European Journal of Human Movement

OPEN ACCESS

Original Research

Performance analysis in elite basketball differentiating game outcome and gender

Marcos Bezerra de Almeida, Sarah Cristina Canuto, Gisele Santos Lima, William Golçalves Oliveira

Federal University of Sergipe, Brazil

* Correspondence: (MBA) mb.almeida@gmail.com

Received: 14/09/2022; Accepted: 23/11/2022; Published: 31/12/2022

Abstract: Traditionally, basketball research has used game-related statistics in order to discriminate winning and losing teams. The aim of this study was to identify which game-related statistics best discriminated winning and losing teams in men and women's team playing Tokyo 2020 Basketball Olympic Tournament. All statistical data for the 26 games of each gender were obtained from the FIBA website. The MANOVA and discriminant analysis models were run to check differences according to gender and game outcome. The main results revealed 2-point field-goals percentage, defensive rebounds, assists, points in the paint, and effective field goal percentage as key variables to succeed in men and women's games. However, there were gender discrepancies on 2-point field-goals made, points from turnovers, turnover per ball possession rate (relevant only when discriminating men's winning teams), and fastbreak points, offensive rebounds percentage, and free-throw rate (only for women's winning teams). Winning and losing discriminant statistics were quite similar for both, men and women's teams when only considering traditional box-score stats, but not when analyzing advanced stats. Men's winning teams are more careful with ball possession and know how to turn defense into offense by scoring more points after an opposing team's turnover, while women's winning teams are more effective in scoring through fastbreak actions, recovering offensive rebounds less efficiently, and shooting proportionally a higher volume of free-throws.

Keywords: team sport, sex, game-related statistics, discriminant analysis.

1. Introduction

Basketball game-related statistics have been used for several purposes regarding teams and players evaluation (J. Lorenzo, Lorenzo, Conte, & Giménez, 2019; Paulauskas, Masiulis, Vaquera, Figueira, & Sampaio, 2018) either during the game (Jesus, Gomes, & Almeida, 2018) or throughout the season (Gomes et al., 2017; Puente, Del Coso, Salinero, & Abián-Vicén, 2015), throughout several years (Canuto, Santos & Almeida, 2022), and when identifying the effects of changing the rules on the way the game is played (Ibañez, Garcia-Rubio, Gómez, & Gonzalez-Espinosa, 2018). Recently, Mandic et al. (2019) presented a long-term box-score data-based comparison between NBA and European teams and players, indicating a trend towards reducing the gap between NBA and Euroleague player/team performance. Additionally, Gasperi et al.

(2020) compared national and foreign women's players from EuroLeague teams, showing that foreign players have a higher performance level for 2-point field-goals and free-throws, besides a better work on assists than national players.

Specifically, during the last two decades at least, a plethora of studies have investigated which game-related statistics best discriminated winning and losing teams (Conte et al., 2018; García, Ibáñez, Santos, Leite, & Sampaio, 2013; M. A. Gómez, Lorenzo, Sampaio, Ibáñez, & Ortega, 2008; S. J. Ibáñez, García, Feu, Lorenzo, & Sampaio, 2009; A. Lorenzo, Gómez, Ortega, Ibáñez, & Sampaio, 2010; Madarame, 2018; Mikołajec, Banyś, Żurowska-Cegielska, Zawartka, & Gryko, 2021). These analyses were extended to understand the possible effects of game location (M. A. Gómez, Lorenzo, Barakat, Ortega, & Palao, 2008), competition stage (García et al., 2013; Giovanini, Conte, Ferreira-Junior, & Nascimento, 2021; Özmen, 2016), margin of victory (Saavedra, Escalantel, Madera, Mansilla, & García-Hermoso, 2014), back-to-back games (S. J. Ibáñez et al., 2009), starters vs non-starters' performance (Sampaio, Ibáñez, Lorenzo, & Gómez, 2006), team's offensive efficiency situation (Santos, Monezi, Misuta, & Mercadante, 2018), among other aspects. In fact, it is important to point out that this kind of information may be helpful for coaches to improve game planning and training program elaboration (Zhai, Guo, Zhang, Li, & Liu, 2020). Not to mention that basketball performance analyses may be differently oriented for each gender.

Although there is an increasing number of women's teams and competitions studies on that matter (Conte & Lukonaitiene, 2018; Gòmez, Lorenzo, Ortega, Sampaio, & Ibàñez, 2009; Leicht, Gomez, & Woods, 2017; Leicht, Gómez, & Woods, 2017), it is no surprise to find out that so far, most investigations comprehended solely men's competition. Consequently, gender performance comparisons in basketball have been impaired. In this sense, Sampaio et al. (2004) compared men's and women's performances (game-related statistics) at FIBA 2002 World Championships. Their main findings revealed women's teams performed higher unsuccessful 2-point field-goals and steals, and men's teams had more blocks. However, this study did not consider win or lose as game outcome. Madarame (2018) compared men and women's teams performance for win/lose differentiation factors in London 2012 Olympics, FIBA 2014 World Championships, and Rio 2016 Olympics. For both genders, defensive rebounds and assists, plus 2-point field-goals made for women differentiated winners from losers. However, in both studies, except for the Olympic Tournaments, men and women's competitions took place on different countries and periods of the year, which may compromise a more accurate comparative analysis.

