RESEARCH ARTICLE

EFFECTS OF GAME-RELATED STATISTICS PARAMETERS ON FINAL OUTCOME IN FEMALE BASKETBALL TEAMS ON THE OLYMPIC GAMES IN LONDON 2012

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A R T I C L E   I N F O

A B S T R A C T

The aim of the present study was to determine which game-related statistics parameters influenced the most on the final result among female basketball teams. Sample of entities was comprised of 12 teams and total of 38 games. Sample of variables was comprised of 13 indicators that determined final result and affecting overall game. To present basic values of each variable, descriptive statistics was used. Multivariate analyses of variance (MANOVA) was used to determine global differences between successful and unsuccessful teams. Also, to determine separate indicator contibutions on final results, multiple regression analysis was performed. Significance was set up at $p \leq 0.05$. Results showed that 2 points-fail (t-value= -3.13; β coefficient= -0.40; p<0,05), 3 points-fail (t-value= -3.75; β coefficient= -0.33; p<0.05), offensive rebounds (t-value= 2.28; β coefficient= 0.24; p<0.05), defensive rebounds (t-value= 3.41; β coefficient= 0.36; p<0.05) and turnovers (t-value= -2.18; β coefficient= -0.20; p<0.05) statistically had impact on the final results of the game. In conclusion, winning teams performed better in shooting elements, along with rebounds and steals, which gave them opportunity to gain the advantage opposed to the opponent and win the competition.

INTRODUCTION

Tracking and recording player's and team's efficiency indicators represents one of the basic parameters of evaluating system in sport. According to Hughes and Bartlett (2002), it is possible to determine which factors are important for accomplishing result. Coaches need that kind of information to determine which kind of training protocol should be applied on the players. Along with that, proper periodization with number of trainings, competitions and recovery periods needs to be established for achieving great sport results.

There has been several studies in different kind of sports analyzing how certain situational parameters influencing final resuls of the game. For example, Ohnjec et al. (2008) conducted the study on a sample of 60 handball matches (120 plays) of the World Championship 2003. Obtained results showed that, in group A, only variable technical error in attack showed statistical impact of the final outcome of the game. Within the group B, variables field shot taken-missed, side shots scored and side shots taken-missed influenced on the final score. In group C, side shots taken, missed, fast break goals taken-missed and technical errors in attack contributed on the final score. Variables goal area line shot-scored, goal area shots taken-missed and side shots taken-missed significantly contributed on the final result. Another study from Vuleta et al. (2012) showed that main predictors for the final outcome were 9 meter shots-unsuccessful and fast break shots scored statistically influenced on the final result of the game in handball matches. Zadražnik et al. (2009) examined differences in the phase of a volleyball game

between the winners and defeated youth female teams for each of the six volleyball rotations separately. Ortega et al. (2009) analyzed the differences in rugby game statistics between winning and losing teams from the Six Nations tournament from the 2003-2006. This evidence have shown that situational efficiency parameters are crucial in every sport.

Basketball, as a team sport, represents the game of fast transitions from the phase of offence to defense and vice versa. Those transitions need to be on a high level of performance, due to develop the advance over the opponent. Studies conducted on female basketball players showed that defensive rebounds discriminated successful from unsuccessful teams (Sampaio et al., 1998; Graber, 1998), together with 3 points-made, fouls and assists. Sampaio et al. (2004) provided evidence that male and female basketball players had different playing tactics and strategies during the game. According to those authors, different factors, like playing position, gender etc. influenced on picking appropriate players in the team. Nakić (2004) showed that successful teams performed better in 2 points-made, defensive rebounds and assists, led by free throws-made, steals, blocks, offensive rebounds, 3 points-made and free throws-fail. Unsuccessful teams were defined with greater level of personal fouls, turnovers, 3 points-fail and 2 points-fail.

To authors' knowledge and after the extensive literature research, there has been only a few studies (Sampaio et al., 2004; Graber, 1998) investigating the contributions of basketball situational efficiency parameters on final result of the game. Also, during ther last decade, there hasn't been a

study related to this topic. Therefore, the aim of present study was to determine which of 13 analyzed game-related statistics parameters influenced the most on the final result among female basketball teams on the Olympic Games in London 2012.

MATERIALS AND METHODS

Sample of entities

Sample of entities was consisted of 38 analyzed games of female basketball playing on the Olympic Games in London 2012 in further order: group A (15 games), group B (15 games), quater-finals (4 games), semi-finals (2 games), finals (1 game) and game for third place (1 game). All the data were collected from Federation Internationale Basketball Association (FIBA) official website. This study was approved by the leading institution of all authors.

