Coll. Antropol. 35 (2011) 4: 1095–1104
Original scientific paper

Differences in Situation Efficacy Indicators at the Elite Basketball Players that Play on Different Positions in the Team

Joško Sindik[1] and Igor Jukić[2]

[1] Institute for Anthropological Research, Zagreb, Croatia
[2] University of Zagreb, Faculty of Kinesiology, Zagreb, Croatia

ABSTRACT

The aim of our study was to determine the differences in situational efficacy for basketball players, in relation to their team positions: between guards and forwards/centres, and between the players on the four major positions in the team. The final sample of subjects (74 basketball players) is selected from the initial sample of 107 subjects, selected from nine men's senior basketball teams that played in A-1 Croatian men's basketball league championship in 2006/2007. Results confirmed the hypothesis that there is a significant difference between different groups of players: point/shooting guards, comparing with forwards/centres; players that play on four positions: point guard, shooting guard, small forward, power forward/centre. Guards have shown greater efficiency and utilization of the three-point shots, while centres are better in two-point shots. Guards have a greater number of assists, successful and unsuccessful three-point shots, while centres are better in the offensive and defensive rebounds, as same as in successful and unsuccessful two-point shots. No statistically significant differences were found among the players on the guard positions (point guard and shooting guard), while only one statistically significant difference is found among the players on the position forward/ centre (small forward and power forward/ centre).

***Key words**: basketball, Croatia, differences, parameters, situational efficacy*

Introduction

Basketball in its nature is a complex kinesiological activity for which the typical are the cyclic and non-cyclic types of movements that precede the main aim of the game, basketball shooting, as well as preventing an opponent to get the ball and throw it to the basket. The game in its course is divided into three main phases: defence, offence and transition[1]. Basketball can be watched as a specific series of tasks that each player is doing having in mind the position and role in the team within a certain game concept[2]. The characteristics that determine success in basketball is defined by the specification equation, which determines optimal »sum« of anthropological characteristics representing correlates of maximum sport achievement[3]. In relation to the game characteristics and numerous limitations defined by the rules of the game, playing basketball requires anthropological characteristics: morphological (the importance of player's height); functional capacities (physical fitness); motor (basic abilities, skills and knowledge). In the specification equation for the success in basketball, personality is one of major determinants of sport success[4]. In team sports, different positional roles have special requirements which should reflect the differences in anthropological characteristics. So, the players could be differentiated, according to their roles in team, by structural and functional characteristics, specific technical and tactical knowledge, etc. Numerous studies researched the differences in anthropological characteristics of players that play different roles in the game, for example in water polo[5–7], at field hockey players[8]. In basketball, players with different roles in the game could be differentiated in their body height, body mass and scores in standard indicators of the playing performance[9,10]. In studies with a purpose to estimate the anthropometric characteristics at female elite basketball players, significant differences between players that play at different team positions are found at: Bosnian sample (the centers are dominantly with longer and wider skeleton dimensionality, as well as body mass)[11]; World Cham-

Received for publication August 29, 2011

pionship's sample (significant differences in absolute size were found between guards, forwards and centers)[12]; the sample of university basketball players (the centers were significantly taller and greater in body mass, but they had significantly lower body density yet displayed higher fat-free mass than were the guards and forwards)[13]. At elite male basketball players that play at different team position, the differences in anthropometric characteristics were found at: junior basketball players in Croatia[14] (the centers have bigger transversal and longitudinal skeleton dimensionality, but not bigger body fat percentage than guards and forwards); elite male basketball players from India (there was found a strong correlations (r=0.90) between the playing ability *versus* height, weight, arm length, arm span, leg length and flexed arm girth, among all the playing positions)[15]. In a 10-year period study of the impact of the rule change in basketball, the physiological profile of basketball players was changed (by generally increasing their level of fitness), while anthropometric characteristics remained constant (the centres being taller and heavier than the forwards and the guards). Guards exhibited the highest VO_2max and were the most affected by the change in the rules (time regulation) with a 19.5% increase[16]. Body height has a negative and medium to high correlation with all the motor tests. This means that there is a high probability that a tall player with achieve worse results in the selected motor tests than a short player, and vice-versa. Shorter players have the advantage in all the motor tests. Because of their lower body 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 depends also on proper technique with or without the ball, where shorter players are usually more successful[10].

Differences in roles are transparent in five positions: point guard (e.g. level of defensive pressure, the ball control, passing skills); shooting guard (e.g. level of defensive pressure, transition defence efficiency, outside shots); small forward (e.g. transition defence efficiency, offence without the ball, dribble penetration); power forward (e.g. inside shots, dribble penetration, efficiency of screening); centre (e.g. defensive and offensive rebound efficiency, inside shots)[9,17–19]. In data selected from 46 matches oft he final basketball tournament oft he Atlanta Olympic Game in 1996, discriminant functions statistically significantly differentiate between the three groups of players. Guards have executed the greatest number of assists and attempted throws from the three- -point field goal area most often. They have the fewest shooting attempts from two-point goal area; they force and commit fewer professional fouls, have the fewest defensive and offensive rebounds as well as an irrelevant number of block shots, comparing with the forwards and centres. Interestingly, they have the most turnovers but their ratio between the assists and the turnovers is better than the ratio in the forwards and centres. Forwards are in almost all variables interposed between guards and centres, except in the overall fewest turnovers and in the number of steals being equal to the scores guards achieved in that variable. Centres are of the greatest body size and the best in blocking the shots; they have the most offensive and defensive rebounds and attempted the most two-point shots, contrary to the fewest three-point throws; they both extort and commit the most professional fouls[9].

