Original Article

Performance differences between winning and losing basketball teams during close, balanced and unbalanced quarters

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ABSTRACT

Csataljay G, James N, Hughes M, Dancs H. Performance differences between winning and losing basketball teams during close, balanced and unbalanced quarters. *J. Hum. Sport Exerc.* Vol. 7, No. 2, pp. 356-364, 2012. Previous studies in basketball performance have tended to assess differences between winners and losers of games. This methodology does not consider the fluctuating nature of scoring within games. Consequently winning and losing performance for each quarter of 26 games of the Hungarian basketball league in 2007/08 were compared with the difference in points scored used as an independent variable with three levels (identified through cluster analysis as close (1 to 5 points), balanced (6 to 11 points) and unbalanced periods (12 to 22 points)). Wilcoxon signed ranks tests identified significant differences between winning and losing quarter performance for 20 performance indicators when all quarters were analysed (n = 100) in comparison to just 5 for close quarters only (n = 42). The five performance indicators (number of successful free throws, number of defensive rebounds, total amount of rebounds and rebounding percentage in offence and defence) suggest that mainly the success in rebounding might be the critical factor that determines winning and losing in these close situations. Kruskal Wallis H tests and Mann Whitney U post-hoc tests revealed differences between winning performances from close, balanced and unbalanced quarters for the 3 point performance (number of successful 3 point shots, number of 3 point attempts and 3 point shooting performance), the number of assist passes and turnovers; these findings could be explained by the significantly different features of defensive resistance during different types of periods. **Key words**: PERFORMANCE INDICATORS, SCORE DIFFERENCES, SCORE FLUCTUATION

INTRODUCTION

Sampaio and Janeira (2003) and Reano et al. (2006) used cluster analysis to establish three different groups of match types according to the game final score differences in order to identify the most powerful game statistics between winning and losing teams. However classifying basketball games solely on the game score does not consider the fluctuation of scoring within a game and it is usually the case that the game winner does not dominate or score more frequently all of the time. Indeed, Choi et al. (2006) analysed 10 basketball games from the English basketball league in 2005-2006 and found that the game loser won 30 % of the quarters played. Analysing each quarter of a game separately may therefore better distinguish between unsuccessful and successful performance. As basketball is played using quarters interspersed by rest periods and coach interventions there is a logical argument to suggest that the four periods can be seen as related but separate events.

The decisions made by the coach when the score is very close, particularly towards the end of the game, can win or lose basketball games. Choosing the best tactical intervention requires detailed domain knowledge regarding players' strengths and weaknesses and probability assessments of success for different offensive and defensive strategies. Statistical evidence of player performances are routinely used to facilitate this tactical decision making but little is known about which factors discriminate success and failure during these crucial periods where there is very little difference in the scoring patterns of the two teams. To address this issue data from each game quarter will be grouped into low, medium and high score differences using cluster analysis techniques. This will make it possible to determine which performance indicators discriminate performance in the crucial periods of little advantage for one team over the other. It is thought that the performance indicators identified will be the most important and few in number in contrast to the large number of significant indicators typically found when all games are analysed on the sole basis of final score irrespective of difference in score e.g. Csataljay at al. (2009). Hence, the final objective will be to compare how the difference in performance between the winning and losing teams changes in relation to the closeness of the score.

MATERIAL AND METHODS

All 26 games played by a Hungarian 1st division basketball team (Falco KC Szombathely) during the regular 2007/08 season were analysed with data grouped into game quarters (n=104) and categorised according to the score for the quarter. 75 quarters were won by the eventual game winner, 25 by the game loser and 4 quarters were tied. These four quarters were ignored when performance differences between winners and losers were analysed. Post event data gathering was undertaken using Focus X2 performance analysis software recording the following performance indicators: number of successful shots, number of shooting attempts and shooting percentage on 3 point shots, 2 point shots from far distance (between the 3 point line and the 3 seconds restricted area), 2 point shots from close distance (from the 3 seconds restricted area) and free throws; number of offensive, defensive and total rebounds; offensive and defensive rebounding rate; number of steals, turnovers, assist passes, blocked shots and suffered fouls; defensive pressure (minimal, half and maximal) on the shooting player; type of offenses like fast breaks, offences against unsettled defence, set offences; and the amount of points scored by teams. Most of the previous researches on basketball performance used the absolute number of rebounds as a variable when differences between winners and losers were analysed. The absolute number of rebounds correlated to the rebounding possibilities (missed shots from the field and missed free throws followed by rebounds) provides more objective and more powerful information about rebounding performance (Csataljayat al., 2011). Therefore in this study both the absolute number and relative value of rebounds were considered.

