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Analysis of game situations in the 3-point shot in women's basketball - A case study

Análisis de situaciones de juego en el lanzamiento de 3 puntos en el baloncesto femenino - Un estudio de casos.

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Abstract

This study analyzes the characteristics of three-point shooting in women's basketball using a cluster-based approach. A total of 174 three-point shots were analyzed from six games played by a Liga Femenina Challenge team during the 2021/2022 season. Observational methodology was employed to define and record situational and technical-tactical variables. A descriptive analysis and k-means cluster analysis were conducted to classify the shots based on the study variables, considering factors such as opposition quality, match status, and defensive pressure.
The results identified five clusters reflecting different game contexts and situational demands. Shots taken under scoreboard advantage and lower defensive pressure demonstrated higher success rates. Perimeter players achieved better efficiency in games won, while post players had a lower impact. Greater accuracy was observed in home games, during the first half, and in the final minutes. The analysis also highlighted that a higher number of passes and ball reversal improved shooting efficiency. Defensive pressure proved to be a critical factor, with better performance observed in shots made without direct opposition. This study underscores the influence of contextual and tactical factors on three-point shooting success, providing practical insights for designing specific training sessions aimed at optimizing offensive performance in women's basketball.
Keywords: match analysis; women's basketball; performance indicators; team sports.

Resumen

Este estudio analiza las características del lanzamiento de tres puntos en el baloncesto femenino mediante un enfoque de clustering. Se analizaron 174 tiros de seis partidos de un equipo de la Liga Femenina Challenge (2021/2022). Se empleó metodología observacional para definir y registrar variables situacionales y técnico-tácticas, realizándose un análisis descriptivo y clúster de k-medias, considerando la calidad del oponente, la situación del marcador y la presión defensiva entre otras variables de estudio. Los resultados identificaron cinco clústeres que reflejan distintos contextos de juego. Los tiros con ventaja en el marcador y menor presión defensiva presentaron mayor acierto. Las jugadoras exteriores fueron más eficientes en partidos ganados, mientras que las interiores tuvieron menor impacto. Se observó mayor precisión como local, en la primera mitad y minutos finales. Además, un mayor número de pases y cambios de lado del balón mejoró la eficacia en el tiro. La presión defensiva fue un factor clave, con mejores resultados en lanzamientos sin oposición. Este estudio destaca la influencia de factores contextuales y tácticos en el éxito del tiro de tres puntos y ofrece implicaciones prácticas para diseñar entrenamientos específicos que optimicen el rendimiento ofensivo en baloncesto femenino.
Palabras claves: análisis del juego; baloncesto femenino; indicadores de rendimiento; deportes de equipos.

Introduction

Modern basketball has undergone significant evolution in recent decades. The three-point shot is considered one of the most influential tactical and technical tools in shaping the game and determining match outcomes (Durmus & Erdeveciler, 2023). It has become a key element in maximizing offensive efficiency and immediately altering competitive dynamics (Freitas, 2021; Malarranha et al., 2013). Its growing prominence has not only transformed how teams structure their strategies but also influenced the way individual and collective performance is analyzed at various competition levels (Leich et al., 2017; Madarame, 2021). In this context, women's basketball has shown increasing interest in the study of three-point shooting, recognizing its impact on performance assessment and the adaptation of sport-specific strategies (Ibáñez et al., 2009; Sampaio & Leite, 2006).The increased relevance of the three-point shot is closely tied to a shift in playing styles observed in recent decades. This shift has been marked by a transition from the predominance of mid-range shooting to a more aggressive focus on three-point shooting, largely driven by the application of data analytics in professional basketball (Mandić et al., 2019). According to Kilcoyne (2020), the implementation of advanced analytical tools has enabled coaches and players to identify game patterns that maximize success probabilities, positioning the three-point shot as a decisive factor. Recent studies have demonstrated that teams with higher accuracy in these attempts tend to achieve better results in high-level competitions, thereby reinforcing its tactical importance and impact on overall performance (Sáenz-López et al., 2017; Csataljay et al., 2013).

The context in which three-point shots are taken also plays a crucial role in their effectiveness. Shot selection under favorable conditions, such as the absence of defensive pressure, the shooter's positioning, or even the game score, significantly influences success rates. Studies such as Ortega et al. (2007) have highlighted the importance of contextual factors in offensive performance, emphasizing the need to consider not only technical skills but also situational aspects that affect game dynamics (Gasperi et al., 2023; Gómez et al., 2013; Gómez et al., 2015). Moreover, technologies such as real-time player tracking and video analysis have enhanced understanding of how and when three-point shots are most effective, providing a solid foundation for continuous performance improvement (Chen et al., 2009).In women's basketball, the three-point shot holds additional relevance due to differences in playing styles and physical characteristics compared to men's basketball (Zhang et al., 2023). While men's and women's basketball share fundamental game principles, differences in speed, strength, and height have led to distinct evolutions in offensive and defensive strategies employed by women's teams (Bezerra et al., 2022; Cabarkapa et al., 2022; Mancha-Triguero et al., 2021; Ziv & Lidor, 2009). These differences influence not only the ability to execute shots but also the way players perceive and respond to game dynamics (Cabarkapa et al., 2022). For example, studies by Ibáñez et al. (2009), Mikołajec et al. (2021), and Moreno et al. (2013) have examined how contextual factors, such as opposition quality, defensive strategies, and game timing, affect offensive performance. Nonetheless, significant gaps remain in the scientific literature, particularly in research specifically focused on women's basketball.

