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THE EFFECT OF PLYOMETRIC TRAININGS MADE WITH MEDICINE BALL ON SOME MOTORIC AND ANTHROPOMETRIC FEATURES OF BASKETBALL PLAYERS

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Abstract:
The purpose of this study is to examine the effect of plyometric trainings made with medicine ball on some motoric and anthropometric features of basketball players. The research group (n = 24) was formed by 14-15 year old male basketball players licenced in Kocaeli Development Sports Club. The athletes were randomly assigned to the experiment (n = 12) and control (n = 12) groups. For the experimental group, in addition to the annual basketball training programmes, plyometric training was applied with medicine ball for 3 days a week for 8 weeks. The control group followed only annual basketball training programme. The tests used in the pre and post tests to measure the motor features of the basketball players participating in the study are standing long jump test, 30 m sprint test, hand grip test, sit and reach flexibility test and vertical jump tests. Skinfold thicknesses, girths and widths of the subjects were measured for anthropometric features. When the motor and anthropometric features of the experimental group and the control group were compared, no statistically significant difference was found (p> 0,05). There was no significant difference found in motor features as a results of the intra-group analysis of the experimental group (p>0.05). There was a significant difference found in anthropometric characteristics when the intra-group results of the experiment group was analyzed (p <0,05). In conclusion, it is seen that plyometric trainings with medicine ball have no positive effect on motor features in this age group but have positive effect on anthropometric features.

Keywords: basketball, medicine ball, plyometric, vertical jump

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1. Introduction

Basketball is one of the world's most popular sports. It has been defined that low-intensity movements such as walking and high-intensity activities such as jumping and sprint should be applied intermittently with different variations. The anaerobic suitability in the game has been determined to be important for technical actions such as tactical movements, defense-offensive games and shooting (Moreira et al., 2017, Te Wierike et al., 2014, De Araujo et al., 2014, Delgado-Floody et al., 2017). In addition to the importance of aerobic metabolism throughout the basketball game, each position has its own specific physical and physiological characteristics and requirements. Speed and agility are the basic elements of almost every defense and offensive movement in basketball players' training and matches.

The ability to repeat high-intensity sprints extended with short rest periods is considered a critical performance factor (Delgado-Floody et al., 2017). When basketball matches are carefully watched, it is understood that basketball is a sport consisting of short duration, high intensity, forward, backward, side, upward effervescence and sudden changes in direction and speed. Players move in a high intensity for a period of 30-90 seconds during the match and they are rested in short periods like breaks, free throws (Taşer, 2004).

The relationship between development and motor performance is generally dependent on anthropometric factors and contributes to the development of performance (Saka et al., 2008). In this period, following the development of the adolescents together with the sport, physical and physiological performance tests as well as the selection of talent and evaluating the performance of the athletes, provides the data about the characteristics of the played game (Yüksek and Cicioğlu, 2002). For this reason, it is important to know the motor and anthropometric characteristics of the athletes in these branches and to establish a sportsman profile specific to the sport (Akçakaya, 2009). The ability to produce maximum power in the basketball field in the shortest time is required to achieve high performance. In addition, strength training is an important part of basketball training programs because it improves sporting performance, reduces disability and is highly motivating for athletes (Santos and Janeira, 2008). The strength, which is defined as the ability to resist a resistance or the ability to withstand a certain amount of force against a load, is divided into different classes according to the contraction patterns of the muscles (Bompa, 1998). The force that is defined as the greatest resistance that the muscles can create is a desirable feature for basketball because it forms the infrastructure for conditioning items such as speed and explosion. On the other hand, it is very important that the explosive force, that is application of the produced force as soon as possible, because basketball is a sport of short duration and highly intensive effort (Taşer, 2004). The application of training programs involving plyometric exercises and explosive-repulsive exercises to produce this force at the highest level can improve the quality of the muscular tension-shortening cycle (Bompa, 2013). Strengthening upper and lower extremity muscles, increasing maximal strength, power, anaerobic performance and vertical jump height are the most important physical performance elements desired in the basketball, and plyometric exercises have been shown in studies that have improved all of these elements very well (Günay et al., 1994). In the direction of this information, studies related to the relationship between some motoric and anthropometric features of plyometric study made with medicine ball in adults are found in the literature. However, studies showing the performance of plyometric training with a medicine ball in the 14-15 age group are limited. In this study, it is aimed to determine the changes that may occur in the parameters of vertical jump, flexibility, hand grip strength, speed, standing long jump and anthropometric features of plyometric training performed for 8 weeks with medicine ball in 14-15 age group basketball players.

