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Shooting effectiveness after offensive rebound and its impact on team success in 3x3 basketball

Efectividad del tiro después de un rebote ofensivo y su impacto en el éxito del equipo en baloncesto 3x3

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Abstract. The purpose of our research was to investigate the shotting effectiveness in 3x3 basketball after an offensive rebound. A total of 16,136 possessions corresponding to 350 games across 18 different competitions, were analysed. The variables collected were as follows: (1) shot at the basket after offensive rebound; (2) shooting effectiveness after offensive rebound; (3) shooting zone; (4) scoring zone. Statistical analyses included series of binomial logistic regression analyses. The results of this study show that the middle area of the arc is regularly used by both winning and losing teams in terms of successful attempts and total shots made. Shooting effectiveness increases when shooting after offensive rebound (OR= 1.51; $p<0.001$) and winning teams exhibited a higher number of total shooting attempts (OR= 1.26; $p<0.001$). Moreover, winning teams were more effective after offensive rebound compared to losers (OR= 1.27; $p= 0.015$). For 3x3 teams, offensive rebounding constitutes a crucial component in increasing scoring opportunities. Furthermore, the location of the shot, exerts a noticeable impact on scoring effectiveness.
Keywords: team sports, performance, games, statistical analysis, accuracy.

Resumen. El propósito de nuestra investigación fue analizar la efectividad del tiro en baloncesto 3x3 después de un rebote ofensivo. Se analizaron un total de 16,136 posesiones correspondientes a 350 partidos en 18 competiciones diferentes. Las variables recopiladas fueron las siguientes: (1) tiro a canasta después de un rebote ofensivo; (2) efectividad en el tiro después de un rebote ofensivo; (3) zona de tiro; (4) zona de anotación. Los análisis estadísticos incluyeron series de regresiones logísticas binarias. Los resultados de este estudio muestran que el área central del campo es utilizada regularmente tanto por los equipos ganadores como por los perdedores en términos de intentos exitosos y tiros totales realizados. La efectividad en el tiro aumenta cuando se tira después de un rebote ofensivo (OR= 1.51; $p<0.001$) y los equipos ganadores exhibieron un mayor número de intentos de tiro totales (OR= 1.26; $p<0.001$). Además, los equipos ganadores fueron más efectivos después de un rebote ofensivo en comparación con los perdedores (OR= 1.27; $p= 0.015$). Para los equipos de 3x3, el rebote ofensivo constituye un componente crucial para aumentar las oportunidades de anotación. Además, la ubicación del tiro ejerce un impacto notable en la efectividad de la anotación.
Palabras clave: deportes de equipo, rendimiento, partidos, análisis estadístico, precisión.

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Introduction

In recent years 3x3 basketball has emerged an innovative sports discipline derived from traditional basketball (Boros et al., 2022). The International Basketball Federation (FIBA) introduced this variation during the Youth Olympic Games in Singapore in 2010, with the goal of attracting new players and increasing its popularity (Snoj, 2021). As a result, it has rapidly spread on a global scale and has been integrated into the prestigious Olympic program from Tokyo 2020 (Boros et al., 2022).

Recently, sports science researchers have investigated the technical-tactical and physical demands of 3x3 basketball during competition (Ferioli et al., 2023). However, only a limited number of studies have delved into crucial aspects of this sport, such as shooting efficiency (Andrianova et al., 2022). This aspect is fundamental because, in comparison to 5x5 basketball, 3x3 basketball involves a higher frequency of shots taken from beyond the 2-point arc and from under the basket (Andrianova et al., 2022; Erčulj et al., 2020). Efficiency has been identified as a differentiating factor between winning and losing teams in 3x3 basketball (Madarame, 2023). Therefore, an in-depth analysis of shooting efficiency is essential for understanding and enhancing performance in this discipline. The rebound is a game-related statistics that discriminate between winning and losing teams (de Almeida et al., 2022) increasing the possibility of success for a team (Sampaio et al., 2010). A team that excels in offensive rebounds increases their scoring opportunities (Oliver, 2004), and defensive rebounds has been identified as the game-related statistics that most differentiate between winning and losing teams (Gómez et al., 2008). Previous studies have established a connection between rebounding and shooting efficiency in 5x5 basketball (Csataljay et al., 2009; Suárez-Cadenas & Courel-Ibáñez, 2017). The performance in sports is influenced by the technical and tactical skills of the players (Hernández-Beltrán et al., 2023; Mejia & Pérez, 2021). The act of securing rebounds not only ensures ball possession but also significantly impacts shooting effectiveness following a rebound (Čauševi ć, 2015; Evangelos & Nikolaos, 2004).

