ORIGINAL ARTICLE

TRENDS in
Sport Sciences
2024; 31(**4**): 207-213
ISSN 2299-9590
DOI: 10.23829/TSS.2024.31.4-2

Evolution of three-point field goals shooting trends in EuroLeague basketball

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Abstract

Introduction. Sports analytics in basketball plays a crucial role in devising innovative game strategies, enhancing scoring opportunities, and achieving greater success. A role of a three-point shot in the EuroLeague basketball has been greatly influenced by analytics, evolving from a sporadically used tool to a fundamental aspect of basketball strategy. Aim of Study. This study examined shot distribution and effectiveness, identifying trends in shooting patterns across 12 seasons of the EuroLeague basketball. Material and Methods. A total of 2812 games were analyzed from the 2010-2011 season to the 2022-2023 season of the EuroLeague, divided into three year groups. In order to examine if there was significant growth in the role of three-point shots, the following statistics were considered: a coefficient (3PA/FGA%) of Three-Point Field Goal Attempts (3PA) and Field Goal Attempts (FGA) per game, a coefficient (3PM/FGM%) of Three-Point Field Goals Made (3PM) and Field Goal Made (FGM), and other various statistics related to shot attempts, shot accuracy, and overall scoring performance, including percentages and counts for both two-point and three-point shots. Results. The number of 3PA significantly increased over the year groups, rising from 20.16 to 24.07 shots per game ($p < 0.001$). Significant growth in 3PA/FGA% (5.74%, $p < 0.001$) and 3PM/FGM% (4.95%, $p < 0.001$) was observed over the years, followed by an increase in 3PM and Three-Point Field Goals Percentage – 3P% ($p < 0.001$). Although there was a decrease in Two-Points Shot Attempts (2PA) from 39.55 to 36.77 shots per game ($p < 0.001$), its efficacy increased. Conclusions. The growing prominence of three-pointers underscores their importance in contemporary basketball, despite initially being overlooked as a game-changing factor.

KEYWORDS: basketball, EuroLeague, three-point field goals, three-pointers efficacy, two-point field goals.

Received: 5 March 2024
Accepted: 26 September 2024

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Introduction

Sports analytics has experienced significant popularity growth over the years. Within sports analytics, the primary objective is to collect and analyze pertinent data to derive valuable insights, thereby positioning players or teams advantageously against their opponents [21]. This dynamic domain is marked by rapid expansion and presents an array of methodologies for exploration [7]. The rise of analytics and data-driven decision-making has significantly shaped three-point shooting trends in the EuroLeague and the NBA (National Basketball Association). Over the years, a three-point shot evolved from a sporadically used weapon to a fundamental aspect of basketball strategy. Its significance became increasingly apparent as players honed their shooting skills and teams devised intricate offensive schemes centered around a three-point line. In the EuroLeague, this evolution has been particularly pronounced, with teams strategically utilizing the three-point shot to exploit defensive weaknesses and create scoring opportunities. On the contrary, Gjøen et al. [8] indicated in their study that since two-point shots are converted more frequently, it may be beneficial to aim for two-

point shots instead of three in certain situations, even if the latter leads to more points.

Since the introduction of the new game regulation regarding three-point shots in the EuroLeague back in the 2010-2011 season, which relocated the three-point arc to a distance of 6.75 meters from a basket, it has been expected that these changes would influence basketball gameplay dynamics [19]. Considering the nature of the rule change and the fact that relocating the three-point arc farther from the basket resulted in a decrease in both an overall three-point shooting percentage and a number of three-point attempts in the NBA, a similar trend was anticipated for the EuroLeague [19]. The majority of rule adjustments implemented in the NBA are geared towards further improving pace, speed, and flow of basketball matches [23]. The EuroLeague has also fueled of three-point shots popularity, as competition rules have been adapted to accommodate a more fast-paced game.

