Artículo original / Original Article

Ball reversal as performance indicator in female basketball

El cambio de lado de balón como indicador de rendimiento en baloncesto femenino

Cotta-Ortega, A.[1], **Gutiérrez-Capote, A.**[1, 2 *], **Contreras, J.M.** [3] **and Piñar, M.I.** [1, 2]

1 Department of Physical Education and Sport, Faculty of Sports Science, University of Granada, Spain.
2 Sport and Health University Research Institute (iMUDS), Granada, Spain.
3 Department of Mathematics Didactics, Faculty of Education, University of Granada, Spain.

*** Correspondence:** Alejandro Gutiérrez Capote - agcapote@ugr.es

DOI: https://doi.org/10.17398/1885-7019.21.49

Recibido: 05/11/2024; Aceptado: 10/12/2024; Publicado: 10/01/2025

OPEN ACCESS

Sección / Section:
Análisis del rendimiento deportivo / Performance analysis in sport

Editor de Sección / Edited by:
Sergio J. Ibáñez
Universidad de Extremadura, España

Citación / Citation:
Cotta-Ortega, A., Gutiérrez-Capote, A., Contreras, J.M. & Piñar, M. I. (2025). Ball reversal as performance indicator in female basketball. E-balonmano Com, 21(1), 49-64.

Fuentes de Financiación / Funding:

This study was supported by grants awarded by the Spanish Ministry of Science, Innovation and Universities: Grant FPU19/06224.

Agradecimientos/ Acknowledgments:

Faculty of Sport Sciences at the University of Granada is gratefully acknowledged for providing its facilities for observer training. Likewise, the work of the observers in the match analysis is recognized.

Conflicto de intereses / Conflicts of Interest:

The authors declare no conflicts of interest

Abstract

The aim of the study was to determine whether ball reversal is a performance indicator in women's basketball. Its influence on various in-game performance variables (shots, rebounds, opposition, etc.) was analysed. A total of 6007 ball possessions from 64 games in the 2020/2021 season of the Liga Femenina Endesa, organized by the Spanish Basketball Federation (FEB), were analysed. Observational methodology was employed for defining and recording variables, and data analysis was conducted using descriptive statistics, the Chi-Square test, and one-way ANOVA. The results revealed that ball reversal had a significant impact on possession outcomes ($p < 0.001$). Specifically, it was associated with a higher number of shot attempts and points scored, an increase in offensive rebounds, and a reduction in turnovers. Incorporating ball reversal during possessions enhances the probability of success, translating into a greater number of points per possession. These findings suggest that ball reversal can thus be considered a performance indicator in women's basketball.

Key words: match analysis; women's basketball; performance indicators: team sports.

Resumen

El objetivo de este estudio fue determinar si el cambio de lado de balón podría servir como un indicador de rendimiento en el baloncesto femenino. Se analizó el efecto del cambio de lado de balón en diversas variables de rendimiento en el juego (tiros, rebotes, nivel de oposición, etc.). Se analizaron un total de 6007 posesiones de balón de 64 partidos de la temporada 2020/2021 de la Liga Femenina Endesa, organizada por la Federación Española de Baloncesto (FEB). Se empleó la metodología observacional para definir y registrar las variables, y el análisis de datos se realizó mediante estadísticas descriptivas, la prueba de Chi-Cuadrado y ANOVA de un factor. Los resultados revelaron que el cambio de lado de balón tuvo un efecto significativo en las finalizaciones de las posesiones ($p < 0.001$). Específicamente, se asoció con un mayor número de intentos de lanzamientos y puntos anotados, un incremento en rebotes ofensivos y una reducción en pérdidas de balón. Incorporar el cambio de lado de balón durante las posesiones aumenta la probabilidad de éxito, lo que se traduce en un mayor número de puntos por posesión. Por lo tanto, el cambio de lado de balón puede considerarse un indicador de rendimiento en el baloncesto femenino.

Palabras clave: análisis de partidos; baloncesto femenino; indicadores de rendimiento; deportes de equipo.

Introduction

Basketball is a dynamic, complex, and nonlinear team sport (Ibáñez et al., 2019; Mancha-Triguero et al., 2020), developed within a motor interaction framework of cooperation and opposition (Cáceres-Sánchez et al., 2021; García-Rubio et al., 2013; Martínez-Santos et al., 2017; Serna, 2014). Players continuously interact with their teammates to achieve collective goals while simultaneously working to neutralize their opponents' attempts to achieve their own. This opposition is manifested in the offensive and defensive phases, where the offensive team attempts to score as many points as possible through shots, maintaining ball possession by avoiding turnovers or deflections, and progressing spatially through dribbling and passing-receiving technical-tactical skills. Conversely, the defensive team seeks to prevent the opponent from scoring, force turnovers, and limit their spatial progression (Cárdenas & Alarcón, 2010; Morales-Belando et al., 2022).

To succeed, players must respond to the complexity of the game by executing a wide variety of technical-tactical actions under demanding conditions (Rodríguez Albuja, 2018). Over the past decade, the number of studies quantifying and qualifying technical and tactical demands during competition has increased, highlighting distinctions between winning and losing teams in basketball competitions (Conte et al., 2018; López-Mursuliz et al., 2022). Among the most important and widely analysed actions are shooting, passing-receiving, and dribbling (Li et al., 2021; López-Mursuliz et al., 2022; Zwierko et al., 2018). Notably, shooting is highlighted as the game's most decisive action, as it is the primary means of scoring points (Cabarkapa et al., 2022). Its effectiveness directly impacts the scoreboard and can determine the game's outcome, as the team that scores the most points ultimately wins (Csátaljay et al., 2009; Ibáñez et al., 2009; Lapresa et al., 2014; Tian, 2016; Vencúrik et al., 2021; Cabarkapa et al., 2022; Gómez et al., 2008; Leicht et al., 2015; Lorenzo et al., 2010; Puente et al., 2015). Thus, teams strive to execute shots under the best possible conditions to maximize their effectiveness during the game (Bar-Eli et al., 2006; Cárdenas & Alarcón, 2010; Quílez et al., 2020; Skinner, 2012). To achieve these optimal conditions, passing plays a fundamental role as the most basic collective interaction within the game (Ortega, 2010). After shooting, passing is considered the second most important technical-tactical action in basketball. Its correct execution not only optimizes game flow but is also decisive for creating clear offensive opportunities, facilitating the proper execution of offensive plays, and enhancing scoring chances (Courel et al., 2013; Nunes et al., 2016).

This is align with authors Doğan & Ersöz (2019), who analysed the EuroLeague during the regular season and playoffs, revealing that three-point shooting percentage and assists were the main differences between winning and losing teams in the regular season, while in the Final Four, two-point and three-point shooting percentages, along with offensive rebounds, were the most distinguishing factors for victorious teams. Other studies, such as those by García-Rubio et al. (2013) and Gómez et al. (2013), indicate that teams with better passing skills, who deliver more assists (shots made preceded by a pass) and commit fewer turnovers, have higher chances of winning games. Building on these findings, Cárdenas & Alarcón (2010) analysed the internal logic of the game and identified general theoretical principles, such as "hindering defensive actions." Within this framework, specific game principles, including ball and player dynamism, aim to create defensive imbalances. These principles facilitate spatial advantages by reversing the ball from one side to the other, forcing the defense to shift its positioning from the help side to the ball side. In addition, in football, Bettega et al. (2021) examined ball circulation as a specific game principle among youth coaches. This principle is employed to maintain possession and disorganize the opposing team, illustrating its broader application across sports to create tactical advantages through ball movement.

