FACTA UNIVERSITATIS
Series: **Physical Education and Sport**, Vol. 16, No 4, 2018, pp. 709 - 723
https://doi.org/10.22190/FUPES181204063S

Research article

INFLUENCE OF GAME-RELATED STATISTICAL ELEMENTS ON FINAL RESULTS IN FIBA EUROBASKET WOMEN 2017

UDC 796.323-055.2
796.093.1(4)

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Abstract. *Research papers investigating the game-related parameters and phenomena of women's basketball matches are relatively smaller in size and number than similar ones treating the same issues in men's basketball – although, there have been some changes in that respect in recent years. This paper includes a sample of 40 games and thirteen variables of standard efficiency recorded at FIBA EuroBasket Women 2017. The research had two basic models of regressions formed, i.e. an absolute and a relative one, each of which had total numbers scored as the dependent variable, and was performed by means of a regression and correlation analysis – a stepwise regression, as a gradual method of fitting regression models in order to define the predictive variables. The obtained regression models and partial correlation indicate that the winning or losing performance was heavily influenced by both field goal efficiency and defensive rebounding, all of which has been corroborated in many other similar research. Also, variables such as turnovers and personal fouls were extracted as significant in terms of the differentiation between the winning and losing team. When we take a closer look and see the observed parameters from the point of view of either First or Final rounds of the competition - since these rounds were played in different formats - it is noticeable that the difference is becoming more and more evident, of course besides shot efficiency, the efficiency of free throws and the quality of defense.*

Key words: *blocks, shooting efficiency, EuroBasket, turnovers, personal fouls, gradual regression, defensive rebounding, women's basketball*

Received December 4, 2018 / Accepted January 04, 2019

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INTRODUCTION

Basketball coaches should make every effort to efficiently track and enhance the level of their players' readiness (Kocić, Berić, Radovanović, & Simović, 2012) and to prepare their teams in order to perform as best as possible for upcoming competitions (Sampaio, Janeira, Ibanez, & Lorenzo, 2006). A better understanding of the tactical elements of the game obtained through the evaluation of collective and team performance of basketball players is vital when it comes to pre-competition training sessions, actual game preparation, and the performance of the team during the match (Courel-Ibáñez, McRobert, Toro, & Vélez, 2018). Notational analysis, with its long tradition in sports dating as far back as the 15th century (Thornton, 1971), and the first works in basketball done by Lloyd Lowell Messersmith in the early 1940s (Messersmith & Corey, 1931), is considered as an objective and reliable way to quantify the key parameters of basketball performance (Nevill, Atkinson, & Hughes, 2008). According to Hughes and Franks (2004), notational analysis is used for: (a) technical and tactical evaluations; (b) educational uses with coaches and players; (c) development of databases and performance models; and (d) analysis of movements, commonly referred to as time-motion analysis.

There are many ways in which researchers analyze the structure of basketball (Selmanović, 2016). Over 200 systems for the objective assessment of basketball have been reported so far (Martinez, 2012), among which the most dominant ones are: a simple linear combination, a simple linear combination of the z-value, partially weighted linear combinations, the index of absolute and relative efficiency of basketball players, MVP assessment, Swalgin's basketball evaluation system, and the PC system for the evaluation of player efficiency (Dizdar, 2002).

The analyses with basketball game-related statistics as a means of performance evaluation are presented in the form of statistical evaluation of various parameters of the game, which should potentially lead to the differentiation between the winning and losing team (Gómez, Lorenzo, Sampaio, & Ibáñez, 2006). Although many authors have stressed that "women's basketball analysis through game-related statistics would seem to be an important area of research" (Gómez, Lorenzo, Ortega, Sampaio, & Ibáñez, 2009, p. 278), still there are only few such papers, and they are far outnumbered by the papers on men's basketball (Dimitros, Garopoulou, Bakirtzoglou, & Maltezos, 2013; Kreivyte et al., 2013; Leicht, Gomez, & Woods, 2017a; Milanović, Štefan, Sporiš, & Vuleta, 2016a). These performance-centered papers seem to be in the pursuit of the "holy grail" (Martinez, 2012), the underlying reasons for their failure to do so are probably as various as they can be, i.e. from the non-linearity of links between efficiency and multidimensionality to unpredictability of the player's reactions in concrete situations on the court and under ever-changing game conditions (Grehaigne & Godbout, 1995). That being so, basketball coaches and researchers are constantly on a quest for a new approach to the game analysis (Trninić, Dizdar, & Dežman, 2000) guided by the words of the famous coach, Pat Riley (1993), who said that not all basketball skills can be measured mechanically, but all of them are measurable in a certain way, which can later be represented in a numerical way.

The aim of this paper is to determine whether the difference in points between the two teams, the winning and losing one, is in the function of differences of quantitatively observed absolute and relative indicators of the situational analysis in basketball during the last continental championship-FIBA EuroBasket Women 2017, and to determine whether there are any significant differences between the parameters recorded during the First and Final Round games.

