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Team statistical determinants of victory in Brazilian basketball

Abstract

Aim: The present study aimed to identify the team variables that better determine victory in Brazilian basketball in a variety of game dynamics (close, even and disparate games).

Methods: Team statistics including: accuracy of free-throws, 2-point shots and 3-points shots, offensive and defensive rebounds, assists, steals and lost balls, violations and committed and received fouls during 182 games of the Brazilian National Basketball League were analyzed by Discriminant Analysis.

Results: Variables that determined overall victory were: defensive rebounds, assists, steals, committed and received fouls and 2-point, 3-point and free-throw accuracy. For disparate games, victory was determined by: defensive rebounds, assists, steals, 2-point, 3-points and free-throw accuracy. For even games, victory was determined by defensive rebounds, received fouls, assists, 2-points and 3-point accuracy. In contrast, no variables were able to identify victory for the close games.

Conclusion: The current results have identified the most important team variables for victory in a range of games.

Keywords: game dynamics, statistical analysis, basketball sporting success

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Introduction

Basketball is one of the most practiced sports in the world.[1] It is characterized as a collective, dynamic and complex sport,[2,3] reliant on game-specific technical and tactical actions.[1] Technical fundamentals include the skills of dribbling, passing, shooting and rebounding.[3] Tactical actions may be classified as being defensive, offensive or transitional based.[4] With increasing competition level, each successful skill and tactical action performed during the game becomes an important contributor to team success. The statistical analysis of such skills and actions has been previously performed during games within the Spanish League[5] with many skills/actions identified as significant factors for team success. For example, winning teams were distinguished from losing teams based upon 1-point (free-throw), 2-point and 3-point shooting accuracy, the number of missed shots secured by the defensive players (defensive rebounds), the total number of times a player assists a teammate scoring (assists), the number of times a ball is stolen from an opposing player (steals) and the number of rule infractions involving physical contact (fouls) completed by players.[6–10] Despite the important contribution of these studies, analyses have only been performed in games of the European national leagues. The dynamics of basketball games in other leagues throughout the world such as the Brazilian National League may be distinct and as such may differentially influence the game outcome (victory or defeat).

The statistical analyses of game performances have been identified as important for future sporting prowess as they help to:

A. Plan and organize the training process via more objective and specific content

B. Modulate learning, training and competition demands

C. Identify the factors inherent to the success within basketball competitions.[11]

Additionally, the importance of game dynamics within basketball has been identified as an important contributor to success.[8,9] For example, game dynamics have been classified by Sampaio[9] based upon the difference between the teams' final scores with disparate games (difference of more than 10 points between the teams), even games (difference between 6 and 10 points between the teams) and close games (difference of less than 6 points between the teams) examined. For disparate games, winning teams were discriminated from losing teams based upon 2 and 3 point shooting accuracy and the number of rebounds.[9] For even games, 2-point shooting accuracy and the defensive rebounds were the factors that determined victory.[9] Finally, for close games, the percentage of free-throw accuracy and the defensive rebounds were the variables that better distinguished the winning teams from the losing one's.[9] Similarly, Navarro and colleagues[12] reported that free-throw accuracy and defensive rebounds were determinant factors for victory in the last 5 minutes of regular game time or overtime for close games. While some studies have examined statistical determinants of winning for European based basketball, it still remains unclear as to which skills/actions predict victory in other basketball games and in particular games of various dynamics.

The aim of the present study was to identify the game skills/actions that determine victory in the Brazilian National Basketball League and whether these variables are influenced by game dynamics. Based on prior European studies,[11,12] 2-point and 3-point shooting accuracy and defensive rebounds were hypothesized to predict game success. Moreover, it was also hypothesized that predictive variables for game success would be significantly influenced by game dynamics (i.e. disparate, even and close games). The identification of these discriminatory variables for basketball would help coaches, trainers and players in planning technical and tactical emphasis during training in the pursuit of team success.

Materials and methods

Sample

All 182 games played by 14 teams during the 2nd edition of the New Brazil Basketball (NBB2) 2009/2010 season were examined with the official league data provided by expert professionals of the Brazilian League following each game.

Procedure

Initially, the data from each game was downloaded from the NBB2 website, the official site of the Brazilian National League. The following variables of each basketball game were examined: free-throw, 2-point and 3-point shot (attempted and accuracy); defensive and offensive rebounds assists; steals and lost balls (balls that were stolen by the opponents); violation (rule infractions that do not involve player contact) and committed and received fouls.

