APPLYING THE WEEKLY PLYOMETRIC MODEL TO JUMPING AND AGILITY IN YOUNG BASKETBALL PLAYERS

Artan R. Kryeziu

FAMA College, Faculty of Children Care and Welfare,
Center of Research of Physical Education, Sport and Health, Pristina, Kosovo

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Abstract
Applying the weekly plyometric model to jumping and agility in basketball. The paper sample consists of 20 players. With 10 basketball players is the control group and while the second group with 10 basketball players is the experimental group-plyometric, a pre-test and post-test. The control group (CG, n = 10; Height = 171.930 cm, Weight = 70.840 kg, BMI = 20.563), the experimental-plyometric group (EG, n = 10; Height = 173.090 cm, Weight = 64.300 kg, BMI = 19.068). In the univariate analysis of variance (ANOVA) and multivariate analysis of variance(MANOVA), significant differences were shown between the control group (CG) and the experimental-plyometric (EG) group (p <0.05), where as in the other analysis of the results in The final measurement tables of the agility and explosive force indicators showed significant low differences. Almost even in the control group (CG) in the initial and final measurement we have the same values of significant differences. However, it is important to note that in the experimental-plyometric group(EG), there were low significant differences in the initial and final measurement in jumping and agility tests. In conclusion, both groups treated in the initial and final measurement have shown considerable improvement in the performance and agility of the young basketball players.

Key words: *model, plyometric, jumping, agility, basketball.*

Introduction

In basketball, the ability to generate maximal strength levels in the shortest period of time (muscular power) has been considered as essential to obtain high sport performance levels (Jose Almeida Martino de Santos & Janeira, 2008). Moreover, dynamic balance and agility are vital components for the success in basketball players. Two methods, plyometric and resistance training, are usually referred to in the literature as improving the most powerful strength characteristics (explosive strength) in basketball players (Asadi, A, Arazi, H. 2012, Kryeziu, A. Begu, B. Asllani, I. Iseni, A. 2019). Plyometric training usually includes stopping, jumping - off and changing the direction of movement explosively. These moves are the components that can help in the development of agility (Craig, 2004; Miller et al., 2006). Several studies have demonstrated the positive effects of plyometric and resistance training for higher increases in the explosive strength indicators (Brown et al, 1986; Fulton, 1992; Matavuljet al, 2001; Wagner & Kocak, 1997). Plyometrics are training techniques used by athletes in all types of sports to increase strength and explosiveness (Chu, 1998; Saez-Saez de Villarreal et al, 2010). Plyometrics consists of a rapid stretching of a muscle (eccentric action) immediately followed by a concentric or shortening action of the same muscle and connective tissue (Chu, 1998). Moreover, Bal et al. (2011) demonstrated that plyometrics also enhanced agility in young basketball players after 6-weeks training. Although plyometric training has been shown to increase performance variables, little scientific information is available to determine if short-term plyometric training actually enhances speed, agility, and leg muscle power in basketball players. This paper is intended to examine the impact of a 4-week plyometric model on jumping and agility of players in the basketball game. Whereas the other goal is to treat the experimental group which followed the 4 week pilot model in basketball and the differences with the control group.

Methods

Subjects
In this paper participated 20 basketball players from the controllers group (N = 10) basketball players, and in experimental-plyometric group (N = 10) aged 15 +/- 6 months.

Procedures
The sample of variables consists of 13 variables, 3 of which are morphological parameters and 10 motor tests. 1. Body weight; 2. Body mass; 3.Body Mass Index; 4.Standing Long Jump Test; 5.Vertical Jump Test; 6.Approach jump; 7.Running (sprint) 20 meters 8.Abdominal Muscles; 9.Push-ups; 10.T-Test; 11.Illinois Agility; 12.Medicine ball in distance; 13. Sit and reach. Measuring instruments are applied by getting based on the authors (Bal et al., 2011; Asadi et al., 2012).

Training procedure of the plyometric program
The plyometric program lasts about 60 minutes or 480 minutes into four weeks, including 10 minutes warming up and preparing muscles for

45 minutes of plyometric training. 5 seconds off from the interval of exercise, and 2 minutes after exercising. The exercises begun have from May 2, 2016, until May 31, 2016, during the interval time from 17:00^{h}to 18:00^h.

The plyometric model was applied based on the publication of the authors Poomsalood & Pakulanon (2015) which was applied to basketball players into 4 weeks of program training.

Table 1. Plyometric training program.

Training	Training volume	Plyometric drills	Sets × Repetitions	Training intensity
1.	100	Front cone hops	3x12	Low
2.		Lateral cone hops	3x12	Low
3		Standing jump and reach	4x7	Low
1.	120	Lateral cone hops	3x10	Low
2.		Standing jump and reach	5x6	Low
3.		Lateral jump over barriers	3x10	Moderate
4.		Alternate bounding	3x10	Moderate
1.	140	Diagonal cone hops	3x8	Low
2.		Lateral jump over barriers	3x8	Moderate
3		Cone hops with 180 degree turn	4x8	Moderate
4.		Cone hops with the change of direction sprint	4x8	Moderate
5		Single-leg vertical jump	4x7	High
1.	120	Diagonal cone hops	3x10	Low
2.		Cone hops with 180 degree turn	3x10	Moderate
3.		Cone hops with the change of direction sprint	3x12	Moderate
4.		Single-leg vertical jump	4x6	High

Statistical analysis
Data processing methods are applied by the program SPSS version 20 which are applied basic statistical parameters and univariate analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA).

