ORIGINAL ARTICLE

Home advantage in soccer: being invincible during home matches may be the reason

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Abstract

Introduction. Previous research has primarily focused on the concept of home advantage, examining the points or wins obtained during home matches. **Aim of Study.** The aim of this study was to analyze the various match outcomes (win, draw, loss) based on the match location (home vs away). **Material and Methods.** The data were collected from 10,785 matches that spanned six seasons of the top five European leagues (the first divisions of England, Spain, Italy, Germany, and France). The data were converted into percentages of wins, draws, and losses according to match location. Independent mean differences, with 95% confidence intervals (CI), were used to analyze the differences across all competitions and within each individual league. **Results.** The results revealed that teams won 38.17% of home matches, drew 25.67%, and lost 36.16% of home matches. Conversely, they won 26.64% of away matches, drew 25.36%, and lost 48.00% of away matches. No differences were found regarding draws between home and away matches. Nevertheless, there were differences in wins (11.53 [7.94, 15.12]) and losses (–11.84 [–15.22, –8.45]) with moderate effect sizes. The Italian and Spanish first divisions presented the smallest and largest differences, respectively, between home and away match outcomes. **Conclusions.** This study indicates that home advantage in the top five European leagues is primarily due to the reduction of defeats during home matches. Furthermore, an analysis of all three match outcomes (win, draw, loss) provides a more comprehensive understanding of the home advantage phenomenon.

KEYWORDS: competition, football, defeat, tie, victory.

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Introduction

The main objective of soccer (association football) is to win, which is achieved by scoring more goals than the opposition. However, the match outcome (i.e., the result) can also be a draw (tie) or a defeat (loss). While coaches try to develop strategies to win, matches are influenced by different contexts. One of these contexts refers to the home advantage, which argues that the team playing at their own stadium has an expected advantage to achieve a positive result [1]. When considering the number of points (three points for a win and one point for a draw) achieved at home [2], this advantage was shown across different continents. Additionally, the home advantage was also reported in women's soccer, even if with lower levels than in men's soccer [3].

Different hypotheses were previously discussed as justifications for this advantage. For instance, referees appear to present home bias [4, 5], although this argument has been disputed [6, 7]. In fact, it is difficult to classify the reason for a correct or incorrect decision of a referee, especially in subjective situations. Nevertheless, one of the justifications for a potential referee bias was attributed to the crowd pressure. Researchers have been evaluating this topic since the recent pandemic (COVID-19) when matches were played without the

presence of spectators. Indeed, during this period of crowd absence, both home advantage and referee bias diminished [8-11]. However, a study that interviewed elite and ex-elite referees shared their opinion that the reduction of home advantage is due to the improvement of referees' performance and quality [12]. Interestingly, soccer fans believe that they can positively affect their team and influence referee's decisions [13]. However, it is difficult to isolate contexts, because every match integrates different stadium attendances and different referee's performances.

Although, the home advantage appears to be decreasing in European soccer [14-16]. Moreover, most studies that investigated this topic focus on wins or points achieved at home, while soccer matches can have three different outcomes (win, draw, loss).

Aim of Study

The aim of this study was to compare match outcomes (win, draw, loss) considering the location (home or away), and to compare the difference on the previous variables for each season and for each league. We hypothesize that the outcomes would be better at home than away, and those differences would be attenuated during the seasons that were disputed throughout the COVID-19 pandemic.

Material and Methods

Data collection
Data were programmatically extracted from www. football-data.co.uk [17], using a custom Python script to automate the retrieval and merging of CSV files for each league and season. The script leveraged standard Python libraries (e.g., pandas, os, glob) to aggregate raw match statistics into a structured dataset, encompassing 10,785 matches involving 140 teams. Post-collection, data were cleaned and organized into three categories: league identification, team identification, and season identification. These teams were distributed as follows: 28 teams from the Premier League (England), 27 teams from La Liga (Spain), 30 teams from Serie A (Italy), 26 teams from the Bundesliga (Germany), and 29 teams from Ligue 1 (France). The dataset encompassed six seasons, from the 2018-2019 season to the 2023-2024 season. Data were organized into three categories: league identification, team identification, and season identification. As teams had outcomes for two different locations (home and away), data from each team were collected separately for home and away matches. Consequently, the data from 140 teams represented 280

sets of values for wins, draws and losses, reflecting the home and away scenarios. Finally, 196 matches were collected per season, during the seasons 2018-2019 to 2022-2023, and 192 matches during the 2023-2024 season (Ligue 1 reduced the number of teams from 20 to 18).