Offensive and defensive rebounding percentages were calculated with the following equations:

Offensive rebounding % = [Off. reb. / (missed 2 pt shots + missed 3 pt shots + missed free throws followed by rebounds)] x 100; where the number of offensive rebounds is compared to the number of missed shots by the same team.

Defensive rebounding % = [Def. reb. / (missed 2 pt shots + missed 3 pt shots + missed free throws followed by rebounds)] x 100; where the number of defensive rebounds is compared to the number of missed shots by the opponent team.

The number of missed free throws that were followed by rebounds was counted from the gathered event list of the observed games.

Collected data were transferred into SPSS 18 statistical software. The 104 quarters were classified into three groups based on the outcome difference by k-means cluster analysis (min=0; max=22; m=6.8; SD=4.7). Results of the cluster analysis showed that the score difference was between 0 and 5 points during close quarters (n=46), between 6 and 11 points at balanced (n=38), and between 12 and 22 points at unbalanced quarters (n=20). Data from 4 quarters where the outcome score was tied were not considered while performance differences related to all quarters (n=100) and close quarters (n=42) were tested. A series of Wilcoxon signed ranks test were used for 28 variables to identify those performance indicators that differentiate between related samples of winning and losing performances from three different types of quarters. The level of significance was set at p<0.05. Kruskal Wallis H tests were used to identify significant differences between the game related statistics of winning team performances for tight, balanced and unbalanced quarters. The level of significance was determined at p < 0.05 when Kruskal Wallis H tests were used. Application of Kruskal Wallis H test in SPSS does not provide post hoc tests. Therefore, a series of Bonferroni adjusted Mann Whitney U post hoc test were employed (recommended by O'Donoghue, 2010) to find differences between the three samples. In order to avoid type I error, the Bonferroni adjusted level of significance was determined at p<0.017 by dividing the threshold p value (0.05) by the number of pairs of groups (n=3).

RESULTS

Testing differences of winning and losing performances from all the 100 observed quarters by Wilcoxon signed ranks test led to the identification of 20 performance indicators that significantly determined (p<0.05) team success within quarters. The most significant differences between winning and losing performances were found for the number of successful three point shots (z=-4.8, p<0.001), the percentage of successful three point attempts (z=-4.6, p<0.001), the percentage of successful two point attempts from close distance (z=-3.9, p<0.001), the amount of successful free throws (z=-3.9, p<0.001), the number of defensive (z=-6.6, p<0.001) and total rebounds (z=-5.8, p<0.001), the percentage of offensive (z=-3.8, p<0.001) and defensive rebounding (z=-4.0, p<0.001) and the assist passes (z=-4.3, p<0.001). The 20 significant performance indicators were reduced to 5 critical elements when only the close quarters with outcome difference between 1 and 5 points were considered. For close quarters the number of successful free throws (z=-2.1, p<0.05), the number of defensive rebounds (z=-3.8, p<0.001) and total rebounds (z=-3.7, p<0.001), and the percentage of offensive (z=-2.7, p<0.01) and defensive rebounding (z=-2.5, p<0.05) contributed to successful performance. Analysis of all the games and tight matches are summarised in Table 1.