It seems fair to assume that the more appropriate type of competition for this kind of analysis is the Olympic Games basketball tournament. The rationale for this approach is that all men and women's teams played throughout the same period and in the same city, which means under the same environmental conditions and at the same basketball venues. In this regard, due to the restrictions of the COVID-19 pandemic, fans were not allowed to attend any matches at the Tokyo 2020 Olympic Games, so there

were neither off-court distractions nor support from the bleachers. Accordingly, Tokyo 2020 Olympic Games may create a unique opportunity to make men's and women's performance comparisons feasible. Therefore, this study aimed to identify game-related statistics that best discriminate winning and losing teams in men and women's Tokyo 2020 Basketball Olympic Tournament.

2. Materials and Methods

Sample

For each gender, 12 teams took part in the tournament, allocated on three groups of four teams. After a group phase, the eight best qualified teams played eliminatory quarterfinals (four games), and then, winners advanced to the final four (semifinal, bronze medal decision and gold medal decision games), totalizing 26 games for each gender. All game statistical data were obtained from the official FIBA open access website corresponding to the Tokyo 2020 basketball Olympic Tournament (ex.: http://www.fiba.basketball/olympics/men/2020/game/0708/France-USA). FIBA displays several game info, however, for the purposes of this study, only "Boxscore" and "Team Comparison" sections were accessed.

Data Collection Procedures

Boxscore section presents raw and non-contextualized game statistics, such as 2-point and 3-point field-goals (made, missed and percentage), free-throws (made, missed and percentage), offensive e defensive rebounds, assists, steals, turnovers, blocked shots and personal fouls. These stats were used to calculate the number of ball possession (BP) and later the so called Four Factors stats. Conventionally, BP finishes after a field-goal, the last free-throw of the sequence or due to a turnover. If a player of the shooting team grabs the offensive rebound, BP is extended for up to 14 seconds. Then, Oliver (2004) suggested an equation to determinate the number of BP based on game-related statistics, as follow:

BP=FGA+(FTA ×.4) +TO-OREB

where: FGA: field-goals attempted; FTA: free-throws attempted; TO: turnovers; OREB: offensive rebounds.

In addition, Oliver (2004) also presented a brief group of advanced statistics called The Four Factors, which means to score efficiently, to take good care of the basketball on offense, to grab as many offensive rebounds as possible, and to shoot as many free-throws as possible. Then, the Four Factors are:

Effective Field Goal Percentage:

eFG%= (Total Field Goals Made + 3Point Shots Made ×0.5)/ (Total Field Goals Attempted) ×100

Offensive Rebounds Percentage:

OREB%= (Offensive Rebounds)/ (Offensive Rebounds +Opposing Team^' sDefensive Rebound) ×100

Turnover/Ball Possession Ratio:

TOV%= Turnovers/ (Ball Possessions) ×100

Free Throw Rate:

FTR= (Free Throws Made)/ (Total Field Goals Attempted) ×100

Team Comparison section indicates how points were scored during the game, like points made after opposing team committed a turnover (Points form Turnovers), points made by fastbreak offense (Fastbreak Points);

points scored after an offensive rebound (2nd Chance Points), points scored inside the restricted area (Points in the Paint), and points scored by non-starter players (Points from the Bench).

Later, all variables were normalized according to total game BP and multiplied by 100 to avoid discrepancies of game-to-game pace (Sampaio & Janeira, 2003). A high number of BP means less average BP time span, and consequently, a faster paced game, and vice-versa (Oliver, 2004).

Statistical Analysis

The original (non-normalized) number of BP for men and for women's games was compared by a Mann-Whiney test, once men's teams BP data did not pass Shapiro-Wil normality test ($p = 0.001$). A multivariate analysis of variance with Bonferroni adjustment for pairwise interaction (game outcome x gender) comparisons was conducted to compare winner vs loser teams, and men vs women teams' performance data. Additionally, Cohen's d effect size (ES) defined as d (0.01) = very small, d (0.2) = small, d (0.5) = medium, d 0(.8) = large, d (1.2) = very large, and d (2.0) = huge (Sawilowsky, 2009), compared the magnitude of the differences between winning and losing teams for each gender, and men vs women for each game outcome (win or lose). In addition, a discriminant analysis was carried out to find out which game-related statistics could best discriminate winning and losing teams by means of structural coefficients (SC). The rule of thumb for considering SC values relevant for analysis was SC ≥0.32 (Tabachnick & Fidell, 2019), and SC interpretation cut-off points was set as follows: 0.71 (excellent), 0.63 (very good), 0.55 (good), 0.45 (fair), and 0.32 (poor) (Comrey & Lee, 1992). Although it is common to classify games by final scoring difference as balanced or unbalanced games in this kind of analysis (M. A. Gómez, Lorenzo, Barakat, et al., 2008; A. Lorenzo et al., 2010; Madarame, 2018), due to the small number of games played on each tournament, we have chosen to consider all games of the same gender as a single group, regardless of final scoring difference. Significance level was set at $p \leq 0.05$, and all statistical analysis were run with the IBM SPSS statistical software version 20.0 (IBM Corp, Armonk, NY).

3. Results

Men's teams presented a higher number of BP than women's (78.8 ± 5.3 vs 75.9 ± 5.3, respectively; $p = 0.03$; ES = 0.55; medium ES). As expected, winning teams scored more points than losing teams, regardless of gender ($p < 0.05$; very large ES for both). For men, winning teams had more successful 2-point field-goals, higher 2-point field-goals accuracy, more defensive rebounds, and more assists than losing teams ($p < 0.05$; large ES for all those stats). They also made more 3-point field-goals ($p < 0.05$; medium ES). Women's winning teams showed higher 2-point field-goals percentage, more defensive rebounds, and more assists than losing teams ($p < 0.05$; very large ES for all those stats). It is also worth mention that women's winning teams made more free-throws and 2-point field-goals, attempted more free-throws, had higher 3-point field-goals accuracy, and committed fewer personal fouls than losing teams ($p < 0.05$; medium ES for all those stats) (see Table 1).

