



## **Strength Development, Muscle and Tissue Damage in Different Training Models**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors TA and VÇ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SÖ and RE managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

**Purpose:** The aim of this study was to determine the effects of during six weeks core and weight lifting trainings on strength development, muscle and tissue damage which may occur.

**Method:** The research group consisted of sixteen volunteers who participated in the same age group. Participants were divided into two groups, core training group (n: 8) and weight lifting training group (n: 8). Participants continued to the program for the group to which the belonged lasted for three days a week for six weeks. Participant's performance measures (Back and leg strength, hand grip strength, vertical jump) were taken and blood samples were taken twice at rest before and at the end of the training sessions. AST, ALT, LDH, CK and CK-MB levels were determined in the blood samples taken. SPSS 22 package program was used in the analysis of the obtained data. Paired samples t test was used for intra-group comparisons.

**Results:** When intra-group analyses are made; there were significant differences in the leg strength, vertical jump, CK and CK-MB values of the weight lifting training group, it was determined that only differences in back and leg strength values occurred in the core training group(p<0,05).

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**Conclusion:** As a result, both core and weight lifting training have led to some improvement in strength parameters. It can be said that especially weight lifting training also causes muscle damage as well as strength development.

*Keywords: Core; strength training; muscle strength; damage.*

## 1. INTRODUCTION

Strength which has a very important function in all sports branches, is one of the basic motoric properties. There are different methods used to improve the strength. These methods are known as activities performed by the individual on his / her own body weight or programs implemented with different types of equipment and devices [1]. Core training and weight lifting training programs are used widely methods among these methods. Core exercises have an important role because of their positive effects on the core region muscles and especially strength development [2]. However, in order to provide improvement in sporting performance, resistance and endurance training for core muscles will be positively reflected in the performance by improving arm and leg strength and increasing the effectiveness in the movements supported by them [3]. In addition, weight lifting exercises are commonly used for all kinds of strength development in sports performance. Trainings for the development of strength can lead to muscle damage, expressed as micro-trauma and micro-injury to skeletal muscle tissue. These damages can cause a decrease in strength, speed and flexibility, and hence performance, depending on the intensity of the activity [4]. The effect on muscle damage is different, as is the level of pain caused by training in different forms. The increase in blood levels of isoenzymes which have been determined as their genetic functions has an important role in determining the damage and the extent of damage. Based on this, muscle damage in humans is determined and associated with elevation in Creatine Kinase (CK) and Lactate Dehydrogenase (LDH) levels [5]. Blood levels of Aspartataminotransferase (AST) and Alaninaminotransferase (ALT) enzymes play a key role in liver, muscle damage and metabolic disorders [6]. Although these aminotransferases (ALT, AST) are specifically known as liver function tests, they do not provide only liver information. AST is primarily found in the liver and heart, but also there are in muscle tissue, red blood cells, pancreas, kidney and brain. Therefore, it is expected that the AST value in the blood will increase in the damage of these tissues. This rise is parallel to the extent of the damage and offers clues about tissue damage

[7]. In this study, we aimed to determine the effects of core training and weight lifting (strength) training on jumping, muscle strength development and some markers related to muscle and tissue damage.

## 2. MATERIALS AND METHODS

### 2.1 Participants

Sixteen male volunteers who do walking exercise for health and 20-24 age group participated in the study. Participants are divided into two equal groups as weight lifting training group (n: 8) and core training group (n: 8) randomly. As the inclusion criteria, it was taken consideration that the participants did not have any injury to be able to participate in the trainings and they did not strength training regularly. As the exclusion criteria, it was determined that the participants had any health problem or injury and did not participate in three training sessions. Before the study, all participants were informed about the study and signed a voluntary consent form. The research was conducted in accordance Human Rights and according to the Declaration of Helsinki. The study was carried out in accordance pre-test post-test model.

### 2.2 Weight Lifting Training group

Weight lifting training program was applied to the participants three days a week for six weeks after two weeks familiarization training. Weights of 65-70% of the 1RM (maximum repetition) values of the participants were performed in a circular training format for six weeks, three days a week, and an exercise program involving both upper extremity and lower extremity muscle groups (chest, shoulder, back, arm, leg). Each exercise unit was applied 15 minutes warming (jogging and stretching), each exercise was performed with 4 sets and 8-10 repetitions. The weights used for weight lifting training were re-designed every week according to the maximum 1 repetition (1RM) of the participants.

### 2.3 Core Training group

The participants did a core training program three days a week for six weeks after two weeks

familiarization training. The study included 8 different forms of exercise. Before the exercises, warmed up for 15 minutes (jogging and stretching), the core exercise program was applied, 8-10 repetitions with intermediate tempo, 4 sets and 15 minutes cool-down.

#### **2.4 Physical Measurements Used in Study**

Following the necessary procedures using TKK 5401 brand hand dynamometer for hand grip strength, using TKK 5402 digital back and leg dynamometer for back and leg strength and using TKK 5406 Jump meter for vertical jump measurements twice before and after the six-week program. Two measurements were taken from participants for each test and the higher measurement was recorded.

#### **2.5 Determination of Muscle and Tissue Damage Markers in Blood Samples**

Blood samples were taken to EDTA tubes in resting condition on morning without breakfast from the participants twice before and after the six-week training program. Blood samples were centrifuged with Nuve NF 400R device at 3000 rpm for 10 minutes and their plasma was separated. AST, ALT, LDH, CK and CK-MB levels in these samples were analysed using Siemens ADVIA 1800 chemistry system.

#### **2.6 Statistical Analysis**

SPSS package program was used for data analysis. Paired samples t test was used to determine the differences in the intra-groups. Significance level was accepted as  $p < 0.05$ .

