Goal-scoring dynamics in the Big-5 European football leagues: Situational and sex-based effects on match outcome

Dinámicas de anotación de goles en las cinco grandes ligas europeas de fútbol: Efectos situacionales y del sexo en el resultado del partido

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Abstract

Introduction: Despite recent advancements in understanding goal-scoring determinants in football, a noticeable research gap persists between women's and men's games, warranting more comprehensive studies.
Aim: This retrospective observational study addressed this gap by examining how situational variables (*country*, *match location*, *match period*, *numerical relation*, *team quality*, and *goal criticality*) and *sex* influence the *match outcome* in the Big-5 European leagues across two seasons (2020/21–2021/22).
Methods: All goals scored by male and female teams in top-tier divisions of English, Spanish, Italian, German, and French football (n = 15,366) were analysed through chi-square tests and multinomial logistic regression.
Results: Bivariate analyses uncovered significant associations of all situational variables with the *match outcome*, except for the *match period*. Detailed results from regression models applied to women's and men's goals demonstrated varying influences of situational variables between them. Country-based differences shaped match results in women's leagues. Moreover, women were more prone to be influenced by the complex interaction of context-related factors during match-play, arguably due to lower professionalism, skill level and competitive balance. Critical goals, which are predominantly scored in the first half, were found to be essential to favourable match outcomes. Nevertheless, scoring under critical circumstances (i.e., that change the competitive status between opposing teams) acquires greater importance as the match unfolds, especially in men's football.
Conclusion: As the game evolves, accommodating these insights will elevate performance and inform strategic decisions for coaches, players, and stakeholders. The pursuit of excellence in football demands a continual embrace of situational awareness.

Keywords

Competitive level; context; game criticality; professional soccer; team success.

Resumen

Introducción: A pesar de los recientes avances en la comprensión de los determinantes de la anotación de goles en el fútbol, persiste una notable brecha de investigación entre los juegos femeninos y masculinos, lo que justifica la necesidad de estudios más holísticos.
Objetivo: Este estudio observacional retrospectivo abordó esta brecha al examinar cómo las variables situacionales (*país*, *localización del partido*, *período del juego*, *relación numérica*, *calidad del equipo* y *criticidad del gol*) y el *sexo* influyen en el *resultado del partido* en las cinco principales ligas europeas durante dos temporadas (2020/21–2021/22).
Metodología: Se analizaron todos los goles anotados por equipos masculinos y femeninos en las divisiones de élite del fútbol inglés, español, italiano, alemán y francés (n = 15,366) mediante pruebas chi-cuadrado y regresión logística multinomial.
Resultados: El análisis bivariado mostró asociaciones significativas entre todas las variables situacionales y el *resultado del partido*, excepto con el *período del partido*. Los resultados de los modelos de regresión aplicados a los goles de mujeres y hombres demostraron influencias distintivas de las variables situacionales entre ambos. Las diferencias basadas en el *país* moldearon los resultados de los partidos en las ligas femeninas. Además, las mujeres mostraron una mayor propensión a ser influenciadas por la compleja interacción de factores contextuales durante el juego, posiblemente debido a un menor nivel de profesionalismo, habilidad y equilibrio competitivo. Los goles críticos, mayormente anotados en la primera mitad, fueron esenciales para obtener resultados favorables. No obstante, marcar en circunstancias críticas (es decir, aquellas que cambian el estado competitivo entre equipos oponentes) adquiere mayor preponderancia a medida que avanza el partido, especialmente en el fútbol masculino.
Conclusión: Conforme el fútbol evoluciona, incorporar estas perspectivas elevará el rendimiento y orientará las decisiones estratégicas de entrenadores, jugadores y otros. Buscar la excelencia en el fútbol requiere una constante adaptación al contexto situacional.

Palabras clave

Contexto; criticidad del juego; éxito del equipo; fútbol profesional; nivel competitivo.

Introduction

Association football (soccer, in the American form) is globally renowned as a low-scoring sport. The majority of matches end with three or fewer goals (Ibáñez et al., 2018; Lago-Peñas, Gómez-Ruano, Megías-Navarro, et al., 2016; Wunderlich et al., 2021). This distinctive feature, paradoxically, amplifies the excitement of goal celebrations and significantly contributes to the sport's enduring worldwide appeal, stressing the value of each goal in shaping the *match outcome*.

Predicting match outcomes has become a prominent topic, driven by the increasing earnings for players and clubs, resulting from successful performances, and the financial prospects for fans through betting. In response to this trend, researchers have harnessed advanced statistical techniques, such as multivariate analysis and machine learning algorithms, to integrate multiple performance- and context-related variables in their quest to forecast match results (Carpita et al., 2015; Y. Li et al., 2020; H. Liu et al., 2016). Notably, apart from identifying technical-tactical behaviours leading to goal scoring, recent research has shed light on the critical role of situational factors under which these successful actions unfold (González-Rodenas et al., 2021; Lago-Peñas et al., 2021; Sanfiz-Arias & López-Alonso, 2024; Sarmento et al., 2018).

The probability of winning is not uniform, favouring the teams that plays at home, a well-documented phenomenon termed the "home advantage effect" (Gómez-Ruano & Pollard, 2022). Indeed, home teams tend to adopt a more aggressive playing style, often scoring first and more frequently, which substantially contributes to their increased likelihood of winning compared to teams that play in the opponent's stadium, i.e. away (Almeida et al., 2022; Carpita et al., 2015; Lago-Peñas, Gómez-Ruano, Megías-Navarro, et al., 2016; T. Liu et al., 2021). Nonetheless, research suggests that *team quality* (relative to the opposing team) emerges as a stronger predictor of *match outcome* than the *match location* (Ibáñez et al., 2018; Lago-Peñas, Gómez-Ruano, Megías-Navarro, et al., 2016; H. Liu et al., 2016). High-quality teams usually exhibit greater defensive compactness (Freitas et al., 2023) while also displaying more offensive behaviours and goal-scoring opportunities (Evangelos et al., 2018; González-Rodenas et al., 2023; Pratas et al., 2018). This dual in-game superiority enhances these teams' odds of winning matches and securing prominent standings in official leagues/tournaments.

Furthermore, a player's dismissal can affect the strength balance between competing teams. Several studies have consistently revealed that a red card weakens the sanctioned team's ability to score and prevent goals, underlining the profound impact *numerical relation* can exert on the *match outcome* (Casal et al., 2021; Y. Li et al., 2020; Pratas et al., 2018). The evolving match scoreline (*match status*) also influences the individual and team's sport-specific behaviours. In a tactical context, teams losing the match tend to adopt a possession-based style of play to equalise the score, whereas winning teams frequently prioritise the usage of direct and counterattacking strategies (Fernandez-Navarro et al., 2018; González-Rodenas et al., 2021; Paixão et al., 2015). A critical determinant of *match status* is the ability to score the opening goal. The "scoring first effect" postulates that when teams break the initial tie (0-0), they win ~70% of matches in men's European leagues, irrespective of *match location* and *team quality* (Fernández-Cortés et al., 2022; Lago-Peñas, Gómez-Ruano, Megías-Navarro, et al., 2016; Martínez & García, 2019). In the first Spanish women's football league, scoring first escalates the odds of winning considerably, ranging from 2.8 to 11.1 times (Ibáñez et al., 2018).