Men's winning teams shot more 3-point field-goals ($p < 0.05$; very large ES), as well as made more 3-point field-goals, committed more personal fouls ($p < 0.05$;

large ES for both stats), and got fewer defensive rebounds ($p < 0.05$; small ES) than women's winning teams. Even men's losing teams shot ($p < 0.05$; medium ES) and made ($p < 0.05$; large ES) more 3-point field-goals than women's ones. Both winning and losing women's teams shot more 2-point field-goals than their male counterparts ($p < 0.05$ for both; medium ES for winner and very large ES for loser teams comparisons). At last, women's winning teams committed more turnovers than men's winners ($p < 0.05$; medium ES) (see Table 1).

Regarding field-goal scoring situation, there were no statistically significant differences between men and women's teams. Despite that, men and women's winning teams scored more points inside the restricted area than losing teams ($p < 0.05$; large ES for both), while men's winners scored more points after opposing team turnovers ($p < 0.05$; large ES), and women's winners scored more points in fastbreaks ($p < 0.05$; medium ES) (see Table 2).

Four Factors multivariate analysis showed that men's winning and losing teams only differed on eFG%, since winning teams had a higher overall field-goal shooting accuracy than losing teams ($p < 0.05$; large ES). Likewise, women's winning teams presented better overall shooting accuracy than losing teams ($p < 0.05$; very large ES). In addition, women's winning teams had a lower offensive rebound percentage and higher free-throw rate than losing ones ($p < 0.05$; medium ES for both stats). Gender comparison indicated that women's winning teams committed more turnovers per ball possession ($p < 0.05$; large ES), while women's losing teams had a worse overall field-goal shooting accuracy and a higher offensive rebound percentage than their men's counterparts ($p < 0.05$; medium ES for both stats) (see Table 3).

Men and women's discriminant functions for winning and losing teams were statistically significant ($p < 0.001$) and classifying correctly 78.8% and 86.5% of the cases, respectively. Main discriminant factors were quite similar for both genders, since 2-point field-goals percentage, defensive rebounds and assists all presented SC between 0.35 and 0.45. In addition, 2-point field-goals made also discriminated men's winning and losing teams. Nevertheless, despite differentiating winning and losing teams, all three of these game statistics must be considered poor discriminating factors ($SC < 0.45$), except for defensive rebounds for women, which are considered fair (see Table 4).

Likewise, field-goal scoring situations were statistically significant and showed satisfactory reclassification levels. For men's teams, Points from Turnovers (very good) and Points in the Paint (good), while for women's teams, Fastbreak Points (very good) and Points in the Paint (excellent) were the variables that best discriminated winning and losing teams (see Table 5).

Finally, the Four Factors presented statistically significant differences and showed satisfactory reclassification level yet presented some differences on discriminant factors between male and female teams. The best discriminant factors for men's teams were turnovers per possession (poor) and effective field-goal percentage (excellent). For women's teams, effective field-goal percentage, offensive rebounding percentage (poor) and free-throw rate (very good) were statistically significant discriminant factors (see Table 6).

Table 1. Descriptive results, multivariate differences and effect size for winner vs loser, and men vs women teams from the Tokyo 2020 Basketball Olympic Tournament, based on basic game-related statistics. Values are displayed as mean ± standard deviation and were normalized to 100 game ball possessions.

Game Stats	Men			Women			ES	
	Winners	Losers	ES	Winners	Losers	ES	Winners	Losers
Total Points	120.1 ± 13.3[ab]	99.6 ± 11.5[b]	1.65	108.1 ± 12.0[a]	90.0 ± 12.7	1.46	.95	.79
2-PTA	49.6 ± 6.9[b]	48.4 ± 8.1[b]	.16	57.7 ± 13.2	60.3 ± 9.0	.23	.77	1.39
2-PTM	28.9 ± 4.2[a]	23.8 ± 6.0	.98	30.2 ± 6.4[a]	25.7 ± 6.2	.71	.24	.31
2-PT%	75.2 ± 12.7[a]	62.5 ± 11.1	1.06	69.3 ± 8.5[a]	57.1 ± 11.9	1.18	.55	.47
3-PTA	40.2 ± 7.4[b]	36.5 ± 8.6[b]	.46	27.4 ± 9.0	30.4 ± 9.0	.33	1.55	.69
3-PTM	15.3 ± 4.6[ab]	12.5 ± 4.1[b]	.64	10.4 ± 5.2	8.4 ± 3.0	.47	1.00	1.14
3-PT%	48.2 ± 10.1	43.9 ± 10.8	.41	48.2 ± 12.8[a]	38.3 ± 12.9	.77	.00	.47
FTA	21.2 ± 5.9	20.7 ± 8.0	.07	21.2 ± 7.2	17.1 ± 8.1	.54	.00	.45
FTM	16.5 ± 4.5	14.7 ± 6.3	.33	18.8 ± 12.1[a]	13.3 ± 6.3	.57	.25	.22
FT%	99.9 ± 12.5	91.9 ± 21.1[b]	.46	100.4 ± 13.1	104.0 ± 17.9	.23	.04	.62
Off Reb	14.5 ± 4.7	12.4 ± 3.9	.49	13.9 ± 8.2	14.6 ± 4.2	.11	.09	.54
Def Reb	37.9 ± 5.9[ab]	32.3 ± 4.6	1.06	41.1 ± 7.6[a]	31.8 ± 4.6	1.48	.47	.11
Assists	29.2 ± 6.5[a]	22.9 ± 5.2	1.07	31.8 ± 5.3[a]	23.5 ± 6.7	1.37	.44	.10
Fouls	23.9 ± 3.7[b]	24.1 ± 4.7	.05	19.6 ± 5.3[a]	23.0 ± 4.8	.67	.94	.23
Turnovers	16.1 ± 5.4[b]	19.1 ± 6.3	.51	20.3 ± 6.4	18.3 ± 4.6	.36	.71	.15
Steals	10.8 ± 4.0	9.0 ± 4.0	.45	9.3 ± 3.0	10.8 ± 4.2	.41	.42	.44
Blocked Shots	3.9 ± 3.1	3.0 ± 2.5	.32	4.3 ± 3.2	3.2 ± 2.6	.38	.13	.08