In recent years, several studies have been conducted on the three-point shooting trends and patterns in the NBA [6, 10, 17, 22]. Additionally, team and individual shooting percentages have been examined, highlighting importance of balanced approaches to scoring and offensive play [24]. Gjøen et al. [8] showed in their study that in certain situations a strategy of taking fewer three-point attempts at the expense of more two-point attempts improves probability of winning. A study by Gou and Zhang [9] revealed that increasing a number and a percentage of three-point offenses in a game can improve probability of winning. Another study's findings suggest that future NBA three-point averages will be higher [5]. Overall, the continued evolution of three-point shooting in the NBA highlights its importance as a fundamental aspect of a game.

However, there are few studies which analyze three-point trends in the EuroLeague basketball based on game-related indicators. According to Štrumbelj et al. [19], moving the three-point arc resulted in lower frequency and percentage of three-point shots and an increased number of two-point shots, leading to a slight decrease in shooting percentage in the first ten seasons of the EuroLeague. Durmuş and Erdeveciler [3] studied shot selection trends in the EuroLeague basketball during a ten-year period, starting from 2013-2014. The results of the study showed that there was a constant and significant shift in shot selection preferences, with a noticeable decrease in two-point attempts, a concurrent increase in three-point attempts and shots made per game. This evolution of three-point shot attempts per game has also been noticed in a study by Ertetik et al. [4].

Aim of Study

The objective of this study was to examine and identify the three-point and two-point shooting trends and effectiveness through game-related statistics over the last 12 seasons in the EuroLeague basketball championship.

Material and Methods

Sample and procedure

Statistical data was sourced from an open-access official website of the EuroLeague (https://www.euroleaguebasketball.net/en/euroleague/stats/), a database that has been deemed reliable in previous research [2]. The dataset covered a span of 12 seasons, excluding the 2019-2020 season due to the COVID-19 pandemic. The data was collected from the 2010-2011 season to the 2022-2023 season, focusing solely on regular seasons and the top 16 rounds. It is important to note that selection of this specific period was considered to match the relocation of the three-point arc to the distance of 6.75 meters from the basket in 2010. A total of 2812 games were analyzed. For clarity and ease of interpretation, the seasons were divided into three groups: Group A (2010-2011 to 2013-2014), Group B (2014-2015 to 2017-2018), and Group C (2018-2019 to 2022-2023). To examine if there was significant growth in the role of three-point shots, an average number of each team's Three-Point Field Goal Attempts (3PA) and Field Goal Attempts (FGA) per game was taken and a proportion (in percent) of those factors was counted (coefficient 3PA/FGA%) [10]. This resulted in the coefficient 3PA/FGA (%) which measures the frequency of three-point attempts among all field goal attempts for every team in each game. As stated by Jaguszewski [10], an advantage of this coefficient lies in its independence from factors such as pace of a game, rebounds, turnovers, free throws, and other descriptive statistics aside from field goal attempts. It offers a more effective estimate for analyzing three-point shots evolution compared to solely considering three-point field goal attempts. Additionally, a coefficient of Three-Point Field Goals Made (3PM) and Field Goal Made (FGM) was calculated (3PM/FGM%) to examine evolution of three-point shots made between the year groups.

Variables used in this study were as follows: Points Per Game (PPG), FGM, FGA, Field Goal Percentage (FG%), Two-Point Field Goals Made (2PM), Two-Point Field Goal Attempts (2PA), Two-Point Field Goals Percentage (2P%), 3PM, 3PA, Three-Point Field Goals Percentage (3P%), 3PA/FGA (%), and 3PM/FGM (%).