In this regard, the study of Cotta-Ortega et al. (2024) has made a valuable contribution by analyzing top-division women's basketball games. It has been shown that the number of ball reversals and their relationship with defensive movement are key factors in increasing shooting opportunities during a game. These findings underscore the importance of training not only shooting technique but also decision-making skills and game-reading abilities in dynamic situations (Cárdenas & Alarcón, 2010). Despite these advances, female players and teams still face limited access to advanced analytical resources and specific data that could enable deeper analyses. This gap in the literature may restrict opportunities for strategic and tactical improvement, affecting the development of competitive women's basketball. Therefore, it is essential for future research to address not only the technical aspects of three-point shooting but also the impact of competitive environmental characteristics, such as league level or cultural differences between national and international competitions (Mandić et al., 2019).

Additionally, integrating specific data from national competitions provides a contextualized approach that enriches the validity of findings and strengthens practical recommendations. This approach would allow for the identification of key moments during games when three-point shots are most effective, as well as the defensive and offensive conditions that favor their success (Suárez-Cadenas et al., 2016; Wang & Zheng, 2022). By doing so, this study not only contributes to advancing scientific knowledge but also offers practical tools for coaches and players seeking to optimize performance in high-pressure situations. This case study aims to provide a detailed analysis of performance patterns in three-point shooting in women's basketball. Through the observation and categorization of specific game situations, it seeks to understand how contextual and tactical-technical factors influence the effectiveness of these shots. Furthermore, the integration of specific data from national competitions offers a contextualized approach that enriches the validity of the findings and enhances practical recommendations.

Methods

Sample

A total of 174 three-point shots were recorded across six games played by the 11 players (age: 26.2 ± 4.02 years old; height: 179.36 ± 8.07) of a Liga Femenina Challenge team (the second division of Spanish women's basketball) during the 2021/2022 season. The 11 players were divided in two groups: 7 perimeter players and 4 post players. The games were randomly selected, ensuring an equal number of wins and defeats for the study.

Design and Variables

The study follows an observational, descriptive, prospective, and cross-sectional design. It focuses on the description and classification of the characteristics of the study variables. The variables under investigation were divided into the following five categories:

1. Control Variables:

- **Player Position:** Refers to the specific position occupied by the player on the court. Players were categorized into two groups: 1) perimeter players (guards, shooting guards, and small forwards) and 2) post players (power forwards and centers) (Domínguez, 2010).
- **Match Location:** Indicates the team's location during the match. Two options were considered: 1) home, when the team played on their home court, and 2) away, when the team played on the opponent's court (Smith, 2005; Bustamante et al., 2022; Gómez et al., 2008).
- **Game Time:** Each quarter (including overtime periods) was subdivided into 5-minute intervals for a more detailed analysis of the variable's influence on three-point shooting (Ibáñez et al., 2009). The quarters were divided as follows: 1) minute 00:00 to 05:00, 2) minute 05:01 to 10:00, and so on up to 8) minute 35:01 to 40:00. 10) minute 45:01 to 50:00. In overtimes cases, they were registered as 9) minute 40:01 to 45:00 and 10) minute 45:01 to 50:00.
- **Game Score:** Refers to the team's final result in the match, categorized as 1) win, if the team won the game, and 2) loss, if the team did not win.
- **Match Status:** The score difference between the team and the opponent at a specific moment during the match, specifically at the time of the three-point shot (Zuccolotto et al., 2018).
- **Match Status Result:** The score difference at the time of the three-point shot, categorized into three groups: 1) positive, when the team was leading, 2) negative, when the team was trailing, and 3) neutral, when the score was tied (Zuccolotto et al., 2018).
- **Quality of Opposition (QOO):** Teams were divided into three categories based on their league standings at the end of the regular season: 1) high-level teams (12 or fewer losses, 1st–6th place), 2) mid-level teams (13–19 losses, 7th–

11th place), and 3) low-level teams (20 or more losses, 12th–16th place). This classification was determined using a k-means cluster analysis (Courel et al., 2018; Sampaio et al., 2010; Sansone et al., 2021).

2. Offensive Variables:

- **Shot Attempt:** The result of the three-point shot, categorized as 1) made or 2) missed.
- **Shooting Kind:** The way in which the three-point shot was executed, classified into six categories (Ibáñez et al., 2009): 1) catch-and-shoot from a stationary pass, 2) catch-and-shoot from an off-ball screen, 3) catch-and-shoot from a pick-and-pop action, 4) catch-and-shoot from a handoff or semi-direct screen, 5) one-on-one after dribbling, and 6) one-on-one after a pick-and-roll.
- **Offense Kind:** The type of offense based on the possession duration before the three-point shot (Prieto-Lage et al., 2022). Four categories were defined: 1) fast break (24–17 seconds), 2) transition (16–9 seconds), 3) set play (under 9 seconds), and 4) offensive rebound (a maximum of 14 seconds after recovering an offensive rebound).
- **Offense Concept:** The play from which the offensive action originated. Three categories were identified: 1) open play, when the ball was live following an offensive or defensive action, 2) baseline inbound, starting from an inbound pass from the baseline, and 3) sideline inbound, starting from a sideline pass due to a turnover, foul, or timeout.
- **Previous Shooting Result:** The outcome of the previous three-point shot, categorized as 1) not attempted, 2) made, or 3) missed (Moreno, 2017).
- **Offensive Style:** The offensive approach used to execute the three-point shot (Courel et al., 2018). Two categories were defined: 1) five-out, when the ball did not enter the paint, and 2) inside-out, when the ball moved through the paint via a pass or dribble.
- **Number of Passes:** The number of passes made before the three-point shot (D'Amour et al., 2015).
- **Number of Ball Reversals:** The number of ball reversals during the possession (Cotta-Ortega et al., 2025).