In recent years, the incorporation of Small-Sided Games has been increasingly adopted in the design of training tasks (Hernández-Beltrán et al., 2022). However, within the scientific literature, there is limited research focused on the importance of shooting effectiveness following an offensive rebound and second-chance opportunities in 3x3 basketball. This is a crucial area for coaches when developing training strategies. The hypothesis of this study is that offensive rebounds enhance shooting effectiveness, and that shot location significantly affects scoring success. Therefore, the focus of the present study is to analyse shotting effectiveness in 3x3 basketball after an offensive rebound, with a particular emphasis on distinguishing between winning and losing teams.

Material and methods

Sample

In order to carry out this study a total of 16.136 possessions corresponding to 350 games (175 for each sex) from 18 different competitions between Senior, U23, U21, U18 and U17 categories during 2019 to 2021 were registered. All included matches were international competitions featuring elite players. It was stipulated that only competitions adhering to the recognized standards of FIBA would be considered. The selected games should have been broadcast on the FIBA 3x3 YouTube Channel. All the collected data was sourced from public channels. All the collected data was sourced from public channels, and therefore no ethical Committee approval consent was required for this study.

The possessions included all instances where the offensive team obtained possession after an offensive rebound and ended in a made or attempted 1-point shot (inside the arc; n= 1366) or 2-point shot (outside the arc; n=389). An offensive rebound was defined as the attacking team regaining possession of the ball after a missed shot (Suárez-Cadenas & Courel-Ibáñez, 2017). The inclusion criteria were as follows: (1) complete games were available; (2) continental or world-level competitions; (3) games across U17 to senior categories for both sexes; (4) possessions that started after an offensive rebound.

Procedure

Three hundred and fifty games were analysed through a systematic observation carried out by experts in the field. The analysts, with university training in the sports field, were trained, following the indications proposed by Anguera (2003), until reaching a level of interobserver concordance of 0.80 in the Kappa index. Once this degree of reliability was reached, the intra-observer reliability was analysed by recording at one week's difference; at that time, the observations were agreed to, the analysis of the parties included in the sample for this study was carried out. The observers' training process used non-sampled parties.

For the spatial distribution of shots, it was used a model adapted from Ortega & Gómez (2009) for 3x3 basketball (Figure 1). The variables collected for this study were as follows: (1) shot at the basket after offensive rebound; (2) shooting effectiveness after offensive rebound; (3) shooting zone; (4) scoring zone.

Eight different binomial logistic regression models have been carried out. Firstly, three models were developed to analyse the shots after offensive rebound (yes/no). These models aimed to determine the likelihood of scoring when shooting after offensive rebound (model 1), the likelihood of shooting from inside the arc after offensive rebound (model 2), and the likelihood of the winning and losing team's shooting after offensive rebound (model 3).

Following this, an additional five models were constructed to assess the shooting effectiveness of the team after offensive rebound. These models took into account factors such as shooting zone (inside/outside) and scoring zone (inside/outside) to estimate the likelihood of the winning and losing teams scoring after an offensive rebound (model 4), the likelihood of scoring from inside the arc after an offensive rebound (model 5), the likelihood of shooting from inside the arc after an offensive rebound (model 6), the likelihood of the winning and losing teams scoring from inside the arc after an offensive rebound (model 7), and the likelihood of the winning and losing teams scoring from outside the arc after an offensive rebound (model 8).

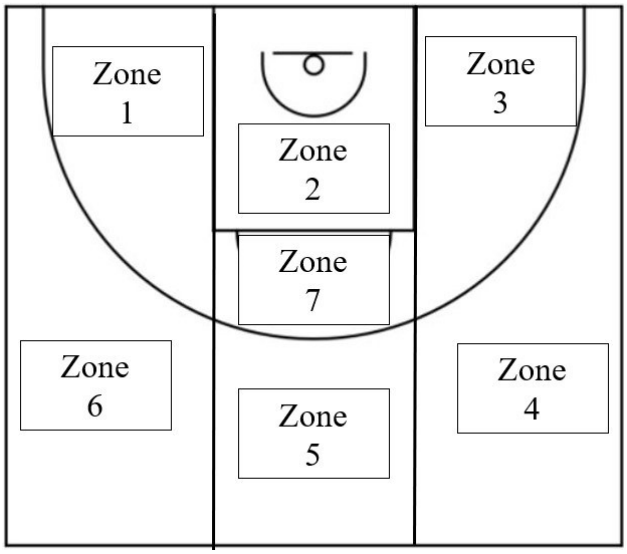

Figure 1 Sectors of shooting zones.