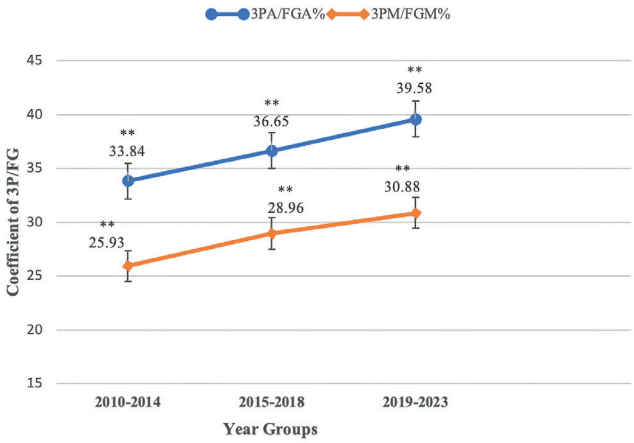
Statistical analysis

All variables are presented as mean ± standard deviation (SD). Normality assumption was assessed using the Kolmogorov–Smirnov test, revealing a non-normal distribution of the data. The non-parametric Kruskal–Wallis test was employed to determine differences between the examined variables among the three year groups. Post hoc comparisons were conducted using the Dunn's method with a Bonferroni correction for multiple tests, when appropriate. The analyses were performed using the SPSS software (version 29.0, SPSS, Inc., Chicago, IL, USA), with a significance level set at $p < 0.05$.

Results

The descriptive data of the examined variables, which includes means and standard deviations, is comprehensively displayed in Table 1 for easy reference and comparison, serving as a foundation for the subsequent statistical analyses and interpretations, with detailed statistics provided for the three groups: 2010-2014, 2015-2018, and 2019-2023.

The results of the 3PA/FGA and 3PM/FGM coefficients across the three groups are illustrated in Figure 1. The increase in the 3PA/FGA% was 2.81% between groups A and B, and 2.93% between groups B and C, resulting in the total increase of 5.74% over the 12 seasons. Upon examining the results from the pairwise comparisons, it was determined that the increase in the 3PA/FGA coefficient was statistically significant for all groups ($\chi^2(2) = 454.855$, $p < 0.001$). On average, the coefficient increased by 0.47% per season.



** statistically significant compared with the previous year group with $p < 0.001$

Figure 1. 3PA/FGA% and 3PM/FGM% trends over the three-year groups

Regarding the 3PM/FGM coefficient, the analysis results revealed a similar increase ($\chi^2(2) = 226.743$, $p < 0.001$) in the percentage across the three groups (Figure 1). The 3.03% growth was observed between groups A and B, and the 1.92% growth between groups B and C, resulting in total growth of 4.95% across the 12 EuroLeague seasons (0.41% per season).

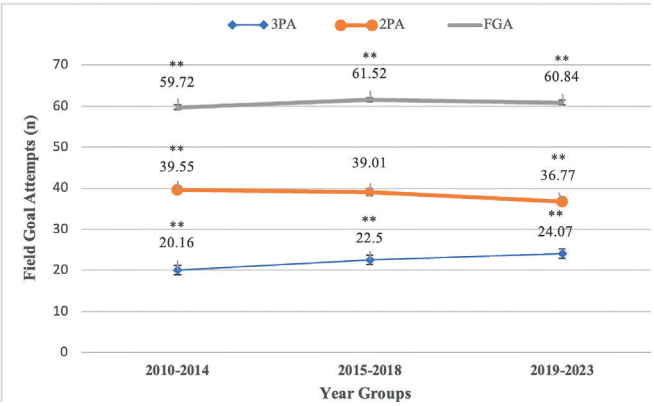
As shown in Figure 2a, there has been a statistically significant increase in the number of 3PA ($\chi^2(2) = 496.176$, $p < 0.001$) across the three groups in the 2010-2023 EuroLeague seasons, rising from 20.16 to 24.07 shots per game. Conversely, the number of 2PA decreased significantly ($\chi^2(2) = 221.559$, $p \leq 0.001$)