Goal scoring in football exhibits a time-dependent pattern, with most goals occurring in the last 15-minute period, including added time (76'–Full-time). Some researchers have recognised this late-phase goal surge as a critical period (Evangelos et al., 2018; Leite, 2017; Mićović et al., 2023; Njororai, 2014). Nevertheless, this assertion hinges on descriptive data alone, disregarding potential interactive effects with other situational variables (Almeida et al., 2022). Recent studies, drawing from Ferreira et al.'s (2014) concept of "game criticality", have classified "critical" goals as capable of changing the competitive status between teams (equalising from 1-0 to 1-1) and "non-critical", which leave the competitive status unaffected (e.g., extending a 3-0 lead to 4-0 or reducing a 2-0 disadvantage to 2-1). These studies found that the probability of scoring critical goals decreases significantly in the late match period, especially when playing at home, facing worse-ranked teams, or in lower age groups (Almeida et al., 2022; Carmo et al., 2020). The quest to unveil the most influential goals to the *match outcome* is still evolving, requiring more extensive data to validate and expand the existing findings, particularly in women's football.

In the past decade, women's football has garnered substantial attention, undergoing rapid growth in terms of participation, professionalism, and competitiveness, yet research in this domain remains in its infancy compared to men's football (Casal et al., 2021; De Jong et al., 2023; González-Rodenas et al., 2023; Okholm Kryger et al., 2022). Notwithstanding the gap in comprehending the technical and tactical aspects of the women's game, available literature has uncovered distinct features. Disparities were observed in kicking power, ball speed, passing accuracy and playing style, with women's football characterised by less precise passing, more frequent ball losses, and a more vertical and quick attacking approach, which results in a different pattern of goal-scoring opportunities (Casal et al., 2021; González-Rodenas et al., 2023; Khatun et al., 2024; Mitrotasios et al., 2022). In contrast, men performed a greater proportion of combinative attacks, more passes per possession, and a higher passing tempo (González-Rodenas et al., 2023; Mitrotasios et al., 2022; Pappalardo et al., 2021).

Despite the recent advancements in understanding the unique determinants of success in women's football, there is still a scarcity of dynamic, multifactorial research approaches to expose the underlying intricacies of goal scoring in football (Almeida et al., 2022; Garnica-Caparrós & Memmert, 2021; Pappalardo et al., 2021). Hence, this study endeavours to bridge this research gap by exploring how situational variables (i.e., *match location*, *match status*, *match period*, *numerical relation*, *team quality*, and *goal criticality*) and *sex* influence the *match outcome* in the Big-5 European football leagues. Given the wide range of situational variables and the exploratory nature of this research, we refrained from formulating hypotheses. However, considering the ongoing development of women's football, we theorise that the scoring dynamics of men's teams may be less affected by context-related influences.

Methods

Study design

This study adopted a retrospective observational design and used archival data from official match records to assess goal-scoring patterns in elite European football. The research followed a quantitative approach to examine situational factors that influence match outcomes through statistical modelling. No direct intervention or performance analysis procedures were employed.

Sample

The sample consisted of all goals scored (n = 15,366) by both men and women professional teams in the top tier of the Big-5 European football leagues (England, Spain, Italy, Germany, and France) during two consecutive seasons (2020/21–2021/22). The official designation of those leagues, by country and sex, are as follows: England (men: *Football Association Premier League*; women: *Football Association Women's Super League*); Spain (men: *LaLiga*; women: *Primera División Femenina*); Italy (men: *Serie A*; women: *Liga Italiana Feminina*); Germany (men: *Bundesliga*; women: *1. Frauen-Bundesliga*); France (men: *Ligue 1*; women: *Feminine Division 1*). Table 1 presents the sample-related details by country and sex.

Table 1. Sample-related details (country, sex, rounds, teams, matches, goalless matches, and goals scored) retrieved from two consecutive seasons (2020/21–2021/22) of the Big-5 European football leagues.

Country	Sex	Rounds (n)	Club Teams (n)	Matches (n)	Goalless Matches (n)	Goals (n)
England	Men	76	23	760	52	2,095
	Women	44	13	263*	14	797
Spain	Men	76	23	760	73	1,904
	Women	64	20	546	29	1,708
Italy	Men	76	23	759**	42	2,249
	Women	44	15	264	11	843
Germany	Men	68	20	611***	34	1,880
	Women	44	14	264	16	925
France	Men	76	22	760	50	2,116
	Women	44	13	264	15	849
All	Men	372	111	3,650	251	10,244
	Women	240	75	1,601	85	5,122

* Three goals were excluded from the sample because of a match result (2020/21 season, round 11: Tottenham Hotspur FC 0 x 3 Birmingham City FC) that was administratively decided by the FA – *Football Association*.

** Three goals were excluded from the sample because of a match result (2020/21 season, round 1: Hellas Verona FC 3 x 0 Roma AC) that was administratively decided by the FIGC – *Federazione Italiana Giuoco Calcio*.

*** Three goals were excluded from the sample because of a match result (2021/22 season, round 27: VfL Bochum 0 x 3 Borussia Mönchengladbach) that was administratively rectified by DFB – *Deutscher Fußball-Bund e.V.*

Data on the goals scored by all teams were collected from the publicly available website (https:// https://www.whoscored.com), which compiles official match results from each country's governing football entities. Prior to data collection, written permission was obtained from the website administrator, and the respective privacy policy was entirely respected. This investigation was conducted in accordance with the principles of the Declaration of Helsinki, and the methodological procedures adhered to the ethics guidelines of the first author's institution.

Variables and procedures

In this retrospective observational study, we proposed eight independent variables: *sex*, *country*, *match location*, *match status*, *match period*, *numerical relation*, *team quality*, and *goal criticality*. The dependent variable was the *match outcome*. Table 2 depicts the categories, the operational definitions, and the collection procedures of independent and dependent variables.

Table 2. Categories, operational definitions, and collection procedures of independent and dependent variables.

Variable	Categories	Operational Definition/Collection Procedures
Sex (independent)	1) Men 2) Women	Recorded as "men" or "women" as a function of the players' biological sex.
Country (independent)	1) England 2) Spain 3) Italy 4) Germany 5) France	Recorded as 1, 2, 3, 4 or 5 based on the country in which the football league was organised and contested.
Match location (independent)	1) Home 2) Away	Recorded as "home" or "away" depending on whether the scoring team was playing at its own ground or that of its opponent.
Match status (independent)	1) Losing by two or more goals 2) Losing by one goal 3) Tied 4) Winning by one goal 5) Winning by two or more goals	Represents the evolving score of a match immediately before the goal-scoring event. Categories were defined in relation to the number of goals scored and conceded by the scoring team at the time of data entry.
Match period (independent)	1) 1–15 min 2) 16–30 min 3) 31 min–HT 4) 46–60 min 5) 61–75 min 6) 76 min–FT	Recorded as 1, 2, 3, 4, 5 or 6 depending on the period in which the goal was scored during the match. Note: HT – half-time; FT – full-time.
Numerical relation (independent)	1) Inferiority (disadvantage) 2) Equality 3) Superiority (advantage)	Refers to the quantifiable disparity in the number of effective players between scoring and conceding teams at the time a goal is scored.
Team quality (independent)	1) Worse-ranked 2) Similarly-ranked 3) Better-ranked	Represents the quality difference between the scoring team and its opponent. Considering the points earned by each team at the end of the season, k-means cluster analyses were performed for grouping teams into quality categories (i.e., three quality groups for leagues up to 12 teams, four quality groups for leagues up to 16 teams, and five quality groups for leagues up to 20 teams). For example, if the scoring team was playing against an opponent from a lower quality group, it was recorded as "better-ranked".
Goal criticality (independent)	1) Critical goal (match status = 2 and 3) 2) Non-critical goal (match status = 1, 4 and 5)	Defines the goal-scoring nature, depending on whether the event changes (or not) the temporary competitive status between opposing teams. It was computed from the variable "match status". For example, if the scoring team made the equaliser (1-1), the goal was deemed "critical". If the scoring team was losing 3-0 or 2-0 and scored to make it 3-1 or 2-1, respectively, the goal was coded as "non-critical".
Match outcome (dependent)	1) Loss 2) Draw 3) Win	Recorded as 1, 2 or 3 depending on the difference between goals scored and conceded by the scoring team at the end of the match.