In professional basketball leagues (NBA, EuroLeague, and ACB), it has been shown that passing is essential for increasing the points scored in games (Courel et al., 2016; Gómez et al., 2016; Marmarinos et al., 2016). Additionally, the number of passes preceding a shot has a direct influence on its success rate (Gómez et al., 2013). In this regard, passing skills and the space for passing and receiving are critical for facilitating subsequent actions by the receiver and creating optimal scoring opportunities, such as shots close to the basket following an inside; Morillo-Baro et al., 2021 pass (Courel et al., 2013) or ball movement along the perimeter to create open spaces for shots (Cárdenas & Alarcón, 2010).

Given this background, although numerous studies analyse individual technical-tactical actions, such as shooting and passing and their interrelations, scientific evidence on collective tactical actions in basketball remains limited (Conte et al., 2018). In the study by Klusemann et al. (2013), up to six tactical actions from the U.S. men's collegiate league (NCAA) were analysed, including ball reversals, defined as moving the ball from one side of the court to the other by crossing an imaginary line between both baskets via passing. The results showed that winning teams performed, on average, 18 more ball reversals than losing teams, highlighting the importance of reversing the ball side to disorganize the defense and reduce opposition to shots (Zuccolotto et al., 2017).

In addition, in the Liga Femenina, optimal and effective actions for possession outcomes have been studied, with off-ball movements and ball reversals standing out as key strategies (Romarís et al., 2012). Beyond basketball, research in other sports has also analysed ball reversals, demonstrating that repeating passes within the same corridor of play without reversing the ball side increases the risk of turnovers. Conversely, teams that actively seek to control the game tend to make more ball reversals to move the opponent, disorganize their defense, and find optimal progression opportunities (Amatria et al., 2023; Merlin et al., 2020; Sanfi-Arias & López-Alonso, 2024). These findings underscore the cross-sport relevance of ball reversals as a tactical action to enhance offensive dynamics and reduce defensive pressure. Teams that excel in passing and receiving achieve better collective performance by increasing the number of passes per possession, delivering more assists, and reducing turnovers (Gómez et al., 2008; Ibáñez et al., 2008).

However, no studies have included this variable as a potential performance factor distinguishing between winning and losing teams at high levels. Nor has it been analysed whether the number of ball reversals facilitates a greater number of shots by reducing opposition or if these reversals improve the quality of shooting situations, thereby increasing effectiveness. Additionally, most studies related to performance indicators in basketball have focused on men’s competitions (Doğan et al., 2016; Gómez et al., 2008; Ibáñez et al., 2003), where field goal percentage and defensive rebounds have been identified as key factors in team victories. However, studies on women's basketball are scarce and do not allow for solid conclusions due to the limited amount of research. Nonetheless, the few available studies suggest that three-point shooting percentage and assists are the most decisive factors differentiating winning and losing teams in women's competitions (Fernández-Cortés et al., 2021; Gómez et al., 2006; Gómez et al., 2009; Saénz López et al., 2017). This study aims to advance this line of research by evaluating whether ball-side switching can be considered a performance factor in this population. Progressing in this direction could provide coaches with key tools to develop cooperative links that improve players’ motor cohesion (Bourbousson et al., 2010; Echeverri, 2020) and optimize decision-making during gameplay (Cárdenas, 2010; Eccles et al., 2009).

This study aims to analyse the effects of ball reversal on specific game variables (e.g., number of shot attempts, shot execution location, shooting effectiveness, possession outcome types, points scored per attack phase, distinction between winning and losing teams, offensive rebounds) to determine if it could be considered a new performance indicator in women’s basketball. Based on the background and objectives of the study, the general hypothesis posits that ball reversal significantly influences specific game variables, resulting in a higher number of shot attempts. As specific hypotheses, it is expected that reversing the ball from one side to the other will reduce defensive opposition, decrease turnovers, and lead to more shot attempts at the basket.

Methods

Sample

A total of 6.007 ball possessions from 64 games in the 2020/2021 Liga Femenina Endesa basketball season were recorded. Ball possessions were classified based on whether they included ball reversal (BR) (n > 0) or not (n = 0). Games were selected randomly, ensuring the inclusion of all teams in the regular season with a minimum of four games per team. Each team's selected games included at least one win and one loss from each half of the regular season.

Design and Variables

The study employed an observational, descriptive, prospective, and cross-sectional design. The research aimed to describe and explore dependency associations between various study variables.

The variables under study were divided into the following three categories:

1. Variables related to ball reversal:

- Ball Reversal (BR): This variable recorded whether the ball movement from one side of the court to the other during the attack phase, crossing the imaginary line that connects both baskets through a pass (Klusemann et al., 2013). A ball reversal occurred when the ball moved from the right to the left wing or vice versa. Ball reversals were counted only when the ball started in the wing positions, excluding initiations from the top of circle position. This variable had two categories: (**0)** No ball reversal throughout the possession and (**1)** At least one ball reversal during the attack phase.
- Number of Ball Reversals (NBR): The total number of ball reversals during the same attack phase was recorded.
- Ball Reversal Type (BRT): Three categories were identified: (**0)** No ball reversal, (**1)** Direct ball reversal: where the ball was directly moved from one side to another with a pass between two players, without an intermediary or dribbling action crossing the imaginary line and **(2)** Indirect ball reversal: where the ball was passed with an intermediary player or a dribble + pass after crossing the imaginary median line.
- Indirect Ball Reversal Type (IBRT): Seven categories were included: (**0)** No ball reversal or direct ball reversal, **(1)** Dribbling and passing: a player dribbles and crosses the imaginary line from one side of the court to the other, giving continuity of play and passes to a teammate, **(2)** Dribbling and hand-off: a player, who is dribbling the ball, crosses the imaginary line from one side of the court to the other, and passes it to a teammate making a hand-off with him , **(3)** Intermediary player in the top of circle position: a player who occupies central court positions with both feet outside the 3-point line, **(4)** Intermediary player in the low post position: an intermediate player occupies inside low post position, **(5)** Intermediary player in the mid-post position: an intermediate player occupies inside middle post position and **(6)** Intermediary player in the high post position: an intermediate player occupies inside high post position (Figure 1).