Table 1. Descriptive data of examined variables

Year-Group	PPG (M)	FGA (M)	FGM (M)	FG% (M)	3PA (M)	3PM (M)	3P% (M)	2PA (M)	2PM (M)	2P% (M)	3PA/FGA% (M)	3PM/FGM% (M)
2010-2014	75.01	59.72	27.24	45.71	20.16	7.04	34.69	39.55	20.2	51.25	33.84	25.93
SD	10.98	5.63	4.47	6.83	4.97	2.87	11.12	6.34	4.38	8.61	7.99	9.94
2015-2018	78.77	61.52	28.42	46.32	22.50	8.21	36.49	39.01	20.21	52.02	36.65	28.96
SD	11.03	6.02	4.45	6.61	5.05	2.96	10.67	6.35	4.29	8.37	7.72	9.68
2019-2023	79.52	60.84	28.66	47.24	24.07	8.82	36.60	36.77	19.83	54.18	39.58	30.88
SD	10.85	5.91	4.27	6.56	5.34	3.09	10.08	6.14	4.25	8.66	8.03	10.06
Mean	78.02	60.75	28.18	46.51	22.47	8.12	36.03	38.28	20.06	52.66	37.02	28.87
SD	11.11	5.91	4.43	6.68	5.38	3.07	10.60	6.38	4.30	8.64	8.25	10.10

Note: M – mean, SD – standard deviation, PPG – Points Per Game, FGA – Field Goal Attempts, FGM – Field Goal Made, FG% – Field Goal Percentage, 3PA – Three-Point Field Goal Attempts, 3PM – Three-Point Field Goals Made, 3P% – Three-Point Field Goal Percentage, 2PA – Two-Point Field Goal Attempts, 2PM – Two-Point Field Goal Made, 2P% – Two-Point Field Goal Percentage, 3PA/FGA% – 3PA/FGA coefficient, 3PM/FGM% – 3PM/FGM coefficient

between the groups, from 39.55 to 36.77 per game. This indicates a shift in playing strategy toward increased three-point shooting. The pairwise comparisons are presented in Table 2.



** statistically significant compared with the previous year group with $p < 0.001$

Figure 2a. Field Goal Attempts (FGA), Three-Point Field Goal Attempts (3PA) and Two-Point Field Goal Attempts (2PA) trends over the three-year groups

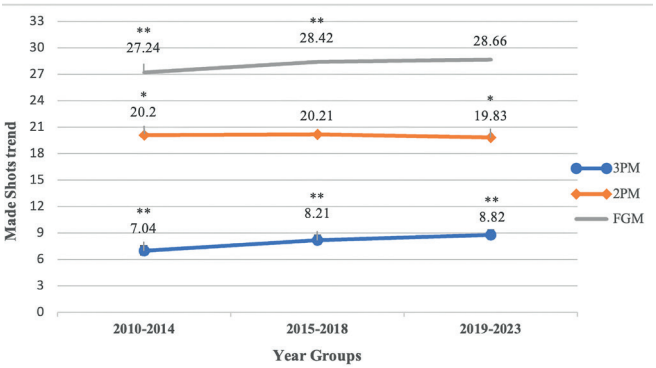
Table 2. Results of Kruskal–Wallis test and post hoc comparisons between three year groups for 3PA, 3PM, 2PA, and 2PM

Groups	2010-2014	2015-2018	2019-2023	Kruskal–Wallis test
			3PA	
2010-2014		**	**	$\chi^2(2) = 496.176$, $p \leq 0.001$
2015-2018	**		**	
2019-2023	**	**		
			2PA	
2010-2014			**	$\chi^2(2) = 221.559$, $p \leq 0.001$
2015-2018			**	
2019-2023	**	**		
			2PM	
2010-2014			*	$\chi^2(2) = 10.340$, $p \leq 0.05$
2015-2018			*	
2019-2023	*	*		
			3PM	
2010-2014		**	**	$\chi^2(2) = 325.920$, $p \leq 0.001$
2015-2018	**		**	
2019-2023	**	**		

Note: 3PA – Three-Point Field Goal Attempts, 2PA – Two-Point Field Goal Attempts, 3PM – Three-Point Field Goals Made, 2PM – Two-Point Field Goals Made
* $p < 0.05$, ** $p < 0.001$

