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Effect of away goals rule and VAR on game-related statistics in the UEFA women's champions league

Joseph A. Stone[1], Alliance Kubayi[2*] and Vasilis Armatas[3]

Abstract

Despite significant debate over UEFA's decision to abolish the away goals rule in 2021 and introduce the use of Video Assistant Refereeing (VAR), little research has considered its potential effects on team performance. Hence, this study investigates how the change in the goals rule and use of (VAR) during the knock phase of UEFA Women's Champions League affected selected game-related statistics. Data were sourced via the Wyscout platform. The sample consists of 78 UEFA Women's Champions League knockout round matches; 30 of the matches took place in seasons with the away goals rule (AGR) and no VAR (2016 to 2019) and 48 in seasons without AGR and VAR included (2021 to 2025). Data analysis was performed using a combination of T-Tests; Mann-Whitney-U Tests and Generalised Linear Models. The findings demonstrate that the change in rules resulted in a reductions in the numbers of balls lost ($p < 0.01$), ball recoveries ($p < 0.01$), long passes ($p < 0.01$), forward passes ($p < 0.05$), passes to the final third ($p < 0.01$), fouls ($p < 0.05$), aerial duels ($p < 0.01$), aerial duels won ($p < 0.01$), and free kicks ($p < 0.01$). In contrast, elimination of the away goals rule and inclusion of VAR led to a significant increase in the number of goals ($p < 0.05$), percentage of accurate passes and counter attacks with shots ($p < 0.05$). Football governing bodies could consider these findings when deciding whether the rule changes has impacted on the women's game as expected.

Keywords Counterattack, Long pass, Leg of competition, Match location, Tactics

Introduction

Women's soccer is growing in popularity and professionalism [1], leading to a parallel growth in the scientific literature on the women's game, such as examining physical demands of the game [2, 3]; players' physical fitness [4]; the effects of scoring first on match outcomes [5]; the technical performance of teams [6]; set-play analysis such as corner kicks [7]; attacking strategies leading to goal-scoring opportunities [8]; and goalkeepers offensive influences of team performance [9]. Despite the increase in research, however, women's professional soccer remains much less comprehensively examined than the men's game.

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Soccer is constantly evolving, not just through on-field tactics and player skill [10], but also through rule changes that impact how the sport is played [11]. Over the years, several law modifications in soccer have demonstrably influenced technical and tactical approaches to the game [12]. For example, the introduction of the back-pass rule in 1992 could be linked to teams to prioritise playing the ball out from the back, fostering a more possession-oriented style [13]. Similarly, the increase in allowable substitutions from two to three per match (since 1995) and now five in some competitions has granted managers greater tactical flexibility, allowing them to tailor their approach based on the game situation and player fatigue. Furthermore, stricter interpretations of dangerous tackles, particularly sliding challenges, have led to a decrease in overly physical play, placing a premium on controlled challenges to win possession. Finally, the arrival of Video Assistant Referee (VAR) technology since 2016 has enhanced officiating accuracy, potentially reducing the tactical fouls employed to disrupt play or cynically stop attacks [14]. These rule changes, implemented at different points in soccer history, have collectively contributed to a shift towards a more technical and strategic approach to the game. Furthermore, these rule modifications have helped to move the game in the direction of safety, fairness, and entertainment for the fans [15, 16].

Similarly to rule changes promoting technical play, the long-established away goals rule, a mechanism used in UEFA club competitions to break ties in knockout matches, was discarded in June 2021 for both men's and women's tournaments. The original away goals rule was designed to encourage away teams to attack, thus resulting in a more active and entertaining match [17, 18]. The decision to remove the rule followed years of debate regarding the rule's fairness and its potential effects on technical performance and playing styles. The away goals rule dictated that if the aggregate score after two legs was tied, the team with more goals scored away from home would advance. A key factor in the rule's abolishment was the diminishing home advantage in modern football, attributed to advancements in infrastructure, standardised pitches, and evolving competition formats [19]. Furthermore, concerns arose that the away goals rule discouraged attacking play, especially by home teams in the first leg, as conceding a goal gave their opponents a crucial advantage.

In the men's game, research has examined the effect of removing the away goals rule on match performance parameters. Bahamonde-Birke and Bahamonde-Birke's [17] examined men's competitions with and without the away goals implementation but focused exclusively on match outcomes and goals scored. Recently, Forrest et al. [20] examined the results from UEFA male competitions to examine the removal of the away goal, demonstrating increasing scoring-rates by teams playing in their own stadium, and the removal of the away goals rule resulted in the removal of the disadvantage from being drawn to play the first match at home. Furthermore, Yildirim and Bilman [21] demonstrated that the AGR in the men's game promoted offensive rather than defensive play concluding that games played under the AGR are found to be more competitive and thus more entertaining and suggest UEFA should consider reinstating the AGR. Kubayi and Stone [11] examined the effect of the away goals rule on playing styles in men's Champions League matches. Their findings highlighted significant changes after the rule's removal findings a decline in several technical and tactical indicators after the rule change, including average pass length, long passes, progressive passes, final third entries, offsides, total duels, and successful duels [11]. Additionally, the number of counterattacks with shots appeared to be influenced by both the away goals rule and whether it was the first or second leg of the competition. Furthermore, the introduction of Video Assistant Referring has impacted on the AGR, with Yildirim and Bilman [22] finding that a modest second-leg home advantage emerges only when the away goals rule is in effect without VAR. The introduction of VAR alongside away goals rule appears to reverse this advantage, though the effect lacks robustness. Crucially, Yildirim and Bilman [22] demonstrated VAR neutralizes the second-leg home advantage only in the presence of AGR, while AGR generates that advantage only when VAR is absent.

