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THE EFFECTS OF RULE CHANGES ON BASKETBALL GAME RESULTS IN THE MEN'S EUROPEAN BASKETBALL CHAMPIONSHIPS

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ABSTRACT
Purpose. The aim the study was to analyze the effects of rule changes in men's professional basketball. Univariate analysis examined game statistics, concentrating only on points scores from selected basketball games and did not include situational variables that may have affected game dynamics. **Methods.** Data on the results of all games played in the men's European Basketball Championships between 1935 and 2013 were collected and subjected to statistical analysis. Six main rule modifications which directly affected game play were identified in chronological order. **Results.** The number of points scored and allowed changed significantly after 1956. The greatest changes in game scores as a result of rule modifications were after rule changes in 1956 and after 1984. **Conclusions.** Rule changes involve processes that modify game conditions and should be validated following reflective analysis.

Key words: basketball, rules of the game, sports championships, statistical analysis

Introduction

Along with the increased popularity of basketball, multiple adjustments have been introduced to the organizational framework of the game by international sports organizations [1–3]. Since 1892, the rules of basketball have undergone many fundamental changes, steps which have led to changes in playing dynamics.

Arias et al. [4] has proposed two types of basic sport rules. The first type of rules refer to internal logic and define the criteria that mark the relationships between a player and the rest of the team, time, spatial boundaries, and game equipment. The second are based on external logic and constitute the criteria that are nonessential to game play including the nature of a sporting event, the scoring system, team differentiators, or playing seasons. Although these elements are not directly intertwined with game 'actions', they can nonetheless affect game dynamics.

When considering team sports played at the competitive level, key elements include the specific methodology of how a score is calculated, the official rules and regulations determining the principles of competition, and the procedures behind team qualification, promotion, or elimination. Competitive success is translated by the standing of teams according to their scores. Tables containing comparative data on various sports results are common in professional sports, where the main purpose of such statistics is to summarize a competitive season, sports event, the achievements of individual players, or to provide various comparative analyses in a given time and space. A sports result in a team sport is measured directly by the points scored and lost in a game according to the formula

$$ST \rightarrow \{(SE_1 sr_1)\ (SE_2\, sr_2)\} \rightarrow s_o$$

where: ST – sports team, SE_j – a given sports event, Sr_j – score at the sports event, and s_o – standing after the sports event.

When considering a team sport such as basketball, history shows that a number of rule modifications have been introduced. The six 'basketball paradigms' having the most direct impact on game play are, (1) by 1915 a) standardizing the usage of backboards and metal hoops with bottomless nets, b) setting the free-throw line 4.5 m from the backboard, c) allowing only five players from each team to be on the court at one time, d) ejecting a player after committing four fouls, e) awarding a successful shot from the court with two points, and f) replacing the soccer ball with a special purpose-built basketball; (2) by the 1956 Melbourne Olympic Games a) the game was expanded by introducing the 3-s rule and the 30-s shot clock after gaining possession of the ball; (3) by 1984 a) introducing the three-point shot from behind a 6.25 m line, b) enlarging the basketball court, c) modifying of the 5- and 30-s rules, d) having seven team fouls in a quarter result in a 'one-and-one' free throw; (4) by 1994 a) having basketball matches divided into two 20-min halves or four 12-min quarters, b) introducing two free throws after seven team fouls in one half of a game; (5) by 2000 a) dividing a basketball game into four 10-min quarters, b) introducing two free throws after four team fouls are committed in a quarter, c) shortening the requirement for a team to advance the ball over the center line within

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10 s of ball possession to 8 s, d) reducing the weight of the official basketball for women; and (6) since 2010 a) moving the three-point line back to 6.75 m, b) changing the shape of the key from a trapezoid to a rectangle, c) introducing the restricted area arc with a marginally wider radius of 1.25 m, d) modifying the 24-s rule, e) introducing stricter penalties for flagrant fouls, especially for unsportsmanlike behavior; f) relaxing restrictions on traveling and illegally returning the ball to the back of the court.