To account for games that had varying number of ball possessions, variables (except for shot accuracy) were normalized in terms of the number of ball possessions.[2,12] This normalization was performed by the multiplication of each dependent variable of interest by 100 and subsequently dividing this result by the number of ball possessions during the game of the respective team. Ball possession (BP) was calculated according to the equation proposed by Oliver (12): BP = Attempted Shots - Offensive Rebounds + Violations - 0.4 x Attempted Free-throws.

Classification of game dynamics was based upon the final scores of the games[8,9] as follows:

A. "disparate games", in which final scores of teams were different by >10 points

B. "even games", in which the final scores of teams were within 6-10 points

C. "close games" in which the final scores of the teams were within <6 points

Statistical analysis

Firstly, the parametric assumptions of normality, homogeneity, and homogeneity of the covariance matrix and co linearity of the data were assessed using the Kolmogorov-Smirnov, Bartlett, Box-M and VIF tests, respectively. Subsequently, a Discriminant Function Analysis was performed to identify the technical skills and actions of the game to distinguish victory from defeat of each game per game dynamic classification. The statistical analyses were performed using SPSS (v.17.0) with the significance level set at 5% ($P<0.05$). Data are presented as mean and standard deviation, where appropriate.

Results and discussion

Discriminant Analysis to distinguish winning and losing teams

Table 1 shows the incidence of all analyzed variables during each game of the 2009/2010 season. The discriminant analysis presented only one canonical function (*Wilks Lambda*=0.60; X^2=179.38; $P<0.001$) that was able to distinguish between the teams that won with those that lost. This canonical function also identified the contributing variables (F=1.362; $P<0.001$) as: defensive rebounds, assists, steals, committed and received fouls and 2-point, 3-point and free-throw shot accuracy (Table 1). The contribution/weight of each dependent variable was greatest for defensive rebounds (r=0.481; $P<0.05$), followed by assists (r=0.452; $P<0.05$), 3-point (r=0.446; $P<0.05$), 2-point (r=0.353; $P<0.05$) and free-throw (r=0.264; $P<0.05$) shot accuracy. The contributions of all other variables were weak and non-significant ($r<0.180$, $P>0.05$).

Table 1 Mean (standard deviation) incidence of each game variable and variables identified by the Discriminant Analysis, for teams 'winning', 'losing' and 'all games' for all games during the 2009/2010 Brazilian Men's National League

Variables	Winning Team	Losing Team	All games teams	Wilks Lambda	F	Significance
3-point shoots	30.86 (7.77)	31.75 (8.65)	31.30 (8.22)	0.996	1.33	P=0.249
2-point shoots	48.37 (6.49)	48.36 (10.09)	48.36 (9.83)	1	0.03	P=0.871
Free-throws attempted	28.91 (9.90)	26.26 (9.46)	27.59 (9.76)	0.979	7.67	P=0.006
3-point shot accuracy (%)	39.74 (10.89)	31.87 (10.60)	35.80 (11.43)	0.881	48.66	P<0.001
2-point shot accuracy (%)	59.18 (10.17)	53.04 (8.59)	56.11 (9.89)	0.946	20.77	P<0.001
Free-throws accuracy (%)	74.35 (11.63)	68.98 (12.27)	71.67 (12.24)	0.979	7.67	P=0.006
Offensive rebounds	12.10 (5.21)	12.47 (4.75)	12.29 (4.98)	0.999	0.49	P=0.484
Defensive rebounds	30.30 (6.05)	25.95 (5.65)	28.12 (6.24)	0.878	50.15	P<0.001
Assists	20.55 (7.00)	15.96 (6.15)	18.25 (6.29)	0.891	44.26	P=0.001
Steals	10.30 (4.00)	9.24 (4.12)	9.77 (4.09)	0.983	6.27	P=0.013
Lost balls	13.00 (4.79)	13.83 (4.78)	13.41 (4.81)	0.993	2.72	P=0.100
Received fouls	25.00 (4.95)	23.75 (5.44)	24.38 (5.23)	0.982	6.51	P=0.011
Committed fouls	24.95 (5.19)	26.34 (5.19)	25.64 (5.23)	0.986	5.27	P=0.022
Violations	3.35 (2.56)	3.30 (2.30)	3.32 (2.43)	1	0.04	P=0.846

Citation: Carvalho EMO, Leicht AS, Nakamura FY, et al. Team statistical determinants of victory in Brazilian basketball. *MOJ Sports Med.* 2017;1(4):70–75. DOI: 10.15406/mojsm.2017.01.00018

Discriminant Analysis to distinguish 'winning' and 'losing' teams per game dynamic category

The descriptive for each variable of the disparate, even and close games are presented in Tables 2, 3 and 4, respectively. Approximately 42.8% of the games were classified as disparate, while 24.7% of games were classified as even and 32.4% of games classified as close.