Statistical analysis

Statistics were computed using the Statistical Package for the Social Sciences (SPSS v17, Armonk, NY: IBM Corp.). Descriptive analysis included percentages of occurrence and effectiveness of shot attempts by zone. Statistical significance was set at $p<0.05$. Statistical analysis included binary logistic regressions where *b*-values (B), Odds Ratio (OR) and their 95% confidence intervals (CI) were calculated. Nagelkerke's R2 was used to assess goodness-of-fit of the models. We analysed the following binary variables: win or lose, offensive rebound (score/not score), shooting zone (inside/outside) and scoring zone (inside/outside).

Results

The distribution of shoots comparing winning and loser teams by shooting zones are illustrated in table 1. A noteworthy trend emerges in Zone 2, where a higher frequency of shots occurs after offensive rebounds, as opposed to zones outside the paint area (93.41%). Both winning and losing teams consistently exploit this central region within the arc for both successful attempts and total shots made.

Table 1.
Distribution of shoots comparing winning and loser teams by shooting zones.

Shooting effectiveness	Shooting zone	Shooting after offensive rebound			Not shooting after offensive rebound		
		Winners n (%)	Losers n (%)	Total n (%)	Winners n (%)	Losers n (%)	Total n (%)
Scored attempt	1	6 (28.57)	8 (61.54)	14 (41.18)	76 (35.51)	54 (27.84)	130 (31.86)
	2	505 (67.88)	327 (61.47)	832 (65.20)	2585 (64.97)	1911 (58.05)	4496 (61.83)
	3	7 (29.17)	5 (45.45)	12 (34.29)	79 (33.76)	65 (28.14)	144 (30.97)
	4	24 (31.58)	11 (21.15)	35 (27.34)	325 (31.89)	236 (23.84)	561 (27.92)
	5	20 (31.25)	11 (23.91)	31 (28.18)	292 (32.48)	202 (23.43)	494 (28.05)
	6	31 (33.70)	18 (30.51)	49 (32.45)	354 (31.89)	263 (25.17)	617 (28.63)
	7	5 (45.45)	2 (22.22)	7 (35)	54 (36.99)	52 (31.90)	106 (34.30)
	Inside	523 (65.87)	342 (59.79)	865 (63.32)	2794 (61.07)	2082 (53.65)	4876 (57.66)
	Outside	75 (32.33)	40 (25.48)	115 (29.57)	971 (32.07)	701 (24.20)	1672 (28.22)
Total shots	1	21 (2.05)	13 (1.78)	34 (1.93)	214 (2.81)	194 (2.86)	408 (2.84)
	2	744 (72.51)	532 (72.98)	1276 (72.71)	3979 (52.33)	3292 (48.57)	7271 (50.56)
	3	24 (2.34)	11 (1.51)	35 (1.99)	234 (3.08)	231 (3.41)	465 (3.23)
	4	76 (7.41)	52 (7.13)	128 (7.29)	1019 (13.40)	990 (14.61)	2009 (13.97)
	5	64 (6.24)	46 (6.31)	110 (6.27)	899 (11.82)	862 (12.72)	1761 (12.25)
	6	92 (8.97)	59 (8.09)	151 (8.60)	1110 (14.60)	1045 (15.42)	2155 (14.99)
	7	11 (1.07)	9 (1.23)	20 (1.14)	146 (1.92)	163 (2.40)	309 (2.15)
	Inside	794 (77.39)	572 (78.46)	1366 (77.83)	4575 (60.17)	3881 (57.26)	8456 (58.80)
	Outside	232 (22.61)	157 (21.54)	389 (22.17)	3028 (39.83)	2897 (42.74)	5925 (41.20)

% in "scored attempt" denotes the score attempt percentage for each zone.
% in "total shots" denotes the percentage of the number of shots in each zone, with respect to the total number of shots (of each group).

Three logistic regressions models, with shooting after an offensive rebound as the dependent variable, are presented in Table 2. In Model 1, it was observed that capitalizing on securing an offensive rebound provides teams with an additional opportunity to score points effectively. Model 2 indicated that as proximity to the basket increased, the effectiveness of shots taken also significantly improved. There was a higher probability of scoring from inside the arc than from outside the arc after an offensive rebound ($p<0.05$). Model 3 demonstrated that winning teams exhibited a higher number of offensive rebounds, leading to an increased number of shot opportunities. Consequently, the likelihood of scoring was higher in comparison to losing teams ($p<0.05$).

