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Original empirical article

THE LEVEL OF SPEED AND AGILITY OF DIFFERENT TYPES OF ELITE FEMALE BASKETBALL PLAYERS *

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Abstract. *In basketball, as in other team ball sports, speed is a complex ability which significantly affects playing performance. The aim of this study was to establish and analyze the development level of speed and agility of different types of female basketball players from the senior women's national teams of Slovenia and Serbia. The guards, the forwards and the centers were compared, and any differences between them established. The study results showed a difference between individual player types in terms of body height and body weight, and some differences were also established in the tests of acceleration with the ball and without it. After eliminating the influence of body height and body weight, the differences in the speed of acceleration decrease and become statistically insignificant. The strongest influence was still observed in the S20 (the 20-metre sprint) and V20 (20-metre dribbling) tests, i.e. with the two variables in which ANOVA shows statistically significant differences between individual player types. In view of the study results, it can be concluded that body height and body weight significantly influence the speed of acceleration, i.e. cyclic speed, even among highly qualified female basketball players at a high international level, whereas the influence of the abovementioned morphological characteristics on the speed of performance of acyclic and agility movement is weaker.*

Key words: *basketball, senior women, motor tests, speed.*

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INTRODUCTION

Speed as a psychomotor ability and the related attributes have an important effect on basketball playing performance (Erčulj, 2004; Jukić, Milanović, & Vuleta, 2005; Zwierko & Lesiakowski, 2007). Movements such as short sprints, fast changes in direction and rhythm (speed), stopping, acceleration and rapid reactions to a given playing situation require a high level of speed development from a basketball player. A player who is not fast enough cannot succeed in modern top-level basketball (Dežman & Erčulj, 2005). Perhaps the only exception to this rule is an extremely tall player (centre); however, there are increasingly fewer of them with inadequately developed speed abilities. It is because of the abovementioned factors and hereditary determination that speed has become an important factor in the selection of basketball players. The appropriate age when young boys and girls should be directed to basketball has already been determined, and, thus, all the subsequent selection phases (Dežman & Erčulj, 2005).

In basketball, as with other team ball games, speed is a complex ability. Generally speaking, speed is an ability which enables a basketball player to move as fast as possible at a given degree of resistance. This movement can be acyclic or cyclic and, consequently, the speed can be acyclic or cyclic (Komi, 2003; Dežman & Erčulj, 2005; Čoh & Hofman, 2003). If the resistance against which the muscles move is high, then the speed or the efficiency of movement largely depends on speed strength.

Specific types of speed, as required in modern basketball, also include agility. Although expert literature abounds with different definitions of agility (Brittenham, 1996; Bompa, 1999; Miller et al., 2001; Sheppard & Young, 2006), the prevailing one is that agility is the ability to rapidly change the direction and rhythm (speed) of movement. Many authors emphasize its importance in the context of the prevention of sport injuries, while some consider it to be a prerequisite for high-level basketball performance (Jakše & Pinter, 2006). Agility comes to the forefront mainly in polystructural complex sports in which movement structures that require many changes of direction of movement prevail (Čoh & Hofman, 2003).

Basketball movements are executed with and without the ball; therefore, in basketball, the speed of movement and agility are divided into those with a ball and those without it. Fast transfers of the ball from the back court to the front court (especially in counter-attacks), faking and penetrating, transitions to dribbling, penetrating and some other movements all require highly developed speed and agility with the ball. Getting open, cutting to the basket, fast running to defend or attack as well as defend against getting open, cutting and faking and penetrating are movements in which speed and agility without the ball come to the foreground.

There are three basic player types in basketball who perform different roles in the play and also differ in terms of playing characteristics (Sampaio et al., 2006): guards, forwards and centers. If a specific player type is to show a high-level of performance and efficiently fulfill his playing role, he must not only have adequate technical and tactical knowledge but also suitable dimensions of psychosomatic status. Individual playing roles require a specific movement structure and, consequently, an adequate level of motor abilities (motor potential) (Erčulj, 1998; Trninić & Dizdar, 2000; Dežman, Trninić, & Dizdar, 2001; Trninić, Karalejić, Jakovljević, Jelaska, 2010a; Trninić, Karalejić, Jakovljević, Jelaska, 2010b). Different levels of development of speed and agility were established in different types of male and female basketball players (Tsitskarsis et al., 2003; Erčulj, Dežman, & Vučković, 2003; Erčulj, 2004; Erčulj et al., 2009). As a rule, the guards dominate in terms of speed and agility, with and without the ball. The guards are followed by the forwards, whereas the centers generally score the worst results in the basketball motor tests designed to examine this ability (Erčulj, 1998; Erčulj et al., 2009). Shorter players have the advantage in motor tests, because with their lower centre of gravity, lower mass and faster nerve-impulse flow due to shorter limbs, they can change direction, accelerate or brake quicker and more easily. A part of the variance of the results in the tests also depends on proper technique with or without the ball, in which shorter players are usually more successful (Dežman, Erčulj, & Vučković, 2002).

