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The effect of plyometric training program on young volleyball players in their usual training period

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ABSTRACT

Vassil K, Bazanov B. The effect of plyometric training program on young volleyball players in their usual training period. *J. Hum. Sport Exerc.* Vol. 7, No. Proc1, pp. S35-S40, 2012. The purpose of this study was to find out the efficiency of composed plyometric training program on youth volleyball players force capabilities in their usual training period. The plyometric training program was applied during 16 week period where was attended twenty-one 12-19 years old youth volleyball players. Twelve of them were female and nine male volleyball players. There were three control testings. All subjects participated in following tests: standing long jump, depth leap long jump, medicine ball throws up in 10 seconds, medicine ball overhead throws forward against the wall in 10 seconds, maximal vertical jumps to the maximal height in 10 seconds, maximal vertical jump height. Testing results statistical analysis has shown athletes legs and arms speed force reliable improvement. Standing long jump, depth leap long jump and maximal vertical jump height test results, what has shown legs explosive power, has not shown remarkable reliable difference ($P>0.05$). Medicine ball throws and maximal vertical jumps to the maximal height in 10 seconds, what show speed force improvement, showed reliable difference ($P<0.01$). **Key words**: TRAINING METHOD, LEGS AND ARMS SPEED FORCE TRAINING.

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INTRODUCTION

Modern volleyball requires for player a good physical endurance, parallel it is very important to develop speed and explosive power and force endurance. Volleyball is also a social game, where next to the good coordination and cleverness comes up to the important place team players good rapprochement and cooperation (Järvekülg, 2002).

Vertical jump ability is critical for success in volleyball. Jumping is utilized during the jump set, jump serve, blocking and spiking. A successful player must not only be able to jump high but must also be able to reach that height quickly. This requires an ability to generate power in a very short time (Powers, 1996). The use of strength during the play is determined by the fact that the usage of maximum strength lasts from 0.5 to 0.7 seconds; however, most of the explosive moments take substantially less time. For this reason the optimal usage and transformation of the gained maximum muscle strength into the "explosivity" of the main muscle group of the lower limbs, which take part in the takeoff, require special power training (Lehnert et al., 2009). Plyometric exercises have been shown to improve jump performance in many sports. These exercises combine strength with speed of movement to produce power. By using the myotatic stretch reflex of the muscle to produce an explosive reaction, plyometric is believed to be the link between speed and strength (Powers, 1996). The plyometric method is ranked among the most frequently used methods for conditioning in volleyball (Lehnert et al., 2009).

This research provides an overview of 16 weeks of plyometric training period which was attended by Kohila volleyball club twenty-one youth volleyball players. All players participated in testing measurements (Beginning of the program, four weeks later and end of the program).

Literature review has shown that in the world has made a lot of researches for plyometric method effectiveness and a little bit less researches about plyometric method efficiency for youth athletes. Most researches main point was to improve and investigate plyometric training effect for the legs. In this research we include also plyometric training effect for the arms. Previous studies handle mostly explosive power improvement. As a novelty in this research is that in the players testing has used the temporal parameters, which has not been observed in previous studies and what will make possible to investigate plyometric training effect to improve speed force. Jalak has defined speed force subsequently: Speed force represents nerve - muscle machine's ability to move the maximum speed of the whole body, body parts (hands, feet, etc.) or equipment (ball, disc, etc.) (Jalak, 2008). The purpose of this study was to find out the efficiency of composed plyometric training program on youth volleyball players force capabilities in their usual training period.

MATERIAL AND METHODS

Plyometric training should progress gradually from lower intensity to higher intensity drills, especially for individuals who lack a significant strength training background.

Table 1. Intensity of various plyometric exercises.

Exercise Type	Intensity
Depth jumps 32-48in (80-120cm)	High
Bounding Exercises	Submaximum
Depth jumps 8-20in (20-50cm)	Moderate
Low impact jumps/throws	Low

Depth jumps have a very powerful training effect so the volume of work should be low, no more than 4 sets of 10 repetitions, 2-3 times per week for advanced athletes and 3 sets of 5-8 repetitions, 1-2 times per week for lower classes of athletes (Baggett, 1995). A two- or three-day rest (48 hour minimum) between sessions will allow full recovery of the musculoskeletal system and further enhance adaptation. The number of repetitions and sets vary depending upon the intensity of the drill. As a rule, a low intensity exercise requires more repetitions. An exercise with a higher degree of difficulty requires fewer repetitions (Brittenham, 1995).

