



Investigation of the Effects of Volleyball Training on Athletes' Liver Enzymes and Muscle Damage Markers

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Aims: It is seen that regular exercises cause physiological changes in the organism. The effects of such a training are not known especially on liver enzymes and muscle damages. In this regard, this study aimed to determine the effects of long-term volleyball training on athletes' indicators of liver enzymes and muscle damages.

Methodology: 20 male volunteer athletes in volleyball branch participated in the study. In the study, a 12-week training program was applied to the athletes four days a week, and one day intended for conditioning training in each week. Blood samples were received from the athletes for two times when they were resting that was before and at the end of the training. Indicators of liver enzymes and muscle damages of athletes were determined in these blood samples received. The data obtained in this study were analysed by SPSS 22 package program. Paired Samples t-test was used in the comparison of pre-post test data of the study group. Significance level was accepted to be $p < 0,05$.

Results: After the data evaluated, it was determined that there was a statistically significant difference between the pre and post-test results of muscle damage indicators and CK (Creatine Kinase) and CK-MB (Creatine Kinase-MB) values of the athletes participating in the study ($p < 0,05$). Considering the pre and post-test results of the athletes' liver enzymes, a statistically significant

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difference was found to be at LDH (Lactate Dehydrogenase), AST (Aspartate Aminotransferase), ALT (Alanine Aminotransferase) and ALP (Alanine aminotransferase) levels ($p < 0,05$) while there was no statistically significant difference at GGT (Gamma Glutamyl Transpeptidase) levels.

Conclusion: As a result, regular volleyball training was determined to cause changes in the athletes' indicators of liver enzymes and muscle damages. Considering the physiological changes caused by the training programs to be applied, it is thought that the performances of the athletes will be positively affected.

Keywords: Muscle damage; liver enzymes; training; volleyball.

1. INTRODUCTION

A regular and long term training results in physical, functional and physiological changes on an organism. However, the scope of training should be designed well for the development, strengthening and adaptation of physical, functional and physiological changes. Prior studies have reported that the training programs with high intensity and practised three times a week have positive effects on the cardiovascular system and blood parameters of an organism [1]. It has been also expressed that regular training has caused changes on indicators of muscle damage and liver enzymes of an organism, and these changes differed according to the variables of age, gender and the training practised [2,3].

The liver is a metabolic organ with energy metabolism, hormones and many more functional features. In the cells of liver functioning as a metabolic organ, the release of enzymes to blood is provided, in addition to storage, release, condensation of many enzymes. Released from these cells, GGT (Gamma Glutamyl Transpeptidase), ALT (Alanine Aminotransferase), AST (Aspartate Aminotransferase), ALP (Alanine aminotransferase) and LDH (Lactaid Dehydrogenase) enzymes help to specify any damage in the liver. Changes are observed in liver enzyme values during heavy and intensive training, and LDH, AST and ALT enzymes are used commonly in determining a hepatocellular damage [4,5,6].

The muscle damage causes burnout, loss of function, weakness and pain in muscles. The intensity, heaviness and scope of training practised are determinant on the damage occurred. Oxidative stress is observed on an organism, especially during high-intensity training, and this is followed by a muscle damage on an organism, and finally, muscle pains occur during and at the end of an exercise as a response of neutrophils to inflammation. CK, CK-

MB, LDH, AST, ALT are biochemical indicators used during a physiological evaluation of muscle damage in an organism [7,8]. Minimising any muscle damage to be observed in an organism is of paramount importance in providing and maintaining the sportive performance.

It is argued that regular training enables athletes to regulate liver enzymes and to prevent any muscle damage [9,10]. This study aimed to determine the effects of regular volleyball training on athletes' indicators of liver enzymes and muscle damages.

2. MATERIALS AND METHODS

2.1 Research Group

20 male athletes, having a license in volleyball and attending volleyball training regularly, participated in this study. In this research, the effects of volleyball training on athletes' indicators of liver enzymes and muscle damages were investigated.