Despite significant debate over UEFA's decision to abolish the away goals rule in 2021, little research has considered its potential effects on technical performance, especially within the women's game. Women specific research on rule changes is important because despite previous research identifying that overall the number of actions, goals and shots per match and the number of entries into the final third of the pitch is similar between men's and women's football, key technical and tactical patterns emerged between the two games [23, 24]. Women's football has been shown to have a lower pass accuracy which causes a higher number of lost possessions within the attacking team's own half leading to a higher number of attacks per match and shorter duration of ball possession [23]. In addition, women's ball recovery times are shorter compared to men's football due to a lower ability to retain possession for long periods of time causing a greater number of interceptions, interceptions in the opposition's half, ball losses, recoveries denoting a more fragmented game in women's football [23, 25].

Given the lack of research into how rule changes may have influenced the women's game, this study investigates how the change in the UEFA Women's Champions League away goals rule and introduction of VAR affected a subset of technical and tactical performance indicators.

By analyzing data from knockout round matches before and after the rule changes, this research aims to illuminate whether the removal of the away goals rule and introduction of VAR has influenced the playing style in the Women's Champions League.

Methods

Match sample

The match sample consists of 78 UEFA Women's Champions League quarter and semi-final knockout round matches; 30 of the matches took place in seasons with the AGR and No VAR (2016–2017, 2017–2018, 2018–2019) and 48 in seasons without AGR and VAR included (2021–2022, 2022–2023, 2023–2024 and 2024–2025). The tournament structure of the champions league moved from knockout matches to a group-stage, followed to knock-out structure in the 2021–2022 season. Hence, for a like-for-like comparison between tournament stage and to mitigate large differences in team strength in the early rounds of the tournament, the later stages of the tournament were selected (i.e. quarter and semi-final). Games that were missing from Wyscout (2016–17: $n = 2$

and 2017–18: $n = 4$) were not included. Because competition finals are played in neutral venues with a single leg, the away goals rule does not apply, and these matches were also excluded from the sample. Furthermore, due to the COVID-19 pandemic in the 2019–2020 season, the structure of the Champions League resulted in teams playing single leg knock-out matches, and therefore this season was not included in the sample. The institutional research ethics committee provided ethical clearance for this investigation.

Data source and technical variables

The Wyscout platform (https://wyscout.hudl.com/) provided the data and granted permission for its use. The selected technical performance indicators followed Kubayi and Stone [11] which included goals, shots, shots on target, passes, percentage of accurate passes, balls lost, ball recoveries, crosses, long passes, forward passes, passes to the final third, fouls, offsides, yellow cards, aerial duels, aerial duels won, counterattacks, counterattacks with shots, corners, and free kicks (see Table 1 for operational definitions). The sample was based on data

Table 1 Operational definitions of the technical variables (further information of each variable can be found here: https://dataglossary.wyscout.com)

Variable	Definitions
Goals	A goal scored as specified in law 10.1 of the IFAB Laws of the Game.
Shots	An attempt towards the opposition's goal with the intention of scoring.
Shots on target	A shot is considered successful if it lands on the target of the goal. A shot that hits the frame of the goal is not considered successful.
Number of passes	An attempt to pass the ball to a teammate.
Accurate passes (%)	A pass is considered successful if a teammate receives the next touch of the ball.
Average passes per possession	The mean number of completed passes per possession.
Average pass length	Mean pass length in meters.
Long passes (ground 45 or high 25)	A ground pass longer than 45 m or a high pass longer than 25 m.
Progressive passes	A forward pass that attempts to move a team significantly closer to the opponent's goal. A pass is considered progressive if the distance between the starting point and the next touch is: • at least 30 m closer to the opponent's goal if the starting and finishing points are within a team's own half • at least 15 m closer to the opponent's goal if the starting and finishing points are in different halves • at least 10 m closer to the opponent's goal if the starting and finishing points are in the opponent's half
Passes to final third	Any pass that originates outside the final third and where the next ball touch occurs within the final third.
Fouls	An offence committed by a player according to law 12 (1, 3) of the IFAB Laws of the Game.
Offsides	As described in law 11 of the IFAB Laws of the Game. Only offsides that are whistled by the referee and where the game is resumed with an indirect free kick awarded to the opposite team are labelled as offsides.
Yellow cards	Disciplinary action by the referee. Indicated by showing a yellow card according to law 12.3 of the IFAB Laws of the Game.
Duels	A challenge between two players to gain control of the ball, progress with the ball, or change its direction.
Defensive duels	When a defender attempts to dispossess an opposition player to stop an attack.
Duels won	If the player stopped the progression of the attacking player with the ball and did not commit a foul, the duel is considered won.
Counterattacks	A transition of possession from the opposing team, where the team is transitioning quickly from a defensive to an attacking phase and trying to catch the opponent out of their defensive shape.
Counterattacks with shots	A counterattack (defined above) that ends in the team taking a shot at the goal.
Corners	A corner kick as specified in law 17 of the IFAB Laws of the Game.
Free kicks	The execution of a free kick according to law 13 of the IFAB Laws of the Game.