The Discriminant analysis showed only one canonical function (*Wilks Lambda*=0.30; X^2=178.61; P<0.001) that was able to distinguish between winning and losing teams for the disparate games. This canonical function identified the contributing variables (F=1.362; P<0.001) as: defensive rebounds, assists, steal and 3-point, 2-point and free-throw shot accuracy (Table 2).

Table 2 Mean (standard deviation) incidence of each game variable and the variables identified by the Discriminant Analysis, for teams winning, losing and all games for disparate games during the 2009/2010 Brazilian Men's National League

Variables	Winning Team	Losing team	All games	Wilks Lambda	F	Significancee
3-point shoots	30.66 (7.85)	30.20 (8.50)	30.43 (8.16)	0.999	0.13	P=0.724
2-point shoots	47.44 (7.26)	48.28 (8.13)	47.86 (7.69)	0.997	0.46	P=0.497
Free-throws	28.64 (7.83)	26.31 (8.31)	27.47 (8.13)	0.979	3.25	P=0.074
3-point shot accuracy (%)	43.12 (11.54)	28.73 (10.58)	35.92 (13.18)	0.77	65.88	P<0.001
2-point shot accuracy (%)	62.55 (9.43)	52.26 (8.51)	57.40 (10.33)	0.75	51.26	P<0.001
Free-throws accuracy (%)	74.41 (12.39)	66.95 (13.13)	70.68 (13.26)	0.92	13.33	P< 0.001
Offensive rebounds	11.36 (5.06)	12.02 (4.65)	11.69 (4.85)	0.995	0.71	P=0.400
Defensive rebounds	31.58 (6.58)	24.58 (4.94)	28.08 (6.78)	0.732	56.38	P<0.001
Assists	22.79 (7.35)	14.53 (6.11)	18.66 (7.91)	0.726	58.21	P<0.001
Steals	10.78 (3.81)	8.82 (3.94)	9.80 (3.98)	0.939	10.01	P=0.002
Lost balls	13.26 (5.03)	14.55 (4.85)	13.90 (4.97)	0.983	2.65	P=0.105
Received fouls	23.89 (4.80)	22.94 (5.16)	23.42 (4.99)	0.989	1.73	P=0.190
Committed fouls	24.32 (4.80)	25.35 (4.98)	24.83 (4.89)	0.991	1.42	P=0.235
Violations	2.82 (2.64)	3.22 (2.29)	3.02 (2.47)	0.994	0.99	P=0.321

Table 3 Mean (standard deviation) incidence of each game variable and variables identified by the Discriminant Analysis, for teams winning, losing and all games during the seven games of the 2009/2010 Brazilian Men's National League

Variables	Winning team	Losing team	All games	Wilks' lambda	F	Significance
3-point	29.62 (7.06)	31.90 (7.79)	30.76 (7.48)	0.977	2.1	P=0.150
2-point	50.26 (8.53)	50.10 (9.40)	50.18 (10.33)	1	0.01	P=0.936
Free-throws	27.91 (8.97)	24.42 (9.05)	26.17 (9.13)	0.963	3.37	P=0.070
3-point accuracy (%)	36.78 (10.05)	31.71 (10.09)	34.24 (10.33)	0.939	5.69	P=0.019
2-point accuracy (%)	57.76 (8.69)	52.40 (7.35)	55.08 (8.44)	0.898	9.96	P=0.002
Free-throw accuracy (%)	76.47 (10.85)	68.56 (9.35)	72.51 (10.83)	0.865	13.72	P<0.001
Offensive rebounds	12.28 (5.09)	13.38 (5.73)	12.83 (5.41)	0.989	0.94	P=0.334
Defensive rebounds	30.97 (5.26)	27.29 (5.70)	29.13 (5.76)	0.897	10.09	P=0.002
Assists	19.29 (5.82)	15.84 (4.49)	17.56 (5.45)	0.899	9.93	P=0.002
Steals	10.01 (4.32)	8.74 (4.61)	9.38 (4.49)	0.98	1.82	P=0.181
Lost balls	12.22 (4.89)	13.14 (4.70)	12.68 (4.79)	0.991	0.82	P=0.368
Received fouls	25.72 (5.22)	23.17 (5.79)	24.44 (5.63)	0.972	2.49	P=0.118
Committed fouls	25.12 (5.70)	26.99 (5.57)	26.06 (5.68)	0.948	4.8	P=0.031
Violations	3.40 (2.07)	3.60 (2.43)	3.50 (2.25)	0.998	0.16	P=0.685