METHODS

The sample included in this work consisted of forty (N = 40) games played at FIBA EuroBasket Women 2017. The event took place in the Czech Republic from 16th to 25th June in Prague (O2 Arena i Královka Arena) and Hradec Králové (Zimní stadion Hradec Králové), with the participation of 16 national teams which previously qualified for the championship: Belarus, Belgium, the Czech Republic, France, Greece, Hungary, Italy, Latvia, Montenegro, Russia, Serbia, Slovakia, Slovenia, Spain, Turkey, and the Ukraine.

The sample in this study is made up of 13 manifest variables gathered during basketball games, which were collected and registered in compliance with FIBA statistics rules and regulations - http://www.archive.fiba: PST - total points, A2 - 2 points attempted, M2 - 2 points made, A3 - 3 points attempted, M3 - 3 points made, AFG - field goals attempted, MFG - field goals made, AFT - free throws, MFT - free throws made, OR - offensive rebounds, DR - defense rebounds, TOTR - total rebounds, AS - assists, PF - personal fouls, TO - turnovers, ST - steals, and BS - block shots.

Alongside variables with absolute values, the present paper included the following variables expressed in relative values (although there are many ways to calculate the parameters of basketball performance, here we followed the recommendations of Trninić (1996): 2% - percentage of two points (M2/A2)*100, 3% - percentage of three points (M3/A3)*100, FG% - percentage of field goals (MFG/AFG)*100, FT% - percentage of free throws (MFT/AFT)*100, OR% - efficiency percentage of offensive rebounds in relation to field points missed {OR/(FGA-FGM)+[(FTA-FTM)=2]}*100, DR% - efficiency percentage of defense rebounds in relation to field points missed by an opponent {DR/(FGA_{opp}-FGM_{opp})+[(FTA_{opp}-FTM_{opp})=2]}*100, AS% - percentage of assist efficiency (AS/MFG)*100, PF% - percentage of personal foul efficiency (PF/BP)*100, TO% - turnover percentage of inefficiency (TO/BP)*100, ST% - steals percentage of efficiency (ST/BP_{opp})*100; BS% - block percentage of efficiency (BS/ BP_{opp})*100, and TBP - team ball possession AFG + 0.5 x FTA - ORB + TO. To calculate the variable of TBP, we used the formula designed by Oliver (2004).

The winning team is of course the one which scores more points when the final whistle is blown. This difference is labeled as ∆PTS and comes as the result of all observed game parameters, or put simply, it is in the function of all parameters. Therefore, ∆PTS can also be defined as an outcome of all observed game parameters as they eventuate. For that reason, we designed a reliable quantitative model measuring the evaluation of influence of certain standard game parameters on the final result, and this model was based on the formation of a multiple linear regression model in which ∆PTS stands as a subordinate (dependent) variable, while differences (∆) of other game parameters stand for insubordinate (independent) variables, and the selection of variables in the set of regression should point to the specific weight of each observed variable (Simović, Komić, Matković, & Nićin, 2012). This paper made use of two basic models of regression. Both of them incorporated the same dependent variable, ∆PTS. The first model was designed to have a set of independent variables, i.e., to be comprised of differentiations between all absolute parameters of the observed parameters of the game, while the second model was designed to have all the independent variables of the relative (derived) parameters of the game.

Our research included all 40 games of the championship (N = 40); we first analyzed the First Round matches (played in league system of competition and divided into 4 groups, *N* = 24), and then the Final Round matches which were played in the format of a single-elimination tournament, and attention was given only to those matches which made teams progress towards the final stage and the medal-competing games (*N* = 12). The matches for the standings 5 to 8 were not taken into consideration since they might have lacked the competitive edge of other elimination games.

Data processing between and within the variables was performed by means of adequate statistical procedures of regression and correlation analysis applied on the established regression models, and it was based on a gradual regression (stepwise), with the defined conditions of regression in place, regarding inclusion or omission of variables in/from the model, i.e. the *F* criterion for inclusion of the variable into the equation set at the .05 level of significance, and .10 for omission from the equation (standard values). Standardization at this level ensured the consistency and comparability of the results at different levels and at different time periods. Also, the determined variables and their parameters were examined in terms of the level of significance they exhibited (*t* test and *F* test), all with an aim to obtain well-defined models providing the grounds for valid extrapolation.

RESULTS

Table 1 Regression and correlation analysis of the first model and second model at the FIBA EuroBasket Women 2017