2-PTA, 3-PTA, and FTA: 2-point shot, 3-point shot and free throw attempted; 2-PTM, 3-PTM, and FTM: 2-point shot, 3-point shot, and free throw made; 2-PT%, 3-PT%, and FT%: 2-point shot, 3-point shot, and free throw percentage; Off Reb and Def Reb: offensive and defensive rebounds. [a] Means statistical difference (p < 0,05) showed for winners vs losers for each gender. [b] Means statistical difference (p < 0,05) showed for men vs women for each result.

Table 2. Descriptive results, multivariate differences and effect size for winner vs loser, and men vs women teams from the Tokyo 2020 Basketball Olympic Tournament, based on field goal scoring situation statistics. Values are displayed as mean ± standard deviation and were normalized to 100 game ball possessions.

Game Stats	Men			Women			ES	
	Winners	Losers	ES	Winners	Losers	ES	Winners	Losers
TO Points	22.6 ± 9.5[a]	14.2 ± 6.9	1.01	19.9 ± 7.8	18.2 ± 6.6	.24	.31	.59
FB Points	18.3 ± 8.2	15.1 ± 8.2	.39	17.1 ± 8.0[a]	12.5 ± 6.4	.63	.15	.35
2C Points	14.7 ± 5.8	12.2 ± 5.2	.45	13.5 ± 7.6	12.6 ± 5.5	.14	.18	.07
Paint Points	48.4 ± 8.0[a]	39.6 ± 11.1	.91	49.0 ± 11.8[a]	39.9 ± 10.3	.82	.06	.03
Bench Points	42.5 ± 15.3	37.1 ± 16.4	.34	34.5 ± 13.2	31.1 ± 15.5	.24	.56	.38

TO Points: points made after opposing team turnovers; FB Points: points made by fastbreak; 2C Points: 2nd chance points (points after an offensive rebound); Paint Points: points made in the restricted area; Bench Points: points made by non-starters players. [a] Means statistical difference (p < 0,05) showed for winners vs losers for each gender.

Table 3. Descriptive results, multivariate differences and effect size for winner vs loser, and men vs women teams from the Tokyo 2020 Basketball Olympic Tournament, based on four factors statistics. Values are displayed as mean ± standard deviation and were normalized to 100 game ball possessions.

Game Stats	Men			Women			ES	
	Winners	Losers	ES	Winners	Losers	ES	Winners	Losers
TOV%	20.5 ± 6.6[b]	24.5 ± 8.2	.54	26.5 ± 7.9	24.4 ± 6.3	.29	.82	.01
eFG%	73.6 ± 9.6[a]	64.0 ± 9.6[b]	1.00	71.5 ± 8.5[a]	57.4 ± 11.2	1.42	.23	.63
OREB%	34.8 ± 8.5	35.0 ± 8.0[b]	.02	32.5 ± 16.7[a]	41.6 ± 10.1	.66	.17	.72
FTR	23.5 ± 6.7	22.3 ± 9.8	.14	30.0 ± 21.9[a]	20.3 ± 11.2	.56	.40	.19

TOV%: turnover per ball possession percentage; eFG%: effective field goal percentage; OREB%: offensive rebound percentage; FTR: free throw rate. [a] Means statistical difference (p < 0,05) showed for winners vs losers for each gender. [b] Means statistical difference (p < 0,05) showed for men vs women for each result.

Table 4. Discriminant analysis structure coefficients (SC) from game-related statistics in men and women Tokyo 2020 Basketball Olympic Tournament.

Game Stats	Men	Women
2-PTA	.05	-.07
2-PTM	.32	.22
2-PT%	.35	.36
3-PTA	.15	-.10
3-PTM	.21	.14
3-PT%	.13	.24
FTA	.02	.16
FTM	.11	.17
FT%	.15	-.07
Off Reb	.16	-.03
Def Reb	.35	.45
Assists	.35	.42
Fouls	-.01	-.21
Turnovers	-.17	.11
Steals	.14	-.12
Blocked Shots	.11	.12
Eigenvalue	2.39	2.78
Wilk's Lambda	.29	.26
Canonical Correlation	.84	.86
Qui-squared	51.834	55.854
P	< .001	< .001
Reclassification (%)	78.8%	84.6%

2-PTA, 3-PTA, and FTA: 2-point shot, 3-point shot and free throw attempted; 2-PTM, 3-PTM, and FTM: 2-point shot, 3-point shot, and free throw made; 2-PT%, 3-PT%, and FT%: 2-point shot, 3-point shot, and free throw percentage; Off Reb and Def Reb: offensive and defensive rebounds. Bold numbers represent SC > .32.

Table 5. Discriminant analysis structure coefficients (SC) from field goal scoring situation statistics in men and women Tokyo 2020 Basketball Olympic Tournament.