In this study, different types of speed were assessed using different measuring instruments (motor tests), which (in terms of muscular activity and co-ordination of agonists and antagonists) represented the predominant types of speed in real situations in basketball. The main aim of this study was to establish and analyze the development level of speed and agility of different types of elite senior women basketball players, using a sample of the top quality female basketball players of Slovenia and Serbia. The data on the structure and development level of speed and agility of top-level female basketball players enabled model values to be generated and international quality norms to be formulated, which can greatly assist both basketball coaches and basketball researchers. Another aim of this study was to establish any differences between the guards, the forwards and the centers in terms of the results of selected speed and agility tests. In contrast to most previous studies, the differences between the player groups will also be established after the elimination of the influence of body height and body weight, since these differ significantly between player types and determine their playing roles.

METHODS

Sample of participants

The sample of participants consisted of twenty-six (26) female basketball players, members of the national teams of Slovenia and Serbia. Their average age was 25.12 (±3.60) years, body height 181.85 (± 9.05) cm and body weight 74.23 (±12.72) kg. Both (national) teams included 13 basketball players: four guards, four forwards and five centers. Two centers of the Slovenian national team had to be excluded from the sample due to injuries. The study participants were tested after the end of the senior women's 2009/2010 competitive season, when their national teams had only just started their preparations for the 2011 European Championship qualifications. The measurements were made in June and July 2010 on Zlatibor (Serbia) and Žalec (Slovenia). Before the testing, the participants signed informed consents. All of the tested players were healthy and had no injuries.

The sample of variables included two anthropometric measures (body height and body weight) and seven (7) measuring instruments (motor tests) to assess different speed types.

Measures and Procedures

Cyclic speed tests, i.e. acceleration with the ball and without it (S20, D20), were conducted using a system of infra-red photocells (Brower Timing System, USA). The measurement procedure and test implementation were described in detail by Dežman and Erčulj (2005). The same applies to the test of agility without the ball (S6X5) and with the ball (D6X5). The SS (side-shuffling in a defensive stance), DJ25S (side-shuffling in a defensive stance from a drop jump) and ZZS (zigzag side-shuffling in a defensive stance) tests were constructed specifically for this study and are therefore presented in a greater detail.

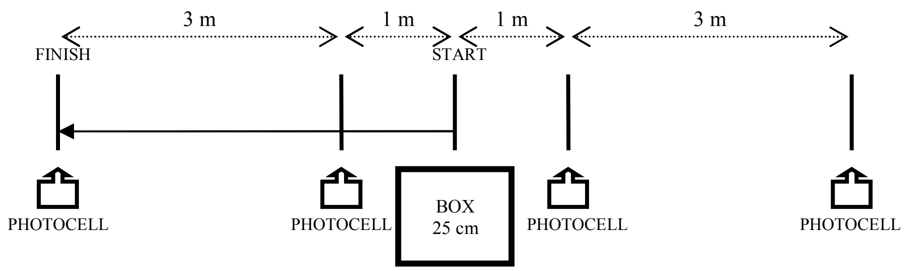

Fig. 1. SS (side-shuffling in a defensive stance) and
DJ25S (side-shuffling in a defensive stance from a drop jump)

Implementation of the SS test:

The participant assumes an initial position (defensive stance), so that the start line is between her feet (the body's centre of gravity is vertically above the start line) and the feet (L, R) are shoulder-width apart. At the measurer's signal, the participant starts side-shuffling (starting with the front leg) towards the finish line. The test is completed when the participant crosses the finish line. The test is conducted to the left and right side.

Implementation of the DJ25S test:

The participant assumes the initial position on a 45-cm high vaulting box. At the measurer's signal, the participant performs a drop jump and after a landing on both feet (with the start line between the feet, the body's centre of gravity is vertical above the line and the feet shoulder-width apart) continues side-shuffling (starting with the front leg) towards the finish line. The test is completed when the participant crosses the finish line. The test is conducted to the left and right side.