3. Defensive Variables:

- **Distance to the opponent:** The distance of the defender from the shooter at the time of the three-point shot (Ibáñez et al., 2009; Ortega et al., 2007). Three categories were recorded: 1) contested, 2) close defender, and 3) open (no defensive pressure).
- **Defense Kind:** The defensive strategy used by the opposing team at the time of the three-point shot (Gómez et al., 2013; Muñoz et al., 2015). Two categories were defined: 1) man-to-man, and 2) zone defense.
- **Previous Action:** The previous action before the three-point shot refers to the last game action that occurred prior to the three-point attempt. This could include actions such as an offensive rebound by the team (classified as an offensive variable) (Ibáñez et al., 2009; Muñoz et al., 2015). Eleven categories were distinguished: 1) Two-point shot made by the opponent, 2) Two-point shot missed by the opponent, 3) Two-point shot missed by the team, 4) Three-point shot made by the opponent, 5) Three-point shot missed by the opponent, 6) Three-point shot missed by the team, 7) Free throw made by the opponent, 8) Free throw missed by the opponent, 9) Free throw missed by the team, 10) Turnover, and 11) Offensive play initiated after a timeout or break.

4. Spatial Variables:

- **Shooting Position (Pos. Tiro):** The court zone from which the shot was taken, divided into five zones: 1) right corner, 2) right wing, 3) top position, 4) left wing, and 5) left corner, adapted from Ibáñez et al. (2001) and Pelechrinis & Goldsberry (2021).

5. Temporal Variables:

- **Possession Type:** The type of possession based on the time remaining on the shot clock (Ibáñez et al., 2009; Prieto-Lage et al., 2022). Three categories were defined: 1) fast break (24–18 seconds), 2) transition (17–9 seconds), and 3) set play (under 9 seconds).

Procedures and Materials

First, the sample was randomized to ensure an equal number of games in which the observed team won and lost during the 2021/2022 season of the Liga Femenina Challenge. The inclusion criteria were as follows: a) regular-season games from both the first and second rounds of the league, b) an equal number of home and away games, and c) three-point shots attempted by players from the first team. An "ad hoc" instrument was developed in accordance with the principles of observational methodology, following the approach adopted in previous studies (Camarano et al., 2024; Flores-Rodríguez & Alvite-de-Pablo, 2024). The games were observed and analyzed using the Longomatch Video Analysis v.2.0. software (Fluendo VAS S.L., Barcelona, Spain).

Subsequently, a three-week observer training period was conducted. Two observers, certified as senior basketball coaches and holding degrees in Sports Sciences with a specialization in basketball, analyzed all games in the sample. Inter- and intra-observer reliability was assessed using the multi-rater k free index (Randolph, 2008) and Cohen's Kappa, respectively. All reliability scores exceeded 0.87, classifying the results as "almost perfect agreement" (Altman, 1991).

The recorded data were exported to Excel 2016 (Microsoft Corporation, Redmond, WA, USA) and analyzed statistically using IBM SPSS Statistics 25 (IBM, Chicago, IL, USA).

Statistical Analysis

All collected data were initially grouped in Excel. A descriptive analysis of the sample data was performed, providing observed frequencies and percentages for each study variable through flow diagrams and tables. Additionally, correlation analyses were conducted to evaluate relationships between key variables.

A k-means clustering method was used to analyze the data, with the silhouette index serving as the criterion for determining the optimal number of clusters. This approach allowed for the categorization of observed three-point shots based on situational and performance variables, generating detailed insights into key patterns associated with three-point shooting.

Results

Figure 1 shows that the percentage of three-point shots attempted and converted was higher in games the team won compared to those it lost.

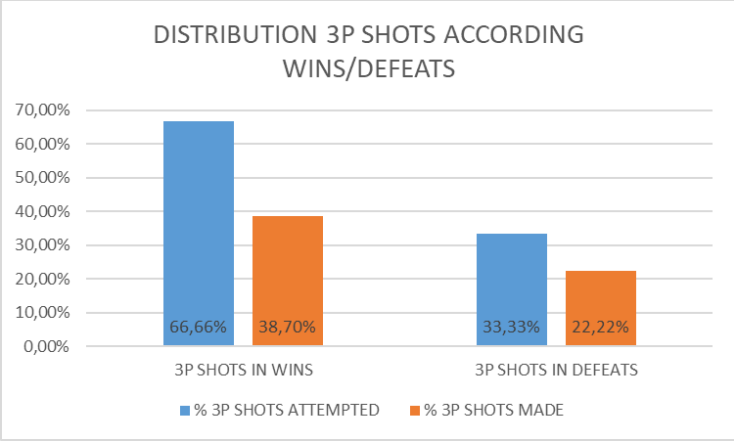

Figure 1. Distribution of three-point (3P) shots based on the team's match results.

Regarding the players' specific positions, it was observed that perimeter players had higher success rates in games won, while post players showed the opposite trend.

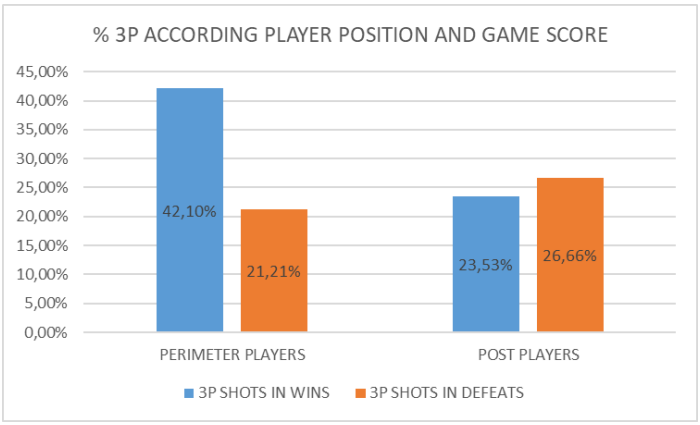

Figure 2. Percentage of three-point (3P) shots by player positions and game score.

