Journal of Physical Education and Sport ® (JPES), Vol. 22 (issue 3), Art 95, pp. 757 - 766, March 2022
online ISSN: 2247 - 806X; p-ISSN: 2247 – 8051; ISSN - L = 2247 - 8051 © JPES

Original Article

Ball screen effectiveness in elite women's basketball

ANA NOIVO[1], ANA PAULA AMORIM[2], EDUARDO GUIMARÃES[3], MANUEL ANTÓNIO JANEIRA[4]
[1,3,4]Centre of Research, Education, Innovation and Intervention in Sport (CIFI[2]D), Faculty of Sport, University of Porto, Porto, PORTUGAL
[2]Centre of Mathematics, University of Minho, Braga, PORTUGAL

Published online: March 31, 2022
(Accepted for publication March 15, 2022)
DOI:10.7752/jpes.2022.03095

Abstract:
Although ball screens are widely used in modern basketball, little is known about its efficiency in female competitions. In this study, we identified the predictors of success in ball screens considering time, space, player, task, and contextual related variables in elite women's basketball. The sample comprised 1131 ball screens from 23 close games of the 2018/2019 Women's Portuguese Basketball League. The following variables were considered: ball screen effectiveness (dependent variable), as well as quarter half, time possession remaining, quarter, zone, orientation, pair of execution, finishing action, defensive strategy, screen type, and offensive system (independent variables). Pearson's Chi-square test was used to determine the effects of the independent variables on ball screen effectiveness, whereas classification tree analysis with exhaustive CHAID method was employed to identify the set of variables that best predicted the success in ball screens. Results showed that quarter half, time possession remaining, finishing action, defensive strategy, and offensive system were the best predictors of ball screen effectiveness. In conclusion, our findings highlight the importance of playing ball screens in transition (that is, in the first 8 s of the ball possession), at the beginning of each quarter (that is, first 5 min), and against slide through and hedge defensive strategies to excel in female basketball games. In addition, a drive from the ball handler, as well as a pop out from the screener were the finishing actions that ensured greater success after the ball screen. Findings improve our understanding on how ball screens must be played in female competitions. Hence, we argue that this information will be helpful for basketball coaches to make safer decisions when planning tactical strategies for their teams.
Key Words: pick and roll; tactical performance; professional players; team sport; classification tree analysis

Introduction

To be successful in basketball, teams must excellently combine an efficient offense with a relentless defense (Lames & Mcgarry, 2007). Although it may appear simple, the truth is that both tasks are mediated by several responses of players and coaches to a highly dynamic and complex game (Courel-Ibáñez et al., 2017). While players rely on their physical attributes and technical-tactical skills to perform optimally, coaches are responsible for the sport preparation and game planning of their teams (Gómez et al., 2015; Koryahin et al., 2019; O'Donoghue, 2014).

In order to help basketball coaches to make accurate tactical and strategical decisions, as well as to better understand the complex network of factors affecting individual and team performance, researchers have been resorting to the performance analysis to identify single and multiple movement patterns during competitions (Drust, 2010). Using video analysis - a broadly employed method to assess team tactics (Hughes & Bartlett, 2002) - several studies have been showing that some game actions are more important than others. Given its high efficiency and aptness to generate collective advantages, the ball screen is an offensive action widely used in nowadays basketball (Bardavío et al., 2017; Stavropoulos et al., 2020). For example, Remmert (2003) reported that ball screens were the most used finishing action in 60 games from different men's and women's national and international championships, yielding 1.08 points per offense. Similarly, Lamas et al. (2011) found a substantial prevalence of ball screens (34.8%) over several other offensive dynamics in 15 games of the men's 2002 FIBA World Championship. Other authors also contended that ball screen is the most used finishing action in today's basketball (Lamas et al., 2015; Arroyave et al., 2015; Nunes et al., 2015; Polykratis et al., 2010). Notwithstanding the sex-differences in the amount of ball screen played (that is, women perform this action less than men), its importance during basketball games of both sexes is undeniable.

Ball screens are appointed as one of the most difficult actions to defend (Nunes et al., 2021; Polykratis et al., 2010), in which the screener plays a decisive role to create an advantage for the ball handler and, consequently, an opportunity to score (Vaquera et al., 2016). Taking into account its importance in modern basketball, some authors focused their analysis exclusively on ball screen and its outcomes. For example, Polykratis et al. (2010) showed that the Greek national team was more successful than its opponents when

Corresponding Author: ANA NOIVO, E-mail: gnoivo@gmail.com

passing the ball inside after the screen. Furthermore, it was found that, in Europe, ball screens were more effective when the dribbler passed the ball to the roller and when two passes were performed after the screen (Marmarinos et al., 2016), whereas in the Olympic Games the drive and pass to the roller were the offensive actions that most contributed to ball screen effectiveness (Koutsouridis et al., 2018). More recently, Remmert and Chau (2019) revealed that the ball handler's shot, the screener's pop out and the pass to a teammate at the perimeter were the more successful finishing actions in German men's teams. Other authors analyzed ball screens according to time, space, player, task and context indicators in Spanish male teams aiming to identify its predictors of success (Gómez et al., 2015; Vaquera et al., 2016; Calvo et al., 2017). Findings showed that ball screen effectiveness depended on the dribbler's action after the screen (Gómez et al., 2015), screen orientation (Gómez et al., 2015), ball possession duration (Calvo et al., 2017; Vaquera et al., 2016) and offensive system (Vaquera et al., 2016).

