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Original scientific paper

Game-Related Statistics that Discriminated Winning and Losing Teams from the Spanish Men's Professional Basketball Teams

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A B S T R A C T

The purpose of the present study was to analyse men's basketball competitions, trying to identify which game-related statistics allow to discriminate winning and losing teams. The sample used corresponded to 306 games from the 2004–2005 Regular Season of the Spanish Men's Professional League. The game-related statistics gathered were: 2 and 3 points field-goals (both successful and unsuccessful), free-throws (both successful and unsuccessful), offensive and defensive rebounds, blocks, assists, fouls, turnovers and steals. The data were analysed in two groups: balanced games (final score differences equal or below 12 points) and unbalanced games (final score differences above 12 points). Discriminant analysis allowed to conclude the following: (i) in balanced games, the variable that best differentiate both groups were the defensive rebounds; (ii) in unbalanced games, the variables that discriminate between both groups were the successful 2 points field-goals, the defensive rebounds and the assists; and (iii) in all games, the statistical analysis identified two variables that discriminate winning and losing teams (defensive rebounds and assists). The defensive rebounds were the only game-related statistic that discriminates both groups in all performed analysis. Coaches and players should be aware of these different profiles in order to increase knowledge about game cognitive and motor solicitation and, therefore, to enhance specificity at the time of practice and game planning.

Key words: *basketball, discriminant analysis, game-related statistics*

Introduction

Sport sciences are one of the topics with great interest to social sciences and particularly to anthropology[1]. Within this research framework, team sports have been analyzed in a way to understand the requirements of high-level player and team performances in several dimensions (biomechanical, physiological, psychological, sociological) and domain applications (volleyball[2], handball[3–4], water-polo[5], or basketball[6–9]). One of the most important variables to analyse is the actions performed by the players and the teams in real competition settings, usually designated by game-related statistics. This field of research is accomplished through the use of notational analysis with the scope of analysing performance is available in several researches and is used by coaches to prepare the training process of players and teams[9].

Particularly in basketball, the analysis of the game-related statistics is very popular among coaches; however, only recently is available scientific research on the usefulness of these variables in characterizing and understanding game performances under different contexts[10]. These researches allow understanding that basketball game performance, as analysed by game-related statistics, can be a reflection of teams' strategies and tactics within the games[11].

In regular seasons, the game-related statistics that can influence the final outcome are the field-goals and the defensive rebounds[10,12–13]. However, in specific game contexts such as close games, other game-related statistics such as fouls and free-throws exhibit higher

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importance[14]. On the other hand, studies that have used samples of European Championships have identified the same game-related statistics associated to the winning teams (both defensive rebounds and field-goal percentage)[15–18].

Other game-related statistics such as offensive rebounds, blocks, turnovers, steals or assists, are not consistently reported as discriminant between winning and losing teams in the available literature[10,12,13,15–18].

Despite the important information of previously presented research, the use of game statistics in pre-experimental and quasi-experimental research has been associated with important threats to internal validity[19]. In fact, game-related statistics can be very useful when the coach wants to analyze team performance against their opponents, but may lack validity when performance needs to be analyzed across the season(s), due to game rhythm contamination, i.e. the simultaneous presence of fast and slow paced games throughout the season[10,19]. For example, the performance of a team A that makes 35 field-goals in an 80 possession game must be different to the performance of a team B that makes 35 field-goals in a 90 possession game. This fact points out the imperative need of normalizing game statistics according to game rhythm[1]. Such procedures have only been applied in a few studies with concluding results and in relation to the rhythm of the game itself[8,14–15].

On the other hand and apart from normalizing game-related statistics to game rhythm, the score final difference is a major variable to take into account, since the literature has shown that balanced and unbalanced games are likely to be analysed separately[10]. Finally, there is already available one study performed with this methodology[10], however, the used sample was a Portuguese basketball league, representing a low-level European standard of play, as noted by the International Basketball Federation.

Therefore, the present study aims to identify the game-related statistics that discriminate between winning and losing teams in Spanish men's balanced and unbalanced basketball games. Establishing theories of successful play based on actual quality, has become more and more important because they directly correlate with successful selection of options in a given game situation and with competitive results[9].

Method

Sample and variables

In order to carry out this study, all 306 games corresponding to the 2004–2005 regular season of the Spanish Men's league have been analyzed. The following game-related statistics were gathered: 2 and 3 points field-goals (both successful and unsuccessful), free-throws (both successful and unsuccessful), offensive and defensive rebounds, blocks, assists, fouls, turnovers and steals. As suggested by the literature, the variables were normalized according to game ball possessions, being multiplied by 100, which allow distinguishing the rhythm of the game[10,11,20]. Ball possessions (BP) were calculated by Oliver[20] equation: (BP = Attempted field goals – offensive rebounds + turnovers – 0.4 × Attempted free throws).