These variables and the respective categories were previously used in performance analysis research (e.g., Almeida et al., 2022; Carmo et al., 2020; Fernandez-Navarro et al., 2018). To operationalise the variables, a Microsoft 365 Excel (Microsoft Corporation, USA) spreadsheet was developed to code all elements of each goal-scoring event – the unit of analysis: season, sex, country (national competition), round, scoring team, conceding team, match location, match status, match period, team quality, goal criticality, and match outcome. The final database was exported to SPSS 28.0 (IBM SPSS Statistics, IBM Corp., Armonk) for statistical analysis.

Statistical analysis

First, we conducted a descriptive statistical analysis using contingency tables. Chi-square tests of independence were applied to assess the relationship between each independent variable and match

outcomes. Adjusted standardised residuals (AR) were computed to further understand the association between each independent variable and match outcomes. Residuals were considered significant if they fell outside the ±2.0 range (corresponding to a 95% confidence interval), indicating higher or lower frequencies than expected. Effect sizes were gauged using Cramer's *V* statistic and interpreted based on Cohen's benchmarks (1988) for varying degrees of freedom. The degrees of freedom for Cramer's *V* were determined as the smaller of (R-1) or (C-1), where R represents rows and C represents columns (Gravetter & Wallnau, 2013).

Subsequently, we employed a multinomial logistic regression model to estimate the probabilities of match outcomes based on *sex*, *country*, *match location*, *match period*, *numerical relation*, *team quality*, and *goal criticality*. As the complete factorial model faced overdispersion issues, two multinomial logistic regression models were developed for each sex. The best-fitting model for men included the main effects of *country*, *match location*, *match period*, *numerical relation*, *team quality*, and *goal criticality*, along with interactions like *country* x *match location*, *country* x *team quality*, *match period* x *goal criticality*, *team quality* x *numerical relation*, and *team quality* x *goal criticality*. Likewise, for women, the model encompassed main effects and interactions involving *country*, *match location*, *match period*, *numerical relation*, *team quality*, and *goal criticality*. In this analysis, "loss" was the reference category, symbolising the least favourable outcome in an official football match. Statistical significance was established at $p \leq 0.05$.

Results

Descriptive statistics

A total of 15,366 goals were analysed, with 66.7% (n = 10,244) scored by men's teams and 33.3% (n = 5,122) by women. Goals were distributed across domestic leagues as follows: English (18.8%, n = 2,892), Spanish (23.5%, n = 3,612), Italian (20.1%, n = 3,092), German (18.3%, n = 2,805), and French (19.3%, n = 2,965). Most goals were scored at home (54.4%, n = 8,362), when drawing (42%, n = 6,458), during the last match period: 76'–FT (21.9%, n = 3,360), in critical and numerical equality circumstances (57.7%, n = 8,872, and 95.3%, n = 14,639, respectively), and by better-ranked teams (54%, n = 8,300).

Bivariate analysis: Associations between variables

Table 3 shows the frequencies of match outcomes associated with each goal-scoring instance as a function of each independent variable. A significant association between *sex* and *match outcome* was found ($\chi2$ (2) = 249.883, $p < 0.001$, $V = 0.128$), indicating a small-sized effect. Men's teams showed contrasting goal patterns compared to women's, favouring losses (AR = 5.0) and draws (AR = 13.9) while scoring fewer goals than anticipated to secure a victory (AR = -14.8). There was also a significant (but trivial) association between *country* and *match outcome*, $\chi2(8) = 30.992$, $p < 0.001$, $V = 0.032$. Whereas English teams fell short of expected goals for losses (AR = -2.4), Italian teams outperformed expectations (AR = 2.4) in this category. Spanish and Italian teams surpassed expected goal counts for draws (AR = 2.1 and 2.8, respectively), contrasting with a shortfall in German teams (AR = -2.5). English teams exceeded expected goals related to wins (AR = 3.2), while Italian teams underperformed (AR = -4.0).

Match location demonstrated a statistically significant relationship of small size with *match outcome*, $\chi2(2) = 152.702$, $p < 0.001$, $V = 0.1$. Home teams outperformed away teams for wins (AR = 11.8) and underperformed for losses and draws (AR = -10.4 and -4.7, respectively). *Match status* was substantially associated with *match outcome*, $\chi2$ (8) = 8087.943, $p < 0.001$, $V = 0.513$, showing deviations from expected values for all scorelines. No association was found between *match period* and *match outcome*, $\chi2(10) = 16.275$, $p = 0.092$, $V = 0.023$. The *numerical relation* established an association with the *match outcome*, $\chi2(4) = 90.224$, $p < 0.001$, $V = 0.054$, with a trivial effect size. Whilst inferiority situations emphasised negative outcomes (e.g., loss: AR = 5.1), scoring with more players than the opponent was linked to positive outcomes (e.g., win: AR = 6.5).

Team quality had a medium-to-large significant relationship with *match outcome* ($\chi2$ (4) = 3385.761, $p < 0.001$, $V = 0.332$). Worse-ranked teams struggled to score goals leading to wins (AR = -48.2), while better-ranked teams excelled (AR = 48.1). When facing evenly matched opponents, a higher frequency of goals than expected was observed for draws (AR = 10.5). Furthermore, *goal criticality* was also

significantly associated with the *match outcome*, $\chi2(2) = 1180.771$, $p < 0.001$, $V = 0.277$, unveiling a small-to-moderate effect size. In fact, an excess of critical goals was observed for draws (AR = 33.9), while critical goals linked to wins were significantly below expectations (AR = -26.3).

Table 3. Absolute (and relative: %) frequencies and chi-square analysis of *match outcome* associated with goals scored, according to *sex*, *country*, *match location*, *match status*, *match period*, *numerical relation*, *team quality*, and *goal criticality*.

