

## A pioneering study on training attacking corners in women's football

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### Abstract

The objective of this study was to develop a novel approach in women's football aimed at enhancing performance in attacking corners. Drawing upon prior research by Beare & Stone (2019) and Libreau & Benguigui (2024), which highlighted the effectiveness of inswing deliveries aimed at the near post or penalty spot, we conducted a 10-week training program with the Montpellier Hérault Sport Club women's team for 10 weeks at a rate of 2 sessions per week on attacking corners during the second part of the 2021/2022 season, comprising 2 sessions per week dedicated to attacking corners. Following this training protocol, their performances significantly improved in the baseline situation worked on in training. Indeed, the players have improved their danger score by successfully moving more often and with better timing into the ball's arriving zone. They have also shot towards the goal more often and scored more frequently. They also significantly improved their performances in attacking corners in matches. The corner kickers improved their accuracy on shots by sending significantly more balls into dangerous areas (at the near post and at penalty spot). In addition, there were fewer corners that were directly intercepted by the opposing goalkeeper or cleared by the opposing defense. There was also a significant increase in the number of shots taken and the number of goals scored. These results show that specific, regular, and consistent training protocols for attacking corners can improve a team's collective effectiveness in a clearly identified phase of the game, both in training and in the match.

**Keywords:** Performance analysis – Soccer – Set Pieces – Sport – Tactical analysis

### Introduction

In modern football, match analyses made possible by technological progress are now considered essential assessments for enabling football clubs to improve their performances (e.g., Dinçer et al., 2017; Wang & Qin., 2020). Football has thus been the subject of much research, the main objective being to improve individual and collective performances by collecting objective, valid, and reliable data (Pulling, 2015). Research in this area has therefore expanded rapidly in recent years, with studies focusing particularly on performance indicators related to possession of the ball, duels, passing, shooting, tactical patterns, the distances covered and running speeds of players, and the context of the match (Barba et al., 2020; Becerra-Patiño et al., 2023; Drust & Green, 2013; Montesano., 2016; Njororai., 2013; Pal'o et al., 2023; Pinca et al., 2021; Stafylidis et al., 2022; Stone et al., 2021; Zhao & Zhang, 2019; Yue, Broich & Mester, 2014).

In this context, it appeared that set-pieces represented a sector of the game that could be used to score a large number of goals, but also offered the possibility for very detailed analyses (Oghonyon et al., 2020; Plakias et al., 2023). In football, a set-piece is a situation where the ball is put back into play after a stoppage in play. A set-piece occurs whenever play is restarted following a foul, a corner, a free-kick, a penalty, or a throw-in. According to Casal et al. (2015), Castaner et al. (2016), Gouveia et al. (2022), Kubayi & Larkin (2019), Mitrotasios et al. (2021), and Pulling et al. (2015), the number of goals scored from set-pieces during a football season represents between 30 and 40% of all goals scored.

The case of corners, which occurs when the ball is sent beyond the line that extends the goal line by the defending team, is particularly interesting because the starting situation is always the same. The ball is consistently placed in the same position relative to the goal, with opponents positioned at a minimum regulated distance from the ball (Maneiro et al., 2019). Therefore, this standardized situation is particularly appropriate for scientific analysis (Maneiro et al., 2019), especially considering its frequent occurrence during matches, averaging 10 per game (e.g., Strafford et al., 2019).

According to the study by De Baranda et al. (2012), it appears that 23.77% of corners taken during the 2006 World Cup resulted in a shot on goal. Similar figures were obtained by Casal et al. (2015), with 26% of corners taken during the 2010 World Cup, EURO 2012, and the 2011-2012 Champions League resulting in a shot on goal, and by Zileli and Soyler (2022) during the 2018 World Cup, with 29.9%. Therefore, corners are important situations that frequently offer opportunities for shots on goal.

It should be noted that until recently, no research had explored the importance and specifics of corners in professional women's football (Beare & Stone, 2019; Lee & Mills, 2021; Libreau & Benguigui, 2024). The study by Beare and Stone (2019) describes how corners were taken during the 2017/2018 season of the FA 1582-----

Women's Super League and evaluates their offensive effectiveness. It was observed that 33.5% of the corners analyzed resulted in a shot, and 4.6% resulted in a goal. In comparison, the study by De Baranda (2012) focusing on corners in the men's 2006 World Cup revealed that only 2.6% of corner shots resulted in a goal, suggesting corners are of greater importance in women's football. The analysis by Beare and Stone (2019) indicates that most corners were executed in the penalty area (18.9%), where the number of shots on target and goals scored is highest. In a study focusing on the 2019 FIFA Women's World Cup, Lee and Mills (2021) demonstrated that shots on target were more frequent when corners were delivered towards the near post (20.9%) and the far post (25%). Additionally, the frequency of shots on target was also higher when six or more attackers were inside the penalty area (23.5%). The likelihood of a shot on target increased concomitantly with the increasing number of attackers.