Table 1. *Analysis of winning and losing performances from all the quarters and close quarters.*

Performance Indicators	All quarters (n=100)		Close quarters (n=42)	
	Winners (mean±SD)	Losers (mean±SD)	Winners (mean±SD)	Losers (mean±SD)
Successful 3 point shots	2.9±1.6***	1.8±1.3	2.2±1.3	1.9±1.3
3 point attempts	6.4±2.2*	5.6±2.2	5.6±2.2	5.7±2.1
%successful 3 point attempts	45.1±22.1***	30.2±20.5	40.2±23.9	34.7±22.5
Successful far 2 point shots	1.0±1.1*	0.7±0.9	1.1±1.0	0.7±0.9
Far 2 point attempts	2.6±1.7	2.3±1.6	2.8±1.7	2.1±1.9
%successful far 2 point attempts	38.5±34.0	32.1±33.9	41.0±35.2	30.2±30.9
Successful close 2 point shots	4.7±2.2*	4.0±2.0	4.4±2.1	4.5±2.2
Close 2 point attempts	7.3±2.5	7.6±2.8	7.6±2.5	8.3±2.9
%successful close 2 pt attempts	63.8±20.2***	52.6±20.7	58.9±19.9	53.6±19.1
Successful free throws made	5.3±3.3***	3.7±2.7	5.2±3.5*	3.8±3.0
Free throw attempts	6.5±3.6**	5.3±3.6	6.4±3.8	5.4±4.0
%successful Free throws	81.0±18.8**	69.2±24.8	80.5±20.0	72.3±21.0
Offensive rebounds	2.9±1.7	2.4±1.8	2.9±1.8	2.2±1.8
Defensive rebounds	7.2±2.1***	5.1±1.7	7.2±1.9***	5.6±1.6
Total rebounds	10.1±2.6***	7.6±2.6	10.1±2.8***	7.8±2.3
Offensive rebounding %	33.0±16.1***	23.5±15.6	31.6±14.1**	22.3±15.9
Defensive rebounding %	74.4±16.8***	63.5±17.1	74.7±16.4*	65.0±16.2
Steals	1.9±1.4*	1.5±1.3	1.7±1.2	1.5±1.0
Turnovers	3.0±1.6**	3.7±1.7	3.5±1.5	3.2±1.6
Assist passes	3.5±1.7***	2.4±1.6	2.9±1.5	2.9±1.7
Blocked shots	0.6±0.8	0.5±0.7	0.5±0.6	0.6±0.7
Suffered fouls	6.0±2.0*	5.4±2.1	5.8±2.1	5.7±2.3
Shots under min. def. pressure	5.8±2.7*	4.9±2.0	5.2±2.4	5.4±1.8
Shots under half def. pressure	3.0±1.6	2.7±1.5	2.5±1.5	2.7±1.5
Shots under max. def. pressure	7.5±2.4	7.9±2.6	8.3±2.6	7.9±2.2
Fast breaks	2.3±1.6**	1.7±1.2	2.1±1.5	1.9±1.2
Offenses against unsettled def.	1.0±1.0*	0.7±1.0	0.9±0.9	0.7±0.7
Offenses against set defence	15.6±2.8	15.3±2.6	15.3±2.9	15.6±2.4
Scored points	25.5±4.7***	18.7±4.3	23.2±4.2***	20.7±4.0

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

The analysis of close versus balanced and unbalanced quarters identified that the growth of score difference went together with the increasing number of significantly distinguishing performance indicators. Winning team performances in the group of small difference quarters can be described by the better free throwing and rebounding performances, but the number of defensive rebounds and total rebounds were determined as the most important performance indicators (p<0.001). The analysis of quarters between 6 and 11 points difference identified 10 significantly differentiating variables. The highest level of significance were found for the number of successful 3 point shots (z=-3.6, p<0.001), the 3 point shooting percentage

(z=-3.8, p<0.001) and similarly to close quarters for the number of defensive (z=-4.3, p<0.001) and total rebounds (z=-3.5, p<0.001). Winning teams showed demonstrable better performance from 21 of the 28 notated variables when high difference quarters were considered. Descriptive statistics and differences between winning and losing performances from balanced and unbalanced quarters can be seen in Table 2.