Statistical analysis
Means ± SD were calculated for the match outcomes (win, draw or loss) according to match location (home or away). Independent mean differences with 95% confidence intervals (95% CI) compared the different outcomes during home matches and away matches for all leagues and within each league. Cohen's d effect sizes were established as trivial (<0.2), small (0.2 < 0.6), moderate (0.6 < 1.2), large (1.2 < 2.0), very large (2.0 < 4.0) and extremely large (>4.0) with 95% CI. If the CI crossed zero, the effect size was considered unclear [18] ($p > 0.05$). All statistical analyses were performed using Microsoft Excel (Microsoft Corporation, Version 16.68) and Jamovi (with ESCI package) [19, 20].

Results

Means ± SD of the percentage of wins, draws and losses of the five leagues combined and of each league are presented in Table 1.

With teams winning more during home matches and losing more during away matches, moderate differences were found between outcomes; no differences were found regarding draws (Table 2 and Figure 1).

The differences previously reported were not equal across the top five leagues (Table 3). Specifically, although the effect sizes of draws were unclear in all leagues, Spanish teams lost more away matches (very large effect size) and Italian teams lost less away matches (small effect sizes) than the other leagues (plots of independent mean differences can be found in Figures S1-S5, Supplementary Materials). Finally, in Serie A (Italian first division), teams did not clearly win more during home matches than during away matches.

Regarding the differences between seasons, while the percentage of draws remained relatively stable across the seasons (around 25%), the number of wins decreased, and the number of losses increased during home matches across the 2020-2021 season (Figure 2). However, these differences were not equal to all leagues (Figures S6-S7, Supplementary Materials). Specifically, in the Premier League, there were no differences between home and away matches across the 2020-2022 seasons (unclear effect sizes) (Table S4, Supplementary Materials). In Serie A, the absence of differences was even longer, across the 2019-2022 seasons, for wins and draws

Table 1. Mean ± SD of the percentage of wins, draws and losses, according to the match location (home vs away)

|	Home			Away		
	Win (%)	Draw (%)	Loss (%)	Win (%)	Draw (%)	Loss (%)
All leagues (n = 140)	38.17 ± 15.92	25.67 ± 7.18	36.16 ± 14.45	26.64 ± 14.59	25.36 ± 6.80	48.00 ± 14.32
Premier League (n = 28)	39.46 ± 17.07	21.93 ± 7.01	38.62 ± 16.19	28.53 ± 14.78	21.50 ± 4.95	49.97 ± 15.00
La Liga (n = 27)	41.42 ± 13.73	28.53 ± 6.07	30.05 ± 9.16	25.20 ± 13.29	27.24 ± 5.13	47.56 ± 13.51
Serie A (n = 30)	34.59 ± 17.43	26.62 ± 6.26	38.79 ± 15.21	26.86 ± 15.86	26.09 ± 7.63	47.06 ± 15.19
Bundesliga (n = 26)	38.48 ± 16.77	24.40 ± 7.86	37.12 ± 17.22	25.13 ± 16.13	25.69 ± 6.00	49.18 ± 15.03
Ligue 1 (n = 29)	37.34 ± 14.47	26.77 ± 7.30	35.89 ± 12.33	27.29 ± 13.43	26.31 ± 8.29	46.40 ± 13.51

Note: n – number of teams

Table 2. Independent mean differences of match outcomes (percentage of wins, percentage of draws, and percentage of losses), according to the match location (home vs away)

n = 140	Independent mean differences (95% CI)	Cohen's effect sizes (95% CI)	p
Wins (%)	11.53 (7.94, 15.12)	0.75 (0.52, 1.00) – moderate	p < 0.001
Draws (%)	0.30 (–1.34, 1.95)	0.04 (–0.19, 0.28) – unclear	p = 0.716
Losses (%)	–11.84 (–15.22, –8.45)	–0.82 (–1.07, –0.58) – moderate	p < 0.001