More recently, Libreau & Benguigui (2024) showed that in the French women's football championship, inswinging corners, those where the ball moves through the air towards the goal, are the most favorable for attacking teams. The areas of the near post and the central area of the penalty area were found to be the most dangerous. It emerged that the balance of power inside the penalty area had no impact on effectiveness, suggesting that organization and coordination of the corner kick with the attackers could be a more important factor. According to Anzer & Bauer (2021) and Alesi et al. (2015), the ability to score goals from corners in football relies on various elements, including repeated and consistent training and coordination among players. Specifically, the corner kick must be delivered with precision and power to reach an area where the ball can be directly attacked by a forward player. Secondly, there needs to be quality in offensive movements and good timing to receive the ball under the best possible conditions. Here, the coordination of movements between the receiver and the kicker comes into play, as well as the occupation of space in front of the goal.

In this context, the objective of our study was to establish, for the first time and in women's football, a training protocol aimed at improving performance in offensive corner kicks. To achieve this, we relied on the findings of previous studies (Beare & Stone, 2019; Casal et al., 2015; Libreau & Benguigui, 2024), which demonstrated that the most dangerous corners are those delivered with an inswinging trajectory, targeting either the near post or the penalty spot, and suggested that increased coordination and synchronization among players enhance the chances of scoring goals. We can thus hypothesize that by implementing a specific training protocol focusing on offensive corner kicks, incorporating work on corner kick and player coordination, we will enhance the performance of a professional women's football team in these game phases, both in training sessions and in matches.

**Method**

Training protocol procedure:

We implemented a training protocol for offensive corner kicks over a period of ten weeks, consisting of two specific training sessions per week during the second part of the championship. At the beginning of each session, we conducted the same exercise to establish a baseline situation and to monitor performance progress. This baseline situation involved a total of 16 corners taken from each side of the field. During the first 10 sessions, the number of inswinging corners (where the ball moves through the air towards the goal) and outswinging corners (where the ball moves away from the goal) was balanced to work on the diversity of trajectories. For the final 10 sessions, the distribution was adjusted to 12 inswinging corners and 4 outswinging corners to emphasize work on the most effective trajectories for attacking (Libreau & Benguigui, 2024, and Lee & Mills, 2021). For each corner, there were five defenders positioned individually in zones 1 (near post), 2 (near post axis), 3 (far post), 4 (near post between 5.50 meters and the penalty spot), and 5 (axis between 5.50 meters and the penalty spot) (Figure 1), and four attackers initially positioned at the edge of the penalty area arc.

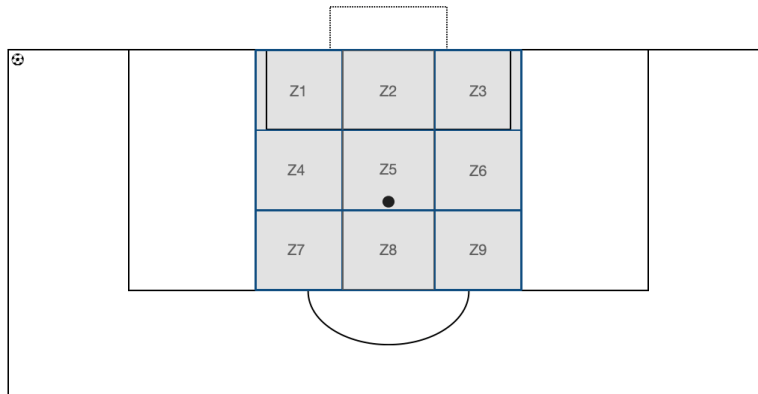


Figure 1. Delivery areas for corners from the left when facing the goal. Each square has sides measuring 5.50 m. For corners arriving from the right, zones Z1, Z4 and Z7 are on the right (at the near post) and zones Z3, Z6 and Z9 are on the left (at the far post). Zones Z2, Z5 and Z8 remain unchanged. For a ball arriving from the right, the zones were reversed, with the Z1 zone on the right (at the near post).