1st MODEL				2nd MODEL			
	t	*p*	*r*		*t*	*p*	*r*
FIBA EuroBasket Women 2017 - Total							
Constant	1.33	.19	-	Constant	1.11	.28	-
ΔMFG	13.45	.00	.91	ΔFG%	8.89	.00	.84
ΔMFT	9.23	.00	.84	ΔDR%	6.64	.00	.75
ΔM2	-5.71	.00	-.69	ΔTO%	-4.17	.00	-.58
				ΔFT%	2.96	.01	.45
				ΔPF%	-2.79	.01	-.43
FIBA EuroBasket Women 2017 - First Round							
Constant	1.28	.22	-	Constant	3.98	.00	-
ΔMFG	6.65	.00	.83	ΔFG%	3.38	.00	.59
ΔMFT	4.39	.00	.70	ΔDR%	2.92	.01	.54
ΔM2	-3.69	.00	-.64				
FIBA EuroBasket Women 2017 - Final Round							
Constant	1.36	.21	-	Constant	1.85	.11	-
ΔMFG	13.47	.00	.98	ΔFG%	6.91	.00	.93
ΔMFT	5.31	.00	.87	ΔBS%	2.34	.05	.66
				ΔTO%	-5.56	.00	-.90
				ΔDR%	2.38	.05	.17

From the obtained regression models and based on the quotients of the partial correlation, it can be concluded that in the first model, the final score of games played at the FIBA EuroBasket Women 2017 was influenced by the variables ΔFGM - field goals made (β = 2.85, $p < .00$) with a partial correlation $r_p = .91$, ΔMFT - free throws made (β =

.86, $p < .00$) with a partial correlation $r_p = .84$, and ΔM2 - 2 points made (β = -.94, $p < .00$) with a partial correlation $r_p = -.69$. The same set of results were obtained in the round robin part of the championship - league competition: ΔFGM (β = 2.97, $p < .00$) with a partial correlation $r_p = .83$, ΔMFT (β = .77, $p < .00$) with a partial correlation $r_p = .70$, and ΔM2 (β = -.92, $p < .00$) with a partial correlation $r_p = -.64$; similar patterns were revealed in the elimination round - knockout competition: ΔFGM (β = 2.08, $p < .00$) with a partial correlation $r_p = .98$ and ΔMFT (β = .80, $p < .00$) with a partial correlation $r_p = .87$.

The following variables had the most significant impact in the second model: ΔFG% - percentage of field goals (β = 1.16, $p < .00$) with a partial correlation $r_p = .84$, ΔDR% - efficiency percentage of defense rebounds in relation to the field points missed by the opponent (β = .39, $p < .00$) with a partial correlation $r_p = .75$, ΔTO% - turnover percentage of inefficiency (β = -.56, $p < .00$) with a partial correlation $r_p = -.58$, ΔFT% - percentage of free throws (β = .10, $p < .01$) with a partial correlation $r_p = .45$, and ΔPF% - percentage of personal foul efficiency (β = -.43, $p < .01$) with a partial correlation $r_p = -.43$. When we take a look at the first round of competition (league system), the statistical significance was observed in ΔFG% (β = .65, $p < .00$) with a partial correlation $r_p = .59$, and ΔDR% (β = .26, $p < .01$) with a partial correlation $r_p = .54$, whereas the final stage (elimination system) data were: ΔFG% (β = 1.03, $p < .00$) with a partial correlation $r_p = .93$, BS% - block percentage of efficiency (β = .32, $p < .05$) with a partial correlation $r_p = .66$, ΔTO% (β = -.77, $p < .00$) with a partial correlation $r_p = -.90$, and ΔDR% (β = .20, $p < .05$) with a partial correlation $r_p = .17$.

The data analysis is particularly noteworthy when looked at from the aspect of the partial correlation (r_p), due to the significant influence that certain selected variables have on the final score of the game (with other, unselected, variables remaining unchanged).

Based on what can be seen from Table 2, it can be inferred that the regression models have statistical significance relative to the included variables.

Table 2 ANOVA of the first and second model at the FIBA EuroBasket Women 2017

	1st MODEL					2nd MODEL				
	Total	*df*	*s*	*F*	*p*	Total	*df*	*s*	*F*	*p*
FIBA EuroBasket Women 2017										
Regression	2434.75	3	811.58	79.39	.00	2052.94	5	410.59	18.62	.00
Residual	368.03	36	10.22			749.84	34	22.05		
Total	2802.78	39				2802.78	39			
First round - league competition										
Regression	833.20	3	277.73	15.75	.00	486.46	2	243.23	7.30	.00
Residual	352.64	20	17.63			699.37	21	33.30		
Total	1185.83	23				1185.83	23			
Final round - knockout competition										
Regression	1077.46	3	538.73	94.69	.00	1066.52	4	266.63	30.03	.00
Residual	51.21	8	5.69			62.15	7	8.88		
Total	1128.68	11				1128.67	11			

Both models exhibit a significant correlation between the dependent (subordinate) variable of (ΔPTS), and the set of insubordinate variables included in the model. The variables included in the models with absolute values for the entire championship explain 85.8% of the phenomenon ($R^2 = .86$, F (1.36) = 32.57, $p < .00$), whereas the variables included in the models with absolute variables of the league stage of the competition explain 65.8% of the phenomenon (R^2 = .66, F (1.20) = 13.658, p < .00). The model with absolute values of the elimination stage explains 94.5% of the phenomenon (R^2 = .95, F(1, 9) = 7.79, p < .00).

