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Original empirical article

DIFFERENCES IN MOBILITY, SITUATIONAL, MOTOR AND FUNCTIONAL ABILITIES OF BASKETBALL PLAYERS AT DIFFERENT LEVELS OF COMPETITION

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Abstract. *In this research three sets of variables estimating mobility (10), situational mobility (13) and functional ability (2) were applied to basketball players at different competition levels. There were 97 participants divided into two sub-samples. The first sub-sample was made up of 48 participants that were competing in the Serbian League and the second sub-sample was made up of 49 participants competing in the First National League. The differences were determined by a Discriminative Canonic Analysis. On the grounds of the results and the discussion, significant statistic differences in mobility and functional abilities (aerobic endurance) were established. It was proved that the basketball players at higher competition level were better. It also showed that there were no statistically significant differences in situational mobility. The statistical significance in functional abilities (aerobic endurance) was to the advantage of the players at the lower competition level.*

Key words: *basketball players, rank competitions, differences.*

INTRODUCTION

Determining the structure of basketball game measurements, as well as their relations to the anthropological dimensions of different levels of the basketball competition has become indispensable when it comes to the possibility of efficient tracking and enhancing the level of the players' readiness. It is known that game of basketball with its structure

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favors certain players' anthropological characteristics, given that the basket raised to a height of 3.05 cm and is characterized by rapid changes in the same direction and rhythm of movement, sudden stopping and starting the dribble, a large number of hops, and all of this in a limited space. Therefore, it will be very useful to determine the span of anthropological measurements and the extent to which they determine the differences between players at different levels of competition. The problem of determining differences between players at different levels of competition used to lie in different procedures which had different aims.

A large number of researches showed that the players competing in the National rank of competition had numerically bigger values of explosive strength, agility, repetitive strength, psychomotor speed and flexibility (Aglioti et al., 2008; Trunić 2006; Ostojić et al., 2005; Sallet et al., 2005; Ćeremidžić 2005; Jovanović-Golubović & Kocić 2002; Dopsaj & Matavulj 1993;) as well as tactical and technical knowledge (Trunić 2006; Jakovljević 2007; Apostolidis et al., 2004; Rowe et al., 1995) than the players competing at the lower ranks. It has been scientifically proven that physical exercise can influence the set of relevant parameters so it can be concluded that there is no better way of transforming such a large number of parameters at the same time.

The aim of the research is to identify differences in motor, situational-motor and functional abilities of players at different level of competition.

THE METHOD

The participants

Ninety-seven participants divided into two sub-samples took part in the research. The first sub-sample was made up of 48 players of the third level of competition i.e., the Serbian League (the average values of their body mass and height were respectively 85.21 kg and 191.24 cm) and the second sub-sample was made up of 49 players of the highest competition level i.e., the First National League (the average values of their body mass and height were respectively 86.61 kg and 193.59 cm). The testing of all the participants was carried out in the first part of the season, after 10 training sessions and 1 game a week. The average number of years spent in the sport was 12-13 in the First National League, whereas that number was 8-9 years in the Serbian League. The youngest participant was 16 and the oldest 38.

The instruments and procedure

Motor abilities were evaluated by the following 10 parameters: the standing long jump (MSDM), the standing triple jump (MTRS), the 20 m run with a high start (M20V), the 4×15 m run with a high start (M4×15), pull ups (MZGB), push-ups (MSKL), hand tapping (MTAP), leg tapping (MTAN), the splits (MŠPA) and low forward bend (MDPK) (Kurelić, 1979 in Jovanović-Golubović, 2003).