Table 2 Technical performance variables between when there was away goal and no away goals rule

	Away goal – No VAR	No away goal- VAR	U/t	Sig.	Effect size	95% CI [Lower: Upper]
Goals	1.18±1.17	1.60±1.33	2333	0.038*	0.19	−0.835 : −0.007
Shots	11.15±6.59	12.22±6.23	2599	0.30	0.09	−3.139 : 1.001
Shots on target	4.00±2.60	4.77±3.19	2500	0.16	0.13	−1.739 : 0.197
Passes	415.87±120.62	425.73±121.68	2771	0.69	0.04	−49.290 : 29.565
Accurate passes (%)	77.02±5.93	80.35±5.24	−3.67	<0.001**	0.61	−5.13 : −1.54
Balls lost	124.92±15.38	109.89±13.85	6.32	<0.001**	1.04	10.33 : 19.73
Ball recoveries	91.87±12.40	83.88±11.09	4.18	<0.001**	0.69	4.22 : 11.76
Long passes	53.93±11.71	41.21±9.31	7.51	<0.001**	1.23	9.38 : 16.07
Forward passes	156.65±31.03	147.57±26.53	3407	0.05*	0.18	−0.136 : 18.291
Passes to final third	57.72±18.65	47.95±16.72	3.39	<0.001**	0.56	4.09 : 15.45
Fouls	9.88±3.37	8.71±3.35	3534	0.02*	0.23	0.083 : 2.267
Offsides	1.87±1.69	1.75±1.30	2822	0.83	0.02	−0.358 : 0.592
Yellow cards	1.50±1.26	1.23±1.03	3178	0.26	0.10	−0.094 : 0.636
Aerial duels	41.17±10.92	26.94±12.30	4744	<0.001**	0.647	10.396 : 18.062
Aerial duels won	18.57±6.09	12.40±6.81	4446	<0.001**	0.54	4.044 : 8.298
Crosses	14.32±8.75	13.96±7.53	−0.02	0.98	0.001	−2.249 : 2.966
Counterattacks	1.67±1.72	1.64±1.58	−0.14	0.89	0.01	−0.502 : 0.564
Counter attacks with shots	0.47±0.70	0.74±0.82	2357	0.03*	0.182	−0.526 : −0.020
Corners	4.75±3.28	4.56±2.98	−0.11	0.92	0.01	−0.819 : 1.194
Free kicks	2.65±2.02	1.77±1.46	3757	0.01**	0.241	0.327 : 1.432

