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DIFFERENCES IN THE DEVELOPMENT OF THE MOTOR ABILITIES OF YOUNG ELITE EUROPEAN AND SLOVENIAN FEMALE BASKETBALL PLAYERS

RAZLIKE V RAZVITOSTI MOTORIČNIH SPOSOBNOSTI VRHUNSKIH (TOP) EVROPSKIH IN SLOVENSKIH MLADIH KOŠARKARIC

ABSTRACT

The aim of the study was to analyse and compare the development levels of certain motor abilities of young elite European and Slovenian female basketball players. The sample of subjects consisted of 48 female basketball players, aged between 14 and 15, who were divided into two groups (23 players from nine European countries competing in Division A of the European Championship and 25 Slovenian players competing in Division B of the European Championship). Using eight motor tests, we investigated the following motor abilities: acceleration and agility (with the ball and without it), explosive strength of the arms and take-off power. Basic descriptive statistics were calculated for both groups of subjects and the differences between them were established using T-tests for independent samples. The study results showed that the elite European female basketball players achieved better results in the tests of explosive strength of the arms, while acceleration, agility and take-off power were relatively equal in both player groups. In our opinion, the relatively highly developed motor abilities and higher values of body height, body mass and number of playing years contribute considerably to the better playing performance of the Division A players compared to their counterparts from the Slovenian national team.

Key words: basketball, women, motor tests, differences

IZVLEČEK

Namen raziskave je bil analizirati raven razvitosti nekaterih motoričnih sposobnosti najboljših evropskih in slovenskih mladih košarkaric in jih primerjati med seboj. V vzorec merjenk smo zajeli 48 košarkaric starih 14 in 15 in jih razdelili v dve skupini (23 košarkaric iz 9-ih evropskih držav, ki nastopajo v A diviziji evropskega prvenstva, 25 slovenskih košarkaric, ki nastopajo v B diviziji evropskega prvenstva). S pomočjo osmih motoričnih testov smo izmerili predvsem naslednje motorične sposobnosti merjenk: hitrost pospeševanja in agilnost (z žogo in brez), ter eksplozivno moč nog in rok. Za obe skupini merjenk smo izračunali osnovne podatke opisne statistike, za ugotavljanje razlik njima pa smo uporabili T-Test za neodvisne vzorce. Rezultati raziskave so pokazali, da najboljše evropske košarkarice dosegajo boljše rezultate v testih eksplozivne moči rok, raven hitrosti pospeševanja, agilnosti (z žogo in brez) ter eksplozivne moči nog pa je pri obeh skupinah igralk dokaj izenačena. Relativno visoka raven razvitosti motoričnih sposobnosti ob dominantnosti v telesni višini, teži in stažu treniranja po našem mnenju precej prispevajo k igralni uspešnosti oz. boljšim rezultatom igralk divizije A v primerjavi z njihovimi vrstnicami iz slovenske reprezentance.

Ključne besede: košarka, ženske, motorični testi, razlike

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INTRODUCTION

Basketball is a relatively multifaceted and complex team game combining cyclic and acyclic movement structures, which mainly consist of fast and dynamic movements with the ball and without it (Erčulj, 1998). Play is characterised by many explosive movements such as short sprints, abrupt stops, fast changes in direction, acceleration, different vertical jumps as well as shots with and passes of the ball (Zwierko & Lesiakowski, 2007; Erčulj, Dežman, & Vučković, 2004). The successful and efficient execution of all these movements and, consequently, the playing performance of female basketball players of different age categories chiefly depend on several motor factors (explosive strength of the legs, strength of the arms and shoulder girdle, agility with the ball and without it, co-ordination, speed of single and alternate movements) (Brack, 1985; Erčulj, 1998; Stone, 2007; Erčulj & Bračič, 2007); physiological factors (anaerobic lactate and alactate capacities) (Jukić, Milanović & Vuleta, 2005; Stone, 2007) and also morphological factors (especially length dimensions) (Erčulj, 1998; Trninić, Dizdar & Dežman, 2000; Karpowitz, 2006).