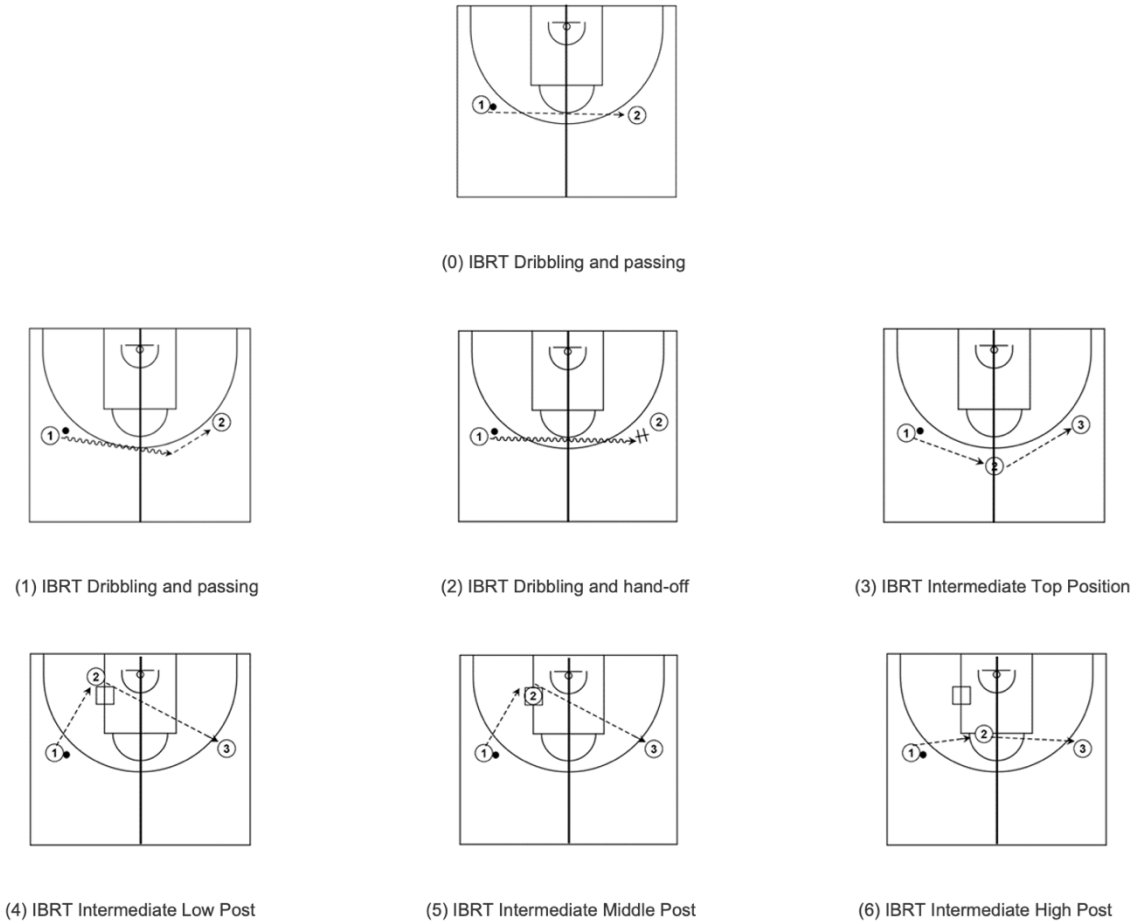

Figure 1. Types of ball reversals.

- Number of Passes per Attack Phase or Global Passes (NPA): Number of times players passed the ball to each other during each possession. The initial jump-ball tap was not counted.
- Number of Players Involved (NPJ): Number of players participating in each phase of the game where the analysed team had ball possession. The inbounder was always counted, and a maximum of five players on the court could participate.

2. Variables related to ball possession completions:

- Attack Phase (AP): The attack phase was defined as each phase of the offensive play. It began when a team obtained ball possession and concluded when possession ended (FIBA, 2024). A team had ball possession when a player fully controlled a live ball, either holding it or dribbling or passing it among team members. A new attack phase started upon any game interruption or when the opposing team gained control of the ball.
- Ball Possession Ending Type (BPET): This variable recorded how a player relinquished control of the ball: 1. Shot attempt, 2. Momentary end of possession (Deflection), 3. Turnover, 4. Jump ball, 5. Violation, 6. Foul received, 7. Foul committed, 8. Referee decision.

3. Variables related to shot attempts:

- Shot Attempt (SA): This variable had three categories: **(0)** No shot attempt, **(1)** Two-point shot attempt, defined as any layup or jump shot within the 6.75 m line (three-point line) or a shot taken with the player's foot on the line and **(2)** Three-point shot attempt, defined as any jump shot or layup taken from beyond the 6.75 m line.

- Shot Effectiveness (SE): Recorded the outcome of a shot attempt as: **(0)** Missed shot or foul drawn during the attempt and **(1)** Successful shot.
- Offensive Rebound (OR): Recorded as: **(0)** No offensive rebound following a shot attempt or if the defensive team secured the rebound and **(1)** Offensive team successfully secured the rebound after their own shot attempt.
- Level of Defensive Pressure on Shot (LDPS): Two categories were recorded: **(0)** Uncontested shot, taken without defensive pressure or with the closest defender more than two steps away.and **(1)** Contested shot, taken under defensive pressure, with an opponent within one step or directly in front of the shooter. Blocked shots were also counted as contested shots.
- Foul on Shot Attempt (FSA): Recorded as: **(0)** No shot attempt or no foul during the shot and **(1)** Foul occurred during the shot attempt.
- Free Throw Attempt (FTA): Recorded depending on whether free throws were attempted in the attack phase, whether resulting from a shot or due to a foul. Categories included: **(0)** No free throw attempt, **(1)** Free throw for foul received during a shot, **(2)** Free throw attempt due to team foul bonus and **(3)** Free throw attempt for unsporting, technical, or disqualifying foul.
- Scoring Efficiency in Possesion (SEP): The number of points scored (0-4 points). Five categories based on points scored: **(0)** No points scored, **(1)** One point scored, **(2)** Two points scored, **(3)** Three points scored and **(4)** Four points scored.
- Scoring Efficiency in Live Play (SELP): Points scored during possession without including free throws (0-3 points). Three categories: **(0)** No points scored, **(2)** Two points scored and **(3)** Three points scored.
- Free Throw Points (FTP): Points scored from free throws during possession (0-3 points). Four categories based on points scored: **(0)** No points scored, **(1)** One point scored, **(2)** Two points scored and **(3)** Three points scored.

Procedures and Materials

First, the sample was randomized to include four games for each of the 16 participating teams in the 2020/2021 Liga Femenina Endesa basketball season, meeting the following inclusion criteria: a) at least one game resulting in a win and another in a loss for each team, and b) games from both the first and second halves of the season. Following this, observer training was conducted over three weeks. Eight basketball-specialized observers, organized into four pairs, analysed all games in the sample. Inter- and intra-observer reliability was measured using the multi-rater k free index (Randolph, 2008) and Cohen's Kappa, respectively. All evaluations yielded reliability scores above 0.87, classified as "almost perfect agreement" (Altman, 1991).

The games were observed and analysed using Longomatch Video Analysis software. Data were then exported to Excel 2016 (Microsoft Corporation, Redmond, WA, USA) and analysed using IBM SPSS Statistics 25 (IBM, Chicago, IL).

Statistical Analysis

All collected data were initially compiled in Excel. Descriptive analysis was performed on the sample games' data, reporting observed frequencies and percentages for each study variable through flow diagrams and tables. A diagnostic analysis of the data was also conducted.

To test for dependency associations of our key variables — ball reversal (BR) and ball possession ending type (BPET) — with other study variables, we used the Chi-square test for qualitative variables. For quantitative variables, normality was assessed using the Kolmogorov-Smirnov test, and homogeneity of variances was tested with Levene's test, followed by a one-way ANOVA. A significance level of $p < 0.05$ was set for both tests. The Chi-square (X^2) and F (one-way ANOVA) values, along with degrees of freedom and p-values, were reported to determine the dependency associations among variables.