*$p < 0.05$; **$p < 0.01$
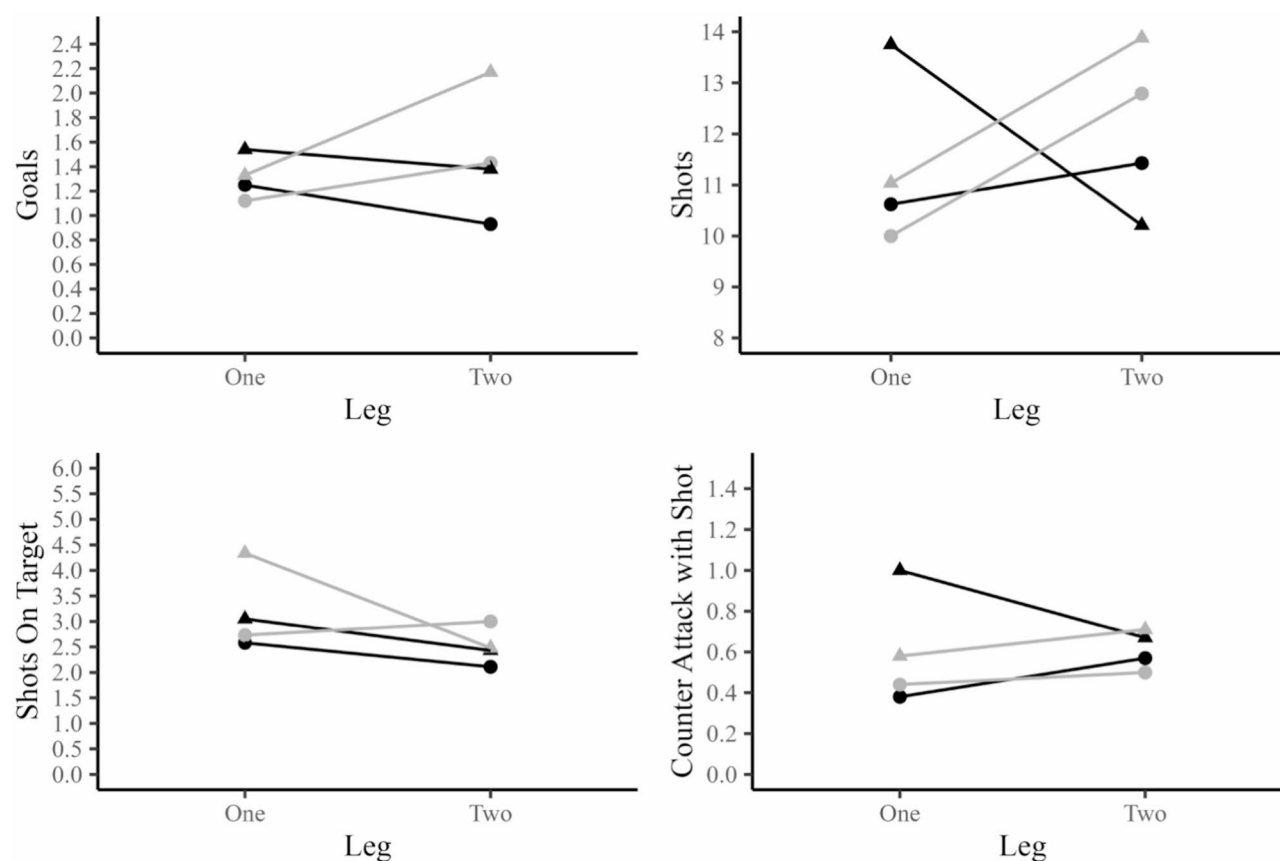
Fig. 1 Attacking variables displayed as mean values per match calculated on away goals rule, leg, and location

from 'normal time', defined as 90 min plus stoppage time, thus excluding the 30 min played during matches that went into extra time. Furthermore, the match outcome (i.e., win, draw, loss) was based on the final score reached within regular time (i.e., 90 min plus stoppage time). Hence matches that went to extra time and penalties were considered a draw. To examine the reliability of the technical performance indicators, inter-observer reliability using Intraclass correlation was conducted by a qualified independent analyst. A single match was selected at random and subjected to analysis and comparison with the Wyscout platform data. The values showed reliable data, ranging from Kappa scores of 0.60 to 1.00 [18].

Data analysis

All statistical analyses were computed using Statistical Package for Social Sciences (SPSS, version 29), with the significance level set at $p = 0.05$. Descriptive statistics such as frequency counts, percentages, means, and standard deviations were subjected to analysis. Prior to conducting inferential statistics, data normality was checked using the Kolmogorov–Smirnov test. For those match performance variables (percentage of accurate passes, balls lost, ball recoveries, long passes, forward passes, and passes to the final third) that were normally distributed ($p > 0.05$), an independent t-test was used to examine significant differences between tournaments played with and without the away goals rule. For match performance variables (goals, shots, shots on target, passes, offsides, yellow cards, crosses, fouls, aerial duels, aerial duels won, counter attacks, counter attacks with shots, corners, and free kicks) that were not normally distributed ($p < 0.05$), the Mann-Whitney U test was used to examine differences between tournaments with and without the away goals rule. Effect sizes (Cohens d or Rank Biserial Correlation) and 95% confidences internals for mean differences are reported. Furthermore, a generalised linear model (GLM) was computed to ascertain if the removal of the away goals rule had a substantial impact on the technical performances of the teams in relation to match location and leg of competition. The first model was specified as follows:

$$Y_i = \beta_{0i} + \beta_{1i} \cdot \text{Away goals rule}$$
$$+ \beta_{2i} \cdot \text{Game location}$$
$$+ \beta_{3i} \cdot \text{Away goals rule} \cdot \text{Game location}$$
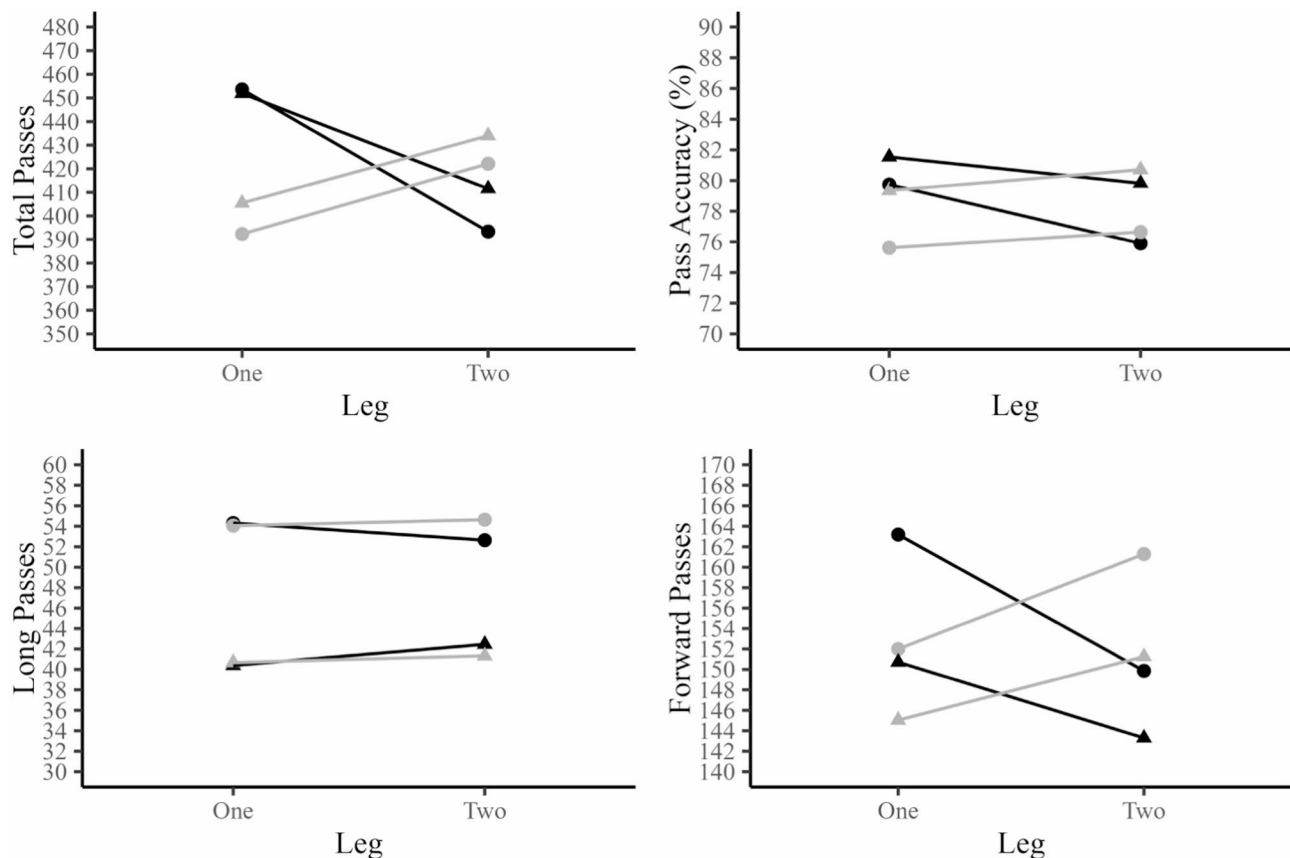$$+ \varepsilon_i$$

Fig. 2 Passing variables displayed as mean values per match calculated on away goals rule, leg, and location

Y_i encompasses all selected (see Table 1) metrics related to match performance. The away goals rule is a categorical variable with a value of one if the away goals rule is applied and zero if it is not. Comparably, game location is a dichotomous variable that equals one for home games and zero for away games. Additionally, an interaction term of these two independent factors was included to show probable linkage, since the location of a game may affect the impact of the away goals rule on match performance indicators. A constant term is indicated by β_{0i}, while the model coefficients that require estimation are represented by β_{1i}, β_{2i}, and β_{3i}. εi is a measure of random error. The second model was specified as follows:

$$Y_i = \beta_{0i} + \beta_{1i} \cdot \text{Away goals rule}$$
$$+ \beta_{2i} \cdot \text{Leg of competition}$$
$$+ \beta_{3i} \cdot \text{Away goals rule} \cdot \text{Leg of competition}$$
$$+ \varepsilon_i$$

In this model, leg of competition (0 = first leg, 1 = second leg) was used in place of game location. A Poisson distribution was first used to fit a GLM to each match performance variable, and overdispersion was examined [19]. While only the percentage of accurate passes was subjected to normal distribution, the other match variables such as goals, shots, shots on target, passes, long passes, forward passes, passes to final third, balls lost, ball recoveries, counterattacks, counterattacks with shots, free kicks, offsides, fouls, aerial duels, aerial duels won, corners, crosses, and yellow cards – were subjected to negative binomial distribution.

Results

Table 2 shows the game performance indicators with and without implementation of the away goals rule during the UEFA Women's Champions League. Eliminating the away goals rule led to a significant increase in the number of goals ($p < 0.05$) percentage of accurate passes ($p < 0.01$) and counter attacks with shots ($p < 0.05$) (see Table 1; Fig. 1). In contrast, the findings demonstrate that removal of the away goals rule resulted in significant reductions in balls lost ($p < 0.01$), ball recoveries ($p < 0.01$), aerial duels ($p < 0.01$), aerial duels won ($p < 0.01$) (see Fig. 3), long passes ($p < 0.01$), forward passes ($p < 0.05$), passes to the final third ($p < 0.01$) (see Fig. 2), fouls ($p < 0.05$), and free kicks ($p < 0.01$) (see Fig. 4).