Independent Variables and Categories	Match Outcome		
	Loss n (%)	Draw n (%)	Win n (%)
Sex *			
Men	1,645 (16.1)	1,904 (18.6)	6,695 (65.4)
Women	667 (13.0)	510 (10.0)	3,945 (77.0)
Country *			
England	393 (13.6)	426 (14.7)	2,073 (71.7)
Spain	531 (14.7)	607 (16.8)	2,474 (68.5)
Italy	507 (16.4)	536 (17.3)	2,049 (66.3)
Germany	440 (15.7)	397 (14.2)	1,968 (70.2)
France	441 (14.9)	448 (15.1)	2,076 (70.0)
Match location *			
Home	1,029 (12.3)	1,208 (14.4)	6,125 (73.2)
Away	1,283 (18.3)	1,206 (17.2)	4,515 (64.5)
Match status *			
Losing by two or more goals	932 (82.8)	131 (11.6)	62 (5.5)
Losing by one goal	624 (25.8)	1,075 (44.5)	715 (29.6)
Tie	698 (10.8)	1,074 (16.6)	4,686 (72.6)
Winning by one goal	57 (1.9)	125 (4.2)	2,785 (93.9)
Winning by two or more goals	1 (0.0)	9 (0.4)	2,392 (99.6)
Match period			
1–15’	334 (15.8)	356 (16.9)	1,418 (67.3)
16–30’	350 (15.4)	351 (15.4)	1,576 (69.2)
31’–HT	423 (15.9)	422 (15.9)	1,808 (68.1)
46–60’	387 (15.7)	382 (15.5)	1,696 (68.8)
61–75’	358 (14.3)	364 (14.5)	1,781 (71.2)
76’–FT	460 (13.7)	539 (16.0)	2,361 (70.3)
Numerical relation *			
Inferiority	51 (28.7)	43 (24.2)	84 (47.2)
Equality	2,229 (15.2)	2,303 (15.7)	10,107 (69.0)
Superiority	32 (5.8)	68 (12.4)	449 (81.8)
Team Quality *			
Worse-ranked team	1,365 (40.4)	816 (24.2)	1,197 (35.4)
Similarly-ranked team	584 (15.8)	781 (21.2)	2,323 (63.0)
Better-ranked team	363 (4.4)	817 (9.8)	7,120 (85.8)
Goal criticality *			
Critical	1,322 (14.9)	2,149 (24.2)	5,401 (60.9)
Non-critical	990 (15.2)	265 (4.1)	5,239 (80.7)

Note: * $p \leq 0.001$. HT – half-time; FT – full-time.

Multinomial logistic regression models

Tables 4 and 5 depict regression coefficients (*B*), standard errors (SE), odds ratios (OR), and 95% confidence intervals (CI) for the parameter estimates of each factor and interaction term within the multinomial logistic regression models applied to major European men’s and women’s football leagues, respectively.

Table 4. Parameter estimates for the multinomial logistic regression of *match outcome* as a function of situational factors in men’s major European leagues (n = 10,244 goals).

Variables / Categories		*B* (SE)	95% CI for Odds Ratio		
			Lower	OR	Upper
Draw (reference: Loss)					
Intercept		0.087 (0.662)			
Country:	England vs. France	-0.304 (0.242)	0.459	0.738	1.187
	Spain vs. France	0.130 (0.259)	0.686	1.139	1.891
	Italy vs. France	-0.082 (0.238)	0.578	0.921	1.468
	Germany vs. France	-0.412 (0.249)	0.407	0.663	1.079
Match Location:	Home vs. Away	0.301 (0.157)	0.993	1.351	1.837
Match Period:	1–15’ vs. 76’–FT***	2.805 (0.561)	5.502	16.528	49.653
	16–30’ vs. 76’–FT***	2.058 (0.316)	4.213	7.829	14.547
	31’–HT vs. 76’–FT***	1.718 (0.261)	3.343	5.572	9.286
	46–60’ vs. 76’–FT***	1.289 (0.267)	2.151	3.628	6.119

	61–75' vs. 76'–FT**	0.774 (0.275)	1.266	2.168	3.713
Numerical Relation:	Inferiority vs. Superiority*	-1.616 (0.749)	0.046	0.199	0.863
	Equality vs. Superiority*	-1.542 (0.622)	0.063	0.214	0.724
Team Quality:	Worse vs. Better-ranked*	-1.767 (0.739)	0.040	0.171	0.727
	Similarly vs. Better-ranked	-1.633 (0.946)	0.031	0.195	1.247

Table 4. (continued)