A comparison was made between three-point shot attempts based on home and away games. A greater number of successful shots and better accuracy were observed when playing at home.

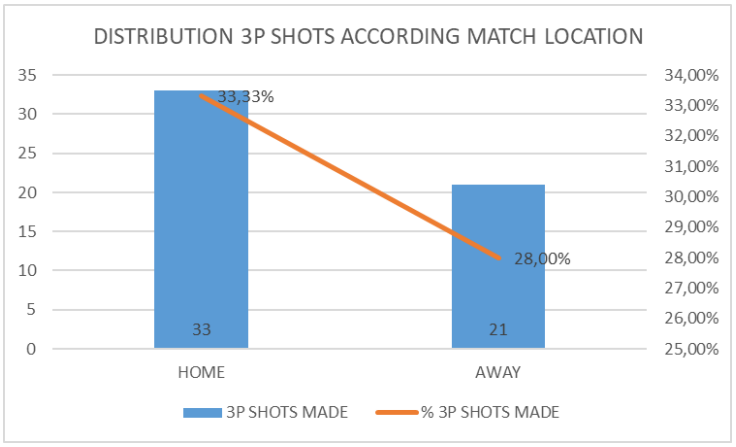

Figure 3. Distribution of three-point shots (3P) based on the match's location factor.

Analyzing the temporal moments during which the three-point shots were attempted, an increase in accuracy was noted as the first half progressed. However, in the second half, success rates dropped, except for the last five minutes, which showed higher success percentages.

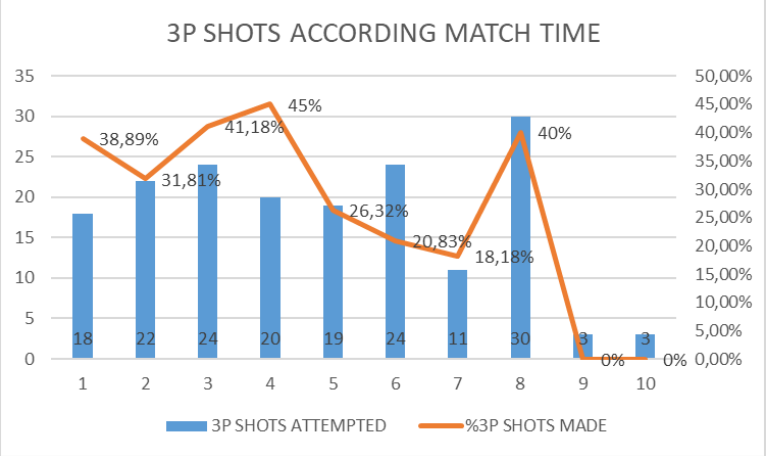

Figure 4. Distribution of three-point (3P) shots by match time.

In Figure 5, the influence of match status on three-point shot attempts is illustrated. Higher success percentages were recorded when the team was leading, followed by instances when the score was tied. However, when trailing, lower success rates were observed despite the higher number of three-point shot attempts.

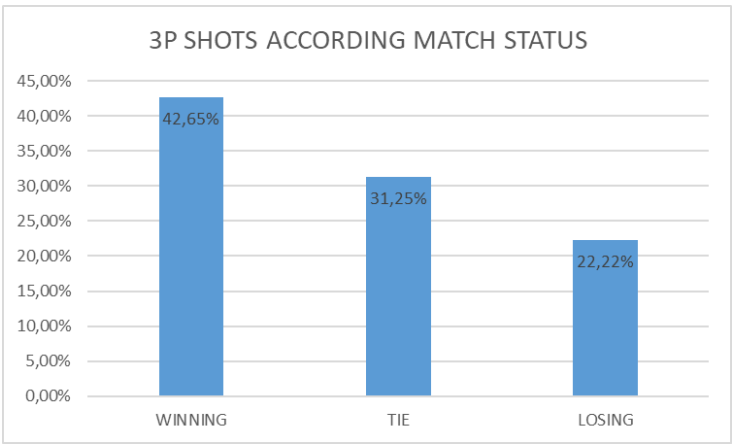

Figure 5. Distribution of three-point shots (3P) based on match status.

Regarding defensive pressure on three-point shot attempts, it was found that lower defensive pressure resulted in a higher number of successful three-point shots.

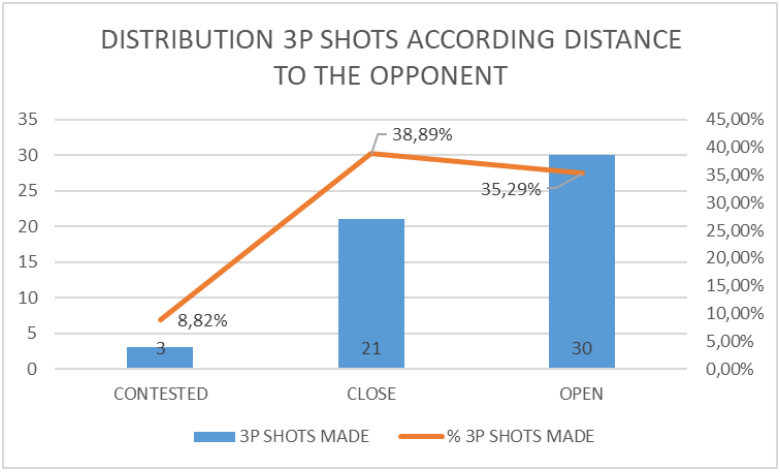

Figure 6. Distribution of three-point (3P) shots by the distance of the defender from the shooter.

In Figure 7, it was found that the court zones with the highest success percentages for three-point shots were the left corner and the right wing.