To assess the outcome of each corner in the baseline situation, we implemented a danger scale ranging from 1 to 4 based on the dependent variables used by Libreau & Benguigui (2024). We assigned a score of 1 to balls intercepted or cleared by the opposing goalkeeper. Next, balls cleared by the opposing defense were assigned a score of 2. Shots were assigned a score of 3, and finally, goals were assigned a score of 4. All these analyses were conducted retrospectively after the training sessions using videos captured by a stationary DJI Mavic Mini® drone. These analyses made it possible to track the level of danger posed by corners over the course of 20 training sessions.

Following the baseline situation provided at the beginning of each session, we introduced other exercises of progressively increasing difficulty to enhance the team's performances in offensive corner kicks. We offered 16 corners in which we varied the number of defenders in the penalty area as well as their positions. At the start of the training protocol, there were only 5 defenders in static positions within the zones. Subsequently, they were allowed to move and change zones in relation to the ball's trajectory. In the final sessions of the training protocol, there were 5 defenders in zones, along with 4 defenders marking the attackers.

Regarding the corner kicker, during the initial training sessions, she was free to send the ball into any area of the penalty area. Then, as the training sessions progressed, we asked her to send the ball only to zones 1, 4, and 5 because these are the areas with the most shots and goals in the French women's football championship (D1 Arkema) according to the study by Libreau & Benguigui (2024). Finally, during the last training sessions in the protocol, we asked her to announce the zone where she would send the ball to ensure she was as precise as possible in her corner kick technique.

Regarding the movement and timing of the attackers, during the initial training sessions, they were free to move within the zone of their choice and at the time they preferred. Then, we instructed the four attackers to move only within zones 1, 4, and 5, and the fourth attacker to finish their run in zone 3, as we observed that many balls were deflected and ended up in that area. We also established starting zones for the attackers based on their intended arrival zones to ensure they arrived with the correct timing, speed, and power. Additionally, we instructed the attackers to coordinate their movements with the corner kicker from the beginning of her run-up. Informed consent was obtained and the methods and protocols for this experiment were approved by the local committee of the host University in accordance with the Declaration of Helsinki.

#### ***Match procedure***

To assess whether this training protocol had an impact on the team's performance during offensive corners in matches, we compared the corner results between the first half of the 2021-2022 season of the French women's football championship, which took place from August 28, 2021, to December 12, 2021 (where no training protocol was implemented), and the second half of this championship season, which took place from January 15, 2022, to June 1, 2022 (the two training sessions per week were conducted in the weeks leading up to the matches during the second half). There were 51 corners in 11 matches during the first half and 43 corners in 11 matches during the second half. We used the same criteria as for the training baseline situation to analyze the outcome of each corner (see above, Libreau & Benguigui, 2024). Additionally, referring to the studies by Libreau & Benguigui (2024) and Beare & Stone (2019), which showed that the most dangerous corners are those kicked with an inswing delivery trajectory and arriving in zones 1, 4, and 5, we also analyzed the method of delivering corners between the first and second part of the season.

#### ***Reliability of corner outcome during training programs***

Intra- and inter-observer tests were carried out to assess the reliability of the methods used to collect the data. Intra-observer analysis was carried out by re-evaluating the same 32 corners (10% of the total corners analyzed) on two separate occasions, four weeks apart, by the principal investigator. A second observer separately assessed the same 32 corners (10% of the total corners analyzed) for comparison with the principal investigator's first observation, to ensure inter-observer reliability. The principal investigator was a video analyst and is therefore qualified to code football situations. The second coder was an assistant coach of a football team and has completed training as a video analyst. The intra- and inter-observer reliability of the data was quantified by calculating Cohen's Kappa (Cohen, 1960). The reliability of each variable is presented with a mean kappa statistic of  $k = 0.91$  and  $k = 0.88$  respectively, corresponding to "excellent" intra- and inter-observer agreement (Fleiss, Lehman et al., 2003).

#### ***Reliability of corner outcome in the championship***

Intra-observer analysis in the championship was carried out by re-evaluating the same 10 corners (10.6% of the total corners analyzed) on two separate occasions, four weeks apart, by the principal investigator. A second observer separately assessed the same 10 corners (10.6% of the total corners analyzed) for comparison with the principal investigator's first observation, to ensure inter-observer reliability. The reliability of each variable is presented with a mean kappa statistic of  $k = 0.95$  and  $k = 0.92$  respectively, corresponding to "excellent" intra- and inter-observer agreement (Fleiss, Lehman et al., 2003).

