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Exercise and Quality of Life Journal (2024) 16(2): 41-48
DOI: 10.31382/eqol.241206

ORIGINAL ARTICLE

Game-related statistics that discriminate between winning and losing U-17 men's and women's basketball teams

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Received: 23. July 2024 | Accepted: 30. November 2024

Abstract

The purpose of the present study was to compare game-related statistics between men's and women's under-17 (U-17) basketball teams and to identify game-related statistics that discriminate between winning and losing teams for both sexes. Games with a final score difference greater than 30 points were excluded from the analysis, so the final sample consisted of 196 games (109 men's and 87 women's games) from the 2022/2023 season of the Triglav Cadet League of Serbia. The following game-related statistics were gathered from the official box scores of the Basketball Federation of Serbia: 2- and 3-point field-goals (successful and unsuccessful), free throws (successful and unsuccessful), defensive and offensive rebounds, assists, steals, turnovers, blocks (committed and received), and fouls (committed and received). Men's teams had significantly better values than women's teams in successful and unsuccessful 2-point field-goals, successful 3-point field-goals, successful and unsuccessful free throws, assists, and turnovers. Women's teams had statistically better values than men's teams in unsuccessful 3-point field-goals, offensive rebounds, steals, and committed fouls. The discriminant factors between winning and losing teams in close games, were successful 2-point field-goals, defensive rebounds and assists for both sexes, and offensive rebounds for men's teams. In balanced games, discriminant factors were assists for both sexes and successful 2-point field-goals for women's teams. In unbalanced games, discriminant factors were assists for both sexes, defensive rebounds for men's teams, and successful 2-point field-goals for women's teams. These findings suggest that there are notable differences in game-related statistics for U-17 men's and women's basketball teams.

Keywords: team sports · youth basketball · game statistics · discriminant analysis · performance analysis

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Introduction

Basketball is one of the most popular team sports, and one of the most watched and followed sports in the world. Quantitative analysis of game-related basketball statistics has been widely used to identify variables that can discriminate between winning and losing teams (Cabarkapa et al., 2022; Gómez, 2006; Ibáñez et al., 2008; Lorenzo et al., 2010; Madarame, 2018a, 2018b; Mikić et al., 2018; Sampaio et al., 2004). It can be used by coaches to develop offensive and defensive team strategies, training programs, and to identify areas for improvement (Cabarkapa et al., 2022). Additionally, coaches use game-related statistics to analyze opponents both as individuals and as a team (Mikić et al., 2018).

Several factors such as game location (home and away), game final score differences (close, balanced, and unbalanced games), team gender (men and women), level of competition, and age can affect game-related statistics (Lorenzo et al., 2010). For example, in women's balanced games, successful 2-point field-goals discriminated U-19 winning teams from losing teams, but not in U-17 teams (Madarame, 2018a). In U-16 male teams, assists and turnovers discriminated winning teams from losing teams in close games, but not in balanced or unbalanced games (Lorenzo et al., 2010). However, regardless of the level of competition or the opponent's level, it seems that defensive rebounds and assists are the most discriminant factors between winning and losing teams (Canuto & Bezerra De Almeida, 2022).

Several studies have identified game-related statistics that discriminate between winning and losing U-19 or younger basketball teams (Lorenzo et al., 2010; Madarame, 2018b; Sampaio et al., 2004). However, only one of them was conducted on U-17 men's and women's teams (Madarame, 2018a). Also, these studies only analyzed tournaments (European Championships, World Championships, etc.), and none of them analyzed game-related statistics in youth competitions throughout the whole season.

Therefore, the present study aims to compare game-related statistics between men's and women's U-17 teams from the Triglav Cadet League of Serbia and also to identify game-related statistics that discriminate between winning and losing basketball teams in close, balanced, and unbalanced games for both sexes.

Method

Sample and variables

The sample was collected from all 264 games of the men's and women's Triglav Cadet League of Serbia (U-17) during the 2022/2023 season. Games with a final score difference greater than 30 points were excluded from the analysis (a total of 68 games), so the final sample consisted of 196 games (109 men's games and 87 women's games). Data were obtained from the official box scores on the website of the Basketball Federation of Serbia (https://lige.kss.rs/). The following game-related statistics were analyzed: 2- and 3-point field-goals (successful and unsuccessful), free throws (successful and unsuccessful), defensive and offensive rebounds, assists, steals, turnovers, blocks (committed and received), and fouls (committed and received). All variables have been normalized according to game ball possessions to eliminate the effect of game rhythm (Sampaio et al., 2004), and then multiplied by 100. As suggested by Oliver (2011), ball possessions (BP) were calculated from field goal attempts (FGA), offensive rebounds (ORB), turnovers (TO), and free throw attempts (FTA) using the following equation:

$$BP = FGA - ORB + TO + 0.4 \times FTA$$

Statistical analysis

Statistical analysis was performed in SPSS statistical software (SPSS 26.0, IBMInc., Chicago, IL, USA). The significance level was $p \leq 0.05$. Descriptive statistics (means±SD) were calculated for each variable. A t-test for independent samples was applied to identify differences in game-related statistics between men's and women's teams and winning and losing game outcomes. Afterward, the sample was divided into three groups according to the final score difference using the cluster of k-means method: 76 games with final score difference equal to or less than 10 points (close games), 72 games with final score difference between 11 and 20 points (balanced games), and 48 games with final score difference greater than 21 points (unbalanced games). Discriminant analysis was used to identify variables that discriminate between winning and losing teams through structural coefficients (SC). Structural coefficients ≥0.30 were considered relevant (Lorenzo et al., 2010; Madarame, 2018a; Mikić et al., 2018).

Results

Descriptive statistics and results of the t-test for game-related statistics between men's and women's teams are presented in Table 1. Men's teams had statistically better values than women's teams in successful 2- and 3-point field-goals, unsuccessful 2-point field-goals, successful and unsuccessful free throws, assists, and turnovers. On the other hand, women's teams had statistically better values than men's teams in unsuccessful 3-point field-goals, offensive rebounds, steals, and committed fouls.

Table 1. Descriptive statistics and differences between men's and women's teams (values are means ± SD)

Variable	Men	Women
2PS *	33.82 (8.87)	31.71 (8.11)
2PU *	32.79 (8.92)	44.03 (10.70)
3PS *	10.07 (4.64)	5.95 (3.55)
3PU *	27.89 (8.46)	19.86 (7.22)
FTS *	22.22 (11.51)	19.44 (9.16)
FTU *	11.95 (6.40)	13.88 (8.12)
DRB	41.35 (10.60)	41.17 (9.93)
ORB *	17.90 (6.44)	21.37 (9.57)
AST *	25.50 (8.82)	23.18 (8.38)
STL *	15.63 (5.07)	20.40 (5.94)
TRN *	27.01 (6.91)	33.15 (8.37)
BLKM	4.92 (3.46)	5.27 (3.77)
BLKR	4.89 (3.41)	5.37 (3.93)
FC *	32.13 (8.19)	30.16 (8.09)
FR	32.47 (10.37)	30.48 (9.55)

Note: 2PS - successful 2-point field-goals; 2PU - unsuccessful 2-point field-goals; 3PS - successful 3-point field-goals; 3PU - unsuccessful 3-point field-goals; FTS - successful free throws; FTU - unsuccessful free throws; DRB - defensive rebounds; ORB - offensive rebounds; AST - assists; STL - steals; TRN - turnovers; BLKM - made blocked shots; BLKR - received blocked shots; FC - committed fouls; FR - received fouls; * $p \leq 0.05$.

Descriptive statistics and results of the t-test for game-related statistics between winning and losing teams for both men's and women's teams in close, balanced, and unbalanced games are presented in Table 2. In close games, the winning men's teams had significantly better values than losing teams in successful 2-point field-goals, defensive rebounds, and assists. Similarly, the winning women's teams had significantly better values than the losing teams in successful 2-point field-goals and assists. In balanced games, the winning men's teams had significantly better values in successful 2- and 3-point field-goals, unsuccessful 2-point field-goals, defensive rebounds, assists, steals, and made and received blocks. The winning women's teams had statistically better values in successful 2-point field-goals, offensive rebounds, assists, steals, and received blocks. In unbalanced games, the winning men's teams had significantly better values in successful 2-point and 3-point field-goals, unsuccessful 2-point field-goals, defensive and offensive rebounds, assists, steals, and made and received blocks. The winning women's teams had significantly better values in successful 2- and 3-point field-goals, defensive rebounds, assists, and turnovers.

The results of the discriminant analysis are shown in Figure 1.