Explosive strength, speed and agility are those abilities that significantly contribute to efficient movement with the ball and without it and play a major role in technical and tactical basketball elements. The level of these abilities, i.e. the motor potential, is most often identified using various motor tests with the ball and without it (Colli et al., 1987). In broader basketball practice, motor tests are the most available and applicable tests as they are implemented in conditions similar to those of training or competition. The systematic monitoring of male and female players' abilities by the use of motor tests is generally helpful as regards the following (Dežman & Erčulj, 2005): monitoring and controlling the efficiency of the training process; monitoring the development of the motor abilities of players; determining the motor potential of players as well as its use during a game; selecting players and guiding them into appropriate playing roles (positions); creating a database at different quality levels (in the case of a standard test battery); and setting norms for players of different ages and for all three playing positions (guard, forward and post).

At the Faculty of Sport in Ljubljana, we have been systematically monitoring the motor abilities of elite young Slovenian basketball players for several years now. We have created an extensive database and, on that basis, established norms for different age categories and playing positions. This enables a comparison between different generations of players and, consequently, an evaluation of the results they achieve during training.

Until recently, the motor abilities of elite Slovenian basketball players could not be compared with the motor abilities of their counterparts with highly developed basketball skills from other countries nor could they be evaluated on an international scale. Last year and this year, the FIBA International Basketball Camp that was organised in Slovenia for female players up to 15 years of age turned out to be a window of opportunity. In agreement with FIBA Europe and the Basketball Federation of Slovenia, in two years we tested 75 foreign female basketball players from 19 European countries and 30 Slovenian female basketball players during the mentioned basketball camp.

The study aimed to establish the level of motor abilities or motor potential of the top quality young European female basketball players aged between 14 and 15 who compete with their national teams at the top competition level (Division A). Moreover, their motor potential was compared to the potential of elite Slovenian female basketball players of the same age who compete at a lower competition level (Division B). To our knowledge, no study has yet been conducted that investigates motor abilities using a sample of female basketball players of such high quality from so many different countries. The data on the structure and level of the motor abilities of female basketball players of such high quality are no doubt highly significant for both basketball theory and practice.

METHOD

Participants

The study sample consisted of 48 basketball players aged between 14 and 15. They were all tested during two international basketball camps held in Postojna, Slovenia. The camps took place from 25 to 30 June, 2007 and from 6 to 11 June, 2008 and were organised by the international basketball organisation FIBA Europe and the Basketball Federation of Slovenia. All players were healthy and had no injuries.

The sub-sample consisted of 25 Slovenian female basketball players, members of the Slovenian national team. The national team competes in the second-level group (Division B) of the European Championship. The selected female basketball players included 11 guards, eight forwards and six posts. Their average age was 14.60 ± 0.50 years, body height 166.37 ± 8.20 cm, body mass 55.98 ± 10.47 kg and number of playing years 3.92 ±1.80.

The foreign basketball players came from nine European countries (the Czech Republic, France, Belgium, Hungary, Spain, Turkey, Latvia, Italy and Germany) and competed in the top-level group (Division A) of the European Championship. Each country was represented by minimally one player and maximally four players. As a rule, these were the top players in their countries and were chosen by their national team selectors. The selected players included 10 guards, six forwards and seven posts. Their average age was 14.70 ± 0.47 years, body height 175.32 ± 7.94 cm, body mass 63.98 ± 7.67 kg and number of playing years 5.70 ±2.20.

Instruments

The study was based on a test battery consisting of eight motor tests that were used for the evaluation of the players' selected motor abilities. All selected tests are proven instruments in a sense of reliability and accuracy (Dežman, 1988; Erčulj, 1996). Co-efficients of reliability in all cases exceed 0.90 (Crombach alpha ≥ 0.93, Lambda 6 ≥ 0.90). Also, a high level of accuracy was confirmed with help of factor analysis.

Table 1: Description of the sample of variables of the motor tests

Code	Test	Main ability	Unit
CMJ	Counter-movement jump	Take-off power	Jump height [cm]
CMJH	Counter-movement jump with hands	Take-off power and inter-muscular co-ordination	Jump height [cm]
S20	20 m sprint	Acceleration and cyclic speed	Run time [sec]
D20	20 m sprint dribble	Acceleration and cyclic speed with the ball	Run time [sec]
S6x5	6 x 5 m sprint	Agility (changing of direction by 180°)	Run time [sec]
D6x5	6 x 5 m sprint dribble	Agility (changing of direction by 180°) with the ball	Run time [sec]
BBT	Women's basketball throw (size number 6)	Explosive strength of the arms and acyclic speed	Throw length [cm]
MBT	Medicine ball throw (2 kg)	Explosive strength of the arms	Throw length [cm]

Procedure

Before the tests were carried out, the co-ordinator guided the players in their warming up (about 25 minutes). The players were then divided into groups of three players each and arranged among five stations where they performed the tests. Two evaluators were working at each station. The subjects moved from one station to another and performed each test three times.