The variables included in the second model - which was based on the relative variables - explain 69.3% of the phenomenon (R^2 = .69, F(1, 34) = 63.68, p < .01). The model with the relative values - the ones which examined the patterns of the league stage matches - explains 35.4% of the phenomenon (R^2 = .35, F(1, 21) = 8.52, p < .01), whereas the model for the elimination stage matches explains 91.3% (R^2 = .91, F(1, 7) = 5.65, p < .05).

The abovementioned findings, observed from the Chaddock scale point of view, demonstrate a strong correlation between the dependent variable PTS, or ΔPTS, and the relating sets of independent variables (5 models in total), while there is a medium range correlation in one model.

Figure 1 shows the included variables from the first model with iterations performed, i.e. values of adjusted R square in each performed iteration. The values of adjusted R square for the entire championship (up to the final step of the iteration) are: (1^{st}) R^2 = .48, F(1, 38) = 36.75, p < .00; (2^{nd}) R^2 = .74, F(1, 37) = 38.22, p < .00; and (3^{rd}) R^2 = .86, F(1, 36) = 32.57, p < .00. The values for the first stage of the competition (league stage) are as follows: (1^{st}) R^2 = .27, F(1, 22) = 9.58, p < .01; (2^{nd}) R^2 = .45, F(1, 21) = 8.30, p < .01; and (3^{rd}) R^2 = .66, F(1, 20) = 13.58, p < .00, while the final round matches recorded the following values: (1^{st}) R^2 = .79, F(1, 10) = 43.40, p < .00; and (2^{nd}) R^2 = .95, F(1, 9) = 28.15, p < .00.

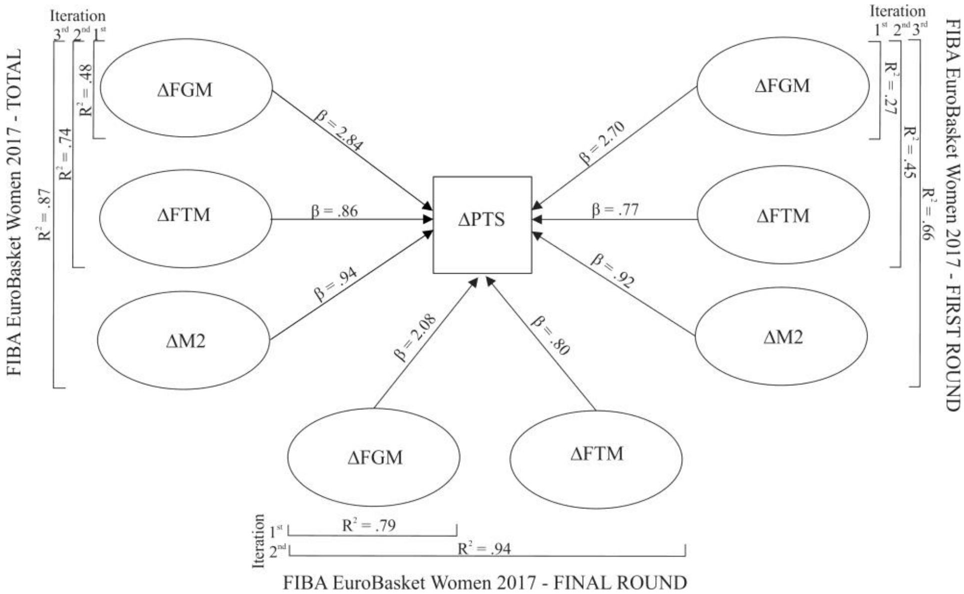

Fig 1 Variables included in the first model at the FIBA EuroBasket Women 2017

Legend: ΔPTS - difference in the number of total points scored; ΔFGM - difference in field goals made; ΔFTM - difference in free throws made; ΔM2 - difference in 2 points made; R^2 - adjusted R square stepwise regression; β - standardized coefficient beta

Figure 2 shows the included variables from the second model with iterations performed, i.e. values of adjusted *R* square in each performed iteration. The values of adjusted *R* square for the entire championship are: (1st) R^2 = .30, $F(1, 38) = 18.04$, $p < .00$; (2nd) R^2 = .48, $F(1, 37) = 14.22$, $p < .00$; (3rd) R^2 = .59, $F(1, 36) = 10.88$, $p < .00$; (4th) R^2 = .63, $F(1, 35) = 5.04$, $p < .03$; and (5th) R^2 = .69, $F(1, 34) = 7.79$, $p < .01$. The values for the first stage of the competition (league stage) are as follows: (1st) R^2 = .13, $F(1, 22) = 4.54$, $p < .05$; and (2nd) R^2 = .35, $F(1, 21) = 8.52$, $p < .01$, while the final round matches recorded the following values: (1st) R^2 = .41, $F(1, 10) = 8.67$, $p < .02$; (2nd) R^2 = .63, $F(1, 9) = 6.96$, $p < .03$; (3rd) R^2 = .86, $F(1, 8) = 16.30$, $p < .00$; and (4th) R^2 = .91, $F(1, 7) = 5.65$, $p < .05$.