Table 2. *Analysis of winning and losing performances, at balanced and unbalanced quarters.*

Performance Indicators	Balanced quarters (n=38)		Unbalanced quarters (n=20)	
	Winners (mean±SD)	Losers (mean±SD)	Winners (mean±SD)	Losers (mean±SD)
Successful 3 point shots	3.1±1.5***	1.7±1.3	3.9±1.6***	1.5±1.4
3 point attempts	6.8±2.0	5.8±2.2	7.1±2.1**	5.2±2.4
%successful 3 point attempts	45.1±19.9***	26.2±17.9	55.4±19.6***	28.3±20.0
Successful far 2 point shots	1.0±1.3	0.9±1.1	1.0±0.8*	0.5±0.7
Far 2 point attempts	2.5±1.8	2.5±1.3	2.5±1.4	2.4±1.4
%successful far 2 point attempts	32.7±32.4	37.6±37.4	44.2±34.8	25.4±32.6
Successful close 2 point shots	4.8±2.1*	3.7±1.6	5.1±2.7*	3.4±1.9
Close 2 point attempts	7.0±2.1	7.0±2.4	7.4±3.2	7.5±3.1
%successful close 2 pt attempts	67.1±20.1*	54.5±21.2	68.1±20.0**	47.0±21.6
Successful free throws made	5.5±3.4*	3.9±2.7	5.3±2.5**	2.9±1.9
Free throw attempts	6.7±3.6	5.7±3.6	6.6±3.5*	4.3±2.0
%successful Free throws	80.0 ±9.2	68.7±27.1	84.1±15.7*	64.3±27.4
Offensive rebounds	2.8±1.8	2.7±1.7	2.7±1.5	2.2±2.2
Defensive rebounds	7.0±2.0***	4.9±2.0	7.7±2.5**	4.7±1.4
Offensive rebounding %	34.0±18.9	26.4±14.0	34.1±14.7*	20.3±17.8
Defensive rebounding %	72.3±16.0*	62.2±18.5	77.5±19.3*	63.0±16.6
Total rebounds	9.8±2.4***	7.6±2.8	10.4±2.8**	7.0±2.7
Steals	2.0±1.4	1.8±1.5	2.2±1.6**	0.8±0.9
Turnovers	2.9±1.7**	3.8±1.7	2.0±1.2***	4.3±1.7
Assist passes	3.5±1.5**	2.1±1.4	4.6±1.9***	2.0±1.5
Blocked shots	0.6±0.8	0.4±0.7	0.8±1.0**	0.2±0.7
Suffered fouls	6.0±1.9	5.3±2.0	6.4±2.0*	4.8±1.7
Shots under min. def. pressure	5.6±2.3	4.7±2.4	7.5±3.3**	4.3±1.5
Shots under half def. pressure	3.2±1.6	2.8±1.6	3.3±1.6	2.4±1.5
Shots under max. def. Pressure	7.4±1.8	7.7±2.8	6.2±2.4	8.2±3.0
Fast breaks	2.0±1.5	1.7±1.3	3.0±2.0**	1.3±1.1
Offence against unsettled def.	1.0±1.1	0.8±1.2	1.1±1.0*	0.5±0.8
Offense against set defence	15.9±2.6	15.0±2.7	15.6±3.1	15.0±2.6
Scored points	26.1±3.7***	18.1±3.5	29.4±4.7***	15.2±3.9

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

Table 3. *Descriptive statistics of winning performances from different types of quarters and results of Kruskal Wallis H tests.*