The aim of the present study was to analyze the effects of the above rule modifications on point scoring in basketball and explore any developmental tendencies. To the authors' knowledge, no studies from the sphere of team sports theory, especially on basketball, have attempted to directly assess the impact of rule modifications on scores. Such enquiry could serve as a basis for understanding the future evolution of game outcomes.

Due to its long history (78 years), it was decided to focus on the Men's European Basketball Championships. Given the aim of the study, the following research questions were posed:

1. How has the structure of point scoring in men's professional basketball developed over the examined period?

2. Which of the changes in the rules of basketball (the six chronological 'paradigms') influenced the evolution of scoring to the greatest extent?

Material and methods

The study analyzed the game results from 38 Men's European Basketball Championships from 1935 to 2013, i.e. beginning with the first championship in Switzerland to the most recent event held in Slovenia. Data were obtained directly from the FIBA Europe website [5] and from Ströher [2]. The study protocol was approved by the ethics committee of the Poznań University of Physical Education and conducted according to the Declaration of Helsinki.

Statistical analysis involved a summary description of all data using basic statistical methods (measures of location, spread, and shape). The arithmetic means, medians, interquartile ranges, and standard deviations were calculated for the number of points scored (PS) and points allowed (PA).

Significant differences between the mean ranks for PS and PA were grouped for each rule paradigm (Rule Changes 1–6) using the Kruskal–Wallis test (as a nonparametric alternative to one-way ANOVA) to allow for multiple comparisons. All statistical procedures were performed using Statistica 9.1. software (Statsoft, USA) with the significance level set at $p < 0.05$.

Results

Table 1 presents the data for all 45 national teams who had participated in the 38 European Basketball Championships, including those from currently defunct states. It is worth noting that 11 national teams participated in more than half of the European Championships. Altogether only 34 national teams advanced to qualify in the European Championships, this decrease had no effect on the standings of the top five teams. Moreover, after the division of the basketball games into halves and quarters, the ranking leaders remained the same: Spain, France, Russia (divided into quarters – 16 teams) and Italy, Yugoslavia, Czechoslovakia (divided into halves – 30 teams). These data illustrate that the performance level of European national basketball teams remained relatively fixed over the studied timeframe.

Table 2 presents the basic descriptive statistics for points scored and allowed in all the basketball matches played in the European Basketball Championships.

Table 1. Participation of national teams in the Men's European Basketball Championships (1935–2013)

No.	Nat. team	*n*	%	No.	Nat. team	*n*	%	No.	Nat. team	*n*	%
1	France	36	94.7	16	Netherlands	13	34.2	31	Egypt	4	10.5
2	Italy	35	92.1	17	Lithuania	12	31.6	32	Estonia	4	10.5
3	Spain	29	76.3	18	Latvia	12	31.6	33	Serbia	4	10.5
4	Czechoslovakia	27	71.1	19	Federal Republic of Germany	12	31.6	34	Macedonia	4	10.5
5	Poland	27	71.1	20	Russia	11	28.9	35	Luxembourg	3	7.9
6	Israel	27	71.1	21	Croatia	11	28.9	36	Great Britain	3	7.9
7	Yugoslavia	26	68.4	22	Slovenia	11	28.9	37	Serbia and Montenegro	2	5.3
8	Bulgaria	24	63.2	23	Sweden	11	28,9	38	Libya	2	5.3
9	Greece	24	63.2	24	Germany	10	26.3	39	Albania	2	5.3
10	Turkey	22	57.9	25	Bosnia and Herzegovina	8	21.1	40	Portugal	2	5.3
11	USSR	21	55.3	26	Austria	6	15.8	41	Georgia	2	5.3
12	Romania	17	44.7	27	Ukraine	6	15.8	42	Montenegro	2	5.3
13	Hungary	15	39.5	28	Switzerland	5	13.2	43	Syria	1	2.6
14	Belgium	14	36.8	29	German Democratic Republic	5	13.2	44	Scotland	1	2.6
15	Finland	14	36.8	30	England	5	13.2	45	Iran	1	2.6

