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Investigating the game-related statistics and tactical profile in NCAA division I men's basketball games

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ABSTRACT: The aim of this study was to analyze the game-related statistics and tactical profile in winning and losing teams in NCAA division I men's basketball games. Twenty NCAA division I men's basketball close (score difference: 1-9 points) games were analyzed during the 2013/14 season. For each game, the game-related statistics were collected from the official teams' box scores. Number of ball possessions, offensive and defensive ratings and the Four Factors (effective field goal percentage; offensive rebounding percentage, recovered balls per ball possession, free throw rate) were also calculated. The tactical parameters evaluated were: ball reversal, dribble in key area, post entry, on-ball screen, off-ball screen, and hand off. Differences between winning and losing teams were calculated using a magnitude-based approach. Winning teams showed a likely higher percentage of 3-point goals made, number of defensive rebounds and steals and a very likely higher number of free throws made and free throws attempted. Furthermore, winning teams showed a likely higher team offensive rating and effective field goal percentage and a very likely higher free throw rate compared to losing teams. Finally, the results revealed a likely higher number of ball reversals and post entries in winning teams compared to losing teams. This study highlighted the game-related statistics and the tactical actions differentiating between winning and losing teams in NCAA Division I men's basketball close games. Coaches should use these results to optimize their training sessions, focusing on those variables that might increase the possibility to win close games.

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INTRODUCTION

Basketball is a court-based sport characterized by intermittent high-intensity efforts [1, 2]. During basketball games, players are repeatedly required to perform rapid specific movements in association with unique technical actions according to specific tactics [1]. The application of sport science to basketball settings has recently grown, leading to an increased number of investigations quantifying the players' technical and tactical demands during games. Previously, several studies have investigated the basketball game-related statistics discriminating between winning and losing teams in basketball [3-5]. In this regard, defensive rebounds and assists have been identified as the game-related statistics that most differentiate between winning and losing teams in Spanish men's professional teams [3]. In a recent study, Dogan et al. [4], through a discriminant analysis, showed that assists (SC=0.532), steals (SC=0.552), defensive rebounds (SC=0.482), turnovers (SC=0.473) and offensive rebounds (SC=0.336) were the game-related statistics that were significant for team success in the Turkish Basketball League. These parameters have been suggested to provide a global view on the evaluation of a team's efficacy. However, it has been suggested that related variables may allow more accurate predictions of team success [6]. Specifically, the integration of offensive and defensive ratings as well as the "Four Factors" (effective field-goal percentage, turnover rate, offensive rebounding percentage, and free throw rate) approach into game-related statistical analyses of team performance has been recommended [7]. These parameters have been shown to discriminate between winning and losing teams in the Australian National Basketball League (NBL) [8] and in the 2010 World Basketball Championship games [9].

While several studies have focused on the game-related statistics discriminating between winning and losing teams in basketball games,

tactical parameters have been less investigated. Previous studies have highlighted the importance and the effectiveness of fast break actions in basketball games as discriminating factors between winning and losing teams [10, 11]. However, most of the ball possessions are played with set offense actions [11, 12], and the importance of an "inside-outside" game in National Basketball Association (NBA) games has been demonstrated [13]. Klusemann and his colleagues [14] categorized six tactical parameters—ball reversal, dribble penetration into the key area, post entry, on-ball screen, hand-off, and off-ball screen—aiming to assess the tactical profile of an Australian elite male junior basketball team during tournament and seasonal basketball competitions. The results of this study indicated a likely greater number of ball reversals and a possible greater number of dribble penetrations into the key area during seasonal games. However, these six tactical parameters, to the best of our knowledge, have not yet been investigated as possible discriminating factors between winning and losing teams. It seems fundamental to assess whether there is a possible difference between winning and losing teams in terms of playing game style. Collectively these studies provided useful information for basketball coaches regarding game-related statistics, their related variables and tactical profile in several championships played with the rules of the International Basketball Federation (FIBA), making it difficult to accurately compare them with games played with different rules and regulations such as college basketball.