Swalgin obtained in his study that four indicators of the playing performance particularly distinguish positions in play: offensive and defensive rebounds and block shots mostly distinguish between centres and guards, on the one hand, and forwards, on the other; assists distinguish guards from forwards and centres, while the three-point field goals separate guards and forwards from centres[20]. The expertise performed by ten basketball professionals using relative importance coefficients with regard to positions in the game, were determined for nineteen performance evaluation criteria. High degree of inter-observers agreement was obtained concerning all positions (from 0.91 to 0.98). In concordance with the obtained results the particular play positions were explicitly described, as well as similarities and differences between them were determined from the aspect of the single criteria importance. The following criteria had an above average importance for the:

Position 1 – level of defensive pressure, transition defence efficiency, the ball control, passing skills, dribble penetration, outside shots, and transition offence efficiency;

Position 2 – level of defensive pressure, transition defence efficiency, outside shots, dribble penetration, offence without the ball, and transition offence efficiency;

Position 3 – transition defence efficiency, outside shots, dribble penetration, offence without the ball, free throws, and transition offence efficiency;

Position 4 – defensive and offensive rebounding efficiency, inside shots, dribble penetration, efficiency of screening, and free throws;

Position 5 – defensive and offensive rebounding efficiency, inside shots, dribble penetration, efficiency of screening, drawing fouls and three-point plays, and free throws[21,22].

Previous research results suggest the differences in the indicators of situational efficiency (situational effectiveness) between certain types of players (players that play on different team positions in the basketball game). The main problem of our study was to determine whether the players in our sample vary in standard and derived parameters of situational efficiency in relation to the position they held within the team. Specifically, the detection of differences in the situational effectiveness in relation to different positions they held within the team could, on the one hand, allow the coach to correct undesirable deviations from »ideal« situational performance of players who play in certain positions. On the other hand, insight into these differences could help to create more adaptable definition of the role of certain players in certain teams, in relation to their specific situational effectiveness. All this could contribute to the quality of the work of trainers, who (having that type of knowledge) could be able to focus better not only on their own actions, but also on training process and coaching during basketball game.

Materials and Methods

This study was conducted with the permission of the Croatian Basketball Association and the clubs, within the period between sixth and eighth round of the A-1 league championship (from the half of December 2006, until the end first half of January 2007).

Subjects

Intentional sample of subjects made top senior Croatian basketball players, that were playing in nine men senior teams in A-1 Croatian Men Basketball League in the 2006/2007 championship: »Cedevita«, »Svjetlost«, »Borik«, »Kvarner«, »Dubrava«, »Dubrovnik«, »Alkar«, »Šibenik« and »Osijek«. Age range of subjects was relatively large (17–40), with average age of 23 and six months. The final sample of subjects (74 basketball players) was selected from the initial sample of 107 subjects. In the final sample, basketball players were differentiated according to their position in their team. Conditions for selecting the players in the final sample was the number of minutes in play (minimum ten minutes in play *per* game), i.e. the number of games played (minimum eight games in which the individual played). In the first part of the research all players on guard positions were compared ($N_1=47$; point guard and shooting guard) and forwards/centres ($N_2=27$; small forward, power forward and centres). In the second part of the research, four groups of players were compared, i.e. players on positions: point guard $N_1=18$; shooting guard $N_2=29$; small forward $N_3=10$; power forward, and centre $N_4=17$.

Variables

For assessing the overall quality of basketball players we used the partial weighted linear combination method[23–26]. There were thirteen standard situational efficiency parameters, which include shooting performance successfulness data for one, two and three points, rebounds (offensive and defensive), turnovers and steals, assists, block shots, personal fouls. Based on the above mentioned standard parameters of situational efficiency, a combined model for assessing the actual quality of basketball players was designed, replacing eight subjectively estimated variables with seven of the corresponding effect of situational variables, in order to more objectively assess the overall quality of the actual players[27]. Those seven variables, named derived coefficients of situational efficiency are: utilization of two-points shot, utilization of three-point shots, free throw utilization, two-points shot effectiveness, three-point shots effectiveness, free throws effectiveness and the overall situational effectiveness[23–26]. In this study, the data about the block shots is omitted, as it is the rare event of presence of which we had no data. Therefore, we conducted our analysis based on twelve out of thirteen of these standard parameters of situational efficiency. All the data about situational efficiency parameters were collected from the Croatian Basketball Association official website: www. kosarka.hr.

Total sample of games that were played (from which the data on the effectiveness of situational players and teams were collected) included sixteen matches for each of the nine teams. Therefore, it is a »runoff« system of competition, in which each team played the other, one home match, and one match on the »visiting« field.

Statistical methods

Statistical analysis of data was performed using the statistical program SPSS 7.5. Descriptive statistics were calculated for all the experimental data. To estimate the differences between the groups of players in variables of situational efficacy, in relation to their positions in the team (guards compared with forwards/centres), discrimination analysis was used. The other type of estimation statistical differences between the groups (comparing players that play in four different positions in the teams: point guard; shooting guard; small forward and power forward/centre) was Kruskal-Wallis test. When the difference between play positions was statistically significant, for testing the differences between the pairs of play positions, we used Mann-Whitney U-test.

Results

Descriptive characteristics

The highest values of arithmetic means were obtained for the parameters of standard situational efficiency (Table 1): successful shots for two points (XSS2), personal faults (XPF), defensive rebounds (XDR). The lowest values of arithmetic means were obtained for the rarest events in the basketball game, which are standard situational efficiency parameters: unsuccessful shots for one point (XUS1), successful three-point shots (XSS3), offensive rebounds, steals (XSB). The highest standard deviations were found for the variables: successful shots for two points (XSS2), defensive rebounds (XDR) and assists (XA). The lowest standard deviations were found for the variables: steals (XSB), successful three-point shots (XSS3) and offensive rebounds (XOR). Based on the values of Max D, we can see that three variables are significantly deviating from the normal curve; unsuccessful shots for the one point XUS1 ($p<0.01$) and assists (XA) and offensive rebounds (XOR), both with $p<0.05$. In particular, the distribution of indicators XUS1 has the asymmetry towards negative values. However, the distributions of certain situational indicators are compatible with previous findings on the distribution of events in the basketball game and there was no reason to omit them from further analysis.