Situational and motor abilities were evaluated by the following 13 parameters: the standing jump shot from point B at different distances and in the same direction (with a backboard (vertically to it) and without it) (SŠBB), the standing jump shot from point C at different distances and the same direction (with a backboard (vertically to it) and without it) (SŠBC), the standing jump shot from point E at different distances and the same

direction (with a backboard (parallel to it) and without it) (SŠPE), the standing jump shot from point F at different distances and the same direction (with a backboard (parallel to it) and without it) (SŠPF), the elevation precision of passing with one hand (PER1), the elevation precision of passing with both hands (PER2), shooting a moving ball (pendulum) directly at the target (PKLD), shooting a moving ball (pendulum) with an obligatory bounce (PKLT), shooting a ball which bounces back after the 3.05 meter fall directly at the target (PODD), shooting a ball which bounces back after the 3.05 meter fall with an obligatory bounce (PODT), dribbling around oneself (KRTE), dribbling between the player's legs (the eight) (KRNO), and dribbling with variances (VODJ) (Jovanović, 1994 in Jovanović-Golubović, 2003).

Functional abilities were evaluated by means of two tests: ASTRAND (the absolute value of oxygen uptake AST1 1/min and the relative value of oxygen uptake AST2 ml/kg/min.) and RAST (The Running Based Anaerobic Sprint Test) (maximum strength RAS1 W, minimal strength RAS2 W, average strength RAS3 W and fatigue index RAS4 W).

Data processing methodology

The discriminant analysis was used to establish the differences between the players at different levels of competition.

RESULTS WITH DISCUSSION

Motor skills:

Table 1. The basic statistical parameters of motor skills.

est	ean	t.dev.	ean	t.dev.
SDM	55.184	3.692	31.500	0.382
TRS	38.755	1.336	07.333	7.898
4X15	3.247	696	3.621	693
20V	.373	267	.452	287
ZGB	.551	.921	.125	.127
SKL	0.571	0.246	8.000	.995
DPK	1.306	.655	8.792	.713
ŠPA	87.673	0.041	90.125	0.757
TAP	9.224	.515	7.750	.710
TAN	7.082	.342	4.104	.928

A review of Table 1 which offers the basic statistical parameters for the motor skills of both subsamples, it was determined that they were fairly homogeneous and that almost no results deviate significantly from the expected value of the possible and real. Based on the presented measures, it can be concluded that the results do not deviate from the real potential results that were achieved in the same basketball league and the players of the First National League subsample is more homogeneous compared to the Serbian basketball league. This conclusion is supported not only by the properly executed selection but also the orientation of the athletes in relation to their motor skills. Although the manifest space based on arithmetic means cannot a priori lead to conclusions about the quantita-

tive differences between groups with a lot of security, we can conclude that the sub-sample of the First National League players scored significantly better results compared to the other sub-sample.

Table 2. Discriminant canonical analysis.

Function	Eigenvalue	Wilks' Lambda	Chi-square	Canon. Corr.	f	sig.
1	.487	.672	35.710	.572	0	000
Test				Function 1		
MSDM				.767		
MTAN				.515		
MX415				-.386		
M20V				.377		
MTRS				.246		
MDPK				.233		
MTAP				.206		
MZGB				.193		
MSKL				.191		
MŠPA				-.086		
Group				Function 1		
The Serbian League				-.698		
The First National League				.684		

Group	Predicted Group Membership		
	The Serbian League	The First National League	Total
The Serbian League	38	10	48
The First National League	12	37	49
The Serbian League	79.2	20,08	100.0
The First National League	24,50	75.5	100.0

Table 2 shows the values of the distinctive root (.48), the percentage of the explained inter-group variability (100.00), the coefficient of the Canonic correlation (.57), Wilks' Lambda value (.67), Bartlett's X2 test (35.71), the degrees of freedom (10) and the statistic significance of the function of the distinctive variables and the group centroids which are marked by the discriminative functions. By the transformation and the condensation of the variables in the motor space, one discriminative function was isolated which absolutely differentiates the groups of athletes on the grounds of discriminant coefficients. The isolated discriminative function explains the differences with 100% of the inter-group variability of the applied discriminative variables. The coefficients which determine the discriminative function show that it discriminates the subgroups of the basketball players at different competition levels on the grounds of the variables referring to explosive strength, segmental speed and agility in particular, and less to flexibility and repetitive strength. The group centroids, their values and the sign show that the players of the First National League were, generally speaking, better at all the ability tests than the players from the lower competition rank. Since the motor efficiency of a person is in direct connection with the levels and mutual relationships of the anthropological characteristics, the outcome, the expected differences, which resulted from the following factors: the systematic influence of the training sessions (which had been the same for all the