Table 2. Descriptive statistics for points scored (PS) and points allowed (PA)

Total	PS	PA
Number of measurements	3720	3720
Minimum	0	0
Lower quartile	67.0	67.0
Marginal median	71.0	71.0
Arithmetic mean	69.9	69.9
Upper quartile	83.0	83.0
Maximum	140	140
Standard deviation	20.01	20.02
Coefficient of variation (%)	28.62	28.64

The results were calculated for a maximum of 11 consecutive European Championship games. Only in one case, the 2011 European Championships, did the Spanish national team play twelve consecutive tournament matches.

A detailed comparison of points scored (PS) and points allowed (PA) in the individual championship games showed that the vast majority of the statistical values favored comparisons made between games divided into quarters. This applied mainly to the arithmetic mean, marginal median, standard deviation, and coefficient of variation.

The minimum number of PS and PA in all analyzed championship games was 0 points in the 1937 Championships between Latvia – Egypt (2:0) and Czechoslovakia – Egypt (2:0). The maximum number of PS and PA was 140 points in the 1955 Championships between Poland – England (140:44). The variability in points scored and lost in all examined games was average (below 30%). There was a noticeable dispersion of PS and PA before the introduction of the rules encompassed in Change 1. Variance between PS and PA can be observed after the introduction of Change 1. After the rules were modified as per Change 2, the number of points (PS and PA) reached similar levels. PS and PA approached values similar to the median after the introduction of Change 4 and subsequent rule modifications.

The Kruskal–Wallis test revealed statistically significant differences between the successive rule changes. Multiple comparisons analysis showed no differences between Changes 2 and 4, 2 and 6, 4 and 5, and 5 and 6. Statistically significant differences were observed between Change 2 and Change 3 and Change 3 and Change 4 with respect to PS in most of the championship games. These results highlight the effects of introducing the three-point shot and time restrictions on offensive play.

Similar results were obtained for PA. No statistically significant differences were observed between Changes 2 and 4, 2 and 6, 4 and 5, and 4 and 6 (Table 3 and 4). Only the differences between Change 3 and Change 2 were statistically significant in the majority of the championship games. A similar relationship was found between Change 3 and 4. No differences between PS and PA were found in any of the rule modifications (Rule Changes 1–6).

Discussion

The rules of basketball refer to both internal logic and external logic. Rules of internal logic may be structural or functional. Structural rules are static and determine the quantitative aspects of game space, time,

Table 3. Multiple comparisons; *p* values for points scored (PS)

	Change 1	Change 2	Change 3	Change 4	Change 5	Change 6
	R:935,11	R:1952,1	R:2802,8	R:2130,3	R:2148,2	R:2079,5
Change 1		0.000	0.000	0.000	0.000	0.000
Change 2	0.000		0.000	0.084	0.009	1.000
Change 3	0.000	0.000		0.000	0.000	0.000
Change 4	0.000	0.084	0.000		1.000	1.000
Change 5	0.000	0.009	0.000	1.000		1.000
Change 6	0.000	1.000	0.000	1.000	1.000	

Table 4. Multiple comparisons; *p* values for points allowed (PA)

	Change 1	Change 2	Change 3	Change 4	Change 5	Change 6
	R:935,93	R:1952,5	R:2806,9	R:2128,6	R:2144,6	R:2075,8
Change 1		0.000	0.000	0.000	0.000	0.000
Change 2	0.000		0.000	0.093	0.012	1.000
Change 3	0.000	0.000		0.000	0.000	0.000
Change 4	0.000	0.093	0.000		1.000	1.000
Change 5	0.000	0.012	0.000	1.000		1.000
Change 6	0.000	1.000	0.000	1.000	1.000	

equipment, and the number of players necessary for game play. Functional rules are qualitative in nature and determine the form and use of structural elements and indicate obligations, rights, and prohibitions concerning space, time, equipment, and relationships with other players. One example of a structural rule in basketball would be how many players per team can be found in a given area at the same time, whereas a functional rule would determine what form of body contact is permitted between players and, if exceeded, what penalties apply. Although the internal logic of a sport is not explained exclusively by its rules, they should define all the conditions necessary to play the game while allowing for certain freedom in athlete behavior. This variation, along with the inherent complexity of all the variables that can affect game play, makes it difficult to determine the exact implications of rule changes [4].

