THE EFFECT OF 5 WEEKS OF PLYOMETRIC AND SPEED TRAINING PROGRAM ON THE DEVELOPMENT OF CHOSEN SPECIFIC INDICATORS IN BASKETBALL

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Abstract

Study's objective was to find out the effect of the training programme on the development of speed, explosiveness and agility through selected tests.The programme focused on the development of different types of speed and agility and was applied to a group of 10 female playersof Premier League basketball team BDŽ ŠK UMB Banska Bystrica in Slovakia.The average age of the group was 20.4±2.2 years, the average body height was 170.3±7.7 cm and the average body weight was 64±6.9 kg.Fitro Agility Check Desk Test was the test of reaction rate in which a statistically and substantively significant difference was observed during the experimental period (T = 0, n = 10, p < 0.05, r = 0.63 - large effect).Similar situation was observed in the 5 metres linear acceleration running (t = 4.457, n = 10,p < 0.05, d = 1.41 - large effect) and in the 10 metres linear acceleration running (t = 5.775, n = 10, p < 0.05,d = 1.83 - large effect), where the significant improvement was identified.We observed the major improvement in the Countermovement Jump, which was confirmed also by the coefficients of statistical and substantive significance (t = -14.354 p < 0.05, d = 4.54).Modified Pro Agility Testalso showed the improvement (T = 11, n = 10, p > 0.05), which is confirmed by the substantive significance level = 0.38 -medium effect. Major improvement was not observed in the Lane Agility Test (t = 0.904, n = 10, p > 0.05, d = 0.29 - small effect).Considering this fact we state that selected intervention programme was suitable mainly for the development of reaction rate, agility, short-term change of direction speed and linear acceleration speed only within the shorter period of time, the major difference was not identified in longer period of time (more than 12 s) and in the introduction of bigger number of direction changes and activity character.

***Key words**: reaction speed, acceleration speed, straight-line speed, speed with change of direction*

Introduction

Game perforamce in basketball is influenced by the large number of factors. In this study we mostly deal with the development of reaction and linear acceleration rate, change direction speed, agility and explosiveness. In our geographical latitude, the analysis of selected condition parameters of basketball players was probably only done by Dobrý and Velenský (1980) a long time ago. According to theirstudy, the average length of speed sections on the offensive is 5.4 metres, on the defence 3.8 metres. The longest average distance, the player run during the release without the ball on the offensive, is 7.6 metres. They also declare that the player run about 5 - 7 kilometres during the match, he makes about 40 - 50 jumps, he changes the direction 640 x atthe most and changes the speed 440 x at the most. The results of the study with the similar purpose from 2002 (Schmidt & Benckendorff, 2003) in Germany during the Play-Off between teams Beyer Leverkusen and Frankfurt Skyliners have recorded the number of metres run by sprint on average 380 m on the offensive, from which 100 metres with dribling and 280 metres on the defence (backwards). Nielson in his presentantion (A Complete Basketball Player, 2014) refers to the fact that player run 43 - 174 sprints during the match in dependance on position, in which he plays. This implies the ability to sprint every 21 seconds. But only 5% of sprints are longer than 4 seconds. Boone and Bourgois (2013) found out that 1000 different types of movement occur during a match and the average duration is shorter than 3 seconds. They state that the change of direction takes place approximately every 2 seconds. According to Kaplan (2014) the fitness preparadness determines the game performance, while the speed section plays a very important role in the woman's basketball. In his article he points out that woman's national team of the Czech Republic on the World Championship in Turkey in 2014 couldn't perform quickly and dynamically enough in the game, according to him it was one of the reason why the team didn't succeed in the 1/8 finals play off match (at that time the CR was on the sixth place in FIBA ranking). Hoffman (2014) states that the significance of speed and agility is the essential success factor predominantly in anaerobic sports like basketball, ice hockey or football. It is defined by the ability of an individual to react to the changes of direction without the speed and accuracy loss. It includes short running with maximal effort and swift change of direction without the speed cut (or with the minimal speed cut). It has also been associated with the ability of movement conversion - so-called ability to shift from one movement pattern to another in the shortest time. It is for example the frequent transition of defensive player from running