Notwithstanding the relevance of the above-mentioned reports, most attention has been given to professional male basketball teams (Gómez et al., 2015; Koutsouridis et al., 2018; Calvo et al., 2017; Marmarinos et al., 2016; Polykratis et al., 2010; Remmert & Chau, 2019; Vaquera et al., 2016). However, due to the well-known sex-differences in anthropometric, technical and tactical characteristics (Drinkwater et al., 2008; Sampaio et al., 2004), men and women have different playing styles (Oliver, 2004). Consequently, there is an emergent need to provide coaches and players with useful information about ball screens effectiveness on women's competition. This is of utmost importance not only to enhance training regimes, but also to advance knowledge on this important topic. Therefore, the aim of the present study was to identify the predictors of success in ball screens considering time, space, player, task, and contextual related variables in elite women's basketball.

Material & methods

Sample

Data for the present study comes from 23 close games out of the 43 games of the 2018/2019 Women's Portuguese Basketball League available from the official online channel (FPB TV) of the Portuguese Basketball Federation: https://www.fpbtv.pt/. These games were selected after performing a k-means cluster analysis (Everitt et al., 2011), which divided the total games into three subgroups based on the final score differences: 23 close games (1 to 10 points), 14 balanced games (11 to 20 points) and 6 unbalanced games (21 to 35 points). In total, the sample comprised 1131 ball screens coming from the 23 close games that fulfilled the condition of having the opposite team playing man-to-man defense.

Procedure

All games were carefully analyzed through systematic observation as advocated by O'Donoghue (2014) using Kinovea® video analysis software (Version 0.8.15). The analysis was carried out by one trained and experienced observer who is graduated in Sport Sciences and has 15 years of experience as a basketball player and 3 years of experience as a basketball coach. Prior to data collection, a pilot study was carried out using a random basketball game for the observer to test the software and proceed with the identification of the different variables. Data reliability was done through the intra-observer testing procedure in order to prevent any learning effects; one month after data collection, the observer analyzed three games randomly selected. Cohen's Kappa correlation coefficient was used to assess intra-observer reliability (Cohen, 1960). The values acquired from the intra-observer reliability for each variable show a high degree of objectivity (ball screen effectiveness = 1.00; time-related variables = 1.00; space-related variables = 0.98; player-related variable = 0.98; task-related variables = 0.99; contextual-related variable = 0.90).

Variables

We considered one dependent variable (ball screen effectiveness) and ten independent variables (quarter half, time possession remaining, quarter, zone, orientation, pair of execution, finishing action, defensive strategy, screen type, and offensive system). As advocated by Gómez et al. (2013) as well as by Koutsouridis et al. (2018), the ball screen effectiveness was transformed into a dichotomous dependent variable classified as successful or unsuccessful according to the action outcome:

- successful when the offensive team made a 2-point or a 3-point shot, received a foul, including a shooting foul from a 2-point or a 3-point shot.
- unsuccessful when the offensive team missed a 2-point or a 3-point shot, made a turnover, received a block, suffered a steal, made an offensive foul or another action not mentioned above.

Following the suggestions made by Gómez et al. (2013), Vaquera et al. (2016) and Koutsouridis et al. (2018), the independent variables covered five fundamental domains: (1) time [quarter half (0-5 or 5-10 min played), time possession remaining (24-16, 16-8 or 8-0 s to shot) and quarter (first, second, third or fourth)]; (2) space [zone of the court where the screen was set (central or lateral zone as shown in Figure 1) and screen orientation (to the lateral zone, baseline or central zone)]; (3) player [pair of execution (point guard (PG) – shooting guard (SG)/small forward (SF), PG – power forward (PF), PG – center (C), SG/SF – PF, SG/SF – C and PF – C]; (4) task [finishing action (see Table 1), defensive strategy (see Table 2) and screen type (side screen, hand-to-hand or back screen); and (5) contextual [offensive system (set play or transition)].

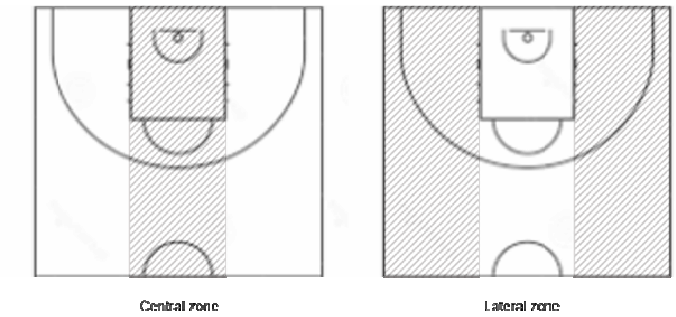

Figure 1. Zone of the court where the screen was set.

