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Research article

Game related statistics which discriminate between winning and losing under-16 male basketball games

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Abstract

The aim of the present study was to identify the game-related statistics which discriminate between winning and losing teams in under-16 years old male basketball games. The sample gathered all 122 games in the 2004 and 2005 Under-16 European Championships. The game-related statistics analysed were the free-throws (both successful and unsuccessful), 2- and 3-points field-goals (both successful and unsuccessful) offensive and defensive rebounds, blocks, assists, fouls, turnovers and steals. The winning teams exhibited lower ball possessions per game and better offensive and defensive efficacy coefficients than the losing teams. Results from discriminant analysis were statistically significant and allowed to emphasize several structure coefficients (*SC*). In close games (final score differences below 9 points), the discriminant variables were the turnovers (*SC* = -0.47) and the assists (*SC* = 0.33). In balanced games (final score differences between 10 and 29 points), the variables that discriminated between the groups were the successful 2-point field-goals (*SC* = -0.34) and defensive rebounds (*SC* = -0.36); and in unbalanced games (final score differences above 30 points) the variables that best discriminated both groups were the successful 2-point field-goals (*SC* = 0.37). These results allowed understanding that these players' specific characteristics result in a different game-related statistical profile and helped to point out the importance of the perceptive and decision making process in practice and in competition.

Key words: Basketball, game-statistics, notational analysis, winners, losers.

Introduction

The use of notational analysis with the scope of analysing performance in team sports has been identified in current research and is used by coaches to prepare the training process of players and teams (Hughes and Franks, 2004; Leite et al., 2009; Ortega et al., 2009; Shearer et al., 2007; Thomson et al., 2009). In basketball, the notational analysis throught game-related statistics and game indicators is very popular among coaches, however, only recently are available scientific research on the usefulness of these variables in characterizing and understanding game performances under different contexts (Gómez et al., 2009; 2010; Ibáñez et al., 2008; Sampaio and Janeira, 2003). This research allows understanding that basketball game performance, as analysed by game-related statistics, can be a reflection of teams' strategies and tactics within the games (Sampaio et al., 2004). In men's senior games, the differences between winning and losing teams are mainly accounted to defensive rebounds (Akers et al., 1991; Gómez et al., 2008; Ittenbach and Esters, 1995; Trninić et al., 2002) and 2-point field-goal percentages (Akers et al., 1991; Ittenbach et al., 1992; Trninić et al., 2002). In addition to these game-related statistics, other research has identified as important to winning basketball games the successful free throws (Ittenbach and Esters, 1995; Kozar et al., 1994; Pim, 1986; Sampaio and Janeira, 2003); the turnovers (Akers et al., 1991); the assists (Melnick, 2001) and the fouls (Pim, 1986). Current research indicates the discriminative game-related statistics of team performances vary according to several contextual factors such as game location (home and away), game type (regular season and playoff), game final score differences (close, balanced and unbalanced games), team gender (men and women), level of competition (Euroleague, National Basketball Association) and age (senior and junior). Regarding this last factor, the studies that analyse team's performance differences in formative years through game-related statistics are only available to U-18 year's teams and are quite scarce. For example, Ibáñez et al. (2003) studied the same championship and found that the differences between winning and losing teams were mainly accounted for defensive rebounds, successful free-throws and successful 2-point field-goals. Studying the 2000 European Championship, Dežman et al. (2002) found some defensive (offensive and defensive rebounds) and offensive (assists and 2 points field-goals) game-related statistics associated to game winners. In the same way, Lidor and Arnon (2000), analysed all the games from the 1994 European Championship for teams U-19 years of age, and found that the 2-point field-goal percentages can predict the final ranking of a team. More recently, Sampaio et al., (2004), studied the teams' performance differences by age throught game-related statistics, and their results showed that senior teams were differentiate from U-18 by a lower percentage of steals and by more assists. On the other hand, some authors (French and Thomas, 1987; Lidor and Arnon, 1997; Millslagle, 1988) pointed out the importance of perceptive and decision-making process when the studies are conducted on youth basketball players. Thus, according to these authors, the difference in U-18 teams' performance is probably determined by physical, phychological, tactical and technical factors that suggest the strategies and tactics used in the game.

From the available literature, no study was con-

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ducted on discriminating between U-16 winning and losing teams in international championships. These players' exhibit different anthropometric, physical and psychological characteristics and these facts imply the formulation of different strategies and tactics to win the games (Gerodimos et al., 2005). In fact, U-16 years of age teams represent the first international competition for basketball teams and this game analysis may allow understanding how these single characteristic teams achieve game success. Thus, the aim of the present study is to identify the game-related statistics that allow us to differentiate between U-16 winning and losing teams in close, balanced and unbalanced games.