Considering derived parameters of situational effectiveness, the highest values of the arithmetic means were obtained for: XC1UT (comparing to all the others shot utility coefficients, one point shot utility coefficient has the highest value 0.73), XC2EF (comparing to all the others the coefficient of efficiency, the two points efficiency coefficient has the highest value 38.88). The lowest arithmetic means were obtained for the derived parameters of situational efficiency: coefficient of utilization for the three-points shot XC3UT has the lowest value (0.31), while the lowest value has coefficient of efficiency for the three-points shot XC3EF (8.84). The highest values of the standard deviations were obtained for the variables: coefficient of utilization for the three-points shot XC3UT (0.15) and coefficient of efficiency for the two-points shot XC2EF (29.26). The lowest values of the standard deviations were obtained for the variables: coefficient of utilization for the two-points shot XC2UT (0.10), and coefficient of performance for the three-points shot XC3EF (7.67). Based on the values of Max D, we can see that from the normal distribution statistically significantly deviate none of the coefficients of utilization and none of the coefficients of efficiency.

Differences in the standard parameters of situational efficacy

Considering the differences between the players that play on the position of point/shooting guards and forwards/ centres, as can be seen from Table 2, we can see that canonical correlation coefficient is very high (0.78). Wilk's Lambda value (0.40), however, indicates that the discriminant function statistically significantly (with $p<0.01$) differentiate the players that play on different play positions, according to the standard parameters of situational efficacy in basketball. Centroids had the values –1.60 for the forwards/centres, and 0.92 for the players at the guard positions (point/shooting guards). Correlations in the structure matrix, that indicate the correlation of discriminatory variables with discriminant function, vary from –0.53 to 0.47. The results of univariate analysis of variance for each standard parameter of the situational efficiency, between the players that play on the position of point/shooting guards and forwards/centres, indicate that there are seven statistically significant differences, as follows: XSS2 (successful two-point shots), XUS2 (unsuccessful two-point shots), XSS3 (successful three-point shots), XUS3 (unsuccessful three-point shots), XA (assists), XOR (offensive rebounds), and XDR (defensive rebounds). All these variables statistically significantly differ players that play on the position of point/ shooting guards from forwards/centres, in the theoretically expected direction: more/less successful two- -point shots for players on the position of forwards/centres; more/less efficient three-points shot for players at the position of point/shooting guards; more assists for point/ shooting guards; more offensive and defensive rebounds

TABLE 1
DESCRIPTIVE STATISTICS FOR THE STANDARD AND DERIVED PARAMETERS OF SITUATIONAL EFFICIENCY FOR BASKETBALL PLAYERS (N=74)

Variables	$\overline{X}$	Minimum	Maximum	Range	Variance	SD	Skew.	Kurtosis	Max D	p
XSS2	34.03	2.00	115.00	113.00	515.53	22.71	1.07	1.14	0.12	0.20
XUS2	26.99	4.00	79.00	75.00	246.81	15.71	0.93	0.92	0.08	0.20
XSS3	12.00	0.00	39.00	39.00	85.18	9.23	0.74	0.07	0.11	0.20
XUS3	23.12	0.00	61.00	61.00	272.90	16.52	0.51	–0.56	0.12	0.20
XSS1	24.12	1.00	72.00	71.00	262.16	16.19	0.94	0.51	0.14	0.15
XUS1	10.22	0.00	97.00	97.00	153.35	12.38	4.90	33.01	0.21	0.01
XA	22.51	1.00	105.00	104.00	371.18	19.27	2.23	6.13	0.18	0.05
XOR	13.88	1.00	48.00	47.00	114.11	10.68	1.28	1.32	0.17	0.05
XDR	31.20	2.00	87.00	85.00	376.22	19.40	0.84	0.35	0.09	0.20
XSB	14.45	0.00	34.00	34.00	60.41	7.77	0.24	–0.60	0.07	0.20
XPF	33.23	4.00	64.00	60.00	146.40	12.10	0.08	–0.49	0.09	0.20
XTB	21.39	3.00	55.00	52.00	134.41	11.59	0.69	–0.31	0.13	0.15
XC2UT	0.54	0.17	0.72	0.55	0.01	0.10	–0.72	1.05	0.08	0.20
XC3UT	0.31	0.00	0.70	0.70	0.02	0.15	–0.39	0.68	0.16	0.10
XC1UT	0.73	0.40	1.00	0.60	0.02	0.13	–0.12	–0.29	0.07	0.20
XC2EF	38.88	0.67	147.77	147.10	855.97	29.26	0.74	0.14	0.14	0.15
XC3EF	8.84	0.00	34.97	34.97	58.89	7.67	0.51	–0.44	0.13	0.20
XC1EF	17.52	0.50	55.74	55.24	146.79	12.12	1.99	7.35	0.136	0.20

Legend: XSS2 = successful shots for two points; XUS2 = unsuccessful shots for two points; XSS3 = successful shots for three points; XUS3 = unsuccessful shots for three points; XSS1 = successful free throws; XUS1 = unsuccessful free throws; XA = assists; XOR = offensive rebounds; XDR = defensive rebounds; XSB = steals; XPF = personal fouls; XTB = turnovers; XC2UT = utilization coefficient for two-points shot; XC3UT = = utilization coefficient for three-points shot; XC1UT = utilization coefficient for free throws; XC2EF = efficiency coefficient for two-point shots; XC3EF = efficiency coefficient for three-point shot; XC1EF = efficiency coefficient for free throws