The height of the vertical jumps was measured using the OptoJump measurement technology (Microgate, Italy). This proven measurement system (Lehance, Croisier, Bury, 2005) from a respected manufacturer uses optical sensors to measure the jump height on the basis of flight time. The measurement accuracy is ± 1 mm. The evaluator first demonstrated both tests (jumps) for each study subject and indicated the important details related to the performance of the test. The subject performed the counter-movement jump (CMJ) by stepping with both feet into the OptoJump area and jumping. She was instructed to drop as fast as possible into a semi-squat (knee angle of 90°) and to push off vertically as fast and high as possible without her hands (by keeping her hands on her hips from the beginning to the end of the jump – until landing). The aim was to jump as high as possible. The height of the jump was measured in centimetres. The subject performed the counter-movement jump with hands (CMJH) by stepping with both feet into the OptoJump area and jumping. She was instructed to drop as fast as possible into a semi-squat (knee angle of 90°) and to push off vertically as fast and high as possible, swinging both arms. The aim was to jump as high as possible. The height of the jump was measured in centimetres.

Prior to performing the acceleration and cyclic speed test (S20), the study subject was instructed to assume a high-start position behind the start line. She had to start as fast as possible and run to the finish line. The measurement was carried out using a system of infra-red photocells (Brower Timing System, USA). The photocells were located at the start and at the finish (20 m). The time of the run was measured in seconds, with an accuracy of ± 0.01 sec.

The test of acceleration and cyclic speed with the ball (D20) was performed in the same way as the S20 test, the only difference was that the subject moved with the ball (dribbling). First, she dribbled the ball with her non-dominant hand and switched hands after 10 m when she started dribbling with her dominant hand until the finish line. The measurement was carried out using the system of infra-red photocells (Brower Timing System, USA). The photocells were located at the start and at the finish (20 m). The time of the run with ball dribble was measured in seconds, with an accuracy of ± 0.01 sec.

The women's basketball throw (BBT) and medicine ball throw (MBT2) tests were performed with the study subject sitting on a chair. She supported her body by wrapping her legs around the chair legs. When throwing the (medicine) ball, she had to keep her back in contact with the back of the chair. Any counter-movement with the ball was not allowed. The aim was to throw the (medicine) ball as far as possible with both hands from the chest. The size of the ball was 6, while the medicine ball weighed 2 kg. The length of the (medicine) ball throw was measured using a measuring tape which was fastened on the floor in the direction of the throw. The length of the throw was measured in centimetres, with an accuracy of ± 0.01 m.

Prior to performing the 6 x 5 m sprint test (S6X5) the study subject was instructed to assume a high-start position behind the start line. At the evaluator's signal she ran to a line, stopped on one foot, turned around, and ran back to the start line. When turning around, the study subject used the leg that was designated by the evaluator and turned 180° in the direction which was also designated by the evaluator. The length of run with the changing of direction was 6 x 5 m. The measurement was conducted using a hand stopwatch. The time of the run was measured in seconds, with an accuracy of ± 0.1 sec.

The test of 6 x 5 m run (D6X5) was performed in the same way as the S6X5 test, the only difference was that the subject moved with the ball (dribbling). When changing direction, she stopped with the leg that was the opposite of the hand with which she dribbled the ball. Along with the change of direction, the subject also changed the dribbling hand. The length of the run with ball dribbling was 6 x 5 m. The measurement was conducted using a hand stopwatch. The time of the run was measured in seconds, with an accuracy of ± 0.1 sec.

The data were processed using the SPSS 15.0 statistical software for Microsoft Windows. The following statistical data were calculated for both sub-samples of subjects: mean value, standard deviation, and minimal and maximal results. The differences between the groups of foreign and Slovenian female basketball players were established with T-tests for independent samples. The statistical significance of the differences was established at a 5% risk level.

