THE IMPACT OF VIBRATION TRAINING ON THE WHOLE BODY, EXPLOSIVE LEG STRENGTH, SPEED AND AGILITY IN BASKETBALL PLAYERS AGED 14-15

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Abstract
Speed represents the ability of the muscle tension in the composition of motor units determined by the body or body parts to travel a long distance in the shortest possible time. Speed is a multidimensional motor ability, mainly manifested through: 1) latency motor response 2) individual movement speed 3) speed of frequency movements 4) sprint speed. Explosive power is the ability of muscles to activate a large number of motor units in the shortest possible time, displaying as much force as possible. The whole body vibration training is a modern training method and is becoming the main prop in improving athletes’ performance. The aim of this study was to determine the effect of vibration training on the lower extremities explosive strength and speed in basketball players. The study comprised thirty male subjects divided into two groups: a control group (K) and experimental (E) group that was involved in vibro training, each group comprising fifteen subjects. By Myotest and half squat jump (SMJ) and squat jump (SJ) following variables were determined: Height, Power, Force, Velocity. Applying tests for speed and agility variables for each test were obtained: running time at 5m, 10m, 20m, T-test, Zig-Zag test, L-test. Vibration training lasted for six weeks, was administered three times a week, with the complete period of stimulation per session of 16 minutes, with three sets of eight repetitions, each repetition last 40 seconds. Six-week whole body vibration training leads to significant changes in the explosive power parameters of the sig = 0.000, which cannot be said for speed and agility.

Keywords: control group, experimental group, motor tests, Myotest, half squat jump, squat jump, initial measurements, final measurements, multivariate analysis of covariance (MANOVA)
modern training method and the vibrating plate becomes the main prop in improving athletes performance. Bosco, Cardinale, Colli, Tihanyi & von Duvillard (1998) reach the conclusion that only ten days treatment on a vibrating plate leads to the improvement of the maximum height of the jump. Vibration training is not only used to improve the performance of athletes, but also leads to the improvements in people with multiple sclerosis (de Ruiter, van Raak, Schilperoort, Hollander, & Haan, 2003).

To measure the explosive power, Myotest, a device that measures the average value during the execution of jumps, was used. To measure speed tests of running at 5, 10, 20 meters (Cochrane, Legg, & Hooker, 2004), T-test (Paule, Madole, Garhammer, Lacourse, & Rozenek, 2000), Zig-zag test (Little & Williams, 2005), L-test (Gabbett, Kelly & Sheppard, 2008) were used.

Torvinen, Kannus, Seivanen, Jervinen & Pasanen (2002) in their study analyze the impact of vibration training on motor skills. Vertical jump height was increased by 2.5 cm, while the control group jump height was increased by 0.3 cm, where the p = 0.001. There was an increase in the static power in the experimental group by 2.5%, but without statistical significance p = 0.25, while in the test of speed and agility there have been no significant changes, neither in the control nor in the experimental group (p = 0.52, p = 0.57). In testing the hand grip there was also not a statistically significant improvement (p = 0.228, p = 0.143). Baros-Musat & Balint (2010) examined the impact of vibration training on the explosive power and speed in basketball players. Vibration training has positively influenced explosive power and speed, there were found statistical differences both between the initial and final measurements, within groups and between groups at the final measurement.

The aim of this research was to determine the effect of the vibration training on the explosive strength of the lower extremities and speed in basketball players.

METHODS

This research comprised 30 male subjects, mean age 14.56 ± 0.5 (Mean ± St.Dev.), expressed in years, mean body weight of 61.28 ± 11.07 (Mean ± St.Dev.), expressed in kg, mean body height of 169.41 ± 7.84 (Mean ± St.Dev.), expressed in cm. The subjects were divided into two groups: a control group (K) of 15 subjects, attending basketball training regularly, and the experimental (E) group, of also 15 subjects, who beside regular basketball training attended the whole body vibration training. All of the subjects involved in the training process were completely healthy, without any hidden injuries.

By Myotest and half squat jump (CMJ) and squat jump from (SJ) following variables have been determined:

(CMJ)
1. HightC (height in cm)
2. PowerC (power expressed in W / kg),
3. ForceC (force expressed in N / kg),
4. VelocityC (acceleration expressed in cm / s).

(SJ)
1. HightC (height in cm)
2. PowerC (power expressed in W / kg),
3. ForceC (force expressed in N / kg),
4. VelocityC (acceleration expressed in cm / s).