Sample of variables

Sample of variables was comprised of 13 standard situational efficiency parameters prescribed by FIBA. Table 1. represented each parameter abbreviation and description.

Table 1 Abbreviation and description of each game-related statistics parameter

Abbreviation	Description
2P-M	2 points-made
2P-F	2 points-fail
3P-M	3 points-made
3P-F	3 points-fail
FT-M	Free throws-made
FT-F	Free throws-fail
RB-O	Offensive rebounds
RB-D	Defensive rebounds
AS	Assists
PF	Personal fouls
TO	Turnovers
ST	Steals
BS	Block Shots

Variables for *2 points* represent primary situational indicators for overall efficiency in the game. Those efficiencies ranged from 55% to 60% from total of scored points in basketball game. One of the most important principle of organized (transitional and set) attack represents *selective shot*. Due to that, organisation of the game must contain ball control and movement line, which allow the releasement of a large number of players for "opened" shot on a different playing positions (Trninić, 1996).

Variables for *3 points* represent great strategic importance, because they make around 25% of total scored points on basketball games and around 36% from total of thrown balls. Because of that, requirements increase in the phase of defense for pressure in front line of defense, but defense spreads. It means that opponent players have much more space for attack. Knight and Newell (1986) considered that total shot percentage mustn't be lower than 52%.

Free throws are defined as indefensible ball throw in the basket made as the result of punishing the opponent's team for personal foul made. Between 15% to 30% of total scored points during the game can be attributed to free throws.

Defensive rebounds represent the number of caught rejected balls in the phase of transitional or set defense. Trninić et al. (1994) showed that defensive rebounds were more significant indicator of situational efficiency than *offensive rebounds*

(RO=0,57). According to Trninić (1996), defensive rebounds account for about 66% of total rebounds. Based on that, that the transition from the phase of defense to the phase of attack start when player comes in possession of the ball, it is necessary to point out that defensive rebounds important component for overall eficiency in the game.

Offensive rebounds represent the number of caught rejected balls in the phase of transitional or set offense. According to Knight and Newellu (1986), the number of caught balls in the phase of defense and attack must be over 58% from the overall rebounds. Well-prepaired and organized attack will cover offensive rebounds and keep defensive balance. It decreases psychological pressure on the shooter and simultaniously increases realization in attack.

Assists, according to Trninić (1996), are factors that produce "easy shots". Also, according to Price and Rao (1974), assists, % of free throws, offensive and defensive rebounds make very important components that discriminate successful from unsuccessful teams. Greater number of assists and got balls generate with greater shoot efficiency, producing greater number of successful throws for 2 points and lower unssuccesful throws for 2 points.

Personal fouls represent illicit and irregular physical touch with the opponent, no matter if the ball is in the game or out.

Turnovers represent lost ball during the basketball game. In basics, minimal number of lost balls (around 6) points high level of individual and team game, along with high level of sports form of individuals and teams. Losing the ball in the phase of transitional and set attack was caused with aggresive defense and level of ball control of the team who is in the phase of attack.

Steals represent successful and unsuccessful throws the ball into the basket, cause higher number of stolen balls creates assumptions for higher number of shots. Obtained balls occur when defensive players intersecting passed balls, outbreaking the ball and dead ball rebounds. Most of the college coaches think that winning 10-12 balls during first half is one of the important defensive goals (Trninić, 1996).

Blocks are events, where team shows individual or collective aggresion in the phase of defense. It represents indicator for evaluation central player in the phase of defense.

The dependent variable was determined numerically, where we used the difference between the final results in successful and unsuccessful team (for example, if the result was 90:100, than we wrote +10 for successful and -10 for unsuccessful team).

Data analysis

For all analyzed parameters, arithmetic mean and standard deviation were calculated. Kolmogorov-Smirnov test was used to determine whether the variables were normally distributed (maxD and p-value). The statistical differences between between game-related statistics were analyzed by using Student's t-test. Global contibution of game-related statistics on final result was determined by using multivariate analysis of variance (MANOVA). To investigate separate contribution of each game-related statistics parameter on the final outcome of the game, multiple regression analysis was performed. Statistical significance was set up at $p \leq 0,05$.

RESULTS

Basic descriptive statistics of the successful and unsuccessful teams are presented in Table 2.

value= 3.41; β coefficient= 0.36; p<0.05) and turnovers (t-value= -2.18; β coefficient= -0.20; p<0.05).

