

Performance indicators that distinguish winning and losing teams in basketball

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Abstract

To prepare a team for basketball games, to build up the best tactics, to make good decisions during a game, coaches need to know which elements of matches are the most crucial ones. Especially at close games where there is small difference between the performances of two teams. The main purpose of this study was to identify those critical performance indicators that most distinguish between winning and losing performances within matches. The statistical analysis of basketball games can lead to the identification of many significant performance indicators, not all of which can be analysed in real time. Therefore, a smaller subset of critical performance indicators can be identified by analysing close matches only. Data from 54 matches were gathered from the official score sheets of the European Basketball Championship 2007. Cluster analysis was used to classify the matches into three types such as tight games, balanced games and unbalanced games. There were 28 of these matches that were close matches where the differences between the two teams were 9 points or less. Wilcoxon signed ranks tests were used to compare 18 performance indicators between the winning and losing teams within each type of match. There were 13 significant performance indicators for the full set of matches. This was reduced to 6 critical performance indicators when only the close matches were considered. The analysis of tight matches explored that the winning teams had significantly less 3 point attempts ($p < 0.05$) with higher shooting percentage ($p < 0.01$). The number of successful free throws ($p < 0.01$), the free throw percentage ($p < 0.001$) and the number of defensive rebounds ($p < 0.01$) also contributed to achieve a higher number of scored points and consequently determined success.

Keywords: basketball, game analysis, close games, performance indicators

1. Introduction

Performance indicators are used to assess the performance of an individual, a team or elements of a team (Hughes and Bartlett, 2002). Well-chosen performance indicators help coaches to identify good and bad performances (Bartlett, 2001; Hughes and Franks 1997, 2004; 2008), either at individual or team level. Performance indicators are often used to define the differences between winning and losing teams. To build up the best strategy, to make rational tactical decision and to enhance the team performance, coaches need to know which elements are the critical ones that most distinguish between winning and losing performances within matches. The International Basketball Federation (FIBA) determined 13 variables, which are officially recorded in every game. Most of the previous researches on performance analysis in basketball are based on the statistical analysis of the official variables.

Trninic *et al.* (2002) analysed the differences between the performance of winning and defeated top quality teams which played in final tournament of the European club championships from 1992 to 2000. They found that defensive rebounds, field goal percentage and free throw percentage were the critical factors that determined success. Other researchers (Mendes and Janeira, 2001; Tsamourtzis *et al.*, 2002) found that defensive rebounding is the main factor that distinguishes winning and losing teams in basketball. During the 1997 European Championship a significant difference between winning and losing teams was determined in the variables successful field goal attempts, assists and successful free throw attempts (Jukic *et al.* 2000). Lidor and Arnon (2000) found that success cannot be described by shooting alone, but a team has to demonstrate a high level in rebounding and passing as well as in shooting. They also identified a significant correlation between the number of total rebounds and the number of points scored by the team, and between the field goal percentage and the number of assists. In a study of Sampaio *et al.* (2004) performance indicators discriminated the teams by gender. Men's teams were discriminated from women's teams by their higher percentage of blocks and successful two point field goals, and lower percentage of steals. Choi *et al.* (2006) used Wilcoxon Signed Ranks tests to identify the critical performance indicators in basketball. 10 basketball matches of the English basketball league were analysed by game data sets and by quarter data sets. They found that analysing performances by game data sets gives different valid performance indicators than analysing by quarter data sets because the performance fluctuates within matches. According to the opinion of Oliver (2004), four factors may be determinant to win basketball games, the shooting percentage from the field, the offensive rebounds, the turnovers and the number of free throw attempts.

According to Sampaio and Janeira (2003) performance indicators are influenced by game location (home and away games) and game type (regular season or play-off). In the 1997-98 and 1998-99 Portuguese Professional Basketball League away wins and regular season profile were best discriminated by successful free throws. Play-off games were best defined by offensive rebounding, home wins were best discriminated by committed fouls. To analyse different type of matches Sampaio and Janeira used cluster analysis to establish three different groups according to the game final score differences. Tavares and Gomes (2003) identified that the points scored, the percentage of successful free-throws, the number of fouls and offensive rating were the game performance indicators that differentiated high performance level junior men teams. In a study of Renao *at al.* (2006) identified game related statistics that differentiate winning

and losing teams at the U-16 European Championship in 2004. With the use of cluster analysis the games were classified into three groups such as close games, balanced games and unbalanced games. It was found that the number of successful 3 point field goals and assists were significantly different when contrasting winning and losing teams in close games.

Analysing all the games of any basketball tournament contains also the matches where there is substantial difference between the performances of two teams. These games increase the number of significant performance indicators when all the games are considered.

In close basketball games coaches have a big role and responsibility in formation of team tactics. Results of analysing close games give useful information about the most important elements that distinguish winning and losing teams. Knowing the crucial performance indicators of close games allows coaches to prepare more detailed practice and game plans and to build up the best winning strategy.

The main purpose of the current study is to find those critical performance indicators that most distinguished between winning and losing teams at different type of matches of the European Basketball Championship for men in 2007.