Game Stats	Men	Women
Points from Turnovers	.63	.23
Fastbreak Points	.24	.64
2nd Chance Points	.27	.13
Points in the Paint	.56	.82
Points from the Bench	.21	.24
Eigenvalue	.67	.26
Wilk's Lambda	.60	.79
Canonical Correlation	.63	.45
Qui-squared	24.487	10.926
P	< .001	.05
Reclassification (%)	76.9%	67.3%

Bold numbers represent SC > .32.

Table 6. Discriminant analysis structure coefficients (SC) from the four factors statistics in men and women Tokyo 2020 Basketball Olympic Tournament.

Game Stats	Men	Women
TOV%	-.43	.19
eFG%	.80	.94
OREB%	-.02	-.44
FTR	.11	.69
Eigenvalue	.41	.59
Wilk's Lambda	.71	.63
Canonical Correlation	.54	.61
Qui-squared	16.384	22.149
P	.003	< .001
Reclassification (%)	67.3%	71.2%

TOV%: turnovers per possession; eFG%: effective field goal percentage; OREB%: offensive rebounding percentage; FTR: free throw rate. Bold numbers represent SC > .32.

4. Discussion

The present study aimed to identify the game-related statistics that best allow discriminating winning from losing teams of men and women's teams in Tokyo 2020 Basketball Olympic Tournament. The main results showed that game-related win or lose discriminant statistics are quite similar for men and women when considering only traditional box-score statistics, but not for advanced statistics, especially the Four Factors. The most relevant SC for men and women altogether were 2-point field-goals percentage, defensive rebounds, assists, points in the paint, and effective field-goal percentage. However, there were gender discrepancies on 2-point field-goals made, points from turnovers, turnover per ball possession rate (relevant only for discriminating men's winning teams), and fastbreak points, offensive rebounds percentage, and free-throw rate (only for women's winning teams).

Men's teams played at a faster pace (more BP), which could create a confounding effect for gender analysis. In fact, even within gender, the variability of the number of BP per game could compromise data interpretations, since the higher the number of BP the higher the number of game actions, like shots, rebounds, assists, or turnovers, for instance (Csataljay, James, Hughes, & Dancs, 2011). Although the numbers are somewhat overestimated as a consequence of the 100 BP normalization procedure, this strategy allowed a more appropriated data analysis and study comparisons (Canuto & Almeida, 2022).

In addition to 2-point field-goals percentage, the largest differences between winning and losing teams regardless of gender were found in defensive rebounds and assists. The identified findings showed a similar magnitude for men's and for women's teams. Our results corroborate similar findings from previous studies, since these box-score statistics have been pointed out as recurrent win/lose discriminant factors (M. A. Gómez, Ibáñez, Parejo, & Furley, 2017; M. A. Gómez, Lorenzo, Barakat, et al., 2008; M. A. Gómez, Lorenzo, Sampaio, et al., 2008; S. J. Ibáñez et al., 2009; Leicht, Gomez, et al., 2017; A. Lorenzo et al., 2010; Madarame, 2017; Trninić, Dizdar, & Lukšić, 2002). In fact, Canuto & Almeida (2022) systematically reviewed the literature on this subject and made clear that defensive rebounds and assists are the strongest game-related statistics for discriminating winning and losing teams. Notwithstanding, our present study adds new insights by means of the inclusion of advanced statistics analysis like field-goal scoring situation and Oliver's Four Factors.

A previous analysis of men's Olympic Tournament teams from Athens 2004 to Rio 2016 highlighted the importance of a high field-goal percentage when winning (Leicht, Gomez, et al., 2017). That should cause no surprise, considering that the objective of the game of basketball is to score more points than the opponent. There is even a popular saying that "basketball is a hit-or-miss game". Then, all the other technical aspects of the game should act to create opportunities for shooting and hitting as many shots as possible to increase victory odds (Lucey, Bialkowski, Carr, Yue, & Matthews, 2014). However, shot selection is not an easy task, after all, there are a lot of cues that players must realize to elucidate the go/no-go shooting decision (Alferink, Critchfield, Hitt, & Higgins, 2009; Skinner, 2012), including defensive players distance and pressure (Lucey et al., 2014). Nevertheless, present data demonstrated its crucial role for men's and women's teams willing to succeed. It is interesting to observe that albeit there is a trend for basketball teams to increase the frequency of 3-point field-goals (M. Á. Gómez, Medina, Leicht, Zhang, & Vaquera, 2020; Jaguszewski, 2020), neither men nor women's teams in our study presented these long-distance field-goals as a win/lose discriminant element (Table 4). Even though professional players tend to attempt more 3-point field-goals than amateur players (S.J. Ibáñez, Feu, García, Parejo, & Cañadas, 2009), even the best basketball shooters are used to find a hard time keeping a 40% 3-point field-goals percentage performance (Rolland, Vuillemot, Bos, & Rivière, 2020).

Although men's and women's winning teams have scored more points in the paint than losing ones this kind of field-goal situation was more decisive for women's teams to win than for men's ones. This seems consistent with the superior performance that women's winners showed on fastbreak which is a high effective way to score (Cárdenas et al., 2015; Conte, Favero, Niederhausen, Capranica, & Tessitore, 2017; Refoyo, Romarís, & Sampedro, 2009), especially in the paint (Conte et al., 2017). Men's winning team scored more points from turnovers than losing teams. Ibáñez et al. (2003) concluded that the more mistakes made, the more chances of being defeated in the match. In our results, the ability to score immediately after the opponent team loses the ball possession as a distinguishing component between winners and losers may represent not only offensive but also defensive efficacy.