Results

In Figure 2, the distribution of frequencies from the study variables related to possession ending types is showed, distinguishing between instances where the ball was moved from one side to the opposite side (BR) and when it was not. The results indicate that possessions involving at least one BR resulted in a higher number of shot attempts, along with fewer turnovers and deflections. Conversely, when no BR occurred, nearly double the number of fouls were received compared to possessions that included a ball reversal.

Regarding shot attempts, there were notably more three-point shots attempted and scored when a BR was executed compared to when it was not. Shot effectiveness showed minimal difference between these types of offensive actions, while points scored in live play were higher for possessions involving ball reversals. However, total points scored per possession, including free throws, were greater when no BR was used.

Table 1. Frequency distribution of game variables based on Ball Reversal in possessions.

	Effectiveness possession	
	BR	Not BR
Shot effectiveness	804 (28.4%)	806 (25.4%)
Two-point shot attemtps	553 (19.5%)	668 (21%)
Three-point shot attempts	251 (8.9%)	138 (4.3%)
Offensive rebounds	255 (9%)	218 (6.9%)
Shooting foul attempts (FSA =1)	159 (5.6%)	222 (7%)
Total fouls received (BPET = 6)	196 (6.9%)	381 (12%)

A comparison was made of the instances when a possession ended with a positive outcome depending on whether at least one BR was used (Table 1). Along with a higher number of three-point shots scored, more offensive rebounds were captured when the ball was moved to the opposite side. In contrast, a greater number of fouls were drawn both during shots and in general play when no BR occurred.

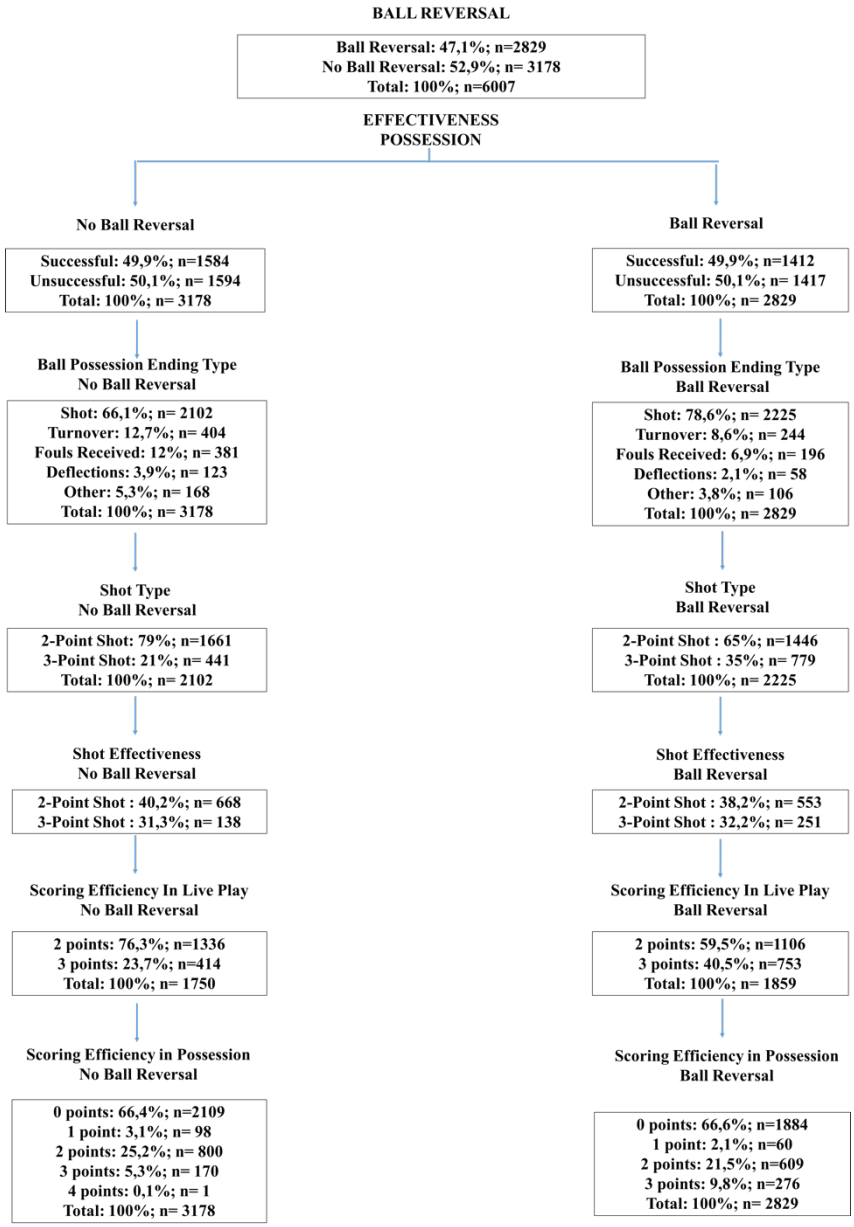

Figure 2. Frequency distribution of possession ending type based on Ball Reversals.

Table 2 shows the frequency distribution of ball reversal types used in possessions. Indirect BR was more frequent than direct BR. However, direct BR were the most common from the second ball reversal onwards within the same possession.

Table 2. Frequency distribution of Ball Reversal types based on BR order in possession.

	Ball Reversal Types		
	Direct BR	Indirect BR	Total
TBR (1st)	1066	1763	2829
TBR_1 (2nd)	483	407	890
TBR_2 (3rd)	101	85	186
TBR_3 (4th)	12	8	20
Total	1662	2263	3925

When indirect BR types were analysed (Table 3), it was found that indirect BR with an intermediary in the guard position (3) were the most commonly used, followed by dribble-to-pass reversals (1) and centers acting as intermediaries in low post.

Table 3. Frequency distribution of indirect Ball Reversal types based on BR order in possession.

	Indirect Ball Reversal Types				
	IBRT (1st)	IBRT_1 (2nd)	IBRT_2 (3rd)	IBRT_3 (4th)	TOTAL
1	458	153	42	4	657
2	55	14	0	0	69
3	1015	156	18	2	1191
4	40	15	7	1	63
5	66	23	7	0	96
6	129	46	11	1	187
Total	1763	407	85	8	2263

Figure 3 illustrates that as the number of ball reversals increases, so do the shot attempts, particularly three-point shots, which increase with a higher number of ball movement from one side to the opposite side. Also, a higher number of passes correlates with an increased attempt rate for three-point shots.