The estimated results of the GLM for the away goals rule, the location of the match, and the interaction of
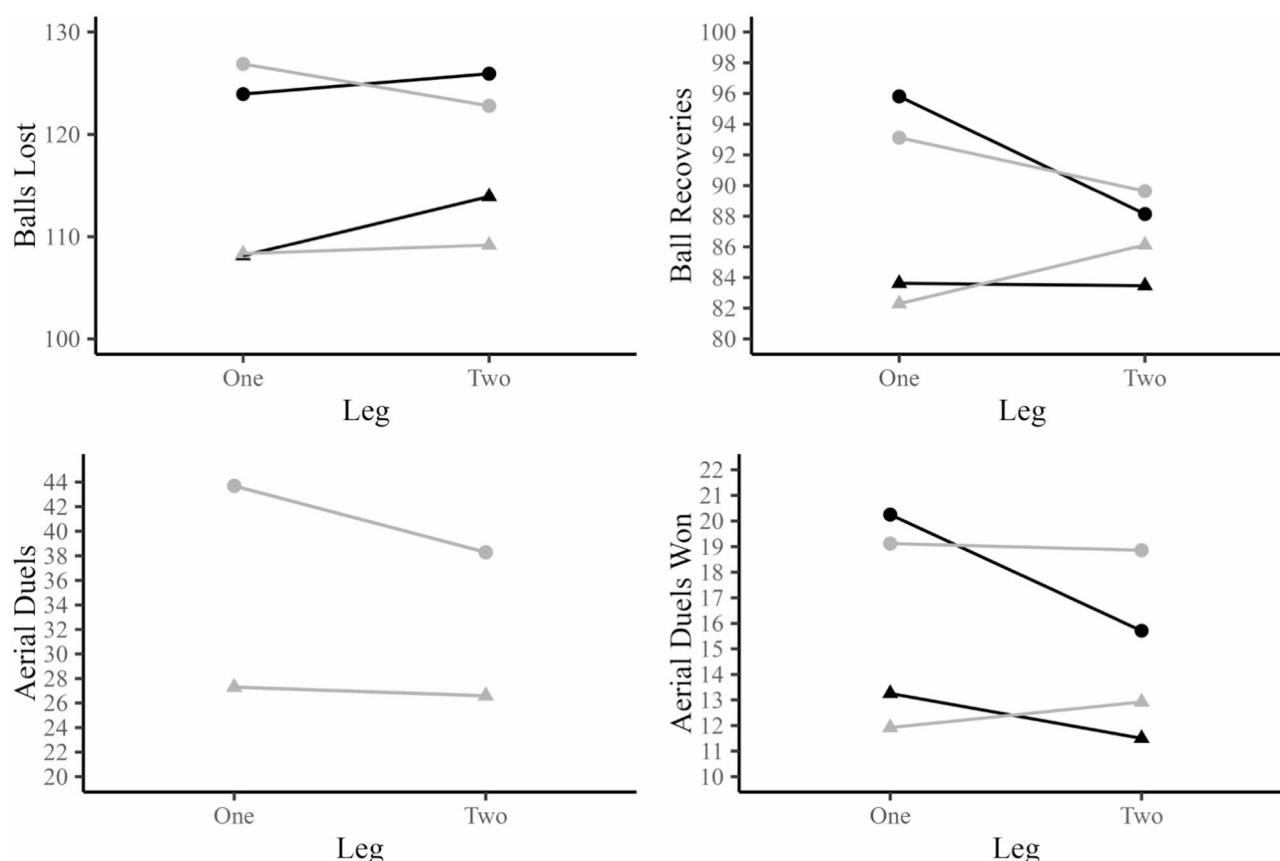