backwards to running forwards, or from defensive movement to running forwards during the match. Speed, explosiveness and agility form an integral part of this sport and they correlate largely. It is difficult to separate these components from each other and to specify their boundaries more precisely. In research conducted on the basketball players of the First Women's League Krasňanská (2015b) demonstrates the large dependence between 5 metres acceleration running and 10 metres acceleration running (r = 0.8835) from the perspective of substantive significance. Large dependence was also found out between test on the device Fitro Agility Check Desk and 5m acceleration running (r = 0.6448) and between the Lane Agility Test and 10m acceleration running(r = 0.5473). On the basis of the measurement results large dependence was identified between 10m hurdle race and modified Pro Agility Test (r = 0.7666) and likewise between 10m acceleration running and 10 m hurdle race (r = 0.7085). Research Shalfawi et al. (2011) confirms the existence of significant dependence between explosive power and acceleration running performance and shows the correlation between vertical jump and runnings for a distance of 5, 10 and 40 metres. None of the 33 professional basketball players with the average age of 27 years showed differences. Due to that it was identified the dependence between runnings for a distance of 5, 10 and 40 metres in connection with vertical jump and vertical countermovement jump (Shalfawi et al. 2011). Young et al. (2002) dealt with the relationship between abilities of change of direction speed and explosive power of lower extremities. They chose the Drop Jump test in order to evaluate the levels of explosive power, which they compared with different variants of linear acceleration running and changes of direction running for a distance of 8 metres. Based on the measurement results they concluded that there exists significant correlation between explosive power of lower extremities (Drop Jump test) and these tests. Explosive power of lower extremities plays an essential role in short acceleration speed and in changes of direction. It is necessary to take into account other technical and external factors during testing as well. Young et al. (1995) at the same time claim that drop jump is one of the most recomended training methods of extensors in several sports that is needed to improve jump level and speed performances.The best contribution of this plyometric exercise is the reduction of contact time with pad. Ziv and Lidor (2010) through a study, which they carried out on the sample of 26 players of both sexes, came to the opinion that plyometric method is the most effective way to develop explosive power of lower extremities, which at present has already been used by the large number of coaches. Based on these findings the plyometrics will be included also in our intervention programme to some extent, which is cofirmed by other authors as well. For example Fleck, Kraemer (1997) claim that stretch-shortening cycle exercises are suitable for the improvement of explosive power or lightweight explosive exercises (30 - 60% 1RM) according to Newton et al. (1996) and Chu (1998). According to Craig (2004), plyometric exercises are used in starts, stops and changes of direction in the explosive way, which is at the same time part of agility development.

Methods

Subject sample

Target group of 10 subject consisted of female players of basketbal club BDŽ ŠK MBU Banská Bystrica, who actively play in the first women's basketball league in Slovakia.The average age of the group was 20.4±2.2 years, the average body height was 170.3±7.7 cm and the average body weight was 64±6.9 kg.

Sampe of measuring instruments

In the main part of one-year training cycle, surveyed basketball players showed the impact of 5-week intervention programme on the development of reaction rate, linear acceleration speed, change of direction speed, agility and explosive power. The training programme consisted of several types of speed exercises and plyometrics. Selected indicators were measured through following tests:

Fitro Agility Check Desk Test:

Player stands in the middle of the square (plates distribution - 0.5m^2) and at visual signal she tries to step on the plate chosen by computer. 20 inputs were chosen, from which we remove 5 best and 5 worst results and the final value is achieved by averaging other results (data are listed in miliseconds). Test is the indicator of reaction rate.

Countermovement Jump - vertical countermovement jump with the activity of both upper extremities:

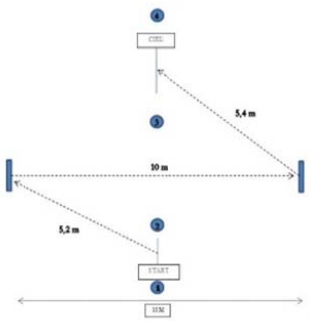
This test is measured through the Myo device, attached to a belt, which records the height of repeated vertical jump (in centimetres).The test tells about explosiveness of lower extremities, while arms range are not depicted in the result, there is only showed the actual height of vertical jump. The tested person stands in the place and at audio signals she does vertical countermovement jump 5 times, while using the activity of both arms simultaneously. We get result after we remove the best and the worst value and the remaining values are averaged. The test is an excellent indicator for measuring the level of explosive power of lower extremities.