Note: n – number of teams, CI – confidence interval
Negative values favor away matches.
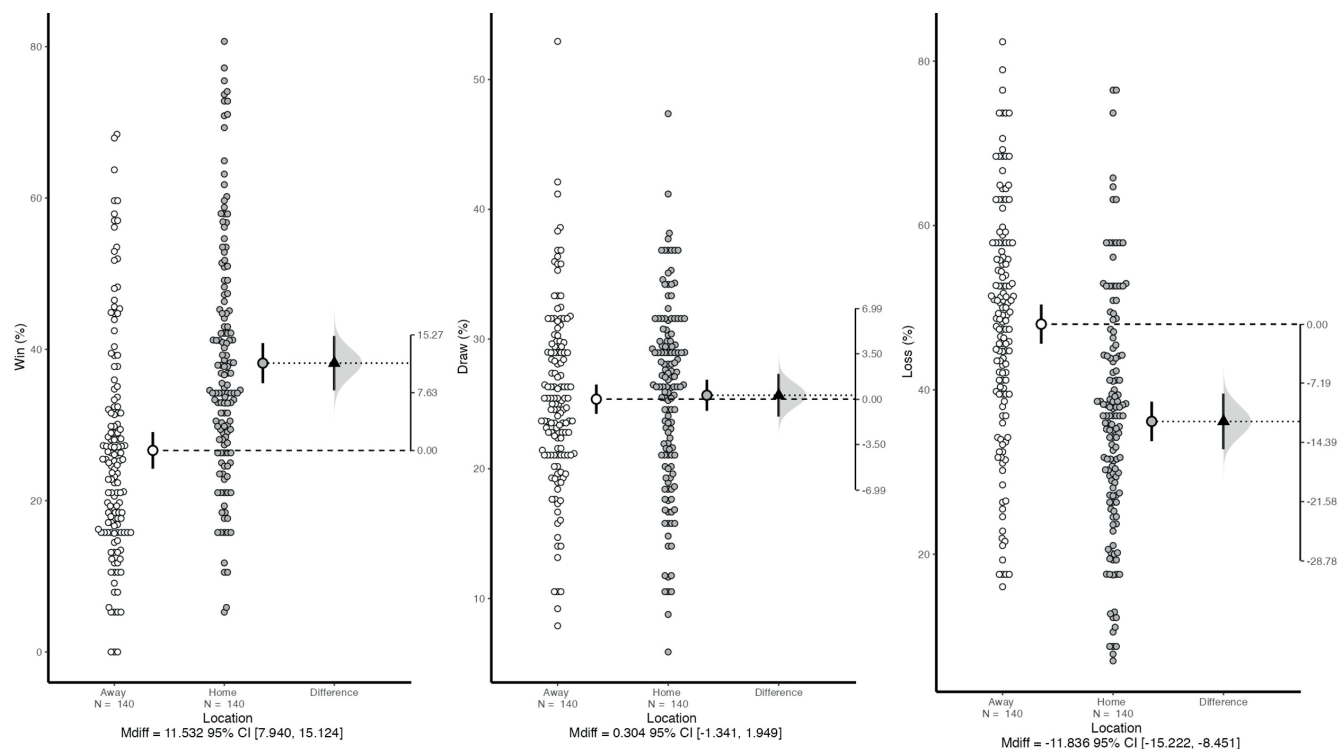
Figure 1. Independent mean differences (95% CI) of the percentage (%) of wins, draws and losses, according to the match location (home vs away)
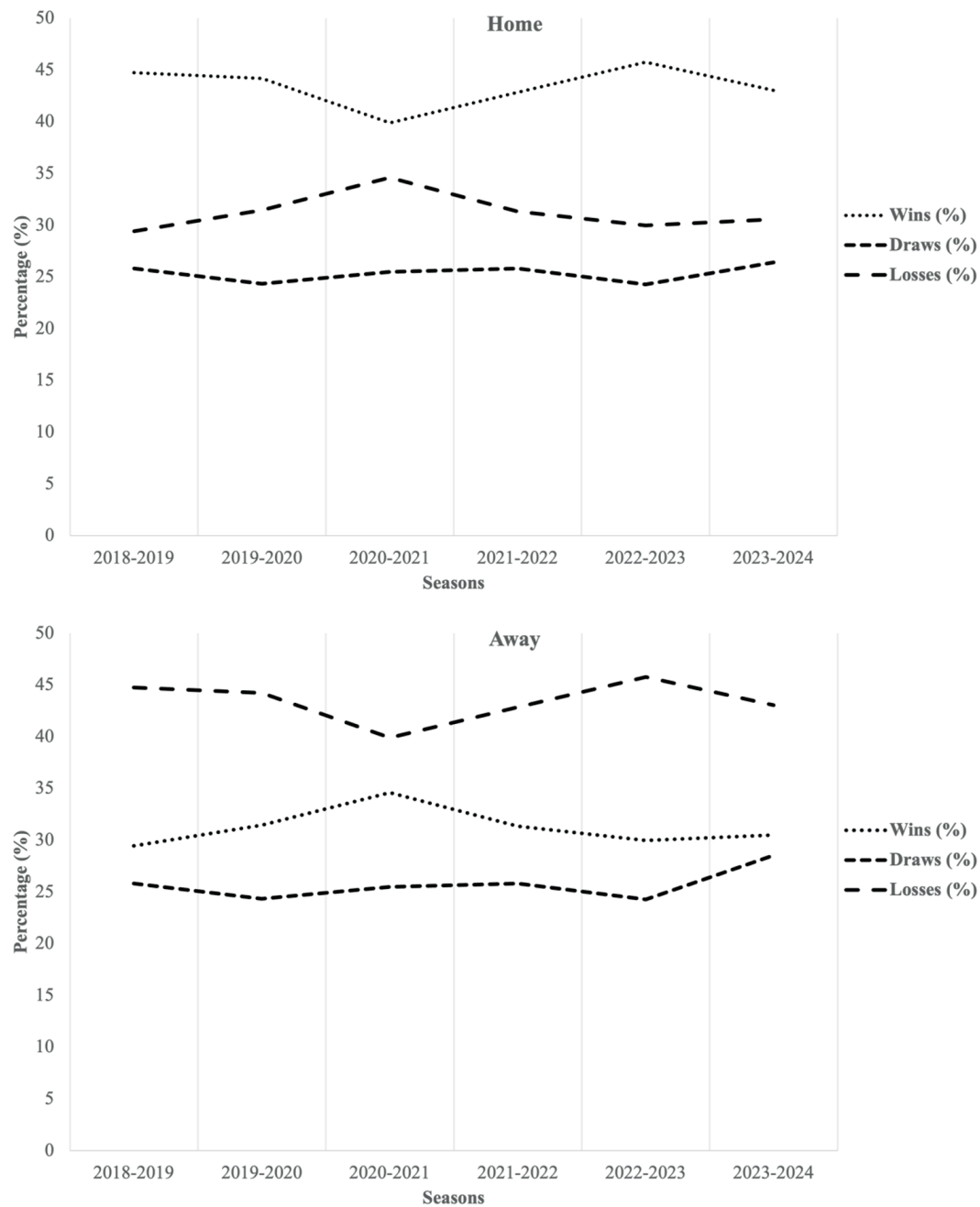
Figure 2. Percentage of wins, draws and losses during home matches and during away matches, during different seasons, considering all leagues