Defensive rebounds could be interpreted as a mark of successful defensive actions since they only exist because the opposing team missed a field-goal or free-throw shot. The former missed shot may be a consequence of adequate positioning, aggressiveness, and quick displacement on the court (Trninić et al., 2002). Besides, most fastbreaks start due to defensive rebounds (Cárdenas et al., 2015; Trninić et al., 2002). Regarding the impact of offensive rebounds on the result of the game, it is noteworthy the fact that the field-goal percentage tends to be greater after an offensive rebound than after the change in ball possession (Csátaljay, James, Hughes, & Dancs, 2017). However, we did not find offensive rebound averages to be different from winning and losing teams or a key discriminant factor.

Winning and losing teams' effective field-goal percentage effect sizes were higher than those presented for men's college basketball teams (Conte et al., 2018). Likewise, these statistics prove to be an excellent discriminator for both men's and women's winning teams. However, gender similarities were restricted to this variable. While men's winners presented fewer turnovers, women's winners had higher free-throw rate. Free-throw rate was also higher among men's college winner teams (Conte et al., 2018). On the other hand, surprisingly, women's losing teams had more offensive

rebounds and higher offensive rebounding percentage than winning teams. Considering that there was no statistical difference for second-chance points, it can be assumed that despite the greater number of offensive rebounds, losing teams just failed on scoring even with an extra shot-clock span. These results are also compatible with a worse performance from losing teams in the 2-point field-goals. In particular, Conte et al. (2018) identified similar findings with no statistical differences for winning and losing male teams.

5. Practical Applications.

This kind of study has some typical limitations that must be addressed carefully for proper data interpretation. First, it analyzes numbers, not people, so, circumstances in which tactical-technical actions occurred are not usually considered. Decision-making, types of defensive and offensive systems, individual players' skills and characteristics, and shot-clock elapsed-time are some elements that could influence ball possession outcomes, and therefore match results. Second, in the present study, the sample size was not large enough to detect possible differences (Pérez-Ferreirós, Kalén, Gómez, & Rey, 2019). However, our results were indeed able to differentiate winning and losing teams. We could aggregate data from previous Olympic Basketball Tournaments to increase sample size, but this would bring other confounding variables regarding spectators' presence and attitude towards the teams (Böheim, Grübl, & Lackner, 2019; McHill & Chinoy, 2020), which we were eager to avoid.

6. Conclusions

In summary, discriminant analysis identified that both men and women's winning teams did a better job selecting the best shooting opportunity, especially on short- and mid-range shots, besides playing at a more collective style of play, and onto try not to grant the opposing team a second chance to score within the same ball possession. Men's winning teams hit more successful 2-point field-goals, are more careful with ball possession, and know how to turn defense on offense by scoring more points after an opposing team's turnover. Lastly, women's winning teams are more effective on scoring through fastbreak actions, recovering offensive rebounds less efficiently, and shooting proportionally a higher volume of free-throws.

Supplementary Materials: The following are available online at http://eurjhm.com/index.php/eurjhm, Figure S1: title, Table S1: title, Video S1: title.

Funding: This research was funded by CAPES, grant number 88887.482699/2020-00.

Acknowledgments: Non declare.

Conflicts of Interest: The authors declare no conflict of interest.

References

Alferink, L. A., Critchfield, T. S., Hitt, J. L., & Higgins, W. J. (2009). Generality of the matching law as a descriptor of shot selection in basketball. J Appl Behav Anal, 42(3), 595-608. https://doi.org/10.1901/jaba.2009.42-595

Böheim, R., Grübl, D., & Lackner, M. (2019). Choking under pressure: evidence of the causal effect of audience size on performance. J Econ Behav Org, 168, 76-93. https://doi.org/10.1016/j.jebo.2019.10.001

Canuto, S. C. & Almeida, M. B. (2022). Determinants of Basketball Match Outcome Based on Game-related Statistics: A Systematic Review and Meta-Analysis. Eur J Hum Mov, 48:4-20. https://doi.org/10.21134/eurjhm.2022.48.2

Canuto, S. C. M.; Santos, L. L. R.; Almeida, M. B. (2022). Longitudinal analysis of Brazilian basketball performance in 13 seasons of Novo Basquete Brasil. Scientia Plena, 18(4): 042801. https://doi.org/10.14808/sci.plena.2022.042801

Cárdenas, D., Ortega, E., Llorca, J., Courel, J., Sánchez-Delgado, G., & Isabel Piñar, M. (2015). Motor characteristics of fast break in

high level basketball. Kinesiology, 47(2.), 208-214.

Comrey, A. L., & Lee, H. B. (1992). A first course in factor analysis (2nd ed.). New York: Psychology Press.

Conte, D., Favero, T. G., Niederhausen, M., Capranica, L., & Tessitore, A. (2017). Determinants of the effectiveness of fast break actions in elite and sub-elite Italian men's basketball games. Biol Sport, 34(2), 177-183. https://doi.org/10.5114/biolsport.2017.65337

Conte, D., & Lukonaitiene, I. (2018). Scoring strategies differentiating between winning and losing teams during FIBA EuroBasket Women 2017. Sports (Basel), 6(2). https://doi.org/10.3390/sports6020050

Conte, D., Tessitore, A., Gjullin, A., Mackinnon, D., Lupo, C., & Favero, T. (2018). Investigating the game-related statistics and tactical profile in NCAA division I men's basketball games. Biol Sport, 35(2), 137-143. https://doi.org/10.5114/biolsport.2018.71602

Csataljay, G., James, N., Hughes, M., & Dancs, H. (2011). Pace as an influencing factor in basketball. In M. Hughes, H. Dancs, K. Nagyváradi, T. Polgár, N. James, G. Sporis, G. Vuckovic, & M. Jovanovi (Eds.), Research methods and performance analysis (Vol. 13). Sopron, Hungary: Routledge.