TABLE 2
DISCRIMINANT ANALYSIS BETWEEN THE PLAYERS THAT PLAY ON POSITIONS OF POINT/ SHOOTING GUARDS (N1 = 47) AND FORWARDS/CENTRES (N2 = 27) FOR STANDARD PARAMETERS OF SITUATION EFFICACY

Discriminant function	Eigenvalue	Wilk's lambda		Canonical correlation		χ^2-test (degrees of freedom)		p
	1.51	0.40		0.78		60.75 (12)		<0.001
Variables	Wilk's lambda	Structure coefficients	F-test (1.72)	p	$\overline{X}$ Guards	$\overline{X}$ Forwards/ centers	SD Guards	SD Forwards/ centers
XSS2	0.91	–0.25	7.01	<0.01	28.94	42.89	19.51	25.40
XUS2	0.93	–0.23	5.85	<0.02	23.74	32.63	14.89	15.76
XSS3	0.75	0.47	24.29	<0.01	15.49	5.93	8.44	7.26
XUS3	0.84	0.36	13.92	<0.01	28.13	14.41	15.20	15.28
XSS1	1.00	–0.02	0.04	>0.20	23.83	24.63	17.14	14.69
XUS1	0.99	–0.09	0.96	>0.20	9.15	12.07	14.14	8.45
XA	0.88	0.29	9.42	<0.01	27.45	13.93	21.74	9.25
XOR	0.71	–0.53	30.13	<0.01	9.51	21.48	7.40	11.36
XDR	0.83	–0.37	14.82	<0.01	25.17	41.70	15.91	20.69
XSB	0.95	0.16	2.67	>0.10	15.55	6.65	8.21	6.65
XPF	1.00	–0.03	0.09	>0.20	32.91	10.47	13.04	10.47
XTB	1.00	0.04	0.15	>0.20	21.79	20.70	11.62	11.59

Legend: XSS2 = successful shots for two points; XUS2 = unsuccessful shots for two points; XSS3 = successful shots for three points; XUS3 = unsuccessful shots for three points; XSS1 = successful free throws; XUS1 = unsuccessful free throws; XA = assists; XOR = offensive rebounds; XDR = defensive rebounds; XSB = steals; XPF = number of personal fouls; XTB = turnovers.

for players on the position of forwards/centres. Based on the discriminant function, it is possible to make even 91.9% of correct classifications of the players that play on the position of point / shooting guards from forwards/ centres.

Differences in the Derived Parameters of Situational Efficacy

Considering the differences between the players that play on the position of point / shooting guards and forwards/ centres, as can be seen from Table 3, we can see that canonical correlation coefficient is moderately high (0.48). Wilk's Lambda value (0.77), however, indicates that the discriminant function statistically significantly (with $p<0.01$) differentiate the players that play on different play positions, according to the derived utilization parameters of situational efficacy in basketball. Centroids had the values –0.71 for the forwards/centres, and 0.41 for the players at the guard positions (point/shooting guards). Correlations in the structure matrix, that indicate the correlation of discriminatory variables with discriminant function, vary from –0.14 to 0.94. The results of univariate analysis of variance for each derived parameter of the situational efficiency, between the players that play on the position of point/shooting guards and forwards/centres, indicate that there is one statistically significant difference: utilization coefficient for the three-point shots (XC3UT). This variable statistically significantly differs players that play on play positions of point/ shooting guards and forwards/centres in theoretically expected direction: higher utilization coefficient value for three-point shots for players at guard positions. Based on the discriminant function, it is possible to make 74.3% of correct classifications of the players that play on the position of point / shooting guards from forwards/ centres.

Considering the differences between the players that play on the position of point/shooting guards and forwards/ centres, as can be seen from Table 4, we can see that canonical correlation coefficient is moderately high (0.55). Wilk's Lambda value (0.70) indicates that the discriminant function statistically significantly (with $p<0.01$) differentiate the players that play on different play positions, according to the derived efficiency parameters of situational efficacy in basketball. Centroids had the values –0.81 for the forwards/centres, and 0.49 for the players at the guard positions (point/shooting guards).

Correlations in the structure matrix, that indicate the correlation of discriminatory variables with discriminant function vary from –0.44 to 0.83. The results of univariate analysis of variance for each derived parameter of the situational efficiency, between the players that play on the position of point/shooting guards and forwards/ centres, indicate that there are two statistically significant differences, as follows: efficiency coefficient for the three-point shots (XC3EF) and efficiency coefficient for the two-point shot (XC2EF). These variables statistically significantly differs players that play on play positions of point/shooting guards and forwards/ centres in theoretically expected direction: higher efficiency coefficient for three-point shots for players at the guard positions and higher efficiency coefficient for two-point shot for players at the forwards/centres position. Based on the discrimi-

TABLE 3
DISCRIMINANT ANALYSIS BETWEEN THE PLAYERS THAT PLAY ON POSITIONS OF POINT/ SHOOTING GUARDS (N1=47) AND FORWARDS/CENTRES (N2=27) FOR DERIVED (UTILIZATION) PARAMETERS OF SITUATION EFFICACY

Discriminant function	Eigenvalue	Wilk's lambda		Canonical correlation		χ^2-test (degrees of freedom)		p
	0.30	0.77		0.48		18.41 (3)		<0.001
Variables	Wilk's lambda	Structure coefficients	F-test (1.72)	p	$\overline{X}$ Guards	$\overline{X}$M Forwards/ centres	SD Guards	SD Forwards/ centres
XC2UT	0.99	–0.14	0.42	>0.20	53.40	55.04	11.39	8.36
XC3UT	0.79	0.94	19.08	<0.01	36.43	22.11	9.86	18.39
XC1UT	0.95	0.41	3.56	<0.10	75.21	69.19	13.26	13.17