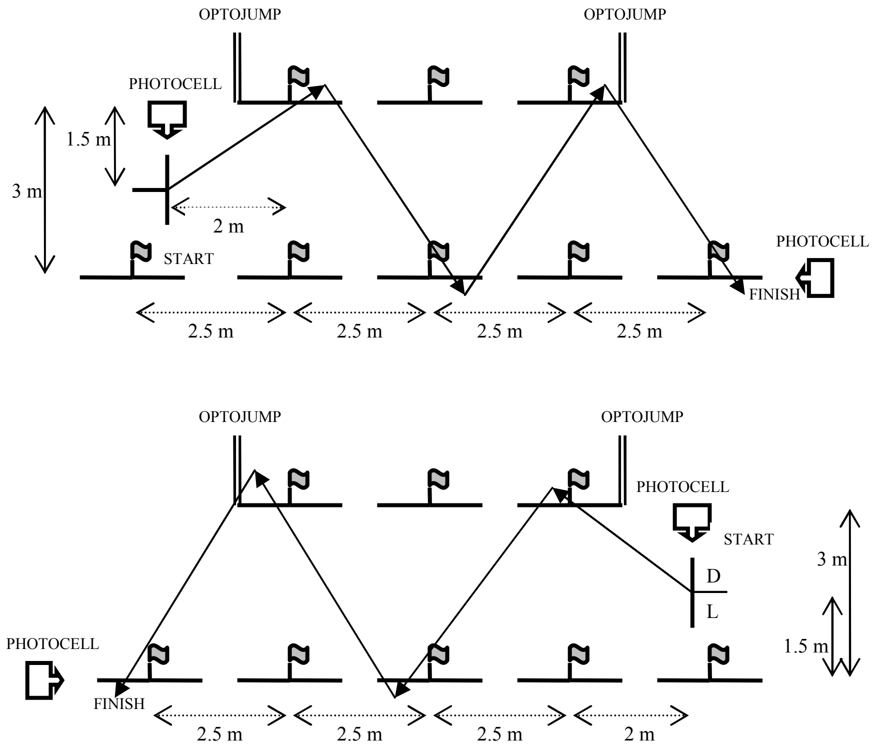

Fig. 2. ZZS (zigzag side-shuffling in a defensive stance)

Implementation of the ZZS test:

The participant assumes the initial position behind the starting line, with feet shoulder-width apart, so that the participant's back is to the direction of the movement. At the measurer's signal, the participant starts side-shuffling backwards towards the first stand until she crosses the line behind the stand with her external leg. She then changes the direction of movement and continues with a spin move of the other leg towards the next stand. The same pattern is performed until the finish line. The test is completed when the participant crosses the finish line. The test is conducted to the left and right side.

To measure the time of the SS, DJ25S and ZZS motor tasks, a system of infrared photocells was used (Brower Timing System, USA), while for the last two tests the OptoJump Next (Microgate, Italy) measuring technology was used, enabling measurement of the contact times in a change of direction and a jump.

The data were processed using the SPSS 19.0 statistical software for Windows. The following descriptive statistical data were calculated for the entire sample of participants: mean value, standard deviation, standard error and minimal and maximal results. To establish the differences between the groups (types) of female basketball players, a one-way analysis of variance was used, along with a multivariate analysis of covariance to eliminate the influence of body height and body weight. The statistical significance of the differences was established at a 5% risk level.

RESULTS AND DISCUSSION

First, the basic characteristics of the selected variables were established for the entire sample and both subsamples of participants, followed by a one-way analysis of variance to identify any differences between individual player types.

Table 2 Descriptive statistics and differences between the player types

		Mean	Std. Dev.	Std. Error	Min.	Max.	F	Sig.
BH	G	171.38	6.163	2.179	161	181		
	F	181.25	2.053	.726	179	184		
	C	190.70	3.164	1.001	186	197		
	Total	181.85	9.054	1.776	161	197	49.640	.000
BW	G	63.13	7.220	2.553	49	74		
	F	73.13	3.758	1.329	67	79		
	C	84.00	13.474	4.261	69	113		
	Total	74.23	12.726	2.496	49	113	10.695	.001
S20	G	3.5075	.15012	.05308	3.36	3.80		
	F	3.5788	.08659	.03061	3.43	3.73		
	C	3.7000	.08505	.03215	3.53	3.79		
	Total	3.5909	.13379	.02790	3.36	3.80	5.525	.012
D20	G	3.6075	.15908	.05624	3.34	3.79		
	F	3.7638	.05706	.02017	3.69	3.86		
	C	3.9314	.17743	.06706	3.71	4.20		
	Total	3.7604	.18838	.03928	3.34	4.20	10.078	.001
S6X5	G	8.8163	.30371	.10738	8.38	9.43		
	F	8.9125	.27575	.09749	8.39	9.20		
	C	9.0836	.30943	.11695	8.53	9.42		
	Total	8.9311	.30327	.06324	8.38	9.43	1.547	.237
D6X5	G	9.0736	.23720	.08965	8.78	9.47		
	F	9.1900	.32591	.11522	8.69	9.60		
	C	9.4764	.33537	.12676	9.14	9.99		
	Total	9.2441	.33528	.07148	8.69	9.99	3.272	.060
SS	G	.8900	.05058	.01912	.82	.97		
	F	.9050	.05686	.02149	.80	.98		
	C	.9500	.05715	.02160	.85	1.03		
	Total	.9150	.05831	.01272	.80	1.03	2.260	.133
DJ25S	G	.9064	.06799	.02570	.82	.98		
	F	.9014	.05742	.02170	.81	.96		
	C	.9536	.07825	.02957	.82	1.06		
	Total	.9205	.06923	.01511	.81	1.06	1.238	.314
ZZS	G	5.3129	.16613	.06279	5.15	5.63		
	F	5.3379	.14597	.05517	5.20	5.56		
	C	5.4486	.29842	.11279	5.17	5.96		
	Total	5.3664	.21223	.04631	5.15	5.96	.794	.467