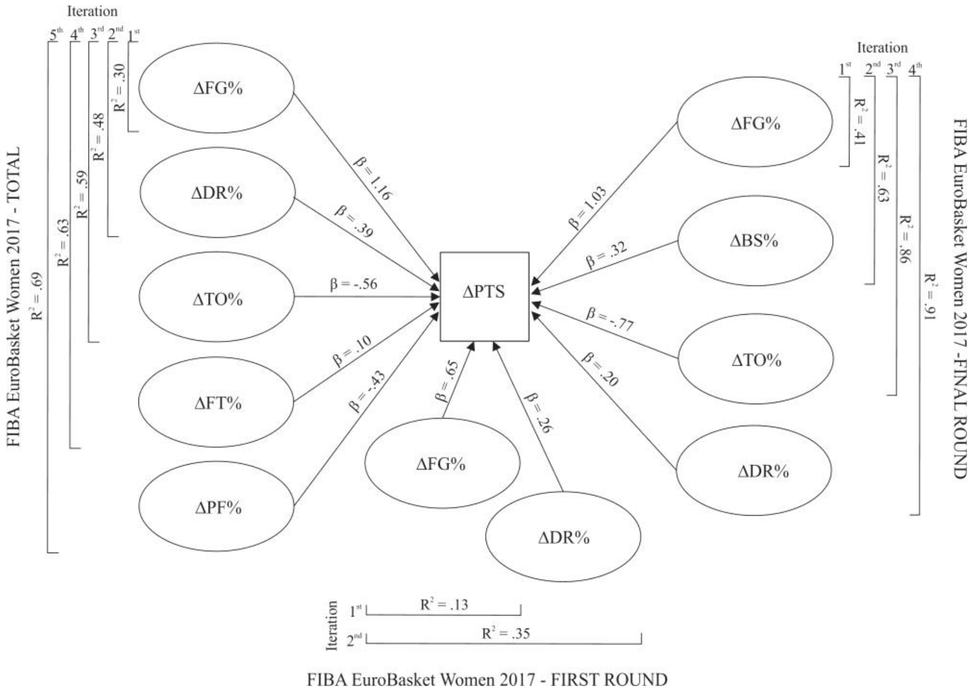

Fig. 2 Variables included in the second model at the FIBA EuroBasket Women 2017

Legend: ΔFG% - difference in percentage field goals; ΔDR% - difference in efficiency percentage of defense rebounds in relation to field points missed by the opponent; ΔTO% - difference in turnover percentage of inefficiency; ΔFT%, difference in percentage of free points; ΔBS% - difference in block percentage of efficiency; ΔPF% - difference in percentage of personal foul efficiency; R^2 - adjusted *R* square stepwise regression; β - standardized coefficient beta

DISCUSSION

Researchers are now able to observe more standard (absolute) and dependent (relative) parameters of the basketball game than ever before; what is more, the proper analytical procedures can put us in the position of finding correlations between the observed indicators and the final result of the basketball game (Milanović, 2013) - this approach is also used when we have to examine and evaluate the players' and teams' performance during the match (Sampaio & Janeira, 2003). There have been many papers in recent years tackling the issue of discrimination between winning and losing teams (Williams, 2014). Papers like these have had a significant influence on the improvement of performance among basketball players (Ibáñez et al., 2008) and also provide a solid foundation theory - and practice-wise - for basketball coaches and coaches in other sports (Hughes & Franks, 2004; Leite, Baker, & Sampaio, 2009; Ortega, Villarejo, & Palao, 2009; Shearer, Thomson, Mellalieu, & Shearer, 2007; Thomson, Watt, & Liukkonen, 2009).

In both observed models, variables included in the first step of iteration were the variables related to field goals: in the first model, the included variable were field goals made (R^2 = .48, $F(1, 38)$ = 36.75, p < .00), while the second model had the variable of percentage of field goals (R^2 = .30, $F(1, 38)$ = 18.04, p < .00), which can be considered as a medium for the strong correlation for both models, i.e. explaining 47.8% in the first and 30.4% of the difference in the second model. The winning teams recorded higher numbers in field goal attempts (*M* = 62.30; *SD* = 5.44 as compared to *M* = 60.53, *SD* = 6.96) and higher total points scored (*M* = 26.58; *SD* = 3.62 as compared to *M* = 21.75, SD = 4.06). Since field-goal shooting is one of the most fundamental basketball skills, it comes as no surprise that such results have been found in this paper - i.e. the winning teams simply outperformed the losing teams in this offensive aspect (Gomez et al., 2006). Leicht et al. (2017a, p. 4-5) have made similar conclusions - field-goal percentage had the biggest impact on the winning outcome (91.1%) and "offered the lowest probability of winning (3.3%) and the greatest probability of losing (96.7%)". Many other studies in men's basketball have found the percentage offield goals as the key indicator in differentiating between the winning and losing team (Csataljay, James, Hughes, & Dancs, 2012; Garcia, Ibanez, De Santos, Leite, & Sampaio, 2013; Gomez, Lorenzo, Barakat, Ortega, & Palao, 2008; Gómez, Pérez, Molik, Syzman, & Sampaio, 2014; Ibáñez et al., 2008; Jukić, Milanović, Vuleta, & Bračić, 2000; Leicht, Gómez, & Woods, 2017b; Simović & Komić, 2008; Simović & Nićin, 2011). These findings support the well-known empirical notion among basketball coaches that successful team offense as well as the final score is dependent on "the quality of player decision making and shot execution as well as upon team coordination" (Brown, 1995, cited in Gomez et al, 2006, p. 364).