### **3. RESULTS**

When Table 1 is evaluated; While there were a significant difference in back and leg strength values ( $p < 0.05$ ), there was no difference in right and left hand grip strength, vertical jump, AST, ALT, LDH, CK, CK-MB values ( $p > 0,05$ ).

When Table 2 is examined; While there were statistically significant differences in leg strength, vertical jump CK and CK-MB levels ( $p < 0.05$ ), there was no significant differences in back force, right and left hand grip strength, AST, ALT and LDH levels ( $p > 0, 05$ ).

### **4. DISCUSSION**

In the study, the strength parameters increased by the weight lifting and core training applied for six weeks. However, there was no statistically significant difference in the enzymes associated with muscle and tissue damage in the core training group. It was observed that there was an increase in the amount of enzymes associated with muscle damage in the group who participated in weight training and caused muscle damage. Resistance exercises administered to elderly individuals for six months clearly led to an increase in their strength [8]. Mortan et al. [9] have investigated the effects of resistance exercises on strength gain and hypertrophy in young trained individuals. As a result of the study, they stated that all body resistance exercises performed 4 days a week for 12 weeks increased the strength parameters. These results support the findings of the present study. Similarly, resistance exercises provide strength gain in elderly adults with high inflammatory status [10]. In another study, it was stated that short-term core exercises lead to an increase in strength parameters [11]. Byrne et al. [12] have reported that CK increased more when the number of repetitions of exercise increased and the circulating concentration increased significantly in a short time. In the other study, Coban has found a significant increase in LDH values with exercise [13]. The effect of maximal strength training on muscle damage and muscle pain and the relationship between pain and damage were investigated and it was found that maximal strength training caused significant muscle damage [5]. Nazari et al. [14] have examined that the effects of resistance exercises on strength performance and markers of muscle damage in active girls. As a result, they stated that resistance exercises increase strength. They also stated that resistance exercises increased LDH level but did not change CK level. In different research, it was reported that exercise affects muscle damage markers [15]. It was concluded that combined aerobic and resistance exercises performed three days a week for 8 weeks had positive effects on liver enzymes in individuals with Nonalcoholic fatty liver disease [16]. Shamsoddini et al. [17] have emphasized that aerobic exercise and resistance training lead to decreases in AST and ALT values. In our study, while weight training increased the AST and ALT levels, there was no change in core group. It was think that to be a difference from the scope of exercise. In another study,

**Table 1. Comparison of pre-post test values of core training group**

Variables	Pre tests		Post tests		p
	Mean	Sd	Mean	Sd	
Back Strength	98,500	15,62	127,400	17,55	0,008*
Leg Strength	97,300	16,44	127,200	19,04	0,037*
Right Hand Grip	45,700	6,77	48,600	8,61	0,486
Left Hand Grip	44,400	9,28	46,600	8,26	0,526
Vertical Jump	39,000	3,16	45,800	8,13	0,125
AST	18,20	11,05	30,60	1,92	0,065
ALT	23,20	7,266	28,60	8,927	0,218
LDH	164,60	30,65	198,80	12,52	0,106
CK	181,00	67,44	241,18	53,78	0,161
CK-MB	19,80	1,86	22,20	1,92	0,790

\* $p < 0,05$ . Sd: Standard deviation, AST: Aspartataminotransferase ALT: Alaninaminotransferase LDH: Lactate Dehydrogenase CK: Creatine Kinase CK-MB: Creatine Kinase Myocardial Band

**Table 2. Comparison of pre-post test values of weight lifting training group**

Variables	Pre Tests		Post Tests		p
	Mean	Sd	Mean	Sd	
Back Strength	127,125	28,63	132,750	35,03	0,648
Leg Strength	111,750	41,36	140,750	38,16	0,026*
Right Hand Grip	43,750	5,37	47,400	2,99	0,177
Left Hand Grip	44,500	5,44	46,075	5,53	0,067
Vertical Jump	47,500	3,78	51,000	3,55	0,001*
AST	16,50	5,19	23,50	3,69	0,098
ALT	15,25	4,50	21,25	1,50	0,066
LDH	161,00	27,37	185,75	18,71	0,201
CK	255,00	97,74	279,50	95,26	0,028*
CK-MB	17,00	6,63	23,00	7,39	0,024*

\* $p < 0,05$ . Sd: Standard deviation, AST: Aspartataminotransferase ALT: Alaninaminotransferase LDH: Lactate Dehydrogenase CK: Creatine Kinase CK-MB: Creatine Kinase Myocardial Band

increases in AST and ALT values were observed after acute swimming exercises [18]. In a different study, it has been shown that increases in AST and ALT values occur with short-term regular exercises [19]. Uadia et al. [20] have reported that 6-week physical and flexibility training increased the AST and ALT values in Nigerian youth as different from present study. In a study, it was emphasized that regular exercises affect many biochemical parameters [21].

## 5. CONCLUSION

As a result, it can be said that both core training and weight lifting training lead to improvement in some strength parameters but especially weight lifting training leads to muscle and strength development as well as muscle damage. This study was conducted on sixteen young male participants. This situation can be considered as a limitation for the research. Future research could be applied to individuals of different gender, age groups and different levels of

physical activity. Scientific studies with higher numbers of participants may provide more important information and data on strength development and associated muscle and tissue damage markers. Despite the limitations, current research results show that regularly applied core and weight lifting trainings are particularly effective in strength development. In conclusion, it could be said that these training models might be beneficial for young male individuals

## DISCLAIMER

This study was presented as oral in 16. International Sport Sciences Congress, 31 Oct.- 3 Nov 2018 Antalya/TURKEY.

## CONSENT AND ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval (the Declaration of Helsinki) has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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