

Game-Related Statistics Which Discriminate Between Winning and Losing Teams in Asian and European Men's Basketball Championships

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Abstract

Background: Basketball is one of the most popular sports in the world. However, men's national teams of Asian countries have not performed well at world-level competitions such as Olympic and world cup games. Clarifying the feature of Asian basketball games would be some help to improve the competitiveness of Asian teams.

Objectives: This study aimed to identify game-related statistics which discriminate between winning and losing teams in Asian men's basketball competitions. In addition, European competitions were also analyzed and the results were compared between Asian and European competitions.

Methods: A total of 179 games from the 2011, 2013 and 2015 FIBA Asia Championships were analyzed for Asian competitions, and a total of 259 games from the 2011, 2013 and 2015 FIBA EuroBasket were analyzed for European competitions. All games were classified into three types (balanced, unbalanced and very unbalanced) according to point differential. A discriminant analysis was performed to identify game-related statistics which discriminate between winning and losing teams.

Results: In European competitions, 76% of the games were classified into balanced games and none of the games was classified into very unbalanced games. In Asian competitions, on the other hand, only 48% of the games were classified into balanced games and 15% of the games were classified into very unbalanced games. In balanced games, defensive rebounds and assists discriminated between winning and losing teams in Asian competitions whereas defensive rebounds did so in European competitions. In unbalanced games, successful 2-point field goals, defensive rebounds and assists discriminated between winning and losing teams in both Asian and European competitions.

Conclusions: Asian competitions had higher proportions of unbalanced and very unbalanced games than European competitions. However, a discriminant analysis, which was performed independently for each type of game, showed similar results between Asian and European competitions. The only difference was observed in balanced games' assists which discriminated between winning and losing teams in Asian competitions but not in European competitions.

Keywords: Athletic Performance, Basketball, Discriminant Analysis, Sports

1. Background

Basketball is one of the most popular sports in the world. At 2016, the international basketball federation (FIBA) is composed of 215 national federations from all over the world (1). Despite its popularity, however, the competitive level of basketball differs among the regions of the world. Men's national teams of Asian countries have not performed well at world-level competitions such as Olympic and world cup games. In the FIBA world ranking updated at August 21, 2016 (2), China ranks 14 and is the highest among Asian countries.

Since the outcome of a basketball game is affected by various factors such as anthropometric (3, 4), physiological (5, 6) and tactical (7, 8) factors, basketball has been studied by various methods. In recent years, performance analyses of basketball games have been especially growing mostly lead by Gomez and colleagues (9-

14). They have conducted dynamic analyses and complex analyses, which have focused on, for example, ball possessions, tactics and situational variables. In addition to these analyses, discriminant analyses of game-related statistics have been widely performed to quantitatively clarify the feature of basketball games (15-21). Although this analysis has been conducted to identify game-related statistics which discriminate between winning and losing teams in a certain league or tournament, previous studies published in major English-language journals have been limited to world-level competitions or professional leagues in western countries (15-18). It has been demonstrated that discriminating statistics vary according to several factors such as gender (18), age (16) and game locations (22). Therefore, game-related statistics which discriminate between winning and losing teams in Asian competitions might be different from those in other regions' competitions.

2. Objectives

This study aimed to identify game-related statistics which discriminate between winning and losing teams in Asian men's basketball competitions. In addition, European competitions were also analyzed by the same method and the results were compared between Asian and European competitions in order to clarify the features of Asian basketball games. European competitions were chosen for comparison because six European teams were in the top 10 of the FIBA World Ranking while no Asian teams were in (2). Clarifying the feature of Asian basketball games would be some help to improve the competitiveness of Asian teams.

3. Methods

3.1. Sample and Variables

A total of 179 games from the 2011 (n = 60), 2013 (n = 57) and 2015 (n = 62) FIBA Asia Championships were analyzed for Asian competitions, and a total of 259 games from the 2011 (n = 90), 2013 (n = 90) and 2015 (n = 79) FIBA EuroBasket were analyzed for European competitions. Data were obtained from the official box scores of the FIBA. This study combined competitions from multiple years to increase the statistical power but was limited to competitions held after 2010 to eliminate any influence of major rule changes (23, 24) which have become effective since October 1, 2010.