Table 3. Independent mean differences (95% CI) of match outcomes (percentage of wins, percentage of draws, and percentage of losses), according to the match location (home vs away) and per country

		IMD (95% CI)	Cohen's ES (95% CI)	p
	wins (%)	10.93 (2.37, 19.48)	0.67 (0.15, 1.25) – moderate	p = 0.013
ENG (n = 28)	draws (%)	0.43 (–2.82, 3.68)	0.07 (–0.46, 0.61) – unclear	p = 0.792
	losses (%)	–11.36 (–19.72, –3.00)	–0.72 (–1.30, –0.19) – moderate	p = 0.009

SPA (n = 27)	wins (%)	16.22 (8.84, 23.60)	1.18 (0.64, 1.83) – moderate	p < 0.001
	draws (%)	1.29 (–1.78, 4.36)	0.23 (–0.31, 0.78) – unclear	p = 0.403
	losses (%)	–17.51 (–23.82, –11.21)	–1.50 (–2.18, –0.94) – large	p < 0.001
ITA (n = 30)	wins (%)	7.73 (–0.84, 16.35)	0.46 (–0.05, 1.00) – unclear	p = 0.077
	draws (%)	0.54 (–3.07, 4.14)	0.08 (–0.44, 0.60) – unclear	p = 0.768
	losses (%)	–8.27 (–16.12, –0.41)	–0.54 (–1.08, –0.03) – small	p = 0.039
GER (n = 26)	wins (%)	13.34 (4.18, 22.51)	0.80 (0.25, 1.41) – moderate	p = 0.005
	draws (%)	–1.29 (–5.19, 2.60)	–0.18 (–0.75, 0.37) – unclear	p = 0.509
	losses (%)	–12.05 (–21.05, –3.05)	–0.73 (–1.34, –0.19) – moderate	p = 0.010
FRA (n = 29)	wins (%)	10.05 (2.71, 17.40)	0.71 (0.20, 1.28) – moderate	p = 0.008
	draws (%)	0.46 (–3.65, 4.57)	0.06 (–0.47, 0.59) – unclear	p = 0.824
	losses (%)	–10.51 (–17.32, –3.71)	–0.80 (–1.38, –0.29) – moderate	p = 0.003

Note: IMD – independent mean difference, CI – confidence interval, ES – effect size, ENG – England, SPA – Spain, ITA – Italy, GER – Germany, FRA – France, n – number of teams
Negative values favor away matches.

during the 2022-2023 season (Table S8, Supplementary Materials). In the Bundesliga, no differences were found across the 2019-2021 seasons (Table S10, Supplementary Materials). In Ligue 1, no differences were found between outcomes during the seasons of 2020-2021, 2022-2023, and 2023-2024 (Table S12, Supplementary Materials). Interestingly, there were moderate to large differences between the percentage of wins and losses when comparing home and away matches for all seasons (Table S6, Supplementary Materials).