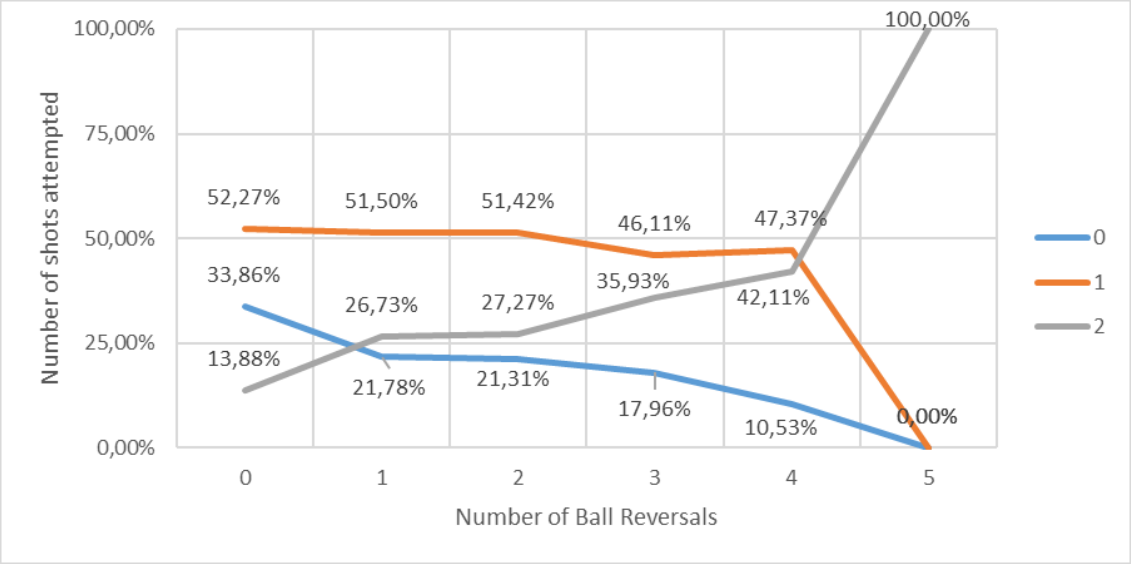

Figure 3. Shot type trends based on the number of Ball Reversals.

Chi-square and one-way ANOVA tests were used to examine the dependency associations between primary variables: Ball Reversals (Table 4) and Ball Possession Ending Types (Table 5), in relation to other study variables. The ball reversal significantly impacts how possessions conclude, as well as variables related to shot attempts (frequency, accuracy, opposition level, shot attempt fouls, and free throw attempts) and scoring efficiency (points per possession, live play, and free throws).

Table 4. Dependency relations of the Ball Reversals variable.

Ball Reversals	X2	Degrees of freedom	p-value
Ball Possession Ending Type	125.7	7	< 0.001
Shot attempt	222	2	< 0.001
Shot effectiveness	7.13	1	0.008
Offensive rebound	20.2	1	< 0.001
Level of Defensive Pressure on Shot	73.1	1	< 0.001
Shooting foul attempt	4.7	1	0.03
Free throw attempt	38	3	< 0.001
Points per possession	53.8	4	< 0.001
Points in live play	50.2	3	< 0.001
Points from free throws	27.8	3	< 0.001

Significance ($p < 0.05$)

Significant differences were also found between the possession ending type variable and quantitative variables: ball reversal types (first, second, and third ball reversal) and indirect ball reversal types (first BR). No significant effects were observed in indirect ball reversals (second and third). From the fourth BR onward, no significant differences emerged by ball reversal type.

Table 5. Dependency relations of the ball possession ending type variable.

Ball possession Ending Type	X2	Degrees of freedom	p-value
Ball reversal type (1^{st})	132	14	< 0.001
Indirect ball reversal type (1^{st})	91.8	42	< 0.001
Ball reversal type (2^{nd})	49.3	14	< 0.001
Indirect ball reversal type (2^{nd})	47.3	42	0.266
Ball reversal type (3^{rd})	24.3	14	0.042
Indirect ball reversal type (3^{rd})	20.8	35	0.972

Significance ($p < 0.05$)

Significant associations were identified between ball possession ending type and qualitative variables: number of ball reversals, passes, and players involved.

Table 6. Dependency relations of the ball possession ending type variable with study qualitative variables.

Ball Possession Ending Type	F-value	Degrees of freedom	p-value
Number of ball reversals	15.8	7	< 0.001
Number of passes	9.5	7	< 0.001
Number of players involved	14.5	7	< 0.001

Significance ($p < 0.05$)

Discussion

The aim of this study was to analyse the effects of ball reversal (BR) on specific game variables to determine whether it can be considered a performance indicator in women's basketball. Matches from the Liga Femenina Endesa were analysed, evaluating different ball possession ending types and scoring efficiency based on the use of ball reversals, including the ball reversal type, total number of passes, and the number of players involved in the plays.

The results of this study align with previous research highlighting that ball reversal, by incorporating key offensive principles of team sports, enhances a team's offensive performance by increasing the number of shot attempts (Courel et al., 2016). In this context, numerous studies have emphasized that shot attempts represent one of the most reliable performance indicators during competition (Cabarkapa et al., 2022; Gómez et al., 2008; Leicht et al., 2015; Mikołajec et al., 2021). Similarly, the systematic review by Canuto et al. (2022) on key statistics in basketball wins and defeats concluded

that teams with higher success rates tend to attempt more shots. These findings, supported by the analysis presented in Figure 2, underscore the relevance of ball reversal as a critical strategy for increasing shot frequency, with 78.6% of possessions that included ball reversal resulting in shot attempts, compared to 66.1% of those without. Consequently, ball reversal increases shot frequency and creates more opportunities for victory by broadening offensive options. However, as Suárez-Cadenas et al. (2016) point out, this increase in shot attempts highlights the importance of proper shot selection, which is essential for optimizing offensive efficiency and minimizing errors.

Our findings further indicate that ball reversal in offensive phases is associated with a higher number of three-point shot attempts and made, resulting in a significant increase in points scored during games compared to possessions where this strategy was not employed. Gou and Zhang (2022) demonstrated that an increase in three-point shooting percentages improved the probability of winning. Additionally, our results suggest that ball reversal not only improves offensive efficiency but is also associated with a significant reduction in turnovers and deflections during offensive phases. These turnovers correlate with the quality of the opposing team and occur more frequently against stronger teams (Dong et al., 2021). Similarly, Sun et al. (2022), in their analysis of the 2019 World Cup, found that high-performing teams had fewer turnovers, more assists, and higher three-point shooting percentages. Although most of the evidence focuses on men's basketball, the results of this study suggest that ball reversal can be equally effective in women's basketball by reducing offensive errors and complicating defensive adjustments by opponents.

The only previous study in the scientific literature that examined ball reversal as a tactical action was by Klusemann et al. (2013), who analysed physical and tactical demands in NCAA men's basketball players, distinguishing between winning and losing teams. They found that winning teams reversed the ball from one side to the other 18 times more frequently than losing teams. Similar results were observed in the present study for women's basketball. Figure 3 illustrates this trend, showing an increase in shot attempts as the number of ball reversals per offensive phase increases. In possessions without ball reversals, 33.9% ended without a shot attempt, while this percentage dropped to 10.5% when four ball reversals were performed. Three-point shot attempts also increased, rising from 26.7% with one ball reversal to 42.1% with four. Similar to the findings of Klusemann et al. (2013) in men's basketball, these results suggest that a higher frequency of ball reversals in women's basketball is associated with an increased number of shot attempts, potentially influencing team victories.