Fig. 3 Defensive variables displayed as mean values per match calculated on away goals rule, leg, and location
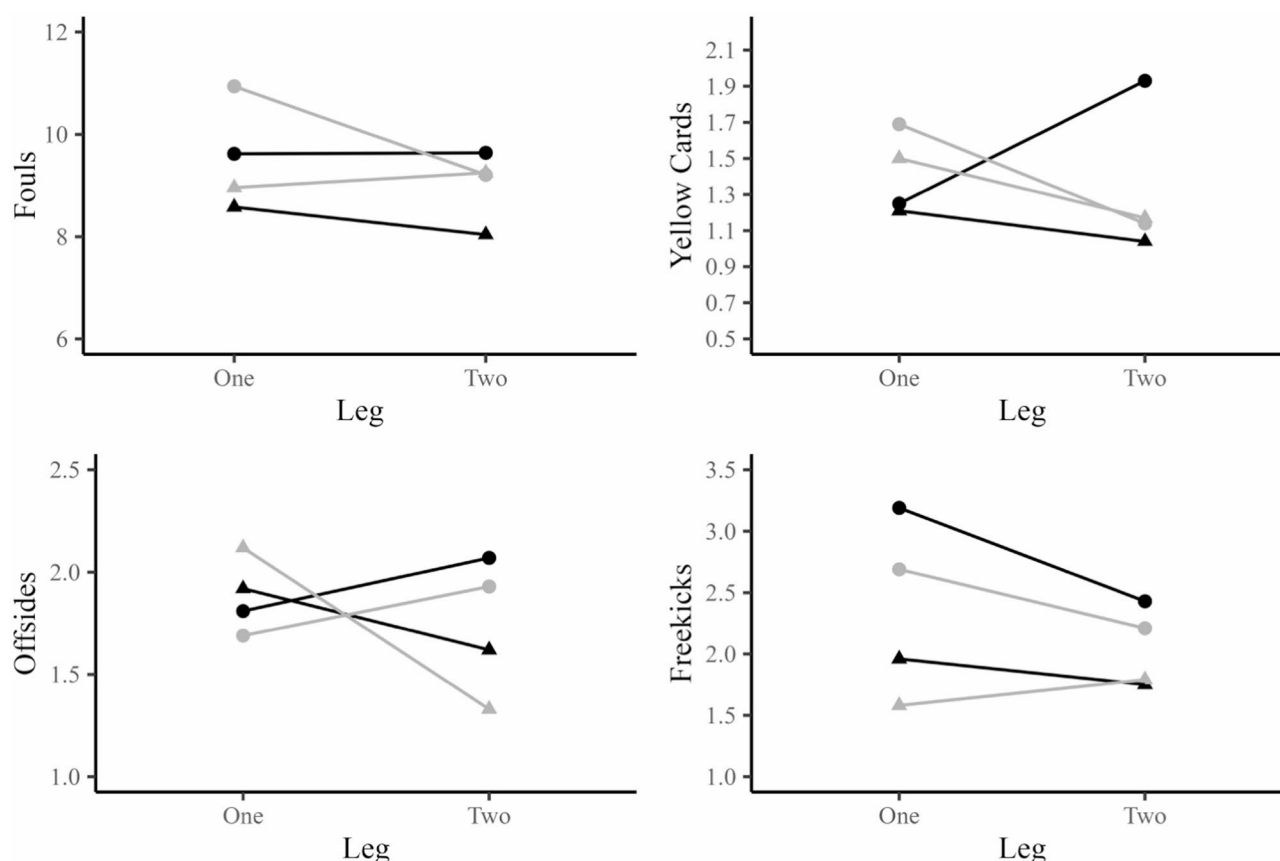
Fig. 4 Disciplinary variables displayed as mean values per match calculated on away goals rule, leg, and location

these two variables are shown in Table 3. The findings show significant main effects on the percentage of accurate passes ($p < 0.05$) when the away goals rule was introduced. No significant ($p > 0.05$) interactions were observed between the away goals rule and match location for any of the match performance variables.

Table 4 presents the estimated GLM results for the away goals rule, leg of competition, and the interaction between the two variables. The results indicated significant main effects in the percentage of accurate passes ($p < 0.05$) when the away goals rule was applied. No significant interactions ($p < 0.05$) were noted between the away goals rule and the leg of competition.

Discussion

This study investigated how the changes of rules in women's football at the elite level has influenced game-related statistics during the final knock-out stages of UEFA Women's Champions League. The findings demonstrated that several performance indicators have changed between two distinct time-periods in the women's champions league where rules modification have included the removal of the Away Goals Rule and the introduction of VAR. The most key variable for match outcomes, goals scored has seen an increase from 1.18 to 1.60 goals scored

per team, per match during the time-period that the away goals rule was removed, and VAR was introduced.

Findings indicate that through the development of the women's game, and possible impact from rule changes, technical aspects of the women's game have also changed. A key finding from this study is the noticeable decline in the number of counterattacks after the removal of the away goals rule. This is consistent with findings by Kubayi and Stone [11], who noted that elimination of the away goals rule resulted in a significant decline in the number of counter attacks during the UEFA Champions League. This seems to imply that, with the rule change, teams may be more comfortable playing cautiously and settle for a penalty knockout rather than trying to counterattack to win the game. Moreover, the increase in the number of counterattacks between leg one and leg two was more prominent when the away goals rule was still in place. While the aim in the first leg may be merely to outwit the opponents, the stakes were higher in the second match due to the possibility of elimination before the next round (e.g., quarter-finals, semi-finals, and finals) [22]. Therefore, when the rule was still in effect, trailing teams would play conservatively, not opening up in the first leg in the hopes of improving their performance in the second. In the second leg, the trailing team would

Table 3 The introduction of away goals rule on match location using GLM

	Goals	Shots	Shots on target	Passes	Accurate passes
Away goals rule (β_1)	−0.28	−0.08	−0.12	−0.01	−2.73*
Match location (β_2)	0.18	0.04	0.07	−0.03	0.65
Away goals rule*Match location (β_3)	−0.04	−0.01	−0.10	−0.02	1.20
	Long pass	Passes to final third	Loss of possession	Ball recoveries	Forward passes
Away goals rule (β_1)	0.26	0.20	0.12	−0.10	0.07
Match location (β_2)	−0.10	−0.05	−0.02	0.01	0.01
Away goals rule*Match location (β_3)	0.02	0.03	0.02	−0.02	−0.01
	Fouls	Offsides	Yellow cards	Aerial duels	Aerial Duels won
Away goals rule (β_1)	0.15	0.09	0.33	0.42	0.38
Match location (β_2)	0.09	−0.02	0.17	−2.06	0.00
Away goals rule*Match location (β_3)	−0.04	−0.05	−0.26	2.31	0.04
	Crosses	Counterattacks	Counterattacks with shots	Corner kicks	Free kicks
Away goals rule (β_1)	0.00	0.02	−0.58	0.04	0.42
Match location (β_2)	0.04	−0.19	−0.25	0.07	−0.09
Away goals rule*Match location (β_3)	0.05	−0.01	0.25	0.00	−0.04