The sample of subjects

The plyometric training program was applied during 16 week period where was attended twenty-one Kohila volleyball club youth volleyball players. Their mean (±SD1) age, height and mass were 15.5 ± 2.03 years, 173.9 ± 9.7 cm and 65.3 ± 10.34 kg, respectively. Twelve of them were female and nine male volleyball players (the players/gender characteristics are given in Table 2). They all had four practical trainings and two gym workout trainings sessions a week, and the sessions lasted 60 to 90 minutes. The plyometric exercises were practiced twice a week (Monday and Wednesday) after warming-up, the resting period between exercises series was one minute.

Table 2. *Descriptive data of the player's characteristics.*

	Age (y)	Height (cm)	Weight (kg)
Female	14.4 ± 1.80	167.8 ± 6.97	59.0 ± 8.85
Male	17.0 ± 1.25	182.0 ± 6.32	73.7 ± 4.71

Procedures
The players had four trainings per week, and two of them had included plyometric training. Training duration was 90 minutes. Prior to each training session, all subjects participated in a 10 minute warm-up period which included jogging at a self-selected comfortable pace followed by calisthenics. After warming-up session players performed plyometric training and after finishing starts with their usual training. All athletes have got instructions how to make exercises correctly before starting plyometric program.

Table 3. *Plyometric training exercises program.*

Day	Number	Exercise
Monday	2 x 10	Squat Jumps
	2 x 10	Lateral Box Push Offs
	2 x 15	Overhead Throws
	2 x 10	Split Squat Jumps
	2 x 15	Power Drop
	2 x 10	Depth Jumps
Wednesday	2 x 10	Squat Jumps
	2 x 10	Lateral Hurdle Jumps
	2 x 15	Overhead Throws
	2 x 10	Split Squat Jumps
	2 x 8	Plyometric Push-Ups
	2 x 10	Single Leg Lateral Hops

Testing procedures
All players participated in three control testing. First measuring was before plyometric training session in November 2010. Second testing was after four weeks plyometric training streak in December 2010 and last control measuring has taken 16 weeks after first testing in February 2011.

1. Standing long jump.
2. Depth leap long jump.
3. Medicine ball throws up in 10 seconds.
4. Medicine ball overhead throws forward against the wall in 10 seconds.
5. Maximal vertical jumps to the maximal height in 10 seconds.
6. Maximal vertical jump height.

Statistical Analyses
Descriptive data were calculated for all variables. Group differences at baseline were evaluated using independent sample T-tests.

RESULTS

Although there were changes in all measured tests, explosive power parameters have not shown remarkable reliable improvement during this research. Standing long jump girl´s group average changed from 194.8 ± 13.2 cm to 203.3 ± 13.2 cm (P>0.05) and boys results average improvement was 240.9 ± 16.7 cm to 248 ± 15.5 cm (P>0.05). Depth leap long jump girl's group average developed from 185.3 ± 14.7 cm to 193.8 ± 13.6 cm (P>0.05) and boys results average changed from 238.3 ± 17 cm to 246.4 ± 17.7 cm (P>0.05) In maximal vertical jump height girl´s group average was reliable improvement from 45.3 ± 6.4 cm to 49.9 ± 6.0 cm (P<0.05). Boys results changed from 62.1 ± 5.9 cm to 67.2 ± 6.3 cm (P>0.05).

Speed force parameters have shown reliable improvement during this research. The program had a greater impact on the girl's group speed force development. Medicine ball throws and maximal vertical jumps to the maximal height test result, what show speed force improvement showed reliable difference. In medicine ball throws up in 10 seconds girl´s group average improvement was 8.3 ± 1.4 times to 10.8 ± 1.1 times (P<0.001) and boys results average improvement was 10.1 ± 1.7 times to 12.1 ± 1.1 times in 10 seconds (P<0.01). In maximal vertical jumps to the maximal height in 10 seconds girl´s group average improvement was 4.1 ± 1.0 times to 5.8 ± 1.2 times (P<0.001) and boys results average improvement was 4.3 ± 0.5 times to 6.6 ± 0.5 times in 10 seconds (P<0.0001).