RESULTS

The basic parameters of descriptive statistics were used to establish the basic characteristics and abilities of the study subjects and T-tests were used to identify the differences between both groups of basketball players.

Table 2: Descriptive statistics

	Group	N	Mean	Std. Dev.	Std. Error Mean	Min.	Max.
S20	DivA	23	3.603	.209	.043	3.19	3.97
	SLO	25	3.596	.123	.024	3.36	4.06
D20	DivA	23	3.854	.306	.063	3.27	4.55
	SLO	25	3.860	.164	.032	3.48	4.50
BBT	DivA	23	755.223	61.855	12.898	650	870
	SLO	25	653.604	74.548	14.910	540	940
MBT	DivA	23	477.834	58.617	12.223	410	720
	SLO	25	409.205	47.690	9.538	330	580
S6X5	DivA	23	9.497	.519	.108	8.75	10.58
	SLO	25	9.590	.558	.111	8.50	11.19
D6X5	DivA	23	10.209	.726	.151	9.19	12.08
	SLO	25	10.093	.544	.108	9.00	11.60
CMJ	DivA	23	26.343	5.149	1.073	17.1	42.1
	SLO	25	27.812	3.847	.769	21.3	34.8
CMJH	DivA	23	32.035	6.033	1.258	23.2	51.6
	SLO	25	32.260	4.049	.809	25.2	41.5

As shown in Table 2, the level of the majority of the motor abilities of the Division A players does not deviate substantially from their Slovenian counterparts. The former dominate only in the (medicine) ball throws. In other tests, the Division A players achieved similar or slightly lower results than established by some other authors; however, they conducted their studies using samples with female basketball players of inferior quality and with a smaller height (Bosco, 1999; Gore, 2000; Erčulj, & Bračič, 2007). It should be emphasised that body height is the dimension in which the Division A players dominate over their Slovenian counterparts (they are 9 cm taller

on average compared to the Slovenian female basketball players). In the context of evaluating the results, it should also be noted that the Division A players' period of playing is considerably longer than that of their Slovenian counterparts. The former started playing basketball at 9 years of age on average, while the latter only started at 11 years.

Table 3: Independent samples T-test

	Levene's Test for Equality of Variances		T-test for Equality of Means	
	F	**Sig.**	**t**	**Sig. (2-tailed)**
S20	7.451	.009	.142	.888
D20	7.059	.011	-.073	.943
BBT	**.009**	**.925**	**5.114**	**.000**
MBT	**.029**	**.866**	**4.465**	**.000**
S6X5	.028	.869	-.594	.556
D6X5	1.381	.246	.627	.534
CMJ	.698	.408	-1.125	.266
CMJH	.528	.471	-.153	.879
DJ25	.001	.977	-.601	.550
KCDJ25	1.992	.165	-1.817	.076

The results of the T-tests show that statistically significant differences between the groups of subjects occurred in the players' ball throw and 2-kg medicine ball throw (BBT, MBT), even with a 1% margin of error. In the other tests, both groups of players were fairly equal as the t-values were much lower and considerably below the level of statistical significance. Figure 1 shows the comparison between the two groups of subjects in standardised Z-scores. To facilitate the interpretation of the results, years of playing (YEARS), body height (BH) and body mass (BM) were included in the motor variables.