Table 1. Description

Finishing action	Definition
Shot ball handler	The ball handler shots the basketball from 2 or 3 points
Drive	The ball handler drives to the basket
Drive opposite side	The ball handler drives to the opposite direction of the screen
Roll	The screener rolls towards the basket and receives the ball
Pop out	The screener pops out away from the basket and receives the ball
Pass to a 3rd player	The ball handler passes to a teammate not directly involved in the screen
+ 1 pass	Finishing action with additional pass
+ 2 passes	Finishing action with two additional passes
Other	Other finishing action not mentioned above

Table 2. Description of the defensive strategy variable.

Defensive strategy	Definition
Deny	The defender leads the ball handler to the opposite side of the screen
Hedge	The screener's defender steps out to stop the ball handler and returns to his defender
Push and Under	The screener's defender bumps his opponent and the ball handler's defender goes under the screen
Slide through	The ball handler's defender goes between the screener and the screener's defender
Trail and Sag	The ball handler's defender steps over the screen and the screener's defender drops into the lane to protect the basket
Switch	The defenders from both players involved in the screen change the matchup between them
Trap	The defenders from both players involved in the screen surround and pressure the ball handler
Other	Other defensive strategy not mentioned above

Data collection and analysis

A crosstabulation was performed for data descriptive and inferential analysis, whereas Pearson's Chi-square test was used to determine the effects of the independent variables on ball screen effectiveness; Cramer's V test was used as a measure of effect size and its interpretation was stablished according to the following criteria: 0.10 = small effect, 0.30 = medium effect and 0.50 = large effect (Volker, 2006). Then, a classification tree analysis was employed to identify the set of variables that best predict success in ball screens (Biggs et al., 1991). The method used in this approach was the exhaustive CHAID (Chi-squared automatic Interaction detection) since it is appropriated for nominal categorical predictors and composed by three steps: merging, splitting and stopping (Baizyldayeva et al., 2013). Starting from the root node, these three steps were applied continuously in each node, providing the tree growth until no further splits were possible. All data analysis were done using IBM SPSS 26.0 (IBM Corp., Armonk, N.Y., USA) and the significance level was set at 5%.

Results

From the total 1131 ball screens analyzed, 708 were classified as unsuccessful actions (62.6%), whereas 423 were classified as successful actions (37.4%). The sample distribution (percentage and case numbers) of each time, space, and player related variables are presented in Table 3. The results for time-related variables showed that only time possession remaining was significantly linked with ball screen effectiveness (χ^2=7.018, p=0.030, ES=0.079). Greater effectiveness was identified when the ball screen was played with 24 to 16 s remaining on the shot clock [27.9% successful versus 21.2% unsuccessful], while lower effectiveness was identified when there were 16 to 8 s left to shoot [61.7% successful versus 66.1% unsuccessful]. In contrast, no significant relationships were noticed neither between ball screen effectiveness and quarter half, nor between ball screen effectiveness and quarter. Also, space- and player-related variables showed no significant relationships with ball screen effectiveness. Table 4 shows the sample distribution of each task and contextual-related variables. The results for task-related variables showed that only finishing action was significantly related with

ball screen effectiveness (χ^2=68.432, p=0.000, ES=0.246). Greater effectiveness was verified when the ball handler drove to the basket [27.9% successful versus 14.3% unsuccessful] and when the ball handler drove to the opposite side of the screen [6.9% successful versus 2.8% unsuccessful], whereas lower effectiveness was identified when the ball handler passed to a 3rd player that was not directly involved in the screen [9.0% successful versus 15.3% unsuccessful] and when the ball handler drove to the basket and the action was followed by two passes [0.7% successful versus 4.9% unsuccessful-]. On the other hand, no significant relationships were identified neither between ball screen effectiveness and defensive strategy, nor with screen type.

For the contextual-related variable (that is, offensive system), the results showed a statistically significant relationship with ball screen effectiveness (χ^2=7.962, p=0.005, ES=0.084). Greater effectiveness was identified on transition [16.5% successful versus 10.7% unsuccessful], while lower effectiveness was identified on set play [83.5% successful versus 89.3% unsuccessful]. Figure 2 illustrates the classification tree analysis of ball screen effectiveness, which included each independent variable from all five domains and resulted in a three-stage tree, meaning that only three variables had a significant influence on ball screen. The three-stage tree was established on level 1 by the finishing action, on level 2 by the quarter half, and on level 3 by the defensive strategy. These three variables developed 8 nodes, of which 6 are final nodes.

