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Research Article

Investigation of the Effect of volleyball Training on Thyroid Hormones and Lipid Metabolism of Athletes

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ABSTRACT

This research was carried out to determine the effects of volleyball training and endurance training applied during the competition period on the athletes' trioid hormones and lipid metabolism. A training program was applied to the research group for 8 weeks, three days a week and 80 minutes a day, taking into account the competition schedule and improving their performance and conditional characteristics. In the study, blood samples were taken from the athletes twice in the resting state, before and after the training programs. Thyroid hormones (TSH, T3, T4) and lipid metabolism (Cholesterol, HDL, LDL, Triglyceride) levels were determined in blood samples taken from athletes. As a result of the research, when the thyroid hormones of the athletes were examined, it was determined that there was a significant difference between the pre-post test results of TSH and T3 levels ($p<0.05$), while there was no statistically significant difference at the T4 level ($p>0.05$). When the lipid metabolism of the athletes is evaluated; It was determined that there was a statistically significant difference between the pre-post test results of cholesterol, HDL, LDL and triglyceride levels ($p<0.05$). As a result; It was observed that routine volleyball training and endurance training applied during the competition period made a difference in the thyroid and lipid metabolism of the athletes. We believe that if the trainings to be applied in line with this information are planned considering the physical and conditional characteristics of the athletes, they will contribute positively to their sportive performance.

Keywords: Volleyball, Thyroid hormones, Lipid metabolism, Training

INTRODUCTION

Volleyball is a popular sport that is followed with great interest worldwide. From a physiological perspective, volleyball is defined as an intermittent sport in which players perform high-intensity movements during the match, followed by low-intensity movements, and this cycle is repeated continuously. Volleyball involves movements such as jumping, hitting the ball, fast running, defense, and blocking, and it requires specific physical performance parameters, including both muscular and cardiovascular strength and endurance, to perform these movements and sustain them throughout the match (Closs et al., 2020). Even if volleyball player has excellent technical and tactical knowledge, they must be able to effectively apply and sustain their fundamental motor skills to achieve success (İpek and Ziyagil, 2002; Koç, 1996). Inadequate physical conditioning in athletes leads to early fatigue, negatively affecting the neuromuscular coordination that influences performance at its peak and makes it difficult to execute the desired technical capacity (Temoçin et al., 2004; Herzog, 1996). Therefore, one of the key conditions for achieving success in volleyball is to have optimal levels of physical conditioning alongside technical and tactical skills.

The thyroid gland produces two amino acid-based hormones, T3 and T4, and it secretes the hormone calcitonin. Adults weigh 25-30 grams the thyroid gland, which can reach up to, has the appearance of a butterfly shape and it is one of the largest endocrine glands in the body (Günay et al., 2018). In Our Body the thyroid gland, including below the larynx and in front of the trachea it is located in the upper and front part of the windpipe. This cloth is immediately there is a parathyroid gland on it, which is quite small, but the thyroid and parathyroid glands, the hormones they secrete, and these hormones they differ from each other in terms of their functions (Günay et al., 2018). The thyroid gland is very full of a secretory substance called a colloid it consists of a number of follicles. These follicles, with epithelial cells it was paved. The main component of the colloid is the thyroid hormones, which also contain, a glycoprotein is a triglobulin that is in the structure. The thyroid gland's minute the blood flow is approximately five times the weight of the gland (Guyton et al., 2007). The effects of thyroid hormones on the organism Tuesday, release

It is known that exercise leads to physiological and anthropometric changes in the human body. These changes include a decrease in body fat percentage, an increase in muscle percentage, and factors such as endurance, strength, and power gains (Fry and Kraemer, 1997). It is known that these changes affect performance variables such as strength and endurance and thus have an impact on sporting success (İnce et al., 2020; Ozan et al., 2020). Acute effects during exercise or chronic effects that occur after exercise, along with resulting changes, occur in conjunction with enzymatic and hormonal adaptations (Hackney and Dobridge, 2009). Exercise interacts directly or indirectly with many hormones in our body. During exercise, hormones' secretion, balance, and effectiveness can vary. The effects of exercise on the endocrine system lead to hormonal regulations that have significant effects on athletes' performance (Günay et al., 2018). One hormone that impacts many parameters influenced by exercise is the thyroid hormone (Ciloğlu et al., 2005).

