from a biracial vein with a fasting and steady-state in one day before and after the last exercise session. Subjects completed menstruation diaries during the training course and they were not menses during the booth blood sampling test. Collected samples were put in sterilized tubes. Sample tubes were separated from the blood cells for 10 minutes by centrifugation with 35000 rpm and kept at -80 ° C. The serum levels of hormones were measured by ELISA using the Foresight Hormone Measurement kits of the Laboratory (ACON of the country of America included Cat.n: II31-3011) TSH, (Cat.n: -I31-3131) fT4, T4 (Cat.n: I231-3021), T3 (Cat.n: II31-3041).

Statistical Analysis

For statistical analysis, first to describe the date from the descriptive statistics of the average indicators and standard deviation then, T-test were used to analyzed the results. SPSS.25 software was used to perform statistical operations $p<0.05$.

RESULTS

The demographic characteristics are presented in Table 1. The level of T4 hormone was not changed significantly after the four weeks of aerobic training (Table 2 and Figure 1), while the T3 level decreases after the exercise program (Table 2 and Figure 2, $P \leq 0.05$). However, the levels of hormone TSH and fT4 were not changed significantly after the four weeks of aerobic exercise program (Tables 2). Besides, there was no significant between-groups difference in thyroid hormone levels ($P > 0.05$).

Table 1: Demographic characteristics of groups

	Control group	Exercise group
Age (year)	16±1	16±1
Height (cm)	162±4	159±.3
Weight (kg)	54±6.14	57±6.15
Body mass index (kg/m^2)	20.59±1.15	22.59±1.88

*Data is presented as mean ± standard deviation

Table 2: The changes in T4, T3, TSH, and fT4 in exercise and control groups

Hormone	Groups	Mean ± SD		Within groups P-value	Mean Difference	Between groups P-value
		pre-test	Post-test			

T4 (µg /dl)	Exercise	0.89±9.41	1.07±9.74	0.08	0.02-	0.9
	Control	1.76±9.12	1.80±9.05	0.20	0.08-	
T3 (ng/ml)	Exercise	0.33±1.29	0.19±1.02	*0.04	-0.27	0.67
	Control	0.23±1.29	0.22±1.18	*0.01	-0.11	
TSH (µlU /ml)	Exercise	0.98±٠3.48	1.58±3.20	0.4	0. 28-	0.17
	Control	0.95±4.04	0.97±4.08	0.23	0.04	
fT4 (ng /dl)	Exercise	0.26±1.17	0.15±1.28	0.18	0.11	0.58
	Control	0.32±1.25	0.3±1.23	0.55	0.02	

*significant differences at P≤0.05. Data is presented as mean ± standard deviation.