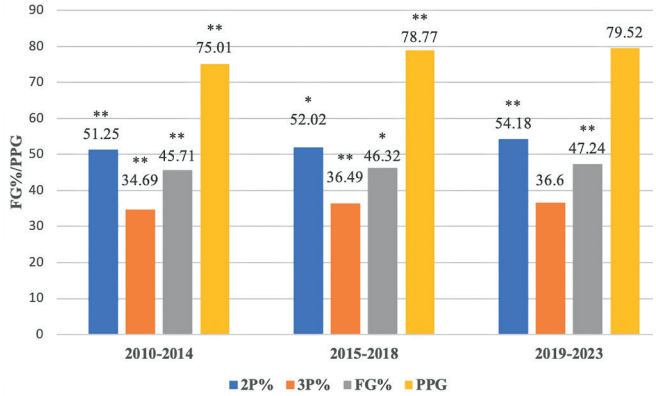
Similar results were observed for the distribution of FGM, with a statistically significant increase ($\chi^2(2) = 325.920$, $p \leq 0.001$) in 3PM per game (Figure 2b). The rise in 3PM was 1.78 shots per game between year groups A and C ($p < 0.001$). Conversely, 2PM showed a decreasing trend. The results of the Kruskal–Wallis test and the post hoc pairwise comparisons between the three groups for the 3PA, 3PM, 2PA, and 2PM variables are presented in Table 2.

The field goal percentages of the shooting variables are depicted in Figure 3. 3P% across the three groups revealed a significant increase ($\chi^2(2) = 35.741$, $p < 0.001$). The growth in 3P% between the three groups is



* statistically significant compared with the previous year group with $p < 0.05$; ** statistically significant compared with the previous year group with $p < 0.001$

Figure 2b. Trends in Two-Point Field Goals Made (2PM), Three-Point Field Goals Made (3PM) and Field Goal Made (FGM) shots over the three year-groups



* statistically significant compared with the previous year-group with $p < 0.05$; ** statistically significant compared with the previous year group with $p < 0.001$

Figure 3. Points Per Game (PPG), Three-Point Field Goals Percentage (3P%), Two-Point Field Goals Percentage (2P%) and total Field Goal Percentage (FG%) over the three year-groups

significant only between groups A and B, while there is no increasing trend between groups B and C (Table 3). Similarly, 2P% demonstrates an increasing trend, despite the significant decrease in 2PA across the groups (dropping from 39.55 to 36.77 attempts per game).
As expected FG% showed the increasing trend between the groups, as it is directly related to 3P% and 2P% (Figure 3). As the effectiveness of FG% continued to grow between the groups, PPG exhibited the similar trend ($\chi^2(2) = 161.692$, $p \leq 0.001$). The results of the pairwise comparisons across the three groups are presented in Table 3.

Table 3. Results of Kruskal–Wallis test and post hoc comparisons between groups for PPG, FG%, 2P%, and 3P%

Groups	2010-2014	2015-2018	2019-2023	Kruskal–Wallis test
			PPG	
2010-2014		**	**	$\chi^2(2) = 161.692$, $p \leq 0.001$
2015-2018	**			
2019-2023	**			
			FG%	
2010-2014		*	**	$\chi^2(2) = 50.590$, $p \leq 0.001$
2015-2018	*		**	
2019-2023	**	**		
			2P%	
2010-2014		*	**	$\chi^2(2) = 115.49$, $p \leq 0.001$
2015-2018	*		**	
2019-2023	**	**		
			3P%	
2010-2014		**	**	$\chi^2(2) = 35.741$, $p \leq 0.001$
2015-2018	**			
2019-2023	**			

Note: PPG – Points Per Game, FG% – Field Goal Percentage, 2P% – Two-Point Field Goal Percentage, 3P% – Three-Point Field Goal Percentage
* $p < 0.05$, ** $p < 0.001$