The further analysis of our data sample follows the same set of findings as previous studies. Namely, out of out of eight variables included in the first and second model, five of them (62.5%) relate to shooting efficiency, 100% in the first model and 40% in the second model, respectively. Alongside with the variables of field goals made and percentage of field goals, free throws made and 2 points made were found significant in the first model, and the percentage of free throws in the second model. The correlations between the shooting parameters and final results have been found in some other studies too (Gómez et al., 2006; Koh, Wang, & Mallett, 2012; Nakić, 2004; Milanović at al., 2016a; Milanović, Štefan, & Škegro, 2016b), while the significance of 2 points made has been found in a study of women's basketball (Gómez et al., 2009). The fact that we extracted the variable of 2 points made as the significant one in terms of the final score could probably be explained by the findings of Oliver (2004) who claims that "in the WNBA the game pace has been getting slower, and efficiency has been getting better, this may be explained because coaches prepare games and competitions with more emphasis on better field-goals selection and better ballhandling skills" (cited in Gómez et al., 2009, pp. 280-281). Some authors even claim that the main difference between men's and women's basketball teams is the fact that women prefer shooting from good positions inside instead of near the 3-point line as is the case in men's games (Mavridis, Laios, Taxildaris, & Tsiskaris, 2003). The same variable has been extracted in some other studies dealing with the men's basketball (Garcia et al., 2013; Gomez et al., 2008; Ibáñez, Garcia, Feu, Lorenzo, & Sampaio, 2009; Lorenzo, Gómez, Ortega, Ibáñez, & Sampaio, 2010; Sampaio & Janeira, 2003).

The variables relating to the free throw showed significance in both models. The winning teams at FIBA EuroBasket Women 2017 recorded (*M* = 16.98, *SD* = 5.57) in comparison to the losing teams (*M* = 15.05, *SD* = 6.74) and of course scored better in this segment of the game (*M* = 12.03, *SD* = 4.51 as compared to *M* = 10.70, *SD* = 5.01). All of that was impacted by the fact that the losing teams recorded more personal fouls (*M* = 20.76, *SD* = 3.50 compared to *M* = 19.55, *SD* = 3.66) - this fact could be interpreted by more organized offensive skills coming from the winning teams. Other studies of game-related statistics in women's (Gómez et al., 2006; Milanović at al., 2016a; Nakić, 2004) and men's basketball (Csataljay et al., 2009; Reano, Calvo, & Tore, 2006; Mendez & Janeira, 2001; Sampaio & Janeira, 2003; Sampaio et al., 2006; Tavares & Gomes, 2003) pointed out the importance of this parameter in terms of its effect on the final score.

Alongside with the mentioned variables, the second model included some other significant variables such as: efficiency percentage of defense rebounds in relation to field points missed by the opponent, percentage of personal foul efficiency, and turnover percentage of inefficiency. The winning teams recorded more defensive rebounds in this championship (*M* = 28.75, *SD* = 3.94) compared to the losing teams (*M* = 25.48, *SD* = 4.27), as well as more rebound attempts (*M* = 38.78, *SD* = 6.16 compared to *M* = 35.73, *SD* = 5.81) which was most definitely due to the poor overall efficiency of the losing teams. All of this is in accord with some previous findings which have claimed that the number of defensive rebounds cannot be taken as a reliable indicator of overall performance but only as the indicator of rebounding, which was first pointed out in 1982 by one of the greatest basketball coaches of all times, Dean Smith, in his seminal work "Basketball, multiple offense and defense" - later to be confirmed in the study of Csataljay et al. (2012): "consequences of rebounding percentages should be used both in offense and in defense instead of the number of rebounds" (p. 363). In other words, the winning teams made their opponents miss field goals thus opening space for more defensive rebounding attempts - which were in turn the key indicators of both defensive and rebounding efficiency (Trninić, 1996). A good rebounding performance opens more opportunities for the transition from defense into fast breaks and eventually scoring more easy points. Some authors tried to account for that fact by saying that the winning teams had taller players on guard and forward positions (PG, SG, SF and PF), when compared to the losing teams (Carter, Ackland, Kerr, & Stapff, 2007). The correlation between defensive rebounds and final score has been established in other works on women's basketball (Gómez et al., 2006; Leicht et al., 2017a; Milanović et al., 2016a; Nakić, 2004) as well as in men's basketball (Garcia et al., 2013; Gómez, Ibáñez, Parejo, & Furley, 2017; Gomez et al., 2008; Gomez et al., 2014; Ibáñez et al., 2009; Lorenzo et al., 2010; Sampaio et al., 2006; Trninić, Dizdar, & Lukšić, 2002).