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Table 4 Mean (standard deviation) incidence of each game variable and variables identified by the Discriminant Analysis, for teams winning, losing and all games during the close games of the 2009/2010 Brazilian Men's National League

Variables	Winning team	Losing team	All games	Wilks' lambda	F	Significance
3-point	31.51 (6.37)	33.22 (6.99)	32.37 (6.71)	0.984	1.924	P=0.168
2-point	47.11 (8.45)	46.55 (8.42)	46.83 (8.41)	0.999	0.127	P=0.722
Free-throws	28.47 (8.52)	26.69 (8.25)	27.58 (8.40)	0.989	1.326	P=0.252
3-point accuracy (%)	37.54 (9.47)	36.14 (9.65)	36.84 (9.55)	0.995	0.693	P=0.426
2-point accuracy (%)	55.80 (10.92)	54.56 (9.48)	55.18 (10.20)	0.996	0.432	P=0.512
Free-throw accuracy (%)	72.66 (11.07)	72.00 (12.63)	72.33 (11.83)	0.999	0.091	P=0.763
Offensive rebounds	12.95 (5.43)	12.37 (3.99)	12.66 (4.75)	0.996	0.444	P=0.506
Defensive rebounds	28.09 (5.30)	26.74 (6.18)	27.42 (5.77)	0.986	1.629	P=0.204
Assists	18.55 (6.60)	17.93 (6.82)	18.24 (6.69)	0.998	0.256	P=0.614
Steals	9.89 (4.00)	10.17 (3.85)	10.03 (3.91)	0.999	0.148	P=0.701
Lost balls	13.25 (4.39)	13.41 (4.76)	13.33 (4.56)	1	0.035	P=0.852
Received fouls	25.93 (4.71)	25.27 (5.31)	25.60 (5.01)	0.979	2.455	P=0.120
Committed fouls	25.65 (5.31)	27.14 (5.04)	26.40 (5.21)	0.996	0.512	P=0.476
Violations	4.01 (2.67)	3.18 (2.23)	3.59 (2.48)	0.972	3.285	P=0.073

For even games, the Discriminant Analysis showed only one canonical function (*Wilks Lambda* =0.45; X^2=65.87; P<0.001) with the following contributory variables (F=1.362; P<0.001): defensive rebounds, committed fouls, assists, free-throw attempted and free-throw, 2-point and 3-point shot accuracy (Table 3). The Discriminant Analysis only presented one canonical function for the close games that was not able to distinguish between the winning and losing teams (*Wilks Lambda*=0.86; X^2=16.36; P=0.230) with no identification of game variables (F=1.362; P<0.001; Table 4).

Determinant variables for victory in basketball games

The current study has demonstrated that game victory during a season of elite basketball competition can be predicted by 2-point, 3-point and free-throw shot accuracy, defensive rebounds, assists, steals, committed fouls and received fouls. In line with our hypothesis, shot accuracy and defensive rebounds were significant contributors to game success and similar to that observed in European based basketball.[9,12] Uniquely though, the current study has identified other important skills that contribute to team success with these providing direction to coaches and athletes for training and ultimately game success. Several authors[8–10] have reported a significant association between 2-point shot accuracy and winning most likely due to the fundamental need to score more than the opposition to win the game. Moreover, the greater reliance on 2-point shot accuracy for winning most likely reflects the greatest shooting attempts within a game of basketball with about 55.2% 2-point shots performed compared to 19.8% 3-point and 25% free-throw in elite competition.[1] Similarly, 3-point shot accuracy has also been identified as a differential factor between victory and loss in a basketball game.[11]Compared to 2-point shot accuracy, 3-point shot accuracy was a lower determinant of winning in the current study as this factor exhibits lower rates of efficacy[1] due to its fixed and longer shooting range (minimum of 6.25 m from the basket).[13] Despite this lower efficacy, the 3-point shot results in a greater score which may compensate its lower rate of success if successful many times. According to Sampaio,[9] greater possibility of scoring more points (3 points instead of 2 or 1) per shot increases the number of points per ball possession and overall score, thus increasing the chances of game success. Further, good 3-point shot accuracy compels the opposing team to adjust its defensive actions that may cause weaknesses closer to the basket, more space between opposing players, less defensive pressure within the restricted area near the basket and a greater chance of scoring 2-points.[9]

While 2- and 3-point shot accuracy have been identified for game success in the current study, free-throw shot accuracy has been indicated as one of the more important determinants for game victory.[9,12] Free-throws result from a player foul during the performance of a shot or when a team exceeds the foul threshold (i.e. 4 per quarter). Subsequently, free-throw accuracy for game success may reflect:

A. The losing teams' inconsistent defense due to a lack of physical/technical/tactical skills

B. The winning teams' aggressive offense that demands great defensive effort to neutralize plays.

Therefore, team's acquisition of fouls rather than causing them may be beneficial leading to a greater free-throw attempts and accuracy for greater team points and eventual victory.[1] In addition to shooting accuracy the defensive rebound has been the fundamental skill identified more than any other in prior basketball studies examining winning and losing teams.[8,11,12,14] Acquiring as many defensive rebounds as possible is essential for two main reasons:

A. All rebounds originate from unsuccessful shots and therefore limits the opposition's scoring

B. Rebounds provide the defending team with a new ball possession to attack and score points.

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Therefore, acquisition of defensive rebounds allows a team to control the scoring opportunities for both teams within a game and therefore a greater impact on final scores and ultimately game success. In line with greater scoring opportunities, greater assists have also been identified as important for game success in basketball.[7,8,10,14] This technical variable is right related to both fundamentals skills of, passing and shooting. Successful passing immediately prior to a shot is a key player skill for basketball and provides better conditions for increased shot accuracy. Thereby, players providing better scoring opportunities via assists in conjunction with superior shooting accuracy will contribute to game success. Assists can also be developed from steals with this technical skill described as a differential factor for victory in basketball games.[7,15] The ability to steal a ball typically reflects a greater tactical defensive ability than the opposition and an opportunity for a counter attack and offensive play. Such opportunities may provide a greater numerical superiority in offense that can lead to potentially greater shooting attempts, accuracy and final score for game success.

Determinant variables for the games victories, in function of the games' dynamics

While a number of technical skills have been identified, the game dynamics were also hypothesized to influence game success with varying levels observed in the current study. Several technical skills were predictive for winning teams during disparate (defensive rebounds, assists, steals, 2-point, 3-point and free-throws shot accuracy) and even (defensive rebounds, assists, received fouls, 2-point and 3-point shot accuracy) games.

Previously, Sampaio[9] and Xu, Zhang and Jia,[15] indicated that greater 2- and 3-point shot accuracy and the greater number of offensive rebounds acquired, were related to victory in disparate games. In the present study, shot accuracy and rebounds were acknowledged to be determinant for game success of both disparate and even games. Thus, coaches and players should concentrate on these important factors for game success in a wide range of game dynamics.

Similar to the current results, assists and steals were also reported be related to game success in disparate games.[5] These results reinforce the importance and dominance of the teams' tactical organization for game success. Another variable that distinguished winning teams from losing teams was free-throw shot accuracy.[9,12] Interestingly, this variable was predictive for winning disparate and even games but not close games. This is contradictory to anecdotal beliefs of players and coaches that free-throw accuracy determines the winning of close games. Further, it may suggest that those other factors identified in the current study are more important for winning close games and those current beliefs about winning close games require further examination. For close games, no variables were able to distinguish between winning and losing teams. In contrast, defensive rebounds and free-throw shot accuracy have been reported to help with game success.[12] Leite[8] suggested that the greater occurrence of games decided by narrow margins indicated similar competitive levels of the teams. Therefore, results of the present study suggest that game success in close games is dependent upon very small differences, possibly physical conditioning, tactical training and psychological aspects, as both teams may exhibit similar performance levels. Physical conditioning may be a decisive factor in elite sports[16,17] with athletes able to apply their technical and tactical performances in a greater manner, particularly at the most important times near the end of a game.[18,19] Further, tactical training may assist teams to control the game dynamics[1,20] through better psychological control[4,15] including decision making during highly stressful situations[21] such as the end of close games. Alternatively, winning close games may depend more on chance or a few time-specific plays rather than skills over an entire game. Therefore, the current results may indicate that player and coaches should train for and plan games so that they are not close as success outcome may be rather random and not predictable based on the current game statistics.

Conclusion

The primary determinants for game success in Brazilian basketball games were the defensive rebounds, assists, steals, committed and received fouls and 2-point, 3-point and free-throw shot accuracy. Development of training for these variables may assist coaches and players for game success during an elite, national competitive season. Game dynamics were observed to influence game success with defensive rebounds, assists, steals and 3-point, 2-point and free-throws shot accuracy important for disparate games; defensive rebounds, received fouls, assists and 3-point, 2-point and free-throws shot accuracy were important for even games. The lack of association between technical skills and success for close games suggests that tactical, physical and psychological preparation might determine the final result more so than technical skills alone. Subsequently, coaches and players should train for these aspects to increase success over a season where approximately 32% of games are close.

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Conflict of interest

Authors declare there is no conflict of interest in publishing the article.

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