THE EFFECTS OF A SIX-WEEK TRAINING PROGRAM ON MOTOR AND FUNCTIONAL SKILLS OF FEMALE BASKETBALL PLAYERS

Abstract
The aim of the study was to determine changes in motor and functional skills of women basketball players caused by the influence of a six-week training process. Six-week training process (pre-season period of the junior female national basketball team of Serbia for European Championship) lasted 43 days, involved 53 workouts and 8 matches. The subjects sample included 13 basketball players, average age 17.76 (±0.43). The first testing was conducted at the beginning of the training program and the second at the end of the program that lasted six weeks. Special tests have been used to assess the following abilities: speed, strength, agility, flexibility and endurance. The research findings show that between the arithmetic mean of initial and final testing, in almost all the tests (Sit and Reach, 10 m Sprint, 10 m Flying sprint, 20 m Sprint, T-test, Half-squat jump, YO YO intermittent test) there is a statistically significant difference (p<0.01), while in tests- Counter Movement Jump and Vertical Jump there is a positive difference that is not statistically significant.

Keywords: TRAINING PROGRAM / TESTING / SPEED / MOBILITY / AGILITY / STRENGTH / ENDURANCE /

INTRODUCTION

Basketball is a team, very dynamic sports activity that is known for explosive movements. Jerky, rapid and short running, abrupt directions changing, sudden stops and jumps are a part of every basketball match (Narazaki, Berg, Stergiou, & Chen, 2008).

Basketball players have to move over the court efficiently. To achieve that, they have to possess a high level of general and specific performance (Foran, 2010).

Physiological responses of basketball players during a match are specific. Oxygen consumption reaches as much as 42 ml/Kg/min or 75% of maximum value. The heart rate reaches 180 bpm, and in short resting periods from 138 to 163 bpm (Narazaki, et al., 2008). The pulse rate is up to 195 bpm, during about 10% of total time of the match. The level of lactate goes up to 6.5 mmol/l, the heart rate to 93% of the maximum value (MHR). Basketball players change the form or intensity of movements every 2 seconds on average (Ben Abdelkrim, El Fazaa, & El Ati, 2007). A basketball player performs from 53 to 157 high-intensity rectilinear movements that last 1.7 seconds on average. He spends 60% of the time moving at low and 15% at very high intensity (McInnes, Carlson, Jones, & McKenna, 1995). During a match, a player covers the distance of up to 6.235 m (Erčulji, Dežman, Vučković, Perš, Perše, & Kristan, 2008).

Conditioning preparation is a complex and comprehensive process of implementing a number of programs for the development and maintenance of functional and motor skills, as well as morphological characteristics (Stefanović, & Jakovljević, 2004).

Correspondence to: Zarić Ivan, WBC „Red star“ Belgrade, Ljutice Bogdana 1a, Belgrade, Serbia, e-mail: zare_dif@yahoo.com
By determining changes in functional and motor abilities after conducting a specific, appropriate training process we can get reliable data of the impact of the training program on the athletes. Thus it has been shown that 8 to 16 aerobic workouts, arranged twice or three times a week, including 4 x 4 minute of interval repetitive consistent training with or without a ball, at the heart rate of 90-95% MHR, increase maximum oxygen consumption (VO2max) of young and adult athletes by 7-10% (Marković, & Bradić, 2008).

The study with the sample of 14 basketball players of the regional area determined the effects of exercises 5-5, 3-3, 2-2 players on the whole court on functional parameters. The study showed that the 2-2 play on the whole court causes the heart rate that is optimal for the development of specific basketball endurance. During this exercise the players reached the average heart rate of 92% MHR and average lactate concentration of 7.8 mmol/l (Castagna, Impellizzeri, Chaouachi, Abdelkrim, & Manzi, 2011). Santos and Janeira (2012), for a sample of 25 young basketball players, aged 14 to 15 years, divided into an experimental and control group, found positive effects of ten weeks’ training on the development of absolute strength on explosiveness parameters. Kukrić, Karalejić, Jakovljević, Petrović and Mandić (2012) have shown positive effects of ten weeks’ application of complex and plyometric training methods to the maximum height of vertical jump of junior basketball players. Jakovljević, Janković and Kukrić (2010) found positive changes in the expression of strength of women basketball players after a preparatory period that lasted 66 days. According to them, these positive changes are not only the result of strength workouts, but to a certain extent, and of the other factors, especially the basketball workouts that contain a large number of motion activities, where the different forms of strength are expressed, especially of the legs. Results of the research on the efficiency of stretching exercises of different volume and frequency, that last 8 weeks on the sample of 53 healthy active persons, that has been conducted by Cipriani, Terry, Haines, Tabibnia, & Lyssanova (2012), have shown that 30-seconds stretching per each set, six times a week has the most positive effects. And, there is no difference whether the program is used 6 days a week or 3 days a week twice a day.