Results

Analysis of variance Multivariate (MANOVA) and analysis of variance univariate (ANOVA) of morphological variables and motor tests between the control and experimental group (plyometric) in the initial measurement.

According to the data in this table no. 3 we see that the standing long jump test and the medicine ball distance test have significant differences of .007, while the vertical jump test has a significant difference of low value .024 between the control and experimental group (plyometric) in the initial measurement.

Analysis of variance multivariate (MANOVA) and analysis of variance univariate (ANOVA) of morphological variables and motor tests between control and experimental group (plyometric) in final measurement.

By observing the table no. 4 where multivariate analysis of variance (MANOVA) of the applied morphological variables and motor variables was presented, between the two groups of testers, significant statistical group differences could be observed in the arithmetic environments of the multivariate analysis of the applied variables. Wilk's lambda is .230, which approximated by F = 3.343, and degrees of freedom df1 = 1 and df2=18, is significant at the level of p = .009.

In the recorded data we see that the agility and explosive force tests of the wings have significantly lower differences between the control and experimental (plyometric) group in the final measurement. Analysis of variance multivariate (MANOVA) and analysis of variance univariate (ANOVA) of morphological variables and motor tests in the control group in the initial and final measurement.

From table no. 6 we can freely conclude that between the two measurements (initial and final) of the test subjects from the control group, there are no significant differences in their multivariate space of the investigated variables. Wilks' lambda is .187, which by approximating F = 4.353, and degrees of freedom df1=1 and df2 =18, is not statistically significant at the level of p = .201.

Analysis of variance multivariate (MANOVA) and analysis of variance univariate (ANOVA) of morphological variables and motor tests in the experimental group (plyometric) in the initial and final measurement
Based on the results shown where the multivariate analysis of variance of the applied morphological variables and motor tests is presented, we can freely conclude that between the two measurements (initial and final), tested by the experimental group (plyometric), there are evident significant differences.

In their multivariate space of the variables investigated. Wilks' lambda reaches .326, which values at approximation of F = 2.072 and degrees of freedom df1 = 1 and df2 = 18 is significant at the level of p = .056.

Table 2. Analysis of variance multivariate (MANOVA).

	Wilks`				
1	Lambda	Rao`s R	df1	df2	P-level
	.051	18.524	1	18	**.007**

Lambda of Wilks is .051 which is worth at the approximation of F = 18,524 and the degrees of freedom df1 = 1 and df2 = 18, is important at the level of p = .007.

Table 3. Analysis of variance univariate (ANOVA).

	Mean Square	**Mean Error**	**F**	**Sig**
Body weight	6.728	95.695	.070	.794
Body mass	213.858	181.784	1.176	.292
Body Mass Index	11.175	11.353	.984	.334
Standing Long Jump Test	432.450	75.028	9.123	**.007**
Vertical Jump Test	192.200	31.533	6.095	**.024**
Approach jump	4.901	800.887	.006	.939
Running (sprint) 20 meters	.052	.384	.135	.717
Abdominal Muscles	22.050	27.383	.805	.381
Push-ups	.050	105.717	.000	.983
T-Test	2.694	1.380	1.952	.179
Illinois Agility	1.540	3.820	.403	.533
Medicine ball in distance	4.214	.456	9.233	**.007**
Sit and reach	100.352	72.966	1.375	.256

Table 4. Analysis of variance multivariate (MANOVA).

	Wilks`				
1	Lambda	Rao`s R	Df1	Df2	P-level
	.230	3.343	1	18	**.009**

Table 5. Analysis of variance univariate (ANOVA).

	Mean Square	**Mean Error**	**F**	**Sig**
Body weight	7.200	97.792	.074	.789
Body mass	144.722	185.869	.779	.389
Body Mass Index	19.052	12.831	1.485	.239
Standing Long Jump Test	30.258	48.984	.618	.442
Vertical Jump Test	2.178	80.946	.027	.872
Approach jump	470.450	699.888	.672	.423
Running (sprint) 20 meters	.018	.172	.105	.750
Abdominal Muscles	16.200	14.889	1.088	.311
Push-ups	.050	148.161	.000	.986
T-Test	6.272	.838	7.481	**.014**
Illinois Agility	19.405	2.502	7.756	**.012**
Medicine ball in distance	3.952	.740	5.338	**.033**
Sit and reach	121.032	68.383	1.770	.200

Table 6. Analysis of variance multivariate (MANOVA).