College basketball is highly competitive and played between teams of university students in the United States. A previous investigation analyzed the performance profile of college basketball games, showing that it is characterized by short live time phases (i.e. 80% of them lasted up to 1 min) and with a live/stoppage time ratio of ~ 1 [2]. College basketball in the United States is regulated by the National Collegiate Athletic Association (NCAA) and entails different rules compared to FIBA championships such as different shot clock duration [35 s and 30 s (before and after the 2015/2016 season, respectively) vs. 24 s] and time allowed to advance the ball across the midcourt line (10 s vs. 8 s). Moreover, NCAA basketball games are composed of two halves of 20-min duration separated by a 15-minute break, while FIBA games are composed of four quarters of 10-min duration with a 10-min break between the second and third quarter and a 2-min break between the first and the last two quarters. These rule differences may lead to a different playing style, making the analysis of game-related statistics and tactical variables warranted in NCAA basketball games. Thus, the aim of this study was to analyze the game-related statistics and tactical profile in winning and losing teams in NCAA division I men's basketball games.

MATERIALS AND METHODS

Participants

This study was approved by an institutional review board, and meets the ethical standards in sports and exercise science research [15]. Twenty NCAA division I men's basketball games were analyzed during the 2013/2014 season. Only close games were selected, with a score difference ranging from 1 to 9 points [16], and each team was evaluated once.

Methodology

According to the NCAA basketball rules, the analyzed games consisted of two 20-min halves separated by a 15-min break period. All games were valid to achieve the best possible ranking position in the NCAA conferences, the winner of which receives an automatic bid to the national championship tournament. All data were recorded and analyzed at the end of the studied season.

For each game, the game-related statistics were collected from the official teams' box scores. The following game-related statistics were considered: field goals made (number and percentage), field goals attempted, 3-point goals made (number and percentage), 3-point goals attempted, free throws made (number and percentage), free throws attempted, offensive rebounds (number and percentage), defensive rebounds (number and percentage), total rebounds, personal fouls, assists, turnovers, blocks, and steals.

Number of ball possessions, offensive and defensive ratings, and the Four Factors were also calculated from game-related statistics values according to previous literature [7], as shown in Table 1.

TABLE 1. Game indicators and their respective formulas.

Indicator	Formula
Number of ball possessions	Field goal attempted – offensive rebounds + turnovers + 0.4* free throws attempted
Team's offensive rating	Points scored/ball possessions
Team's defensive rating	Points allowed/ball possessions
Effective field goal percentage	(Field goals made + 0.5* 3-point field goals made)/ field goals attempted
Offensive rebounding percentage	Offensive rebounds / (offensive rebounds + opponent's defensive rebounds)
Recovered balls per ball possession	(Steals + blocked shots + opponent's turnover)/ball possessions
Free throw rate	Free throws made / field goals attempted

Tactical parameters were assessed via notational analysis technique. The videos of the games were downloaded from a public website (https://corp.synergysportstech.com/) and were analyzed by two experienced video analysts using the software Kinovea (version 0.8.15; www.Kinovea.org). This software has already been adopted in the literature for the analysis of technical, tactical and physical parameters in basketball [17]. The tactical parameters evaluated were: ball reversal, dribble in key area, post entry, on-ball screen, off-ball screen, and hand off. Each parameter was previously defined in the literature and quantified as the number of offensive tactical elements within a game [14]. Each observer analyzed five half games twice at least a month apart and the relative and absolute reliability were calculated using the intraclass correlation coefficient (ICC) and coefficient of variation (CV), respectively. The results showed good test-retest relative (ICC= 0.87-0.98) and absolute (CV= 2-4%) reliability.