members of one team), the less systematic influence of the games played (which had varied from one game to another and had changed from one player to another), the unsystematic influence of all the other factors and the appropriate distribution of the content (which had enabled the alternating activation of all the most important mechanisms responsible for global motor efficiency). The moderate homogeneity of the players of both ranks proved the anticipated difference among them and showed that 38 players of the Serbian League out of 48 had the characteristics of the group they belonged to and that 10 did not. When it comes to the players of the First National League, it appeared that 36 players had the characteristics of the second group and 12 of the first one. The correctness of the group abilities can be proven by the data on the homogeneity of the subgroup which was 79,2% for the players of the Serbian League and 75.5% for the players of the First National League. A large number of studies support the outlined results (Aglioti et al., 2008; Trunić 2006; Ostojić et al., 2005; Sallet et al., 2005; Ćeremidžić 2005; Jovanović-Golubović and Kocić 2002; Dopsaj and Matavulj 1993).

Situational and motor abilities:

Table 3. The basic statistical parameters for the subgroup of the highest competition rank.

est	ean	t.dev.	ean	t.dev.
ŠBB	.833	.662	.063	.506
ŠBC	.896	.771	.583	.730
ŠPE	.313	.570	.354	.689
ŠPF	.417	.945	.479	.779
ER1	.225	.117	.821	.549
ER2	.829	.432	.708	.390
KLD	.292	.819	.542	.277
KLT	.604	.234	.604	.298
ODD	.396	.482	.438	.337
ODT	.042	.190	.146	.307
RTE	7.021	.800	4.438	.392
RNO	0.563	.856	0.354	.626
ODJ	2.104	.268	1.521	.920

Table 3 shows the same basic statistical parameters of situation-motor skills for both subsamples, which do not deviate from the expected and real potential value. Situational-motor skills in the equation specification of success in basketball are dominant and the relevant area during the programmed training process, and the results obtained in both sub-samples of respondents are quite similar. The reason for all this is found in the importance attached to their adoption and development as well as to the fact that other abilities and traits important for success in basketball develop through situational training. The largest influence on the development of situational-motor skills is the training process, which is different for all the members of the team and the competition cycle. The expected obtained quantitative differences in the mean values were not statistically significant, which suggests the same quality and belonging to the same population. The only

positive symmetry is expressed in the mobile shooting of the ball variable (the pendulum) with an obligatory bounce (PKLT) in both sub-samples, which supports the claim that the results of both sub-samples were grouped in the zone of lower values. From there it can be concluded that given the structural characteristics of the basketball game, in which the dynamic, fast changes of direction and rhythm of movement in all positions are the basic characteristics, special attention must be paid to adding the development of precision in all ranks of the competition. It is known from practice that very little time is devoted to this kind of precision during training.

Table 4. Discriminant canonical analysis.

Function	Eigenvalue	Wilks' Lambda	Chi-square	Canon. Corr.	df	sig.
1	.140	877	1.573	350	3	563
Test				Function 1		
KRTE				.658		
PER2				-.479		
PER1				-.288		
SŠBC				.242		
PKLD				.211		
VODJ				.157		
SŠBB				-.137		
KRNO				.093		
PODT				-.091		
PODD				-.066		
SŠPF				-.036		
SŠPE				.027		
PKLT				-.007		
Group				Function 1		
The Serbian League				-.374		
The First National League				.366		

Group	Predicted Group Membership		
	The Serbian League	The First National League	Total
The Serbian League	29	19	8
The First National League	17	32	9
The Serbian League	60.4	39.6	00.0
The First National League	34.7	65.3	00.0

The results of the discriminant analysis of the situational and motor abilities show that there was no statistically significant difference between the players regarding the competition rank.