Additionally, it is known that thyroid hormones have effects on basal metabolic rate and protein synthesis. Considering these characteristics, it is believed that the thyroid hormone directly affects many parameters related to exercise and is directly associated with exercise, although the results of studies on its effects vary. Although there is no clear result regarding the sources of these differences, it is believed that they vary according to the type, intensity, and duration of exercise, but more research is needed in this regard.

The energy sources used during exercise and physical activity are carbohydrates and fats. Four main endogenous sources of energy are available during exercise. These include plasma glucose obtained through liver glycogenolysis, fatty acids (FFAs) released from adipose tissue lipolysis, FFAs produced by the hydrolysis of very-low-density lipoproteins and triglycerides, and muscle glycogen and intracellular triglycerides present in skeletal muscle. Fats and carbohydrates are oxidized simultaneously, but their utilization rates during physical activity vary depending on the intensity, duration, and intensity of exercise (Achten et al., 2002).

Hydrophobic lipid compounds are transported in the form of lipoproteins. These lipoproteins differ in size, density, and lipid-to-protein content. They are classified into three main categories: very low-density lipoproteins (VLDL), low-density lipoproteins (LDL), and high-density lipoproteins (HDL) (Aslan and Sarikaya, 2022). When examining the studies, it is generally observed that exercise positively affects lipid metabolism through various mechanisms. However, some studies show the opposite. Furthermore, it has been reported that exercise has beneficial effects on lipid profiles and reduces the risk of cardiovascular disorders, but contradictory results have been observed regarding which type and intensity of exercise provide these benefits (Özhan et al., 2000). These conflicting results are believed to stem from differences in the intensity, type, and duration of the training (Aslan and Sarikaya, 2022; Bülbül et al., 2022). When reviewing the literature, it has been found that endurance training in athletes leads to an increase in muscle glycogen and triglyceride stores and an increase in the enzymes involved in the transport and breakdown of fats (Güldalı, 2018). Therefore, endurance training may have positive effects on the lipid profile of volleyball players.

MATERIAL-METHOD

Research Group

A group of 15 male athletes voluntarily participated in the research, who are licensed in the sport of volleyball in Van province and regularly attend training sessions.

Training Program

During the 8-week period, a training program was implemented for the research group to maintain their performance and improve their conditioning, taking into account the match schedule of three days per week, with each session lasting 80 minutes. The applied training program included warm-up exercises of 10-20 minutes before the training sessions, followed by 35-60 minutes of training focused on technical-tactical aspects and conditioning specific to matches. Cooling-down exercises of 5-10 minutes were performed at the end of each training session. The intensity of the applied training program was adjusted according to the conditioning characteristics of the research group, starting at a maximum intensity of 60-70% and gradually increasing to 75-80% as the competition schedule progressed. The intensity of the training program was determined using the Karvonen method.

Biochemical Measurements

In the study, two blood samples were taken from the athletes in a resting state, before and after the training program. Approximately 7cc of blood samples were collected from the athletes' arm veins using a tourniquet that trained individuals applied to the upper arm. The collected samples were analyzed in a specialized hospital laboratory using specially prepared anticoagulant tubes to determine the levels of thyroid hormones (TSH, T3, T4) and lipid metabolism markers (cholesterol, HDL, LDL, triglycerides).

Statistical Analysis

The data were analyzed using the SPSS 22 software package. Normality tests were conducted to determine whether the data followed a normal distribution, and it was found that the data met the assumptions of normality. Paired samples t-test was used to compare the pre-and post-test data of the research group. A significance level of $p<0.05$ was accepted.