Statistical analysis

A magnitude-based approach was used to assess the chance of a true difference (i.e. greater than the smallest worthwhile change) between winning and losing teams in game-related statistics, their related variables, and tactical parameters. All data were log-transformed for analysis to reduce bias arising from non-uniformity error and then analyzed for practical significance using magnitude-based inferences on a modified statistical spreadsheet [18]. Data were expressed as mean ± SD, percentage mean difference and effect size with their 90% confidence intervals between conditions. The smallest worthwhile change was calculated as a standardized small effect size (0.2) multiplied by the between-athlete SD. Chances of real differences in variables were assessed qualitatively as <1%, almost certainly not; 1-5%, very unlikely; 5-25%, unlikely; 25-75%, possibly; 75-95%, likely; 95-99%, very likely; and >99%, most likely. Clear effects greater than 75% were considered substantial [19]. If the chances of a variable having higher and lower differences were both >5%, the true effect was deemed to be unclear. Effect sizes of <0.20, 0.20–0.59, 0.60–1.19, 1.20–1.99 and >2.00 were considered trivial, small, moderate, large, and very large, respectively [19].

RESULTS

The differences in game-related statistics between winning and losing teams are shown in Table 2. Winning teams showed a likely higher percentage of 3-point goals made [ES: -0.44 (CI: -0.96; 0.08)], number of defensive rebounds [ES: -0.49 (CI: -1.01; 0.03)] and steals [ES: -0.52 (CI: -1.04; 0.01)] and a very likely higher number

TABLE 2. Game-related statistics for winning and losing teams expressed as mean ± standard deviation (SD), percentage (%) mean difference and effect size (ES) with their 90% confidence intervals (CI) and magnitude-based inference.

Game Related Statistics	Winning teams	Losing Teams	% Mean difference (90% CI)	ES (90% CI)	Magnitude-based Inference
Field Goal Made	25.2 ± 4.9	24.5 ± 4.7	-0.7 (-3.3; 1.9)	-0.14 (-0.66; 0.39)	Unclear (14/44/42)
Field Goal Attempt	55.1 ± 7.1	57.9 ± 10.0	2.8 (-1.9; 7.4)	0.29 (-0.24; 0.81)	Unclear (61/33/6)
% Made field goal	46.0 ± 8.9	42.8 ± 8.5	-3.2 (-7.8; 1.5)	-0.35 (-0.87; 0.17)	Possibly -ive (4/27/69)
3pt Made	7.1 ± 3.4	6.9 ± 2.9	-0.3 (-1.9; 1.4)	0.00 (-0.52; 0.52)	Unclear (26/48/26)
3pt Attempted	18.0 ± 7.3	20.3 ± 5.3	2.3 (-1.1; 5.7)	0.44 (-0.08; 0.96)	**Likely** +ive (78/20/2)
% 3pt Made	39.6 ± 12.0	34.3 ± 12.9	-5.2 (-11.9; 1.4)	-0.44 (-0.96; 0.08)	**Likely** -ive (2/20/78)
Free Throw Made	18.5 ± 4.9	14.6 ± 3.8	-4.0 (-6.3; -1.6)	-0.86 (-1.38; -0.34)	**Very likely** -ive (0/2/98)
Free Throw Attempted	25.7 ± 6.4	20.2 ± 5.3	-5.6 (-8.7; -2.4)	-0.90 (-1.42; -0.38)	**Very likely** -ive (0/1/99)
% Made Free Throw	72.3 ± 9.4	73.0 ± 10.3	0.7 (-4.5; 5.9)	0.05 (-0.47; 0.57)	Unclear (32/47/21)
Offensive Rebound	11.8 ± 5.5	11.1 ± 4.9	-0.7 (-3.4; 2.1)	0.05 (-0.58; 0.47)	Unclear (21/47/32)
Defensive Rebound	24.7 ± 5.4	22.0 ± 3.9	-2.8 (-5.3; -0.2)	-0.49 (-1.01; 0.03)	**Likely** -ive (2/16/82)
Total Rebound	36.5 ± 9.0	33.0 ± 7.7	-3.5 (-7.9; 1.0)	-0.38 (-0.90; 0.15)	Possibly -ive (4/25/71)
% Offensive Rebound	31.3 ± 9.6	32.4 ± 7.6	1.1 (-3.5; 5.8)	0.21 (-0.31; 0.73)	Unclear (51/39/10)
% Defensive Rebound	68.7 ± 9.6	67.6 ± 7.6	-1.1 (-5.8; 3.5)	-0.11 (-0.63; 0.42)	Unclear (16/45/38)
Personal Foul	17.7 ± 2.3	21.3 ± 4.3	3.6 (1.7; 5.5)	0.93 (0.41; 1.46)	**Very Likely** +ive (99/1/0)
Assist	14.0 ± 5.4	11.8 ± 4.2	-2.2 (-4.7; 0.4)	-0.40 (-0.92; 0.13)	Possibly -ive (3/23/74)
Turnover	11.7 ± 4.4	11.2 ± 3.7	-0.5 (1.7; 2.2)	-0.01 (-0.54; 0.51)	Unclear (25/48/28)
Block	3.5 ± 3.1	3.7 ± 2.3	0.2 (-1.3; 1.7)	0.49 (-0.06; 1.05)	**Likely** +ive (81/17/2)
Steal	6.1 ± 2.6	4.9 ± 2.8	-1.2 (-2.7; 0.3)	-0.52 (-1.04; 0.01)	**Likely** -ive (1/14/84)