The offensive turnovers usually come as a result of poor ball passing or receiving, travelling or double dribble and a violation of rules (stepping out of bounds, shot-clock violation, illegal screen, palming, three-second or five-second violation, etc.). The significance of this variable has been stressed in other papers too (de Carvalho, Leicht, Nakamura, Okuno, & Okazaki, 2017; Lorenzo et al., 2010). Some correlation patterns between turnovers and final results in women's basketball have been pointed out by Milanović et al. (2016a). Our research has found that the losing teams (*M* = 15.88, *SD* = 3.35) had more TOs relative to the winning teams (*M* = 14.33, *SD* = 4.41), which in turn resulted in an increased number of offensive opportunities (*M* = 73.73, *SD* = 4.08 compared to *M* = 72.78, *SD* = 4.82). If we describe basketball as a game of errors (Wooden & Walton, 1998), then the winning team is the one which makes fewer errors in total. Turnovers reduce the shooting percentage and increase the same aspect of the game in the opposing team, which can be taken as double-sided inefficiency (Trninić, 2006). Of course, we have to differentiate between two sets of turnovers: the rules of the game violation (resulting in the loss of ball possession) and poor offensive skills (bad passing and receiving, poor dribbling skills) - the latter set of turnovers, as a result of aggressive defense, is more damaging since they tend to open space for the opposing team to move the ball up the court and into a scoring position as quickly as possible.

The losing teams had more personal fouls (*M* = 20.78, *SD* = 3.50) as opposed to the winning teams (*M* = 19.55, *SD* = 3.66), which could be associated with better offensive skills of the winning teams and poor defensive performance in the losing teams. A similar set of results was found in the studies on women's basketball (Milanović et al., 2016a; Nakić, 2004) and studies examining the same phenomenon in men's basketball (Sampio et al., 2006).

The up-to-date basketball research with notational analysis in the center of performance analysis has put most of its focus on different efficiency parameters such as: home court advantage (Gomez et al., 2008), dips in form during the regular season (Ibáñez et al., 2008), difference in the number of total points scored (Sampaio & Janeira, 2003), and differences between the regular season and play-off competitions (Garcia et al. 2013; Sampaio & Janeira, 2003). The home court advantage cannot be taken too seriously at this championship, as the only team enjoying it ended as low as 13 in the final standings. So it is clear that competitions like these are not affected significantly by this occurrence. As far as national team competitions are concerned, since they take place over a relatively short period of time, i.e. FIBA EuroBasket Women 2017 took place over the course of ten days, we can talk about the teams as coming to the tournament either in-form or out-of-form. However, it is very difficult to talk about an individual's or the team's dips in form during the competitions themselves. The final score differential could have been interesting for analysis, but small subgroups (for instance "unbalanced games" category with only two games observed at a time) had not been found adequate for a statistical analysis due to their small size.

The present paper focused on the difference of the selected variables across different formats of competition - League system vs. Single-elimination system. Speaking more empirically, coaches, players and media people all agree on one thing - the most important moment in the competition is the transition period from a league to elimination system of championship (the championship that we investigated was played by the single-elimination system after the group stage - all the way to the final match for the title). This difference between these two formats of competition is further emphasized by examples of some national teams being eliminated as soon as they enter the single-elimination system even if they made it on top of the group in the league system of competition.

The first model reveals that the same variables were included for the competition overall (ΔMFG, ΔMFT and ΔM2) and the final stage of it - however, the final stage (single-elimination) lacked the variable of *2 points made.* This is to say that the free throw efficiency is very significant in elimination games. There are many studies supporting the same empirical view that provide ample evidence of the significance of free throw efficiency - together with defensive rebounds - and they have been backed up by the experts from men's basketball as well (López-Gutiérrez & Jiménez-Torres, 2013).

The second model figures, analyzing the first round (league system of competition), point to the two variables (ΔFG% and ΔDR%) as statistically significant in terms of differentiating between the winning and losing teams. This finding has been the most common one in up-to-date notational analysis in basketball. In order to avoid reiteration of everything that has previously been said, let us just refer to the two latest papers by Anthony Leicht et al. (2017a, 2017b), who found similar evidence in both women's (2016, Rio de Janeiro, n = 38; 2012, London, n = 38; 2008, Beijing, n = 38; 2004, Athens, n = 42) and men's Olympic tournaments (2016, Rio de Janeiro, n = 38; 2012, London, n = 38; 2008, Beijing, n = 38; 2004, Athens, n = 42). Needless to say, both of them spoke in favor of field-goal percentage and defensive rebounds as significant factors in terms of the final score.