The aim of this study was to determine changes in functional and motor skills of women basketball players after a six-week training process. It is expected that the motor and functional skills of women basketball players will be improved in the final test compared to the initial test after the training process.

**METHOD**

**Subjects sample**

The sample of subjects included thirteen female basketball players, the junior national team of Serbia, average age 17.76 (±0.43), average height 180.3 (±9.93) cm and average weight 70.384 (±8.6) kg. All subjects were at least five years in the systematic training of basketball. Prior to testing, medical examinations were conducted and any health problems didn’t detect. The subjects voluntarily agreed to participate in the study.

**The sample of variables and instruments**

Using the tests to assess functional and motor skills that affect the efficiency in basketball: speed, strength, endurance, flexibility and agility (Brittenham, 2005) the independent variables were obtained:

- Sit and reach score (cm)
- Acceleration at 10 m (s)
- Maximum speed at 10 m (s)
- Acceleration at 20 m (s)
- Velocity of directions changing (s)
- Maximum jump height, vertical half-squat jump with arms on hips (cm)
- Maximum jump height, vertical counter-movement jump with arms on hips (cm)
- Aerobic endurance (m)

The standardized tests that have been used in previous researches of functional and motor skills of athletes / basketball players are applied:

- Sit and Reach (S&R) (Brittenham, 2005)
- 10 m Sprint (10S) (Mirkov, Nedeljković, Kukolić, Uğarković, & Jarić, 2008)
- 10 m Flying sprint (10FS) (Mirkov, et al., 2008)
- 20 m Sprint (20S) (Mirkov, et al., 2008)
Zarić I., The Effects of A Six-Week Training Program on Motor and Functional... PHYSICAL CULTURE 2014; 68 (1): 75-82

Linear periodization is applied in the planning and programming of the training process. The general tendency of six-week training is linear intensity enhancement. The volume of training was higher at the beginning and the intensity was lower. The increase in the program intensity is followed by a gradual decrease in its volume. Intensity is monitored by palpatory measurement. Intensity increased gradually in training micro-cycles so that later a sharp decrease in load could provide cumulative training effects. The average intensity in six weeks’ training program was 74% MHR.

The general preparation period, including running outside, stretching exercises, strength exercises and a warm-up part without a ball, accounted for a significant part of the preparation with total of 2333 minutes, or 42% of the training process. The percentage of general preparation dominated the first, the second and the third micro-cycle and constantly declined during preparation period. On the other hand, the constant increase of the percentage share of the specific workouts is a logical consequence of the approaching of competition.

The entire six-week training process lasted 43 days and consisted of 12 micro-cycles, with a total of 53 individual training sessions and 8 pre-season matches; 13 strength workouts (individual training lasted an average of 65.3 minutes); 3 workouts of aerobic endurance (capacity) (individual training lasted an average of 75 minutes); 4 workouts of aerobic endurance (power) (individual training lasted an average of 65 minutes); 7 glycolytic speed endurance workouts (individual training lasted an average of 120 minutes); 26 basketball tactical-technical workouts (individual training lasted an average of 92.5 minutes).

- T - test for agility measurement (TT) (Miller, Herniman, Ricard, Cheatham, & Michael, 2006).
- Half-squat jump (SJ) (Kukric, Karalejic, Petrovic, i Jakovljevic, 2009)
- Counter Movement Jump (CMJ) (Mirkov, et al., 2008)
- Vertical Jump (VJ) (Mirkov, et al., 2008)
- YO-YO Intermittent test (YO-YO) (Castagna, Impellizzeri, Rampinini, D’Ottavio, & Manzi, 2008).

In tests: Sprint 10 m, Sprint 20 m, Flying sprint 10 m, running time is measured electronically. An electronic jump mat was used in the tests: Half-squat jump, Counter Movement Jump, Vertical Jump. The Jump mat and photocells are a part of the PAT01 system (Physical Ability Testing), produced by UNO-LUX NS, Belgrade. Body height and body weight were measured in accordance with the International Biological Program.

Protocol of the experiment

The experimental research consisted of three parts: initial testing, six weeks’ training process and final testing. The first testing was conducted at the beginning of the training process, and the second test was conducted at the end of the training process. Both tests were done in a sports basketball hall, on the parquet floor, at 9 am, at the optimal air temperature.