Winning team performances Performance Indicators	Close quarters (n=42) (mean±SD)	Balanced quarters (n=38) (mean±SD)	Unbalanced quarters (n=20) (mean±SD)	H values of Kruskal Wallis H test
Successful 3 point shots	2.2±1.3	3.1±1.5	3.9±1.6	17.2 ***
3 point attempts	5.6±2.2	6.8±2.0	7.1±2.1	7.5 *
%successful 3 point attempts	40.2±23.9	45.2±19.9	55.4±19.6	7.0 *
Successful far 2 point shots	1.1±1.0	1.0±1.3	1.0±0.8	1.0
Far 2 point attempts	2.8±1.7	2.5±1.8	2.5±1.4	0.6
%successful far 2 point attempts	41.0±35.2	32.8±32.4	44.2±34.8	1.8
Successful close 2 point shots	4.4±2.1	4.8±2.1	5.1±2.7	0.7
Close 2 point attempts	7.6±2.5	7.0±2.1	7.4±3.2	1.4
%successful close 2 pt attempts	58.9±19.9	67.1±20.1	68.1±20.0	4.5
Successful free throws made	5.2±3.5	5.5±3.4	5.3±2.5	0.3
Free throw attempts	6.4±3.8	6.7±3.6	6.6±3.5	0.2
%successful Free throws	80.5±20.0	80.0±19.2	84.1±15.7	0.6
Offensive rebounds	2.9±1.8	2.8±1.8	2.7±1.5	0.1
Defensive rebounds	7.2±1.9	7.0±2.0	7.7±2.5	2.1
Total rebounds	10.1±2.8	9.8±2.4	10.4±2.8	1.3
Offensive rebounding %	31.6±14.1	34.0±18.9	34.1±14.7	0.7
Defensive rebounding %	74.7±16.4	72.3±16.0	77.5±19.3	0.4
Steals	1.7±1.2	2.0±1.5	2.2±1.6	1.2
Turnovers	3.5±1.5	2.9±1.7	2.0±1.2	13.8 **
Assist passes	2.9±1.5	3.5±1.6	4.6±1.9	11.4 **
Blocked shots	0.5±0.6	0.6±0.8	0.8±1.0	1.0
Suffered fouls	5.8±2.1	6.0±2.0	6.4±2.0	1.2
Shots under min. def. pressure	5.2±2.4	5.6±2.3	7.5±3.3	7.2 *
Shots under half def.pressure	2.5±1.5	3.3±1.6	3.3±1.6	4.7
Shots under max. def. pressure	8.3±2.6	7.4±1.9	6.2±2.4	8.8 *
Fast breaks	2.1±1.5	2.0±1.5	3.0±2.0	4.5
Offences against unsettled def.	0.9±0.9	1.0±1.1	1.1±1.0	0.6
Offences against set defence	15.3±2.9	15.9±2.6	15.6±3.1	1.3
Scored points	23.2±4.2	26.1±3.7	29.4±4.7	23.7 ***

Significant difference between the 3 independent samples: * p < 0.05, ** p < 0.01, *** p < 0.001

Kruskal Wallis H tests (see Table 3) revealed significant differences between close, balanced and unbalanced quarters when the number of successful three point shots (p<0.001) and the three point shooting percentage (p<0.05) were analysed. Man Whitney U post hoc tests showed that winning teams had significantly less made three point shots during close quarters than in balanced (U=515.5, z=-2.8, p<0.05) and in unbalanced periods (U=173.5, z=-3.8, p<0.05). The percentage of successful three point shots was also lower in close quarters than in unbalanced ones (U=251.0, z=-2.6, p<0.05). Whereas

Kruskal Wallis H test identified significant difference when the number of three point attempts were analysed between the three types of quarters ($p<0.05$), neither of the three pairs of groups showed significant divergence when the Bonferroni adjusted level of significance ($p<0.017$) was considered for the post hoc tests. Kruskal Wallis H test explored significant differences with the number of assist passes ($p<0.01$) and the number of turnovers ($p<0.01$). The winning teams had significantly higher number of turnovers ($U=181.5$, $z=-3.7$, $p<0.05$) and less assist passes ($U=210.0$, $z=-3.3$, $p<0.05$) when played close quarters compared to unbalanced quarters. Significant differences were revealed with the shooting attempts under minimal pressure ($p<0.05$) and under maximal pressure ($p<0.05$). Winning teams had significantly more easy shots under minimal defensive pressure in unbalanced quarters than when the result was tight ($U=251.5$, $z=-2.6$, $p<0.05$), and had significantly more difficult shooting opportunities under maximal defensive pressure in close quarters related to unbalanced ones ($U=234.0$, $z=-2.8$, $p<0.05$). Significant difference was found between the three different types of quarters at the amount of scored points per quarters ($p<0.001$) when Kruskal Wallis H test was applied. Bonferroni adjusted Mann Whitney U tests revealed significant differences for all the three pairs of samples. Winning teams could score more points in balanced ($U=465.0$, $z=-3.2$) and unbalanced quarters ($U=134.0$, $z=-4.3$, $p<0.05$) than in tight ones, and also scored more points in unbalanced quarters than in balanced ones ($U=220.0$, $z=-2.6$, $p<0.05$)

