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THE EFFECT OF 8-WEEK PLIOMETRIC EXERCISES ON SOME PHYSIOLOGICAL PARAMETERS OF MALE BASKETBALLERS AGED 10 – 14 YEARS

Muzaffer Selcuk[1],
Vedat Cinar[2],
Mücahit Sarikaya[1],
Salih Oner[1],
Süha Karaca[1]
[1]Yuzuncuyil University,
School of Physical Education and Sports,
Van, Turkey
[2]Firat University, Faculty of Sports Sciences,
Elazig, Turkey

Abstract:
The aim of this study is to review the effect of 8-week plyometric exercises on vertical jump, flexibility, hand grasping force, sit-up, push-up, balance and sprint performances of male basketball players aged 10-14. The study includes 38 basketball players aged 10-14. Basketball players are divided into two groups as experimental group (n=19) and control group (n=19). Experimental group underwent plyometric exercises three days a week for eight weeks along with their regular basketball exercises. Control group only continued their regular basketball exercises. A week before the study and also after the study, vertical jump, flexibility, hand grasping force, sit-up, push-up, balance and 30 m sprint run test measurements have been taken from both groups. For data analysis, Paired Samples T test and Independent Samples T test were used. As a result, among the pretest and posttest measurements, it is seen that regarding vertical jump, flexibility, hand grasping force, sit-up, push-up and balance test, there is significance ($p<0.05$) in favor of experimental group. When the pretest and posttest of experimental group are compared, statistical significance is seen ($p<0.05$) in terms of vertical jump, flexibility, hand grasping force, sit-up, push-up and balance measurements. No statistical significance is seen ($p>0.05$) between the pretest and posttest values of the control group in terms of vertical jump, flexibility, hand grasping force, sit-up, push-up, balance and 30 m sprint. It can be reckoned that 8 weeks of plyometric exercises applied to male basketball players aged 10-14 have positive effects on vertical jump, flexibility, hand grasping force, sit-up, push-up and balance performances.

Keywords: basketball, plyometric, training

1. Introduction

Within the annual exercise plan of athletes, there are many comprehensive exercises applied in order to prepare the athletes for the competitions by developing biomotoric attributes such as body composition, force, velocity, stamina, flexibility, balance and strength (Vural et al., 2017; Pancar et al., 2017a; 2017b; Biçer et al., 2015; Özdal, 2015; 2016; Özer et al., 2017). These exercises which are applied intensely before the season starts, are decreased in terms of intensity during the season and replaced with technical tactic exercises specific to the sports branch (Bostancı et al., 2017). Although this can be an expected application, it may result in decrease in the performance of athletes in terms of biomotoric attributes during the season. Hoffman et al. (1991), in their study in which they compared the biomotoric attributes of basketball players before and after the season of 25 weeks, found that at the end of the season, compared to the pre-season period, there is statistical decrease in terms of maximal squat, vertical jump and velocity performances of athletes. During the season, in order to keep the biomotoric attributes the athlete gains during preparation period, these kinds of exercises should also be applied in addition to the branch-specific exercises. However, the exercise model which can create the desired effect without harming the athlete during season should be defined well. Plyometric exercises are known as the exercise methods which improve the explosive force and enable the fast and effective usage of muscle force (Adams et al., 1992). Plyometric exercises are also defined as the exercises which combine speed and power for explosive, reactive or enhanced power. They are also defined as an exercise type which ensures a faster and more powerful muscle regulation by using the natural elasticity of human muscles and neural tense capacity or myotatic reflexes (Chu 1998). It is possible in the literature to see plyometric exercises defined as effective exercise methods which develop branch-specific biomotoric attributes and which include endeavors appropriate for competition environment specifically for branches requiring force and speed such as jumps, rapid runs and direction changes (Matavulj et al., 2001, Rimmer et al., 2000, Diallo et al., 2001, Reyment et al., 2007). However, regarding the effects of plyometric exercises which are added to the seasonal basketball exercises on biomotoric attributes, there are no studies found in the literature. The aim of this study is to review the effect of plyometric exercises which are added to the seasonal basketball exercises on biomotoric performances of athletes.

