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The Effect of Heavy Exercise on Plasma Lipid Levels in Elite Volleyball Male Athletes

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Abstract

It is known that physical activity plays a cardioprotective role. Various types of physical exercise have positive effects on the plasma lipid panel, which generally indicates the risk of cardiovascular disease. The aim of this study is to examine the plasma lipid levels of elite volleyball players who trained heavily for 10 weeks. Male elite volleyball athletes voluntarily participated in the study, who are healthy and between the ages of 18-35 (n=18). Body mass index (BMI) values were calculated by measuring the weight and height of all athletes participating in the study before and after heavy exercise. Before and after the heavy exercise program, blood plasma samples were taken from the athletes for biochemical and hematological analyzes. When the plasma values of the athletes were compared before and after exercise, no statistically significant difference was found ($p>0.05$). It was determined that the total cholesterol (TC) value in the plasma lipid panel of the athletes after heavy exercise decreased ($p<0.05$) and the high-density lipoprotein cholesterol (HDL-C) value increased ($p<0.05$) statistically significantly. There was no difference in low-density lipoprotein cholesterol (LDL-C) and triglyceride (TG) values ($p>0.05$). In conclusion, the increase in HDL-C plasma value and decrease in TC plasma value in elite volleyball athletes after heavy exercise in this study shows that heavy volleyball exercises reduce the risk of cardiovascular disease.

Keywords: Volleyball, Heavy exercise, HDL cholesterol, LDL cholesterol, Triglyceride

Elit Voleybol Erkek Sporcularda Ağır Egzersizin Plazma Lipid Düzeylerine Etkisi

Özet

Fiziksel aktivitenin kardiyoprotektif bir rol oynadığı bilinmektedir. Yapılan çeşitli fiziksel egzersiz türlerinin genel olarak kardiyovasküler hastalık riskini gösteren plazma lipid paneli üzerine olumlu etkileri bulunmaktadır. Bu çalışmada 10 hafta boyunca ağır antreman yapan elit voleybol sporcularında plazma lipid düzeylerinin incelenmesi amaçlanmıştır. Araştırmaya gönüllü ve sağlıklı 18-35 yaş aralığında erkek elit voleybol sporcu katılmıştır (n=18). Tüm deneklerin ağır egzersiz öncesi ve sonrası kilo ve boyu ölçülerek, vücut kitle indeks (BMI) değerleri hesaplanmıştır. Ağır egzersiz programına başlamadan ve egzersiz programı sonrası sporculardan biyokimyasal ve hematolojik analizler için kan plazma örnekleri alınmıştır. Sporcuların egzersiz öncesi ve sonrası plazma hematolojik değerleri karşılaştırıldığında istatistiksel olarak anlamlı fark bulunmamıştır ($p>0.05$). Sporcuların ağır egzersiz sonrası plazma lipid panelinde total kolesterol (TC) değerinin azaldığı ($p<0.05$) ve yüksek yoğunluklu lipoprotein kolesterol (HDL-C) değerinin istatistiksel anlamlı arttığı ($p<0.05$) görülmüştür. Plazma düşük dansiteli lipoprotein kolesterol (LDL-C) ve trigliserid (TG) değerlerinde fark görülmemiştir ($p>0.05$). Sonuç olarak, bu çalışmada ağır egzersiz sonrası elit voleybol sporcularında HDL-C plazma değerinin artışı ve TC plazma değerinin azalması kardiyovasküler hastalık riskini azalttığını göstermektedir.

Anahtar Kelimeler: *Voleybol, Ağır egzersiz, HDL kolesterol, LDL kolesterol, Trigliserid*

Introduction

Exercise is essential for human life (Altınışık and Çelik, 2021), and it also contributes to the developmental dimensions of individuals (Altınışık, İhan and Kurtipek, 2021). It is known that physical exercise plays a beneficial role in preventing the risk of cardiovascular and metabolic diseases (Powers, 2002). In addition to exercises that require low energy (walking, dance, etc.), various individual and team sports that require high energy also play an essential role in protecting cardiovascular health (İslegen, 2007). It has been reported in many studies that exercise has a positive contribution to the reduction of body weight and fat stores and to blood lipid levels (Studd, 2000).