5 metres acceleration linear running: Starting position is the half-high standing start, related to the character of game activity. Foot lies 25 centimetres in front of the starting line (knee is on the level of the starting line) and photocells are placed at waist height (potentially slightly below). The role of test subjects is to run a certain distance with maximal effort, it is done 2 times, results are recorded in seconds (two decimals) through mobile photocells. Every player starts by herself according to her feelings. Test is the excellent instrument for

measuring short acceleration speed, in which the level of explosive power of lower extremities plays an important role.

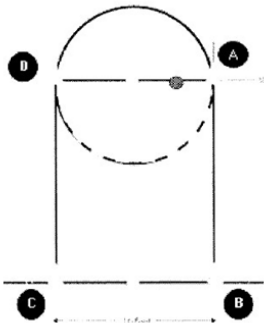
10 metres acceleration linear running: Starting position is the half-high standing start, related to the character of game activity. Foot lies 25 centimetres in front of the starting line (knee is on the level of the starting line) and photocells are placed at waist height (potentially slightly below). The role of test subjects is to run a certain distance with maximal effort, it is done 2 times, results are recorded in seconds (two decimals) through mobile photocells. Every player starts by herself according to her feelings. Test is the excellent instrument for measuring short acceleration speed, in which the level of explosive power of lower extremities plays an important role.

Modified Pro Agility Test:
Modified version of Pro Agility Test was carried out for technical reasons. This test is normally good indicator of abilities to quickly change direction at the shortest time and greatly demonstrate the level of agility in basketball. The distance between photocell no. 1 and no. 2 is 1 metre, between photocell no. 2 and no. 3 are 2 metres and between photocell no. 3 and no. 4 are 2 metres. Other figures are shown in the pic. 1. The role of subjects is to start as quickly as possible to the left side marker, touch it by foot, keep running to the right side marker, also touch it by foot and reach the goal (or vice versa). Test is carried out twotimes; results are recorded in seconds (two decimals) through mobile photocells. Test belongs to the traditional battery of so-called agility tests (we know its course in advance).



Picture 1: Modified Pro Agility Test (Krasňanská, 2015a)

Lane Agility Test:
Test is very good indicator of abilities to quickly change direction at the shortest time and greatly demonstrate the level of agility in terms of change of direction speed in basketball. Participants began in a staggered stance with one foot just behind cone A at the starting line (Figure 2). On his/her own volition, the subject sprinted forward towards cone B starting the timer when crossing the beam. At cone B, the subject side-shuffled to the right towards cone C, then back pedaled to cone D. At coneD, subjects side shuffled to cone A. At cone A, subjects had to ensure their outside foot cleared an extension of the free throw lane line. Without a pause, subjects then reversed their direction and sideshuffled to the right back to cone D. At coneD, participants sprinted forward towards cone C, then side-shuffled towards cone B. Lastly, they finished with a back pedal through the beam at the finish line, stopping the timer. Each subject remained facing the baseline the entire trial (Brown, 2012).
Test is carried out 2 times, results are recorded in seconds (two decimals) through mobile photocells.



Picture 2: Lane Agility Test (Brown, 2012)

Jugo Test:
Test belongs to specific basketball tests when player shoots at the basket from 10 different positions. 5 positions are located 6.25 metres from the basket, other 5 positions are situated 4.25 metres at the line between more distant marker and basket (Pupiš et al., 2011). After shooting, player runs under the basket for a new ball and he/she shoots for 2 minutes.

The number of shot attempts is counted (for specific basketball purposes and success rate). Test is the indicator of short anaerobic endurance. By means of described tests reseasrch measurements were carried out three times:

1. testing - the beginning of the control period
2. testing - the end of the control period = the beginning of the experimental period
3. testing - the end of the experimental period

Within the implementation of intervention programme were incorporated profesionally selected stimuli into training units in order to develop various types of speed for the duration of 25 - 30 minutes at the beginning of the training, three times a week, for a period of 5 weeks (5 microcylces, 1 mesocycle). Training stimuli comprised of plyometric exercises, exercises on the development of reaction rate, acceleration linear speed, frequency rate and various exercises focused on the development of change of direction speed. Each of these parts had its representation to a greater or lesser extent during individual phases of experimental period.