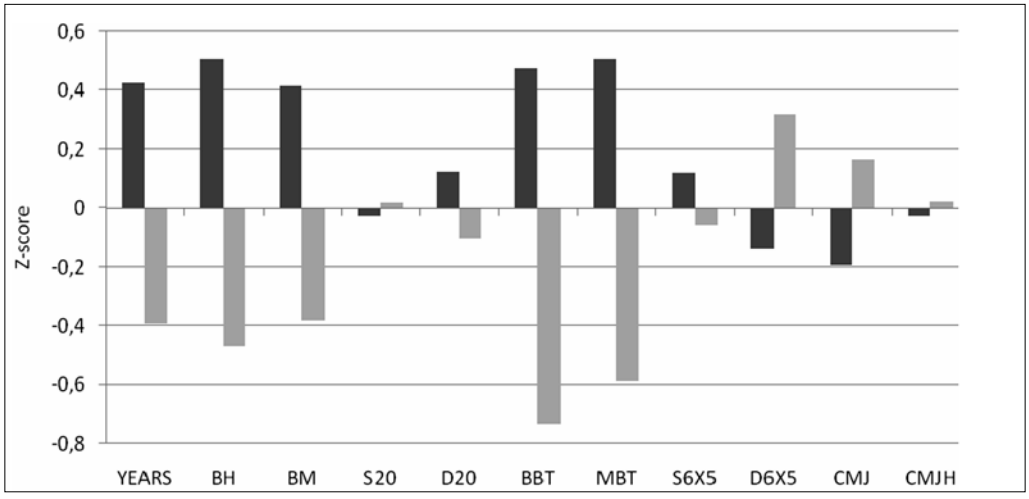

Figure 1: Comparison between the top European and Slovenian players in standardised Z-scores

DISCUSSION AND CONCLUSION

Based on the results of the BBT and MBT tests, it can be established that the European female basketball players who compete at the top national-team level (Division A) achieved higher values of explosive strength of the arms than their counterparts from Slovenia. The tests used to measure this ability differ considerably from the majority of other motor tests in terms of the movement structure and measured ability (Erčulj, 1998; Erčulj & Bračič, 2007). In our opinion, the first test mainly measures the explosive strength and acyclic speed of arms, whereas the results of the second tests are affected slightly more by the maximum and absolute strength of the arms. It can be concluded that the Division A players performed better in both tests mainly because they are taller and heavier than their Slovenian counterparts. Body characteristics that facilitate the good performance of both tests include a higher muscle mass (Malina, 2004), which means a larger cross-section of the extensor muscles of the arms and thus a larger physiological cross-section of the muscles in general (Ušaj, 1996). Performance in these tests largely depends on absolute strength as it involves the production of force of the active body mass on an external object (basketball or medicine ball) (Šturm, 1975). The weight of the objects used in our study (balls) was the same for all subjects, irrespective of the evident differences in their total and active body mass. An important factor influencing the results of both tests is the length of the upper extremities (Kovač, 1999) enabling the production of force on the object over a longer distance and thus a higher start speed. In this context, the factors influencing the production of force also include the length of the active muscle prior to contraction (Stiff, 2005) where taller players with longer arms and extensor muscles of the arms had an advantage. Several previous studies confirmed that taller female basketball players scored better results than shorter ones in the tests of a (medicine) ball throw. The best results in these tests are achieved by female basketball players with an extreme body height who play the position of post, followed by forwards and guards (Erčulj & Dežman, 1995; Erčulj, Dežman, & Vučković, 2002; Erčulj & Bračič, 2007). It may be concluded from the results of the above-mentioned tests that the Division A players shoot at the basket (mainly from large distances) and pass the ball (mainly long passes) more easily and efficiently. Higher absolute strength of the arms and the shoulder girdle also facilitates efficient contact play in the crowd under the basket, which is particularly important for tall players.

There were no statistically significant differences between both groups of basketball players in terms of the other motor tests. The values of acceleration and agility (with the ball and without it) and explosive strength of the legs are relatively equivalent in both groups of players. These results were recorded irrespective of the fact that the Division A players were 9 cm taller on average and that the body height of female basketball players usually negatively impacts the level of development of their abilities (Erčulj & Dežman, 1995; Erčulj, 1996; Erčulj, Dežman, & Vučković, 2002; Erčulj & Bračič, 2007). Given the above, it can be estimated that the Division A players, compared to the quite shorter Slovenian players, have relatively highly developed motor abilities. This is to some extent due to the greater playing experience of the Division A players and, consequently, the relatively high level of their technical knowledge. The latter is more evident in complex tests, including ball dribbling. As body mass is an important factor of playing performance in basketball, it is highly probable that the foreign players, given the same or even higher levels of motor abilities, will be more efficient and achieve better results. In contrast, the player selection procedure in Slovenia should focus more attention on body height. Moreover, taller female basketball players should, whenever possible, be prioritised in selections for basketball competitions and for the national team. Knowing the basketball practice

in Slovenia, we estimate that these resources have already been exploited due to the small size of the available population. Therefore, more attention should be focused on the volume and quality of training, while any deficit in height should be compensated for by high-quality conditioning and technical-tactical preparations. Last but not least, the systematic training of basketball should also start at an earlier age so that Slovenian female basketball players can catch up with their elite foreign counterparts in this aspect.

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