Legend: XC2UT = utilization coefficient for two-points shot; XC3UT = utilization coefficient for three-points shot; XC1UT = utilization coefficient for free throws

TABLE 4
DISCRIMINANT ANALYSIS BETWEEN THE PLAYERS THAT PLAY ON POSITIONS OF POINT/ SHOOTING GUARDS (N1 = 47) AND FORWARDS/CENTRES (N2 = 27) FOR DERIVED (EFFICIENCY) PARAMETERS OF SITUATION EFFICACY

Discriminant function	Eigenvalue	Wilk's lambda		Canonical correlation		χ^2-test (degrees of freedom)		p
	0.43	0.70		0.55		25.36 (3)		<0.001
Variables	Wilk's lambda	Structure matrix	F-test (1.72)	p	$\overline{X}$ Guards	$\overline{X}$ Forwards/ centres	SD Guards	SD Forwards/ centres
XC2EF	0.92	0.83	6.139	<0.02	3270.40	4962.41	2457.96	3384.58
XC3EF	0.77	–0.44	21.426	<0.01	1160.23	402.00	745.55	539.29
XC1EF	0.99	0.05	0.089	>0.20	1784.15	1696.44	1287.59	1087.69

Legend: XC2EF = efficiency coefficient for two-point shots; XC3EF = efficiency coefficient for three-point shot; XC1EF = efficiency coefficient of free throws

nant function, it is possible to make 79.7% of correct classifications of the players that play on the position of point/shooting guards from forwards/ centres.

Differences in the situational efficiency between four players' positions in team

In the Table 5 is apparent that there are a number of statistically significant differences in situational effectiveness among basketball players with different positions within team. Statistically significant differences were not found in parameters: successful and unsuccessful free throws, steals and turnovers, personal fouls. Among the utilization coefficients, only statistically significant difference was found for utilization coefficient three-points shot. Among the efficiency coefficients, no statistically significant differences were found in the free throws efficiency coefficient.

When comparing the differences that were statistically significant for all four positions on the team (Mann-Whitney U-test), we didn't found statistically significant differences between the players that play on guards position (point/shooting guards) in all the standard or derived parameters of situational efficiency. On the other hand, we have found a small number of statistically significant differences between the players that play on forwards/centres position in all standard and derived parameters of situational efficiency: small forwards were statistically significantly better than power forwards/ centres in successfulness of free throws (U = 42, p<.05).

In accordance to our expectations, we have found statistically significant differences in the parameters of situational efficacy for basketball players who play on guard positions, comparing with forwards and centres. Small forwards were statistically significantly better than point guards in: successful two-point shots (U=47.5, p<.05), unsuccessful two-point shots (U=48.5, p<.05), unsuccessful free throws (U=46.5, p<.05), offensive rebounds (U=7.5, p<.01), defensive rebounds (U=32.5, p<.01), effectiveness of two-point shots (U=47, p<.05). Point guards were statistically significantly better than small forwards in: successful three-point shots (U=37, p<.01), unsuccessful three-point shots (U=35.5, p<.01), effectiveness of three-point shots (U=47, p<.05). Small forwards were statistically significantly better than shooting guards in: successful two-point shots (U=62, p<.01), unsuccessful two-point shots (U=60, p<.01), successful free throws (U=81.5, p<.05), unsuccessful free throws (U=65, p<.01), offensive rebounds (U=36, p<.01), defensive rebounds (U=58, p<.01), effectiveness of a two-point shots (U=70, p<.05). Shooting guards were statis-

TABLE 5
DIFFERENCES IN SITUATION EFFICACY PARAMETERS AT PLAYERS THAT PLAY ON FOUR POSITIONS: POINT GUARDS, SHOOTING GUARDS, FORWARDS AND CENTRES

Variable	χ^2-test (df=3)	Significance	Average rank			
			Point guard	Shooting guard	Small forward	Power forward. centre
XSS2	8.97	<0.05	36.03	30.84	53.70	40.88
XUS2	8.90	<0.05	35.92	30.84	53.50	41.12
XSS3	23.97	<0.01	48.86	45.22	25.15	19.56
XUS3	14.35	<0.01	47.94	42.28	23.55	26.50
XSS1	5.88	>0.10	41.36	33.64	50.15	32.56
XUS1	6.90	<0.10	33.89	33.16	52.70	39.79
XA	14.35	<0.01	48.03	40.81	35.95	21.62
XOR	26.53	<0.01	22.78	32.09	60.65	48.71
XDR	13.34	<0.01	33.03	29.71	54.80	45.35
XSB	7.65	<0.10	45.86	37.17	42.10	26.50
XPF	1.90	>0.20	35.17	38.07	45.30	34.41
XTB	2.96	>0.20	43.36	34.90	42.10	33.03
XC2UT	1.60	>0.20	40.75	34.24	42.30	36.79
XC3UT	17.54	<0.01	43.31	45.09	36.45	19.03
XC1UT	4.47	>0.20	43.92	39.64	32.10	30.24
XC2EF	7.89	<0.05	36.67	31.10	52.70	40.35
XC3EF	22.52	<0.01	47.86	45.24	27.75	19.06
XC1EF	5.52	>0.10	43.44	34.10	47.15	31.32

Legend: XSS2 = successful shots for two points; XUS2 = unsuccessful shots for two points; XSS3 = successful shots for three points; XUS3 = unsuccessful shots for three points; XSS1 = successful free throws; XUS1 = unsuccessful free throws; XA = assists; XOR = offensive rebounds; XDR = defensive rebounds; XSB = steals; XPF = personal fouls; XTB = turnovers XC2UT = utilization coefficient for two-point shots; XC3UT = utilization coefficient for three-point shots; XC1UT = utilization coefficient for free throws; XC2EF = efficiency coefficient for two-point shots; XC3EF = efficiency coefficient for three-point shots; XC1EF = efficiency coefficient for free throws

tically significantly better than small forwards in: successful three-point shots (U=65, p<.01), unsuccessful three-point shots (U=65.5, p<.01), effectiveness of three-points shot (U=74.5, p<.05).