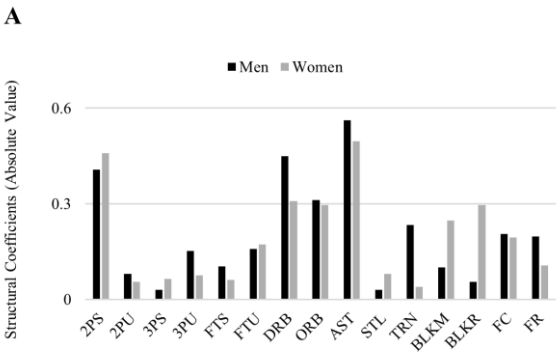

Figure 1A. Structural coefficients of game-related statistics in close games

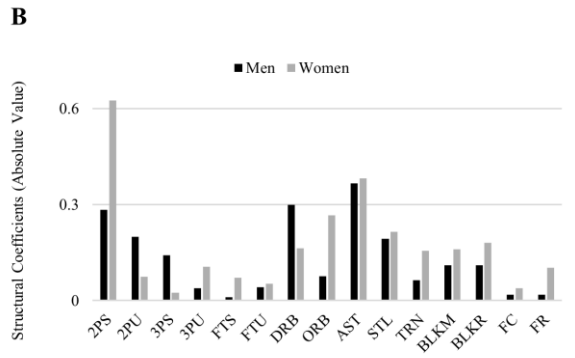

Figure 1B. Structural coefficients of game-related statistics in balanced games

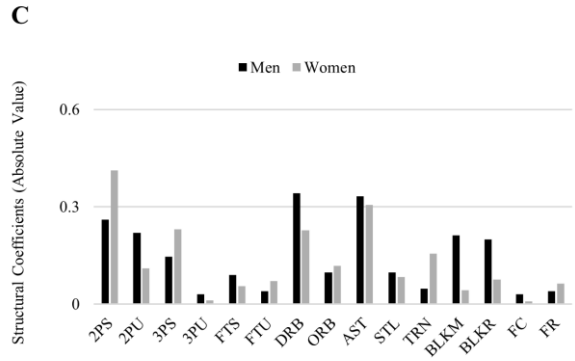

Figure 1C. Structural coefficients of game-related statistics in unbalanced games

The obtained discriminant functions were all statistically significant ($p \leq 0.05$), except for women's close games. The analysis correctly classified the following percentages of data: 77.8% for men's close games, 75.0% for women's close games; 96.7% for men's balanced games, 98.0% for women's balanced games; and 100.0% for both men's and women's unbalanced games. In close games (Figure 1a), variables that discriminated winning teams from losing teams for both sexes were successful 2-point field-goals (men, SC=0.407; women, SC=0.459), defensive rebounds (men, SC=0.449; women, SC=0.309) and assists (men, SC=0.563; women SC=0.496), whereas in men's games, it was also offensive rebounds (SC=0.312). In balanced games (Figure 1b), variables that discriminated between winning and losing teams for both sexes were assists (men, SC=0.366; women, SC=0.382) and successful 2-point field-goals for women's games only (SC=0.625). In unbalanced games (Figure 1c), it was assists (men, SC=0.332; women, SC=0.306) that discriminated between winning and losing teams for both sexes, as well as defensive rebounds (SC=0.342) for men's games, and successful 2-point field-goals (SC=0.412) for women's games. Assists were the only variable that discriminated between winning and losing teams in all three types of games, for both sexes.

Table 2. Descriptive statistics and differences between winning and losing men's and women's teams in close, balanced, and unbalanced games (values are means ± SD)