Most studies researching the dynamics of basketball usually are based on a singular analysis of competitive results [6–8]. Researchers analyzing basketball statistics can be divided into two groups. The first deals with indicators describing situational efficiency whereas the second uses various methods to assess basketball players during game play. Most of the assessment procedures use simple, one-factor models that do not consider the relationships between numerous causal variables influencing the dependent variable (the score.

Earlier studies on elite basketball by Gómez et al. [9], Durković et al. [10], Ibáñez et al. [11], Karipidis et al. [12], Pojskić et al. [13], Šeparović and Nuhanović [14, 15], Trninić et al. [3] attempted to determine which game-related statistical parameters best discriminated winning and losing basketball teams. Other studies searched for correlations between various game-related parameters and the win–loss record. Melnick [16] analyzed five NBA seasons to determine a relationship between team assists and team success. However, there have been very few studies on the effects of rule modifications and game outcomes. This is important as objective data are required to determine if certain game rules ought to be changed [17–21]. Rule changes directly affecting game outcomes in top-level basketball constitute an immensely complicated process determined by multiple factors. The identification, verification, and understanding of these factors is indispensable for coaching purposes and requires the application of complex analytical research methods [9, 11, 12, 15, 22, 23].

Performance analyses in basketball is a fundamental tool for coaches, allowing them to obtain valid and reliable information on their team and competitors. This information can be used to not only identify the most valuable players but also determine the importance of specific roles as well as evaluate the performance of starting players and substitutes [24, 25]. Such analysis can determine how each player contributes to team performance [26] as well as assess the impact of rule changes on game results [27].

The aim of the present study was to determine the effects of rule changes on scoring by examining the results in the European Basketball Championships over the last decades. Rule changes modify the game conditions with a certain goal in mind. For example, in 2000 the International Basketball Federation (FIBA) changed the rules of basketball in Europe to speed up offensive play with hopes of increasing viewership and attracting more sponsors. This was performed by reducing backcourt time from 10 to 8 s and the shot clock from 30 to 24 s. These changes in combination with the continuous improvement of defensive tactics significantly altered offensive play.

However, the results of the present study show that successive changes in official rules have not always had a direct impact on sports outcomes. The number of points scores and points allowed changed significantly as a consequence of such modifications starting from 1956. The largest effect on the pace of a basketball game, and indirectly on the number of scored points, was a decrease in shot time and rules on advancing the ball over the center line.

The greatest changes in game scores were noted following the introduction of Changes 2 and 3. In particular, Change 3 decidedly increased the number of scored and allowed points in the matches under study. Similar observations were also made by Gomez et al. [27] and Ibáñez et al. [11]. This suggests a quickened game pace [28] and indicative of better physical parameters permitting more intensive defensive play, more physical contact, and game play based on defensive rebounds to gain ball possession and the use of fouls to block offensive.

Therefore, it is possible to distinguish two explanations for rule changes in basketball. The first is the need to modify the accepted threshold of poor sporting behavior. The second is the need to modify game dynamics and motor demands, allowing the game to improve over time. Such changes help smooth out game play and facilitate referring and resolve in-game contentions. Rule changes also help improve the game's popularity among spectators. Future changes in basketball may involve increased time restrictions to enhance viewership by increased game dynamics. Other changes could include moving the three-point line by a few centimeters, requiring a greater development of player techniques and skills.

Conclusions

The present study is novel as no other studies in the literature have analyzed the effects of rule modifications in basketball on game results. Since the data set used in the study is relatively small, any conclusions can be considered arbitrary and demand additional examination. However, future research should concentrate on data originating from teams of a similar competitive level.

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