By speed and agility tests following time variables been determined:
1. 5m running time (time expressed in seconds)
2. 10m running time (expressed in s)
3. 20m running time (expressed in s)
4. Time of t-test performance (expressed in seconds)
5. Time of Zig-Zag test performance (expressed in seconds)
6. Time of L-test performance (expressed in seconds)

The measurement was performed by Myotest. Subjects have demonstrated the performance of CMJ and SJ. Each of the subjects performed 5 CMJ and SJ jumps and the accelerometer calculated mean values. In speed tests while running at 5, 10 and 20 meters subjects were taking a standing position and after the beep they started running and with the top speed movement passed through the target. Rest time between tests was three minutes.

In Zig-Zag-test five cones have been set at a five meter distance with the angle between the cones of 100°. The task was set to participants to perform slalom between cones.

In L-test three cones that shaped letter L have been set at a five meter distance, the task was to run past the cones that were placed in the shape of the letter L, rotate around the last cone and run back to the first cone, following the L path.

T-test had four cones placed in a letter T shape, three cones had been placed on the same line at a distance of five meters, and fourth against the central cone, within ten meters of the start and end cone. Subjects run from the first cone to the center and then to the left side of the cone, and the cone to the right, again return to the central cone and then back again to the first, which is now the final cone.

Vibration training lasted for six weeks, three times
a week, with the total period of stimulation per session of 16 minutes, with three sets of eight repetitions, each repetition lasting 40 seconds. The pause between repetitions was one minute and two minutes between sets. Vibration frequency varied from 20Hz in the first series, then at 25Hz to 30Hz in the second series to the third series, with movement amplitude of 1-6mm. Upon completion of the training, all subjects performed a passive stretching of the lower extremities (Paradisis & Zacharogiannis, 2007). Additional physical activity that could affect the course of the study was not allowed.

To determine intergroup differences in the initial and final measurement between groups a multivariate analysis of variance (MANOVA) was used.

RESULTS AND DISCUSSION

The results of the initial and final measurements are very similar, indicating that basketball training did not improve the monitored variables; in some variables results were even weaker in the final test.

In table 3 the results of mean values in the final measurements are quite different as compared to the initial measurement, which shows the vibration program had a great impact on tested variables.

Table 4. shows that there is no statistically significant difference between the groups in the initial measurement sig = 0.083, but there are statistically significant differences in the final measurement between groups sig = 0.002.

Table 5. shows that there were statistically significant differences between the groups in the final measurement.
and in variables of the explosive power where sig ≤ 0.005, while in the variables of the speed and agility, there is no statistically significant difference sig > 0.005.

Table 6. shows that there are no statistically significant differences between the initial and final measurements in K group F = 0.168; sig = 0.985.

Based on Table 7 it can be concluded that the whole body vibration training affected only the explosive force sig = 0.000, while in tests of speed and agility there were no significant changes sig = 0.709; sig = 0.966.

The results of this research are consistent with studies of Wilcock, Whatman, Harris, & Keogh (2009) who analyzing a large number of works reached a conclusion that strength training has a positive effect on the lower extremities power, where the increase of force depends on the type of muscle and ranges from 0.3 to 12.7 N / kg, whereas in this study, 4.1 N / kg in CMJ and 4.3 N / kg in SJ were found. Also, there was an increase of strength with significance of p = 0.0038, the increase of the height of the jump varied from 0.3cm to 8.8cm versus 3.7 cm obtained in CMJ and 4.5 cm in SJ. Vibration program did not affect the results of improvement in any of the tests, neither the speed nor agility. Cochrane, et al., (2004), examined the impact of the vibration training on vertical jumping, speed and agility. During the training subjects were taking five different positions on the vibrating plate. After the testing, no statistically significant results in any of the tested variables: CMJ, SJ, running at 5, 10, 20 meters, 505-test, test-AG, UAB test, were obtained.

The results of this study do not fit exactly with the results gained, because in the current research there has not been improvement of the speed and agility, but there has been an increase in the vertical jump. The results of the research (Cochrane et al., 2004), can be justified by its short vibration training program. Results of Paradisis & Zacharogiannis (2007) research are not completely

and in variables of the explosive power where sig ≤ 0.005, while in the variables of the speed and agility, there is no statistically significant difference sig > 0.005.