At level 1, the root node was split by the finishing action (adj. p-value < 0.0001, χ^2 = 62.949) into four nodes. Yet, the nodes that showed high effectiveness were node 2 (drive; drive to the opposite side; roll +2 passes) with 54.7% of success and node 1 (roll; other) with 42.6% of success. In contrast, node 3 (pass to a 3rd player; drive +2 passes; drive opposite side +1 or 2 passes; pass to a 3rd player +2 passes) with 77.8% of unsuccess, as well as node 4 (shot ball handler; drive +1 pass; pop out; pop out +1 or 2 passes; pass to a 3rd player +1 pass; roll +1 pass) with 66.4% of unsuccess showed low effectiveness. At level 2, significant differences were identified when the quarter half (adj. p-value = 0.027, χ^2 = 4.897) was included in node 4. The ball screens were more effective in the first 5 min of the quarter (node 5: 37.9% successful) and less effective in the last 5 min of the quarter (node 6: 71.5% unsuccessful). At level 3, significant differences were identified when the defensive strategy (adj. p-value = 0.004, χ^2 = 16.655) was included in the first 5 min of the quarter. The combination of the finishing action (node 4), the quarter half (node 5) and the defensive strategy, with node 8 that comprehend the actions of slide through and hedge (59.1% successful) provided the greatest effectiveness. Finally, the classification tree model explained 66% of the total variance of the ball screen effectiveness.

Table 3. Frequency of ball screen effectiveness according to time, space, and player related variables [Crosstab Command: Pearson's Chi-square (χ^2), degrees of freedom (df), significance (*p*), expected frequency distribution (EFD) and effect size (ES)].

Independent variables	Unsuccessful *n* = 708		Successful *n* = 423		χ^2	df	*p*	EFD
	%	*n*	%	*n*				
Time-related variables								
Quarter half								
0-5 min played	49.2	348	53.2	225	1.728	1	0.189	208.69
5-10 min played	50.8	360	46.8	198				
Time possession remaining								
24-16 s	21.2	150	27.9	118				
16-8 s	66.1	468	61.7	261	7.018	2	**0.030***	50.12
8-0 s	12.7	90	10.4	44				
Quarter								
First	26.4	187	28.6	121				
Second	24.0	170	24.8	105	1.793	3	0.617	100.98
Third	25.8	183	22.5	95				
Fourth	23.7	168	24.1	102				
Space-related variables								
Zone								
Central	68.2	483	68.1	288	0.002	1	0.962	134.64
Lateral	31.8	225	31.9	135				
Orientation								
To the lateral zone	18.9	134	17.5	74				
To the baseline	3.2	23	3.5	15	0.409	2	0.815	14.21
To the central zone	77.8	551	79.0	334				
Player-related variable								
Pair of execution								
PG - SG/SF	1.1	8	1.4	6				
PG - PF	21.0	149	20.1	85				
PG - C	41.8	296	44.7	189	2.317	5	0.804	4.11
SG/SF - PF	16.1	114	13.5	57				
SG/SF - C	19.1	135	19.1	81				
PF - C	0.8	6	1.2	5				

Notes: (*) = $p < 0.05$; PG = point guard; SG = shooting guard; SF = small forward; PF = power forward; C = center.

Table 4. Frequency of ball screen effectiveness according to the task and contextual related variables [Crosstab Command: Pearson's Chi-square (χ^2), degrees of freedom (df), significance (p), expected frequency distribution (EFD) and effect size (ES)].

Independent variables	Unsuccessful n = 708		Successful n = 423		χ^2	df	p	EFD
	%	n	%	n				
Task-related variables								
Finishing action								
Shot ball handler	13.7	97	11.1	47				
Drive	14.3	101	27.9	118				
Drive + 1 pass	10.5	74	8.5	36				
Drive + 2 passes	4.9	35	0.7	3				
Drive opposite side	2.8	20	6.9	29				
Drive opposite side + 1 pass	2.1	15	1.2	5				
Drive opposite side + 2 passes	1.0	7	0.5	2				
Roll	9.3	66	11.6	49				
Roll + 1 pass	1.7	12	1.7	7	68.432	16	**0.000***	2.62
Roll + 2 passes	0.7	5	1.2	5				
Pop out	11.2	79	9.5	40				
Pop out + 1 pass	3.5	25	3.5	15				
Pop out + 2 passes	1.0	7	0.7	3				
Pass to a 3rd player	15.3	108	9.0	38				
Pass to a 3rd player + 1 pass	5.1	36	4.5	19				
Pass to a 3rd player + 2 passes	2.4	17	0.9	4				
Other	0.6	4	0.7	3				
Defensive strategy								
Deny	0.3	2	0.2	1				
Hedge	9.3	66	10.6	45				
Push and Under	4.1	29	3.1	13				
Slide through	12.9	91	13.0	55	6.570	7	0.475	1.12
Trail and Sag	30.4	215	30.0	127				
Switch	29.2	207	28.4	120				
Trap	8.8	62	6.6	28				
Other	5.1	36	8.0	34				
Screen type								
Side screen	95.8	678	94.8	401				
Hand to hand	2.1	15	1.7	7	2.353	2	0.308	8.23
Back screen	2.1	15	3.5	15				
Contextual-related variable								
Offensive system								
Set play	89.3	632	83.5	353	7.962	1	**0.005***	54.6
Transition	10.7	76	16.5	70				

Note: (*) = $p < 0.05$.