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 and fouls committed. These variables were normalized to 100 game ball possessions (15-18) in order to eliminate the effect of game rhythm. Game ball possessions were calculated as an average of team ball possessions of both teams (25). Team ball possessions (TBP) were calculated from field goal attempts (FGA), offensive rebounds (ORB), turnovers (TO) and free throw attempts (FTA) using the following equation (25):

$$\text{TBP} = \text{FGA} - \text{ORB} + \text{TO} + 0.4 \times \text{FTA}$$

3.2. Statistical Analysis

Statistical analyses were performed with R version 3.3.0 for Windows (26). Unless otherwise stated, $P < 0.05$ was considered significant. A k-means cluster analysis was performed using R package "classInt" (27) to classify the games into three types (balanced, unbalanced and very unbalanced) according to point differential (16, 28, 29). A chi-square test was used to analyze the difference in the proportion of game types between Asian and European competitions. After the analysis, very unbalanced games were

eliminated from further analyses. The difference between winning and losing teams in each variable was analyzed by an unpaired t-test. A discriminant analysis was performed using R code "candis" (30) and "geneig" (31) to identify game-related statistics which discriminate between winning and losing teams in each game type. An absolute value of a structural coefficient greater than 0.30 was considered relevant for discrimination between winning and losing teams (15-18, 22).

4. Results

Game classification made by a k-means cluster analysis is shown in Table 1. The chi-square test was significant ($P < 0.01$), indicating a difference in the proportion of game types between Asian and European competitions.

Table 1. Game Classification by Final Point Differentials^a

Variables	Balanced	Unbalanced	Very Unbalanced
Point differential	≤ 15	16 to 39	≥ 40
Asia, number (%)	86 (48)	66 (37)	27 (15)
Europe, number (%)	196 (76)	63 (24)	0 (0)

^a $\chi^2 = 57.3$; $P < 0.01$.

Results of an unpaired t-test and a discriminant analysis are shown in Tables 2 and 3. In balanced games, a significant difference between winning and losing teams was observed in successful 2-point field goals, successful free throws, unsuccessful free throws, defensive rebounds, assists and fouls in Asian competitions ($P < 0.05$), whereas it was observed in successful 2-point field goals, successful 3-point field goals, unsuccessful 3-point field goals, successful free throws, defensive rebounds, assists, steals, blocks and fouls in European competitions ($P < 0.05$). In unbalanced games, a significant difference was found in each variable ($P < 0.05$) in both Asian and European competitions except in unsuccessful free throws ($P < 0.05$, only in Asian competitions) and offensive rebounds (not significant in both Asian and European competitions).

Absolute values of SC are presented in Figure 1. In balanced games, defensive rebounds ($|\text{SC}| = 0.36$) and assists ($|\text{SC}| = 0.35$) discriminated between winning and losing teams in Asian competitions whereas defensive rebounds ($|\text{SC}| = 0.32$) did in European competitions. In unbalanced games, successful 2-point field goals (Asia, $|\text{SC}| = 0.37$; Europe, $|\text{SC}| = 0.33$), defensive rebounds (Asia, $|\text{SC}| = 0.39$; Europe, $|\text{SC}| = 0.33$) and assists (Asia, $|\text{SC}| = 0.42$; Europe, $|\text{SC}| = 0.33$) discriminated between winning and losing teams in both Asian and European competitions.

Table 2. Game-Related Statistics of Balanced Games

Variables	Asia					Europe					
	Winners		Losers		SC	Winners		Losers		SC	
	Mean	SD	Mean	SD		Mean	SD	Mean	SD		
Successful 2-point field goals ^{a, b}	27.5	6.3	25.1	5.5	0.26	30.0	6.6	27.6	6.3	0.20	
Unsuccessful 2-point field goals	29.8	8.0	31.8	6.6	-0.18	29.3	7.4	29.9	7.3	-0.05	
Successful 3-point field goals ^b	9.6	4.0	8.8	3.5	0.14	10.6	4.0	9.7	3.7	0.13	
Unsuccessful 3-point field goals ^b	20.7	6.2	21.5	5.3	-0.09	19.3	6.1	22.2	5.9	-0.27	
Successful free throws ^{a, b}	21.9	12.9	17.5	6.2	0.28	22.8	8.1	19.7	7.8	0.21	
Unsuccessful free throws ^a	10.4	6.2	8.5	4.7	0.23	8.0	3.8	8.0	4.1	0.01	
Defensive rebounds ^{a, b}	39.0	6.2	35.7	5.7	0.36	38.5	6.7	34.7	6.4	0.32	
Offensive rebounds	18.6	7.5	16.8	5.3	0.17	16.1	6.1	15.4	6.2	0.06	
Assists ^{a, b}	19.2	5.9	16.2	5.3	0.35	23.5	7.4	20.5	7.1	0.22	
Steals ^b	8.4	4.6	7.4	3.5	0.16	7.9	3.7	7.0	3.5	0.13	
Turnovers	17.8	5.1	19.4	5.4	-0.19	18.3	5.7	19.0	5.2	-0.08	
Blocks ^b	3.8	2.9	3.4	2.6	0.09	3.9	2.9	3.1	2.1	0.17	
Fouls ^{a, b}	25.6	5.9	29.5	10.5	-0.30	31.6	5.7	32.8	5.6	-0.11	
Eigenvalue						0.6					
Wilks' Lambda						0.63					
Chi-square						76.6					
P						< 0.01					
Canonical correlation						0.61					
Reclassification, %						81					