Table 2 Basic descriptive parameters of successful and unsuccessful female basketball teams

Game-related statistics	N	Mean±SD		maxD		p-value*	
		Winning	Defeated	Winning	Defeated	Winning	Defeated
2P-M	38	23.87±6.28*	17.84±3.94	0.12	0.13	p>.20	p>.20
2P-F	38	26.03±6.39*	28.76±5.42	0.11	0.11	p>.20	p>.20
3P-M	38	5.03±2.47	4.50±1.90	0.14	0.13	p>.20	p>.20
3P-F	38	10.05±3.61*	11.95±3.00	0.14	009	p>20	p>.20
FT-M	38	14.03±5.22*	11.08±4.78	0.09	0,16	p>.20	p>.20
FT-F	38	4.26±2.51	4.29±2.61	0.20	0.21	p>.10	p>.20
RB-O	38	13.37±4.33	12.66±4.41	0.10	0.09	p>.20	p>.20
RB-D	38	29.71±4.70*	23.63±4.30	0.07	0.10	p>.20	p>.20
AS	38	18.92±5.38*	12.74±3.80	0.12	0.12	p>.20	p>.20
PF	38	17.00±3.46	18.58±4.75	0.15	0.09	p>.20	p>.20
TO	38	14.76±4.10 *	17.00±4.11	0.15	0.13	p>.20	p>.20
ST	38	8.05±3.08*	5.50±2.73	0.11	0.18	p>.20	p>.20
BS	38	4.55±2.68*	2.29±1.56	0.09	0.15	p>.20	p>.20

*Student t-test for independend samples p<0,05

Presenting shooting results, from the total of 1585 2 points-made, successful teams, during whole competition scored 907 points for 2, which was 57.22%, in contrast to unsuccessful teams, who scored 678 points for 2 or 42.78%. Opposed to successful 2 points-made, unsuccessful teams made more 2 points-fail (1093 or 52.50%) opposed to successful teams (989 or 47.50%). From the total of 362 successful shots for 3 points, successful teams scored 191 (52.76%), opposed to 171 (47.24%) scored by unsuccessful teams. In variable 3 points-fail, successful teams performed lower in unsuccessful scores for 3 points (382 or 45.69%) than unsuccessful teams (454 or 54.31%). Results from free throws-made showed higher percentage of realization by successful teams (533 or 55.87%) in contrare to unsuccessful (421 or 44,13%). while similar percentages were obtained in free throws-fail among successful (162 or 49.84%) opposed to unsuccessful (163 or 50.16%) teams. Successful teams did more offensive (508 or 51.36% vs. 481 or 48.64%) and defensive rebounds (1129 or 55.70% vs. 898 or 44.30%). Also, successful teams performed better in assists (719 or 59.77% vs. 484 or 40.23%), steals (306 or 59.42% vs. 209 or 40.58%) and blocks (171 or 66.54% vs. 87 or 33.46%), but lower in personal fouls (646 or 66.54% vs. 706 or 52.22%) and turnovers (561 or 46.48% vs. 646 or 53.52%).

Results of global contributions of game-related parameters on the final outcome of the game are presented in Table 3. In general, all of the 13 game-related statistics parameters contributed on the final results between successful and unsuccessful teams.

Table 3 Multivariate analysis of variance between successful and unsuccessful female basketball teams

Effect	Test	Value	F-value	p-value
Win/lose	Wilks lambda	0,33	9,63	*0,00*

p<0,05

The associations between game-related statistics and the final outcome are presented in Table 4. Final outcome was significantly associated with 2 points-fail (t-value= -3.13; β coefficient= -0.40; p<0,05), 3 points-fail (t-value= -3.75; β coefficient= -0.33; p<0.05), offensive rebounds (t-value= 2.28; β coefficient= 0.24; p<0.05), defensive rebounds (t-

Table 4 Effects of game-related statistics on the final outcome (dependent variable)

Game-related statistics	Female teams (38 games)		
	β	t-value	p-level
2P-M	-0,09	-0,57	0,57
2P-F	-0,40	-3,13	*0,00*
3P-M	0,10	0,93	0,36
3P-F	-0,33	-3,75	*0,00*
FT-M	0,10	0,95	0,34
FT-F	-0,08	-0,93	0,36
RB-O	0,24	2,28	*0,03*
RB-D	0,36	3,41	*0,00*
AS	0,13	1,03	0,31
PF	-0,06	-0,82	0,42
TO	-0,20	-2,18	*0,03*
ST	0,17	1,55	0,13
BS	0,13	1,34	0,19
R		0,82	
R²		0,67	

p<0,05

DISCUSSION AND CONCLUSION

The aim of the present study was to determine which situational efficiency parameters influenced the most on the final result among female basketball teams on the Olympic Games in London 2012.