Csátaljay, G., James, N., Hughes, M., & Dancs, H. (2017). Analysis of influencing factors behind offensive rebounding performance in elite basketball. Int J Sports Sci Coaching, 12(6), 774-781. https://doi.org/10.1177/1747954117738900

García, J., Ibáñez, S. J., Santos, R. M., Leite, N., & Sampaio, J. (2013). Identifying basketball performance indicators in regular season and playoff games. J Hum Kinet, 36, 161. https://doi.org/10.2478/hukin-2013-0016

Gasperi, L., Conte, D., Leicht, A., & Gómez-Ruano, M. (2020). Game related statistics discriminate national and foreign players according to playing position and team ability in the Women's Basketball EuroLeague. Int J Environ Res Public Health, 17(15). https://doi.org/10.3390/ijerph17155507

Giovanini, B., Conte, D., Ferreira-Junior, A., & Nascimento, V. B. (2021). Assessing the key game-related statistics in Brazilian professional basketball according to season phase and final score difference. International Journal of Performance Analysis in Sport, 21(2), 295-305. https://doi.org/10.1080/24748668.2021.1881358

Gomes, J. H., Mendes, R. R., Almeida, M. B., Zanetti, M. C., Leite, G. S., & Ferreira Jr, A. J. (2017). Relationship between physical fitness and game related statistics in elite professional basketball players: Regular season vs. playoffs. Motriz: J Phys Ed, 23(2), e101626. https://doi.org/10.1590/S1980-6574201700020004

Gòmez, M., Lorenzo, A., Ortega, E., Sampaio, J., & Ibàñez, S. J. (2009). Game related statistics discriminating between starters and nonstarters players in Women's National Basketball Association League (WNBA). J Sports Sci Med, 8(2), 278-283.

Gómez, M. A., Ibáñez, S. J., Parejo, I., & Furley, P. (2017). The use of classification and regression tree when classifying winning and losing basketball teams. Kinesiology, 49(1), 47-56.

Gómez, M. A., Lorenzo, A., Barakat, R., Ortega, E., & Palao, J. M. (2008). Differences in game-related statistics of basketball performance by game location for men's winning and losing teams. Percept Mot Skills, 106(1), 43-50. https://doi.org/10.2466/pms.106.1.43-50

Gómez, M. A., Lorenzo, A., Sampaio, J., Ibáñez, S. J., & Ortega, E. (2008). Game-related statistics that discriminated winning and losing teams from the Spanish men's professional basketball teams. Coll Antropol, 32(2), 451-456.

Gómez, M. Á., Medina, R., Leicht, A. S., Zhang, S., & Vaquera, A. (2020). The performance evolution of match play styles in the Spanish Professional Basketball League. Appl Sci, 10(20), 7056. https://doi.org/10.3390/app10207056

Ibáñez, S., Sampaio, J., Sáenz-López, P., Giménez, J., & Janeira, M. (2003). Games statistics discriminating the final outcome of Junior World Basketball Championship matches. J Hum Mov Studies, 45, 1-19.

Ibáñez, S. J., Feu, S., García, J., Parejo, I., & Cañadas, M. (2009). Shot differences between professional (ACB) and amateur (EBA) basketball teams: multifactorial study Rev Psicol Deporte, 18(suppl.), 313-317.

Ibañez, S. J., Garcia-Rubio, J., Gómez, M. Á., & Gonzalez-Espinosa, S. (2018). The impact of rule modifications on elite basketball teams' performance. J Hum Kinet, 64, 181-193. https://doi.org/10.1515/hukin-2017-0193

Ibáñez, S. J., García, J., Feu, S., Lorenzo, A., & Sampaio, J. (2009). Effects of consecutive basketball games on the game-related statistics that discriminate winner and losing teams. J Sports Sci Med, 8(3), 458-462.

Jaguszewski, M. (2020). Increasing role of three-point field goals in National Basketball Association. TSS, 27(1), 5-11. https://doi.org/10.23829/TSS.2020.27.1-1

Jesus, C. S., Gomes, J. H., & Almeida, M. B. (2018). Effects of prior high-strength effort on technical-tactical performance in university basketball players. J Phys Educ, 29, e2977. https://doi.org/10.4025/jphyseduc.v29i1.2977

Leicht, A. S., Gomez, M. A., & Woods, C. T. (2017). Team performance indicators explain outcome during women's basketball matches at the Olympic Games. Sports (Basel), 5(4). https://doi.org/10.3390/sports5040096

Leicht, A. S., Gómez, M. A., & Woods, C. T. (2017). Explaining match outcome during the men's basketball tournament at the Olympic Games. J Sports Sci Med, 16(4), 468-473.

Lorenzo, A., Gómez, M., Ortega, E., Ibáñez, S. J., & Sampaio, J. (2010). Game related statistics which discriminate between winning and losing under-16 male basketball games. J Sports Sci Med, 9(4), 664-668.

Lorenzo, J., Lorenzo, A., Conte, D., & Giménez, M. (2019). Long-term analysis of elite basketball players' game-related statistics throughout their careers. Front Psychol, 10, 421. https://doi.org/10.3389/fpsyg.2019.00421

Lucey, P., Bialkowski, A., Carr, P., Yue, Y., & Matthews, I. (2014). How to get an open shot: analyzing team movement in basketball using tracking data. Paper presented at the MIT Sloan Sports Analytics Conference, Boston, MA, United States.