Variables / Categories		*B* (SE)	95% CI for Odds Ratio		
			Lower	OR	Upper
Goal Criticality:	Critical vs. Non-critical***	4.076 (0.290)	33.375	58.897	103.936
Country x Match Location:	England x Home vs. France x Home	-0.286 (0.227)	0.482	0.751	1.172
	Spain x Home vs. France x Home	0.048 (0.231)	0.667	1.049	1.649
	Italy x Home vs. France x Home	-0.125 (0.218)	0.576	0.883	1.353
	Germany x Home vs. France x Home	0.112 (0.232)	0.710	1.118	1.760
Country x Team Quality:	England x Worse vs. France x Worse	0.438 (0.276)	0.930	1.549	2.659
	England x Similarly vs. France x Similarly	0.242 (0.311)	0.693	1.274	2.343
	Spain x Worse vs. France x Worse	-0.188 (0.292)	0.467	0.828	1.469
	Spain x Similarly vs. France x Similarly	0.120 (0.326)	0.595	1.128	2.138
	Italy x Worse vs. France x Worse	0.059 (0.268)	0.627	1.061	1.794
	Italy x Similarly vs. France x Similarly*	0.683 (0.308)	1.082	1.979	3.620
	Germany x Worse vs. France x Worse	0.219 (0.287)	0.709	1.245	2.185
	Germany x Similarly vs. France x Similarly	0.521 (0.314)	0.910	1.683	3.113
Match Period x Goal Criticality:	1–15' x Critical vs. 76'–FT x Critical***	-4.690 (0.588)	0.003	0.009	0.029
	16–30' x Critical vs. 76'–FT x Critical***	-3.941 (0.364)	0.010	0.019	0.040
	31'–HT x Critical vs. 76'–FT x Critical***	-3.523 (0.315)	0.016	0.030	0.055
	46–60' x Critical vs. 76'–FT x Critical***	-2.830 (0.324)	0.031	0.059	0.111
	61–75' x Critical vs. 76'–FT x Critical***	-1.916 (0.336)	0.076	0.147	0.284
Numerical Relation x Team Quality:	Inferiority x Worse vs. Inferiority x Better	-0.365 (0.938)	0.110	0.694	4.362
	Inferiority x Similarly vs. Inferiority x Better	0.215 (1.210)	0.116	1.240	13.283
	Equality x Worse vs. Equality x Better	0.245 (0.718)	0.313	1.277	5.218
	Equality x Similarly vs. Equality x Better	0.746 (0.921)	0.347	2.109	12.818
Team Quality x Goal Criticality:	Worse x Critical vs. Worse x Non-critical	0.359 (0.224)	0.923	1.432	2.223
	Similarly x Critical vs. Similarly x Non-critical	0.326 (0.250)	0.849	1.386	2.263
	Win (reference: Loss)				
	Intercept***	3.872 (0.598)			
Country:	England vs. France	-0.014 (0.205)	0.660	0.986	1.473
	Spain vs. France	0.096 (0.228)	0.705	1.101	1.721
	Italy vs. France	0.012 (0.206)	0.676	1.012	1.515
	Germany vs. France	-0.296 (0.210)	0.493	0.744	1.121
Match Location:	Home vs. Away***	0.574 (0.136)	1.359	1.775	2.318
Match Period:	1–15' vs. 76'–FT**	1.407 (0.466)	1.639	4.085	10.183
	16–30' vs. 76'–FT***	0.789 (0.212)	1.453	2.201	3.332
	31'–HT vs. 76'–FT**	0.407 (0.152)	1.114	1.502	2.026
	46–60' vs. 76'–FT*	0.323 (0.146)	1.037	1.381	1.838
	61–75' vs. 76'–FT	0.157 (0.088)	0.894	1.170	1.531
Numerical Relation:	Inferiority vs. Superiority***	-2.713 (0.692)	0.017	0.066	0.258
	Equality vs. Superiority*	-1.392 (0.588)	0.079	0.249	0.788
Team Quality:	Worse vs. Better-ranked***	-2.949 (0.668)	0.014	0.052	0.194
	Similarly vs. Better-ranked	-1.298 (0.847)	0.052	0.273	1.437
Goal Criticality:	Critical vs. Non-critical***	0.953 (0.205)	1.736	2.594	3.877
Country x Match Location:	England x Home vs. France x Home*	-0.472 (0.190)	0.429	0.624	0.906
	Spain x Home vs. France x Home	0.283 (0.204)	0.889	1.327	1.980
	Italy x Home vs. France x Home	-0.240 (0.190)	0.542	0.787	1.143
	Germany x Home vs. France x Home	0.288 (0.198)	0.906	1.334	1.966
Country x Team Quality:	England x Worse vs. France x Worse**	0.650 (0.234)	1.210	1.915	3.031
	England x Similarly vs. France x Similarly	0.246 (0.258)	0.771	1.279	2.123
	Spain x Worse vs. France x Worse	-0.369 (0.261)	0.414	0.691	1.154
	Spain x Similarly vs. France x Similarly	-0.093 (0.284)	0.522	0.912	1.592
	Italy x Worse vs. France x Worse	-0.100 (0.235)	0.571	0.905	1.436
	Italy x Similarly vs. France x Similarly	0.160 (0.267)	0.695	1.173	1.981
	Germany x Worse vs. France x Worse	0.274 (0.245)	0.814	1.315	2.125
	Germany x Similarly vs. France x Similarly	0.012 (0.267)	0.600	1.012	1.707
Match Period x Goal Criticality:	1–15' x Critical vs. 76'–FT x Critical***	-2.754 (0.497)	0.024	0.064	0.168
	16–30' x Critical vs. 76'–FT x Critical***	-2.241 (0.274)	0.062	0.106	0.182
	31'–HT x Critical vs. 76'–FT x Critical***	-1.957 (0.213)	0.090	0.141	0.222
	46–60' x Critical vs. 76'–FT x Critical***	-1.633 (0.232)	0.124	0.195	0.308
	61–75' x Critical vs. 76'–FT x Critical***	-1.210 (0.235)	0.188	0.298	0.473
Numerical Relation x Team Quality:	Inferiority x Worse vs. Inferiority x Better	-0.484 (0.877)	0.110	0.616	3.441
	Inferiority x Similarly vs. Inferiority x Better	0.254 (1.065)	0.160	1.289	10.395
	Equality x Worse vs. Equality x Better	-0.498 (0.661)	0.166	0.608	2.220
	Equality x Similarly vs. Equality x Better	-0.508 (0.837)	0.117	0.602	3.106
	Worse x Critical vs. Worse x Non-critical***	1.114 (0.158)	2.235	3.045	4.150

Team Quality x Goal Criticality:	Similarly x Critical vs. Similarly x Non-critical***	0.620 (0.175)	1.319	1.860	2.622

Model $\chi^2(76) = 3159.910$, $p \leq 0.001$. Pseudo $R^2 = 0.2$ (Cox & Snell), 0.320 (Nagelkerke), 0.174 (McFadden)
Note: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

In both models, the predicted values exhibited no statistically significant differences compared to the observed values (men: Pearson = 0.315, Deviance = 0.878; women: Pearson = 0.253, Deviance = 0.993), indicating a good model fit. Based on the Nagelkerke's Pseudo R^2 values, the factors incorporated into the model elucidate 32% of the variability in match outcomes for men, whereas the factors encompassed within the women's model expound 49.1% of the same variability. These values denote robust coefficients of determination, ranging from decent to very decent.

Table 5. Parameter estimates for the multinomial logistic regression of *match outcome* as a function of situational factors in women's major European leagues (n = 5,122 goals).

Variables / Categories		*B* (SE)	95% CI for Odds Ratio		
			Lower	OR	Upper
Draw (reference: Loss)					
Intercept***		-16.687 (0.998)			
Country:	England vs. France	1.374 (0.848)	0.750	3.951	20.818
	Spain vs. France	0.537 (0.617)	0.510	1.710	5.733
	Italy vs. France	1.450 (0.840)	0.821	4.265	22.146
	Germany vs. France	-0.065 (0.686)	0.244	0.938	3.598
Match Location:	Home vs. Away***	15.475 (0.134)	4042044.1	5255254.1	6832606.4
Match Period:	1–15' vs. 76'–FT**	2.747 (0.868)	2.842	15.589	85.515
	16–30' vs. 76'–FT*	1.531 (0.682)	1.215	4.625	17.610
	31'–HT vs. 76'–FT***	1.945 (0.467)	2.800	6.991	17.458
	46–60' vs. 76'–FT*	1.047 (0.489)	1.094	2.905	7.425
	61–75' vs. 76'–FT*	1.067 (0.463)	1.172	2.905	7.201
Numerical Relation:	Inferiority vs. Superiority***	14.372 (1.007)	242281.25	1743890.0	12552156.9
	Equality vs. Superiority***	-1.542 (0.622)	949082.88	3692410.2	14365334.7
Team Quality:	Worse vs. Better-ranked***	-3.013 (0.797)	0.010	0.049	0.235
	Similarly vs. Better-ranked	-1.282 (0.731)	0.066	0.277	1.162
Goal Criticality:	Critical vs. Non-critical***	4.071 (0.572)	19.088	58.596	179.875
Country x Team Quality:	England x Worse vs. France x Worse	-0.315 (0.988)	0.105	0.730	5.061
	England x Similarly vs. France x Similarly	-0.462 (0.923)	0.103	0.630	3.847
	Spain x Worse vs. France x Worse	0.866 (0.751)	0.545	2.376	10.353
	Spain x Similarly vs. France x Similarly	-0.458 (0.696)	0.162	0.632	2.475
	Italy x Worse vs. France x Worse	-0.773 (0.964)	0.070	0.462	3.055
	Italy x Similarly vs. France x Similarly	-1.153 (0.917)	0.052	0.316	1.905
	Germany x Worse vs. France x Worse	0.825 (0.847)	0.433	2.281	12.009
	Germany x Similarly vs. France x Similarly	-0.044 (0.771)	0.211	0.957	4.341
Match Location x Numerical Relation:	Home x Inferiority vs. Home vs. Superiority***	-17.594 (1.365)	1.575E-9	2.286E-8	3.318E-7
	Home x Equality vs. Home x Superiority***	-14.963 (0.001)	3.173E-7	3.173E-7	3.173E-7
Match Period x Goal Criticality:	1–15' x Critical vs. 76'–FT x Critical***	-5.097 (0.922)	0.001	0.006	0.037
	16–30' x Critical vs. 76'–FT x Critical***	-3.937 (0.750)	0.004	0.020	0.085
	31'–HT x Critical vs. 76'–FT x Critical***	-4.039 (0.566)	0.006	0.018	0.053
	46–60' x Critical vs. 76'–FT x Critical***	-2.859 (0.589)	0.018	0.057	0.182
	61–75' x Critical vs. 76'–FT x Critical***	-2.434 (0.580)	0.028	0.088	0.273
Team Quality x Goal Criticality:	Worse x Critical vs. Worse x Non-critical	0.513 (0.493)	0.636	1.670	4.388
	Similarly x Critical vs. Similarly x Non-critical	0.653 (0.476)	0.755	1.921	4.887
Win (reference: Loss)					
Intercept***		5.862 (0.785)			
Country:	England vs. France	0.409 (0.737)	0.355	1.505	6.376
	Spain vs. France*	-1.099 (0.496)	0.126	0.333	0.880
	Italy vs. France	0.439 (0.736)	0.367	1.552	6.566
	Germany vs. France	-0.949 (0.539)	0.134	0.387	1.114
Match Location:	Home vs. Away	-0.236 (0.785)	0.169	0.790	3.681
Match Period:	1–15' vs. 76'–FT*	1.652 (0.716)	1.283	5.220	21.243
	16–30' vs. 76'–FT***	1.643 (0.391)	2.404	5.173	11.130
	31'–HT vs. 76'–FT**	0.861 (0.285)	1.352	2.365	4.136
	46–60' vs. 76'–FT*	0.603 (0.252)	1.115	1.827	2.995
	61–75' vs. 76'–FT	0.458 (0.236)	0.995	1.581	2.512
Numerical Relation:	Inferiority vs. Superiority***	-2.939 (0.899)	0.009	0.053	0.308
	Equality vs. Superiority*	-1.453 (0.606)	0.071	0.234	0.767
Team Quality:	Worse vs. Better-ranked***	-7.320 (0.598)	0.000	0.001	0.002
	Similarly vs. Better-ranked***	-3.698 (0.540)	0.009	0.025	0.071
Goal Criticality:	Critical vs. Non-critical	0.560 (0.422)	0.766	1.750	3.999
Country x Team Quality:	England x Worse vs. France x Worse	0.059 (0.844)	0.203	1.060	5.547
	England x Similarly vs. France x Similarly	-0.233 (0.791)	0.168	0.792	3.734