2. Material and Method

38 male basketball players aged 10-14, who have been practicing the sport with a license in city of Van voluntarily participated in the study with consent forms obtained from their parents. 19 athletes are selected as experimental group which underwent plyometric exercises and 19 athletes are selected as control group. Random selection is used in defining the groups. The experimental group is scheduled with 3 days a week plyometric exercises in addition to their basketball technique-tactic exercises. Control

group is asked to keep up with their regular exercises. Before the exercise program and also 8 weeks after the program, certain measurements are obtained from the athletes and the difference between pre and posttest values are reviewed.

A. Hand grasping force: Right and left grip force measurements are taken by using Takei brand hand dynamometer.

B. Vertical jump: Takei brand jump mat for vertical jumps and standard meters with 0,1 cm sensitivity for horizontal jumps are used.

C. 30 m sprint test: The participants are kept waiting at start point on measured ground after warmups. With start sign, they run for 30 m with maximal speed. The distance between start and end points is defined with Photocell (New Test 2000). The test is repeated for two times for each participant and the best rank is registered (Sarikaya et al. 2016)

D. Flexibility: For flexibility test, sit-lie test is used. Test device is placed on a plat surface. The athlete is asked to take his shoes off and place his feet on "0" reference point. Measurement ruler is placed to be on -25 cm at the beginning of the test. During measurement, pressure is placed on the athlete's knees in order to prevent their bending. Then, without letting the athlete do intermittent impacts or sudden pushing movements, he is asked to place the measurement board to the furthest possible point by pushing it slowly and in a controlled way. After staying at that point for 2 seconds, the reached distance is registered. The athletes are given two chances. Best rank is saved as the flexibility performance (Sarikaya et al., 2016).

E. Pushups: The athlete is asked to hold the bench from somewhere close to the edges and to keep his feet closed together on the cushion. The body is moved with the angle the arms create in a smooth way. The athlete is asked to lower his body and to bent his elbows until his chin touches on the edge of the bench. And then the arms are asked to move back to the beginning position. Test is not limited with a duration. The athlete performs as many pushups as possible until exhaustion. Every correctly performed pushup is registered.

F. Situps: The athlete is asked to stay in lying back position with his knees bent at 90 degrees, his ankles bent, his soles on the ground and hands clamped together behind the head. The participant's feet are kept still by test team and the test begins with the start sign. For 30 seconds the participant stands and moves back to the beginning position with his forehand exceeding his knee. During this 30 seconds, every correct situp the athlete performs is registered (Sarikaya et al.)

G. Balance: Balance performances are measured with Flamingo Balance Test (FDT). The participants stand on and stay in balance on a wooden balance device of 50 cm length, 4 cm height and 3 cm width. He then bends the other leg from the knee and pulls it towards the hip, holding it with the hand of the same side. While experimental group is staying in balance like this, the timer starts and the athlete tries to stay like this for one minute. When the balance is disrupted, the timer is stopped. When experimental group regains the balance and steps on the balance device, the timer is started again, from where it was left. For one minute, test is continued. When the time is up, every attempt

to regain balance is counted and the number is saved as the score of the test (Sipal, 1989).

2.1 Plyometric Exercise Program

The exercises takes place 3 days a week (Mondays, Wednesdays and Saturdays) and are performed in pool. Relaxing intervals are paid attention to.

A. 1-4 Weeks

- **Pushup:** Pushups are performed in sets of 3 x 8. While doing the pushups, both hands of the athlete must be on medicine ball and the ball needs to touch the athlete's chest.
- **Balanced pushup**: Balanced pushups are performed in sets of 3 x 5. While doing the pushups, one hand of the athlete is asked to be on the medicine ball and the other is on the mat. The purpose of this exercise is to encourage the athlete to ensure shoulder balance.
- **Over head pass**: The athletes are asked to perform over head pass with medicine ball with set of 1 x 30.
- **Waist pass**: The athletes are asked to perform waist pass with medicine ball with set of 1 x 30.
- **Jump squat**: The athletes are asked to perform jump squats with sets of 3 x 8.

