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THE EFFECT OF PLYOMETRIC TRAINING ON ATHLETIC PERFORMANCE AND OXYGEN SATURATION IN YOUNG MALE BASKETBALL PLAYERS

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Abstract:
The aim of the study is to examine the effect of plyometric training on athletic performance and oxygen saturation in young male basketball players. 22 male basketball players who regularly practice basketball participated in the study. Participants were divided into two different groups as the experimental group (n:11 age: 20.41±3.27) and the control group (n:11 age: 21.78±2.32). A plyometric training program was applied to the experimental group 3 days a week for 6 weeks. Both groups continued their normal basketball training. Exercises known as drop jump, box jump, squat jump, split squat jump and overhead slam were applied to the plyometric training group. Anaerobic power, speed (20 m), flexibility (sit and reach) and oxygen saturation (SpO_2) values were measured before and after the plyometric training. SPSS 22.0 package program was used for statistical evaluation. Shapiro-Wilk test was used for the normality of the data. Paired Sample t-test was used for within-group comparisons for statistical analysis of the data. The significance level was applied as $p<0.05$. Anaerobic power, speed, flexibility, and SpO_2 values of the experimental group were found to be significant at the $p<0.05$ level. The values of the control group were not significant ($p>0.05$). As a result, it can be said that the 6-week plyometric training program applied to young male basketball players has a positive effect on athletic performance and SpO_2 values.

Keywords: plyometric training, basketball, athletic performance, oxygen saturation

1. Introduction

Examining the factors affecting the performance level of athletes in different branches has been a broad research topic in sports science. The main purpose in sports branches is to increase the performance of the athlete by improving motoric features. Researchers

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conduct research on athletes in terms of physical, physiological, and psychological aspects of the development of physical performance (1).

Strength, anaerobic power, balance, and speed are important basic factors for athletic performance in basketball (2). Various training methods have been used to improve athletic performance in basketball players (3). Plyometric training is one of the most used methods (4). Plyometric exercises consist of components such as strength, explosive strength, and speed (5). During plyometric training, a stretching event occurs in the tendon and connective tissues. This gives rise to potential elastic energy. Along with this energy, it is stored in the eccentric contraction, and great power is released during the concentric contraction with the effect of gravity (6). It has been stated that the development of parameters such as vertical jump and balance with plyometric training affects performance in basketball positively (7). It is important to develop skills such as balance, speed, flexibility, vertical jump, change of direction, and quickness for athletic performance in basketball. Plyometric training is examined within the scope of sports science with many athletic performance parameters such as power, strength, sprint, and vertical jump. Plyometric training may be the most effective way to improve the physical capacity of athletes (8). The plyometric training program can contribute positively to basketball players with effective muscle contractions. Adding plyometric exercises can be considered as an alternative training method in basketball.

Oxygen is carried in the blood with a large amount of hemoglobin throughout the body. Oxygen saturation is the ratio of oxygen in the blood to hemoglobin (9). Oxygen saturation in the blood and the factors that play a role in the oxygenation of the body during exercise and training have been an interesting research topic in sports sciences.

The aim of this study is to examine the effect of plyometric training on athletic performance and SpO_2 in young male basketball players and to make suggestions to trainers and athletes for training planning.

2. Methods

2.1. Study Protocol

A total of 22 male basketball players aged 18-23, who regularly practice basketball, participated in the study voluntarily. The subjects were divided into two groups the experimental group (n=11, age: 20.41±3.27) and the control group (n=11, age: 21.78±2.32). Both groups continued their normal basketball training. A plyometric training program was applied to the experimental group 3 days a week for 6 weeks. Anthropometric (height, body weight, body mass index) measurements were taken before the study. Anaerobic power, speed (20 m), flexibility (sit and reach), and SpO_2 values were measured before and after the plyometric training. Participants were asked not to take supplements or do heavy exercise during the study.

