

Effect of Short-Term Plyometric Exercises on Element Metabolism in Adolescents

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Abstract

The aim of this study is to examine the effects of short-term plyometric exercises on element metabolism in adolescent males. For this purpose, a total of 24 volunteer men between the ages of 16-18 who do not exercise regularly participated in the study. Before the study, the groups were randomly divided into two groups as control group (n: 12) and exercise group (n: 12). Blood samples were taken from both groups before the study and one day after the end of the study for elemental determination. Sodium, potassium, phosphorus, magnesium, calcium and iron levels were analyzed in blood samples. No application was made to the control group. The individuals in the exercise group were given a 60-minute plyometric exercise program, three days a week for four weeks, with jump intensity varying between 180-270 ground contact. In the findings obtained, calcium and iron levels were found to be significant in favor of the post test in the exercise group ($p < 0.05$). Considering the difference between the groups, a statistically significant difference was found in favor of the exercise group ($p < 0.05$). No significance was found in the control group ($p > 0.05$). As a result, we can say that plyometric exercises applied for four weeks affect calcium and iron levels in element metabolism.

Keywords: Element, Adolescent, Plyometric

Introduction

Physical and physiological fitness is required for a successful performance in sports. Unless the physical and physiological characteristics of the athlete are suitable for the sport branch, the desired sportive performance cannot be achieved completely (Zorba, 2014). Physical structure will be positively affected when combined with other performance variables such as strength, strength, flexibility, speed, endurance (Açıkada and Ergen, 1990; Özdal et al. 2019). Since ancient Greece, coaches and athletes have tried to discover techniques to improve speed and strength. It is the combination of power, speed and strength that forms the core of many sports. While explosive movements are applied to improve the speed of the

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athlete, a system has been developed to activate the explosive reaction later. This method, called pliometric, aims to increase the explosive reaction of the athlete with strong muscle contraction as a result of rapid eccentric contraction. In summary, pliometric studies consist of explosive movements that will bring the muscles to the level of maximum power generation in the shortest time (Bayraktar, 2006).

In order for the metabolic functions in the body to continue within normal limits, some elements must regulate the blood and tissues. Vigorous physical activity can increase the energy conversion rate in skeletal muscle severally, and this increase can alter the levels of elements in the blood in various ways (Maughan, 1999). Among these elements, potassium, sodium, phosphorus, magnesium and calcium are considered to be very important for metabolic balance in sports and physical activity since they participate in the structures of various bone elements, nucleic acids, cell membranes, proteins and enzymes (Maughan, 1999).

For this purpose, it has been an issue of how the short-term plyometric exercises in adoleucan men will affect the element metabolism.

Methods

Experimental design

This study is a randomized, experimental study with a control group. Inclusion criteria were determined as being healthy, not having a chronic disease, not doing regular sports. Four-week pliometric studies were performed at the same time, three days a week. We asked individuals not to engage in strenuous physical activity other than exercises.

Subjects

Healthy and volunteer individuals who did not exercise regularly, were selected from male adolescents who were educated in a high school for the study. For this purpose, a total of 24 volunteer males between the ages of 16-18 were selected for the study. The average age of the individuals participating in the study was 17.00 ± 0.72 years; average height was recorded as 168.80 ± 3.25 cm and body weight as 71.15 ± 1.78 . Voluntary consent was obtained from the students, as well as an informed parent consent form from the parents. The measurements of the subjects were taken one day before the training programs started and one day after the end of the training program.

Exercise Protocol

The exercise program applied is presented in Table 1. Four-week jump training, 60 minutes three days a week, continuing with the intensity of jumping between 180-270 ground contact count A program was prepared in which 1-2 minutes rest breaks between sets and 3-4 minutes between sets were given and gradually increasing number of leaps (Pancar et al. 2018).The pliometric training program was conducted by literature review (Ateş, Demir and Ateşoğlu, 2007; Reyment et al. 2006) and an exercise program suitable for this age group was prepared.

Table 1. Weekly exercise program

W	1. day	2. day	3. day
1	Jump rope 2x10 Double leg forward bounce 2x10 One leg forward bounce 2x10	Double Leg Splash 2*10 Double Leg Bounce Using Handles 2*10 Hexagonal work	Jump rope 2x10 Double leg forward bounce 2x10 One leg forward bounce 2x10
2	Jump rope 2x10 Pushing the Body Up by Changing the Legs 2x10 Double foot pulling knees bounce 2*10	Leap forward over funnel 2x10 Change direction with long jump 2x10 Side jump over obstacle 2*10	Double foot pulling knees bounce 2x10 Jump rope 2x10 Double leg forward bounce *10
3	Jump rope 3*10 Double leg jump from ground to case 3x5 Double Leg Splash 3x10 With Arms	One leg forward bounce 3*10 Double Foot Bounce Using Handles 3*10 Change direction with long jump 3*5	One leg forward bounce 3x10 Double leg forward bounce 3x10 Jump rope 3x10
4	Jump rope 3x10 Bounce from the ground to the case 3x10 Hex work 3x10	Change direction with long jump 3x10 Leap forward over funnel 3x10 Double feet pulling the knees to the abdomen 3x10	Hex work 3x10 double foot splash 3x10 to the case Jump rope 3x10

Blood Test Procedure

Venous blood samples in the amount of 5 ml were taken from the subjects participating in the study before the study and one day after the end of the study in the central laboratory of Gaziantep University Faculty of Medicine between 09:00 and 10:00. Sodium, potassium, phosphorus, magnesium, calcium and iron levels were analyzed in the blood samples taken at the end of the study. All samples were centrifuged at 4000 rpm for 5 minutes in a Nüve brand centrifuge and serum samples obtained were studied in a Beckman Coulter autoanalyzer and the results were recorded.