Madarame, H. (2017). Game-related statistics which discriminate between winning and losing teams in Asian and European men's basketball championships. Asian J Sports Medine, 8(2). https://doi.org/10.5812/asjsm.42727.

Madarame, H. (2018). Age and sex differences in game-related statistics which discriminate winners from losers in elite basketball games. Motriz: J Phys Ed, 24(1), e1018153. https://doi.org/10.1590/S1980-6574201800010001

Mandić, R., Jakovljević, S., Erčulj, F., & Štrumbelj, E. (2019). Trends in NBA and Euroleague basketball: analysis and comparison of statistical data from 2000 to 2017. PLoS One, 14(10), e0223524. https://doi.org/10.1371/journal.pone.0223524

McHill, A. W., & Chinoy, E. D. (2020). Utilizing the National Basketball Association's COVID-19 restart "bubble" to uncover the impact of travel and circadian disruption on athletic performance. Sci Rep, 10(1), 21827. https://doi.org/10.1038/s41598-020-78901-2

Mikołajec, K., Banyś, D., Żurowska-Cegielska, J., Zawartka, M., & Gryko, K. (2021). How to win the Basketball Euroleague? Game performance determining sports results during 2003-2016 matches. J Hum Kinet, 77, 287-296. https://doi.org/10.2478/hukin-2021-0050

Oliver, D. (2004). Basketball on paper: rules and tools for performance analysis. Washington, D.C.: Brassey's, Inc.

Özmen, M. U. (2016). Marginal contribution of game statistics to probability of winning at different levels of competition in basketball: evidence from the Euroleague. Int J Sports Sci Coaching, 11(1), 98-107. https://doi.org/10.1177/1747954115624828

Paulauskas, R., Masiulis, N., Vaquera, A., Figueira, B., & Sampaio, J. (2018). Basketball game-related statistics that discriminate between european players competing in the NBA and in the Euroleague. J Hum Kinet, 65, 225-233. https://doi.org/10.2478/hukin-2018-0030

Pérez-Ferreirós, A., Kalén, A., Gómez, M. Á., & Rey, E. (2019). Reliability of teams' game-related statistics in basketball: number of games required and minimal detectable change. Res Q Exerc Sport, 90(3), 297-306. https://doi.org/10.1080/02701367.2019.1597243

Puente, C., Del Coso, J., Salinero, J. J., & Abián-Vicén, J. (2015). Basketball performance indicators during the ACB regular season from 2003 to 2013. International Journal of Performance Analysis in Sport, 15(3), 935-948. https://doi.org/10.1080/24748668.2015.11868842

Refoyo, I., Romarís, I. U., & Sampedro, J. (2009). Analysis of men's and women's basketball fast-breaks. Rev Psicol Deporte, 18(3), 439-444.

Rolland, G., Vuillemot, R., Bos, W., & Rivière, N. (2020). Characterization of space and time-dependence of 3-point shots in basketball. Paper presented at the MIT Sloan Sports Analytics Conference, Boston, United States. https://hal.archives-ouvertes.fr/hal-02482706

Saavedra, J. M., Escalantel, Y., Madera, J., Mansilla, M., & García-Hermoso, A. (2014). Comparison of game-related statistics in men's international championships between winning and losing teams according to margin of victory. Coll Antropol, 38(3), 901-907.

Sampaio, J., Godoy, S. I., & Feu, S. (2004). Discriminative power of basketball game-related statistics by level of competition and sex. Percept Mot Skills, 99(3 Pt 2), 1231-1238. https://doi.org/10.2466/pms.99.3f.1231-1238

Sampaio, J., Ibáñez, S., Lorenzo, A., & Gómez, M. (2006). Discriminative game-related statistics between basketball starters and nonstarters when related to team quality and game outcome. Percept Mot Skills, 103(2), 486-494. https://doi.org/10.2466/pms.103.2.486-494

Sampaio, J., & Janeira, M. (2003). Statistical analyses of basketball team performance: understanding teams' wins and losses according to a different index of ball possessions. International Journal of Performance Analysis in Sport, 3(1), 40-49. https://doi.org/10.1080/24748668.2003.11868273

Santos, Y. Y. S., Monezi, L. A., Misuta, M. S., & Mercadante, L. A. (2018). Technical Indicators registered as a function of the playing time in Brazilian basketball. Rev Bras Cineantropom Desempenho Hum, 20(2), 172-181. https://doi.org/10.1590/1980-0037.2018v20n2p172

Sawilowsky, S. S. (2009). New effect size rules of thumb. Journal of Modern Applied Statistical Methods, 8(2), 597-599. https://doi.org/10.22237/jmasm/1257035100

Skinner, B. (2012). The problem of shot selection in basketball. PLoS One, 7(1), e30776. https://doi.org/10.1371/journal.pone.0030776

Tabachnick, B. G., & Fidell, L. S. (2019). Using multivariate statistics (7th ed.). Boston: Pearson.

Trninić, S., Dizdar, D., & Lukšić, E. (2002). Differences between winning and defeated top quality basketball teams in final tournaments of European club championship. Coll Antropol, 26(2), 521-531.

Zhai, Z., Guo, Y., Zhang, S., Li, Y., & Liu, H. (2020). Explaining positional differences of performance profiles for the elite female basketball players. Front Psychol, 11, 558750. https://doi.org/10.3389/fpsyg.2020.558750