of free throw made [ES: -0.86 (CI: -1.38; -0.34)], and free throws attempted [ES: -0.90 (CI: -1.42; -0.38)]. Losing teams showed a likely higher number of 3-point goals attempted [ES: 0.44 (CI: -0.08; 0.96)] and blocks [ES: 0.49 (CI: -0.06; 1.05)] and a very likely higher number of personal fouls [ES: 0.93 (CI: 0.41; 1.46)]. No differences were observed for the other game-related statistics.

Considering the analysis of the related variables, winning teams showed a likely higher team offensive rating (the same result for team defensive rating) [ES: -0.69 (CI: -1.22; -0.17)] and effective field goal percentage [ES: -0.43 (CI: -0.96; 0.09)] and a very likely higher free throw rate [ES: -0.97 (CI: -1.49; -0.45)] compared to losing teams (Table 3).

The analysis of technical parameters revealed a likely higher number of ball reversals [ES: -0.59 (CI: -1.11; -0.06) and post entries [ES: -0.71 (CI: -1.24; -0.19)] and a lower number of dribbles in the key area [ES: 0.52 (CI: -0.01; 1.04)] and off-ball screens [ES: 0.54 (CI: 0.02; 1.07)] in winning teams compared to losing teams (Table 4).

DISCUSSION

This study aimed to assess the game-related statistics, their related variables and the tactical parameters differentiating between winning and losing teams in NCAA division I men's basketball close games. The main findings are that winning teams presented: a) a more effective team offensive rating highlighted by a better shooting performance and specifically the percentage of 3-point goals made, effective field goal percentage and free throw rate; b) a more effective defensive rating characterized by a substantially higher number of defensive rebounds and steals; 3) a substantially higher number of ball reversals and post entries and fewer dribbles in the key area and off-ball screens.

TABLE 3. Derived game indicators and the Four Factors for winning and losing teams expressed as mean ± standard deviation (SD), percentage (%) mean difference and effect size (ES) with their 90% confidence intervals (CI) and magnitude-based inference.

Derived game indicators and the Four Factors	Winning teams	Losing Teams	% Mean difference (90% CI)	ES (90% CI)	Magnitude-based Inference
Number of ball possession	65.28 ± 5.46	66.01 ± 5.10	0.73 (-2.09; 3.55)	0.14 (-0.38; 0.67)	Unclear (43/44/14)
Team's offensive rating	1.14 ± 0.14	1.05 ± 0.13	-0.10 (-0.17; -0.02)	-0.69 (-1.22; -0.17)	**Likely** -ive (0/6/94)
Team's defensive rating	1.06 ± 0.13	1.13 ± 0.14	0.07 (0.00; 0.14)	0.49 (-0.03; 1.01)	**Likely** +ive (82/16/2)
Effective field goal percentage	0.53 ± 0.11	0.48 ± 0.10	-0.10 (0.01; 0.06)	-0.43 (-0.96; 0.09)	**Likely** -ive (2/20/77)
Offensive rebounding percentage	0.33 ± 0.11	0.30 ± 0.07	-0.03 (-0.08; 0.02)	-0.16 (-0.68; 0.36)	Unclear (13/42/45)
Recovered balls per ball possession	0.32 ± 0.11	0.31 ± 0.10	-0.01 (-0.07; 0.04)	-0.08 (-0.60; 0.44)	Unclear (19/46/35)
Free throw rate	0.35 ± 0.11	0.25 ± 0.08	-0.10 (-0.15; -0.05)	-0.97 (-1.49; -0.45)	**Very likely** -ive (0/1/99)

TABLE 4. Tactical indicators for winning and losing teams expressed as mean ± standard deviation (SD), percentage (%) mean difference and effect size (ES) with their 90% confidence intervals (CI) and magnitude-based inference.