	Spain x Worse vs. France x Worse***	1.895 (0.592)	2.086	6.650	21.199
	Spain x Similarly vs. France x Similarly	0.803 (0.549)	0.762	2.233	6.548
	Italy x Worse vs. France x Worse	-0.754 (0.835)	0.092	0.471	2.417
	Italy x Similarly vs. France x Similarly	-0.502 (0.785)	0.130	0.605	2.818
	Germany x Worse vs. France x Worse*	1.381 (0.661)	1.089	3.981	14.554
	Germany x Similarly vs. France x Similarly	0.581 (0.595)	0.557	1.788	5.740
Match Location x Numerical Relation:	Home x Inferiority vs. Home vs. Superiority	-0.460 (1.183)	0.062	0.631	6.410
	Home x Equality vs. Home x Superiority	1.144 (0.793)	0.663	3.139	14.854
Match Period x Goal Criticality:	1–15' x Critical vs. 76'–FT x Critical***	-2.997 (0.775)	0.011	0.050	0.228
	16–30' x Critical vs. 76'–FT x Critical***	-3.197 (0.493)	0.016	0.041	0.108
	31'–HT x Critical vs. 76'–FT x Critical***	-2.266 (0.422)	0.045	0.104	0.237
	46–60' x Critical vs. 76'–FT x Critical***	-2.076 (0.410)	0.056	0.125	0.280
	61–75' x Critical vs. 76'–FT x Critical***	-1.334 (0.416)	0.117	0.263	0.596

Table 5. (continued)

Variables / Categories		*B* (SE)	95% CI for Odds Ratio		
			Lower	OR	Upper
Team Quality x Goal Criticality:	Worse x Critical vs. Worse x Non-critical***	2.099 (0.381)	3.863	8.157	17.221
	Similarly x Critical vs. Similarly x Non-critical***	1.176 (0.347)	1.642	3.243	6.403

Model $\chi^2(64) = 2357.603$, $p \leq 0.001$. Pseudo $R^2 = 0.369$ (Cox & Snell), 0.491 (Nagelkerke), 0.331 (McFadden)
Note: * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$.

Considering both models, all factors significantly impacted the *match outcome*. *Country* only influenced the *match outcome* in women's football. Teams in *Primera División Femenina* (Spain) displayed a decrease of 66.7% ($p = 0.027$) in the odds of scoring a goal that would lead to a win (vs. a loss), in comparison to teams in *Feminine Division 1* (France). The impact of *match location* on *match outcome* was significant in both models. In women, the odds of achieving a draw (vs. a loss) are remarkably higher when playing at home compared to away ($p < 0.001$). For men, the likelihood of scoring a goal leading to a win increases by 77.5% when playing at home ($p < 0.001$).

An analogous trend was observed across *sex* concerning the impact of *match period* on *match outcome*. The odds of achieving a draw (vs. a loss) increase significantly across all periods relative to the final one (76'–FT), with more pronounced effects observed during the earlier periods. Specifically, for men, the odds increase by 1552.8%, 682.9%, 457.2%, 262.8%, and 116.8% in the first, second, third, fourth (all $p < 0.001$), and fifth period ($p = 0.005$), respectively; for women, the probabilities increase by 1458.9%, 362.5%, 599.1%, 185%, and 190.5% in the first ($p = 0.002$), second ($p = 0.025$), third ($p < 0.001$), fourth ($p = 0.032$), and fifth period ($p = 0.021$), respectively. Moreover, for men, the odds of achieving a victory (vs. a loss) saw significant increases of 308.5%, 120.1%, 50.2%, and 38.1% with goals scored in the first ($p = 0.003$), second ($p < 0.001$), third ($p = 0.008$), and fourth period ($p = 0.027$), respectively, compared to goals scored in the final period. In women's leagues, the likelihood of winning increases by 422%, 417.3%, 136.5%, and 82.7% with goals scored in the first ($p = 0.021$), second ($p < 0.001$), third ($p = 0.003$), and fourth period ($p = 0.017$), respectively.

The *numerical relation* affected the *match outcome*, but comparing both sexes did not reveal equivalent findings. While men's teams showed a significant decrease in the probabilities of achieving a draw (vs. a loss) by 80.1% ($p = 0.031$) and 78.6% ($p = 0.013$) when goals are scored under numerical inferiority and equality, respectively, the chances of women's teams dramatically increase by approximately 174 million and 369 million percent ($p < 0.001$) in the same circumstances. In turn, the likelihood of a win (vs. a loss) for goals scored under numerical inferiority or equality, compared to superiority, significantly reduces by 93.4% ($p < 0.001$) and 78.6% ($p = 0.018$), respectively, for men, and declines by 94.7% ($p = 0.001$) and 76.6% ($p = 0.016$), respectively, for women.