DISCUSSION AND CONCLUSIONS

Testing differences between winning and losing performances from 100 quarters of basketball matches revealed 20 distinguishing performance indicators. The amount of key elements of basketball performance was reduced to 5 critical elements when only quarters with low difference between winning and losing teams were analysed. Based on the results of Wilcoxon signed ranks tests the number of successful free throws and the rebounding performance both in offence and in defence led to successful performance during close periods. Previous studies also found the importance of free throws (Mendes & Janeira, 2001; Trninic et al., 2002; Ibáñez et al., 2003; Sampaio & Janeira, 2003; Tavares & Gomes, 2003; Reano et al., 2006; Csataljay et al., 2009) and getting rebounds in offence (Dezman et al., 2002; Oliver, 2004) and in defence (Mendes & Janeira, 2001; Trninic et al., 2002; Tsamourtzis et al., 2002; Csataljay et al., 2009). Comparing winning and losing performances from different types of quarters also showed that the bigger the difference between the scored points of two teams the higher number of distinguishing performance indicators can be explored (Table 1 and Table 2). These results support the idea of previous researches (Sampaio & Janeira, 2003; Reano et al., 2006; Csataljay et al., 2009) that different types of performances should be considered in order to find valid performance indicators.

Analysis of getting rebounds both in offense and in defence raised some contradictions when the importance of the number of rebounds and the rebounding rates were compared. Analysis of winning and losing team performance indicators identified significant differences for the offensive rebounding rate for all quarters ($p<0.001$), for close quarters ($p<0.01$) and for unbalanced quarters ($p<0.05$) however there was no difference found for the number of offensive rebounds in these types of quarters. For tight, balanced and unbalanced periods the levels of significance were different between the amount of defensive rebounds and the defensive rebounding rate. Comparing the amount of rebounds between two teams by itself does not consider the amount of missed shots followed by rebounding possibilities. Many of the previous researches that identified the importance of rebounds used official box scores of whole matches or accumulated team statistics from championships for data collection (Mendes & Janeira, 2001; Trninic et al., 2002; Csataljay et al., 2009). These sort of statistical compilations provide information about the amount of missed shots from the field but do not contain any data whether a missed free throw was followed by

another free throw or by a rebounding opportunity; therefore rebounding percentages cannot be calculated. For this reason more sophisticated data collection should be used for rebounding situations with either in event or post event notation of matches. These findings support the suggestions of Csataljay et al. (2011) that in order to avoid misleading consequences, the number of rebounds always should be related to the rebounding opportunities both in offence and in defence.

Analysing the characteristic features of winning performances from different types of periods showed that the bigger the difference was between the scored points of the two teams the more points were scored by the winner team. One of the reasons of the previous findings could be the difference between the defensive resistance of defeated teams for close and unbalanced quarters. Winning teams had more easy shooting opportunities without defensive pressure during unbalanced quarters related to tight ones; and had more shooting attempts under maximal defensive pressure for close periods than for unbalanced ones. As a consequence of the variety of defensive performance of losing teams, winning teams made less successful 3 point shots during close quarters than in balanced and unbalanced periods; and achieved higher efficiency for 3 point shots in unbalanced quarters than in close ones. The higher number of turnovers during close quarters also could impede winning teams to increase the score difference. In contrast, higher point difference was achieved, when they could play more collectively and players assisted each other with more successful assist passes.

Team performance is often fluctuates during basketball matches, therefore more detailed findings can be achieved from analysis of shorter periods of games. Global analyses of whole tournaments and championships also can be misleading when distinguishing performance indicators are identified, because matches with substantial differences between performances of two teams increase the amount of significant indicators. For basketball coaches it is more important to know the critical elements of successful performance that can lead to victory during close games. The number of successful free throws and the rebounding performance both in offence and in defence were identified as critical performance indicators during close periods of basketball games. The results of the study showed that in order to avoid misleading consequences rebounding percentages should be used both in offense and in defence instead of the number of rebounds. Differences between winning performances from close, balanced and unbalanced quarters were found for the 3 point performance, the number of assist passes and turnovers and can be explained by the features of defensive resistance in different types of periods.

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