2. Method

The study group consisted of 24 male basketball players, 14-15 years old, licensed in Kocaeli Development Sports Club and active for at least 2 years. Groups were randomly assigned to control (n = 12) and experiment (n = 12) groups. In addition to the annual basketball training in the experimental group (n = 12), plyometric trainings with medicine ball was done for 8 weeks. The control group (n = 12) only continued their annual basketball training. Team trainings were ignored in the study. Preliminary information was given about the purpose of studying the subjects, and it was explained that the study is based on the principle of voluntarism and that they have the right to leave study whenever they want. Before starting to work, necessary permissions were obtained from the athletes and their families. All training sessions were held at Cahit Elginkan Anatolian High School Indoor Sports Hall. The training was conducted for 3 days a week and 1 hour 50 minutes - 2 hours a day during the days when there is no basketball training for the athletes in the study.

A total of 14 training sessions were organized with health medicine ball. 20 min warm-up part was done before the training. The training consisted of a total of 14 different movements. 2 kg medicine ball was used and movements were made as 3 sets and 10 reps in first four weeks, in the last four weeks 3 kg medicine ball was used and the number of the set was arranged as 4 sets and 8 reps.

1st-3rd-5th-7th weeks movements: lunge, backward lunge, medicine ball backward throw, medicine ball standing chest throw, one hand medicine ball throw, v-sit Russian twist, lunge twist.

2nd-4th-6th-8th weeks movements: medicine ball half squat, medicine ball quarter jump squat, medicine ball lunge, medicine ball sit up throw, medicine ball jumping lunge, medicine ball lateral scoop toss, kneeling overhead medicine ball overhead toss, medicine ball rotational jumping lunge.

Rests between sets are 3 minutes and rest between movements is 5 minutes. After the training was over, 15 minutes of cool-down and stretching were performed. At the beginning of the study, height, weights, vertical jump distance, flexibility, hand grip strength, 30 m sprint time, standing long jump distance, circumference, diameter measurements and skinfold thickness were measured for both groups.

2.1 Data Analysis

Data obtained pre and post test in the study were analyzed in the IBM SPSS Statistics 21.0 package program. The Mann Whitney U test was used for intergroup evaluations and the Wilcoxon test was used for intra-group evaluations. All tests were performed at 95% confidence interval and $\alpha = 0.05$ significance level.

3. Results

Table 1: Comparison of Descriptive Statistics of Age, Height and Weights of Experimental and Control Groups

	Group	N	Mean	Standard Deviation
Age (Year)	Experimental Group	12	14,58	0,51
	Control Group	12	15	0,34
Athlete's age	Experimental Group	12	1,83	0,83
	Control Group	12	2,33	1,43
Height (cm)	Experimental Group	12	170,56	8,15
	Control Group	12	178,41	5,9
Weight (kg)	Experimental Group	12	65,58	8,69
	Control Group	12	68,70	9,26

Table 2: Intra-Group Comparisons of Skinfold Thickenss of Experimental and Control Groups

		Experimental Group Mean±SD	p	Control Group Mean±SD	p
Biceps	Pre-test	5,37±3,54	**0,007***	3,82±1,53	**0,003***
	Post-test	4,70±3,09		4,23±1,37	
Triceps	Pre-test	10,36±6,66	**0,008***	6,30±3,01	**0,002***
	Post-test	8,64±6,23		7,41±3,41	
Subscapula	Pre-test	10,84±6	**0,023***	10,52±4,86	**0,003***
	Post-test	9,48±5,53		11,60±5,26	
Thigh	Pre-test	17,81±8,69	**0,005***	17,85±8,51	**0,002***
	Post-test	15,71±7,92		20,34±9,40	

p<0,05.

When the pre- and post-test results of experimental and control groups are compared, there was a statistically significant difference between all skin fold thicknesses in both groups ($p < 0.05$) (Table 2).