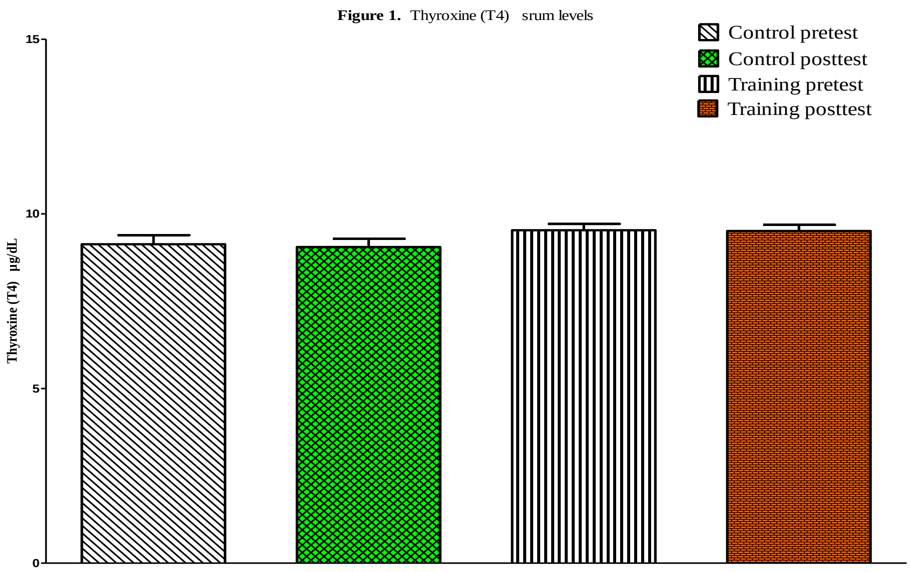

Figure 1: Serum levels of T4

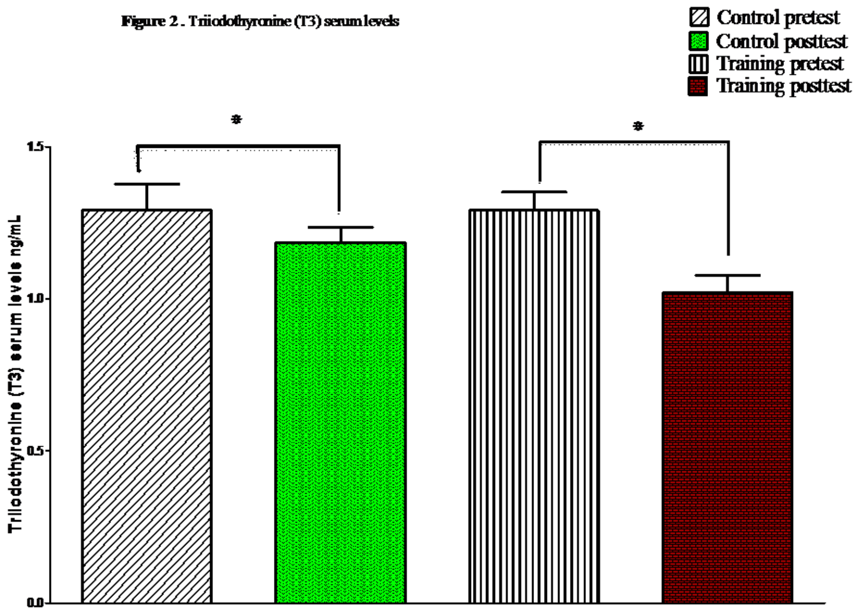

Figure 2: Serum levels of T4

*Significant difference compared with pretest value at P≤0.05.

DISCUSSION

The result indicated that although there is a significant reduction in the biologically active form of thyroid hormone; T3 levels after four weeks of aerobic exercises, but, there were not observed the significant differential effect on other thyroid hormones (T4, TSH, andfT4). There are similar studies to our research such as Onsori and Galedari (2015); Bararpour, Mierzai, Jalalvand, & Chale Chale (2016); Kahani, Baghshani, and Rashidlamir, (2019), Nicoll, Hatfield, Melanson, & Nasin, (2018); Masaki et al., (2019), (Onsori & Galedari, 2015; Nicoll, Hatfield, Melanson, & Nasin, 2018, Kahani, Baghshani, & Rashidlamir, 2019; Masaki et al., 2019) whom reported no changes in thyroids hormone after exercise. But, those researches demonstrated increase in thyroids hormone is similar to present studies such as Kocahan and Dundar (2018), Arbabi et al. (2015), Shin and Kim (2018), Ciloglu et al. (2005). The exercise-induced response and adaptation of thyroid hormones can be related to the type, intensity, duration and frequency of exercise training intervention and also participant's physical fitness levels.

The type of exercise intervention may have different responses and metabolic adaptations. In this regard, Nicoll, Hatfield, Melanson, and Nasin (2018) investigated the pre and post running season thyroid hormone levels in athletic reported although TSH, T3, and T4 did not change from PRE to POST, but the percent change in T3 had significant correlation with running performance (Nicoll, Hatfield, Melanson, & Nasin, 2018). The same as our finding, Kahani, Baghshani, and Rashidlamir (2019) neither showed that 8 weeks of moderate to high-intensity resistance training did not significantly change the levels of T4, TSH and fT4 (Kahani, Baghshani, & Rashidlamir, 2019). In contrast, Kocahan and Dundar (2018) reported that the levels of TSH and T4were increased in the course of a low (50 meter), moderate (200 meters), and high (400 meters) distance swimming training 20 young men (Kocahan and Dundar, 2018). Masaki et al., (2019) similar to our results reported significant reduction in fT3, TSH, and none change in fT4 after acute aerobic training in middle age hypothyroidism patients and euthyroid subjects (Masaki et al. 2019). Therefore it could be assumed that a short duration of aerobic training alike with the present study can be considered as a potent stimulus of thyroid hormones in response to exercise training.