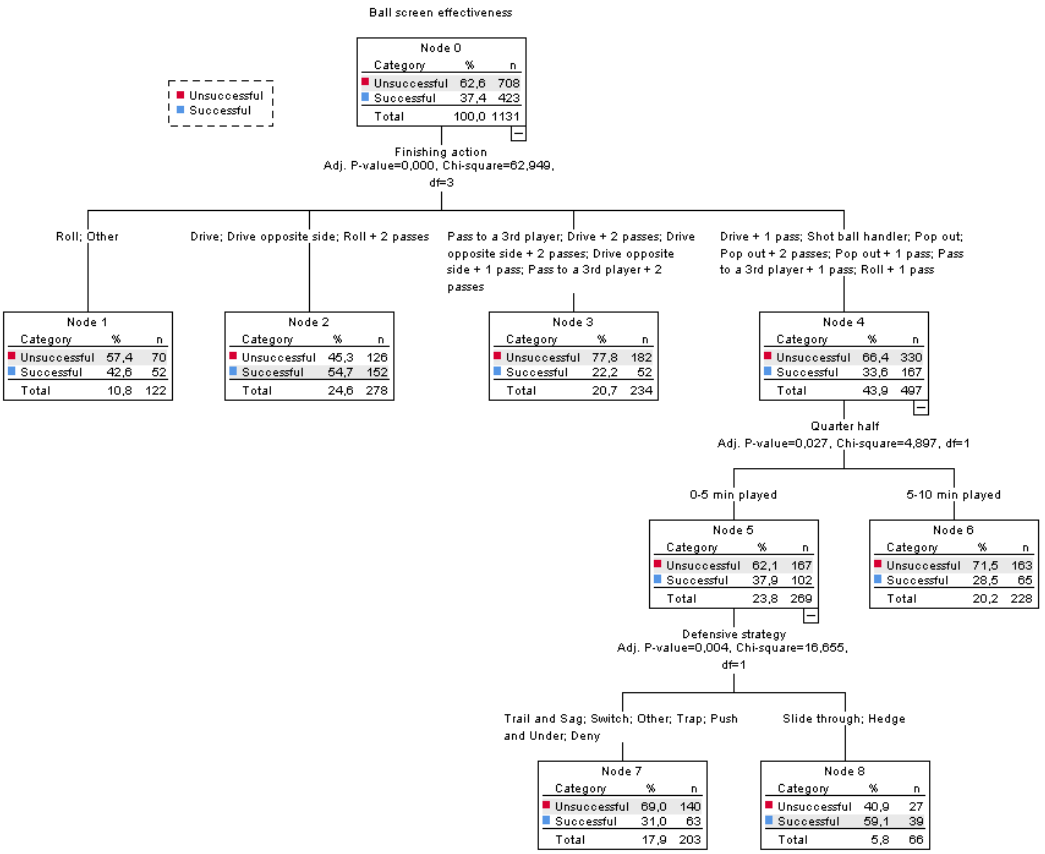

Figure 2. Exhaustive CHAID tree describing the ball screen effectiveness (%) according to time, space, player, task, and contextual related variables.

Discussion

In this study, we identified the predictors of success in 1131 ball screens coming from 23 close games of the Women's Portuguese Basketball League considering time, space, player, task, and contextual related variables. To the best of our knowledge, this is the first time that a study analyzed ball screen effectiveness using a sample of elite women's basketball players. Thus, since available literature on ball screens mainly includes samples of men's basketball, comparisons are somewhat limited to the findings on male teams.

In very general terms, our results showed that ball screen effectiveness was lower (37.4% versus 48-75%) than in men's games (Gómez et al., 2015; Koutsouridis et al., 2018; Marmarinos et al., 2016; Vaquera et al., 2016). These sex-differences may be explained by the slower game pace and lower-intensity activities of the women's competitions (Oliver, 2004; Scanlan et al., 2015), since ball screens effectiveness appears to be linked with the pace of play, that is, higher game pace represents more success on ball screens (Calvo et al., 2017). Furthermore, we found that time remaining possession, quarter half, finishing action, defensive strategy, and offensive system were the indicators that most affected ball screen effectiveness.

Time-related variables

Results showed that only time possession remaining was significantly associated with ball screen effectiveness, namely when the ball screen was played in the first 8 s of the offense. Conversely, Gómez et al. (2015) and Vaquera et al. (2016) found that male teams are more successful on ball screens during the last 8 s. These sex-differences are most probably due to the slower pace of the women's games (Oliver, 2004). By increasing the game's rhythm through fast transitions, teams may catch the opponent off guard in ball screen situations and compromise their defensive strategy. Also, this may reflect a tendency of the female teams to recover defensively in a slow and disorganized way.

Regarding both quarter half and quarter variables, none showed a significant relationship with ball screen effectiveness. Nonetheless, it should be noted that the number of ball screens and its success rate was higher in the first quarter (28.6%). This may suggest that at the beginning of the game female teams were not yet strategically adjusted to each other, even though coaches resort to scouting to better prepare their teams to start every game in good defensive and offensive conditions (Markoski et al., 2012). This also may explain why the

offense overcomes the defense in ball screen situations more often during the first quarter. On the other hand, the number of ball screens executed in the second and fourth quarters was lower than those played in the first and third quarters. This is most probably a consequence of fatigue, which leads to a decrease in the game pace and to a lower number of ball screens performed. In fact, Staunton et al. (2018) and Abdelkrim et al. (2007) showed that the amount of sedentary behaviors and less intense activities increase substantially in the end of both half, that is, second and fourth quarter. At the same time, coaches' tactical strategies may also play a role. When a team is winning by a minor margin, there is a tendency to slow down the game pace to control the game without mistakes in fast breaks or quick transitions. Inversely, when a team is winning by a larger margin, coaches usually give opportunities to those players with less playing time. In both scenarios, the amount of ball screens played and its effectiveness might be compromised.

