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EFFECT OF THE 12 WEEK PROGRAM FOR DEVELOPING EXPLOSIVE STRENGTHENING IN STUDENTS 'AGILITY AND FLEXIBILITY PERFORMANCE

Original scientific paper

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Abstract

The purpose of this study is to validate the effect of the 12-week plyometric training program on agility and flexibility performances. The research was conducted on a sample of 170 male testers aged 14 years ± 6 months, pupils of "Naim Frasheri" and "Bajram Shabani" elementary schools-Kumanovo, North Macedonia. The sample was comprised of 170 entities, divided into 2 groups: Group A: Experimental group (EG, n=90) the Group B, Control group (CG, n=80). Subjects from GroupA were subdued to a 12-week program for the development of pliometrics, while Group B did not receive special training except regular physical education classes. For evaluating agility and flexibility performances we tested a total of 4 motor variables: 1) T-Test (MTT); 2) Aunt with a bow (MAB); 3. Wounds (MWO) and 4. Sit and reach (MSR). The study had longitudinal character, and lasted a total of 12 weeks, with 36 hours of exercise. Analysis of variance univariate and multivariate (ANOVA-MANOVA) and covariance (ANCOVA-MANCOVA) was used to determine the significant differences between the control and experimental groups in the initial and final measurements. The results of the study after applying the experimental model, in the final measurements, show that all motor variables have statistically significant differences with (p=0.005) between the control and experimental groups. According to data from the one-way analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA), no significant differences were shown in any of the tests. While univariate analysis of covariance (ANCOVA) and multivariate analysis of covariance (MANCOVA) we find the data system of this space there are significant differences between each other. In this case, agility performance showed statistically significant differences (p=0.004), whereas flexibility tests showed statistically significant differences (p=0.000). All tests are in favor of the experimental group, which can prove that this plyometric training model has a positive effect on the development of agility and flexibility performances, and the same model can be applied to elite athletes.

Keywords: *plyometric model, agility, flexibility, training process*

INTRODUCTION

Nowadays, researches and tests on sports and different physical activities are very common, which implies that there is a better organization at the collective measurements with children, teenagers and athletes in special conditions. All these measurements and tests are done with a certain purpose, mainly to clarify their profile and their development process as well as their actual state regarding their motor skills and their anthropological status in general. It is also well-known that the plyometric training, the programs for strength increase and the combined programs have a higher positive effect upon certain motor skills (Feigenbaum, 2000). Other published reports suggest to maximize strength and movement speed, combining a specific model of exercises, are required. Those may include light and heavy weights (Baher, 2003). On research made on runners of recreational sustainability, resulted that strength training and explosive training was highly more efficient in contrast to the traditional exercises (Taipale, 2014). Plyometric training is different from the traditional training for strength training because the training is done at a higher speed and increases muscle strength (Donald, 1998). Many researchers have pointed out that plyometric training and strength exercises, especially when they are used with a program or a designed mode and are applied to children and athletes for a longer period, they improve their sports performance and muscle strength (Miller, 2006). Agility and explosive strength are important motor skills that have been researched at a large number of sports and especially at sports games and matches (Sheppar & Uoung, 2006). Activities that have dealt with strength increase, explosive strength and agility, are linked directly with the nervous system factors and impose high metabolically needs and coordinating skills, so they should be done when the athlete has a low level of fatigue (Bompa & Half, 2009). Apart from the training programs for explosive strength increase, in the improvement of athletic performance, circular exercises are also crucial, which are also important for muscle strength, stability, cardiovascular fitness and flexibility (Gopinathan, 2019). Many types of research have shown that young athletes' flexibility and their speed characteristics, can help them to be part of any kind of sports (Mehmet, 2014). Normally, more researches are needed to understand the values and importance of these plyometric exercises and other exercises for strength increase. The main purpose of this paper is to verify the efficiency of the 12-week program for strength increase during agility performance and flexibility.

METHODS

Sample of entities

The sample of entities is composed out of 170 students of two elementary schools "Naim Frasheri" and "Bajram Shabani" – Kumanovo. All the testers are in normal health conditions, and they are divided into two groups: group A experimental (EG, n=90), height 167.50cm, weight 59.40 kg, BMI 21.096), this group apart from the regular classes of physical education, followed three more additional classes weekly, which mainly included exercises for explosive strength increase and group B, Control group (CG, n=80), height 166.86cm and weight 58,190 kg, BMI 20.80), which were not active in any special exercising program, apart from the regular physical education classes. Descriptive parameters of participants for both groups are presented in Table 1.