Statistical analysis

All analyzed games have been divided into two groups by means of automatic classification, using the cluster analysis of k-means[21] based on the final result of the games. The cluster analysis has classified 70.3% of the sample in games with final score differences equal or below 12 points (balanced games), whereas the remaining 29.7% of the sample were classified in another group with score differences above 12 points (unbalanced games). The data analysis was carried out separately taking into account each of these obtained groups.

A t-test for independent samples was carried out in order to do a first examination of the existing differences between the groups of variables[22]. Secondly, a discriminant analysis was carried out to find the statistical team variables that better contribute to discriminate both groups. By means of structural coefficients (SC) we identified the variables that better allowed discriminating winning from losing teams. It was considered as relevant for the interpretation of the linear vectors that the SC above 0.30[22,23]. When appropriate, Bonferroni adjustment was used to correct for multiple tests. The whole statistical analysis has been performed with a significance level of $p \geq 0.05$.

Results

Descriptive results of the game-related statistics for winning and losing teams are presented in Table 1. In the analysis of all games, statistically significant variables were the successful 2 and 3 points field-goals, unsuccessful 3 points field-goals, assists, steals, turnovers and fouls. In balanced games, the variables with statistically significant differences between both groups were the successful and unsuccessful 2 and 3 points field-goals, defensive rebounds, assists and steals. In unbalanced games, statistically significant variables between both groups were the successful and unsuccessful free-throws and 2 points field-goals, defensive rebounds, turnovers, assists and steals.

In Table 2, the results of the multivariate analysis are represented for balanced and unbalanced games and for all the games. All the discriminatory functions obtained have been significant ($p \geq 0.05$), and classified correctly 81.3% of the balanced games, 98.6% of the cases in unbalanced games and 87.4% of the cases in the analysis of all games.

Discriminant analysis in balanced games identified the defensive rebounds (SC = 0.37) as a major contributing variable to winning or losing games. In unbalanced games, the variables that had a higher discriminatory power were the successful 2 points field-goals (SC = 0.33), defensive rebounds (SC = 0.37) and assists (SC =

TABLE 1
DESCRIPTIVE RESULTS AND UNIVARIATE DIFFERENCES IN BALANCED, UNBALANCED AND ALL GAMES FROM THE REGULAR SEASON (VALUES ARE MEAN±STANDARD DEVIATION AND WERE NORMALIZED TO GAME BALL POSSESSIONS AND MULTIPLIED BY 100)

Game-related statistics	All games		Balanced games		Unbalanced games	
	Winners	Losers	Winners	Losers	Winners	Losers
	X ± SD	X ± SD	X ±SD	X ± SD	X ± SD	X ± SD
Successful 2-pt field-goals	30.6 ± 5.5	28.9 ± 5.5*	34.0 ± 6.4	26.1 ±5 .3*	31.8 ± 6.1	27.9 ± 5.6*
Unsuccessful 2-pt field-goals	26.5 ± 6.0	27.9 ± 6.9*	25.9 ± 6.7	31.3 ± 7.3*	26.3 ± 6.2	29.1 ± 7.2
Successful 3-pt field-goals	10.3 ± 3.4	9.5 ± 3.6*	11.7 ± 4.1	8.2 ± 3.2	10.8 ± 3.7	9.1 ± 3.5*
Unsuccessful 3-pt field-goals	16.2 ± 4.8	18.5 ± 5.3*	14.5 ± 4.1	18.5 ± 4.9	15.6 ± 4.6	18.5 ± 5.2*
Successful free-throws	25.2 ± 8.6	21.1 ± 7.2	23.2 ± 8.1	19.9 ± 7.8*	24.5 ± 8.4	20.7 ± 7.4
Unsuccessful free-throws	8.5 ± 4.2	7.9 ± 4.1	7.2 ± 3.6	8.7 ± 4.4*	8.1 ± 4.1	8.7± 4.2
Defensive rebounds	32.8 ± 5.9	29.1 ± 5.5*	35.6 ± 5.5	26.9 ± 5.8*	33.8 ± 5.9	28.3 ± 5.6*
Offensive rebounds	15.0 ± 5.3	15.3 ± 5.5	14.9 ± 5.3	16.3 ± 5.4	15.0 ± 5.3	15.6 ± 5.5
Assists	18.6 ± 5.1	16.2 ± 5.0*	22.5 ± 5.4	14.4 ± 4.6*	20.0 ± 5.5	15.5 ± 4.9*
Steals	11.8 ± 5.3	10.9 ± 3.8	12.5 ± 4.3	10.4 ± 3.9*	12.1± 5.0	10.7 ± 3.8*
Turnovers	17.5 ± 4.9	18.5 ± 4.8*	16.5 ± 4.4	20.2 ± 5.2*	17.1 ± 4.7	19.1 ± 4.9*
Blocks	4.3 ± 2.7	3.7 ± 3.2	5.2 ± 3.1	3.2 ± 2.2	4.5 ± 2.9	3.5 ± 2.9
Fouls	31.1 ± 4.9	32.8 ± 4.9*	30.4 ± 5.5	30.9 ± 5.4	30.8 ± 5.2	32.2 ± 5.1*

* p≥0.05

0.39). Finally in all games, the most discriminatory variables were defensive rebounds (SC = 0.42) and assists (SC = 0.38).