Moreover, the results demonstrate that the number of passes in a possession directly influences the type of outcomes, following a pattern similar to that observed with ball reversals. A higher number of passes is associated with an increased percentage of shot attempts at the end of offensive phases. Table 6 confirms significant effects of both the number of passes and ball reversals on how possessions conclude. According to Serna et al. (2021), playing with more passes instead of dribbling facilitates the generation of shots with less defensive opposition. Additionally, the results in Table 4 reveal that ball reversals reduce the level of defensive pressure on shots, improving their effectiveness. The importance of passing for offensive efficiency was studied by Gómez et al. (2013) in both men's and women's basketball games across different phases. Their findings showed that in men's games, the number of passes and player interactions were discriminant factors only in the first and last five minutes of the game, with fewer interactions toward the end, favouring individual actions. However, in women's games, the number of passes was higher throughout more phases of play. This difference may be explained by the distinct pace of play between genders. A similar study in soccer found that winning teams in the Italian league over two seasons had the highest success rates in passes and shots on target across the league (Hwang, 2024). This effectiveness was determined by the number of shots on target, goals scored, and passes leading to these shots.

The frequency analysis (Table 2) shows that the most common type of ball reversal is indirect (2,263 possessions), followed by direct (1,662 possessions). Table 3 details that within indirect ball reversals, 84.7% involve actions such as dribbling or the use of an intermediate player in a top position, while only 15.3% correspond to interior plays. This contrasts with men's basketball, where interior passes are considered essential for increasing offensive effectiveness (Courel et al., 2016; Courel et al., 2018). Additionally, Serna et al. (2021) emphasized that interior play draws defensive attention and

facilitates open shots. However, the results suggest an evolution in women's basketball tactics, where outside play is gaining prominence, gradually shifting away from traditional strategies centered on inside players.

In summary, this study demonstrates that ball reversal is a relevant tactical component for offensive performance in women's basketball. Our findings indicate that offensive phases involving ball reversal are associated with a higher percentage of shot attempts, particularly three-pointers, and a significant reduction in turnovers and deflections, thereby improving offensive efficiency. Moreover, the statistical analysis confirms that the number of passes and player interactions directly influence the generation of less contested shot opportunities, highlighting the importance of ball circulation as an offensive strategy in team sports. These results not only validate ball reversal as an effective tactical tool but also emphasize its utility in designing specific training strategies and integrating it into detailed analyses of competitive performance.

Limitations

The unique findings of this study provide valuable insights for practitioners into how ball reversal can be used as a tactical tool to enhance offensive performance. However, several limitations should be acknowledged. Specifically, situational variables such as home-court advantage, match status, possession type, and league ranking of the observed teams, as well as the defensive pressure on players' passing and receiving actions, were not analysed.

Future Research Directions

It would be interesting, as a future perspective, to analyse the association between ball reversal and situational variables, as well as the type and location of opposition relative to the receiver. Furthermore, the results encourage replicating the study with different populations and categories to determine the extent to which this action occurs in the game, particularly in developmental categories, to facilitate and increase open shots. Assuming a higher level of complexity, associations could be explored between ball reversal and preceding or subsequent collective actions to identify the most effective ways to capitalize on this game action.

Conclusions and Practical Applications

This study highlighted the impact of ball reversals on possession endings in women's basketball. The results showed that this tactical principle increases shot attempts and scoring while reducing turnovers and deflections and promoting a higher number of offensive rebounds. These improvements emphasize the use of ball reversals to disrupt opposing defenses and create more favourable opportunities during competition. Consequently, ball reversal is established as a key performance indicator, facilitating strategic actions that enhance the likelihood of success in women's basketball.

In terms of practical applications, these insights can be highly beneficial for coaches aiming to optimize team performance. Coaches should design tasks that encourage ball reversals to reduce defensive pressure and promote more open shot opportunities. For instance, collective game situations such as 3x3 or 4x4, where players are required to execute at least two ball reversals before attempting a shot, could be implemented. This approach not only fosters offensive actions but also encourages defensive behaviors such as pass interception, enhancing tactical awareness and creating better spaces for attacking receptions.

Additionally, assigning double value to possessions that incorporate ball reversals could further incentivize this tactical action. Coaches should also focus on developing offensive systems that, either directly or indirectly, integrate quick ball reversals to create more open shooting opportunities, especially for three-point attempts. These strategies leverage the benefits of ball reversals to improve both individual and team performance in basketball.

References

Altman, D. G. (1991). Mathematics for kappa. *Practical statistics for medical research*, *1991*, 406-407. https://doi.org/10.1201/9780429258589

Amatria, M., Maneiro-Dios, R., Moral-García, J. E., & López-García, S. (2023). El "cambio de orientación" como medio facilitador del éxito en el fútbol. *Retos: nuevas tendencias en educación física, deporte y recreación*, (48), 519-526.

Arenas-Pareja, M. Á., López-Sierra, P., Ibáñez, S. J., & García-Rubio, J. (2023). Influence of Menstrual Cycle on Internal and External Load in Professional Women Basketball Players. *Healthcare,* 11(6), 822-829. https://doi.org/10.3390/healthcare11060822

Bar-Eli, M., Avugos, S., & Raab, M. (2006). Twenty years of "hot hand" research: Review and critique. *Psychology of Sport and Exercise*, *7*(6), 525-553. https://doi.org/10.1016/j.psychsport.2006.03.001

Bettega, O. B., Scaglia, A. J., Nascimiento, J. V., Ibáñez, S. J., & Galatti, L. R. (2021). Princípios de jogo e estratégias de treino de treinadores de jovens no futebol de elite. *E-Balonmano. Com: Revista de Ciencias del Deporte*, *17*(1), 45-58. https://doi.org/10.17398/1885-7019.17.45

Bourbousson, J., Sève, C., & McGarry, T. (2010). Space–time coordination dynamics in basketball: Part 1. Intra-and inter-couplings among player dyads. *Journal of sports sciences*, *28*(3), 339-347. https://doi.org/10.1080/02640410903503632

Cabarkapa, D., Cabarkapa, D. V., Philipp, N. M., Eserhaut, D. A., Downey, G. G., & Fry, A. C. (2022). Impact of distance and proficiency on shooting kinematics in professional male basketball players. *Journal of Functional Morphology and Kinesiology*, *7*(4), 78. https://doi.org/10.3390/jfmk7040078

Cáceres-Sánchez, L., Escudero-Tena, A., Fernández-Cortés, J., & Ibáñez, S. J. (2021). Analysis of training variables of basketball in a formative stage. A case study. (2021). *E-Balonmano Com: Journal Sports Science*, *17*(2), 135-144. https://doi.org/10.17398/1885-7019.17.135

Canuto, S., & Becerra de Almeida, M. (2022). Determinants of Basketball Match Outcome Based on Game-related Statistics: A Systematic Review and Meta-A nalysis. *European Journal of Human Movement*, (48), 4-20. https://doi.org/10.21134/eurjhm.2022.48.2

Cárdenas, D. (2010). La toma de decisiones en baloncesto: bases neuropsicológicas y su aplicación práctica. Aportaciones teóricas y prácticas para el baloncesto del futuro, 131.

Cárdenas, D., & Alarcón, F. (2010). Conocer el Juego en Baloncesto para jugar de forma inteligente. *Wanceulen E.F. Digital*, *6*, 52–72.