2.2. Plyometric Training

In our study, in addition to regular basketball training, the experimental group was given a plyometric training program 3 days a week for 6 weeks. Exercises known as drop jump, box jump, squat jump, split squat jump and overhead slam were applied to the plyometric training group. Plyometric exercises were applied for 3 weeks (3 sets*12 repetitions) and 3 weeks (3 sets*15 repetitions) for 6 weeks. During the plyometric training, 60 seconds of rest was given between sets and 15 seconds of rest between repetitions. Athletes were asked to perform plyometric exercises at the maximal level. Measurements were taken 1 day before the plyometric training program and 1 day after the training (10).

2.3. Body Weight and Height Measurement

The weights of the participants in the study were measured with the help of a metal rod on a scale with 0.1 kg precision, and their height was measured with a digital device (11).

2.4. 20 meters Speed Test

For the speed test, the subjects were asked to run in a straight line as soon as possible in a 20 m field. Active warm-up time was given to the subjects before the measurement. For evaluation, the subjects were given a 3-minute rest break, two trials were performed and the fastest time was recorded (12).

2.5. Flexibility Test

The flexibility (Sit and Reach test) test measures the flexibility of the lower back and front leg muscles. A static sit-and-reach bench was used for the test. The test protocol was explained to the subjects before the measurement. Subjects sat on flat ground and placed the soles of their feet on the measuring bench. Both directories were asked to be side by side. The arms were asked to reach as far as possible. It was waited for 2 seconds at the maximum reach distance. 3 trials were made. The best value was recorded in centimeters (13).

2.6. Vertical Jump Test

The distance the subjects could reach was measured by standing sideways, feet shoulder-width apart, in front of the board determined in centimeters. The subjects were told how to do the test. with legs shoulder-width apart, body close to the wall, and with the pen in hand, they were asked to spring up in one move and put it at the highest point they could touch. The first reach and jump distance were recorded in cm. Three trials were made and the best score was recorded. Lewis formula was used to calculate anaerobic power (11).

2.7. SpO_2 Measurements

Oxygen saturation measurements were made using a pulse oximeter device. Before the measurements, the subjects were informed about the SpO_2 test. The subjects were rested

before the measurement and SpO_2 values were measured by placing the oximeter probe on their index fingers in the sitting position. The value that appears on the digital screen has been saved (14, 15).

2.8. Statistical Analysis

Statistical analyzes of this study were performed with the SPSS statistical program (SPSS for Windows, version 22.0, SPSS Inc. Chicago, Illinois, USA). Shapiro-Wilk Test was applied to determine the normality of the data before statistical operations. Mean and standard deviation values were used as descriptive statistics. Paired Samples T-Test was used for in-group comparisons. Statistical results were analyzed at $p<0.05$ significance levels. The G Power 3.1 program was used to determine the number of subjects participating in the study.

3. Results

Table 1: Descriptives

Variable	Experimental Group	Control Group
	Mean±SD	Mean±SD
Age (years)	20.41±3.27	21.78±2.32
Height (cm)	1.90± 0.63	1.89± 0.84
Weight (kg)	87.62± 6.12	85.52 ± 5.63
BMI (kg/m^2)	24.27± 2.36	23.94± 1.86

Descriptive information of the experimental and control groups is given in Table 1.

Table 2: Experimental group pretest-posttest analysis results

Variable	Pre-test (n:11)	Post-test (n:11)	t	p
	Mean±SD	Mean±SD		
Anaerobic Power (kgm/sec)	157.42±3.62	160.75±5.27	-3.489	**0.001***
Speed 20 m (sec)	3.42±0.37	2.97±0.21	6,157	**0.001***
Flexibility (cm)	35.12±3.72	38.45±3.76	-7.287	**0.001***
SpO_2 (%)	97.12± 0.11	98.9 ± 1.47	-3.621	**0.001***

*$p<0.05$

In Table 2, the comparison of the pre-test and post-test measurement results regarding the data obtained after the plyometric training program applied to the experimental group is given. Anaerobic power, speed, flexibility, and SpO2 values of the experimental group were found to be significant at $p<0.05$ level.