Statistical analysis

SPSS 22.0 (SPSS Inc., Chicago, IL, USA) program was used for statistical analysis. Values were represented as mean and standard deviation, and significance was set at 0.05. Kolmogorov-Smirnov test was performed to assess normality, and 2x2 mixed-factor analysis of variance and least significant difference tests were performed to analyze intra- and intergroup differences.

Results

The data obtained are shown in Table 2 as mean and standard deviation. Although changes in sodium, potassium, phosphorus and magnesium levels were detected in the exercise group in the findings obtained at the end of the study, these changes were not statistically significant ($p > 0.05$). On the other hand, a significance was found in calcium and iron levels in favor of the exercise group ($p < 0.05$).

Table 2. Statistical analysis of the data of the control and exercise groups

		Control G. Mean+SD	Exercise G. Mean+SD
Sodium (mmol/L)	Pre-test	142.75±1.49	143.63±3.34
	Post-test	143.63±2.20	145.13±1.36
	Difference	1.88±2.03	1.50±3.96
Potassium (mmol/L)	Pre-test	4.75±0.32	4.89±0.47
	Post-test	4.93±0.54	4.80±0.36
	Difference	0.17±0.67	-0.09±0.57
Phosphorus (mg/dL)	Pre-test	3.35±0.37	3.54±0.57
	Post-test	3.53±0.80	3.49±0.78
	Difference	0.18±0.72	-0.05±0.59
Magnesium (mg/dL)	Pre-test	2.10±0.11	2.14±0.14
	Post-test	2.16±0.32	2.08±0.21
	Difference	0.06±0.31	-0.06±0.24
Calcium (mg/dL)	Pre-test	10.00±0.29	10.33±0.30
	Post-test	10.13±0.34	9.94±0.30 ^A
	Difference	0.13±0.42	-0.39±0.30 ^B
Iron (ml/ng)	Pre-test	126.38±29.62	115.25±41.30
	Post-test	124.25±24.64	137.25±45.22 ^A
	Difference	-2.13±38.17	22.00±55.26 ^B

SD: Standard deviation, A: significant difference between pre-test and post-test, B: different significance from control group; Significance at $p < 0.05$ level

Discussion and Conclusion

In this study conducted, a four-week plyometric exercise program applied to adolescent men created a significant change in calcium and iron levels when compared to the control group. It did not cause a significant change in sodium, potassium, phosphorus and magnesium values.

Physical, physiological, psychological and motoric features of individuals who exercise are said to be positively affected and developed (Fox et al. 1999). Exercise creates stress in the human organism, this stress also creates a variety of physiological and metabolic effects in the human body. One of these effects is changes in the blood (Hazar and Yılmaz 2008). The body mineral content consists of 2 % sodium, 5 % potassium and 3 % chlorine. Sodium, chlorine and potassium are present in whole body fluids and tissues. The most important functions of these elements in the body balance, acid-base balance and muscle to ensure the regular operation. Sodium, chlorine and potassium are absorbed in the small intestine and excreted in urine, feces and sweat. In such cases it is necessary to remove the minerals thrown away. The average 20-28 grams of magnesium in the human body is found in 60% of the bones, 27% in the muscles, 13% in the other tissues and body fluids. Magnesium has duties in the body such as energy metabolism, regular functioning of the muscle and nervous system, formation of bones and teeth, regulation of blood pressure (Samur, 2008).

Elements exist in nature in different forms, and these elements are essential for the body to perform different functions. Most elements mediate vital reactions by acting as cofactors or catalysts (accelerators of chemical reactions) for many enzymes. In our study, a statistically significant difference was found in the exercise group compared to the control group in terms of iron levels. In a study, it was found that exercise done until daytime fatigue did not cause a significant change in iron, zinc, manganese, boron, copper and nickel values in serum when compared with pre-exercise values (Gülınar and Ünsal, 2018; Erdoğan and Sarıkaya, 2020; Turğüt and Sarıkaya, 2020; Pancar et al. 2018). Insufficiency of iron, which is an O₂ binding molecule of cytochromes and cofactor of many enzymes, directly leads to hemoglobin deficiency and causes a decrease in exercise performance through the heart and muscular system. Therefore, it can be said that there is an important relationship between physical performance and iron (Maughan, 1999). Iron plays a role in binding, transporting and releasing oxygen. Some of the trace elements control important biological processes in protein formation involved in life processes. Trace elements are essential for cell functions at the biological, chemical and molecular levels. Phosphorus has roles in physical exercise, such as maintenance of metabolic balance, energy metabolism, and cellular respiration (Speich et al. 2001). It has been reported that long jogging exercises performed in high temperature and humid

environment cause an increase in plasma sodium and potassium levels, while it results in significant suppression in magnesium levels (Singh and Sirisinghe, 1999). At the same time, it has been emphasized that regular and programmed plyometric exercises positively affect performance in branches such as football, volleyball, basketball, and handball where jumping is prominent (Reyment et al. 2006).

In our study, in terms of calcium, plyometric exercises applied to the exercise group increased calcium levels. Considering the exercise-calcium relationship, it is noted that very vigorous exercise can increase calcium loss (Maughan, 1999). As a result, we can say that plyometric exercises applied for four weeks affect calcium and iron levels in element metabolism.

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