Results showed that, on a global level, game-related statistics parameters had significant contributions on final outcome of the basketball game. Also, results from the present showed that 2 points-fail, 3 points-fail, offensive and defensive rebounds and turnovers had statistically significant contibution on the final outcome.

Variable 2 points-fail showed negative difference between successful and unsuccessful teams. Successful teams scored less unsuccessful shots for 2 (47.50%) opposed to unsuccessful teams (52.50%). Successful teams sent more shots from favorable positions, they had better shot selection and greater number of shots from the zone of high percentage of shots. It was also assumed that defense of successful teams was successfully prevented regular entrance and line movement of the unsuccessful players in transitional and set attack. Along with 2 points-fail, 3 points-fail represented significant negative contributor of discriminating successful from unsuccessful teams. Successful teams performed lower percentage of 3 points-fail (45.69%) than unsuccessful teams

(54.31%). Quality defense of successful teams forced unsuccessful teams on higher number of unsuccessful shots for 2 points (successful teams 26.03 vs. unsuccessful teams 28.76). Turnovers, with smaller, but significant contribution on the final score, represented lost balls during the game. Unsuccessful teams had greater number of lost lost balls than successful teams (17.00 vs. 14.76). In percentages, from total turnovers, successful teams performed 46.48%, opposed to 53.52% among unsuccessful teams. As mentioned before, quality defense with agressive play, making pressure and inaccurate passing, led to stealing the ball and made the fast transition from the phase of defense to the phase of attack. According to presented results, negative contribution on the efficiency in the game had offensive rebounds (-0.508). This result came from the fact that successful teams had greater percentage (51.38%) than unsuccessful teams (48.62%). Nevertheless, aggresive offensive rebounds in the phase of attack represented significant indicator for successfulness. According to Trninić et al. (1997), offensive rebounds were defined as extension of aggresion of attack that opened the option of greater shoot percentage. This meant that the team had to close the way towards the basket. In that way, team who got in possesion of the ball had bigger percentage of shots and more succesfull transition from the phase of attack to defense and vice versa.

Along with offensive rebounds, defensive rebounds contributed the most on the efficiency in the game (-0.623). Trninić et al. (1997) explained that by maintaining the pressure on the ball in the phase of defense, stopping the opponents to achieve regular entrance in transitional and set offence along with stopping the attack with more than one shot. Successful teams forced unsuccessful teams for higher number of unsuccessful shots from the game and created greater chance for defensive rebounds (successful teams 55.70% vs. unsuccessful teams 45.30%).

Analyzed differences from the present study (table 2) were similar to results obtained from Gomez et al. (2006), where in balanced games, winning and defeated female basketball players showed differences in 2 points-fail, 3 points-made, free throws-made, free throws-fail, assists and fouls. Winning teams performed better in variable 2 points-made, 2 points-failand 3 points-fail (lower results), free thows-made, turnovers, blocks, assists and defensive rebounds. Authors explained those results by better individual and group stability. Also, successful offenses depend on player's decision making and coordination (Brown, 1995). Brandenburg (1994) reported that defensive rebounding teams had more opportunities to shoot, score points and win the game.

Koh et al. (2012) reported that field goal percentage, including 2 point shots, represented one of the key factors in determining team's success among Youth Olympic Female Basketball Teams. Those results were similar with present study, where 2 points-made made the biggest difference between teams according to outcome, but study was conducted on young female basketball players opposed to senior players.

Results from Šeparović and Nožinović (2007), which were conducted on male basketball population, showed quite similar values with the present study. In weaker basketball Bosnian league, only two variables statistically contributed on the final score of the game: defensive rebounds and steals. Obtained values conducted on Good Year basketball teams (Regional Basketball League) showed that 2 points-made, 3 points-made, free throws, offensive rebounds, turnovers and steals contributed the most on the final results.

Based on obtained results in the study, model game of the successful teams was based on strict selection of a 2 and 3 point shots from the external positions, as many offensive rebounds (to start new attack in the game) along with defensive rebounds (try to win the ball in defense with fast transitions in the phase of attack). Also, assists with stolen balls speed the game up and player's creativity came to higher level of performance. All these indicators comprised technical and tactical actions in the phase of attack and defense, where players had to be well-prepaired for the upcoming competition during the specific cycle period.

In conclusion, results from present study showed that 2 points-fail, 3 points-fail, offensive rebounds, defensive rebounds and turnovers had the biggest and statistically significant impacts on the final result. This was not suprising, while shooting precission in all team sports needed to be on top level of preparedness to achieve great sport results. Nevertheless, all situational efficiency components had to preserve quality of the game with harmonical technical-tactical and cognitive performance during the preparation, competitive and recovery periods.

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