The sample of variables is composed out of 4 main motor tests and those are: two variables for agility such as: Aunt with a bow (MAB), and T-test (MTT) and two variables for flexibility evaluation such as: Sit and reach (MSR) and Wounds (MWO). The measure-

Table 1. Descriptive characteristics of groups (arithmetic mean; standard deviation)

Variables	Control group (n=80)				Experimental group (n=90)			
	Mean		St. dev.		Mean		St. dev.	
	IT	FT	IT	FT	IT	FT	IT	FT
Age	14.3	14.6	2.63	2.54	14.6	14.9	2.78	2.63
Height	166.86	168.275	8.469	8.187	167.506	170.406	7.32	7.176
Weight	58.190	59.36	11.196	11.284	59.406	60.255	11.83	11.322
BMI	20.807	20.877	3.304	3.241	21.096	20.735	3.790	3.639

Table 2. Representation of experimental program classes (modified by Antekolovic et al. 2004)

Experimental program	Number of classes
General and basic physical training program	9
Explosive force	4
Primary velocity factors	3
Overall durability	2
Specific-physical preparation program for the development of explosive force	27
Preparatory exercises in motion	8
Depth jumps in the Swedish mass	3
Stretching exercises	4
Depth jumps in Swedish box	6
Depth jumps at stations	6

ments are based upon the following authors Milanovic (1981), Aslani (2007), Radic & Simeonov (2009), Iseni (2016).

Description of the experimental program

The three-month training program for the explosive strength increase was applied solely at the experimental group, which apart from the regular classes, underwent three additional classes of training a week, 36 hours in total, for 12 weeks. The testers of the control group were not active during that process. Each training class of the program was divided into 4 parts, of which: the entrance (8-10 min), preparation (10-15 min), main part (25-30min) and the finishing part (8-15 min). The training program applied in this research is composed out of different movements, such as: running, sprints jump with a single and both legs, stretches, deep jumps and stationary deep jumps. This training model was applied based on the publications of the authors Asllani (2007), Jakovljevic (2013). The applied training model is described in Table 2 and is the experimental program modified by Antekolovic, Zufar & Hofman (2004).

Statistical analysis

The researchers' results are elaborated in the statistical program SPSS 22.0 version. To verify the differences between the two groups, we used the univariate and multivariate analysis of Variance (ANOVA – MANOVA), whereas to define the differences between the two groups in the final measurements and to define the effect of the experiment program used the univariate and multivariate analysis of Covariance (ANCOVA – MANCOVA).

RESULTS

Results of conducted Multivariate analyses of variance (MANOVA) are presented in Table 3. From the summary it can be seen that the basic variables among both groups are very different. This can be seen at Wilks Lambda with values 54, which is close to the F at Rai 10.003 and with the liberal scales df1= 13 and df2=155, gives high importance among both groups with Q(F) test = .00.

Table 4, presents the results univariate analyses of variance (ANOVA) of the main basic motor variables among the two groups with the initial measurements. From the given results it can be noted that there are not important statistical differences among both groups.

Table 5 presents the results from multivariate analysis of covariance (MANCOVA) during the final measurements with partitioning and neutralizing the differences of the average values from the initial measurements, where can easily be seen that there are significant changes and differences among the groups. This can be seen from the Wilks' Lambda,64, which is close to F at Rao's of 6-127, and with the liberal scales df1=13 and df2=142, give importance to the differences among the groups in the level Q(F) test=.00. From this analysis, it can easily be seen that the experimental program for the improvement of explosive strength, had a highly positive effect on the transformational process of the agility and flexibility variables at the experimental group in comparison to the control group.

From the description of the Table 6 we're shown the results of the Univariate analysis of covariance (ANCOVA), where it can very easily be noted that there are differences in all the basic motor variables and in all the tests the results are in favor of the experimental group. The main differences are shown at these variables: Sit and reach (MSR)(.00), Wounds (MWO)(.03), Aunt with a bow (MAB),(.00) and T-Test (MTT), (.00). Based on these results we can conclude that the applied experimental program causes a high improvement in the development of flexibility and agility at the experimental group.

Table 3. Multivariate analysis of variance (Manova) on the agility and flexibility variables between the control and experimental group in initial measurements

Effect		Value	F	Hypothesis df	Error df	Sig.
GR	Pillai's Trace	.456	10.003b	13.000	155.000	.000
	Wilks' Lambda	.544	10.003b	13.000	155.000	.000
	Hotelling's Trace	.839	10.003b	13.000	155.000	.000
	Roy's Largest Root	.839	10.003b	13.000	155.000	.000

Table 4. Univariate analysis of variance (ANOVA) on agility and flexibility variables between control and experimental groups in initial measurements