Space-related variables

Despite the absence of significant relationships between zone and orientation and ball screen effectiveness, we noticed a prevalence of this action in the central zone of the court and oriented towards the center. This is consistent with previous reports from men's basketballers, in which the authors also observed that ball screens occur more frequently and with higher effectiveness in the central zone of the court (Nunes et al., 2015; Vaquera et al., 2016), and with an orientation towards the center (Gómez et al., 2015). Coaches choose preferentially the center of the court to play the ball screens mostly because it is the zone where the players have wider space to create advantageous situations, avoiding the lateral zones of the court where offensive actions can be conditioned by the sideline.

Player-related variable

Although the pair of execution was not significantly related to ball screen effectiveness, our results showed that the pairs PG-C and PG-PF were the most used. Similarly, other authors sampling male teams came to the same conclusions (Koutsouridis et al., 2018; Polykratis et al., 2010). This was somewhat expected since the screener is usually an inside player and the ball handler an outside player. With such pair of execution, coaches intend to combine body size and physical characteristics with outstanding technical skills (Ackland et al., 1997; Carter et al., 2005; Drinkwater et al., 2008; Gómez et al., 2015). At the same time, coaches pretend to move the screener's defender away from the basket, which is typically the tallest opponent, in order to get more advantages inside the paint (Koutsouridis et al., 2018).

Task-related variables

Findings showed that finishing action was the only task-related variable significantly linked to ball screen effectiveness. Greater effectiveness occurred when the ball handler drove to the basket and towards the opposite side of the screen. Although comparisons are limited due to the non-existence of similar approaches in female basketball, our results corroborate previous data from male competitions showing that the ball handler's drive is a highly effective finishing action (Koutsouridis et al., 2018; Polykratis et al., 2010; Calvo et al., 2017; Marmarinos et al., 2016; Gómez et al., 2015). These findings were somewhat expected because this offensive response, often linked to a bad defense, increases the chances to shoot near the basket or to suffer a foul as the players advance towards the basket.

On the other hand, lower effectiveness was observed when the ball handler passed to a third player not involved in the screen, and when the ball handler's drive was followed by two passes. Similarly, the pass to a third player after the ball screen was a finishing action not quite successful in several men's games (Koutsouridis et al., 2018; Polykratis et al., 2010; Gómez et al., 2015). However, there is no apparent consensus across the literature. For example, Remmert and Chau (2019) and Marmarinos et al. (2016) contended that the pass to a third player is a very effective option. From our point of view, these discrepancies in the ball screen effectiveness are most possibly related to the better or worse shooting percentage of the players not involved in the screen. Concerning the lower effectiveness of the ball handler's drive followed by two passes, we contend that teams take too long to perform this action, which allows the defenders to help and recover or perform a precise defensive rotation. Open shots become harder to get and, consequently, the effectiveness of the ball screens drops.

In contrast, the defensive strategy and the type of screen did not affect ball screen effectiveness. Nonetheless, the ball screens were more successful when the opponent team was not able to perform a structured and organized defensive strategy. On the other hand, the defensive strategy that worked better against the ball screen situations was the trap defense. Aiming to force a turnover or a bad decision due to the pressure made by two defenders on the ball handler, this defensive strategy was also the one that caused more trouble to the offense in men's elite games and, consequently, promoted a lower ball screen effectiveness (Koutsouridis et al., 2018). In addition, the defensive strategies that were more often used on the ball screens were the switch and the trail and sag. On the one hand, coaches tried to take advantage of the homogeneity between players in terms of body size to switch and maintain pressure on both dribbler and screener. On the other hand, they choose the trail and sag strategy to keep the pressure on the ball handler avoiding deep defensive rotation.

Although the screen type was not significantly associated with ball screen effectiveness, it should be highlighted that the hand-to-hand and back screens had greater success than side screens. Similar findings were also reported by Gómez et al. (2015) in men's games. Since side screens are more common in today's basketball, the defenders are apparently better prepared to stop it. Coaches should use other screen types to create different advantages and to get the opponents by surprise.

Contextual-related variable

Findings showed that offensive transition had greater effectiveness than the set play, which is in line with the greater effectiveness observed in the first 8 s of the ball possession. Contrary, Vaquera et al. (2016) reported that ball screens played by males were more effective during a set play (5x5 situation). These discrepancies may be explained by the well-known sex-differences in physical, physiological, technical and tactical characteristics (Oliver, 2004). Since transitions are great situations to score easy baskets (Moselhy, 2018; Oliver, 2004), coaches of women's teams should continue to promote ball screens in transition to take advantages from disorganized defenses.