Abbreviate: SC, Structural Coefficient.

^aA significant difference exists between winning and losing teams in Asian games ($P < 0.05$).

^bA significant difference exists between winning and losing teams in European games ($P < 0.05$).

5. Discussion

The purpose of this study was to identify game-related statistics that discriminate between winning and losing teams in Asian men's basketball competitions. In addition, European competitions were also analyzed by the same method and the results were compared between Asian and European competitions in order to clarify the feature of Asian basketball games.

Prior to a discriminant analysis, all games were classified into three types according to point differential. The proportion of the game types significantly differed between Asian and European competitions. In European competitions, 76% of the games were classified into balanced games and none of the games was classified into very unbalanced games. In Asian competitions, on the other hand, only 48% of the games were classified into balanced games and 15% of the games were classified into very unbalanced games. This result indicates a huge disparity in team strength between strong and weak teams in Asian competitions. Reducing the disparity would in part contribute to improving the competitiveness of Asian teams through intensified competition in the region.

In balanced games, defensive rebounds discriminated between winning and losing teams in both Asian and Eu-

ropean competitions. Getting a defensive rebound is important because it ends a possession of the opponent team and starts the offense of the own team. A number of studies have shown that defensive rebounds discriminate between winning and losing teams (15-18, 29).

Along with defensive rebounds, assists have been demonstrated as a discriminating factor between winning and losing teams in basketball games (15, 16, 18). In balanced games, assists discriminated between winning and losing teams only in Asian competitions, indicating the importance of assists for winning in tight games in Asian competitions. It should be noted, however, that the number of assists per 100 ball possessions was greater in European competitions than in Asian competitions in both winning and losing teams. Therefore, although it is difficult to make a definitive conclusion from the result, the difference in passing skills between a good passing team and a bad passing team may be larger in Asian teams than in European teams.

In unbalanced games, a discriminant analysis showed very similar results between Asian and European competitions. Successful 2-point field goals, defensive rebounds and assists discriminated between winning and losing teams in both Asian and European competitions. This result is consistent with a previous study by Gomez et al. (15).

Table 3. Game-Related Statistics of Unbalanced Games

Variables	Asia					Europe				
	Winners		Losers		SC	Winners		Losers		SC
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Successful 2-point field goals ^{a, b}	31.5	5.9	21.8	5.0	-0.37	34.1	6.3	24.3	5.1	0.33
Unsuccessful 2-point field goals ^{a, b}	26.8	6.5	34.0	8.0	0.20	25.4	7.6	33.0	7.3	-0.20
Successful 3-point field goals ^{a, b}	11.6	4.7	8.2	3.4	-0.17	12.0	5.0	8.8	3.8	0.14
Unsuccessful 3-point field goals ^{a, b}	19.1	7.0	21.6	6.3	0.08	18.4	6.1	22.4	7.5	-0.12
Successful free throws ^{a, b}	19.0	9.8	13.0	6.0	-0.15	20.6	8.3	16.1	6.0	0.12
Unsuccessful free throws ^a	9.1	6.2	7.1	3.9	-0.08	8.3	4.2	7.5	4.4	0.03
Defensive rebounds ^{a, b}	41.8	5.5	31.8	5.2	-0.39	42.2	6.2	31.1	7.2	0.33
Offensive rebounds	17.9	6.8	16.1	6.6	-0.05	15.9	4.4	15.3	5.1	0.02
Assists ^{a, b}	25.6	6.5	14.1	4.4	-0.42	29.6	7.1	18.6	5.9	0.33
Steals ^{a, b}	10.4	4.7	7.0	3.1	-0.18	9.6	4.1	6.8	3.3	0.15
Turnovers ^{a, b}	17.7	4.7	22.5	6.3	0.18	18.4	5.8	21.3	5.4	-0.10
Blocks ^{a, b}	3.8	2.6	2.5	2.0	-0.11	4.6	3.0	2.7	2.4	0.14
Fouls ^{a, b}	23.1	5.4	26.0	10.2	0.07	29.0	5.6	31.8	7.1	-0.09
Eigenvalue					5.97					6.58
Wilks' Lambda					0.14					0.13
Chi-square					239.7					237.9
P					< 0.01					< 0.01
Canonical correlation					0.93					0.93
Reclassification, %					100					99

Abbreviation: SC, Structural Coefficient.