Exercise intensity can be expressed as a key element in the regulating of physiological and endocrine adaptations following exercise training. The moderate intensity of aerobic training at 70% of maximum heart rate accomplished in the present study can be considered as an important factor for moderate changes in the level of thyroid hormones. Ciloglu et al. (2005) investigated the effects of one bout of low, moderate and high intensity bicycle ergometer exercise (45%, 70%, and 90% of maximum heart rate) in 60 young male trained athlete, and demonstrated that moderate exercise performed at the anaerobic threshold induces the most noticeable changes in any hormone levels. Although, the amount of T4, fT4, and TSH continued to increase at high-intensity exercise, the level of T3 and fT3 started to fall (Ciloglu et al., 2005). However, as a result of differences in training duration, gender and physical fitness levels between studies it is difficult to reach a common conclusion regards optimum training intensity that could affect thyroids hormone.

The physical fitness levels of subjects can be another effective factor to influence thyroid hormone levels. Some studies have been investigated the effect of different training intensities and training models in athletes and non-athletes on the level of thyroid hormones. Onsouri et al. (2015) similar to our result reported that there were no significant changes in the plasma concentration of TSH, T3, and T4 after 12 weeks of moderate-intensity (50% to 75% of the maximum heart rate) aerobic exercise in 30 inactive middle-aged obese women (Onsori and Galedari, 2015). Brapour et al. (2016) reported that there was no a significant decrease in T3 and T4 levels following eight weeks of exercise with parasite training in trained officer students (Bararpour, Mierzai, Jalalvand, & Chale Chale, 2016). Shirvani and Sobhani (2016) showed the levels of T3 and T4 hormones were significantly increased after 8 weeks of graded aerobic running within and between athlete and non-athlete groups but, there was no significant difference in the non-athlete group same as our results (Shirvani & Sobhani, 2016).

Obesity and body mass index has recently been reported to correlate with levels of thyroid hormones (Jonklaas and Razvi, 2019). Pankar et al. (2017) studied the effect of four weeks of low-intensity physical activity on thyroid hormones in obese and overweight boys. All samples performed the selected exercise (basketball, football, and walking) for four weeks (three days a week, 60 min). Measurement of TSH, T3, and T4 showed significant differences one day before and after four weeks of low-intensity training, but there were no significant differences in the pre-test and post-test between obese and overweight boys groups ($P > 0.05$) (Pancar, Özdal, & Çinar, 2017). Hence it could be suggested that normal weight and body mass index of present study subject induces minimal to moderate effects of exercise on thyroids hormone, however, it needs to be clear in further studies.

Sleep control and diet of samples were the limitations of this study. The nutritional status can affect the levels of thyroid hormones. Büyükipekçi, Sarıtaş, Soylu, Mistik, and Silici (2018) showed no changes in levels of TSH and fT3 and decreased levels of fT4 after Royal gel and honey in young men young athletes (20 to 25 years) (Büyükipekçi, Sarıtaş, Soylu, Mistik, & Silici, 2018).

CONCLUSIONS

Based on the results it has reveal that the four week of moderate-intensity aerobic training induces moderate to non-effects on levels of thyroid hormones in inactive adolescent girls, which it could be due to the short duration of the training program, the training intensity and normal body weight and body mass index of participants. It is necessary to consider variables such as type, intensity, time of exercise training as a non-pharmacological strategy that influences metabolic and hormonal adaptations in future research.

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Conflict Of Interest

The authors declare that there is no conflict of interest regards the manuscript.

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