DISCUSSION

In the discussion section of the statistical analysis, what can be noted is that the use of the set of plyometric exercises has shown athletes legs and arms speed force improvement, but explosive power parameters has not shown remarkable reliable difference. Standing long jump, depth leap long jump and maximal vertical jump height test results, what has shown legs explosive power, were not reliably different. Medicine ball throws and maximal vertical jumps to the maximal height in 10 seconds, which demonstrate speed force abilities, showed reliable difference. A considerable increase in the jumping and throwing skills was found among the members of the experimental group, and so it is more justified to use this type of plyometric exercises to improve speed force skills than explosive power.

Standing long jump and depth leap long jump results statistical analysis shows that girls and boys group T-test results did not show reliable difference in the average results (P>0.05). Depth leap long jump results are smaller. This is expected result, because it can be assumed that depth leap long jump technique was new for athletes and was hard to adjust quickly to the new technique.

Medicine ball throws up and medicine ball overhead throws forward against the wall test results showed arms muscle speed force improvement. In medicine ball throws up in girls group got an improvement 2.6 times (30.1%) and boy´s 2 times (19.8%). Girls and boys group average comparison of the test results showed that in this assay were reliable differences (P<0.01). Medicine ball overhead throws forward against the wall test result got improvement in female group 2, 3 times (25.6%) and in male group 1, 7 times (14.9%). Both group average comparison of the test results showed that in this assay were reliable differences (P<0.01). The noted difference occurs under the influence of the applied experimental factor, by means of which we can conclude that the used experimental program of plyometric training had a positive effect on the transformation of arms speed force of the subjects. Girls group got better improvement than boys. It can be assumed that girl's group got better improvement is due to the fact that girl arms elementary speed force was lower.

Whole athletes group shows 4.9 cm increase in maximum height of vertical jump which is similar for volleyball players to the block jump. This result numerically does not differ a lot from Milic et al. (2008) research result where two-foot block jump has increase 3.53 cm. Analysing female and male groups separately we can see that female group result shows reliable difference ($P<0.05$), but male group result did not show reliable difference ($P>0.05$). It can be assumed that girl's group got better improvement is due to the fact that girl legs elementary explosive power was lower. Female group increase was 4.7 cm which result is similar to the Lehnert et al. (2009) research where maximal vertical jump has shown increase 4 cm. Male group increase was 5.1 cm which result is similar to the Shaji and Isha (2009) research where maximal vertical jump has shown increase 4.8 cm. Faigenbaum et al. (2007) got vertical jump increase in their research 3.4 cm. It can be assumed that the difference between results is affected by the length of the experiment. Adams et al. (1992) research compared three training programs: Squat, plyometric and squat-plyometric. Examination of the mean scores shows that the squat group increased 3.30 cm in vertical jump, the plyometric group increased 3.81 cm and the squat-plyometric group increased 10.67 cm. This research results indicate that combined training can be more effective than plyometric training alone.

In addition to the development of vertical jumping ability, we can see that in test results there is one important increase in maximal vertical jumps to the maximal height in 10 seconds which indicate speed force. This shows 46.5% increase for whole group, it is 1.95 times more than in first testing. Girls group got an improvement 1, 8 times (41.5%) and boy´s group 2, 2 times (53.5%). This is very important skill in volleyball, because a volleyball match can be played for five sets, which means that the match can last about ninety minutes, during which time a player can perform 250-300 actions dominated by the explosive type strength of the leg muscles. Of the total number of actions, jumps take up around 50- 60%, high speed movements and changes of direction in space about 30% and falls about 15 % (Stojanovic & Kostic, 2002). T-test analysis showed that both group average indicators before and after the eksperiment had reliable differences ($P<0.01$). Based on this result we can conclude that plyometric exercises are effective tools for improving young volleyball player's ability to perform repeated maximal jumps at the maximum height.

There are general principles that apply to plyometric training regarding the muscular pattern of movement in the process of overcoming any strain, but each volleyball player requires an individual program. The vertical jump is an individual characteristic, and so one needs to select exercises and determine their intensity and extent accordingly. One of the significant conditions that come with using plyometric method, are the characteristics determined by the age of each individual volleyball player.

CONCLUSIONS

Based on results of the research we can conclude, that: explosive power parameters have not shown remarkable reliable improvement but speed force parameters have shown reliable improvement during this research. The program had a greater impact on the girl's group speed force development.

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