Methods

Sample and variables

All 122 games in the 2004 (n = 61) and 2005 (n = 61) European Championships in U-16 were analyzed. Data was selected from the official boxscores of FIBA (International Basketball Federation). The following absolute game-related statistics were gathered: number of ball possessions, free-throws, 2 and 3 point field goals (both successful and unsuccessful), offensive rebounds, defensive rebounds, assists, steals, turnovers, blocks and committed fouls. Afterwards, the variables were normalized according to game ball possessions and multiplied by 100 (Sampaio and Janeira, 2003). This fact points out the imperative need of normalizing game statistics according to game rhythm due to game rhythm contamination, i.e. the simultaneous presence of fast and slow paced games throughout the season. 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. Ball possessions (BP) were calculated by Oliver's (2004) equation (BP= Attempted field goals – offensive rebounds + turnovers - 0.4 × Attempted free throws). Finally, the offensive (OE) and defensive efficiency (DE) were calculated using the same author's equation. (OE= points scored divided by ball possessions × 100; DE= points allowed divided by ball possessions × 100). Data reliability was tested to 10% of the sample and results were higher than 0.96.

Statistical analysis

A t-test for independent samples was carried out to identify univariate differences between the game-related statistics between winning and losing teams. Afterwards, the sample was divided into three groups using the cluster of k-means method to identify a cut-off value of point differences and classify the games (Norušis, 2004; Sampaio et al., 2010a; 2010b). This algorithm aims to classify your objects based on attributes into a K number of groups (Bishop, 1995). The grouping is done by minimizing the sum of squares of distances between data and the corresponding cluster centroid, which represent the arithmetic mean for each dimension separately over all the points in the cluster. The cluster analysis classified the games in three groups: 46% of the sample fit in the group with score differences equal or below 9 points (close games), 44% of the sample fit in to the group of games with final score differences between 10 and 29 points (balanced games), and 10% of the sample were classified in another group of games with final score differences above 30 points (unbalanced games). Subsequent analyses were performed for each of these three groups. A discriminant analysis was carried out to try to find those variables that best separate winning and losing teams (Ntoumanis, 2001). The structural coefficients (SC) identified the variables that best contribute to differentiating the group of game winners from the game losers. Relevant for the discrimination between groups was the SC above |0.30| (Tabachnick and Fidell, 2001). Validation of discriminant models was conducted using leave-one-out classification (Norušis, 2004), i.e. each case is classified by applying the classification function computed from all the data except the case being classified (Lachenbruch, 1975). Statistical significance was set to 5%.

Results

Descriptives results of the variables for winning and losing teams in all games are presented in Table 1 and 2. Winning teams had statistically significant differences ($p \leq 0.05$) from losing teams in OE, successful and unsuccessful 2 point field-goals, successful free-throws, defensive rebounds, assists, steals, turnovers, blocks and fouls.

Table 1. Descriptive results and univariate differences in all games. Values are means (±SD) and were normalized to game ball possessions and multiplied by 100.

	Winning teams	Losing teams
Offensive efficiency	99.4 (11.1)	81.7 (13.3) *
Defensive efficiency	89.8 (15.3)	90.4 (15.1)
2-pt successful	29.9 (6.5)	24.3 (5.8) *
2-pt unsuccessful	30.3 (8.3)	33.3 (8.2) *
2-pt percentage	49.9 (8.9)	42.4 (8.7)
3-pt successful	6.9 (3.3)	6.1 (3.6)
3-pt unsuccessful	15.4 (5.6)	16.4 (6.4)
3-pt percentage	31.0 (11.1)	26.8 (10.3)
Free-throws successful	18.5 (7.6)	14.5 (7.4) *
Free-throws unsuccessful	11.3 (5.1)	10.1 (5.5)
Free-throws percentage	61.5 (12.8)	58.2 (10.2)
Defensive rebounds	33.5 (6.7)	29.5 (6.3) *
Offensive rebounds	15.9 (5.6)	14.6 (5.7)
Assists	13.8 (5.1)	10.0 (5.0) *
Steals	14.5 (5.1)	12.2 (4.3) *
Turnovers	21.3 (5.3)	24.4 (6.9) *
Blocks	5.1 (3.5)	3.9 (2.9) *
Fouls	25.0 (6.1)	27.6 (6.5) *

* $p \leq 0.05$

The obtained discriminant functions were all statistically significant ($p \leq 0.05$) and they classified correctly 76% of the cases in close games, 93% of the cases in balanced games and 100% of the cases in unbalanced games.