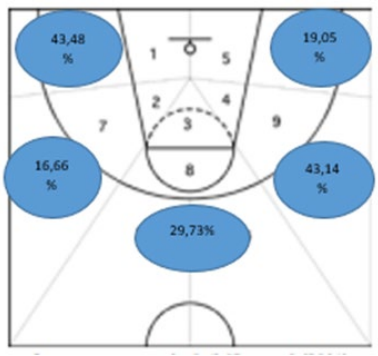

Figure 7. Three-point shooting percentages based on the court zones, adapted from the court graph by Ibáñez, Lozano, and Martínez (2001).

In Figure 8, the influence of possession type on three-point shot attempts is shown. Higher success percentages were recorded for possessions with fewer seconds used (fast breaks).

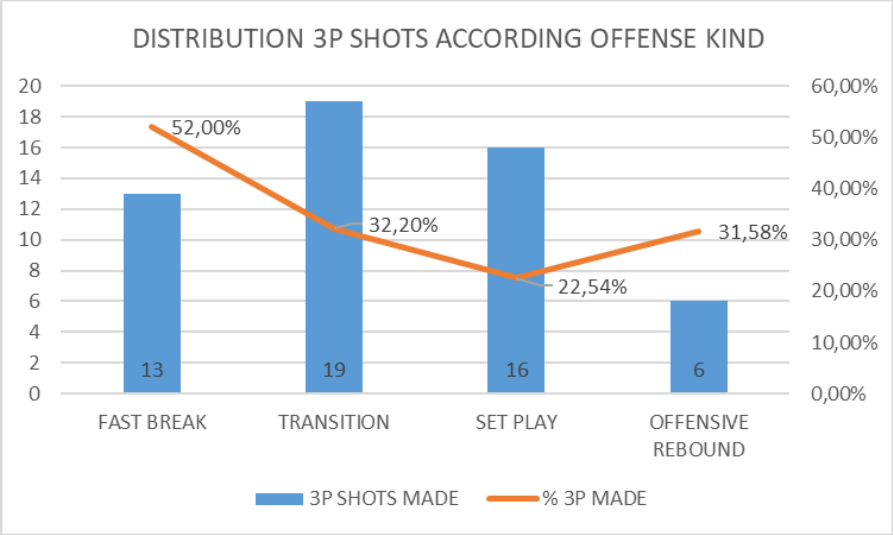

Figure 8. Distribution of three-point (3P) shots by the type of offensive play.

Analyzing the effect of the result of the previous shot on the observed attempt, better success percentages were found when the previous shot was successful, while the lowest success rates were observed when the previous shot had been missed.

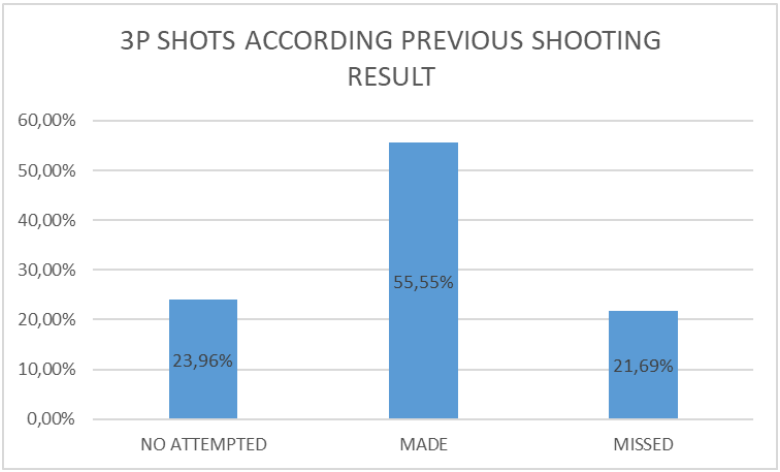

Figure 9. Three-point (3P) shot success based on the result of the previous three-point shot.

Regarding the number of passes and ball reversals, it was found that a higher number of three-point shot attempts occurred when there were more passes and ball reversals. Also, Figure 11 shows more 3 point shots made when there was at least one ball reversal.

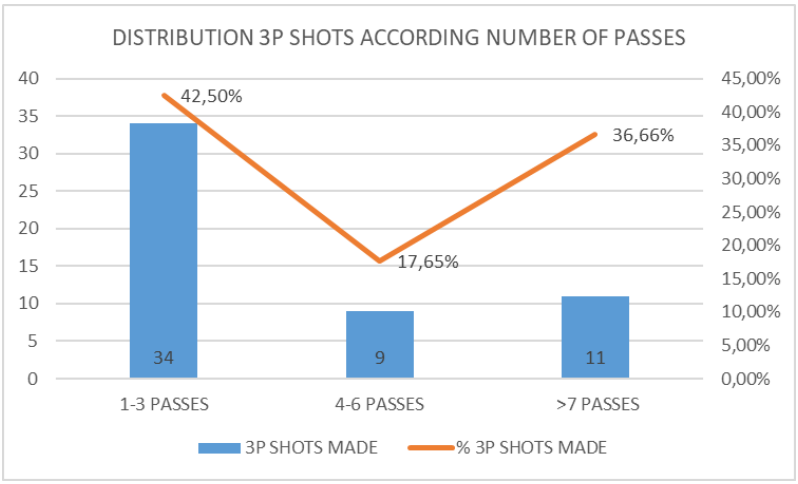

Figure 10. Three-point (3P) shot attempts based on the number of passes.