2.2 Training Program

A training program for eighty minutes of volleyball training, four days a week, was applied to the research group for twelve weeks, one day of which was to work on fitness training. In this training program, the athletes firstly did warm-up exercises for 15-20 minutes, then they made exercises regarding condition or volleyball training for sixty minutes. At the end of these exercises, they did stretching exercises. The training program practised was adjusted in a maximal heart rate of 60-65% level during the study by considering the fitness characteristics of the athletes. The intensity of the training program was adjusted in accordance with the Karvonen method.

2.3 Biochemical Measurements

In the study, blood samples were taken from the athletes twice at rest, before starting and at the

end of training. The athletes in the study group were observed permanently, and they were informed on not using any fortification and drug to affect the metabolism, being careful related to their nutrition, rest periods and sleep patterns, and they were asked to follow these instructions. In order to identify the muscle damage indicators (CK, CK-MB) and liver enzymes (ALT, AST, GGT, LDH) levels in the blood samples received from the athletes in the study group, an average of 7 cc blood samples were taken with sterile injectors as a result of the tourniquet applied to the arm from the arm vein by experts in resting and sitting position. The samples received from the study group were analyzed in a private hospital laboratory using pre-prepared anticoagulant tubes.

2.4 Data Analysis

The data were analyzed by SPSS 22 package program. In order to specify whether inter-group data distributed normally, the normality test (Shapiro Wilk.) was administrated. After determining the normal distribution of data, Paired Samples t-test was utilised for the comparison of the pre-post test data of the research group. Significance level was accepted to be $p < 0,05$.

3. RESULTS

The examination of Table 1 showed that there was statistically significant difference according to the pre-post test results of the CK and CK-MB values of the athletes participating in the study.

According to the pre-post test results of the liver enzymes values of the athletes participating in the study, the examination of Table 2 showed that there was a statistically significant difference in AST, ALT, ALP and LDH levels ($p < 0.05$) while there was no statistically significant difference in GGT levels .

4. DISCUSSION

A regular training cause physiological changes in and organism. In this respect, the effects of regular volleyball training on athletes' indicators

of liver enzymes and muscle damages were determined in this study.

As a result of training, metabolic changes occur in the organism, and changes in cytokine levels, heart, liver and kidneys are seen. All these factors result in muscle damage in the organism due to metabolic and mechanical changes caused by training. These damages in the organism affect the performances of athletes negatively [11]. Significant increases in CK and CK-MB values of the athletes participating in the study were found as a result of the training. In the research carried out by Kaptanoglu et al. [12], they reported that a regular training program and flaxseed supplement led to changes on CK, CK-MB, liver enzymes and some biochemical parameters. Berriel et al. [13] found out changes in CK and stress levels of the volleyball players to whom they applied a 16-week training program during the championship period. In the study conducted by Kan and Karacan [14] on taekwondo player to whom were administrated a twelve-week anaerobic training program, they reported significant increases in athletes' creatine kinase and lactate levels. In their study on the effect of preparation period training on physical performance and biochemical indicators of Brazilian elite male volleyball players, Horta et al. [15] stated that the practised training resulted in changes in the muscle damage indicators of athletes. Erdogan and Sarikaya [16] found that the twelve-week training program they had practised caused changes in CK, CK-MB and element metabolism of athletes. In another study implementing a twenty-eight-day training program, Assunção et al. [17] found that the CK levels of the group to which they provided syzygium cum (SC) nectar supplement remained lower than the CK levels of the control group, and syzygium cum (SC) supplement reduced the indicators of oxidative stress and muscle damage. Soyal and Celik [18] found out significant changes in CK levels and handgrip strength of the judoist who were administrated a strength training of six weeks. These results urged us to consider that the intensity, scope and duration of training to be practised will minimise the muscle damage in the organism.