It is stated in various studies that the anti-inflammatory effect of high-density lipoprotein cholesterol (HDL-C) becomes more potent as a result of the implementation of exercise programs and thus is effective in reducing the risk of cardiovascular disease. It is stated in various studies that the anti-inflammatory effect of high-density lipoprotein cholesterol (HDL-C) becomes more potent as a result of the performance of exercise programs and thus is effective in reducing the risk of cardiovascular disease (Yesil and Altıok, 2012; Gunay, 2003; Daglı and Karaca, 2017; Aydın, 2006; Uzun, 2016). Low-density high-density lipoprotein cholesterol (HDL-C) and high-density low-density lipoprotein-C (LDL-C) are atherosclerotic cardiovascular disease risk factors. When the studies are examined, it is observed that a 1% increase in total cholesterol (TC) causes a 2% increase in cardiovascular disease, while a 1% decrease causes a 2-3% decrease in the risk of a heart attack. It has been determined that an 11% decrease in LDL-C level causes a 19% decrease in cardiovascular disease, and a 1 mg/dl increase in HDL-C level causes a 3% decrease in coronary risk (Studd, 2000). Physical activity and exercise, especially aerobic activity, cause a significant increase in plasma HDL-C levels and a decrease in LDL-C levels. It was observed that individuals with low HDL cholesterol levels before exercise had an increase in HDL cholesterol levels after exercise (Tran et al. 1983).

Triglyceride (TG) is the main energy source in physical activity and endurance exercise. Serial measurements by biopsy or magnetic resonance spectroscopy have shown that the intramyocellular triglyceride pool decreases during exercise and post-exercise (Watt et al. 2002; Kiens and Richter, 1998). The fact that this intramyocellular fatty acid oxidation exceeds triglyceride formation during and after exercise suggests that triglycerides are used as a substrate (Kiens, 1993). TG release during exercise also reduces TC and LDL-C levels (Farsani et al. 2011). In addition, it is stated that regular, long-term, and moderate-intensity aerobic exercises reduce TC, LDL-C, and TG levels (Akgün, 1994).

Studies report that exercise can affect various indicators related to the metabolism of blood lipids. It is seen that exercise positively affects cardiovascular health by increasing serum HDL-C levels and decreasing TC, LDL-C, and TG levels. Previous research has shown that blood lipid levels

improve with heavy exercise in trained athletes (Brites et al. 2005, Zmuda et al. 1997, Kaynat et al. 2015). Therefore, heavy exercise may have a positive effect on blood lipid levels also in volleyball athletes. The purpose of this study is to compare plasma TC, LDL-C, HDL-C, and TG levels of elite male volleyball players before and after heavy exercise without weight loss and to examine whether there is a difference between these parameters. The purpose of this study is to compare plasma TC, HDL-C, LDL-C, and TG levels of elite male volleyball players before and to examine whether there is a difference between these parameters after heavy exercise without weight loss.

Method

Research Group

Eighteen healthy athletes aged between 18-35, playing in Tokat Belediye Plevnespor men's elite volleyball team, were incorporated into this study after their written informed consent was obtained. Athletes participated in a 10-week heavy exercise program during their routine exercise training. No dietary restrictions were applied to the athletes. Body mass index (BMI) was counted by measuring the weight and height of all subjects before and after heavy exercise.

Data Collection Process

Heavy exercise training was done in the form of two-hour workouts twice a day, 6 days in a week for 10 weeks. Morning training was done as strength coordination training, and evening training was done in the form of exercise with the ball in the sports hall. Two blood samples were taken from the athletes for biochemical and hematological analysis; before starting a heavy exercise program and after a 10-week heavy exercise program. Blood tests were performed after 12 hours of fasting. 10 mL of blood was collected in heparin by Vacutainer BD system for the biochemical analyses. 4 mL of blood were sampled in EDTAK3 for the hematological analyses. Hematological analyses were operated in an automatic SYSMEX with a flow cytometry spectrophotometric method. The biochemical analyzes were performed on ROCHE COBAS C501 auto analyzers based on spectrophotometry.

Statistical Analyzes

Statistical analyzes were performed using the SPSS 20.0 (SPSS, Chicago, IL, United States) program. The compliance of the parameters with the normal distribution was evaluated with the Kolmogorov-Smirnov test. The dependent sampling t-test (Paired t-test), which is used to contrast the mean values of the numerical data obtained from two dependent groups, was used to contrast the pre- and post-training levels of all parameters. Significance was considered for $p>0.05$.

Results

In this study, the average levels of the physical characteristics; age, height, weight, and body mass index -Body Mass Index, BMI) of the athletes are given in Table 1. There was no statistically significant difference between the body weights and body mass index values of the athletes before and after heavy exercise ($p>0.05$).