B. 4-8 Weeks

In addition to the exercises between 1st and 4th weeks, below exercises are performed.

Jumps:

- **Side jump**: This exercise includes jumping from a platform of 10 cm to the ground, towards right and left with both feet.
- **Squat jump:** This exercise includes jumping above from the squat position after touching the ground with both feet down from the 10 cm platform, with the support of arms.
- **Increased height jump**: Jumping from the ground to platforms of sequenced heights (10, 20, 30 and 40 cm).
- **Decreased height jump:** Jumping from the ground to platforms of sequenced heights (40, 30, 20 and 10 cm).
- **One foot to the left-one foot to the right jump:** Jumps performed using only one foot.
- **Different height jump:** Jumping without touching the ground on platforms of 30, 20, 40, 10, 30 cm.
- **Increased height squat jump:** After jumping to platforms of 10, 20, 30 and 40 cm height, touching the ground and jumping in squat position.

For the statistical data analysis, non-parametric tests of Wilcoxon and Mann Whitney U tests are used.

3. Fındıngs

Table 1: In-group pretest and posttest evaluation

Parameters	N		Control Group Mean ±Ss	Intra Control Group		Experimental Group Mean ±Ss	Intra Experimental Group	
				z	p		z	p
Vertical Jump (cm)	19	Pretest	20,74±7,38	-,874[a]	,382	21,16±8,45	-3,846[a]	,00**
		Posttest	20,47±6,53			26,79±9,06		
Dominant Hand Grip Force	19	Pretest	12,02±4,08	-2,043[b]	,041*	12,16±4,47	-3,824[a]	,00**
		Posttest	12,19±4,14			15,11±6,02		
Non-dominant Hand Grip Force	19	Pretest	10,22±3,61	-,992[b]	,321	10,28±3,80	-3,824[a]	,00**
		Posttest	10,34±3,72			12,89±5,47		
Flexibility (cm)	19	Pretest	10,79±3,10	-,735[b]	,462	11,05±3,31	-3,844[a]	,00**
		Posttest	11,01±2,73			14,42±4,29		
30 m (sec)	19	Pretest	6,21±,56	-2,894[a]	,004**	6,29±,65	-2,487[b]	,01**
		Posttest	6,09±,56			6,26±,66		
Situp	19	Pretest	20,95±3,58	-,257[a]	,797	21,11±3,23	-3,839[a]	,00**
		Posttest	20,79±3,77			26,26±3,80		
Pushup	19	Pretest	6,95±1,68	-1,789[b]	,074	6,89±1,29	-3,852[a]	,00**
		Posttest	7,37±1,95			9,42±1,92		
Balance	19	Pretest	7,02±1,37	-,347[a]	,729	6,79±1,78	-3,552[b]	,00**
		Posttest	6,89±,94			5,21±2,10		

Wilcoxon [a]=Positive Rank[b]=Negative Rank*p<0,05**p<0,01

As can be seen in Table 1, between the pretest and posttest values, dominant hand grip force (p<0,05) and 30 m 30 m (p<0,01) parameters of Control group and vertical jump, dominant and non-dominant hand grip force, flexibility, 30 m, situp, pushup and balance parameters of Experimental group, statistical significance is found (p<0,01).

As can be seen in Table 2, while there is no statistical difference between the pretest values of Experimental and Control Groups (p>0,05); among posttest values, parameters such as vertical jump, dominant and non-dominant hand grip force, flexibility, situp, pushup and balance parameters statistical significance is seen between pretest and posttest values(*p<0,05, **p<0,01).