As for the single-elimination system (Final Round), ΔFG% and ΔDR% were extracted alongside with two more variables - ΔBS%, ΔTO%. There were more defensive rebounds (M = 30.00, SD = 3.41 in comparison to M = 24.92, SD = 5.20), fewer turnovers (M = 15.67, SD = 5.90 to M = 16.00, SD = 3.98), and more block shots (M = 3.17, SD = 2.17 to M = 2.25, SD = 1.54) in the winning teams, which most definitely supports the claim that the winning teams excel in defense in later stages of competition. Aggressive and tough defense is most certainly an aspect of the game we should count on when preparing teams for single-elimination games, i.e. final stage matches (games for medals and standings 5-8).

The limitations of this study are primarily concerned with the nature of notational analysis and the collected performance indicators, since such sets of data are usually gathered by a third party which may have made occasional slips or errors in the process, thus jeopardizing the validity and reliability of the research findings (Škegro, 2013). For instance, one study analyzed different research from the field of notational analysis, a total of 72 research projects, and found that almost 70% of authors conducted no examination about the reliability of performance and efficiency indicators (Hughes, Cooper, & Nevill, 2002). Our study analyzed the data from the continental championship which is undoubtedly a top-tier basketball event in all aspects - from the competition management and organization, to the quality of the participating national teams. The source of data was the official FIBA website (https://archive.fiba.com). The researchers who collect and analyze data samples related to players' and teams' performances in competitions are still looking for an objective set of tools in order to come up with a reliable means of evaluation - however, the notational analysis still takes a significant place in this respect (Hughes, & Franks, 2004). This method should be constantly developed and reexamined in order to meet higher standards of reliability - hopefully the present paper can make a small contribution in this direction.

The avenues of further research should go in the direction of including the last couple of women's continental championships in one study, as had already been done with Olympic tournaments in both men's and women's basketball (Leicht et al., 2017a; Leicht et al., 2017b), men's world championships (Simović & Komić, 2008) or women's European championships (Kreivyte et al., 2013), and thus to shed some more light on the nature of the observed variables and their change across several competitions - that would also clarify the situation with different formats of competition and rules of the game and their influence on the game indicators.

CONCLUSION

The present paper applied regression stepwise models on the eight variables that were found to have the most significant influence on the final score, i.e. those that made most of the difference between the winning and losing teams at FIBA EuroBasket Women 2017. Of the total number, 5 (five) variables (62.5%) were shooting efficiency parameters: field goals made, free throws made, 2 points made, percentage of field goals, and percentage of free throws. Also, the included variables were those related to defensive rebounding and turnovers, which clearly indicates that the final score is heavily influenced by the two following variables - shooting efficiency and defensive rebounding; other variables come and go in terms of their significance and depend somewhat on the focus of research and the nature of the competition itself. When looking at the variables from the point of view, of two different formats of competition (league vs. elimination), the first model reveals that the only change that took place was the decrease in statistically significant variables during the elimination format of competition; and, as point out by other researchers and basketball experts, the importance of free throw efficiency is pointed out yet again as one of the key indicator of the teams' efficiency in the elimination games. The second model records an increased number of variables in the final stage of the competition (elimination format) as opposed to the first stage (league competition) - the variables such as block percentage of efficiency, turnover percentage of inefficiency and efficiency percentage of defense rebounds in relation to field points missed by opponent indicate that, alongside with the overall shooting efficiency and free throws, the quality of defense plays a crucial role in single-elimination matches. Any further research in this field should aim at providing some more practical guidelines for basketball coaches so that they can develop frameworks for training with special emphasis given to the game parameters found as significant herein.

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UTICAJ ELEMENATA STATISTIKE UTAKMICE NA KONAČNI REZULTAT FIBA EVROPSKOG PRVENSTVA ZA ŽENE 2017

Istraživanja koja nastoje da objasne pojave i fenomene tokom takmičenja u ženskoj košarci su još uvek skromna po broju u poređenju sa istraživanjima sprovedenim u muškoj košarci, iako se, poslednjih nekoliko godina taj odnos sve više menja. U ovom radu posmatrano je četrdeset utakmica i trinaest registrovanih varijabli standardne efikasnosti tokom FIBA Evropskog prvenstva za žene 2017. Formirana su dva osnovna modela regresije, apsolutni i relativni, koji su za zavisnu varijablu imali broj postignutih poena, a istraživanje je sprovedeno regresionom i korelacionom analizom postepenom (tzv. stepwise) regresijom. Iz dobijenih regresionih modela i parcijalne korelacije ustanovljeno je da su na razliku između pobedničkih i poraženih timova uticaj imali pokazatelji efikasnosti šuta i skok u odbrani, što je dokazano u prethodnim mnogobrojnim istraživanjima i u muškoj i ženskoj košarci. Pored njih izdvojene su i varijable izgubljene lopte i lične greške. Kada se posmatraju razlike između prvog i drugog dela ovog takmičenja, koja su igrana po različitim sistemima takmičenja, vidljivo je da sve više dolazi do izražaja, naravno pored efikasnosti šuta, efikasnost izvođenja slobodnih bacanja i kvalitet odbrane.

Ključne reči: *blokirani šutevi, efikasnost šuta, EuroBasket, izgubljene lopte, lične greške, postepena regresija, skok u odbrani, ženska košarka*