#### ***Data analysis***

Data were exported from SportsCode and descriptive analyses were completed in Microsoft Excel (Version 16.16.27, Microsoft Cooperation, United States) to calculate relative frequencies for each variable. The data were analyzed further in SPSS (Version 24.00 SPSS Inc., USA).

Regarding analysis of the training protocol data, we calculated the mean danger level of each corner for each of the 20 sessions, then conducted a repeated measures ANOVA and a Newman-Keuls post hoc test. To interpret the effect sizes (ES) of the statistical differences in the ANOVA, we used eta squared ( $\eta^2$ ). The alpha level was set at .05. Regarding analysis of the data corresponding to corners during championship matches, bivariate analyses ( $\chi^2$ ) were used to analyze the method of delivering corners, the landing zone of the ball, and the outcome of the corner based on each part of the season (with or without the training protocol). An important assumption of the chi-square test is that the expected values should not be less than 5 (Field, 2009). The effect sizes of Cramer's V (V) were calculated and described as small ( $V = 0.10$ ), medium ( $V = 0.30$ ), or large ( $V \geq 0.50$ ) (Gravetter & Wallnau, 2007). The alpha level was set at .05.

We also performed a Student's t-test to compare the average hazard score of corners taken in the first leg with those taken in the second leg. To assess the reliability and variability of the measurements, we calculated the coefficient of variation [ $CV = (SD/mean) 100$ ]. The alpha level was set at .05.

**Results**

Analyzing evolution in the training protocol

The repeated measures variance analysis (ANOVA) of the danger score of corners during the baseline situation showed a significant effect of the session factor  $F(1.19) = 1.67$ ,  $p < .05$ ,  $\eta^2 = 0.10$  (Figure 2). The Newman-Keuls post hoc test did not reveal any significant differences between the different danger scores for the various sessions.

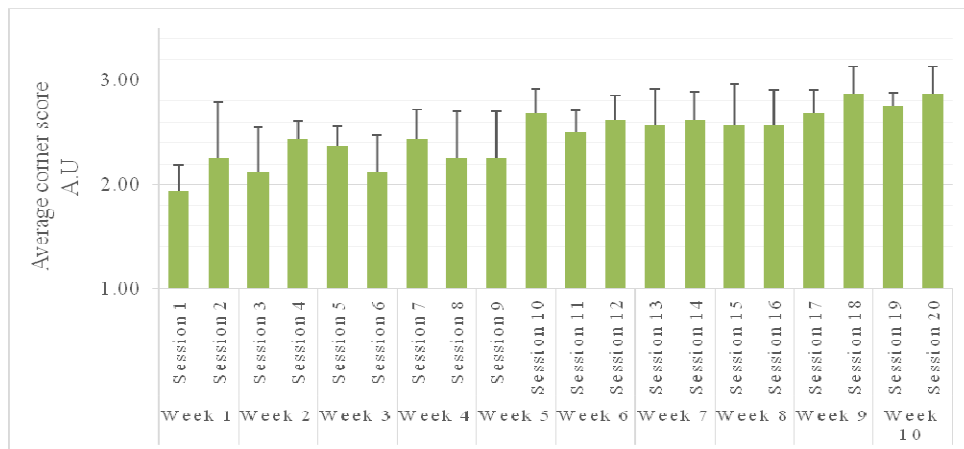


Figure 2. Evolution in the danger score of offensive corners during the 10-week training protocol. Error bars indicate the standard deviation for each session.

Analyzing the transferability of training performances to offensive corner situations during championship matches The results also showed statistically significant associations between the methods of delivering corners and the phase of the championship ( $X^2 = 10.8$ ;  $p < .05$ ,  $V = 0.255$ ). An increase in the number of inswinging corners and a decrease in outswinging corners could be observed during the second half of the championship season. (Figure 3)