Table 2: Intergroup pretest and posttest evaluation

Parameters	N		Control Group Mean ±Ss	Experimental Group Mean ±Ss	Intergroup	
					z	p
Vertical Jump (cm)	19	Pretest	20,74±7,38	21,16±8,45	-,102	,918
		Posttest	20,47±6,53	26,79±9,06	-2,062	,039*
Dominant Hand Grip Force	19	Pretest	12,02±4,08	12,16±4,47	-,102	,919
		Posttest	12,19±4,14	15,11±6,02	-2,264	,024*
Non-dominant Hand Grip Force	19	Pretest	10,22±3,61	10,28±3,80	-,365	,715
		Posttest	10,34±3,72	12,89±5,47	-2,337	,019*
Flexibility (cm)	19	Pretest	10,79±3,10	11,05±3,31	--,147	,883
		Posttest	11,01±2,73	14,42±4,29	-2,525	,012*
30 m (sec)	19	Pretest	6,21±,56	6,29±,65	-,161	,872
		Posttest	6,09±,56	6,26±,66	-,657	,511
Situp	19	Pretest	20,95±3,58	21,11±3,23	-,103	,918
		Posttest	20,79±3,77	26,26±3,80	-3,576	,000**
Pushup	19	Pretest	6,95±1,68	6,89±1,29	-,241	,810
		Posttest	7,37±1,95	9,42±1,92	-2,976	,003**
Balance	19	Pretest	7,02±1,37	6,79±1,78	-,401	,688
		Posttest	6,89±,94	5,21±2,10	-2,643	,008**

4. Discussion and Result

When literature is reviewed, many studies are seen regarding the development of different methods to increase forces. In addition to the regular exercises, as stated in these studies as well, different results are obtained in related studies about vertical jump, hand grip force, flexibility, 30 m sprint, situp, pushup and balance performances. In a study which can be seen as similar with this one, Stojanovic and Kostic (2002) reviewed the effect of 8 week plyometric exercises on spike jump, block jump and horizontal jump of volleyball players. In the study, when the jumping values of control group and experimental group are compared, statistical significance is found with experimental group. Toumi et al. (2004) found that rapid and short contractions while doing plyometric exercises have a positive effect on repetitive jump height. Anıl et al. (2001) found that after 8 week of exercise program, when pretest and posttest values of experimental group are compared, values of vertical and horizontal jump, anaerobic power, 30 m velocity, flexibility, body intensity, fatless body weight and body fat percentage showed significant improvement. Kobal et al. (2017) seen that there is significance in dynamic power and vertical jump values as a result of enriched plyometric exercises of different combinations on elite young footballers.

Bereket and Tuncel (1994), put forward that as a result of the effect of plyometric exercises on vertical jump and 20 m run times of female volleyball players aged 16-26, improvement of 20 m run is 0,07 sec. in control group, 0,65 sec. in elite volleyball player

experimental group, 0,30 sec. in average volleyball players. Cicioglu (1995) saw that as a result of the plyometric exercises applied on male basketballers aged 14-15, body fat percentage is 9.33 before exercise program and 8.46 after exercise program. Erol and Sevim, as a result of quick force exercises performed with basketballers aged 16-18, seen a difference in body fat percentage to be 10.96 before the program and 9.69 after the program. As per the results obtained in this study, plyometric exercises caused a decrease in body fat percentage and an increase in fatless body weight. The following results are seen after the applied exercise program: there is significant increase in velocity value of 30 m and vertical jump of the experimental group ($P>0.05$).

Esfangreh (2011) reviewed the effect of 6 week plyometric exercises on dynamic postural control. As a result of the study, it was seen that plyometric exercises served as an increase in dynamic postural control and that it decreased the risk of injury which is frequently seen with athletes. Pancar et al. (2018) reviewed the effect of 8 week plyometric exercises on female handball players aged 12-14. As a result of the study, with flexibility and vertical jumps, a significant increase is seen between pretest and posttest values. Arazi and Asadi (2011) looked into the effect of plyometric exercises performed in the water and on the ground on power, velocity and balance of young basketball players. As a result, plyometric exercises performed on the ground is seen to have a higher effect on dynamic balance. Paterno et al. (2004) found similar results as per their findings.

In conclusion, in this study, it is detected that 8 weeks of plyometric exercises form a program with significant effects in developing values of vertical jump, hand grasping force, flexibility, 30 m sprint, situp, pushup and balance. Additionally, it is believed that further studies to be made in this field of basketball will strengthen this positive effect.

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