Classification Tree

Results showed that the best success predictors in ball screens were the finishing action, quarter half and defensive strategy. Briefly, ball screens were more effective (59.1%) during the first 5 min of the quarter (node 5), against slide through and hedge defenses (node 8) and when the attacking team performed the following actions: a shot from the ball handler; a pop out; a pop out followed by one or two passes; and a drive, a pass to a third player or a roll followed by one pass (node 4). In part consistent with our findings, Gómez et al. (2015) found that the ball handlers' action after the screen was one of the most important predictors of ball screen effectiveness in men's basketball. This reflects the weakness of such defensive strategies. When dealing with minor defensive pressure, dribblers have more time and space to decide. This may explain why several finishing actions emerged as successful options in ball screens.

This study is not without limitations. First, we acknowledge that the sample size and its representativeness may restrict the ability to generalize our findings. However, this is a common shortcoming in research using subsamples based on final game score differences. Second, we recognize that a joint analysis with games from both regular season and playoff may be a limited approach. Yet, we strongly believe that such division would compromise the sample size and, consequently, the findings and conclusions of the study.

Conclusions

In conclusion, this study improves current understanding on how ball screens should be played in female competitions. Our findings allowed us to establish the following conclusions. First, ball screens were more successful during the first 8 s of the ball possession and during the first 5 min of the quarter. Second, a drive from the ball handler and a pop out from the screener were the finishing actions that ensured greater success after the ball screen. Third, ball screens in transition were more effective. Four, female teams were more successful when the opponents used slide through or hedge defenses against the ball screen. We, therefore, highlight the importance of playing ball screens in transition, as well as at the beginning of each quarter. In other words, being aware when to use this offensive action can increase the chances of the attacking team being successful. In addition, it must be emphasized the crucial role of the ball handler, who needs to be skillful enough to create advantageous situations not only for herself, but also for the remaining four teammates on the court. In fact, selecting the proper finishing action against the defensive strategy of the opponents requires high level of technical-tactical skills.

Finally, we argue that this information may be helpful for basketball coaches to make safer decisions when planning tactical strategies for their teams. We also recommend coaches to utilize ball screens not only to score easy baskets, but also to create advantages for every player on the basketball court. Furthermore, when planning their daily training routines, we suggest coaches to dedicate more time developing ball screen specific technical and tactical skills. In future studies, researchers need to consider more often the use of female competitions to analyze collective tactical performance. Moreover, researchers can also consider the inclusion of more detailed and precise information regarding the complex dynamics underlying the execution of ball screens, as well as individual data from players and coaches as active participants on every basketball game or competition.

References

Abdelkrim, N. B., El Fazaa, S., & El Ati, J. (2007). Time-motion analysis and physiological data of elite under-19-year-old basketball players during competition. *British Journal of Sports Medicine, 41*(2), 69–75.

Ackland, T. R., Schreiner, A. B., & Kerr, D. A. (1997). Absolute size and proportionality characteristics of World Championship female basketball players. *Journal of Sports Sciences, 15*(5), 485–490.

Arroyave, V. M., Bardavio, J. S., Sobrino, G. D., & González, R. H. (2015). Influence of direct blocking and one-on-one on successful shooting in basketball [in Spanish]. *Apunts Educación Física y Deportes, 1(*119), 80–86.

Baizyldayeva, U., Uskenbayeva, R., & Amanzholova, S. (2013). Decision making procedure: applications of IBM SPSS cluster analysis and decision tree. *World Applied Sciences Journal, 21*(8), 1207–1212.

Bardavío, J. S., Arroyave, V. M., González, R. H., Leri, E. S., & Granja, O. (2017). T-patterns initiated with ball screen or one-on-one in basketball. *Revista de Psicología del Deporte, 26*(1),81–86.

Biggs, D., Ville, B. De, & Suen, E. (1991). A method of choosing multiway partitions for classification and decision trees. *Journal of Applied Statistics, 18*(1), 49–62.

Calvo, J. L., García, A. M., & Navandar, A. (2017). Analysis of mismatch after ball screens in Spanish professional basketball. *International Journal of Performance Analysis in Sport, 17*(4), 555–562.

Carter, J., Ackland, T. R., Kerr, D. A., Stapff, A. B., & Carter, J. E. L. (2005). Somatotype and size of elite female basketball players. *Journal of Sports Sciences, 23*(10), 1057–1063.

Cohen, J. A. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement, 20*(1), 37–46.

Courel-Ibáñez, J., McRobert, A. P., Toro, E. O., & Vélez, D. C. (2017). Collective behaviour in basketball: a systematic review. *International Journal of Performance Analysis in Sport, 17*(1–2), 44–64.

Drinkwater, E. J., Pyne, D. B., & McKenna, M. J. (2008). Design and interpretation of anthropometric and fitness testing of basketball players. *Sports Medicine, 38*(7), 565–578.

Drust, B. (2010). Performance analysis research: meeting the challenge. *Journal of Sports Sciences, 28*(9), 921.