Considering the fact that we tried to make speed abilities more effective, we were guided by following rules:

- work interval (WI) = the lenght of individual sections was measured in order not to exceed 6 seconds
- rest interval (RI) was selected in a ratio of 1:30 every time
- exercises in every training unit were arranged in following order:
  - plyometric exercises
  - frequency exercises
  - linear runnings
  - change of direction exercises
- reaction stimuli were also part of these exercises in dependence on particular training method
- order in some training units (TU) was sligthly modified, which had principally related with the fact that length of one exercise was shorter than the length of another one
- we always followed the rule that the shortest time periods and reaction rate exercises are put into the beginning of the training unit within the limits
- on the contrary, longer exercises (5 - 6 seconds) are placed in the end

There were put these particular stimuli within individual training units:

- *plyometric exercises* (we initially selected the height about 25 - 30 centimetres, considering the fact that it is now the value of real jump of a given group): from standing up with legs together jump to standing up on one leg and then jump up on an raised platform, jump down from the higher plyobox and then jump up on the lower one, jumps into sprint, jumps from plyobox - jump over lower hurdle - jump over higher hurdle - potentionally jump over another lower hurdle, jumps up on plyobox on one leg, on both legs, jumps from raised platform, jump over and short sprint
- *frekvency exercises:* jumps between markers, lines, runnings across frequency ladder - linear, sideways, backwards, rotating, alternating jumps and climbing the stair, hopping between markers and jump over higher hurdle, hopping with legs together, frequency jumps up towards basket board, running against the wall
- *acceleration runnings forwards (and backwards) without change of direction:*on various initiatives, or after jump, chase for a distance of 10 metres - one player stands 1.5 metre in front of another one - the back one tries to catch the front one
- *change of direction exercises + agility:* running from the appointed place towards two cones (choice of 5 cones, coach determines the number of cone and player has to quickly evaluate the situation, run to the cone linearly, defensive movement backwards), 3-Cone Drill, six-round drill (running from the corner of the free throw line into the cross linearly, +defensive movement sideways, running backwards to the second corner of the free throw line, defensive movement to the starting point), running forwards - defensive movement sideways - forwards - defensive movement sideways, passing two cones (2 metre distance) facing the same direction in defensive position, hexagon (running forwards from the centre marker - step on marker - running backwards, markers are placed from the centre at a distance of 2 metres and at the corners of notional hexagon, running from the half of the court towards basket, get a pass and do a lay-up, radial runnings, horizontal eight - constantly facing the same direction, running from the starting point towards notional rectangle (distance 2 metres) - linear running there, defensive movement backwards, running around central circle - beginning at the join of circle and center line, running directly along the center line, change of direction at the second join and continue along the circumference of a circle - return to the starting point
- running along the same line and then along the second side of the circle, jumps over the sides of notional hexagon, runnings with change of direction in different places, change of direction with passing the opponent, sudden braking, indication of shooting
- *rubber rope* (brake): due to the fact that we had only one such tool, players take turns so that to keep RI, that means every player skipped one set from some exercise during the TU

Detailed exercise schedule is available at authors of the article.

Within the study we used arithmetic mean (x) from the measure of location and (standard) deviation of difference (SD) from the measure of variability in terms of depictive characteristics of descriptive statistics. Normality of data distribution was assessed through Shapiro-Wilkov test. We used the Wilcoxon test for non-parametric distribution and paired t test for parametric data distribution to find out the significance of differences between results. Probability of error of first kind was defined as $\alpha = 0.05$ for all statistical analyses. We used Cohen's coefficients "d" and "r" for the calculation of substantive significance (effect size).

The coefficient "d" was calculated according to formula $d = |M|/SD$, where M represents mean of differences and SD represents deviation of differences; Yatani, 2015).

Coeffiecient was interpreted as follows:

- d = 0.20 – small effect,
- d = 0.50 – medium effect,
- d = 0.80 – large effect (Cohen, 1988).

The effect size coefficient (r) was calculated according to the formula $ES (r) = |z|/\sqrt{n}$ (Corder & Foreman, 2009) and was interpreted as follows:

- d = 0.10 – small effect,
- d = 0.30 – medium effect,
- d = 0.50 – large effect (Cohen, 1988).

The statistical analysis was carried out by software IBM® SPSS® Statistics V19 (Statistical Package for the Social Sciences).

Results and discussion

The results of individual tests carried out on the sample of basketball female players from Banská Bystrica points out to the improvement in the level of given conditions during the experimental period, what confirms the adequacy of selected training methods and tools. In this part we show particular results and conditions changes during the control and experimental period.