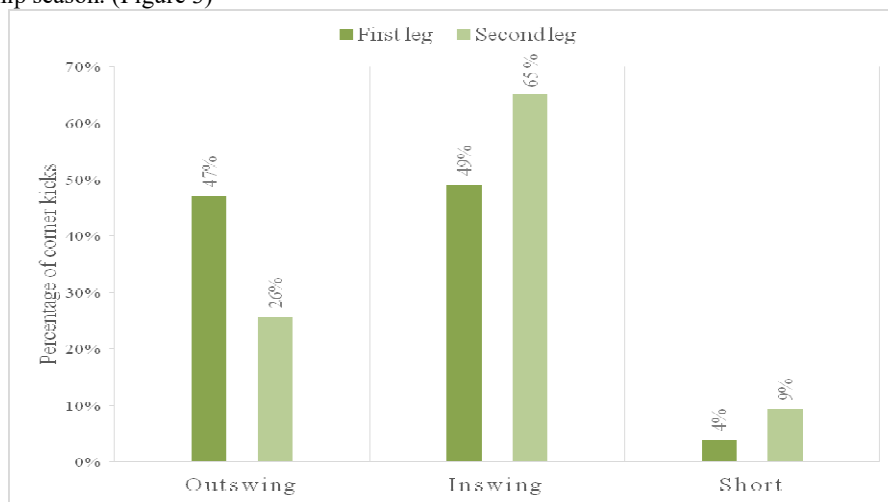


Figure 3: Comparison of corner kicking methods for the MHSC women's team between the first and second legs of the 2021/2022 season - outswing, inswing and short.

The results also revealed statistically significant associations between the corner delivery zones and the leg of the championship ( $X^2 = 14.6$ ;  $p < .05$ ,  $V = 0.421$ ). An increase in the proportion of corners arriving in the most dangerous zones (1, 4 or 5) was observed, increasing from a total of 37.2% in the first leg of the season (zone 1: 13.7%; zone 4: 9.8%; zone 5: 9.8%) to a total of 74.4% in the second leg (zone 1: 23.3%; zone 4: 23.3%; zone 5: 27.9%) (Libreau & Benguigui, 2024, and Beare & Stone, 2019, Figure 4).



Figure 4. Comparison of the percentage of balls arriving in each zone during corners between the first and second half. (Z) corresponds to the delivery area.

We also compared the mean danger scores of corners from the first leg to the corners from the second leg using the Student's t-test which revealed a significant improvement in performances between these two phases of the championship ( $t(2.45) = 92$ ;  $p < .05$ ,  $\eta^2 = 0.067$ ). The improvement in the outcome of each corner was significantly associated with the second leg of the championship ( $X^2 = 12.2$ ;  $p < .05$ ,  $V = 0.486$ ). Corners with a score of 1, meaning those directly into the arms of the opposing goalkeeper, decreased from 23.5% to 18.6%. Corners with a score of 2, meaning those cleared by the opposing defense, decreased from 45.1% to 32.6%. Regarding corner outcomes with a shot on goal, corresponding to a score of 3, they increased from 29.4% to 44.2%. Goals, corresponding to a score of 4, increased from 2% to 4.7% between the first leg and the second leg. (Figure 5).

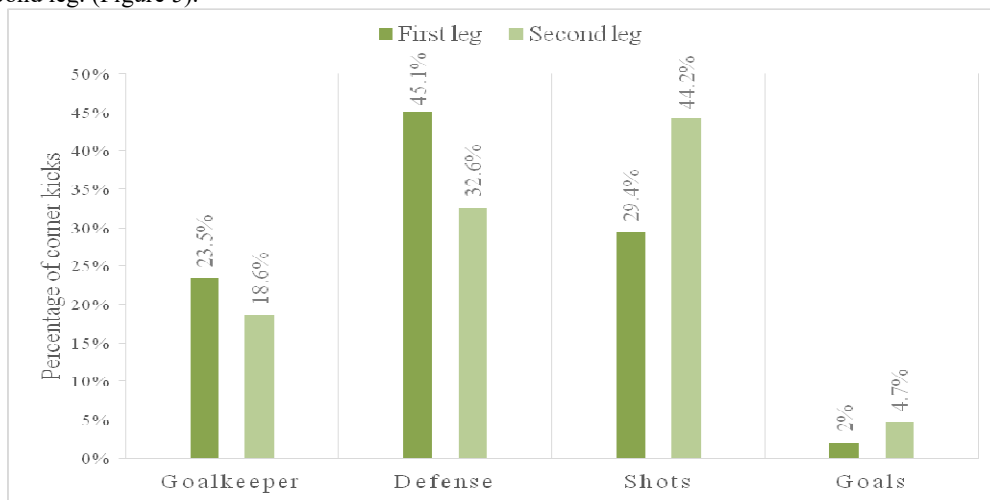


Figure 5: Comparison of the outcome of MHSC's corners between the first and second legs of the French women's football championship. "Goalkeeper" corresponds to balls intercepted or cleared by the goalkeeper; "Defense" corresponds to balls cleared by the defense. (X) corresponds to the scores on the danger scale for the purpose of the corner.