	Close games		Balanced games		Unbalanced games	
Variable	Winners	Losers	Winners	Losers	Winners	Losers
			Men			
2PS *†‡	35.81 (7.54)	31.10 (8.09)	38.29 (8.24)	29.65 (7.40)	39.89 (9.29)	28.18 (6.33)
2PU †‡	31.17 (8.15)	32.14 (8.01)	30.03 (6.86)	36.39 (9.25)	28.11 (8.70)	39.04 (8.92)
3PS †‡	11.07 (4.58)	10.87 (4.55)	10.60 (4.30)	8.27 (4.12)	11.95 (5.99)	8.00 (3.12)
3PU	28.61 (8.87)	30.72 (9.85)	25.84 (8.13)	27.07 (8.02)	27.33 (7.63)	28.61 (7.45)
FTS	25.81 (13.25)	23.82 (12.53)	20.07 (10.74)	19.61 (11.47)	25.16 (10.14)	20.43 (8.54)
FTU	14.20 (6.76)	12.52 (7.44)	11.47 (5.58)	10.50 (6.22)	11.05 (6.20)	12.36 (5.80)
DRB *†‡	45.47 (12.46)	38.29 (8.82)	44.98 (8.27)	35.77 (7.47)	50.63 (8.89)	33.95 (8.29)
ORB ‡	20.03 (7.58)	16.71 (6.79)	18.06 (5.11)	16.55 (4.98)	20.27 (7.16)	16.34 (6.92)
AST *†‡	28.90 (9.70)	21.85 (7.01)	30.00 (7.45)	20.79 (5.26)	32.70 (9.03)	19.01 (4.93)
STL†‡	15.77 (6.41)	15.51 (5.28)	17.24 (4.75)	13.93 (3.99)	16.98 (4.81)	14.46 (4.35)
TRN	29.37 (7.85)	26.42 (9.22)	25.92 (4.60)	27.23 (5.88)	27.48 (7.02)	25.63 (6.51)
BLKM †‡	4.48 (3.15)	4.05 (2.68)	6.10 (4.18)	4.54 (2.89)	7.03 (4.02)	3.16 (2.10)
BLKR †‡	4.11 (2.69)	4.34 (3.05)	4.53 (2.69)	6.04 (4.09)	3.23 (2.19)	6.98 (4.16)
FC	33.53 (7.16)	35.86 (8.09)	30.23 (8.95)	30.84 (8.72)	30.83 (6.58)	32.03 (7.43)
FR	36.78 (9.91)	33.56 (11.94)	31.10 (8.87)	30.32 (11.45)	32.89 (9.09)	30.86 (9.23)

Note: * $p \leq 0.05$ in close games; † $p \leq 0.05$ in balanced games; ‡ $p \leq 0.05$ in unbalanced games.

Table 2(continued). Descriptive statistics and differences between winning and losing men's and women's teams in close, balanced, and unbalanced games (values are means ± SD)

	Close games		Balanced games		Unbalanced games	
Variable	Winners	Losers	Winners	Losers	Winners	Losers
			Women			
2PS *†‡	34.37 (8.12)	29.89 (7.99)	37.25 (4.98)	26.87 (5.61)	36.66 (5.61)	24.31 (6.24)
2PU	44.75 (11.26)	45.43 (9.05)	44.83 (10.48)	42.26 (11.43)	39.52 (10.29)	45.68 (11.92)
3PS ‡	5.97 (3.71)	5.68 (3.78)	5.10 (2.93)	5.32 (2.83)	9.01 (3.40)	5.18 (3.18)
3PU	19.54 (7.30)	20.24 (7.67)	17.79 (6.97)	20.20 (7.53)	20.68 (4.43)	21.05 (8.56)
FTS	20.18 (8.98)	20.88 (9.37)	16.79 (6.74)	18.75 (10.29)	18.06 (10.01)	20.77 (9.43)
FTU	14.69 (9.50)	12.88 (7.70)	12.99 (8.50)	14.39 (8.21)	13.05 (5.82)	15.52 (7.86)
DRB ‡	44.28 (11.06)	40.15 (11.00)	42.43 (8.67)	37.95 (8.77)	44.66 (8.62)	36.09 (6.12)
ORB †	23.73 (8.41)	20.37 (10.14)	24.78 (11.03)	17.12 (6.91)	23.41 (11.10)	17.84 (7.11)
AST *†‡	25.15 (8.19)	20.54 (7.08)	26.38 (8.52)	17.59 (5.93)	30.71 (7.78)	19.92 (6.13)
STL †	20.30 (6.32)	19.72 (5.55)	23.11 (5.86)	19.30 (5.41)	21.43 (6.72)	18.89 (5.23)
TRN ‡	33.04 (9.35)	32.63 (7.61)	31.71 (7.89)	35.72 (8.50)	29.98 (6.13)	36.13 (9.23)
BLKM	5.79 (4.10)	4.59 (3.88)	5.87 (3.69)	4.22 (2.74)	6.12 (4.17)	5.29 (3.54)
BLKR †	4.54 (3.78)	6.03 (4.43)	4.17 (2.88)	6.12 (3.90)	5.03 (3.32)	6.58 (4.58)
FC	30.03 (7.39)	31.74 (7.09)	28.84 (7.61)	29.91 (10.05)	29.56 (8.43)	29.92 (9.14)
FR	32.04 (9.69)	30.79 (9.57)	28.03 (8.56)	31.26 (11.30)	28.35 (8.91)	31.16 (8.84)