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. *Biology of sport*, *35*(2), 137-145. https://doi.org/10.5114/biolsport.2018.71602

Courel, J., McRobert, A., Ortega, E., & Cárdenas, D. (2016). Inside pass predicts ball possession effectiveness in NBA basketball. *International Journal of Performance Analysis in Sport*, *16*(2), 711-725. https://doi.org/10.1080/24748668.2016.11868918

Courel, J., Suárez-Cadenas, E., Ortega, E., & Cárdenas, D. (2018). Propuesta para el entrenamiento del juego interior en baloncesto. *Apunts Educación Física y Deportes*, *34*(133), 98-115. https://doi.org/10.5672/apunts.2014-0983.es.(2018/3).133.07

Courel, J., Suárez, E., Ortega, E., Piñar, M. I., & Cárdenas, D. (2013). Is the inside pass a performance indicator?: Observational analysis of elite basketball teams. *Revista de Psicología del Deporte*, *22*(1), 191-194.

Csataljay, G., O'Donoghue, P., Hughes, M., & Dancs, H. (2009). Performance indicators that distinguish winning and losing teams in basketball. *International Journal of Performance Analysis in Sport*, *9*(1), 60-66. https://doi.org/10.1080/24748668.2009.11868464

Doğan, İ., & Ersöz, Y. (2019). The important game-related statistics for qualifying next rounds in Euroleague. *Montenegrin Journal of Sports Science and Medicine*, *8*(1), 43-49. https://doi.org/10.26773/mjssm.190307

Doğan, İ., Işik, Ö., & Ersöz, Y. (2016). Examining the Turkish men's professional basketball team's success according to game-related statistics with discriminant analysis. *International Journal of Performance Analysis in Sport*, *16*(3), 829-836. https://doi.org/10.1080/24748668.2016.11868931

Dong, R., Lian, B., Zhang, S., Zhang, M., Huang, S. Z., & O'Donoghue, P. (2021). Addressing opposition quality in basketball performance evaluation. *International Journal of Performance Analysis in Sport*, *21*(2), 263-276. https://doi.org/10.1080/24748668.2021.1877938

Eccles, D. W., Ward, P., & Woodman, T. (2009). Competition-specific preparation and expert performance. *Psychology of Sport and Exercise*, *10*(1), 96-107. https://doi.org/10.1016/j.psychsport.2008.01.006

Echeverri, J. A. (2020). La formación de entrenadores deportivos más allá de su connotación en el rendimiento. *VIREF Revista de Educación Física*, *9*(4), 27-37.

Fernández-Cortés, J. A., Mandly, M. G., García-Rubio, J., & Ibáñez, S. J. (2021). Aportación de las jugadoras profesionales de baloncesto en función del puesto específico y la fase de competición. *E-Balonmano. Com: Revista de Ciencias del Deporte*, 17(3), 223-232. https://doi.org/10.17398/1885-7019.17.223

FIBA (2024). Reglas de juego FIBA actuales. Disponible en: https://www.fiba.basketball/documents/official-basketball-rules/current.pdf

García-Rubio, J., Ibáñez, S. J., De Santos, R. M., Leite, N., & Sampaio, J. (2013). Identifying basketball performance indicators in regular season and playoff games. *Journal of human kinetics*, *36*(1), 161-168. https://doi.org/10.2478/hukin-2013-0016

Gómez, M. A., Gasperi, L., & Lupo, C. (2016). Performance analysis of game dynamics during the 4th game quarter of NBA close games. *International Journal of Performance Analysis in Sport*, *16*(1), 249-263. https://doi.org/10.1080/24748668.2016.11868884

Gómez, M. A., Lorenzo, A., Ibañez, S. J., & Sampaio, J. (2013). Ball possession effectiveness in men's and women's elite basketball according to situational variables in different game periods. *Journal of sports sciences*, *31*(14), 1578-1587. https://doi.org/10.1080/02640414.2013.792942

Gómez, M. A., Lorenzo, A., Sampaio, J. & Ibáñez, S.J. (2006). Differences in game-related statistics between winning and losing teams in women´s basketball. Journal of Human Movements Studies, 51, 357-369

Gómez, M. Á., Lorenzo, A., Ortega, E., Sampaio, J., & Ibáñez, S. J. (2009). Game related statistics discriminating between starters and nonstarters players in Women's National Basketball Association League (WNBA). *Journal of sports science & medicine*, *8*(2), 278-285.

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. *Collegium antropologicum*, *32*(2), 451-456.

Gou, H., & Zhang, H. (2022). Better offensive strategy in basketball: a two-point or a three-point shot?. *Journal of Human Kinetics*, *83*(1), 287-295. https://doi.org/10.2478/hukin-2022-0061

Hodges, N. J., & Franks, I. M. (2008). The provision of information. *The essentials of performance analysis: An introduction*, 21-39.

Hughes, M., & Bartlett, R. (2002). The use of performance indicators in performance analysis. *Journal of sports sciences*, *20*(10), 739-754. https://doi.org/10.1080/026404102320675602

Hwang, H. (2024). Effect of pass and shoot efficiency: Analysis of Italian first league ranking. *Journal of Human Sport and Exercise*, *19*(1), 139-147. https://doi.org/10.14198/jhse.2024.191.12

Ibáñez, S.J., García-Rubio, J., Rodríguez-Serrano, D. & Feu, S. (2019). Development of a Knockout Competition in Basketball: A Study of the Spanish Copa del Rey. Front. Psychol. 10:2457. https://doi.org/10.3389/fpsyg.2019.02457

Ibáñez, S.J.; García-Rubio, J.; Feu, S.; Parejo, I. & Cañadas, M. (2009) La eficacia del lanzamiento a canasta en la NBA: Análisis multifactorial. *Cultura, Ciencia y Deporte, 4*(10), 39-47. https://doi.org/10.12800/ccd.v4i10.132

Ibáñez, S. J., Sampaio, J., Feu, S., Lorenzo, A., Gómez, M. A., & Ortega, E. (2008). Basketball game-related statistics that discriminate between teams' season-long success. *European journal of sport science*, *8*(6), 369-372. https://doi.org/10.1080/17461390802261470

Klusemann, M. J., Pyne, D. B., Hopkins, W. G., & Drinkwater, E. J. (2013). Activity profiles and demands of seasonal and tournament basketball competition. *International journal of sports physiology and performance*, *8*(6), 623-629. https://doi.org/10.1123/ijspp.8.6.623

Lapresa, D., Alsasua Santos, R., Arana Idiakez, J., Anguera Argilaga, M. T., & Garzón Echevarría, B. (2014). Análisis observacional de la construcción de las secuencias ofensivas que acaban en lanzamiento en baloncesto de categoría infantil. *Revista de Psicologia del Deporte, 23(2), 365-376*.

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*, *5*(4), 96. https://doi.org/10.3390/sports5040096

Li, F., Li, Z., Borović, I., Rupčić, T., & Knjaz, D. (2021). Does fatigue affect the kinematics of shooting in female basketball?. *International Journal of Performance Analysis in Sport*, *21*(5), 754-766. https://doi.org/10.1080/24748668.2021.1945878

López-Mursuliz, A., Peña, Y., & Govea, C. (2022). Indicadores para evaluar los elementos técnicos ofensivos en atletas de baloncesto 3x3, categoría 11-12 años. *Ciencia y Deporte*, *7*(2), 142-156. https://doi.org/10.34982/2223.1773.2022.V7.No2.011

Lorenzo, A., Gómez, M. Á., Ortega, E., Ibáñez, S. J., & Sampaio, J. (2010). Game related statistics which discriminate between winning and losing under-16 male basketball games. *Journal of sports science & medicine*, *9*(4), 664.