### Discussion

The aim of this study was to analyze the effects of a training program on offensive corner kicks for a professional women's football team. During this training program, we began by evaluating the danger posed by each corner kick in a reference situation during training sessions. The average danger score improved over the course of the sessions confirming the effectiveness of the training program (Figure 2). It is worth noting that this occurred in a context where defense in the reference situation was also training and could have improved,

potentially masking an improvement in offensive effectiveness. It is possible that there was improvement in defense, but it did not overshadow the offensive improvement. This is likely because there was no specific work on defense. Next, we wanted to determine whether this training program improved the team's performances in offensive corner kicks during championship matches. We noted a significant improvement in the accuracy of corner kicks between the first and second leg of the championship season that included the training protocol. A greater number of kicks reached the most dangerous zones, namely in zone 1 and 4, i.e., at the near post, and in zone 5, i.e., at the penalty spot (Figure 1). We can thus assume that this improvement is the result of the repeated and consistent training protocol (Alesi, 2015), and is also possibly the result of improvement in motor coordination with the kick related to more precise intentions regarding the zone targeted (Wang et al., 2013).

We also noted a significant improvement in the average danger score of offensive corner kicks between the first and second leg of the championship season. This resulted in a decrease in the number of balls directly caught by the opposing goalkeeper, as well as in the number of balls cleared by the opposing defense, and an increase in the number of shots on goal from corner kicks and the number of goals (Figure 5). It is likely that the improvement in this score was a result of the work done during the training protocol, which possibly improved the inter-individual coordination between the corner kick taker and the receivers, as well as the receiving and shooting behaviors of the players in the penalty area. By working on repeating corner kicks in training, we can suppose that we improved the perceptual and decision-making abilities of the attackers, allowing them to better adjust their runs according to the ball's trajectory during corners in matches. It has been demonstrated that the prior sports experiences of high-level players play an important role in their predisposition to adapt (Santos et al., 2016). Thus, thanks to their experience, trained players can better adapt the timing of their run to the trajectory of the ball throughout training sessions and translate these improvements into championship matches. Also, given that high-level players manage to find the most optimal solution for a given task (Coutinho et al., 2018), it is likely that trained players have become more versatile and skilled in using space in the penalty area thanks to the training program. This is probably linked to the cognitive abilities of high-level football players that can be used to anticipate the behaviors and movements of both opponents and teammates (Alesi et al., 2015). Thus, during the training program, we worked on the starting points and directions of the different runs of the receiving players, allowing each player to know what she had to do on each corner kick, as well as to know what her teammate would do in terms of movement during matches. This also allowed the receiving players to focus more on timing and the trajectory of the ball with the corner kick taker.

Although the results provide evidence of the positive effects of the training program on the performance of the MHSC women's team during offensive corner kicks, some limitations must be noted. First, the number of corner kicks in each half season is relatively low because there are only 12 teams in this league and thus only 11 matches per half season. It would be interesting to implement the same training protocol with a team that has more matches in the season, and therefore normally more corner kicks, to see if the results would be even more significant. Also, for the first time in football, we implemented a training protocol for offensive corner kicks. We thus have no elements of comparison to know if what we did was the best solution for improving a team's performances in these phases of play. It would be interesting to conduct further studies of this type to compare the results and determine the best protocol to implement to improve a team's performances in offensive corner kicks.

## Conclusion

This study can be considered as a first step in showing how specific protocols can improve the collective efficiency of a team in a well-identified phase of play. The training protocol significantly improved the accuracy of the corner shot. This has also led to an improvement in the number of shots on goal and goals in training and in the game. Thanks to our results, coaches of football teams and especially women's football teams will become aware of the importance of training in offensive corners. Performance in these phases of play can improve with regular and specific training. This may allow some teams to score more goals and potentially win more games, given the importance of these goals to the final result (e.g. Kubayi & Larkin, 2019, Mitrotasios et al., 2021). It also opens up perspectives for larger-scale work in quantifying and improving performance on aspects that could be on more open phases of the game through methods for capturing and analyzing team sports.

**Conflicts of interest** The authors have no conflict of interest.

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