* by ANOVA

Legend: BH – body height, BW – body weight, G – guards; F – forwards; C – centers

Basketball is a sport which involves several types of players. They assume different playing roles that require players of a suitable height. Therefore, it is only natural that in our study, which involved top quality senior women basketball players, statistically significant differences were observed between player types in terms of body height (BH) and body weight (BW) (Table 2). As expected, the tallest and heaviest players are the centers, followed by the forwards, whereas the guards are the smallest and lightest. The difference between the guards and the centers in terms of average body height and average body weight was almost 20 cm and over 20 kg, respectively.

These marked differences in body height and playing position result in a specific profile and/or structure of motor abilities of individual player types. Irrespective of these considerable differences in terms of arithmetic means, the conducted ANOVA showed statistically significant differences only in the tests of speed of acceleration without the ball and with it (S20, D20), whereas the differences in the test of shuttle dribbling (D6X5) bordered on statistical significance. On average, the best results in practically all of the tests were achieved by the guards (the only exception was DJ25S), followed by the forwards, whereas the centers were the most inferior in all of the tests. Such results were expected; they are also congruent with some previous studies (Erčulj, Dežman, & Vučković, 2003; Tsitskarsis, Theoharopoulus, & Garefis, 2003; Erčulj, Dežman, & Vučković, 2004; Erčulj et al., 2009) and correspond to the guards' playing role. An important element of this role is the rapid changes of direction of movement when getting open, faking and penetrating, as well as fast acceleration over a longer distance when the ball is transferred to the front court and returned to the back court. One can also say that individual types of players differ mostly in terms of the results of the tests with the ball (D20, D6X5). Movements with the ball are more complex and more demanding in terms of coordination. Therefore, they are most efficiently and rapidly executed by the guards whose technical knowledge is generally better and who dribble the ball the most (Erčulj et al., 2009). The playing role of the centers does not require such a high level of technical knowledge and ball dribbling skills, whereas the forwards are somewhere between the guards and the centers.

As already mentioned in the Introduction, differences between the motor abilities of individual types of basketball players have already been established and confirmed by previous studies; however, these mainly applied univariate methods (analysis of variance, the t-test). Therefore, our study aimed to confirm the existence of differences using the multivariate analysis of covariance. Given that individual player types differ considerably in terms of their body height and body weight (Table 2), we decided to establish whether there are any differences between them, even after the influence of both measures is eliminated.

Table 3 Estimated Marginal Means and Tests of Between-Subject Effects with body height (BH) as a covariate

		Mean	Std. Error	F Sig.	Partial Eta Squared
S20	G	3.405	.074	.089	.356
	F	3.576	.042		
	C	3.809	.073		
D20	G	3.633	.100	.847	.124
	F	3.767	.057		
	C	3.915	.099		

S6X5	G	8.838	.181	.476	.012
	F	8.888	.103		
	C	8.976	.180		
D6X5	G	9.153	.209	.652	.032
	F	9.222	.119		
	C	9.398	.207		
SS	G	.911	.037	.502	.025
	F	.905	.021		
	C	.929	.037		
DJ25S	G	.917	.047	.786	.050
	F	.901	.027		
	C	.943	.046		
ZZS	G	5.200	.144	.356	.109
	F	5.340	.081		
	C	5.559	.142		

*Covariates appearing in the model are evaluated at the following values: ATV = 181.43

Table 4 Estimated Marginal Means and Tests of Between-Subject Effects with body weight (BW) as a covariate*