Table 3: Intra-Group Comparisons of Circumference Measurements of Experimental and Control Groups

		Experimental Group	p	Control Group	p
		Mean±SD		**Mean±SD**	
Biceps	Pre-test	25,75±3,33	0,720	27,41±3,60	0,107
	Post-test	25,91±3,82		27,91±3,69	
Forearm	Pre-test	24,83±2,28	0,236	26,41±2,64	0,200
	Post-test	24,41±1,92		27±3,61	
Chest	Pre-test	86,33±7,47	0,877	88,83±7,98	**0,046***
	Post-test	86,84±8,48		89,66±8,34	
Waist	Pre-test	76,66±7,46	0,591	80,91±6,47	**0,011***
	Post-test	76,75±9,04		82,75±7,08	
Hip	Pre-test	92,66±9,35	0,54	92,16±9,09	**0,030***
	Post-test	93,91±9,68		93,25±9,06	
Thigh	Pre-test	52±7,67	**0,22***	51,08±6,74	0,057
	Post-test	53,16±7,33		51,75±6,95	
Calf	Pre-test	36,41±3,52	**0,26***	37,83±5,42	**0,007***
	Post-test	38,41±4,61		39,25±6,26	

p<0,05

When the pre test - post test results of circumference measurements of the experimental and control groups were compared as intra-group, statistically significant were found in thigh and calf circumferences in the experimental group(p<0,05). Also there was a statistically significant difference in the chest, waist, hip, thigh and calf circumferences in the control group (p<0,05).

Table 4: Intra-group Comparisons of Motor Features of Experimental and Control Groups

		Experimental Group	p	Control Group	p
		Mean±SD		**Mean±SD**	
Vertical Jump	Pre-test	40,33±9,67	0,424	38,5±8,67	0,747
	Post-test	40,83±10,42		38,66±9,56	
Standing long jump	Pre Test	170,25±25,76	0,765	175,11±17,54	0,861
	Post-test	171,88±26,12		175,44±18,93	
Sit and reach (right)	Pre-test	18,85±9,41	0,593	21,74±10,37	0,255
	Post-test	16,92±12,48		20,1±11,14	
Sit and reach (left)	Pre-test	18,60±9,09	0,666	18,78±10,76	0,790
	Post-test	17,64±10,61		18,4±11,14	
30m Sprint	Pre-test	5,40±0,78	0,121	5,71±0,98	0,654
	Post-test	5,38±1,12		5,69±1,23	
Hand grip(right)	Pre-test	23,53±14,09	0,388	33,15±7,34	0,844
	Post-test	23,47±16,56		29±14,12	
Hand grip(left)	Pre-test	25,68±11,96	0,084	33,24±6,65	0,105
	Post-test	28,48±9,78		33,45±6,49	

p<0,05

When the pre-test post-test results of the motor properties of the experimental and control groups were examined as intra-group, there was no statistically significant difference (p> 0,05) (Table 4).

4. Discussion and Conclusion

The purpose of this study is to examine the effect of plyometric trainings made with medicine ball on vertical jump, hand grip strength, flexibility, standing long jump, 30-meter-sprint and anthropometric features of basketball players. The weight of the medicine ball used in training according to age groups is similar to the studies in the literature. Santos and Janeira (2008) used 2 kg medicine ball for plyometric training in their study with basketball players aged 14-15 years. Faigenbaum and Mediate (2006) stated that the ideal medicine ball weight for young athletes was initially 2 kg. When the studies for young basketball teams' were examined in literature, it was seen that the mean of height, vertical jump distance and standing long jump distances of the athletes were closer to each other. Jakovljevic et al (2011) found that the mean of height of athletes was 186 ± 9,754 cm and their body weights were 68,72 ± 11,091 when they were working with a group of 14-year-old basketball players. Carvalho et al. (2011) reported that the mean height of the athletes was 177 ± 10,9 cm and the body weights were 67,4 ± 12.9 kg in the study of 14-16 age group young basketball players. In the 14-16 age group, the speed and duration of development may differ for each sport depending on genetic and environmental factors. For this reason, it can be considered that the differences that arise when teams are compared in terms of height averages are due to the development processes. In addition, although these differences seem to be numerical, it has been observed that the average height is close to each other in the studies carried out. Genetic and muscle fibril types play a key role in the development and display of these traits, along with the ability to improve speed, agility and strength. For this reason, these characteristics may vary considerably between athletes.