Tactical Indicators	Winning teams	Losing Teams	% Mean difference (90% CI)	ES (90% CI)	Magnitude-based Inference
Ball reversal	95.7 ± 34.1	77.8 ± 41.9	-17.9 (-38.3; 2.4)	-0.59 (-1.11; -0.06)	**Likely** -ive (1/10/89)
Dribble in key area	44.0 ± 12.9	49.0 ± 7.7	4.9 (-0.8; 10.6)	0.52 (-0.01; 1.04)	**Likely** +ive (84/14/1)
Post entry	33.4 ± 13.9	24.2 ± 9.9	-9.2 (-15.6; -2.7)	-0.71 (-1.24; -0.19)	**Likely** -ive (0/5/95)
On ball screen	46.0 ± 16.9	47.8 ± 14.5	1.8 (-6.6; 10.2)	0.18 (-0.34; 0.70)	Unclear (47/41/11)
Off ball screen	36.2 ± 20.9	47.4 ± 20.8	11.2 (0.0; 22.3)	0.54 (0.02; 1.07)	**Likely** +ive (86/13/1)
Hand off	17.0 ± 9.4	15.1 ± 9.9	-1.9 (-7.0; 3.3)	-0.41 (-0.94; 0.12)	Possibly -ive (3/22/75)

Previous studies investigating the differences between winning and losing teams in game-related statistics documented that defensive rebounds and assists were the most important indicators influencing winning in professional men's Spanish basketball game play [3] and in the Australian NBL [8]. The findings in our study confirm previous research regarding defensive rebounds, but assists showed only a possible difference between winning and losing teams. The possible difference could be explained by the fact that NCAA college basketball is usually characterized as a more physical game characterized by several 1-on-1 situations compared to other international basketball leagues. Furthermore, winning teams showed a substantially higher number of free throws made and attempted and a better percentage of 3-point goals made compared to losing teams. These results could be associated with a possible better physical performance for winning compared to losing teams. In fact, previous investigations revealed a positive correlation between vertical jump performance and three-point shooting accuracy over a season [20, 21]. Specifically, Pojskic et al. [21] suggested that players with higher vertical jump capacities are able to perform the shot with a lower release velocity, allowing more time for proper shooting execution. Therefore, further studies should investigate the difference of anaerobic performance in association with shooting accuracy between winning and losing college teams during games.

In addition to a substantially lower number of free throws made and attempted and a worse percentage of 3-point goals made, losing teams showed a substantially higher number of personal fouls. Collectively these data are in line with those reported in NBA games [16], where in the last quarter the most important game indicators were free throws scored, defensive fouls and 3-point field goals from central positions. In addition, Malarranha et al. [9] identified that the free throws are important indicators during the last five minutes of a close game to win a game. These findings are explained by the fact that fouls are used during the last stage of close games to reduce the game pace and to get the ball back after missed free throw opportunities [16, 22]. The agreement between studies from different leagues highlights the universal importance of these game-related statistics in determining team success in close basketball games.