Prior to the testing, the subjects were preparing for the tests by slow 8-minute running, exercises of 4-minute dynamic stretching and 3-minute speed and agility exercises. The tests were conducted in the following order: 20m Sprint (photocells were placed at the start point, at 10 m and 20 m from the start, so they also gave results for the tests 10m Sprint and 10m Flying sprint), T-test, Half-squat jump, Counter Movement Jump, Vertical Jump, Sit-and-reach and YO-YO Intermittent test.
Table 1. Analysis of the training process

<table>
<thead>
<tr>
<th>Microcycles</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
<th>11.</th>
<th>12.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of days</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Number of workouts</td>
<td>5</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Number of matches</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Number of strength workouts</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Number of workouts of aerobic capacity</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Number of workouts of aerobic power</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Number of workouts of speed endurance</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Number of tactical-technical workouts</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>The volume (minutes) – all workouts</td>
<td>335</td>
<td>630</td>
<td>630</td>
<td>850</td>
<td>210</td>
<td>525</td>
<td>270</td>
<td>540</td>
<td>150</td>
<td>630</td>
<td>710</td>
<td>90</td>
</tr>
<tr>
<td>The volume (minutes) - general means</td>
<td>335</td>
<td>370</td>
<td>375</td>
<td>214</td>
<td>95</td>
<td>199</td>
<td>90</td>
<td>165</td>
<td>70</td>
<td>160</td>
<td>215</td>
<td>45</td>
</tr>
<tr>
<td>The volume (minutes) - specific</td>
<td>-</td>
<td>260</td>
<td>255</td>
<td>301</td>
<td>115</td>
<td>326</td>
<td>180</td>
<td>375</td>
<td>80</td>
<td>470</td>
<td>135</td>
<td>45</td>
</tr>
<tr>
<td>The volume (minutes) - competition</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>335</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>360</td>
<td>-</td>
</tr>
</tbody>
</table>

**Data processing**

All results are processed by methods of descriptive and comparative statistics. In the field of descriptive statistics, measures of central tendency (arithmetic mean) and dispersion (standard deviation) were counted. In the field of comparative statistics, T-test for small dependent samples and with the statistical significance level $p < 0.01$ was used. All statistical calculations were done by the program IBM SPSS statistics version 19. USA.

**RESULTS**

Table 2 shows the arithmetic mean, standard deviation, maximum and minimum values of the initial and final testing. The values of the variables, the maximum jump height in the Vertical Jump, the maximum speed at 10 m, acceleration at 20 m, aerobic endurance, at the final test, can be compared with the values of female basketball players (juniors) from Australia (Stapff, 2000) where it can be concluded that the subjects have identical results in the maximum speed at 10 m, acceleration at 20 m and aerobic endurance, and worse results in maximum jump height in the Vertical Jump comparing to them.

The research findings show that between the arithmetic mean of initial and final testing, in almost all tests (Sit and reach, Sprint 10 m, Flying sprint 10 m, Sprint 20 m, T-test, Half-squat jump, YO-YO intermittent test) there is a statistically significant difference ($p < 0.01$). In relation to the initial and final testing, in Counter Movement Jump and Vertical Jump tests there is some improvement, but it is not statistically significant. Thus, the results indicate the effectiveness of a six-week training program on motor and functional skills of female junior basketball team of Serbia.
DISCUSSION

The greatest progress, when initial and final tests compared, was made in the endurance test (Yo-Yo intermittent test), there was improvement by 51.93%. It can be concluded that this ability developed most during the training focused on basic and specific running of high-intensity. Basic running included 4 x 4 minute intervals of repetitive consistent performance, with the heart frequency of 90-95% MHR, training was arranged four times a week (Marković, & Bradić, 2008). The specific running with high intensity (90% VO2max or 95% MHR) included 35-45 activities (Wenger, & Bell, 1986) in the main part of 7 individual workouts. The intensity and types of matches (Ben Abdelkrim, et al., 2007), may also have impact on this change. In the first phase of aerobic endurance workout that lasted 20 minute, running techniques were trained. Economical running leads to longer resistance to a certain intensity of sports activities or velocity increase at some time. The assumption is that economical movement changes in directly affect players’ endurance (Foran, 2010). In the final phase of the basic workouts of aerobic endurance, speed-strength muscular endurance exercises were done (running up the stairs at the maximum speed and high skipping 20 m x 5) in order to exhaust reserves of minimum glycogen in muscles so that the level of glycogen in muscles increases during super-compensation (Zeljaskov, 2004).