Discussion

The purpose of the present study was to identify the game-related statistics that discriminate between winning and losing teams in Spanish men's basketball. The authors argued that the game final scores differences and the standard of competition would configure different game tactics and strategies[9], thus, this would be relected in different discriminant game-related statistics.

The results presented several differences from those obtained in previous studies. This can be a result of player and teams' adaptation to evolution and also through rule changes. For example, the recent change in possession time from 30 to 24 seconds implied a full reorganization from the strategic and tactical point of view, with particular influence in players' cognitive and motor systems. In the present study, only the defensive rebounds were the most powerful variables in discriminating winning and losing teams in all three analyses (all games, balanced games and unbalanced games). Defensive rebounds are correlated with overall defensive success[23] and it is usually a consequence of well performed organized defensive pressure. This game-related statistic is the basis for team play because it opens up more opportunities for primary and secondary fast-breaks and assists. Additionally, it reduces the chances for the opponents' efficiency by not allowing them an extra ball possession, decreasing their shooting attempts; drawing fouls play and effectiveness in transition defence[9].

The normalization of game-related statistics to 100 ball possessions allowed to control for game rhythm and to compare both groups (winners and losers) in different type of games. Also, this methodological approach may have increased the validity of the subsequent analysis. Despite the considerable methodological differences, our results can be compared with the most current studies differentiating both groups.

When considering the variables that best differentiate winning teams from losing ones in all games, comparing the results with the specialized literature which analyzes the regular leagues of all the countries, similarities are found in the defensive rebounds and in the assists[12,13]. On the other hand, our results are similar to those researches which study European Championships in assists and defensive rebounds[15–18,23]. The importance of assists and defensive rebounds could be explained by the first principle of a successful offense: shot selection. This principle creates higher field-goal percentages and reduces opportunities for defensive rebounds, leading to a more successful transition in defense[9,13].

As far as the game types, the results found showed two groups clearly differentiated: the balanced games (70.3%, with scores differences below 12 points) and the unbalanced games (29.7%, with score differences above 12 points), in the same way as other authors declare[8] and also was observed the predominance of balanced games over the unbalanced ones[10,23].

TABLE 2
DISCRIMINANT ANALYSIS STRUCTURE COEFFICIENTS (SC) FROM GAME-RELATED STATISTICS IN BALANCED, UNBALANCED AND ALL GAMES

Game-related statistics	Balanced games	Unbalanced games	All games
Successful 2-pt field-goals	0.16	0.33 *	0.29
Unsuccessful 2-pt field-goals	–0.11	–0.18	–0.18
Successful 3-pt field-goals	0.12	0.23	0.21
Unsuccessful 3-pt field-goals	–0.26	–0.22	–0.27
Successful free-throws	0.29	0.10	0.21
Unsuccessful free-throws	–0.07	–0.08	–0.01
Defensive rebounds	0.37 *	0.37 *	0.42 *
Offensive rebounds	–0.02	–0.06	–0.05
Assists	0.26	0.39 *	0.38 *
Steals	0.11	0.12	0.13
Turnovers	–0.11	–0.18	–0.17
Blocks	0.09	0.18	0.16
Fouls	–0.20	–0.02	–0.12
Eigenvalue	0.80	4.15	1.24
Wilks' λ	0.55	0.19	0.44
Canonical Correlation	0.66	0.89	0.74
c2	229.5	340.1	487.1
p	<.000	0.000	0.000
Reclassification (%)	81.3%	98.6%	87.4%

* SC discriminant value ≤0.30.

In balanced games, the differences between winners and losers were similar to those reported earlier in the literature, with the winners outperforming in defensive rebounds[12,13,15–18,23]. These results can be linked to a better performance of fastbreaks, transition moves and set offences (related to the efficiency in 2 and 3 points field-goals, and in free-throws, not giving up the defensive rebound), apart from being related to predominant beginnings in winning teams (defensive rebounds) which leads to obtain more positive situations in their offences[9,23]. Finally, it is also reflected in these results the importance of factors such as perception, decision-making, and expertise in developing more consequent game actions, more assists near the basket or with easy shots[24,25]. Lidor and Arnon[26] also pointed other components that contribute to the success of these teams, such as psychological (the ability to cope with mental barriers such as anxiety, motivation, and fear), sociological (team cohesion, leadership) and physiological (fitness) aspects of the game.