Fitro Agility Check Desk Test
We didn't observe significantdifferences in the parameter diagnosed by the Fitro Agility Check Desk device during the control period (T = 16, n = 10, p > 0.05), what also confirms the effect size coefficient, which was r = 0.26 and this implies that it is a small effect. Abilities of players were at similar level during the control period (table 1). During the experimental period we observed a large effect both statistically and in terms of substantive significance (T = 0, n = 10, p < 0.05, r = 0.63 - large effect). In practise it means that there was a major improvement during the experimental period (table 1).

Table 1: Fitro Agility Check Desk Test:

Test	x	SD	p / ES
FITRO 1	608.6	41.7	p > 0.05
FITRO 2	594.9	31.7	r = 0.26 – small effect
FITRO 2	594.9	31.7	p < 0.05
FITRO 3	562.8	32.4	r = 0.63 – large effect

x – arithmetic mean
SD – standard deviation of difference
p – significance level
ES – substantive significance - effect size

Countermovement Jump
We didn't observe statistically major differences in the Countermovement Jump test during the control period (t = -1,927, n = 10, p > 0,05). In terms of substantive significance, we observed value of the effect size coefficient, at the level d = 0.61 and it shows that it is a medium effect (table 2).

During the experimental period we observed a large effect both statistically and in terms of substantive significance (t = -14.354 p < 0.05, d = 4.54). In practise it means that there was a major improvement during the experimental period (table 2).

Table 2: Countermovement Jump

Test	x	SD	p / ES
CMJ 1	29.91	2.03	p > 0.05
CMJ 2	30.34	2.08	d = 0.61 – medium effect
CMJ 2	30.34	2.08	p < 0.05
CMJ 3	34.99	2.040	d = 4.54 – large effect

5 metres acceleration running
We didn't observe significant differences in the 5 m acceleration running during the control period (t = 0.339, n = 10, p > 0.05), what also confirms the effect size coefficient, which was d = 0.11 and this shows that it is a small effect. Abilities of players were at similar level during the control period (table 3). During the experimental period we observed a large effect both statistically and in terms of substantive significance (t = 4.457, n = 10, p < 0.05, d = 1.41). In practise it means that there was a major improvement during the experimental period (table 3).

Table 3: 5 metres acceleration running:

Test	x	SD	p / ES
5M RUNNING 1	1.16	0.08	p > 0.05
5M RUNNING 2	1.15	0.08	d = 0.11– small effect
5M RUNNING 2	1.15	0.08	p < 0.05
5M RUNNING 3	1.06	0.05	d = 1.41 – large effect

10 metres acceleration running
We didn't observe significant differences in the 10 m acceleration running during the control period (t = -1.309, n = 10, p > 0.05), what also confirms the effect size coefficient, which was d = 0.41 and this shows that it is a small effect. Abilities of players were at similar level during the control period (table 4). During the experimental period we observed a large effect both statistically and in terms of substantive significance (t = 5.775, n = 10, p < 0.05, d = 1.83). In practise it means that there was a major improvement during the experimental period (table 4).

Table 4: 10 metres acceleration running

Test	x	SD	p / ES
10M RUNNING 1	2.01	0.11	p > 0.05
10M RUNNING 2	2.03	0.11	d=0.41–small effect
10M RUNNING 2	2.03	0.11	p < 0.05
10M RUNNING 3	1.91	0.08	d= 1.83–large effect

Modified Pro Agility Test
Modiefied pro Agility Test couldn't be implemented in test group before the beginning of the control period. During the experimental period we didn't observe any statistically significant difference (T = 11, n = 10, p > 0.05). We observed a medium effect (r = 0.38) in terms of substantive significance what points out to the fact that there was an improvement during this period (table 5).

Table 5: Modified Pro Agility Test

Test	x	SD	p / ES
PRO 1	5.28	1	p > 0.05
PRO 2	5.39	0.1	d = 0.11 – small effect

Lane Agility Test
We didn't observe significant differences in the Lane Agility Test during the control period (t = 0.603, n = 10, p > 0.05), what also confirms the effect size coefficient, which was d = 0.19 and this shows that it is a small effect. Abilities of players were at similar level during the control period (table 6).
However, during the experimental period wedidn't observe any statistically major difference (t = 0.904, n = 10, p > 0.05) as well. We observed a small effect (d = 0.29) in terms of substantive significance what confirms the fact that there also wasn't a major improvement during the experimental period (table 6).