Table 4. MANOVA- differences between groups in the initial and final measurement

<table>
<thead>
<tr>
<th>Effect</th>
<th>Value</th>
<th>F</th>
<th>Df1</th>
<th>Df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilkins’L Initial measurement</td>
<td>.338</td>
<td>2.100*</td>
<td>14.0</td>
<td>15.000</td>
<td>.083</td>
</tr>
<tr>
<td>Wilkins’L Final measurement</td>
<td>.181</td>
<td>4.859*</td>
<td>14.0</td>
<td>15.000</td>
<td>.002</td>
</tr>
</tbody>
</table>

Table 5. ANOVA- in the final measurement between groups

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>F</th>
<th>Sig.</th>
<th>Dependent variable</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HeightC</td>
<td>19.357</td>
<td>.000</td>
<td>VelocityS</td>
<td>7.805</td>
<td>.009</td>
</tr>
<tr>
<td>ForceC</td>
<td>.063</td>
<td>.003</td>
<td>T5</td>
<td>.039</td>
<td>.845</td>
</tr>
<tr>
<td>PowerC</td>
<td>.001</td>
<td>.005</td>
<td>T10</td>
<td>.469</td>
<td>.499</td>
</tr>
<tr>
<td>VelocityC</td>
<td>.011</td>
<td>.004</td>
<td>T20</td>
<td>2.758</td>
<td>.108</td>
</tr>
<tr>
<td>HeightS</td>
<td>35.590</td>
<td>.000</td>
<td>Zigttest</td>
<td>7.896</td>
<td>.009</td>
</tr>
<tr>
<td>ForceS</td>
<td>17.978</td>
<td>.000</td>
<td>Ltest</td>
<td>2.560</td>
<td>.121</td>
</tr>
<tr>
<td>PowerS</td>
<td>9.103</td>
<td>.005</td>
<td>Ttest</td>
<td>1.655</td>
<td>.209</td>
</tr>
</tbody>
</table>

Table 6. MANOVA- repeated measurements for the K group

<table>
<thead>
<tr>
<th>Effect</th>
<th>Value</th>
<th>F</th>
<th>Df</th>
<th>Df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilks’ Lambda</td>
<td>.478</td>
<td>.168*</td>
<td>13.0</td>
<td>2.00</td>
<td>.985</td>
</tr>
</tbody>
</table>

Table 7. MANOVA – repeated measurements of speed, agility and explosive power for the E group

<table>
<thead>
<tr>
<th>Abilities</th>
<th>Effect</th>
<th>Value</th>
<th>F</th>
<th>Df1</th>
<th>Df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>Wilks’ Lambda</td>
<td>.948</td>
<td>.354*</td>
<td>2.0</td>
<td>13.0</td>
<td>.709</td>
</tr>
<tr>
<td>Agility</td>
<td>Wilks’ Lambda</td>
<td>.995</td>
<td>.035*</td>
<td>2.0</td>
<td>13.0</td>
<td>.966</td>
</tr>
<tr>
<td>Explosive power</td>
<td>Wilks’ Lambda</td>
<td>.048</td>
<td>22.882*</td>
<td>7.0</td>
<td>8.0</td>
<td>.000</td>
</tr>
</tbody>
</table>
identical to the current research results. Primarily because of that, before mentioned studies report improvement in speed abilities in running 10 meters (4.3%) versus obtained 0.07 s, running 20 m (3%) compared to 0.01 obtained, 40 m (2.2%), 50 m (2.1%) and 60 m (2.1%), which was in all tests, p < 0.005, while the tests of the force also have been improved as well as in the current research CMJ (3.3%), NJ and 30CVJT (7.8%).

Cochrane & Stannard (2005) examined the impact of vibration training on the explosive strength, flexibility and hand grip. The amplitude of the plate in training was 6 mm, frequency 26 Hz, and the subjects occupied six different positions on the vibrating plate. There was an increasing amount of CMJ, p < 0.001; 2.2 cm; with hand grip there was no statistically significant difference p > 0.005, because in muscles that are not directly exposed to vibration training there is no change. In flexibility there was also a statistically significant change 8.2%; p < 0.005.

CONCLUSION
Six-week whole body vibration training leads to significant changes in the parameters of the explosive power of the sig = 0.000, which cannot be said for speed and agility. It is necessary to conduct a large body of research within this field, especially with the increased length of the program and a large range of plate compactors, in both Hz and amplitude (mm). It is also necessary to examine how changes in the position of the vibrating plate during the treatment affect the performance of athletes, and the combination of vibration training with other types of training. Vibration training can be used as an additional type of training while increasing the explosion of the lower extremities, but it is also necessary to examine the impact of the program on the athletes.

REFERENCES


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