Results from close games enhanced the importance of assists (SC = 0.33) and turnovers (SC = -0.47). However, in balanced games it was the defensive rebounds (SC = -0.36) and the successful 2 points field-goals (SC = -0.34) that discriminated both groups. In unbalanced games, only the successful 2 point field-goals (SC = 0.37) discriminated between winning and losingteams (Table 3). There was no discriminant game-related statistic common to all three analyses.

Table 2. Descriptive results and univariate differences in close, balanced, and unbalanced games from the European Championships. Values are means (±SD) and were normalized to game ball possessions and multiplied by 100.

	Close Games		Balanced Games		Unbalanced Games	
	Winners	Losers	Winners	Losers	Winners	Losers
2-pt field-goals						
Successful #†	27.5 (5.4)	26.4 (4.8)	30.6 (6.6)	23.8 (5.7)	36.1 (5.5)	18.5 (6.1)
Unsuccessful #†	32.5 (8.8)	32.0 (8.2)	29.1 (7.9)	34.1 (7.4)	26.8 (6.8)	34.8 (11.5)
%2	46.6 (8.4)	44.9 (6.9)	51.7 (6.4)	43.2 (8.9)	57.5 (5.4)	40.0 (8.3)
3-pt field-goals						
Successful	7.5 (3.3)	6.5 (3.3)	6.6 (3.3)	6.2 (4.1)	6.3 (2.8)	4.4 (2.5)
Unsuccessful	16.9 (6.2)	17.0 (6.6)	14.4 (5.1)	16.3 (6.6)	13.7 (3.9)	15.0 (4.1)
%3	46.6 (8.4)	24.2 (9.8)	28.7 (12.9)	29.6 (9.7)	28.1 (10.1)	18.6 (7.3)
Free-throws						
Successful #	17.4 (7.7)	16.0 (7.2)	19.5 (7.8)	13.4 (7.7)	18.1 (6.1)	13.5 (5.8)
Unsuccessful	10.8 (4.6)	9.5 (4.6)	11.7 (5.5)	10.2 (5.4)	11.1 (5.7)	12.3 (8.3)
%1	51.7 (14.8)	54.0 (17.1)	63.6 (9.2)	50.6 (17.6)	65.6 (12.3)	54.5 (15.2)
Rebounds						
Defensive rebounds #†	32.1 (6.2)	32.1 (5.8)	34.9 (6.6)	28.1 (5.1)	33.2 (8.1)	25.2 (8.4)
Offensive rebounds #	15.7 (5.8)	15.8 (6.1)	15.8 (5.7)	13.5 (5.0)	16.7 (4.3)	14.9 (6.3)
Offensive efficiency	91.3 (8.5)	82.8 (9.6)	98.3 (10.2)	78.8 (9.2)	109.4 (9.5)	73.5 88.2)
Defensive efficiency	91.5 (9.4)	82.1 (8.7)	98.2 (9.2)	76.6 (9.1)	107.0 (9.9)	70.9 (9.7)
Assists *#†	13.1 (5.2)	10.9 (5.2)	13.8 (4.7)	9.7 (4.8)	17.2 (5.4)	7.7 (3.7)
Steals #†	13.6 (4.7)	12.2 (4.3)	14.7 (4.9)	12.2 (4.3)	17.4 (6.1)	12.2 (4.6)
Turnovers *†	20.1 (5.5)	23.5 (6.2)	22.3 (5.1)	23.7 (6.9)	21.9 (4.8)	31.5 (6.1)
Blocks #	4.4 (3.1)	4.2 (2.9)	5.2 (3.6)	3.7 (2.8)	7.1 (4.2)	3.9 (3.7)
Fouls #	25.4 (5.6)	27.1 (6.3)	25.2 (6.4)	28.5 (6.9)	22.4 (6.2)	26.2 (5.9)

* $p \leq 0.05$ in close games; # $p \leq 0.05$ in balanced games; † $p \leq 0.05$ in unbalanced games.

Table 3. Discriminant Analysis Structure Coefficients (SC) from game-related statistics in close, balanced, unbalanced, and all games.