	Wilks`				
1	Lambda	Rao`s R	Df1	Df2	P-level
	.187	4.353	1	18	.201

Table 7. Analysis of variance univariate (ANOVA).

	Mean Square	**Mean Error**	**F**	**Sig**
Body weight	.364	122.181	.003	.957
Body mass	3.200	151.611	.021	.886
Body Mass Index	1.653	8.780	.188	.670
Standing Long Jump Test	1.458	26.650	.055	.818
Vertical Jump Test	2.738	33.035	.083	.777
Approach jump	.648	511.719	.001	.972
Running (sprint) 20 meters	.362	.185	1.951	.179
Abdominal Muscles	57.800	13.111	4.408	**.050**
Push-ups	252.050	128.161	1.967	.178
T-Test	.260	1.561	.167	.688
Illinois Agility	.058	4.155	.014	.907
Medicine ball in distance	.857	.877	.978	.336
Sit and reach	3.200	77.889	.041	.842

This table does not show significant differences between the control group in the initial and final measurement.

Table 8. Analysis of variance multivariate (MANOVA).

	Wilks`				
1	Lambda	Rao`s R	Df1	Df2	P-level
	.326	2.072	1	18	**.056**

Table 9. Analysis of variances univariate (ANOVA).

	Mean Square	Mean Error	F	Sig
Body weight	.265	71.306	.004	.952
Body mass	.648	216.041	.003	.957
Body Mass Index	.070	15.404	.005	.947
Standing Long Jump Test	378.450	97.361	3.887	**.064**
Vertical Jump Test	115.200	79.444	1.450	.244
Approach jump	610.513	989.056	.617	.442
Running (sprint) 20 meters	.929	.370	2.507	.131
Abdominal Muscles	48.050	29.161	1.648	.216
Push-ups	238.050	125.717	1.894	.186
T-Test	.125	.658	.190	.668
Illinois Agility	8.541	2.167	3.942	**.063**
Medicine ball in distance	.741	.320	2.316	.145
Sit and reach	7.688	63.461	.121	.732

In this table only the jump test and agility test showed statistically significant very low differences in the experimental (plyometric) group in the initial and final measurement.

Discussion and conclusion

The improvement of either vertical-and horizontal-jump performance in basketball players as a consequence of a multipurpose plyometric training intervention (i.e., vertical and horizontal-jump exercises) (Luebbers, PE, 2003). This loaded (i.e., 10-11% of body mass) plyometric training showed to provide a further advantage over the standard (i.e., body mass) condition (Luebbers, PE, 2003). This confirmed our work hypothesis giving evidence that loads (i.e., ca. 10% of body mass) added to dynamic exercise may provide training besides acute benefits over explosive-power performance (Burkett, LN, 2005; Thompsen, AG, 2007).

Vertical jump is a frequent act performed by basketball players as part of defensive (e.g., blocking, rebounding, and stealing) and offensive (e.g., passing, rebounding, and shooting) maneuvers during training and competition (Ziv, G 2009.). A number of observational studies have been performed to gain information on the VJ performance of basketball players (Ziv, G 2009.). Comparison with published papers showed that in this study, CMJ and SJ performances were within the range of those basketball players. It appears that loads added to standard plyometric training program may result in greater vertical and horizontal-jump performances in basketball players (Khlifa, R. 2010). Anaerobic power significantly improved PRE to POST-4 in both groups. There were no significant differences between the 2 training groups. Four-week and 7-week plyometric programs are equally effective for improving vertical jump height, vertical jump power, and anaerobic power when followed by a 4-week recovery period. However, a 4-week program may not be as effective as a 7-week program if the recovery period is not employed (Luebbers PE, 2003). Of the 6-week intervention, results revealed, agility performance were statistically changed across the times in the experimental group. The plyometric training group had a quicker time and reduced time on the ground across the time for the hexagon agility test.

The results that plyometric training could be an effective training technique to improve the agility performance among silatolahraga athletes (Dahlia Al-Syurgawi 2018).

In the paper-experiment the control group and the experimental-plyometric group were treated which were treated in morphological variables (Body weight, Body mass and Body mass index), explosive force tests (Standing Long Jump Test, Vertical Jump Test, Approach jump).One leg and Running (sprint) 20 meters), repetitive-force tests (Abdominal Muscles, Push-ups), agility test (T-test, Agility Illinois**),**explosive force of the upper extremities (Medicine ball in distance) and flexibility test (Sit and reach).

According to what is presented in the plyometric training model we see that it has a positive impact on the accomplishment of important motor tasks, but more important is because the model was deliberately implemented with the effect of the plyometric training process achieved. The jump and agile indicator have some level of improvement in these skills in order to increase the effect of the training process.

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Correspondence to:
Prof. Artan R. Kryeziu, PhDc
Fama College, Faculty of Children Care and Welfare
Center of Research, Studies in Physical Education, Sport and Health - CRSPES
Bajram Kelmendi, 45A, 10000 Prishtina, Republic of Kosovo
Tel: +383 (0) 49 118 998
E-mail: artankryeziu88@hotmail.com