Table 6: Lane Agility Test

Test	x	SD	p / ES
LANE 1	12.90	0.42	p > 0.05
LANE 2	12.83	0.47	d = 0.19 – small effect
LANE 2	12.83	0.47	p > 0.05
LANE 3	12.72	0.50	d = 0.29 – small effect

Jugo Test
We didn't observe significant differences in the Jugo Test during the control period (T = 0, n = 10, p > 0.05). Effect size coefficient was r = 0.37 what shows that it is a medium effect. So there was a slight improvement during the control period (table 7).
During the experimental period we didn't observe statistically signififcant difference (T = 3, n = 10, p > 0.05) as well. We didn't observe any difference (r = 0) in terms of substantive significance, what confirms the fact that there was not any improvement during this period (table 7).

Table 7: Jugo Test

Test	x	SD	p / ES
JUGO 1	23.3	1.25	p > 0.05
JUGO 2	23.7	1.64	r = 0.37 – medium effect
JUGO 2	23.7	1.64	p > 0.05
JUGO 3	23.7	1.89	r = 0 – small effect

The reason for the implementation of the research was the fact that speed abilities, explosiveness and agility subside during the season due to the lack of adequate training tools.Because of that we dediced to create a training programme which would result in the greatest increases at the shortest time possible within the development of these abilities. We selected the period of 5 weeks considering the fact that 4 weeks are regarded to be the minimum period necessary to achieve effective improvement. To implement particular exercises we tried to follow this plan and include factors that we evaluated as really effective within a short period of time. Because of that we tried not to exceed the duration of 30 minutes in the training, three times a week. So we looked for the least time-consuming activity which *would bring the greatest benefit in a short period of time.* This idea arose particularly due to the reason that basketball coaches have to include huge number of specific and non-specific factors into the TU during the season and they doesn't have too many opportunities for the adequate development of all condition, coordination and basketball abilities and skills.

As part of our research we used tests which we selected as appropriate indicators to find out the level of given parameters for women. In basketball we regard reaction and action ability to change the direction as important and because of that we included measurment of the Fitro Agility Check Desk. We can consider explosivness and the associated ability to do repeated rebounds either under basket or anywhere on the court to be limiting factors. We used Countermovement Jump Test diagnosed by the Myo device to measure this ability. Further we investigated short-area linear speed, of which 5 metres acceleration linear running and 10 metres acceleration linear running were indicators. We regard abilities of reaction and agility as important as well. Measurement on the Fitro Agility Check Desk device is just combination of these abilities, which demonstrates the reaction and action ability of players and at the same time puts emphasis on the change of direction and conditions.Modified Pro Agility Test and Lane Agility Test were indicators of change of direction speed, partialy combined with the anaerobic alactacid ability (in the Lane Agility Test). Jugo Test was an additional test through which we wanted to evaluate indirect influence of training programme on the development of short anaerobic endurance. Selected training programme, despite its relatively short duration, showed significant effect on the improvement of majority of given indicators, so we think that we met appointed objective. Significant improvement was achieved (T = 0, n = 10, p < 0.05, r = 0.63 - large effect) in a test carried out on the Fitro Agility Check Desk device, in both linear acceleration running tests (*5 m*: t = 4.457,n = 10,p < 0.05, d = 1.41 - large effect;*10 m:* t = 5.775, n = 10, p < 0.05, d = 1.83 - large effect),and in the Pro Agility Test (T = 11, n = 10, p > 0,05), what confirms the level of substantive significance r = 0.38 - medium effect. Probably the greatest improvement was in the Countermovement Jump (improvement on average by 4.65 cm), what is confirmed also by the huge effect size coefficient (d = 4.54 - large effect). However, in our study we came to the conclusion that the development of speed abilities can not sufficiently influence the development of the abilities in which anaerobic alactacid mechanism is also evident source of energy (primary source remains creatine phosphate). Results of the Lane Agility Test (t = 0.904, n = 10, p > 0.05, d = 0.29 - small effect)are an example of this finding, but it is not speed test in the true sense considering the fact that averaged achieved times were above 12 seconds in both control and experimental period.