Game-related statistics	Close Games	Balanced Games	Unbalanced Games
Successful 2-pt field-goals#†	.18	-.34	.37
Unsuccessful 2-pt field-goals	.04	.20	-.10
Successful 3-pt field-goals	.23	-.03	.08
Unsuccessful 3-pt field-goals	-.01	.09	-.04
Successful free-throws	.15	-.24	.09
Unsuccessful free-throws	.23	-.08	-.02
Defensive rebounds #	-.01	-.36	.12
Offensive rebounds	-.01	-.13	.04
Assists*	.33	-.27	.25
Steals	.24	-.16	.12
Turnovers*	-.47	.07	-.22
Blocks	.07	-.15	.09
Fouls	-.21	.15	-.07
Eigenvalue	.38	2.56	17.19
Wilks' Lambda	.72	.28	.05
Canonical Correlation	.52	.84	.97
Chi-squared	31.7	139.3	52.2
Significance	<.05	<.01	<.01
Reclassification	76%	93%	100%

* SC discriminant value ≥|0.30| in close games; # in balanced games; † in unbalanced games.

Discussion

The purpose of this research was to identify the game-related statistics that differentiate winning and losing teams in U-16 basketball teams. Physical and technical performance differences should configure different game tactics and strategies, and necessarily be reflected in game-related statistics. The result from the average number of ball possessions of 78.2 ± 6.8 is higher than the 73.4 ± 2.7 for U-18 teams presented by Ibáñez et al. (2003). This difference may reflect the importance of shorter ball possessions, which is a characteristic of youth teams with a higher number of ball passes per game (Ortega et al., 2006a). The results also showed higher values in winning teams in OE (99.4 ± 11.1 vs. 81.7 ± 13.3) and in DE (89.8 ± 15.3 vs. 90.4 ± 15.1), which are lower than the EO value of 101.38 ± 15.62 and the DE of 101.95 ± 16.83 found by Ibáñez et al., (2003). These results may suggest that U-16 players make unforced or forced errors and cannot maintain possession, then it may generates more fast-break offenses and a higher game pace during the U-16 games.

In close games, winning teams had better values in turnovers and assists. On one hand, the turnovers are considered as a consequence of predominant systems of controlled style of play, therefore they may indicate a high teamwork, and a more experienced and physical players (Trninić et al., 2002). The controlled style of play reduce risks in resolving game situations because it increases collective play and reduces frequency of prime generators of turnovers, such as passing errors, player's losing balance due to inadequate foot-work or poor dribbling. In these games with a smaller point differential, the variables that best discriminate the groups are highlighted in such a way that the results of the winning teams can be inferred for different game strategies and tactics (Ibáñez et al., 2003; Sampaio and Janeira, 2003). Thus, the differences could be determined by the importance of offensive structures, with a higher percentage of set offences versus fastbreaks, spending more time and mores passes per possession trying to break more successfully the opposite defence (Ortega et al., 2007). Consequently, after these misses in offence the teams can lose a higher number of ball possessions (Dežman et al., 2002). Indeed, National teams' coaches should select the players with better technical and tactical characteristics trying to gain advantage in offensive and defensive phases. Finally, it is also re-

flected in these results the importance of factors such as perception, decision-making, and expertise in developing more consequent game actions, trying to make fewer steals against pressure defences, and getting more assists near the basket or with easy shots (French and Thomas, 1987; Millslagle, 1988). Lidor and Arnon (1997) 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.

In balanced games, winning and losing teams were discriminated by successful 2 point field-goals and defensive rebounds. This last 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, their drawing fouls play and their effectiveness in transition defence (Trninić et al., 2002). These differences could also be related to the anthropometric conditions in U-16 compared with other categories (Gerodimos et al., 2005), as well as comparing winning and losing teams, where the anthropometric and physical conditioning factors have a more important role, over another factors (Carter et al., 2005; Ortega et al., 2006b). For example, winning teams present taller and stronger players that secure more defensive rebounds, thus allowing making more fast-breaks (Sampaio and Janeira, 2003).

In unbalanced games, our results enhanced the importance of the successful 2-point field-goals (Akers et al., 1991; Ibáñez et al., 2003; Ittenbach et al., 1992). These results suggest better offensive organization in winning teams with better and faster decisions, which have consequences such as less time dribbling, more ball passes and fewer ball steals (Stavropoulos and Foundalis, 2005).

Conclusion

Globally, our results helped to understand how the basketball teams won the U-16 championships games and are useful in fulfilling a gap in the literature. It is here pointed out the importance of the perceptive and decision making process by youth and adult. In practical applications, the coaches could control some reference values from these variables to prepare practices according to competition demands.

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Key points

- The players' game-related statistical profile varied according to game type, game outcome and in formative categories in basketball.
- The results of this work help to point out the different player's performance described in U-16 men's basketball teams compared with senior and professional men's basketball teams.
- The results obtained enhance the importance of the perceptive and decision making process in practice and in competition.

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