Yazarer et al. (2004) reported that the vertical jump average of 25 basketball players aged between 11 and 15 years was 39,12 ± 9,54 cm. Savucu et al. (2004) stated that the vertical jump average of the 30 basketball player who constitutes youth team of Fenerbahçe is 50.83 ± 5,26 cm. Baydil (2006) found that the long jump distance of male students of 12-14 age group (Kastamonu City sample) were found as 146,61 ± 16,90 cm. In our study, the difference between the long jump distance of the athletes and the vertical jump distance of the athletes shows that the explosive force characteristics of the athletes vary. In addition, the likelihood of teams pursuing different training models in annual training programs can also be considered as a factor. In the basketball branch, speed is a priority when it comes back to attack and defend. It is important to develop the speed characteristics of basketball players because of their competition features. Jakovljevic et al. (2012) studied 12 and 14-year-olds with basketball players, while 12-year-old basketball players were 30 m. sprint time was 5,25 ± 0,24 sec. In addition, basketball players in the age group of 14 are 30 m. sprint time was measured as 4,92 ± 0,31 sec. In the study performed by Atlı (2009), the athletes' mean of 30 m was found to be 4,88 ± 0,26 sec in basketballers, 4,58 ± 0,06 sec in footballers, and 4,78 ± 0,14 sec in sedanters. In this study, the time of a 30-meter sprint athletes is higher than the literature. The reasons might be because of neuromuscular function difference of the athletes, the slow twitch fibre (Type-1)-fast twitch fibre (Type-2) ratios, genetic factors and the lack of specific trainings for speed and agility. Analyzing these differences by applying aerobic and anaerobic endurance tests can be an important reference for determining the dominant features of athletes. Another motoric feature, flexibility, is a feature that can be seriously improved with general and branching flexibility exercises.

The high elasticity of the athletes directly affects the range of movement and the prevention of injuries positively. The athletes participating in our work have been given general flexibility training in the warm-up and cool-down sections and the development as numerical values has been achieved. In order for this development to take place statistically, these trainings should be continued within the annual training plans. It is thought that the development that occurred in 8 weeks period would be statistically revealed when the flexibility trainings would be spreaded throughout the year. Flexibility is a feature that is considered in almost all branches. Flexibility, which is crucial for activating and accelerating muscle activation, has been investigated in many studies (Metaxas et al., 2009; Bavlı, 2008; Yörükoğlu and Koz, 2007) and included in the warm-up-cooling-down sections. Ahmed (2013) found that upper extremity fatigue in young basketball players caused a significant decrease in hand grip strength and pass accuracy, and suggested training for the upper limb. The main reasons for the decrease in motor skills and technical skills may be the muscular fatigue and the slowing of nerve-muscle conduction due to repeated effort. For this reason, the hand grip strength and the technical characteristic of the branch may have been adversely affected. In our study, development was observed in right hand grip strength and left hand grip strength force but no statistical difference was found. Gaurav, Singh and Singh (2010) found that the biceps skinfold thickness of basketball players was 4.88 ± 1.25 mm, triceps skinfold thickness was 7.48 ± 1.31 mm, subscapular skinfold thickness was 12.55 ± 3.04 mm, suprailiac skinfold thickness 14.77 ± 2.94 mm, calf 13, 07 ± 3,57 mm respectively. Atlı (2009) found that the mean skin fold thickness was 5.53 ± 2.23 mm in biceps, 7.85 ± 3.43 mm in triceps, and 9.22 ± 2.24 mm in subscapula for basketball players. Jakovljevic et al. (2011) stated that 14-year-olds were elite male basketball players had an arm circumference of 24,34 ± 1,97 cm, forearm circumference of 24,58 ± 1,92 cm, thigh circumference of 51,17 ± 4,04 cm, calf circumference of 35,21 ± 2,67 cm.

Gryko, Kopiczko, Mikolajec, Stasny and Musalek (2018) studied the skin fold thicknesses (14.09 ± 0.30 years) of young basketball players according to the position they played. The skin fold thicknesses of the players playing in the guard position were determined as biceps 4,21 ± 1,0 mm, triceps 8,29 ± 1,04 mm and subscapula 6,88 ± 1,45 mm. For the players who played in the forward position, the skin fold thicknesses were found as biceps 3.85 ± 1.07 mm, triceps 7,17 ± 2,02 mm and subscapula 6,61 ± 1,07 mm. The skin fold thicknesses of the players in the pivot position were determined as biceps

5,27 ± 2,15 mm, triceps 10,33 ± 4,7 mm, subscapula 8,97 ± 4,64 mm. It is known that the players who play in the pivot position are longer and heavier than the players who play in the position of guard and forward. Accordingly, the skin fold thicknesses and fat percentage may be higher. Decreasing the skin fold thickness as a result of our study shows that the intensity of the training is appropriate and the stimulus level is optimal. In addition, athletes' nutritional habits and developmental periods may have had a positive impact on the reduction of skin fold thickness. As a result of our study, there was significantly decrease found for biceps skinfold, triceps skinfold, subscapula skinfold, thigh skinfold, thigh and calf circumferences in experimental group ($p<0,05$). For control group, all skinfold measures and increased significantly and chest, waist, hip and calf circumferences. ($p<0,05$).

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