Discussion

The purpose of this study was to compare game-related statistics between men's and women's U-17 basketball teams and also to identify game-related statistics that discriminate between winning and losing teams in close, balanced, and unbalanced games. When comparing the shooting performance between men's and women's teams (Table 1), it can be observed that the women's teams had a lower success rate in all shooting statistics (free throws and 2- and 3-point field-goals), except for unsuccessful 3-point field-goals. This could be associated with physical differences between male and female players, especially anthropometric characteristics (height, weight, body proportion, and composition) (Sampaio et al., 2004). Differences in strength between males and females could play a significant role in shooting performance, with male athletes being significantly stronger than females in upper-body strength (Bartolomei, Grillone, Di Michele, & Cortesi, 2021). Interestingly, introducing a smaller and lighter ball (size 6) in women's basketball did not lead to an improvement in shooting accuracy (Podmenik, et al., 2012). Also, the lower shooting performance in women's teams may be associated with female players experiencing higher anxiety levels compared to male players. Guillén and Sánchez (2009) found that female basketball players had a certain amount of anxiety related to their treatment in the world of women's basketball and that gender stereotypes impact their anxiety level. Men's teams had more assists compared to women's teams, which corresponds to better shooting performance by men's teams because more successful shots create more opportunities for assists. Assists are considered an indicator of a player's perceptual and decision-making abilities (Madarame, 2018a).

The women's teams had significantly more offensive rebounds compared to the men's teams, which could be explained by a larger number of unsuccessful 2-point field-goals and unsuccessful free throws. More missed shots create more opportunities for offensive rebounds. Women's teams had significantly more turnovers, which in turn creates more chances for steals and, therefore, better values compared to men's teams. Also, men's teams committed more fouls per game, which could be attributed to their more aggressive style of play compared to women's teams.

In close games, winning and losing teams were discriminated by successful 2-point field-goals, defensive rebounds, and assists for both sexes, and by offensive rebounds for men's teams. These results demonstrate the importance of shooting efficiency. A team that has better shooting efficiency is most likely to win the game (Cabarkapa et al., 2022). FIBA (2018) defined assists as a "pass that leads directly to team-mate scoring", so assists are a direct indicator of good team offense and

players' ability to pass the ball. A greater number of assists suggests that winning teams are sharing the ball more efficiently, which may be of critical importance in close games (Cabarkapa et al., 2022). Assists represent a discriminant factor for the season-long success of the basketball team (Ibáñez et al., 2008), and are also an important factor in close and balanced games in U-16 men's teams (Lorenzo et al., 2010). They are, along with defensive rebounds, the most discriminant factor between winning and losing teams, regardless of game location, phase of the competition, or the opponent's level (Canuto & Bezerra De Almeida, 2022). Defensive rebounds present a basis for team play because they open up more opportunities for fast-breaks while not allowing extra ball possession to the opponents, thus decreasing their shooting attempts (Lorenzo et al., 2010).

In balanced games, the discriminant factors between winning and losing teams were assists for both sexes and successful 2-point field-goals for women's teams. Contrary to this, Madarame (2018a) did not find assists to be a discriminant factor in both men's and women's U-17 balanced games, nor successful 2-point field-goals in U-17 women's teams. However, Madarame (2018a) observed that there is a recent trend in which women's balanced games are discriminated by successful 2-point field-goals, but men's balanced games are not.

In unbalanced games, winning and losing teams were discriminated by assists for both sexes, successful 2-point field-goals for women's teams, and defensive rebounds for men's teams. These results somewhat confirm the findings of Madarame (2018a), who found that assists were a discriminant factor in unbalanced games in U-17 women's teams but not in the men's teams, and that defensive rebounds were a discriminant factor in both men's and women's U-17 teams. Also, he found that successful 2-point field-goals were a discriminant factor in U-17 women's teams but not in men's teams, which corresponds to the findings of the present study. However, Lorenzo et al. (2010) found that successful 2-point field-goals discriminate between winning and losing teams in unbalanced U-16 games.

In conclusion, based on observed differences in game-related statistics, the present study demonstrated that men's teams had better shooting efficiency and fewer turnovers compared to women's teams. Also, the results of the discriminant analysis demonstrated that winning and losing teams differ mostly in successful 2-point field-goals, offensive and defensive rebounds, and assists. Assists were the only variable that discriminated between winning and losing teams in all three analyses (close, balanced, and unbalanced games) for both men's and women's teams. Therefore, this indicates the importance of a good team's offense. The findings of this study suggest that there are differences in U-17 men's and women's basketball games, as well as between winning and losing men's and women's basketball teams. This data may be useful for coaches and analysts in preparing their teams and analyzing opponents during competitions.

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