2. Methods

In this study the European Basketball Championship 2007 for men was analysed. The tournament was held in Spain. Sixteen teams competed in four groups at the preliminary round. Only the top three teams from each group joined to the qualifying round. These 12 teams that had qualified were divided into two groups of six teams. The best four teams from each group moved to the quarterfinals and played for the 1st - 8th place.

The required data were gathered by using the official score sheets on the official website of the tournament. The official performance indicators in basketball are number of 3 points attempts, number of successful 3 points shots, percentage of successful 3 points shots, number of 2 points attempts, number of successful 2 points shots, percentage of successful 2 points shots, number of free throw attempts, number of successful free throws, percentage of successful free throws, offensive rebounds, defensive rebounds, total rebounds, assist passes, personal fouls, steals, turnovers, blocked shots and points scored by the team. All the 54 matches of the European Basketball Championship 2007 were analysed.

Data processing was made by SPSS 15.0. Cluster analysis was used to classify the matches into three types such as close games with final score differences between 1 and 9 points, balanced games (10-22 points) and unbalanced games (22-34 points difference). Wilcoxon signed ranks tests were used to compare 18 performance indicators between the winning and losing teams within each type of match. The level of significance was set at $p < 0.05$.

3. Results

Analysing all the games of any basketball tournament contains also the matches where there is substantial differences between the performances of two teams. These games increase the number of significant performance indicators when all the games are considered. The analysis of performance indicators in basketball can lead to the identification of many significant performance indicators, not all of which can be analysed in real time. Therefore, a smaller subset of critical performance indicators can be identified by analysing close games only.

By using cluster analysis tight games were identified with final score differences below 9 points. The difference was between 10 and 22 points at balanced games and over 22 points at unbalanced games. There were 28 of the 54 matches that were close matches, 20 of them were balanced games and 6 of them unbalanced games. By analyzing all the games of the European Basketball Championship 2007 (n=54) there were 13 significant performance indicators for the full set of matches. Apart from the scored points the most significant ones were the percentage of successful 3 point shots ($p < 0.001$), the number of successful free throws ($p < 0.001$) and the defensive rebounds ($p < 0.001$). The 13 significant performance indicators were reduced to 6 critical performance indicators when only the close matches (n=28) were considered. At closed games the percentage of successful free throws ($p < 0.001$) seemed to be the most crucial performance indicator that distinguished between winning and losing teams. Analysis of all the games and tight matches are summarised in Table 1.

Table 1: Analysis of All the Games and Close Matches

Performance Indicator	All matches (n=54)		Close matches (n=28)	
	Winners (mean±SD)	Losers (mean±SD)	Winners (mean±SD)	Losers (mean±SD)
Successful 2 point shots	19.0±4.2*	16.8±4.8	17.6±3.7	17.5±5.5
2 point attempts	36.5±5.7	36.5±5.4	36.3±6.3	36.8±5.7
%successful 2 point attempts	52.5±8.3**	46.9±9.9	48.6±7.3	49.6±10.4
Successful 3 point shots	8.0±2.6*	6.8±2.3	7.7±2.7	7.0±2.1
3 point attempts	20.6±4.4**	23.3±4.7	20.4±4.2*	22.9±4.5
%successful 3 point attempts	39.1±10.2***	29.2±7.5	37.8±10.6**	30.3±7.2
Successful free throws made	17.0±5.3***	12.7±5.5	17.8±5.7**	13.5±5.0
Free throw attempts	22.7±6.3**	19.2±7.8	23.3±6.6	20.6±5.9
%successful Free throws	74.7±10.0**	67.3±14.1	76.0±9.6***	64.5±14.2
Offensive rebounds	9.7±3.7	10.8±3.5	10.0±4.2	10.6±3.5
Defensive rebounds	26.9±3.9***	22.1±4.1	26.4±3.7**	22.8±4.7
Total rebounds	36.6±5.4**	32.9±5.2	36.4±5.9	33.5±5.1
Assist passes	12.4±3.5*	10.5±3.9	11.3±3.2	10.6±3.6
Personal fouls	21.0±4.6*	22.9±3.9	22.0±3.7	23.1±4.1
Turnovers	12.6±4.0	13.4±3.8	13.4±4.3	13.0±3.9
Steals	6.4±2.6	6.3±2.6	6.0±2.5	6.6±2.8
Blocked shots	2.7±1.6	2.4±1.3	2.6±1.5	2.6±1.4
Points	79.3±8.7***	67.7±8.9	76.0±8.4***	70.8±8.1

Significantly different to losing team: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

At balanced games (n=20) the analysis showed 8 significant performance indicators (Table 2). The most significant ones were the 2 point shooting percentage ($p < 0.001$) and the 3 point shooting percentage ($p < 0.001$).

The group of unbalanced games contained only 6 matches. Because of the small number of matches the statistical analysis of unbalanced games explored only 5 significant performance indicators that differentiate winners and losers, although substantial differences can be seen at several performance indicators in Table 2.