Table 3: Analysis of the pretest-posttest data of the control group

Variable	Pre-test (n:11)	Post-test (n:11)	t	p
	Mean±SD	Mean±SD		
Anaerobic Power (kgm/sec)	156.52±2.52	157.22±2.17	-4.257	0.387
Speed 20 m (sec)	3.21±0.21	3.20±0.19	1.218	0.215
Flexibility (cm)	34.87±6.79	35.52±6.72	-1.895	0.211
SpO_2 (%)	97.65± 0.84	97.81±1.09	-2.159	0.387

In Table 3, shows the comparison of the first and last test measurement results of the control group. No significance was found in the control group parameters ($p>0.05$).

4. Discussion

In this study, after the 6-week plyometric training program applied to the experimental group, a significance level of $p<0.05$ was found in anaerobic power, speed, flexibility, and SpO_2 values. No significance was found in the control group parameters ($p>0.05$).

In sports branches, strength plays an important role in moving fast, changing direction and maximizing jump level during competitions and trainings. Plyometric training methods have an important place in the development of strength in a short time. It is known that these training methods, which provide athletic performance improvement, have a significant effect on vertical jump and anaerobic power (16). In basketball training, plyometric training methods are needed for the development of strength, quick strength, and jumping ability. In addition, these trainings play an important role in the development of the athletic performance of athletes. Recently, plyometric training has been included in strength training (17, 18).

In our study, after the plyometric training program applied to the experimental group, significance was determined in the anaerobic power values ($p<0.05$). In a study conducted on basketball players, a significant increase was found in vertical jump values after 6 weeks of plyometric training (19). In another study, a significant increase was found in the anaerobic power values of the subjects at the end of the plyometric training performed in athletes (20). As a result of 8-week plyometric training performed on young football players, statistical significance was found in anaerobic power values (21). In a study conducted on taekwondo players, an increase was found in anaerobic power and athletic performance values after plyometric training (22). Significant increases were found in vertical jump values after another 6-week plyometric training program on athletes (23). The results obtained in our study are similar to the information given in the literature. In our study, it can be said that the improvement in the anaerobic power values of the experimental group was due to the increase in muscle strength as a result of the plyometric training they had done.

In our study, significance was determined in the speed values after the plyometric training program applied to the experimental group ($p<0.05$). Speed is more limited to development than other motor components. Speed depends on the genetic factors of the

athlete and is an important factor for athletic performance (24). A significant difference was found in the speed values after plyometric training applied to young football players (21). In a study applied to basketball players, an increase in speed values was found after plyometric training (25). In a study conducted on taekwondo players, an increase in speed values was found after plyometric training (22). There are other studies in the literature showing that plyometric training improves speed performance (26, 27). Our study supports the literature. In our study, it is thought that the increase in speed in the experimental group is due to the development of neuromuscular adaptation as a result of regular plyometric exercises.

In our study, a $p<0.05$ level of significance was found in the flexibility values of the experimental group after the plyometric training program. In a study conducted with football players, it was concluded that 10-week plyometric exercises had a positive effect on flexibility values (28). An increase in flexibility values was found after the plyometric training program applied to taekwondo athletes (22). In another study, an increase was found in the flexibility values of the experimental group after 8 weeks of plyometric training (29). Studies in the literature are generally in the direction that plyometric exercises improve flexibility. It is thought that the flexibility development in the experimental group in our study is due to the intermuscular adaptation as a result of plyometric training.

In our study, significance was determined in SpO_2 values after the plyometric training program applied to the experimental group ($p<0.05$). Oxygen saturation is the amount of oxygen in the blood that is transported in relation to hemoglobin (9). Özdal et al. found that 8-week aerobic training had a positive effect on arterial blood hemoglobin oxygen saturation in athletes and sedentary individuals (30). An increase in capillary oxygen saturation was found after the swimming training program in sedentary individuals (31). In another study, it was found that aerobic training applied to judo athletes significantly increased SpO_2 values (32). Our study is similar to the studies in the literature. In our study, it can be said that the significant increase in SpO_2 values as a result of plyometric training in the experimental group was due to the development of respiratory muscle strength.

As a result, it can be said that the 6-week plyometric training program applied to young male basketball players has a positive effect on athletic performance and oxygen saturation. It can be recommended that regular plyometric exercises be added to basketball training programs.

Conflict of İnterest Statement

There are no potential conflicts of interest between the authors of this article.

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