In the Big-5 European leagues, *team quality* significantly influenced the *match outcome* in men's and women's matches. Worse-ranked teams had substantially reduced chances of achieving a draw or a win (vs. a loss) compared to better-ranked sides. For men, these odds lower by 82.9% ($p = 0.017$) and 94.8% ($p < 0.001$), while for women, the decreases are 95.1% and 99.9% (both $p < 0.001$), respectively. Furthermore, when similarly-ranked teams score a goal, the probability of achieving a victory (vs. a loss) decreases by 97.5% ($p < 0.001$) relative to better-ranked teams. For both men's and women's teams, scoring under critical conditions significantly increases the likelihood of a draw (vs. a loss) by 5789.7% and 5759.6% ($p < 0.001$), respectively, compared to non-critical conditions. Exclusively for men, the

odds of scoring a goal leading to a win (vs. a loss) increase by 159.4% ($p < 0.001$) under critical circumstances.

Despite these findings, it is important to acknowledge that some main effects might have been superseded by interaction terms within the models, thus requiring careful interpretation. The factor *country* significantly interacted with *match location* in the men's model and *team quality* in both models. Particularly, when competing in the *Premier League* (England) at home, securing a win (vs. a loss) through a goal was 37.6% ($p = 0.013$) less likely than when playing as hosts in *Ligue 1* (France). In *Serie A* (Italy) men's matches, similarly-ranked teams had a 97.9% higher chance ($p = 0.027$) of securing a draw (vs. a loss) compared to their French counterparts. Conversely, for worse-ranked English teams, the likelihood of a goal resulting in a win (vs. a loss) is 91.5% higher ($p = 0.006$) than their counterparts in *Ligue 1*. In women's leagues, weaker teams in Spain and Germany are 565% ($p = 0.001$) and 298.1% ($p = 0.037$) more likely, respectively, to score goals leading to a win compared to worse-ranked French teams.

The interaction between *match location* and *numerical relation* significantly predicted the *match outcome* in European women's leagues. In contrast to hosts competing in superiority situations, home teams are about 100% less likely to score a goal resulting in a draw, rather than a loss, when in numerical inferiority or equality ($p < 0.001$). The interaction between *match period* and *goal criticality* yielded significant results in both models. The likelihood of achieving a draw or a win (vs. a loss) following a critical goal shows a distinct reduction in all match periods (all $p \leq 0.001$) before the final one (76'–FT). For securing a draw in men's matches, noteworthy decreases of 99.1%, 98.1%, 97%, 94.1%, and 85.3% occurred from the first to the fifth period, respectively; women's matches presented similar declines: 99.4%, 98%, 98.2%, 94.3%, and 91.2%. In men, the likelihood of a goal leading to a win (vs. a loss) gradually diminishes from the first to the fifth period, decreasing by 93.6%, 89.4%, 85.9%, 80.5%, and 70.2%, respectively, compared to the last period. Women's matches displayed a non-linear decline in (negative) odds across periods: decreases of 95%, 95.9%, 89.6%, 87.5%, and 73.7%, respectively. These findings underscore the heightened importance of a critical goal in influencing a favourable match outcome as time progresses.

Incorporating the interaction *numerical relation* x *team quality* into the men's model did not significantly affect any pairwise comparison. Lastly, the models revealed significant interactions between *team quality* and *goal criticality* to predict the *match outcome*. In detail, for men's teams, both worse- and similarly-ranked groups displayed increased odds of achieving a win (vs. a loss) by approximately 204.5% and 86% (all $p < 0.001$), respectively, when a critical goal is scored instead of a non-critical one. Under the same scoring conditions, women's teams displayed even more prominent effects, with worse- and similarly-ranked teams experiencing approximately 715.7% and 324.3% higher odds of securing a win (all $p \leq 0.001$), respectively.

Discussion

In professional football analysis, a noticeable gap persists between studies focusing on men's and women's games (McFadden et al., 2020; Okholm Kryger et al., 2022). While some research has highlighted performance-related disparities across various competitions to discern success factors concerning *sex*, there remains a lack of comprehensive, multifaceted investigations for uncovering the nuanced subtleties of goal scoring in high-level football (Casal et al., 2021; Garnica-Caparrós & Memmert, 2021; Pappalardo et al., 2021). This study aimed to address this gap by examining both situational and sex-based effects on the *match outcome* in the Big-5 European football leagues.

The bivariate and multivariate statistical procedures employed in this study disclosed pivotal insights: (1) situational variables influence both men's and women's football, yet the extent of this influence varies between sexes; (2) goal-scoring periods, numerical relations, and *team quality* emerged as crucial factors impacting the *match outcome* in European professional football; (3) country-based differences predominantly shape match results in women's football; (4) a complex interplay of factors, including *match location*, *team quality*, and *goal criticality*, manifests in marked differences in influencing match outcomes, particularly striking in women's football; (5) irrespective of *sex*, the impact of critical goals on *match outcome* significantly intensifies throughout a match.

In line with previous research (Lago-Peñas et al., 2021; H. Liu et al., 2016; Sanfiz-Arias & López-Alonso, 2024; Sarmento et al., 2018), and regardless of *sex*, this piece provides additional evidence elucidating the impact of situational variables on performance and competitive outcomes in football. As we first expected, the multinomial regression model developed for women accounted for 49.1% of the variability in match outcomes, a value higher than the 32% explained by the men's model. This outcome, reminiscent of findings in younger football competitions (Almeida et al., 2022), implies that women may remain more susceptible to in-match contextual influences than their male counterparts in professional football. Despite impressive recent developments, the women's game is still in a technical and tactical evolution phase. On average, female players exhibit a less controlled team game, characterised by more divided and lost balls (i.e., transition moments), and a reliance on individual duels (Casal et al., 2021; Mitrotasios et al., 2022; Sørensen et al., 2022). Successful women's teams are also more dependent on a key star player, contrasting with men's lower centralisation and direct individual dependencies (De Jong et al., 2023). The perceived overall lower skill level is probably the underlying reason for the pronounced impact of situational variables on determining the *match outcome*.

On the other hand, women's football appears to be influenced to a greater extent by country-based differences, reflecting less standardised mechanisms of globalisation, professionalism and competitiveness compared to men's leagues (González-Rodenas et al., 2023; Okholm Kryger et al., 2022; Pappalardo et al., 2021). Whist Italian and German women's competitions seem to be more competitive than the French league, in men's football, it is the *Premier League* where contextual circumstances (i.e., *match location* and *team quality*) had a greater (positive) impact on goals leading to wins. This finding supports the differences previously detected across European football leagues regarding goal-scoring patterns (Leite, 2017; C. Li & Zhao, 2021) and other performance- and competitive-related outcomes (Fernandez-Navarro et al., 2018; Lago-Peñas, Gómez-Ruano, Megías-Navarro, et al., 2016; Pollard & Gómez, 2014).

The "home advantage effect" was attested as a contributing factor to the *match outcome* through bivariate analysis and across both multivariate models (Gómez-Ruano & Pollard, 2022; H. Liu et al., 2016; Pollard & Gómez, 2014). Host teams in the Big-5 European football leagues enjoy greater chances of converting goals into victories rather than draws or losses. Nevertheless, our analysis sustains the assertion that playing at home is more decisive in men's games (Casal et al., 2021). Men's teams showed a significantly higher likelihood of winning at home, an effect not affirmed in women's football where the probability of drawing (vs. losing) stood out. This observation could be attributed to variations in competitive balance within professional football. In essence, the higher the competitive balance, the higher the magnitude of home advantage (Pollard & Gómez, 2014).