In the tests for speed and agility assessment there has been statistically significant progress between the initial and final testing and it equals to 4.65% in the test Sprint 10 m, 3.51% in the Flying sprint 10 m test, 3.35% in Sprint 20 m test and 6.95% in T-test. These changes can be ascribed to the positive effects of strength training and exercises for acquiring: running techniques, techniques for rapid changes of direction, techniques for swift passes, abrupt stops and goes, that were done 2 to 3 times a week in the first phase of the workout that lasted 20 minutes. Rectilinear sprint may be useful if bioenergy similarity taken into account, but that method for acceleration development has insufficient value in sports that abound in jerky stop and go movements, lateral movements, backward movements and various turns, where a player makes tactical decisions at the same time. Dynamic
demands are achieved in many directions, and unlike the rectilinear motion speed, they are much more dependent on eccentric muscle strength, dynamic balance (proprioception) and flexibility. It is assumed that workouts on basketball techniques also had a positive effect on these motor skills. For example, dribbling performance, known as crossover (explosive movement of reversible type of muscle contraction), dribbling known as crossing over (jerky direction change with one leg stepping forward just after making a swift explosive movement) (Foran, 2010).

The test for flexibility assessment indicates positive progress between the initial and final tests and equals to 9.74%. Statistically significant progress is a consequence of static and dynamic stretching. At the beginning of every workout, there was 5-minute dynamic stretching and at the end of every workout there was 10-minute static stretching, three sets of 10 - 15 seconds for each muscle group. The length of stretching depends on the objective: 10 to 15 seconds – muscle stretches, 30 seconds – muscle and muscle membrane stretch, 60 seconds – muscle, muscle membrane and tendon stretch (Foran, 2010).

The results of three tests assessing the strength of legs are different. In the test Half-squat jump there was statistically significant progress from the initial to final testing by 12.65%, while in the Counter Movement Jump and Vertical Jump tests progress is noticeable and equals to 1.4% and 4.19% from the initial to final testing, but is not statistically significant. In the test that did not require much movement coordination (half-squat jump) maximal muscular strength could be exerted, while in tests that required more coordination maximal muscular strength could not be achieved because of an improper performance of technique. Absolute strength workouts and dynamic stretching exercises have impact on explosive muscular strength of lower and upper limbs (Santos, & Janeira, 2012; Gelen, 2011). Athletes that have the maximum level of flexibility generate a lot of power in a high range of motion (Foran, 2010).

CONCLUSION

The main objective of this study was to identify the nature of changes in motor and functional skills of female basketball players of the junior national basketball team of Serbia, after the implementation of a six-week training program. After the implementation of a six-week training program, motor and functional skills of female basketball players have improved in the final testing compared to the initial testing, what explicitly show the effectiveness of implemented six-week training process. The changes in results of the selected tests prove the hypothesis.

In almost all the tests there is a statistically significant difference (p<0.01) between the arithmetic mean of the results of the initial and final measurements, while in only two tests - Counter Movement Jump and Vertical Jump there is a positive difference that is not statistically significant.

The greatest progress, when initial and final tests compared, was made in the endurance test (Yo Yo intermittent test), there was improvement by 51.93%. In the tests for speed, agility and flexibility assessment, there was also a statistically significant improvement (4.65% in the test Sprint 10 m, 3.51% in the test Flying sprint 10 m, 3.35% in Sprint 20 m test, 6.95% in T-test and 9.74% in Sit and reach test). The results of three tests assessing the strength of legs are different, only in the test Half-squat jump there was statistically significant progress (12.65%).

Conditioning coach in addition to the basic part should be familiar with the specifics of sports branches / discipline to be able to plan and program the intensity and volume of the technical and tactical workouts. Also, he needs to cooperate inevitably with the head coach in the planning and programming of training (choice of methods and means of training, periodization...).

Making of training programs, primarily, in relation to the components of the load, should be achieved on the basis of proper manifestation of energetic and motor patterns that occur during the competition / basketball game. In this way the basketball speed, agility, coordination, endurance, strength, flexibility are significantly improved, while basketball patterns of movement, and even requests for specific positions on the basketball team, are developed by using of specific exercises.
REFERENCES


EFFEKTE EINES SECHSWÖCHIGEN TRAINING PROZESSES AUF DIE MOTORISCHE UND FUNKTIONELLE FÄHIGKEIT VON BASKETBALLSPIELERINNEN

Zusammenfassung


Schlüsselwörter: TRAININGSPROGRAMM / TEST / GESCHWINDIGKEIT / BEWEGLICHKEIT / GEWANDTHEIT / KRAFT / AUSDAUER

Received: 14.01.2014.
Accepted: 25.04.2014.