Table 2: Analysis of Balanced and Unbalanced Matches

Performance Indicator	Balanced matches (n=20)		Unbalanced matches (n=6)	
	Winners (mean±SD)	Losers (mean±SD)	Winners (mean±SD)	Losers (mean±SD)
Successful 2 point shots	19.8±3.9**	16.3±4.2	23.5±4.2*	14.8±1.8
2 point attempts	36.2±5.1	35.9±5.1	39.0±4.2	37.2±5.3
%successful 2 point attempts	55.5±6.8***	45.3±9.4	60.2±8.6*	40.3±5.1
Successful 3 point shots	8.5±2.4*	6.9±2.3	8.0±3.0	6.2±3.4
3 point attempts	20.9±4.8	23.9±5.2	20.5±4.9	23.2±4.1
%successful 3 point attempts	40.9±9.6***	28.7±7.1	38.9±11.5	25.4±10.2
Successful free throws made	16.8±5.0*	13.1±5.7	14.0±4.5	7.8±5.7
Free throw attempts	22.9±5.8*	18.9±8.8	18.7±5.6	10.3±10.2
%successful Free throws	72.9±10.3	72.0±10.5	75.3±11.8	64.9±21.9
Offensive rebounds	9.6±3.2	10.7±3.3	8.7±3.1	11.7±4.5
Defensive rebounds	26.9±4.4**	21.5±3.4	29.0±3.0*	20.7±3.1
Total rebounds	36.5±5.2	32.2±5.3	37.7±3.3	32.3±5.5
Assist passes	13.2±3.4*	10.8±3.7	14.8±3.6	8.8±6.5
Personal fouls	20.9±5.0	22.9±3.8	16.8±5.6	21.8±3.3
Turnovers	12.1±3.7	13.1±3.1	10.5±2.0*	16.2±4.5
Steals	6.5±2.3	6.0±2.5	8.3±3.4	6.2±1.3
Blocked shots	2.5±1.3	2.3±1.0	4.0±2.8	2.0±1.3
Points	82.4±7.3***	66.8±7.0	85.0±8.2*	56.0±9.2

Significantly different to losing team: * p < 0.05, ** p < 0.01, *** p < 0.001

4. Discussion

The main aim of this study was to identify those critical performance indicators that most distinguish between winning and losing teams, according to the game final score differences. Analyzing all the 54 matches of the European Basketball Championship 2007 led to the identification of 13 significant performance indicators. The three most significant ones were the shooting percentage of 3 point shots (p<0.001), the number of successful free throws (p<0.001), and the number of defensive rebounds (p<0.001). Analysis of all the games of the tournament contained also the easy winnings where there were huge differences between the performances of the two teams and winner teams often achieved better results in most of the notated performance indicators. These 13 significant performance indicators were reduced to 6 critical performance indicators when only the close matches (n=28) were considered.

To prepare a team for basketball games, to build up the best tactics, to make good decisions during a game, coaches need to know which elements of matches are the most crucial ones. Especially at close games where there is small differences between the performance of two teams. During close matches where the difference between the final results of the two teams were 9 points or less the winning teams had significantly less 3 point attempts (p<0.05) with higher shooting percentage (p<0.01). It means that winner teams in defence covered the most dangerous area close to the basket and forced the opposite players to shoot from outside. The significantly higher number of defensive rebounds (p<0.01) also mean that they kept attention to guard the area around the basket

with good box out and positioning. The higher number of successful free throws ($p < 0.01$) and the free throw percentage ($p < 0.001$) also contributed to achieve a higher number of scored points and consequently determined success. The importance of defensive rebounds (Mendes and Janeira, 2001; Trninic et al., 2002; Tsamourtzis et al., 2002) and free throws (Jukic *et al.* 2000; Oliver, 2004; Sampaio and Janeira, 2003; Tavares and Gomes, 2003; Trninic *et al.*, 2002) were highlighted by previous researches also.

At balanced games (final score difference between 10 and 22 points) the better shooting performance and defensive rebounding ($p < 0.01$) led teams to victory. The significantly higher number of defensive rebounds ($p < 0.01$) and assist passes ($p < 0.05$) and the better shooting percentage could reflect that after good defensive rebounding the winner teams made easy baskets from fast breaks. Tsamourtzis et al. (2005) identified that fast breaks and their effectiveness are important factors to achieve the victory. There were significant differences at 2 and 3 point shooting percentage ($p < 0.001$). Beside the better offensive performance it could be the result of the difference in quality of defence between winning and losing teams.

Because of the small number of matches ($n=6$) the analysis of unbalanced games explored only 5 significant performance indicators that differentiate winners and losers, although relatively huge difference can be seen at several performance indicators in Table 2. The reason of the huge difference between the 2 point shooting percentage ($p < 0.05$) and turnovers ($p < 0.05$) can be explained with the difference between the defensive performance of the winning and losing teams.

Results obtained from balanced and unbalanced games show that winning teams made better performance in most of the game statistics. At close games winning teams were discriminated from losing teams by the 3 point performance, the free throws performance and the defensive rebounding.

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