Research has shown that *team quality* has a greater influence on *match outcome* than *match location*, with the latter playing a "plus value" role (Ibáñez et al., 2018; Lago-Peñas, Gómez-Ruano, Megías-Navarro, et al., 2016; T. Liu et al., 2021). The statistical analyses revealed that worse-ranked teams struggled to score goals, resulting in draws or wins less frequently than their better-ranked counterparts. These results align with the fact that high-level teams regularly demonstrate stronger defensive compactness and more proficient attacking actions (Freitas et al., 2023; González-Rodenas et al., 2023; Pratas et al., 2018). Interestingly, a large discrepancy between quality groups was found in women's leagues, warranting further investigation to thoroughly comprehend the roots of sex-based differences in competitive outcomes in professional football.

The football-related literature unanimously agrees on the detrimental effect a player's dismissal has on the balance of forces between opposing teams. On the one hand, it hampers the collective ability to create goal-scoring opportunities, and on the other hand, it compromises the defensive stability crucial for preventing goals (Casal et al., 2021; Lago-Peñas, Gómez-Ruano, Owen, et al., 2016; Y. Li et al., 2020; H. Liu et al., 2016). Our findings largely validate the negative impact of a red card on the sanctioned team's *match outcome*, exception for the likelihood of drawing in the women's model. This incongruence may be due to sampling issues, as red cards were uncommon in women's football, and most teams that received a red card ultimately lost the match. However, the likelihood of winning showed a comparable and significant decline for both sexes when a goal was scored under numerical inferiority. Therefore, ensuring an effective emotional and behavioural control is vital to prevent unnecessary player dismissals and enhance team success.

The available empirical evidence suggests a time-dependent nature in football goal scoring, with a greater number of goals scored in the last 15-min period plus added time (Pratas et al., 2018; Wunderlich et al., 2021). This temporal feature, mainly attributed to the onset of fatigue and the adoption of riskier attacking strategies to change the scoreline (González-Rodenas et al., 2021; Njororai, 2014; Pratas et al., 2018), has led researchers to designate the period 76'–FT as critical to the *match outcome* (Evangelos et al., 2018; Leite, 2017; Mićović et al., 2023; Njororai, 2014), a claim challenged by our findings. Firstly, despite confirming a late-phase goal surge, the chi-square test uncovered a non-significant association between *match period* and *match outcome*. Secondly, both regression models unveiled significantly heightened odds of goals resulting in a draw or a win throughout all 15-min intervals preceding the final one, with particularly pronounced values for goals scored within the initial 30 minutes. This finding is coincidental with previous studies that upheld that critical goals predominantly occur in early match periods (Almeida et al., 2022; Carmo et al., 2020). Thirdly, the extensively documented "scoring first effect" further supports our contention. Regardless of *match location* and *team quality*, teams scoring the opening goal win ~70% of matches in European men's leagues (Fernández-Cortés et al., 2022; Lago-Peñas, Gómez-Ruano, Megías-Navarro, et al., 2016; Martínez & García, 2019), and boosts the odds of winning in women's football (Ibáñez et al., 2018). Altogether, these points concur to contradict the plea that the final minutes are the most critical phase of the game.

Building upon the notion of "game criticality" (Ferreira et al., 2014), we examined how scoring under critical conditions led to identical probabilities of a draw for both sexes and significantly increased the odds of winning exclusively for men. However, given football's low-scoring disposition, the interaction *match period* x *goal criticality* in both models stresses the growing importance of a critical goal for achieving a draw or a win as the match progresses. When a critical goal is scored at the beginning of the match, its influence on the *match outcome* is less meaningful, as the conceding team has more time to equalise or mount a comeback (Lago-Peñas, Gómez-Ruano, Megías-Navarro, et al., 2016; T. Liu et al., 2021). Additionally, scoring a critical goal seems paramount for worse- and similarly-ranked teams, as it significantly enhances their chances of winning. When these teams score non-critical goals, it usually implies they are trailing and grappling to overcome a negative scoreline, a trend especially evident in European women's teams. As seen, inequalities in professionalism and competitive balance contribute not only to performance differences (González-Rodenas et al., 2023; Okholm Kryger et al., 2022; Pappalardo et al., 2021), but also impact competitive outcomes. Overall, enhanced competitiveness appears to correlate with an augmented impact of goals scored in critical conditions.

Limitations and future research directions

The current findings should be considered in light of certain limitations. First, sampling challenges arose in women's matches where a small proportion of goals occurred post-player dismissals. Second, the classification of 15-min periods, though widely adopted (Almeida et al., 2022; Evangelos et al., 2018; Mićović et al., 2023), may introduce methodological bias due to variations in added time. Third, notwithstanding the analysis of a large goal sample, our study only covered two consecutive seasons in the Big-5 European leagues. Generalising these findings to other seasons or competitions should be done cautiously, weighing up possible changes in goal-scoring event features over multiple seasons (Wunderlich et al., 2021).

Future research should expand the goal sample across multiple seasons and diverse competitions, including UEFA Champions League or FIFA World Cup, to mitigate sample-related issues and gain insights into evolving goal-scoring dynamics in elite men's and women's football. The explanatory power of regression models can be enhanced by encompassing performance-related statistics and considering variables like the *match situation* (open play, corner kick, direct/indirect free kick, throw-in, penalty kick). A comprehensive set of factors promises new explanations for the emergence of criticality in football.

Practical applications

Considering the insights gained from the study, professional football coaches can be advised on some actionable strategies:

- Include contextual scenarios in training for players to develop situational awareness and adaptability in diverse match conditions, regardless of *sex* (e.g., playing against a weaker side, under numerical inferiority, and losing by one goal).
- Consider league-specific factors and varied competitiveness in women's football to design tailored training programs, addressing specific contextual demands (e.g., playing away against a better-ranked opponent) to improve competitiveness.
- Acknowledge challenges of numerical inferiority (e.g., red cards) to prompt defensive stability, collective cohesion, and emotional control. Informed match decisions, including strategic substitutions, mitigate detrimental effects.
- Instil an offensive mindset, reinforcing the importance of scoring first for a positive match trajectory. Adopting a defensive playing style against superior opponents while exploiting mistakes/distractions through counterattacks or set plays can be effective.
- Stress the implications of critical goals in team discussions, especially towards the end of matches, to enhance a team's ability to manage high-pressure situations. Particularly for men, incorporating critical goal scenarios in practice may refine mental and tactical preparedness for late-phase decisive moments.

Conclusion

The purpose of this study was to analyse the impact of situational and sex-based factors on match outcomes across the Big-5 European football leagues. The findings shed light on subtle contextual influences that help explain what contributes to success in professional football. *Match location*, *match period*, *numerical relation*, *team quality*, and *goal criticality* all impact match outcomes, with some sex-specific variations. Women's match results, uniquely conditioned by country-based dynamics, exhibit a heightened susceptibility to the complex interplay of predictors in the regression model, confirming our expectations. Critical goals, frequently occurring early in matches, significantly influence match outcomes, gaining even greater importance as full-time approaches, especially in men's football. As the game evolves, adapting to these insights will elevate performance and inform strategic decisions for coaches, players, and stakeholders. Pursuing excellence in the game demands a continual embrace of situational awareness.

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