Tablo 1

Physical Characteristics of Athletes

	Before Heavy Exercise (n=18)	*After Heavy Exercise (n=18)*	*P value*
Age (years)	23.3±4.8	-	-
Length (m)	1.9±0.1	-	-
Body Weight (kg)	88.8±8	88.7±8	0.823
B.M.I. (kg/m^2)	23±2	23.1±2	0.125

B.M.I. : body mass index; Values expressed as mean±SD; N = number of samples.

The statistical results of the mean ±SDs of hematological and biochemical parameters evaluated before and after heavy exercise of elite volleyball male athletes participating in the study and the differences between the groups are given in Table 2. When the hematological values of the athletes were compared before and after exercise, no statistically significant difference was found between the values of all parameters (erythrocyte (RBC), leukocyte (WBC), hemoglobin (HGB), platelet (PLT) and hematocrit (HCT) (Figure 1. $p>0.05$; $t(18) = 0.141$, $p = 0.889$; $t(18) = 1.88$, $p = 0.148$; $t(18) = 1.376$, $p = 0.187$; $t(18) = 1.516$, $p = 0.148$; $t(18) = 0.199$, $p = 0.844$). When the biochemical values of the athletes before and after exercise were compared, the TC plasma level in the lipid panel decreased significantly. (Figure 2, $p<0.05$; $t(18) = 4.19$, $p = 0.001$). HDL-C plasma level before and after exercise were statistically significant ($p<0.05$; $t(18) = 3.85$, $p = 0.001$). Although the LDL-C and TG plasma levels of the athletes decreased after heavy exercise compared to their pre-exercise values, there was no statistically significant difference between the two groups ($p>0.05$; $t(18) = 1.07$, $p = 0.298$; $t(18) = 1.44$, $p = 0.166$).

Tablo 2

The Effects of Blood Sampling on Hematological and Biochemical and Parameters in Athletes

	Before Heavy Exercise (n=18)	*After Heavy Exercise (n=18)*	*p value*
Hematological Parameters			
Erythrocytes (RBC) (10^{12}/L)	4.99±0.66	5.00±0.79	0.889
Total leukocyte count (WBC) (10^9/L)	6.49±0.32	6.01±0.33	0.148
Hemoglobin (HGB) (g/dl)	14.80±0.21	15.07±0.21	0.187
Haematocrit (HCT) (%)	44.20±0.74	45.10±0.86	0.148
Platelets (PLT) (10^9/L)	223.88±13.87	222.16±10.01	0.844

Biochemical parameters			
TC (mg/dl)	159.63±7.91	151.22±7.19	0.001*
HDL-C (mg/dl)	44.62±1.85	49.74±1.54	0.001*
LDL-C (mg/dl)	92.17±5.76	89.40±5.82	0.298
TG (mg/dl)	66.29±6.03	60.44±6.82	0.166

RBC, erythrocytes; WBC, total leukocyte count; HGB, Hemoglobin; HCT, Haematocrit; PLT, Platelets; TC, total cholesterol; HDL, high density lipoprotein; LDL, low density lipoprotein; TG, triglycerides; Values expressed as mean±SD; N = number of samples. Statistically significant difference between before and after heavy exercise (* $p < 0.05$).