Through the condensation of the variables in the situational and motor space, one discriminative variable was isolated. It did not separate the groups of players on the grounds of the discriminative coefficients. Its Canonic value was .3.5. The importance of this discrimination was checked by Wilks' test and Bartlett's χ^2 with 13 degrees of freedom. The result was a significance of Sig.=.5.6 which could not be considered important since the important values of the generalized distance of the group centroids were at the following levels: $p<.05$ and $p<.01$ (table 5). It is our opinion that the fact that there were no differ-

ences resulted from the factors which influenced the quality of the players. In reality, talent is the most important thing; however, in professional sport only the most persistent persevere. Some clubs have both talented and the persistent players, whereas some clubs lose their best players for certain reasons. The differences in quality can be explained by different types of selection for different teams. The quality differences are also influenced by material, social and personnel factors. Therefore, it can be concluded that there are periods when there are no significant differences between the teams when it comes to quality and efficiency. This has been proven by a large number of studies (Trunić 2006; Jakovljević 2007; Apostolidis et al., 2004; Rowe et al., 1995).

Functional abilities:

Table 5. Basic statistical parameters for functional skills.

Test	Mean	St.dev.	Mean	St.dev.
AST-1	4.73	1.01	4.19	.85
AST-2	53.53	8.77	48.88	7.66
RAS-1	65.07	16.33	72.97	15.93
RAS-2	42.74	10.89	47.37	14.12
RAS-3	53.68	12.14	58.78	13.41
RAS-4	6.10	3.77	7.88	2.82

Based on the analysis results shown in table 5, we get the functional abilities of both subsamples. The obtained values indicate that the aerobic capacity of the respondents from the First Federal League are high, but compared to the values of oxygen consumption and sports classes, they are medium. The results clearly indicate that the training process leading to the functional adaptation of the cardiovascular and respiratory systems is reflected in the fact that the aerobic capacity of these respondents is higher than the corresponding value for gender and age. This is an expected result given the range of competition. The aerobic capacity of the respondents of the Serbian league is average.

The values of the test for assessing anaerobic capacity are low compared to the corresponding sex and age. The explanation for the results can be found in the low motivation of the participants to perform the test. This is supported by a small difference between the maximum and average values expressed during the test. As a prerequisite to performing the RAST test, and similar motor tests (the Margaria step test, Wingate test), motivation is required.

Table 6 shows that the difference between the groups of players in regard to the six variables estimating functional abilities is at the p=.00 level. Wilks' Lambda (which gives the same results as Mahalonobis's distance) was checked through the X2 test, and its result of 30.1 is statistically significant for the given degree of freedom. The group centroids, which are, at the same time, the arithmetic mean values of the groups, were calculated so that the positions of the groups in the discriminative space could be estimated. The values and the signs of the centroids, which are .62 for the players of the Serbian League and -.60 for the players of the First National League, led to the following conclusions: the players of the First National League had better results for the absolute value of the oxygen consumption parameter (AST1) than the players of the Serbian League; this entails that they had better aerobic abilities. The players of the First National

Table 6. Discriminant canonical analysis.

Function	Eigenvalue	Wilks' Lambda	Chi-square	Canon. Corr.	df	sig.
1	.387	.721	30.105	.528	6	.000
Test				Function 1		
AST-1				-.483		
AST-2				-.467		
RAS-4				.430		
RAS-1				.391		
RAS-3				.319		
RAS-2				.289		
Group				Function 1		
The Serbian League				.622		
The First National League				-.609		

Group	Predicted Group Membership		
	The Serbian League	The First National League	Total
The Serbian League	34	14	48
The First National League	14	35	49
The Serbian League	70.8	29.2	100.0
The First National League	28.6	71.4	100.0