ANOVA						
		Sum of Squares	Df	Mean Square	F	Sig.
MSR	Contrast	2.092	1	2.092	.049	.825
	Error	7191.808	168	42.808		
MWO	Contrast	517.383	1	517.383	2.558	.112
	Error	33985.211	168	202.293		
MAB	Contrast	.516	1	.516	.153	.696
	Error	567.889	168	3.380		
MTT	Contrast	.031	1	.031	.030	.862
	Error	170.749	168	1.016		

Table 5. Multivariate analysis of covariance (MANCOVA) on agility and flexibility variables between control and experimental groups in final measurements with neutralization of differences with initial measurements

Effect		Value	F	Hypothesis df	Error df	Sig.
GR	Pillai's Trace	.359	6,127a	13.000	142.000	.000
	Wilks' Lambda	.641	6,127a	13.000	142.000	.000
	Hotelling's Trace	.561	6,127a	13.000	142.000	.000
	Roy's Largest Root	.561	6,127a	13.000	142.000	.000

Table 6. Univariate analysis of covariance (ANCOVA) in agility and flexibility variables between control and experimental groups in final measurements with neutralization of differences with initial measurements

ANOVA						
		Sum of Squares	Df	Mean Square	F	Sig.
MSR	Contrast	128.402	1	128.402	8.320	.004
	Error	2376.567	154	15.432		
MWO	Contrast	504.122	1	115.695	4.357	.038
	Error	17817.052	154	202.293		
MAB	Contrast	29.282	1	29.282	21.795	.000
	Error	206.899	154	1.344		
MTT	Contrast	6.959	1	6.959	19.106	.000
	Error	56.094	154	.364		

DISCUSSION

The main purpose of this research is to verify the effect of the training model for the improvement of the explosive strength during the performance of agility and flexibility. Checking the initial measurements in both subjects was confirmed that there are some noticeable differences among the groups. After applying the experimental program, which lasted for 12 weeks only for the experimental group, when checking the final results and measurements, was confirmed that all the results were in favor of the experimental group, in all four variables. Results from our study are confirmed in other similar studies as well. Shaik & Mondal (2012) tested a functional program on 19 students for 8 weeks period of time and they concluded that this model of training has highly improved speed, strength, flexibility and agility. Authors Šalaj, Milanovic & Jukic (2007), applied for a proprioceptive program by using balance plates for the improvement of the performance during jumps and agility on 75 students during 10 weeks, and at the end of the experiment they concluded that the training program had a positive effect on the improvement of the explosive strength and agility. In their study, Faigenbaum et al. (2007) tested a combined program, plyometric training and high resistance training on 13 students and only resistance training on 14 other students, of the ages 12-15 years old, during 6 weeks. And they came to a conclusion that the combined program showed better results, especially at high jumps and agility. One of the Asadi's researches (2012), he tested 18 students of the ages of 20 years old, where he found huge differences on the agility tests like Ilinoi and T-tests, who followed the training model during 6 weeks. Dinc & Ergin (2019) applied a program for the improvement of the main elementary strength on 28 students of the ages of 19 years old, during eight weeks and they concluded that they manifested a positive difference. On another Asadi's & Ramires' research (2016), they applied study research on 30 students of the ages of 20, during 6 weeks. On their final measurements, huge differences were found when the experimental group showed better results after undergoing the 6-week program. Highly improved were flexibility, speed, explosive strength and agility. In their study, Nobre et al (2017) applied a 12-week program on 7-9 years old children which were overweight and obese and divided them into two groups. The experimental group and the control group, which didn't do any of the exercises. At the end of the experiment, they realized that the experimental group had noticeably better results. The authors Johnson, Salzberg & Stevenson (2011) came to some very important results after applying the plyometric training program, where the best improvements were shown at the explosive strength, agility and flexibility, this model was applied on 5-14 years old children and it took 10 weeks. The authors Chaovachi, Othman, Hammami, Drinkwater & Behm, (2014) also completed 2 training models, one model was plyometric and the other was combined plyometric and flexibility training, after the research they realized that the combined program showed better results on the flexibility tests, strength and speed. This experiment took 8 weeks and was applied to 12-15 years old children.

CONCLUSION

Analyzing these results and discussions we can easily conclude that the modified program during 12 weeks affected positively affected positively on the improvement of the motor abilities, more specifically it improved the final results of agility and flexibility. From this experiment, we can confirm that this kind of training program should be used as a model for all teachers, trainers and researchers, who want to increase athletic performance at students and athletes. The present study provides further evidence of increased agility performance and flexibility through the model with a plyometric training program. Even the weight of this study is to be achieved through practical data when applying the model of the plyometric training program to the students who attended this program; however, the practical data disintegrates us for the advancement and favor of the group that follows the plyometric training program mode.

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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