The team's offensive/defensive rating of success and the "Four Factors" have been considered as the best predictors of the game outcome in basketball due to their holistic approach in examining the team performance [8, 23]. Consistently with previous investigations, the analysis of the offensive/defensive rating of success in this study revealed a substantial difference between winning and losing teams [8, 23]. Conversely, the analysis of the "Four Factors" revealed that effective field goal and free throw rate were the only parameters substantially differentiating between winning and losing NCAA teams, while no substantial differences were found for offensive rebounding percentage or recovered balls per possession [8, 23]. The lack of substantial difference in the offensive rebound percentage is a likely consequence of the similar number of offensive rebounds in winning and losing teams. This result seems in contrast with that documented in a previous study [9] in which the offensive rebounding percentage was suggested as a fundamental parameter influencing the game's final outcome, particularly in the second half of the game. A possible explanation for this result is that in the current investigation only close games were considered and therefore no substantial differences were observed in the number of offensive rebounds between winning and losing teams. This is in line with the findings of Gomez et al. [3] in which no differences were found in games with a final score difference equal to or below 12 points. Therefore, the offensive rebounding percentage is likely not able to differentiate between winning and losing teams in close games. Future studies should address the importance of this parameter for the game outcome in close games by performing regression analysis.

The results of this study also showed that the number of recovered balls per possession does not differentiate between winning and losing teams in close games. This result is not surprising considering that Sampaio et al. [23] substituted recovered balls per possession (steals + blocked shots + opponents' turnovers / ball possessions) for turnovers per possession in a prediction model for game outcome during international games. They found this model to be successful at predicting the game outcome, suggesting that the use of this indicator might better predict team success than the traditional Four Factors. The findings in our study confirm this result and suggest the use of a better parameter able to differentiate between winning and losing teams in close games.

This is the first study analyzing differences in tactical indicators between winning and losing teams in college basketball close games. The findings showed that winning teams performed substantially more ball reversals and post entries than losing teams. A possible explanation of this result could be the use of different defensive strategies adopted by losing teams. Although previous literature documented that man-to-man defense is the most used in both European and college basketball [24, 25], zone defense is mainly used to interrupt the scoring run of the opposite team and slow the tempo of the game [25]. Switching to a zone defense usually produces greater protection of the lane and the center of the 3-point area. Therefore, this defensive strategy could produce a higher number of ball reversals and post entries to move the ball as quickly as possible in order to find an open space to effectively attack the basket. The possible use of a zone defense by the losing teams could also be likely explained by the substantially lower number of dribble penetrations in the key area shown by winning teams. In fact, a further aim of the use of the zone defense could be to stop the dribble penetrations and one-to-one actions.

Although this study provided new information regarding the main technical and tactical indicators differentiating between winning and losing teams in close college basketball games, there are some limitations. Firstly, only 20 games were analyzed, and future studies should provide the same analysis with a more robust sample; secondly, no indications were provided regarding the tactical strategies adopted during these close games, which could have influenced the

use of different tactical indicators; lastly, no data were provided on the effectiveness of these tactical indicators. Therefore future studies should mainly focus on a) prediction of technical and tactical indicators differentiating between winning and losing teams in close college basketball games; b) analysis of technical and tactical indicators according to different tactical strategies; c) analysis of the effectiveness of the tactical indicators analyzed.

The analysis of the main technical and tactical indicators differentiating between winning and losing teams in college basketball close games provides useful information for basketball coaches when planning their training sessions. From a practical standpoint, this study highlighted that college basketball coaches should mainly focus on the training of the main game-related statistics differentiating between winning and losing teams such as defensive rebounds, percentage of 3-point goals made, and free throws and steals. Considering that these game-related statistics have been suggested to be likely related to players' anaerobic performance during games [20], strength and conditioning coaches should optimize their training and recovery strategies in order to ensure that their players always perform at their best. Considering the tactical indicators, this study suggests training the ability to quickly move the ball through ball reversals to find the best solution to drive to the basket with post entry as one of the main possible effective actions.

CONCLUSIONS

This study highlighted the game-related statistics and the tactical actions differentiating between winning and losing teams in NCAA Division I men's basketball close games. Winning teams had a better offensive and defensive rating characterized by a better percentage of 3-point goals made, free throws made, defensive rebounds and steals. From a tactical standpoint, winning teams performed more ball reversals and post entries than losing teams, while they performed substantially fewer dribbles in the key area and off-ball screens. Coaches should use these results to optimize their training sessions and focus on the training of those variables that might increase the possibility to win close games.

Conflict of interests

The authors declare no conflict of interests regarding the publication of this manuscript.

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