RESULTS

In the first part, the mean values of the data obtained in the research were compared between the groups in the second part and presented and interpreted in tables.

Table 1. Paired Samples t Test Analysis Results of Thyroid Hormones of Volleyball Players

	Pre-Test	Final Test	t	p
TSH	2,12±0,35	2,16±0,35	-4,958	0,00*
T3	3,85±0,12	3,87±0,12	-3,761	0,00*
T4	1,31±0,13	1,27±0,07	1,512	0,15

When the pre-post test results of TSH and T3 levels of the athletes were evaluated in Table 1, it was determined that there was a statistically significant difference ($p<0.05$), while there was no statistically significant difference in T4 level ($p>0.05$).

Table 2. Lipid Metabolism of Volleyball Players Paired Samples t Test Analysis Results

	Pre-Test	Final Test	t	p
Cholesterol(μg/dL)	122,53±10,39	115,60±12,06	2,788	0,01*
HDL(μg/dL)	40,50±3,89	45,57±1,51	-6,049	0,00*
LDL(μg/dL)	65,66±2,73	62,56±3,63	5,293	0,00*
Triglycerides(mg/dL)	83,33±7,49	79,67±5,90	4,746	0,00*

When Table 2 was analyzed, it was determined that there was a statistically significant difference between the pre-post test results of lipid metabolism, cholesterol, HDL, LDL and triglyceride levels of the athletes ($p<0.05$).

When the pre-post test results of TSH and T3 levels were evaluated, it was determined that there was a statistically significant difference ($p<0.05$), while there was no statistically significant difference in T4 level.

DISCUSSION and CONCLUSION

In this study, it is important to examine the effects of endurance training in volleyball on thyroid hormones and lipid metabolism of athletes. Based on the information we obtained, in this study, we aimed to examine the effects of endurance training programs on thyroid hormone levels and lipid profiles in volleyball athletes with a scientifically based approach to understand the physiological requirements of volleyball sport and to improve the performance of athletes. In this way, we sought to answer the questions of how understanding how lipid metabolism and thyroid hormones respond to endurance training programs can help optimize training methods and help athletes perform better. In addition, in this study, we aimed to help us understand the effects of volleyball training on health and to guide health professionals who aim to take measures to protect the health of athletes.

Exercise creates stress for the organism and disturbs the balance of hemostasis. While hemostasis is restored during the recovery process, serious problems arise in cells, organs and hemostasis, especially in hormones secreted during exercise. Many regulatory mechanisms are activated to ensure hemostasis (Philippou et al., 2017). Especially in acute and chronic exercise, thyroid hormone (TSH, T3, T4) release increases. Together with exercise, thyroid hormones improve the endurance of the organism. By affecting the metabolism of proteins, carbohydrates and fats, these hormones increase the adaptation of the organism to the physiological and metabolic changes that will occur as a result of exercise (Elliott-Sale et al., 2018; Louzada & Carvalho, 2018). In this context, thyroid hormones play an important role in meeting the metabolic needs that increase with exercise, and these hormonal changes continue during, immediately after and in the following hours, causing the organism to adapt and ensure hemostasis.

In this study, it was determined that endurance training at Max 60-80% intensity to increase endurance for 8 weeks, 3 days a week and 80 minutes a day for 8 weeks caused a statistically significant increase in TSH and T3 levels ($p<0.05$). However, when we examined T4 levels, it was observed that endurance training did not cause any change ($p<0.05$).