Table 1. Muscle damage paired samples t test analysis results of athletes

| | Pre Test | Post Test | t | p |
|-------|--------------|-------------|---------|-------|
| CK | 107,45±11,63 | 127,55±9,25 | -14,625 | 0,00* |
| CK-MB | 23,54±3,96 | 27,89±5,30 | -3,798 | 0,00* |

Table 2. Paired samples t-test analysis results regarding liver enzymes of the athletes

| | Pre Test | Post Test | t | p |
|-----|--------------|--------------|--------|-------|
| AST | 24,70±3,04 | 27,75±3,41 | -2,987 | 0,00* |
| ALT | 15,95±2,68 | 14,30±3,31 | 2,176 | 0,04* |
| LDH | 234,45±16,25 | 249,35±18,95 | -6,036 | 0,00* |
| GGT | 13,55±2,52 | 13,80±1,96 | -0,493 | 0,62 |
| ALP | 204,20±13,47 | 198,30±11,66 | 3,678 | 0,00* |

The intensity, scope and duration of training lead to some changes in some enzymes (AST, ALT, ALP, GGT), having important functions in the organism and released by the liver as a metabolic organ. As a result of these changes, metabolic and cellular damages are seen in the organism [19,20]. As a result of the training of the athletes participating in the study, liver enzyme levels; changes in LDH (Lactad Dehydrogenase), AST (Aspartate Aminotransferase), ALT (Alanine Aminotransferase) and ALP (Alanine aminotransferase) GGT (Gamma Glutamyl Transpeptidase) levels were determined. Córdova et al. (2019) investigated the effect of an iron supplement on cyclists' muscle damage, iron metabolism, and cortisol levels in a three-stage race period [21]. They found out significant changes in LDH and cortisol levels, while there was not any significant difference in CK levels. Pancar [22] found out that a four-week training program did not statistically differ in the liver enzymes levels of the participants. Keymasi et al. [23] indicated that an eight-week training program led to positive changes in liver enzymes and body composition of the participants. In the study carried out by Zinvand Lorestani et al. [24], it was stated that a twelve-week aerobic training program caused changes in liver enzymes, thyroid hormone metabolism and anthropometric indices of obese children. Hazar et al. [25] found in their study that there were changes in the AST and ALT, CK and CK-MB levels of athletes in an acute exercise program. Selçuk et al. [26] concluded that a ten-day acute training program resulted in changes in AST, ALT, CK and some biochemical parameters of tennis players. In another study conducted by de Moraes et al. (2018), it was reported that training and N-acetylcysteine (NAC) supplement caused changes in ALT, AST, LDH, ALP, CK and some biochemical parameters, indicators of cell damage and oxidative stress in volleyball players, and N-acetylcysteine (NAC) provided with training would decrease oxidant effect [27]. Akbulut [28] expressed that eight weeks of resistance exercises had important effects on liver enzymes and body composition of participants. Uadia et al. [29] argued that a six-

week training program did not lead to any change in liver enzymes and some biochemical parameters of the participants. In the study performed by Turgut and Sarikaya (2020), it was found out that an eight-week training program caused important changes in liver enzymes (AST, ALT) and lipid metabolism (triglyceride, HDL, LDL and total cholesterol) of participants [10]. Demirci et al. [30] urged that a thirty days of boxing training and quercetin supplement resulted in positive changes in liver enzymes and CK levels. Based on these results, we consider that regular and long-term training programs will have positive effects on liver enzyme levels of the organism.

5. CONCLUSION

As a result; It has been determined that regular and long-term volleyball training affects the liver enzymes and muscle damage markers of the athletes. As a result of these training practised; It was observed that there were increases in levels of LDH, AST, GGT, CK and CK-MB, and a decrease in ALT levels. In the light of this information, we believe that if training programs are designed and applied in different age groups, it will affect the sportive performance positively.

CONSENT AND ETHICAL APPROVAL

The study was carried out in accordance with the Helsinki Declaration. Signed written informed consent was provided from all participants prior to the study. Written ethical approval has been collected and preserved by the author.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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