Marmarinos, C., Apostolidis, N., Kostopoulos, N., & Apostolidis, A. (2016). Efficacy of the "pick and roll" offense in top level European basketball teams. *Journal of human kinetics*, *51*, 121-128. https://doi.org/10.1515/hukin-2015-0176

Martínez-Santos, R., Martínez-Gutiérrez, E., & Mujika-García, M. (2017). Lógica temporal del tiro libre en ACB. *Revista de psicología del deporte*, *26*(3), 101-107.

Merlin, M., Cunha, S.A., Moura, F.A., da Silva, R., Gonçalves, B., & Sampaio, J. (2020). Exploring the determinants of success in different clusters of ball possession sequences in soccer, Research in Sports Medicine, 28 (3), 339-350, https://doi.org/10.1080/15438627.2020.1716228

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. *Journal of human kinetics*, *77*(1), 287-296. https://doi.org/10.2478/hukin-2021-0050

Morales-Belando, M. T., Díaz-Aroca, Á., & Arias-Estero, J. L. (2022). Propuesta de enseñanza del baloncesto desde un enfoque global. *Manual para la formación de jóvenes deportistas en deportes colectivos*, 115-129.

Morillo-Baro, J.P.; Troyano-Gallegos, B.; Alejandre Estable, A.; Vázquez-Diz, J.A.; Reigal Garrido, R.E.; Hernández-Mendo, A. y Morales-Sánchez, V. (2021). Influencia del juego interior de la selección española de baloncesto en el rendimiento: análisis de coordenadas polares. *Cuadernos de Psicología del Deporte*, 21(3), 179-191. https://doi.org/10.6018/cpd.466201

Nunes, H., Iglesias, X., Daza, G., Irurtia, A., Caparrós, T., & Anguera, M. T. (2016). Influencia del pick and roll en el juego de ataque en baloncesto de alto nivel. *Cuadernos de Psicología del Deporte*, *16*(1), 129.

Ortega, E. (2010). Medios técnico-tácticos colectivos en baloncesto en categorías de formación. *Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte/International Journal of Medicine and Science of Physical Activity and Sport*, *10*(38), 234-244.

Pérez- Lobato, A. (2018). Influencia del rebote en baloncesto. *Revista Mundo Entrenamiento. El deporte bajo evidencia científica*.

Puente, C., Coso, J. D., 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

Quílez, A., Courel, J., & Rojas, F. J. (2020). The basketball pass: A systematic review. *Journal of human kinetics*, *71*, 275. https://doi.org/10.2478/hukin-2019-0088

Randolph, J. J. (2008). *Online Kappa Calculator* [Computer software]. Recuperado de: http://justus.randolph.name/kappa.

Reina, M. (2020). *Cuantificación de la carga externa e interna a través del uso de dispositivos inerciales en baloncesto femenino* (Tesis Doctoral, Universidad de Extremadura).

Rodríguez Albuja, L. O. (2019). *El desarrollo de la velocidad acíclica y su incidencia en los fundamentos técnicos ofensivos del baloncesto de la categoría sub 12 del semillero deportivo CEMIDER del municipio del Cantón Rumiñahui en el año 2018* (Bachelor's thesis).

Romarís, I. U., Refoyo, I., & Coterón, J. (2012). La finalización de las posesiones en baloncesto: estudio de la acción de finalización. *Cuadernos de Psicología del Deporte, 12*(1).

Sáenz-López, P., Rebollo, J. A., & Vizcaino, C. (2017). Claves en la victoria de la Copa de la Reina de baloncesto en 2016. *Cuadernos de Psicología Del Deporte*, *17*(3), 223–230.

Sanfiz-Arias, H., & López-Alonso, V. (2024). Influencia de las variables situacionales en los cambios de dirección de la posesión de balón en fútbol Influence of situational variables on changes in direction of ball possession in football. Retos, 53, 233-241.https://doi.org/10.47197/retos.v53.101859

Serna, J. (2014) Inteligencia Motriz e Inteligencia Emocional en el Baloncesto. Ph.D. Thesis, INEFC-Universidad de Lleida, Lleida, España.

Serna, J., Muñoz-Arroyave, V., March-Llanes, J., Anguera, M. T., Prat, Q., Rillo-Albert, A., ... & Lavega-Burgués, P. (2021). Effect of Ball Screen and One-on-One on the Level of Opposition and Effectiveness of Shots in the ACB. *International Journal of Environmental Research and Public Health*, *18*(5), 2676-2683. https://doi.org/10.3390/ijerph18052676

Skinner B (2012) The Problem of Shot Selection in Basketball. *PLoS ONE* *7*(1), e30776. https://doi.org/10.1371/journal.pone.0030776

Suárez-Cadenas, E., Courel, J., Cárdenas, D., & Perales, J. C. (2016). Towards a decision quality model for shot selection in basketball: An exploratory study. *The Spanish journal of psychology*, *19*, 55-62. https://doi.org/10.1017/sjp.2016.53

Sun, W., Chee, C., Kok, L., Lim, F., & Samsudin, S. (2022). Evaluation of differences in the performance strategies of top and bottom basketball teams utilizing rank-sum ratio comprehensive. *Frontiers in Sports and Active Living*, *4*. https://doi.org/10.3389/fspor.2022.1052909

Tian, C. (2016, December). Mechanical Analysis of Basketball's Movement Trajectory after Its Shooting Action. In *2016 4th Intl Conf on Applied Computing and Information Technology/3rd Intl Conf on Computational Science/Intelligence and Applied Informatics/1st Intl Conf on Big Data, Cloud Computing, Data Science & Engineering (ACIT-CSII-BCD)* (pp. 406-408). IEEE.

Vencúrik, T., Knjaz, D., Rupčić, T., Sporiš, G., & Li, F. (2021). Kinematic analysis of 2-point and 3-point jump shot of elite young male and female basketball players. International journal of environmental research and public health, 18(3), 934. https://doi.org/10.3390/ijerph18030934

Zhai, Z., Guo, Y., Li, Y., Zhang, S., & Liu, H. (2020). The regional differences in game-play styles considering playing position in the FIBA female continental basketball competitions. *International Journal of Environmental Research and Public Health*, *17*(16), 5827. https://doi.org/10.3390/ijerph17165827

Zuccolotto, P., Manisera, M., & Sandri, M. (2018). Big data analytics for modeling scoring probability in basketball: The effect of shooting under high-pressure conditions. *International journal of sports science & coaching*, *13*(4), 569-589. https://doi.org/10.1177/1747954117737492

Zwierko, T., Popowczak, M., Woźniak, J., & Rokita, A. (2018). Visual control in basketball shooting under exertion conditions. *The Journal of sports medicine and physical fitness*, *58*(10), 1544-1553. https://doi.org/10.23736/S0022-4707.17.07522-3