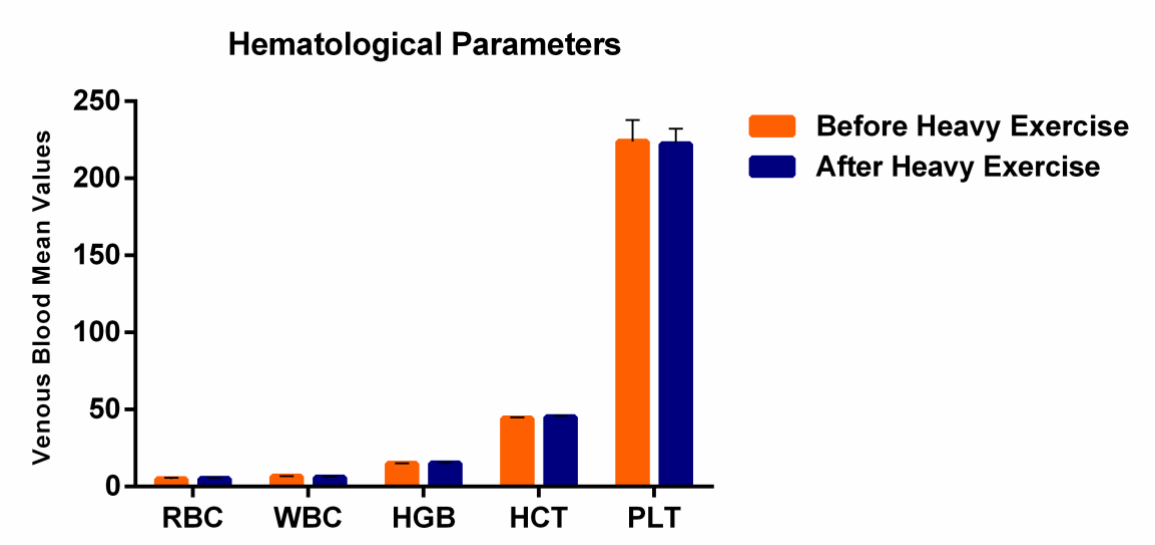

Figure 1

Mean values of the hematological parameters of elite volleyball players before and after heavy exercise (n=18). RBC, erythrocytes; WBC, total leukocyte count; HGB, Hemoglobin; HCT, Haematocrit; PLT, Platelets.

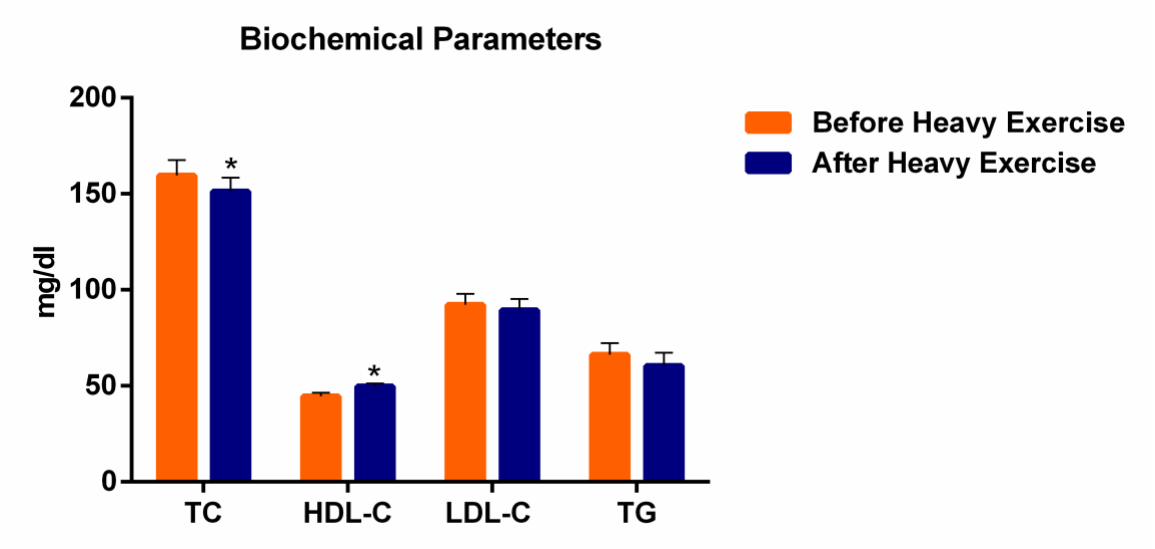

Figure 2

Mean values of daily life of elite volleyball players before and after exercise. * $p < 0.05$ statistically significant difference between before and after heavy exercise (n=18). HDL, high density lipoprotein; TC, total cholesterol; LDL, TG, triglycerides; low density lipoprotein;

Discussion and Conclusion

It was aimed to compare the plasma TC, HDL-C, LDL-C, and TG levels of elite male volleyball players before and after heavy exercise and to examine whether there is a difference between these parameters in this study. The hypothesis of the study is that heavy exercise may have a positive effect on blood lipid levels in volleyball athletes. Volleyball is defined as an interval sport with short periods of exercise and rest intervals (Turnagöl, 1994; Lale et al. 2003). Volleyball training is an important factor that directly affects the performance and cardiovascular characteristics of athletes (Manna et al. 2012; Erdogan et al. 2017).