Discussion

Basketball has greatly changed over recent years, with sports analytics playing a crucial role in devising innovative game strategies, enhancing scoring opportunities, and leading to greater success. This study specifically highlights the transformative impact of data-driven decision-making on the three-point shooting trends in the EuroLeague. By focusing on the shot distribution and effectiveness over the past 12 seasons, this study uncovers how the strategic use of analytics has reshaped basketball gameplay, emphasizing the pivotal role of three-point shots in modern offensive schemes.
The recent rule changes and the evolution of new tactics, combined with the enhancement of players' skills have introduced new trends in the game. There is no doubt that the three-point shot is one of the essential elements of the modern basketball [15]. This study examined the shot distribution and effectiveness, to identify trends in the shooting patterns across the 12 seasons in the EuroLeague. The results showed that there was a significant rise in the three-point field goal attempts across the seasons, along with a decrease in the two-point field goal attempts. These changes indicate the trend toward offensive strategies aimed at three-point field goals in the EuroLeague, the result that coincides with previous studies [3, 15]. On the contrary, according to Madarame [14] and Štrumbelj et al. [19], moving the three-point arc farther away from a basket resulted in a setback in an increase of three-point shots, while the number of two-point field goals increased. Tang et al. [20] mentioned in their study that a high percentage of three-point field goals in the 2010 World Cup had a significant impact on training and development of three-point shooting basketball skills globally. According to Wang and Zheng [23], this trend primarily stems from coaches integrating a three-point field goal into offensive tactics. Furthermore, encouraging players to drive to a basket or attempt three-pointers explains the decline in two-point field goal attempts [12]. The three-point field goals play a pivotal role in team's success [16], and increasing the percentage of three-point field goals can lead to more productive offense [9].
Therefore the concept that teams should attempt more three-point shots because a three-point shot is worth more than a two-point shot is a highly ambiguous statement [13,18]. As European players develop stronger three-point shooting skills, coaches are increasingly incorporating these shots into their offensive schemes. This shift is supported by research showing that a higher number and percentage of three-point shots can significantly improve a team's probability of winning [9]. Nowadays, an ability to shoot from beyond an arc is crucial, and a lack of this ability decreases a number of options in any team's offensive tactics [10]. Modern basketball often emphasizes faster pace and more spacing. The three-point shot helps stretch defenses, creating more space for ball movement and driving

lanes. This style of play has become increasingly popular in Europe, as it aligns with the global trend toward a faster, more perimeter-oriented game.

In terms of shooting effectiveness, the findings indicated the increase in both three-point and two-point shot percentages across the 12 seasons in the EuroLeague. While Mandić et al. [15] reported no significant trend in a two-point field goal percentage in the EuroLeague from 2000 to 2017, Štrumbelj et al. [19] observed a decrease in both two-point and three-point shooting percentages in a study spanning from 2000 to 2011. Additionally, Zając et al. [24] noted that a value of three-point shots closely resembles that of two-point midrange shots. Consequently, in terms of optimal shot selection, teams should prioritize creating open two-point field goals following a drive, and three-point shots executed by highly skilled players. Rule changes that prohibit hand-checking have also improved two-point field goal accuracy [23]. The positive trend in three-pointers' accuracy is also related to a revolution in tactics, called "positionless basketball", in which players who are usually post players are now able to shoot three-pointers with great success [24]. Greater success is associated with three-point shooting effectiveness [1]. Additionally, with the widespread application of data analytics in coaching and game strategy design, coaches and players can craft customized game plans and make more informed decisions regarding shot selection during gameplay. This would result in improved field goal accuracy [23].

In terms of points per game, the findings indicated the notable upward trend across the seasons. This observation aligns with the study by Štrumbelj et al. [19], which suggests that game's pace acceleration, resulting in a higher number of possessions, may be seen as a desirable outcome, making games more engaging. The increase in points per game can be attributed to the rise in field goal attempts and the improved shooting effectiveness. Similar findings were reported in a study by Katris [11].

Conclusions

In conclusion, this study reveals the statistically significant rise in the frequency of attempted three-point field goals throughout the past 12 seasons in the EuroLeague championship. Moreover, it highlights the enhanced effectiveness of these shots over the seasons, emphasizing their impact on points per game, thus providing more opportunities to win. Although there has been a decrease in the frequency of two-point field goals, their efficacy has increased. The growing prominence of three-pointers underscores their importance in contemporary basketball, even though it was initially overlooked as a game-changing factor.

Conflict of Interest

The authors declare no conflict of interest.

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