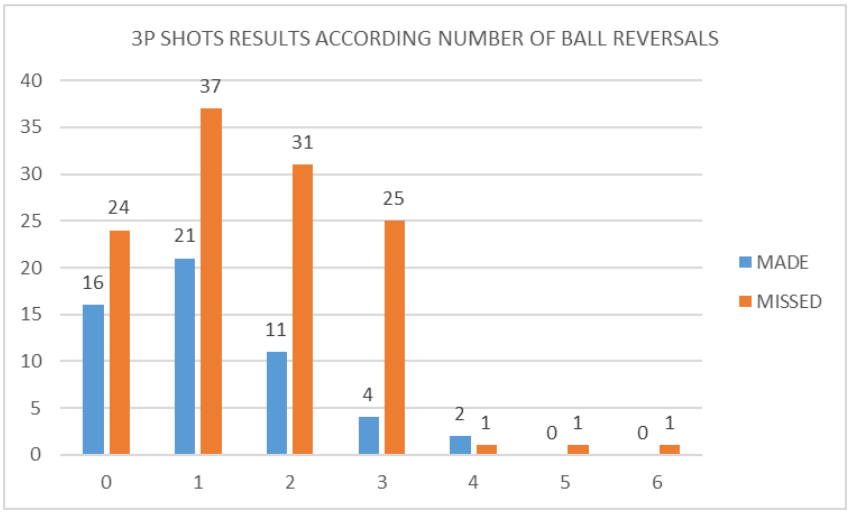

Figure 11. Three-point (3P) shot attempts based on the number of ball reversals.

When analyzing the influence of opposition quality (**Figure 12**), higher success and efficiency were observed in games against lower-quality opponents based on league standings.

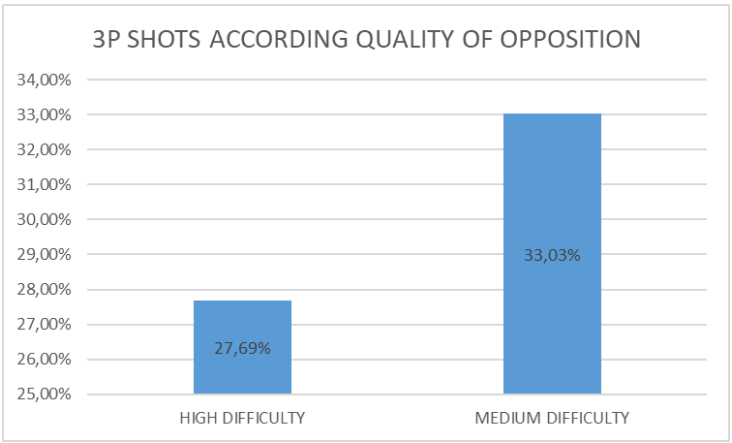

Figure 12. Three-point (3P) shots based on the quality of the opposition.

A correlation matrix was created for all study variables. No significantly high correlations were found among the variables.

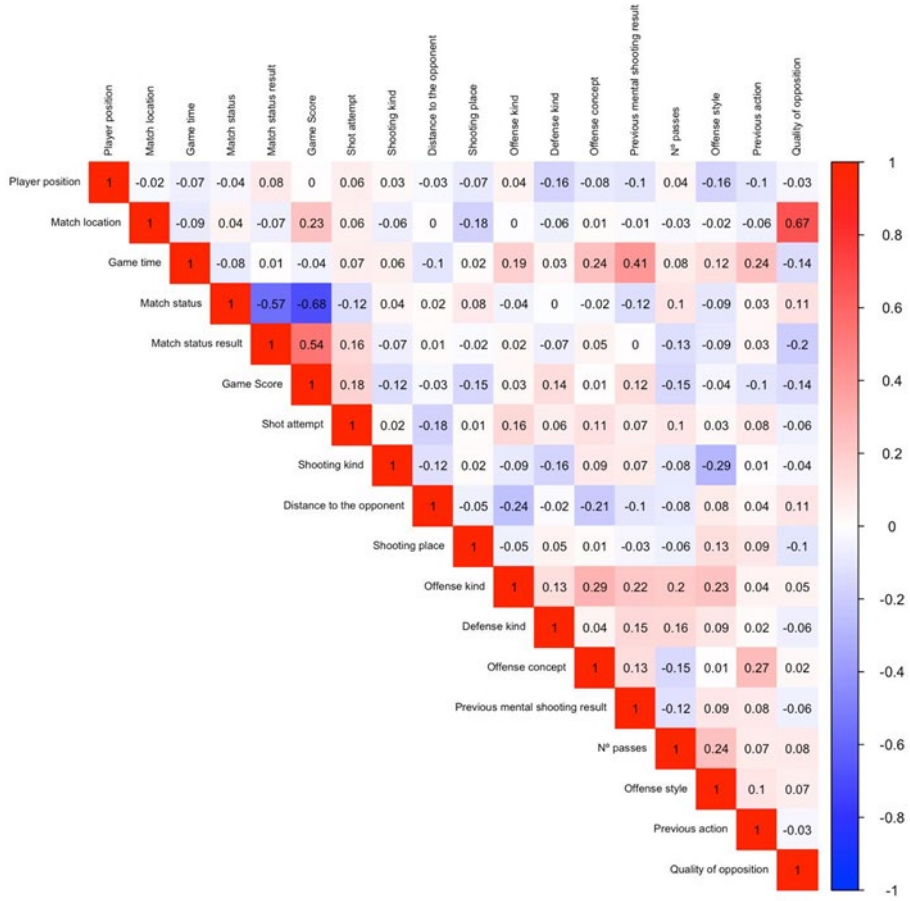

Figure 13. Correlation matrix for the study variables.

The silhouette method was used to determine the optimal number of clusters. Five clusters were identified as optimal for classification.