Power forwards/centres were statistically significantly better than point guards only in offensive rebounds (U=36, p<.01). Point guards were statistically significantly better than power forwards/ centres in: successful three-point shots (U=33, p<.01), unsuccessful three-point shots (U=69.5, p<.01), assists (U=55, p<.01), steals (U=69, p<.01), utilization of a three-point shot (U=50, p<.01), effectiveness of three-point shots (U=50, p<.01). Power forwards/centres were statistically significantly better than shooting guards in: offensive rebounds (U=133, p<.01) and defensive rebounds (U= 141.5, p< .05).

Shooting guards were statistically significantly better than power forwards/centres in: successful three-point shots (U=71, p<.01), unsuccessful three-point shots (U=137.5, p<.05), assists (U=112, p<.01), utilization of three-point shots (U=72, p<.01), effectiveness of three-point shots (U=65, p<.01).

Discussion and Conclusion

The main finding of this the study is the fact that the basketball players in our sample statistically significantly differ in the standard and derived parameters of situational efficiency, according to their position within teams. Discriminant function differs significantly those basketball players who are playing on the positions of point/ shooting guard and forward/centre, according to the set of standard and the set derived parameters of situational efficiency in basketball. All obtained statistically significant differences are as we have expected from previous studies[9,20–22]. In the space of standard parameters of situational efficiency, we found statistically significantly more parameters in point and shooting guards, (comparing with forwards and centres): successful and unsuccessful shots for three points and assists. On the other hand, the forwards/centres (comparing with point and shooting guards) had statistically significantly more successful and unsuccessful shots for two points, offensive and defensive rebounds. Sindik[28] (using the same data as this research) found that successful and unsuccessful two-point shots are differentiating factors that significantly distinguish basketball players from more and less successful teams in Croatian A-1 Championship League. Observed differences in this study are also expected: players from more successful teams have statistically significantly better two-point shots, comparing with the players from less successful teams[28]. In other words, forwards/centres can be more responsible for differentiation better and worse basketball teams in Croatian A-1 Championship League.

The results of this study may be partly caused by a relatively small number of centres in the examined sample of basketball players. On the other hand, it is possible that the best (situational extremely efficient) forwards/centres are concentrated in the more successful teams A-1 league. The following reason for the results that we obtained may be due to a certain particularity of observed A-1 league season. It is probably that players from all teams might have been less motivated to give their best because the team »Zabok« give up the championship immediately before the championship started, which caused less uncertainty in the championship (none team can be relegated from the league). The consequence can be clearly »polarized« situation in the championship, with two teams fighting for the first position (»Svjetlost« and »Cedevita«) and the rest of seven »resigned« teams, already in an early stage of championship (at the time of testing).

On the level of derived parameters of situational efficiency, it was found that the discriminant function significantly distinguished basketball players who play in positions of point/shooting guard and forwards/centres in the parameters: utilization coefficient for the three-point shot, efficiency coefficient for the three-point shot and efficiency coefficient for the two-point shots. The direction of the differences is the same as at standard parameters of situational efficiency: forwards/centres have better efficiency coefficient for the two-point shots, while the guards have better efficiency and utilization coefficients for the three-point shot. These findings, at the level of derived parameters of situational efficiency, confirmed the results obtained for standard parameters of situational performance. Comparison between players belonging to more and/or less successful teams has shown that players from a more successful teams show a more efficiency and utilization in performing two-point shots[28]. Nakić[29] found similar results at the teams that participated at the European championships in basketball: more successful are differentiated from less successful teams on criteria of utilization and efficiency of two-points shot. So, we can carefully consider the hypothesis do (or when, in what situations) the forwards/centres are those who make successful teams? Practical implication of these findings can be directed to basketball coaches, in the direction of future improvement of the basketball as a team sport. In spite of »specialized« team positions, in dynamic basketball game we can train the specific type of players with »mixed« team positions (for example point guard-small forward, power forward-centre, etc.). The players with »mixed« team positions can be used only in specific phases of the game (for example, at the end of the game or in the offence), or during the whole game. This type of specialization can make the basketball more complex and dynamic team sport.

Beyond and besides the considering the reasons of differences between the players that play on different team positions in parameters of situational efficiency, we have to explain general advantages and shortcomings of this study, as same as the directions for the future researches.

In scientific terms, the main advantage of this study is the fact that it is one of the rare researches with top Croatian basketball players as subjects, where we included all available players in the A-1 Croatian basketball league. With a proper caution, the results could be generalized on a whole population of elite Croatian basketball players.