*$p < 0.05$; **$p < 0.01$

Table 4 The introduction of away goals rule on the leg of competition using GLM

	Goals	Shots	Shots on target	Passes	Accurate passes
Away goals rule (β_1)	−0.41	−0.00	−0.09	−0.04	3.99**
Leg of competition (β_2)	−0.21	−0.03	−0.01	0.01	0.18
Away goals rule* Leg of competition (β_3)	0.22	−0.19	−0.17	0.02	1.23
	Long pass	Passes to final third	Loss of possession	Ball recoveries	Forward passes
Away goals rule (β_1)	0.25	0.16	0.11	0.05	0.55
Leg of competition (β_2)	−0.03	0.05	−0.03	−0.02	0.01
Away goals rule* Leg of competition (β_3)	0.04	0.04	−0.04	0.08	0.01
	Fouls	Offsides	Yellow cards	Aerial duels	Aerial Duels won
Away goals rule (β_1)	0.09	0.30	0.33	0.36	0.35
Leg of competition (β_2)	0.14	0.31	0.20	0.03	0.03
Away goals rule* Leg of competition (β_3)	0.07	−0.45	−0.25	0.11	0.10
	Crosses	Counterattacks	Counterattacks with shots	Corner kicks	Free kicks
Away goals rule (β_1)	0.04	0.30	−0.25	−0.02	0.27
Leg of competition (β_2)	−0.01	0.09	0.14	−0.10	1.16
Away goals rule* Leg of competition (β_3)	0.02	−0.59	−0.42	0.11	0.23

*$p < 0.05$; **$p < 0.01$

play aggressively and counterattack the opponents to prevent losing and elimination from the competition [17].

The findings demonstrated that post rule changes, the percentage of accurate passes increased significantly, but long passes, forward passes, and passes to the final third noticeably decreased. The results demonstrate they could be an evolution into the tactic play in elite women's football, using shorter, less risky passes, and could indicate less drive to play forward and to retain possession. This could be influenced by the regulation change that removes the possibility of winning through the away goals rule could lead to more patience build up play. Alternatively, the present observation shows that teams could have been incentivized by the rule adjustment to 'park the bus' to settle for a draw [18], thus leading to extra time [11]. Furthermore, the present study

has revealed a notable decrease in the number of aerial duels following the removal of the away goals rule. This may indicate that players were less inclined to attack and made fewer long passes, which lessened the necessity for players to compete for aerial balls.

The study further showed that the changes in rules resulted in a considerable decrease in ball losts and ball recoveries. Given that there the change to the away goals rule could result in reduced urgency to score more goals when playing away, teams may have taken to use more controlled and 'safer' attack options by keeping possession of the ball through short passing than using less accurate, long passes [23, 24]. A decrease in the number of ball recoveries from leg one to leg two when the away goals rule was still in place may indicate that players would not play aggressively to regain possession. In

addition, there were significant interactions between the away goals rule and the leg of competition, with the number of fouls and free kicks decreasing after the rule changes. This could be linked to a slight decrease in fouls committed, which leads to referees awarding fewer free kicks, or players being aware of the use of VAR and hence being more conservative in the use of aggressive play.

Limitations

Although the findings here contribute to understanding how removing the away goals rule has affected game-related statistics in the UEFA Women's Champions League, the limited number of matches and seasons covered by the study could restrict the generalisability of the results. Research could also examine how team quality in the women's game may influence the impact of rule changes. Future research could examine how the technical and tactical metrics may continue to evolve in future years of the competitions or examine other competitions which have seen similar rule changes. Future studies could also investigate how the UEFA Women's Champions League's removal of the away goals rule has changed the game's physical demands. Finally, as Kubayi and Stone [11] highlighted in their discussion of the men's game, future mixed-method research could be used to explore perceptions of the away goals rule among coaches and fans to obtain rich data on the impact of this rule change.

Conclusion

This study has examined how match performance metrics have changed following the UEFA Women's Champions League's removal of the away goals rule. The results demonstrate that removing the away goals rule has impacted several of the game's performance parameters, with a reduction in the numbers of balls lost, long passes, forward passes, passes to the final third, aerial duels, and aerial duels won. However, there was an increase in the percentage of accurate passes when the away goals rule was removed. The results demonstrate that removing the away goals rule has influenced some game-related metrics of teams in the UEFA Women's Champions League.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13102-025-01418-6.

> Supplementary Material 1

Declarations

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