League had better results for the relative value of the oxygen consumption parameter (AST2) than the players of the Serbian League. The value of the fatigue index parameter (RAS4) was higher for the players of the Serbian League than for the players of the First National League. The value of the maximal strength parameter (RAS1) was higher for the players of the Serbian League than for the players of the First National League. The players of the Serbian League also had higher values of the average strength parameter (RAS 3) than the players of the First National League. The players of the Serbian League had higher values of the minimal strength parameter (RAS 2) than the players of the First National League. Since kinesiological movements, especially those related to sports and competition, are characterized by high intensity, it is then obvious that even anaerobic energetic mechanisms have a very important role. Since all the abilities are connected to anaerobic energy capacity, it is then interesting to observe that all the mechanisms of the energy loading of the anaerobic sources have got an exclusively aerobic character. Anaerobic working capacity can be estimated in two ways: directly, using the test for indicating the alactate (phosphate) component and indirectly, using the tests for indicating the lactate component. The following parameters RAS1, RAS2, RAS3, and RAS4 which indicate maximal strength, minimal strength, average strength and fatigue were calculated by the Running-based Anaerobic Sprint Test. This test showed that the players of the Serbian League had better results than the players of the First National League. However, the results differ in reality. Body functioning is known to be extremely complex. The vegetative and the animal subsystems are connected both directly and indirectly. There are similar connections between the transport and the loco-motor systems, the sensory-motor and the loco-motor systems, the sensory-motor and the vegetative systems, the vegetative and the transport systems. Based on cybernetic theory, the anaerobic threshold is made up of the functional units of connative regulators, motor regulators and the regulators of the anaerobic threshold which are mutually connected. It is vital to say that the

functional units of the connative regulators are: the regulator of the organic systems, the regulator of the regulative function correlation and the activity regulator. It is clear that anaerobic abilities are greatly under the influence of connative regulators. Hence, it is the place to find the explanations for the achieved results, since they are responsible for both the activity and the energy level at which all other systems function. A large number of studies have proven these results (Cormery et al., 2008; Delextrat & Cohen 2008; Malićević 2007; Vamvakoudis et al., 2007; Vasiliauskas et al., 2006; Ostojić et al., 2005; Sallet et al., 2005; Apostolidis et al., 2004; Metikoš et al., 1986; Metaxas et al., 2009).

CONCLUSION

The results show that in basketball there is good orientation and selection of the players, i.e. the training process is the main generator of the differences between motor and functional abilities. The lack of statistically significant differences in situational and motor abilities points to the high quality of work in basketball schools, starting at the earliest age, because the learnt structures of the movements are qualitatively at the same level at different competition ranks. The contribution of this research is in defining the state of training abilities of the First Federal and Serbian Basketball League basketball players so as to pinpoint the direction of theory and practical training of the named basketball players relative to their rank of competition. The theoretical value of this research is that basketball coaches and sports experts increase the level of information about the differences in the studied anthropological characteristics and situational-motor abilities of the players of the First Federal and Serbian League.

The results of motor, situational-motor and functional abilities will enable a higher level of individualization of the training process, and in particular will prove useful for the adequate planning, programming and implementation of work.

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RAZLIKE U MOTORIČKIM, SITUACIONO-MOTORIČKIM I FUNKCIONALNIM SPOSOBNOSTIMA KOŠARKAŠA RAZLIČITOG RANGA TAKMIČENJA

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Sa ciljem utvrđivanja razlika u motoričkim, situaciono-motoričkim i funkcionalnim sposobnostima košarkaša različitog ranga takmičenja, na uzorku od 97 ispitanika podeljenih u dva subuzorka, prvi od 48 ispitanika koji se takmiče u Srpskoj ligi i drugi od 49 ispitanika koji se takmiče u Prvoj Saveznoj ligi za košarkaše, primenjena su tri seta varijabli za procenu motoričkih (10), situaciono-motoričkih (13) i funkcionalnih (dve) sposobnosti. Razlike su utvrđene Diskriminativnom kanoničkom analizom. Na osnovu rezultata i diskusije utvrđeno je postojanje značajnih statističkih razlika u motoričkim i funkcionalnim (aerobna izdržljivost) sposobnostima u korist košarkaša višeg ranga takmičenja. Statistički značajne razlike ne postoje u situaciono-motoričkim sposobnostima. Dobijena je statistička značajnost i u funkcionalnim (anaerobna izdržljivost) sposobnostima u korist košarkaša nižeg ranga takmičenja.

Ključne reči: *košarkaši, rang takmičenja, razlike.*