Sullo et al. found that strenuous swimming exercises in rats caused a statistically significant increase in TSH levels similar to the results in our study. Altaye et al. also found a statistically significant increase in TSH, T3 and T4 levels in adolescent children as a result of aerobic endurance exercises performed for 16 weeks (Altaye et al., 2019). In their study, Krotkiewski et al. observed that 12 weeks of aerobic exercise resulted in a statistically significant increase in TSH and T3 values in obese women, while there was no statistically significant change in T4 levels (Krotkiewski et al., 1984). Similarly, Galbo et al. reported in their study on rats that gradually increasing exercise from easy to difficult caused a statistically significant increase in TSH levels, but there was no statistically significant change in T3 and T4 levels (Galbo, 1977). Based on this information and study results, aerobic endurance exercises may increase the secretion of thyroid hormones. However, when we look at the literature, studies are showing the opposite of our results. Bansal et al. reported that aerobic endurance exercise for 1 hour a day for 12 weeks caused a statistically significant decrease in TSH level (Bansal et al., 2015). Onsori and Galadari reported that 12 weeks of aerobic exercise caused a statistically significant decrease in T3 and T4 levels in contrast to our study (Onsori and Galadari, 2015). Similarly, it was found that Pilates exercises for 1 hour daily, 3 days a week for 8 weeks did not cause a statistically significant change in TSH, T3 and T4 values in sedentary women aged 25-40 years (Mehrevar, 2018). Akbulut et al. stated that eight-week tabata training and vitamin E supplementation significantly affected thyroid hormone metabolism (Akbulut et al., 2019). Mustafa et al. reported that there was no statistically significant change in TSH, T3 and T4 levels after exercise (Mustafa et al., 2011). In the literature, there are many studies examining the relationship between thyroid hormones and exercise, which show similar results to the results obtained in our study. However, there are also many studies showing no change in TSH, T3 and T4 levels or showing the opposite of the results we obtained in our study. The differences in the results of studies examining the relationship between thyroid hormones and exercise are thought to be due to variability in internal and external factors, making it difficult to gather the results at a single point.

In this study, the effects of endurance training on lipid profile in volleyball players were examined. Total cholesterol, triglyceride, HDL and LDL levels, which are used as markers in the evaluation of cardiovascular health, were analyzed. As a result of the analysis of the data we obtained, there was a statistically significant increase in HDL levels, known as benign cholesterol, and a statistically significant decrease in triglyceride, total cholesterol and LDL levels, which are accepted as risk indicators if they are high. In line with these results, it can be said that endurance training has positive effects on lipid profile.

When we look at the literature, there are many studies with similar results. For example, in their study, Genç and Bilici reported that there were large differences between the lipid levels between cross-country skiing athletes, one of the leading endurance sports, and sedentary individuals, and that cross-country skiing athletes had higher HDL values (Genç & Bilici, 2019). Similarly, Aslan and Sarikaya reported in their study on rats that aerobic endurance exercises increased HDL levels on lipid profile and caused a decrease in triglyceride, total cholesterol and LDL levels (Aslan and Sarikaya, 2022). In addition, Ulama and Sarikaya reported in their study that 8-week aerobic endurance training caused an increase in HDL levels in the exercise group compared to the control group on lipid profile, similar to our study. In line with this information, it can be thought that endurance training has positive effects on lipid profile, but there are also studies in the literature showing that endurance training has no effect on lipid profile or vice versa. In another study, Erdoğan determined that long-term endurance training had a positive effect on the lipid metabolism and liver enzymes of athletes (Erdoğan, 2022). In their study, Akın and Arıkan reported that endurance training performed 3 days a week for 8 weeks caused a statistically significant decrease in HDL, LDL, total cholesterol and triglyceride levels (Akın & Arıkan, 2020).

The increase in thyroid hormones after exercise and the positive effects on lipid profile have generally been observed in the literature. However, some studies obtained different results with the study results. The possible reasons underlying these differences are due to the variability of internal and external factors. Factors such as duration of exercise, intensity, training program, individual differences, sample size, and study methods may cause differences in results. Furthermore, the complexity of metabolic responses and the influence of other factors involved in the regulation of thyroid hormones may also contribute to the variability of results. In conclusion, while the results obtained in this study generally support the findings in the literature, there are studies with different results. The reasons for these differences are due to a variety of factors and the results may be difficult to generalize. Further research, standardization of methods and careful control of working conditions are needed.

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