The psychological side must be considered in the analysis of the type of games, since winning teams show a higher adaptation to the rhythm of the game as well as to the game score which would imply better performances in their offenses[27]. Moreover, the best values in defensive rebounds can also be explained by greater anthropometric measures, agility, manual coordination and ball control of the winning teams' centres over the losing teams[28].

In unbalanced games, the differences between winning and losing teams were in the successful 2 points field-goals, defensive rebounds[12–13] and assists. In this type of games it is outstanding the better ability of winning teams when controlling the game situation as well as according to be ahead in the scoreboard, since it would reflect a better stability in their performance[27]. The best values in defensive rebounds and assists can be associated to (i) better actions in offense and defence of their centres and guards[28,29], and to (ii) better adaptations of winning teams to use their ball possessions in a more rational way, as well as the use of tactic situations that provide advantages of offense like 2 on 2 and 3 on 3, so that they can obtain clearer situations of shot in their offences[9,28].

The results obtained in all games identified the importance from the defensive rebounds and assists. This allows to suggest the need for a harder training in tactics when attacking in order to carry out situations of advantage (2 on 1; 2 on 2 and 3 on 3), as well as an improvement of the technical aspects in the shots previous actions. Also, the assists (because they are expressed as a ball pass to an easy basket) are the reflection of a well-developed offensive strategy that allows the cognitive and motor system to perform easily and adequately.

Coaches and players should be aware of these results in order to control in a better way the training and the game situation depending on its development[11]. Apart

from this process, high-level selectors can use these results to: i) select basketball players according to specific profiles and; ii) have a more precise assessment of the impact of changing to another league or competition upon a teams' game-related statistical profile, e.g., selecting centres with a very high number of defensive rebounds to play in European and World championships or, on the other hand, selecting guards with a very high number of assists and 2 point field-goals percentage to play in the Spanish League.

Conclusions

The discriminatory power of game-related statistics allowed us to understand that winning balanced games was the result of more success in defensive rebounds. This profile helps the coach to prepare practices according to this specificity and, to be ready to control these variables in competition. On the contrary, winning unbalanced games was the result of having more success in 2 points field-goals, defensive rebounds and assists. Coaches should be aware that dominating these variables will increase the probability to win the games.

Finally, the variables that better differentiate winners from losers in a global way were the defensive rebounds and assists. Winning teams had a higher tactical team discipline and responsibility in controlling defensive position and in ball control for getting an open field-goal opportunity. Thus, these results indicate that the common aspect of the successful teams is their cooperation on both defence and offence. Therefore, in men's basketball, it is necessary to increase the technical and tactical aspects of the field-goals process in training, as well as the defensive aspect of the rebounds and steals.

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STATISTIKA IGRE KOJA RAZLIKUJE POBJEDNIČKE I GUBITNIČKE TIMOVE ŠPANJOLSKE MUŠKE PROFESIONALNE KOŠARKAŠKE LIGE

SAŽETAK

Svrha ove studije je bila analizirati muška košarkaška natjecanja, pokušavajući identificirati statistiku igre koja dozvoljava da se razlikuju pobjednički i gubitnički timovi. Uzorak je činilo 306 igara redovite sezone španjolske muške profesionalne lige iz 2004./2005. godine. Napravljena je sljedeća statistika igre: koševi od 2 i 3 boda (uspješni i neuspješni), slobodna bacanja (uspješna i neuspješna), ofenzivni i defenzivni skokovi, blokade, asistencije, prekršaji, izgubljene i ukradene lopte. Podaci su analizirani u dvije skupine: izjednačene igre (konačni rezultat je isti ili je razlika manja od 12 bodova) i neizjednačene igre (razlika u konačnom rezultatu veća od 12 bodova). Diskriminantna analiza dozvoljava da se zaključi sljedeće: (i) u izjednačenim igrama varijabla koja najbolje razlikuje obje grupe su defenzivni skokovi; (ii) u neizjednačenim igrama varijable koje razlikuju obje grupe su uspješni koševi (koji nose dva boda), defenzivni skokovi i

asistencije; (iii) u svim igrama, statistička analiza je identificirala dvije varijable koje razlikuju pobjedničke i gubitničke timove (defenzivni skokovi i asistencije). Defenzivni skokovi bili su jedina za igru značajna statistika koja ukazuje na razlike u obje grupe u svim izvedenim analizama. Treneri i igrači trebali bi biti svjesni ovih različitih vrijednosti kako bi povećali znanje o spoznajnim i motoričkim poticajima igre i, tako, povećali specifičnost u razdoblju treniranja i planiranja igre.