		Mean	Std. Error	F Sig.	Partial Eta Squared
S20	G	3.482	.054	.300	.326
	F	3.572	.044		
	C	3.736	.056		
D20	G	3.610	.069	.868	.322
	F	3.767	.057		
	C	3.939	.071		
S6X5	G	8.750	.127	.777	.112
	F	8.892	.104		
	C	9.061	.131		
D6X5	G	9.181	.139	.200	.038
	F	9.232	.114		
	C	9.361	.143		
SS	G	.889	.026	.937	.120
	F	.905	.021		
	C	.951	.027		
DJ25S	G	.903	.033	.847	.092
	F	.901	.027		
	C	.958	.033		
ZZS	G	5.344	.101	.600	.018
	F	5.340	.083		
	C	5.415	.104		

*Covariates appearing in the model are evaluated at the following values: AT = 73.71.

After eliminating the influence of body height and body weight (Tables 3 and 4), it can be established that the differences between individual player types decrease but are not completely eliminated. The trend of the centers achieving the worst results continued. The differences in the Estimated Marginal Means after the elimination of the influence of body height and body weight also decrease with technically more demanding movements, which are performed with the ball and are most typical of the guards. It can be established that the influence of the covariates is not statistically significant in any of the dependent variables. In both covariates, the strength of the influence (Partial Eta Squared) is the highest with the variables S20 and D20. The influence of body height and body weight is thus the strongest in the tests of acceleration with and without the ball, namely with the two variables where the ANOVA revealed the largest and statistically significant differences between different player types. It is evident that in other motor tasks, body height and body weight are less of a hindrance in achieving good results, which means that there is a higher possibility of compensation on the account of the training of technique and co-ordination. This is by all means information that should also be considered in practice, specifically in the training of elite female basketball players.

CONCLUSION

In view of the study results, it can be concluded that in a sample of top quality senior women basketball players at the international level, the differences between individual types of players can also be confirmed. The player types are markedly different in terms of their body height and body weight, while differences were also established in the tests of acceleration with and without the ball. Evidently, these are mainly the consequence of differences in body height and body weight and less of different playing roles of individual player types and the required technical knowledge. After eliminating the effect of body height and body weight, the differences between individual player types in terms of acceleration with and without the ball decrease and become statistically insignificant. The strongest influence was still observed in the tests S20 and D20, i.e. with the two variables where the largest and/or statistically significant differences between individual player types occur.

The study results show that body height and body weight significantly influenced the speed of acceleration and/or the cyclic speed even among high-quality female basketball players at a high international level, whereas the influence of the abovementioned morphological characteristics on the speed of performance of acyclic and agility movements is weaker. Based on the findings of the study, we wish to emphasize the importance of the training of technique and co-ordination for the tallest female basketball players (centers) with which they can to some extent compensate for their lack of speed in the execution of complex basketball movements due to their body height and body weight. A faster execution of such movements enables tall female basketball players to broaden their skills and boost their playing performance on the perimeter positions, which is also a trend in modern elite basketball.

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NIVO BRZINE I AGILNOSTI RAZLIČITIH TIPOVA VRHUNSKIH KOŠARKAŠICA

Frane Erčulj, Mitja Bračič, Saša Jakovljević

U košarci kao i u ostalim timskim sportovima sa loptom, brzina je složena sposobnost koja značajno utiče na učinak u igri. Cilj ovog istraživanja je da odredi i analizira ravzoj nivoa brzine i agilnosti vrhunskih košarkašica, koje igraju na različitim pozicijama, seniorskih reprezentacija Slovenije i Srbije. Poredili su se bekovi, krila i centri i određivane su razlike menđu njima. Rezultati istraživanja pokazuju da postoji razlika između pojedinačnih vrsta igrača u pogledu telesne visine i težine a nađene su i neke razlike na testovima ubrzanja sa i bez lopte. Kada je elimnisan uticaj telesne visine i telesne težine razlike u brzini ubrzanja su se smanjile i postale statistički beznačajne. Najveći uticaj je i dalje primećen na testovima S20 (sprint na 20m) i V20 (dribbling na 20 m), tj. kod dve varijable u kojima ANOVA pokazuje statistički značajne razlike među pojedinačnim tipovima igračica. U svetlu rezultata studije, može se zaključiti da telesna visina i telesna masa značajno utiču na brzinu ubrzanja tj.na cikličnu brzinu, čak i kod visoko kvalifikovnaih košarkašica na međunarodnom nivou, dok je uticaj gore navedenih morfoloških karakteristika na brzinu izvođenja acikličnih pokreta i okretnosti slabiji.

Ključne reči: *košarka / seniorke / motorički testovi / brzina*