We especially selected this test to find out to what extent the development of speed without the planned training of anaerobic short endurance will influence these differences. Within additional Jugo Test, that wasn't primarily selected test, we found out that given training programme didn't indirectly influence the development of the short anaerobic endurance ($T = 3$, $n = 10$, $p > 0.05$, $r = 0$), which is stressed by the fact that there was not any major improvement even in the Lane Agility Test, which is quite shorter than Jugo Test, however we observed only small improvement. Considering the fact that some players were injured or ill during the testing, it was imposible to collect more results. The implementation of such research is complicated in our circumstances. The biggest problems are the lack of subjects and time aspect. To select period of at least 10 successive months is difficult in this sport. The squat is not usually complete at the beginning of the ATC (August-September), also the level of these abilities is relatively well developed because in terms of training they are at the height of their development at the end of this period. In following months the level of speed abilities still remains at very good level and according to coaches these abilities subside during December. This month would be an optimal beginning of the research but such control period wouldn't be adequately assessed due to time off (holidays). Because of that we selected the end of the season as the control and experimental period, when the frequency of matches is similar and there is no long-term time off. However, in terms of implementation of given exercises it is possible to include programme in any period. We especially selected the end of the season from the scientific and methodologically permissible aspect. Therefore the most adequate period to examine the intervention programmes in basketball is considered to be the period after the New Year which we can recommend it. For the future it would be appropriate to get more subjects but if we want to maintain homogeneity and keep all research conditions, this aim will be a big challenge and hardly feasible. In general we can evaluate that we were able to collect results of 10 subjects mainly thanks to the effort and willingness of the coach, players and implementated team, what we regard as a success in this sport.

Conclusion

Study results shows the positive influence of the training programme on the speed development. The biggest difference was identified in the Countermovement Jump and the Modified Pro Agility Test. We think that the reason of this improvement was the number of plyometric exercises in the training units. However, we did not observe any significant difference during the experimental period in the Lane Agility Test and the Jugo Test. This result is explained by the fact that the duration of the test was on average longer than 12 seconds. Our programme was primarily applied to the short-area speed up to 6 or 8 seconds.

According to some authors (Dovalil et al., 2009) the duration of 12 seconds is still considered to be the speed zone but at present we follow shorter period of time and because of that we focused our programme on the short-area speed. This explains the fact that we didn't observe major improvement in the Lane Agility Test. Providing that you are interested in this study, you can take a look in the content of all training units at the authors of the article.

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UČINAK 5 TJEDANA PLIOMETRIJE I PROGRAMA TRENINGA BRZINE NA RAZVOJ ODABRANIH SPECIFIČNIH INDIKATORA U KOŠARCI

Sažetak

Cilj istraživanja bio je pronaći učinak programa treninga na razvoj brzine, eksplozivnosti i pokretljivosti kroz odabrane testove. Program se fokusirao na razvoj različitih vrsta brzine i pokretljivosti i bio je primijenjen na skupinu od 10 igračica Premier lige košarkaškog tima BDŽ ŠK UMB Banska Bystrica u Slovačkoj. Prosjean uzrast skupine bio je 20.4±2.2 godine, prosječna tjelesna visina bila je 170.3±7.7 cm i prosječna tjelesna težina bila je 64±6.9 kg. Fitro Agility Check Desk Test bio je rest brzine reakcije, u kojem je promatrana statistički i postupno značajna razlika za vrijeme eksperimentalnog razdoblja (T=0, n=10, p<0.05, r=0.63 - veliki učinak). Slična situacija promatrana je u linearnom ubrzanom trčanju na 5 metara (t=4.457, n=10, p<0.05, d=1.41 - veliki učinak) i u linearnom ubrzanom trčanju na 10 metara (t=5.775, n=10, p<0.05, d=1.83 - veliki učinak), gdje je identificiran značajan napredak. Zapazili smo veliki napredak u vertikalnom skoku, što je također potvrđeno koeficijentima statističkog i nezavisnog značaja (t= -14.354, p<0.05, d=4.54). Modified Pro Agility Test također je pokazao napredak (T=11, n=10, p>0.05), što je potvrđeno nezavisnom razinom značaja = 0.38 -srednji učinak. Veliki napredak nije opažan testom pokretljivosti na stazi (t=0.904, n=10, p>0.05, d=0.29 -malen učinak). Uzimajući u obzir ovu činjenicu, tvrdimo da je odabrani program posredovanja bio podoban uglavnom za razvoj brzine reakcije, pokretljivosti, kratkotrajne promjene brzine smjera i linearnog ubrzanja samo unutar kratkog vremenskog razdoblja. Glavna razlika nije identificirana u duljem vremenskom razdoblju (dulje od 12 s) i u uvodu većih brojeva promjena brzine i karaktera aktivnosti.

Ključne riječi: *brzina reakcije, brzina akceleracije, brzina na ravnoj stazi, brzina s promjenom smjera*

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