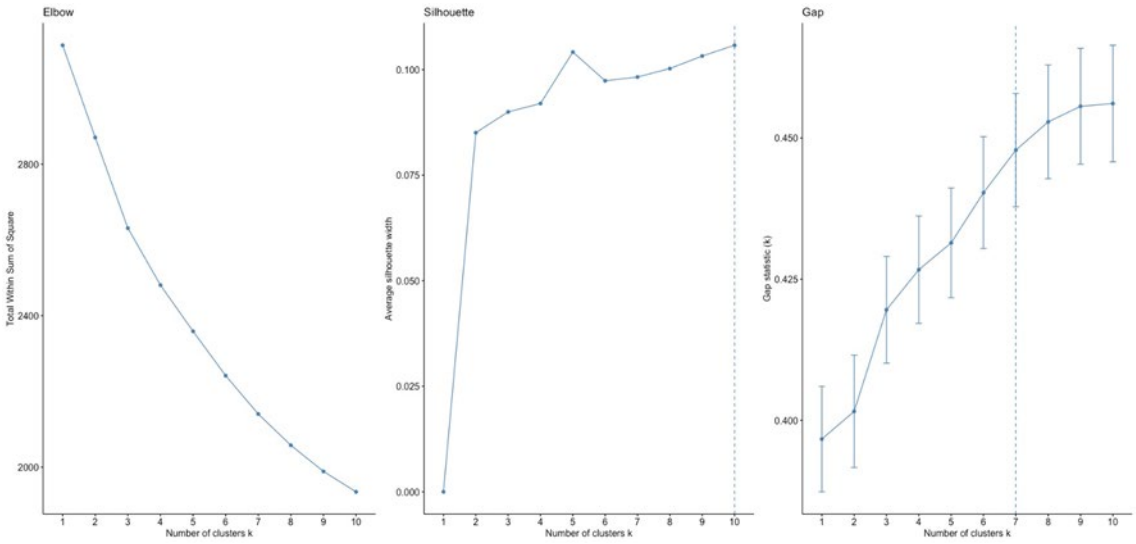

Figure 14. Silhouette method for determining the optimal number of clusters.

Cluster Analysis

Five clusters were created based on the study variables:

Cluster Grouping Details:

- **Cluster Group A:**
  Two clusters were identified when the team was leading, the defender was close, and the player had made their previous three-point shot. The team ultimately won the game, and the attempted three-point shot followed a three-point shot made by the opponent.
  - **Cluster 1:** This cluster included shots taken from the left wing during positional attacks. The team was leading by a narrow margin against higher-quality opponents. These shots occurred during "five-out" offensive plays without inside ball movement.
  - **Cluster 2:** This cluster included shots taken during transition plays from the top position. The team was leading by a wider margin against mid-quality opponents. These shots involved interior ball movement.
- **Cluster Group B:**
  Three clusters were identified when the match status was negative, the team ultimately lost, and the shots were uncontested. The player had missed their previous three-point shot.
  - **Cluster 3:** This cluster included shots taken from the right wing when the team was trailing by a large margin.
  - **Cluster 4:** This cluster included shots taken during home games when the team was trailing by three points and the shots occurred during transition plays against high-quality opponents.
  - **Cluster 5:** This cluster included all three-point shots attempted against zone defenses. These shots followed a free throw made by the opponent, involved more passes, and all shots were missed.

Discussion

The objective of this case study was to conduct a detailed analysis of performance patterns in three-point shooting in women's basketball, identifying key variables such as match status, court position, opposition quality, and technical-tactical factors. Among the main findings were: higher efficiency in games won; better percentages for perimeter players; the advantage of playing at home; temporal variations in shooting accuracy; the influence of defensive pressure; and a positive impact of passing over excessive dribbling. Additionally, cluster analysis identified patterns that could be used to design more specific training sessions.

The study's findings, such as the effectiveness of three-point shooting in competition, reaffirm the importance of three-point shots in competitive performance in women's basketball. Games were won when the team achieved better three-point shooting percentages, confirming that teams with higher long-range accuracy are more likely to succeed. This aligns with previous studies highlighting the relevance of this type of shot in modern basketball (Gou & Zhang, 2022; Sampaio & Leite, 2006). Specifically, the analysis showed that the team not only attempted more three-point shots in games they won but also converted them more frequently, consolidating the idea that efficiency in this type of shot is a key differentiator in performance.

Regarding player positions, perimeter players demonstrated a significant impact on games won, underscoring their importance in offensive development. Perimeter players attempted nearly four times as many three-point shots as post players, achieving a 32.4% efficiency rate compared to 25% for post players. Notably, in games won, perimeter players achieved a 42% success rate in three-point shots, whereas in games lost, they recorded only 21.2%. On the other hand, post players achieved a 23.5% success rate in games won, but their percentage increased to 26.6% in games lost. This finding aligns with studies like those of Ibáñez et al. (2009), which emphasize the ability of perimeter players to create space and score under favorable conditions. However, when three-point shooting efficiency decreases, the role of post players becomes more crucial. Studies by Hatem et al. (2020) indicate that post players compensate for missed perimeter

shots by increasing their offensive rebounding and second-chance points, which could explain the rise in their shooting efficiency in games lost. Similarly, Fernández-Cortés et al. (2021) highlight that in decisive competition phases, post players increase their rebounding and scoring contributions in the paint, making them essential for maintaining offensive effectiveness when outside shooting is unreliable.

The lower performance of post players in games won raises questions about how to optimize their contributions to the game. Strategies to diversify their roles, integrating outside shooting or combined plays with perimeter players, could be explored to enhance their impact in demanding competitive contexts. Additionally, reinforcing offensive rebounding tactics and designing set plays that involve inside players more actively in scoring opportunities could further balance the team's offensive efficiency across different game situations.