Everitt, B. S., Landau, S., Leese, M., & Stahl, D. (2011). *Cluster Analysis* (5th ed.). Chichester, UK: John Wiley & Sons, Ltd.

Gómez, M. A., Battaglia, O., Lorenzo, A., Lorenzo, J., Jiménez, S., & Sampaio, J. (2015). Effectiveness during ball screens in elite basketball games. *Journal of Sports Sciences, 33*(17), 1844–1852.

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.

Hughes, M. D., & Bartlett, R. M. (2002). The use of performance indicators in performance analysis. *Journal of Sports Sciences, 20*(10), 739–754.

Koryahin, V., Iedynak, G., Blavt, O., Galamandjuk, L., Ludovyk, T., Stadnyk, V., Bezgrebelnaya, E., Korol, A., & Gavrilenko, M. (2019). The main aspects of the implementation of technical and physical training of basketball players. *Journal of Physical Education and Sport, 19*(Suppl. 2), 358–362.

Koutsouridis, C., Karamousalidis, G., & Galazoulas, C. (2018). The efficacy of "High Pick and Roll" in relation to the defence's reaction and its effect on the result of the game. *International Journal of Performance Analysis in Sport, 18*(4), 554–567.

Lamas, L., Junior, D. D. R., Santana, F., Rostaiser, E., Negretti, L., & Ugrinowitsch, C. (2011). Space creation dynamics in basketball offence: validation and evaluation of elite teams. *International Journal of Performance Analysis in Sport, 11*(1), 71–84.

Lamas, L., Santana, F., Heiner, M., Ugrinowitsch, C., & Fellingham, G. (2015). Modeling the offensive-defensive interaction and resulting outcomes in basketball. *PLoS ONE, 10*(12), 1–14.

Lames, M., & Mcgarry, T. (2007). On the search for reliable performance indicators in game sports. *International Journal of Performance Analysis in Sport, 7*(1), 62–79.

Markoski, B., Ivankovic, Z., & Ivkovic, M. (2012). Using neural networks in preparing and analysis of basketball scouting. In A. Karahoca (Ed.), Data Mining Applications in Engineering and Medicine (pp. 109–132). Rijeka: InTech.

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*(1), 121–129.

Moselhy, S. (2018). Transitions effect on basketball matches results. *International Journal of Sports Science and Arts, 7*(7), 81–94.

Nunes, H., Iglesias, X., & Anguera, M. T. (2021). Decision Making and Defensive Effectiveness of Ball Screen in Top-Level Basketball. *Revista De Psicología Del Deporte, 30*(2), 208–222.

Nunes, H., Iglesias, X., Daza, G., Irurtia, A., Caparrós, T., & Anguera, M. T. (2015). The influence of pick and roll in attacking play in top-level basketball [in Spanish]. *Cuadernos de Psicología del Deporte, 16*(1), 129–142.

O'Donoghue, P. (2014). *An Introduction to Performance Analysis of Sport*. Abingdon, UK: Routledge.

Oliver, D. (2004). *Basketball on paper: rules and tools for performance analysis*. Washington, DC: Potomac Books, Inc.

Polykratis, M., Evangelos, T., & Zaggelidis, G. (2010). Relation of effectiveness in pick n' roll application between the National Greek team of and its opponents during the men's World Basketball Championship of 2006. *Journal of Physical Education and Sport, 29*(4), 57–67.

Remmert, H. (2003). Analysis of group-tactical offensive behavior in elite basketball on the basis of a process orientated model. *European Journal of Sport Science, 3*(3), 1–12.

Remmert, H., & Chau, A. T. (2019). Players' decisions within ball screens in elite German men's basketball: observation of offensive–defensive interactions using a process-orientated state-event model. *International Journal of Performance Analysis in Sport, 19*(1), 1–13.

Sampaio, J., Godoy, S., & Feu, S. (2004). Discriminative power of basketball game-related statistics by level of competition and sex. *Perceptual and Motor Skills, 99*, 1231–1238.

Scanlan, A. T., Dascombe, B. J., Kidcaff, A. P., Peucker, J. L., & Dalbo, V. J. (2015). Gender-specific activity demands experienced during semiprofessional basketball game play. *International Journal of Sports Physiology and Performance, 10*(5), 618–625.

Staunton, C., Wundersitz, D., Gordon, B., & Kingsley, M. (2018). Accelerometry-derived relative exercise intensities in elite women's basketball. *International Journal of Sports Medicine, 39*(11), 822–827.

Stavropoulos, N., Hatzimanouil, D., Stavropoulos, D., & Skandalis, V. (2020). Effectiveness of ball handler's offensive movements in ball screen offense in European elite basketball teams. *Journal of Physical Education and Sport, 20*(2), 744–751.

Vaquera, A., García-Tormo, J. V., Gómez Ruano, M. A., & Morante, J. C. (2016). An exploration of ball screen effectiveness on elite basketball teams. *International Journal of Performance Analysis in Sport, 16*(2), 475–485.

Volker, M. A. (2006). Reporting effect size estimates in school psychology research. *Psychology in the Schools, 43*(6), 653–672.