The main shortcoming of this research may be partly reflected in the results obtained: the specificity of a particular event, i.e. 2006/2007 A-1 League Croatian Championship in basketball. From the beginning this championship showed a little uncertainty, because of the competitive domination of two teams (»Cedevita« and »Svjetlost«). Besides, it was (even for the least successful team) practically impossible for any team to be relegated from the A-1 League, regardless of their results. That assumed absence of uncertainty might affect negatively to the motivation and unpredictable to the situational effectiveness of individual players, in fact. For example, basketball players from less successful teams could be very relaxed during the games, with a consequence of lower focus during assists, steals, shooting, with more turnovers. On the other hand, basketball players from the most successful teams during their games could have periods of much focused, as same as periods of very relaxed playing, sometimes with the same players (who contributed in making significant point difference between their and opponent team), but sometimes with their substitutes from the bench, who could have just relaxed game approach. The substitutes in less successful teams can have quite different role: they probably have to try the »mission impossible« in games with the most successful teams (to reverse the game result, when their team is losing). All mentioned possibilities could have different influence on situation-related efficiency, depending of different team positions. We can assume that »over-relaxation« as well as »tensed focus« (for the substitutes, especially in less successful teams) could have stronger influence on the situation-related efficiency of guards (with more three-point shots, assists, steals, two-point shots from longer distance) comparing with centres or forwards.

The other important factor was the reselection of the initial sample of 107 players, which can have an impact in the imbalance in the proportions of players that play on different team positions (relatively low variability in the situational parameters of efficiency can be caused by multiple selection in the sample of players). Specifically, the number of games played and time spent in the game, reduced the sample size. It's very probable that players who are dropped out from the final sample were those who are less efficient. Also, researching only a players from A-1 league (and not the players from four most successful Croatian teams: »Cibona«, »Zadar«, »Zagreb« and »Split«), was probably the factor that additionally reduced the variance of the parameters of the situational efficiency. These two types of reselection (excluding the players from four most successful Croatian teams, as well as the players who didn't play enough) could have an influence on the situation-related efficiency, depending of player's team positions. It's possible that some imbalance exist between the players who didn't play enough and their team positions, in the interaction with their situation-related efficiency and the reasons why they didn't play enough (for example, maybe the most of high quality guards didn't play enough because of injury, while the most of low quality forwards didn't play enough because of their low quality). However, situation-related efficiency in four the most successful Croatian teams, according to the players that play on different team positions, could be different than in A-1 league, even in Croatian League for the Champion (where four most successful Croatian teams compete together with four most successful teams in A-1 league). We can assume that the relationship between the best A-1 teams and four the most successful Croatian teams could be very similar as the relationship between the best and less efficient A-1 teams (in each Croatian League for the Champion, four the most successful Croatian teams showed the dominance, comparing with the best A-1 teams).

Potential explanations mentioned above (shortcomings of the research) that could affect on the results obtained, can be the guidelines for the future research. In future studies we can try to increase the number of subjects (attempting to include the injured or for any other reasons absent players, as well as the players excluded from this research according to criteria number of games played and time spent in the game). We can research the players from four most successful Croatian teams, which would (probably) lead to a higher variability in the situational parameters of the effectiveness. Therefore, one of the proposals for the future research can go toward the replication of the same type of studies sequentially in few basketball championships, where the differences in the situational efficiency parameters may be better reflected[22]. Additional thing what we can do in future researches is the improvement in the equalization of the term »elite players«, especially for the explanation purposes for the results obtained. The term »elite players« have the different meaning in different countries, depending of a quality of basketball competitions in a specific country (except the trainers' work and the basketball tradition is some country, important factors are financial possibilities of basketball teams to keep their best players). Changing (or equalization) the system of basketball competitions in different countries is the first step in this direction.

Results that we obtained confirmed the hypothesis that there is a significant difference between different groups of players (point/ shooting guards and forwards/ centres; players that play on four positions: point guard, shooting guard, small forward, power forward/centre). Guards have shown greater efficiency and utilization of the three-point shots, while centres are performing better in two-point shots. Guards have a greater number of assists, successful and unsuccessful three-point shots, while centres perform better in the offensive and defensive rebounds, as same as in successful and unsuccessful two-point shots.

No statistically significant differences were found among the players on the guard positions (point guard and shooting guard), while only one statistically significant difference is found among the players on the position forward/centre (small forward and power forward / centre).

Acknowledgements

The study was conducted as a by-product of a doctoral dissertation »Correlation between Conative characteristics of top basketball players and the situational performance in basketball«. The support of my mentors PhD Vera Ćubela Adorić and PhD Igor Jukić (co-author of this article), as well as PhD Smiljka Horga and PhD Dražan Dizdar, who contributed with helpful comments during planning and writing the dissertation, is gratefully acknowledged.

Appendix

Derived parameters of situational efficiency

Utilization coefficient for two-point shots: XC2UT XSS2 = / (XSS2 + XUS2)

Utilization coefficient for three-point shot: XC3UT = XSS3 / (XSS3 + XUS3)

Utilization coefficient for of free throws: XC1UT XSS1 = / (XSS1 + XUS1)

Efficiency coefficient for two-point shots: XC2EF = 2 x x XSS2 XC2UT

Efficiency coefficient for three-point shot: XC3EF = x 3 x XSS3 XC3UT

Efficiency coefficient for free throws: XC1EF XSS1 = x XC1UT

Legend: XSS2 = successful shots for two points; XUS2 = unsuccessful shots for two points; XSS3 = successful shots for three points; XUS3 = unsuccessful shots for three points; XSS1 = successful free throws; XUS1 = unsuccessful free throws; XA = assists; XOR = offensive rebounds; XDR = defensive rebounds; XSB = steals; XPF = personal fouls; XTB = turnovers