^a A significant difference exists between winning and losing teams in Asian games ($P < 0.05$).^b A significant difference exists between winning and losing teams in European games ($P < 0.05$).

In the study, they analyzed 306 games in the Spanish Men's professional league and demonstrated that successful 2-point field goals, defensive rebounds and assists discriminated between winning and losing teams in unbalanced games.

As described in the Introduction, results of world-level competitions and the FIBA world ranking (2) clearly demonstrate that Asian teams are generally inferior to European teams. In this study, however, a discriminant analysis shows similar results between Asian and European competitions, indicating that a fundamental feature of basketball game would be similar between the two regions. Therefore, the difference in team strength between the two regions would be attributed to factors which cannot be detected by this analysis. One of the factors might be individual players' ability and/or experience. In contrast to European players, there are very few Asian players who have played in top-level professional leagues. In the national Basketball Association (NBA), for example, no Asian players were listed in opening night rosters for the 2016 - 2017 season while 61 European players were listed in (32).

5.1. Conclusion

Asian competitions had higher proportions of unbalanced and very unbalanced games than European com-

petitions. However, a discriminant analysis, which was performed independently for each type (balanced and unbalanced) of game, showed similar results between Asian and European competitions. In balanced games, defensive rebounds discriminated between winning and losing teams in both Asian and European competitions. In unbalanced games, successful 2-point field goals, defensive rebounds and assists discriminated between winning and losing teams in both Asian and European competitions. The only difference was observed in balanced games' assists which discriminated between winning and losing teams in Asian competitions but not in European competitions.

Limitations of this study should be noted. Since the result of this study was derived only from 13 game-related statistics, details of the games have not been fully investigated. George et al. (33), for example, conducted a study focused on "inside game" of basketball, and reported a difference in proportion of the player's position who received a pass in the post between NBA and Euroleague. Therefore, a more detailed analysis might reveal a difference between Asian and European competitions.

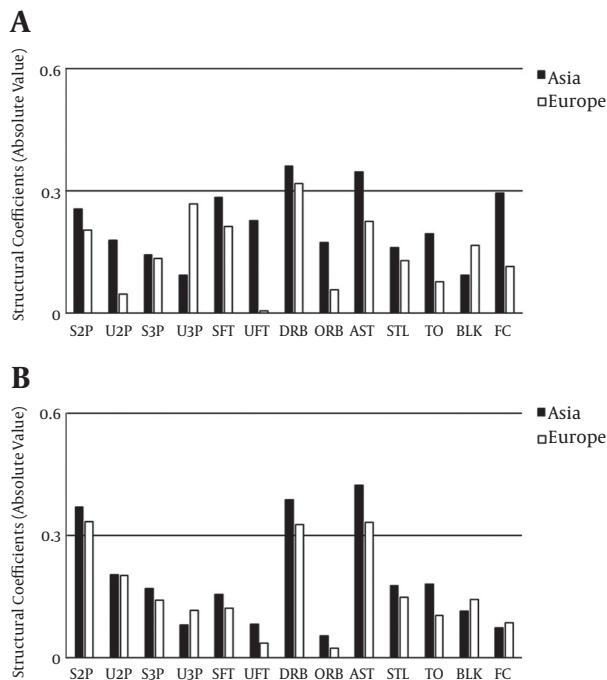


Figure 1. Structural Coefficients of Game-Related Statistics in Balanced (A) and Unbalanced (B) Games. S2P, Successful 2-Point Field Goals; U2P, Unsuccessful 2-Point Field Goals; S3P, Successful 3-Point Field Goals; U3P, Unsuccessful 3-Point Field Goals; SFT, Successful Free Throws; UFT, Unsuccessful Free Throws; DRB, Defensive Rebounds; ORB, Offensive Rebounds; AST, Assists; STL, Steals; TO, Turnovers; BLK, Blocks; FC, Fouls Committed

Footnote

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