Table 2.
Results from logistic regression models using as dependent variable shooting after offensive rebound.

	Model	Total shooting attempts (n=16136)			
		β coefficient	*p*-value	OR	95% - CI
Scored vs missed shots	Model 1	0.414	< 0.001	1.51	1.37-1.67
Inside vs outside shots	Model 2	0.901	< 0.001	2.46	2.19-2.77
Winners vs Losers	Model 3	0.227	< 0.001	1.26	1.14-1.39

β: regression coefficients; CI: confidence intervals; OR: Odds Ratios.

The results of the additional five regression models, focusing on shooting effectiveness, spacing, and scoring after offensive rebounds, are summarized in Table 3. Model 4 identified a significant difference in the likelihood of scoring after offensive rebound between winning and losing teams ($p<0.05$) with winning teams showing a higher probability. Model 5 emphasized that maximizing rebounding opportunities near the basket increased scoring efficiency, particularly with shots inside the arc after offensive rebounds ($p<0.05$). Models 6, 7, and 8 revealed no significant differences between winning and losing teams in terms of the number of shots attempted, shooting effectiveness within the inside zone, and shooting effectiveness within the outside zone after offensive rebounds, respectively ($p>0.05$).

Table 3.
Results from logistic regression models using as dependent variable effectiveness after offensive rebound (score/not score), shooting zone (inside/outside) and scoring zone (inside/ outside) in winners and losers teams.

	Model	Shooting attempts after offensive rebound (n=1755)			
		β coefficient	p-value	OR	95% - CI
Effectiveness (Score)					
Winners vs Losers	Model 4	0.238	0.015	1.27	1.05-1.54
Inside vs Outside	Model 5	1.414	< 0.001	4.114	3.22-5.25
Inside shot attempt					
Winners vs Losers	Model 6	0.063	0.593	1.065	0.85-1.34
Inside Zone (Score)					
Winners vs Losers	Model 7	0.163	0.094	1.18	0.97-1.42
Outside Zone (Score)					
Winners vs Losers	Model 8	0.306	0.130	1.36	0.91-2.02

β: regression coefficients; CI: confidence intervals; OR: Odds Ratios.

Discussion

The aim of this study was to analyse shotting effectiveness in 3x3 basketball after an offensive rebound, with a particular emphasis on distinguishing for both winning and losing teams. The findings confirm the hypothesis that offensive rebounds are crucial for increasing scoring opportunities. Furthermore, shot location significantly impacts scoring effectiveness. This valuable information holds considerable potential for sports science researchers, coaches, and practitioners alike, especially as they strive to enhance performance and optimize offensive and defensive efficiency. Additionally, the insights gained from this analysis may prove useful in informing the design of training tasks and strategies.

Our study aligns with Suárez-Cadenas & Courel-Ibáñez (2017) research, with the exception of models 3 and 8. Their model reveals significant differences in the number of

shots after an offensive rebound between winning and losing teams, while our model 8 indicates no significant differences in shots made from outside the arc after an offensive rebound between winning and losing teams. These differences could be attributed to differences in the samples and the specificity of the 3x3 basketball context (Boros et al., 2022). Our study emphasizes the importance of considering these factors, underscoring the ongoing need for detailed research in this field to fully understand the complex dynamics of influencing this effectiveness of shooting after an offensive rebound in 3x3 basketball.

One of the main findings of this study is the direct relationship identified between shooting effectiveness and the advantage of securing the offensive rebound (model 1). This aligns with prior research indicating that offensive rebound is a key factor for creating enhanced scoring opportunities and improving field goal percentage (de Almeida et al., 2022; Oliver, 2004). Consequently, the offensive rebound emerged as one of the most relevant factors in ball possession ends (Matulaitis & Bietkis, 2021; Reina et al., 2020).

Another noteworthy revelation from our study unfolds in model 2, illuminating a heightened effectiveness after an offensive rebound, particularly from within the arc. This unveils a direct correlation between the paint area and the outcomes of possessions subsequent to an offensive rebound in the scrutinized games. The strategic utilization of the offensive key area is highlighted, echoing the sentiment that elevated offensive effectiveness often originates in this crucial zone (Gómez et al., 2013). It suggests teams capitalize on their proximity to the basket, a tactical approach substantiated by research (Csátaljay et al., 2017). This phenomenon arises from defensive disorganization by the opponent, results in closer shots with an augmented success rate (Courel et al., 2013).