REFERENCES

1. JUKIĆ I, Estimating of the motor-functional preparation in one-year cycle of the training elite female basketball players. Master Thesis. In Croat (University of Zagreb, Zagreb, 1998). — 2. TRNINIĆ S, Structural analysis of knowledge in basketball. PhD Thesis (University of Zagreb, Zagreb, 1995). — 3. MILANOVIĆ D, JUKIĆ I, DIZDAR D, Kineziologija, 28 (1995) 42. — 4. GABRIJELIĆ M, Manifest and latent dimensions of top athletes in some team sports games in motor and conative area. PhD Thesis. In Croat (University of Zagreb, Zagreb, 1977). — 5. LOZOVINA M, PAVIČIĆ L, LOZOVINA V, Naše more, 54 (2007) 137. — 6. LOZOVINA V, PAVIČIĆ L, LOZOVINA M, Coll Antropol, 27 (2003) 343. — 7. LOZOVINA V, GUSIĆ Ž, LOZOVINA M, Naše more, 53 (2006) 72. — 8. WEIGAND DA, STOCKHAM K J, J Sport Behav, 23 (2000) 61. — 9. TRNINIĆ S, Recognizing, evaluating and encouraging the elite basketball players (Croatian Basketball Federation, ACBC – Association of Croatian Basketball Coaches, IBA – International Basketball Academy, Zagreb). — 10. DEŽMAN B, ERČULJ F, VUČKOVIĆ G, Classifying young basketball players into playing positions with chosen anthropometric and motor variables. In: Proceedings book (Kinesiology – New perspectives, Opatija, Croatia, 2002). — 11. BAŠINAC I, MIKIĆ B, POJSKIĆ H, Sport Scientific and Practical Aspects, 6 (2009) 20 — 12. ACKLAND TR, SCHREINER AB, KERR DA, J Sports Sci, 15 (1997) 485. — 13. LAMONTE MJ, MCCKINNEY JT, QUINN SM, BAINBRIDGE CN, EISENMAN PA, J Strength Cond Res, 13 (1999) 264. — 14. JELIČIĆ M, SEKULIĆ D, MARINOVIĆ M, Coll Antropol, 26 (2002) 69. — 15. VISWANATHAN J, CHANDRASEKARAN K, International Journal of Sports Science and Engineering, 5 (2011) 67. — 16. CORMERY B, MARCIL M, BOUVARD M, Br J Sports Med, 42 (2008) 25. — 17. DIZDAR D, TRNINIĆ S, MILANOVIĆ D, Kinesiology, 29 (1997) 47. — 18. DIZDAR D, TRNINIĆ S, MATKOVIĆ, B, Hrvatski športskomedicinski vjesnik, 10 (1995) 108. — 19. TRNINIĆ S, VISKIĆ-ŠTALEC N, ŠTALEC J, DIZDAR D, BIRKIĆ Z, Kinesiology, 27 (1997) 27. — 20. SWALGIN K, Kinesiology, 30 (1998) 31. — 21. TRNINIĆ S, DIZDAR D, Coll Antropol 24 (2000) 217. — 22. DEŽMAN B, TRNINIĆ S, DIZDAR D, Coll. Antropol. 25 (2001) 141. — 23. DIZDAR D, Evaluation of a set of methods for assessing the actual quality of basketball players. PhD Thesis. In Croat. (University of Zagreb, Zagreb, 2002). — 24. ELBEL ER, ALLEN F, Res Q Exerc Sport, 12 (1941) 538. — 25. ERČULJ F, Kineziologija, 29 (1996) 42. — 26. TRNINIĆ S, PERICA A, DIZDAR D, Criteria for the situation related efficiency evaluation of the elite basketball players. In: Proceedings book (Kineziologija za 21. stoljeće, Opatija: 2001). — 27. TRNINIĆ S, DIZDAR D, DEŽ- MAN B, Combined model of expert system for the actual assessment in basketball players. In: Proceedings book (Kinesiology – New perspectives, Opatija, Croatia, 2002). — 28. SINDIK J, Correlation between conative characteristics of top basketball players and their situational efficiency. PhD Thesis. In Croat (University of Zagreb, Zagreb, 2009). — 29. NAKIĆ J, Differences in standard and derived parameters of situational efficiency between male and female senior basketball teams at the European basketball championships in 2003. MS Thesis. In Croat (University of Zagreb, Zagreb, 2004).

J. Sindik

Institute for Anthropological Research, Ljudevita Gaja 32, 10 000 Zagreb, Hrvatska, e-mail: josko.sindik@inantro.hr

RAZLIKE U POKAZATELJIMA SITUACIJSKE UČINKOVITOSTI VRHUNSKIH KOŠARKAŠA KOJI IGRAJU NA RAZLIČITIM POZICIJAMA U MOMČADI

SAŽETAK

Cilj našeg istraživanja bio je utvrditi razlike u situacijskoj učinkovitosti košarkaša, u odnosu na njihovu poziciju u momčadi: između bekova i krila/centara te između igrača na četiri glavne pozicije u momčadi. Konačni uzorak ispitanika (74 košarkaša) odabran je iz početnog uzorka od 107 košarkaša, izabranih iz devet košarkaških momčadi iz A-1 Hrvatske muške košarkaške lige u prvenstvu 2006/2007. Rezultati su potvrdili hipotezu da postoji statistički značajna razlika između različitih skupina igrača: bekova (playmakera i šutera zajedno) u usporedbi s krilima/centrima, te između igrača koji igraju na četiri mjesta u momčadi: playmaker, bek šuter, krilo, krilni centar/centar. Bekovi su pokazali veću učinkovitost i iskoristivost šutova za tri poena, a krila/centri su učinkovitiji u šutiranju za dva poena. Bekovi imaju veći broj asistencija, uspješnih i neuspješnih šutova za tri poena, a krila/ centri su uspješniji u napadačkim i obrambenim skokovima, kao i u uspješnim i neuspješnim šutovima za dva poena. Nema statistički značajnih razlika između igrača na pozicijama bekova (playmaker i bek šuter), dok je samo jedna statistički značajna razlika je pronađena među igračima na poziciji krila/centara (krilo i krilni centar/centar).