The home-court advantage emerged as a crucial factor, as teams playing at home showed greater efficiency in three-point shooting. This result is consistent with previous studies that attribute this advantage to familiarity with the facilities and support from the local audience (Barreira & Morgado, 2022; Bustamante et al., 2022; Dellagrama et al., 2023; Gómez & Pollard, 2011). Coaches could maximize this factor by training strategically adapted situations to the local environment, ensuring the team leverages this psychological and tactical advantage. The analysis of the temporal moments in the game revealed interesting patterns. Efficiency was higher during the first half, likely due to higher physical and mental energy levels, while the last five minutes of the game showed a spike in accuracy, possibly related to tactical adjustments and a focus on key plays. These results are consistent with those of Csataljay et al. (2013), who highlight the importance of physical endurance and strategic adaptability in maintaining efficiency throughout the game. Match status significantly impacted three-point shooting accuracy. Teams achieved better accuracy rates when leading or tied, suggesting that emotional and psychological states play a crucial role in decision-making (Fernández-Leo et al., 2020; Ortega et al., 2007). In situations of disadvantage, although attempts increased, efficiency decreased, indicating the need to train players to handle pressure and make optimal decisions even in adverse contexts. This finding underscores the importance of incorporating match-status simulations into training sessions to improve psychological and tactical resilience.

Another key finding was the influence of passing in creating favorable shooting opportunities. The analyzed team achieved better success rates and a higher number of three-point shot attempts when making more passes and ball movements, highlighting the importance of ball circulation in offensive success (Courel et al., 2016; Serna et al., 2021). Additionally, shots taken after shorter possessions, such as in fast-break situations, showed higher success rates, emphasizing the relevance of quick transitions as an effective tactical tool. Defensive pressure proved to be a determining factor in shooting efficiency. Attempts made under lower pressure had a higher success rate, reinforcing the importance of freeing key players from defensive pressure through the design of specific plays. This finding aligns with research highlighting how quick plays and proper space occupation can reduce the opponent's defensive effectiveness (Cárdenas & Alarcón, 2010). Furthermore, court positions, such as the left corner and the right wing, were identified as key areas with higher probabilities of success, providing valuable information for optimizing offensive strategies. An interesting aspect was the relationship between the result of the previous shot and the efficiency of the next. Shots taken after a made attempt had higher success probabilities, as reflected by Bocskocsky et al. (2014), whose research in the NBA found that players who made one or more of their last four attempts increased their efficiency by 54% on subsequent attempts. Conversely, shots taken after a missed attempt showed lower efficiency, highlighting the importance of working on psychological recovery after errors to maintain consistency throughout the game (Moreno, 2017). In this context, Sighinolfi (2020) emphasizes that the ability to perform under pressure is crucial in basketball, suggesting that effective coping strategies and psychological resilience are critical factors determining performance consistency, especially after unsuccessful outcomes or high-pressure situations. The quality of the opposition also significantly influenced the results. Teams achieved better accuracy rates against lower-quality opponents, possibly reflecting less defensive pressure or greater confidence in these contexts (Dong et al., 2021). However, this finding underscores the need to develop strategies that maintain efficiency against high-level opponents, ensuring teams remain competitive in more challenging contexts.

Finally, cluster analysis provided an integrated view of game dynamics, identifying specific patterns that influence the success of three-point shooting for the analyzed team. For example, clusters associated with positive match status and lower opposition quality highlighted favorable conditions, while those related to disadvantageous scores and high defensive pressure highlighted challenges in more demanding contexts (Terhanian & Terhanian, 2024). These results offer practical tools for designing personalized training sessions that address the specific needs of teams in different scenarios. Overall, the results of this study expand our understanding of the contextual, tactical, and psychological factors influencing three-point shooting performance in women's basketball. The findings highlight the importance of comprehensive preparation that combines technical and strategic aspects to maximize competitive performance.

Limitations

This study presents certain limitations that should be considered. First, all three-point shots analyzed belong to a single team. Therefore, the sample of analyzed games could be expanded to achieve a more robust and representative analysis. Ideally, this would include a game against every league opponent, extending the analysis to different seasons for the same team or broadening the sample to include multiple teams, which would allow for the evaluation of their evolution and dynamics in various contexts.

Additionally, the inclusion of low-difficulty teams, alongside the medium- and high-difficulty teams analyzed in this study, could provide a more comprehensive understanding of how this factor influences three-point shooting effectiveness.

Finally, although shooting technique is a determining factor in shooting success, it was not considered as a variable in this study due to the limitations of match recordings, which used a single camera and provided insufficient angles for analysis.

Future Research Directions

Future studies could focus on expanding the sample to include different leagues and categories, allowing for comparisons between national and international competitions. It would also be relevant to analyze the evolution of three-point shooting performance over multiple seasons to identify patterns in playing styles. Another approach could involve investigating how psychological training influences recovery after errors and consistency in high-pressure situations, particularly in relation to key moments in the game when more or fewer shots are made.

Finally, the application of advanced statistical analyses could provide a deeper understanding of the interactions between game variables, such as opposition quality and defensive pressure, offering practical tools for coaches to enhance performance.

Conclusions and Practical Applications

The findings reveal that the effectiveness of three-point shots varies significantly depending on the state of the game and specific conditions. Results suggest that strategy and preparation in critical situations must be enhanced during training sessions to optimize three-point shooting performance.

Although no significant correlations were identified, the clusters reveal trends that could be valuable for coaches and analysts.

CRediT authorship contribution statement

A. Cotta-Ortega: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **J.M. Contreras:** Formal analysis, Data curation, Methodology, Validation & Supervision. **P. López-Sierra:** Conceptualization, Writing – review & editing. **A. Gutiérrez-Capote:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **M.I. Piñar:** Conceptualization, Methodology, Investigation, Validation, Supervision, Writing – original draft, Writing – review & editing.

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