Endurance athletes have higher plasma HDL cholesterol levels and lower plasma triglyceride concentrations than sedentary controls (Thompson et al. 1991). In a study, when distance runners and normal subjects who did not exercise were compared, HDL cholesterol levels were found to increase in distance runners (Herbert et al. 1984). It has also been reported that endurance exercise training increases HDL cholesterol and reduces triglycerides in male individuals who have not exercised before (Thompson, 1990).

However, the effects of exercise on lipid metabolism also differ according to the type, duration, and intensity of exercise (Ipekoglu and Balcı, 2016). When the literature is examined, studies with examples are reached, as we have included in the discussion section on the relationship between various training types and serum lipid levels. In the study where Gürsoy (2008) compared the serum lipid profile of students who regularly do sports and sedentary students, he concluded that the TC levels of the students who regularly do sports are lower than those sedentary students, and the HDL-C level of is significantly higher than the sedentary group.

Genc and Bilici (2019), in their study with elite female athletes, determined that long-term endurance training caused an increase in serum HDL-C levels of female ski runners, but had no significant effect on LDL, TG, and TC, which are other serum lipids.

Goksu (2015) showed that the endurance training method applied for 6 weeks caused a decrease in TC and LDL-C values, while an increase in HDL-C values in elite basketball players.

In the study of Kaynar et al., (2015) in which they focused on the effect of short-term exercise (training + match) on serum lipid levels before and after training in elite-level wrestlers, they

concluded that post-exercise HDL, LDL, and total cholesterol levels were higher than pre-exercise levels and there was no significant difference in TG levels after specific exercise.

Koc and Tamer (2008) showed that there was a significant heighten in HDL-C level in serum lipid values of the experimental group compared to the control group when continuous running and interval running were added to the applied training program. Thompson et al., (2004) found that intense exercise causes a decrease in LDL-C and an increase in HDL-C levels values after exercise. When the research results are compared, it is seen that they are parallel.

Witek (2009) examined the TG, TC, LDL-C, HDL-C, and creatinine values in a study focusing on the changes in the blood parameters of elite volleyball players during the competition period. Although the creatinine value in the study decreased considerably compared to the first measurement, it was still high during the competition period. It is seen that HDL-C and TG values decrease during the competition period, while LDL-C and TC values increase gradually. The results of the research and our study findings are not parallel and it is a very rare result in the literature. Witek (2009) associated their findings with the report of Magkos et al., (2006). According to the report; It has been reported that in individuals who are exposed to long-term exercise TG levels decrease when VLDL (low-density lipoprotein) is rapidly eliminated and this result is associated with an increased concentration of intermediate-density lipoproteins (IDL), which are precursors of LDL-C.

Lilic et al. (2009) found that as a result of their research on athletes who were in the 6-month intensive training period, there was no significant alteration in TC and TG levels compared to pre-season but there was a significant increase in HDL-C levels as well as significant decreases in LDL-C levels. When compared with the research we have done, it is thought that the significant changes in the parameters of Lilic et al., (2009) are due to diet program practices as well as training.

It is known that various types of physical exercise generally affect the lipid profile positively, reducing cholesterol, LDL-C and triglyceride concentrations, and increasing HDL-C values. This condition is directly related to cardiovascular health. In parallel with this information, in this study, plasma lipid levels of male elite volleyball players who trained intensely for 10 weeks were investigated. The research results are as follows;

When the hematological values of the athletes were compared before and after exercise;

- There was no statistically significant difference in all parameters (RBC, WBC, HGB PLT, HCT).

When the biochemical values of the athletes before and after exercise were compared;

- TC value decreased significantly in the lipid panel,
- HDL-C values before and after exercise were found to be statistically significant,

- Although LDL-C and TG values decreased after heavy exercise compared to the values before heavy exercise, there was no statistically significant difference between the two groups.

When the literature is examined, based on the results of this research, which is parallel to the findings of many studies; It is seen that 10 weeks of heavy exercise did not cause a change in hematological values in elite male volleyball players, but it caused a significant change in TC and HDL-C values in terms of biochemical values, while it did not significantly affect LDL-C and TG levels. It is thought that the reason for the consequences obtained may be owing to the fact that elite level volleyball players are already at a certain training level and their nutritional habits.

Suggestions;

- Plasma lipid values can be examined by comparing athletes in different branches,
- Changes in plasma lipid levels as a result of intense training of athletes in the same branch and at different levels can be examined,
- By applying a special training and diet program to any specific branch, the plasma lipid values at the end of this period can be compared.

Conflicts of Interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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