In comparison to losing teams, winning teams attempted more shots following offensive rebounds (model 3). This is debatable with other studies that obtain not significant differences in the number of shots after offensive rebound between winning and losing teams (Ibáñez et al., 2008). Notably, catching offensive rebounds not only correlates with a higher volume of shot attempts, but also contributes to a higher number of shooting fouls (Csátaljay et al., 2017). Our findings underscore the strategic significance of capitalizing on second-chance opportunities arising from offensive rebounds.

After offensive rebound, there is a significant difference between winning and losing team, providing evidence in support of the hypothesis that offensive rebounds can create better scoring opportunities and ultimately lead to higher game success (model 4). This is debatable with other studies that says points scored from second chance may not be a discriminatory parameter between winning and losing teams in close games (Conte & Lukonaitiene, 2018). Although players with less experienced in this element, allowing the opponents to capture more offensive rebounds (Trninić et al., 2002). Moreover, it revealed that shots taken following an offensive rebound were more frequently within the arc, so these findings suggest that offensive rebounds play a critical role in a team's performance and overall success (model 5). Effective offensive decision-making leads to good shot selection (Csataljay et al., 2009; Suárez-Cadenas et al., 2016) and to score more points, individual action has become more crucial than teamwork (Ibáñez et al., 2018).

Between winning and losing teams, the number of shots attempted inside the arc is not considered a relevant factor in the success of a team (model 6). In addition, the effectiveness in scoring shots inside the arc, no significant differences are found (model 7). These interesting results are consistent with research that reveals the non-consideration of attempted and successful shots inside the arc after offensive rebound as relevant factor for a team's success (Suárez-Cadenas & Courel-Ibáñez, 2017). Although, it's necessary to search more specific aspects of the execution of made shots inside the arc and its relationship with the overall team performance emerges as a key area of research (Csátaljay et al., 2017).

In relation to shots scored outside the arc, there are no significant differences between winning and losing teams (model 8). This finding does not align with previous research asserting that winning teams record a larger proportion of shots scored from outside the arc (Ibáñez et al., 2009). This discovery suggests that, understanding the factors determine the effectiveness of shots outside the area may be delimited by tactical aspects that define the games strategies. Therefore, considering our findings, basketball coaches should focus on shooting situations according to offensive rebound, finishing near to the basket, and decision making after grabbing a rebound in their training designs. It will help to increase players' shooting efficiency and, eventually, the performance of the team, by developing customised exercises based on these results.

Previous studies have shown that in 5x5 basketball, there are no significant differences in the number of offensive rebounds between winning and losing teams in closed games (Conte et al., 2018). Offensive rebound has a positive impact in the outcome and it's more decisive in the second half of the game (Malarranha et al., 2013). Players with a high impact inside the paint are who contribute with the highest number of offensive rebound (Sampaio et al., 2006). There is a trend where players shoot from shorter distances after an offensive rebound to score more points (Mexas et al., 2005). However, other studies claim that with a higher pace of play, a greater number of shots from outside the arc are achieved, while maintaining an average field goal percentage (Christmann et al., 2018).

Despite the innovative findings of this study, it is essential to acknowledge and address certain limitations. Firstly, it had to exclude any possessions that began with an offensive rebound but for broadcasting requirements could not be seen in their whole. This could have had an impact on the results obtained. Secondly, the total sample was compiled only using data from one competition year for each type of event that was documented. By comparing results

from several competitions throughout time, future study may be able to increase the sample size. Thirdly, a quantitative sample has been the focus of this descriptive study. To support the data gathered a qualitative analysis ins required in addition to the quantitative study (García et al., 2013). Finally, the results of this study are only applicable to professional 3x3 competitions and cannot be generalised to amateur levels or where the dynamics of the game might be different.

The available evidence regarding the effectiveness of shooting after offensive rebounding in 3x3 basketball is essential for developing strategies aimed at enhancing game performance. The main findings of this study can be utilized to gain crucial insights into game patterns, asses the effectiveness of moves, and design training strategies based on results. Future studies should delve deeper into the activities that follow an offensive rebound, exploring four potentially interconnected characteristics: improving game strategy, acquiring specific skills, optimizing performance, and strengthening the competitive advantage.

Conclusions

The results suggested that offensive rebounding emerges as a pivotal factor in amplifying scoring opportunities for 3x3 teams. Seizing second-chance opportunities elevates the probabilities of scoring success. Moreover, shot's location (inside/outside the arc) wields a discernible impact on scoring effectiveness. These findings provide valuable insights into the profound importance of offensive rebounding and its implications for scoring efficiency in the context of 3x3 basketball.

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