Discussion

This study analyzed the home advantage across the five major leagues of European soccer (according to UEFA) during the last six seasons (from 2018-2019 to 2023-2024). Previously, home advantage was often assessed by the points gained from home matches, with values >50% indicating home advantage [1-3]. However, this point-based approach overlooks key differences, such as the distinction between winning one match out of three or drawing all three. In our study, we found that the main tendency was for teams to avoid defeats at home (Table 1), while nearly half of away matches resulted in losses (48%), supporting our hypothesis.

Different arguments, such as a potential referee bias [4, 5], or having more fans supporting the home team [21], have been discussed to justify the home advantage phenomenon. However, the team quality can be crucial to this topic. For example, one study [22] analyzed home advantage in the Brazilian first division by categorizing teams as high, medium, and low quality, finding a lower home advantage for low quality teams. While we did not categorize teams by quality, differences between teams are shown in Figure 1. Specifically, we can see that some teams win ~75% of the home matches, while others barely win in the same situation (~10%). These differences between teams can potentially be justified with the inclusion of relegated teams (teams that ended a specific season at the bottom of the tables), since lower divisions appear to benefit less from home advantage [23].

Beyond team differences, notable patterns emerged within each league. In Serie A, Italian teams had more away defeats than home losses (small effect), although wins were similar for both home and away matches. A similar trend was observed in La Liga, where away defeats were more frequent than wins. Interestingly, we found no differences between home and away matches regarding draws (Table 3). This novel finding can change how the home advantage is usually assessed. Additionally, this also highlights the reasoning of expecting different results when assessing different soccer leagues [2, 24].

Although previous studies reported that this advantage appeared to be decreasing [14-16], we found that teams playing at home still benefit from some advantage. To understand this evolution, we analyzed each season individually. Generally, during home matches, the percentage of draws remained consistent across seasons, while wins increased and losses decreased during the 2020-2021 season (Figure 2). Since the

recent COVID-19 pandemic led teams to compete in stadiums without fans, research highlighted a reduction on home advantage [25]. However, during this period, several changes occurred towards soccer competitions besides the presence of fans. For instance, the physical capacities and performances of players decreased after COVID-19 infections [25, 26]. Two important findings regarding the impact of the pandemic on the home advantage phenomenon need to be addressed: the range of values and league differences. First, the highest (45.76% in 2023-2024) and the lowest (39.91% in 2020-2021) percentage of wins showed a difference of less than 6%, indicating a small effect size and confirming the continued presence of home advantage, even at its lowest. Second, home advantage varied across leagues (Tables S3-S12, Supplementary Materials). For instance, Ligue 1 (2022-2023 and 2023-2024 seasons) showed no differences between home and away results. These findings suggest that other factors, beyond the COVID-19 pandemic, influence the home advantage. Overall, while the pandemic attenuated home advantage, this effect was not universal across leagues (Figures S6 and S7, Supplementary Materials), partly supporting our hypothesis.

The home advantage is a complex phenomenon influenced by various factors not assessed in this study. While numerous studies have proposed different explanations for the home advantage, no singular or decisive factor has been identified. While the presence of fans and referee bias appear to play a role, it would be interesting to extend the knowledge on players' confidence [27] and coaches' decisions [28].

Considering the multiple factors that influence home advantage, practitioners should focus on three key findings from this study. First, in all leagues and seasons analyzed, the sum of wins and draws at home always exceeded 60%, suggesting that teams generally avoid losses at home. This may lead coaches to adopt more dominant, offensive strategies at home [28]. Second, while the home advantage fluctuates across seasons, it does not show a consistent decline. For example, while some leagues showed changes during the COVID-19 pandemic, La Liga and Ligue 1 were exceptions. Finally, the percentage of wins and draws at home varied between 37% to 48% and 19% to 29%, respectively, meaning practitioners can use this data to assess opponents' home performance when playing away.

Conclusions

To conclude, although recent research has suggested a decrease of home advantage, we found that this concept is mostly due to avoiding defeats during home matches. Furthermore, within the five top European soccer leagues, the Italian and the Spanish first divisions presented the smallest and largest differences, respectively, between home and away outcomes. Instead of analyzing the home advantage solely through the lens of points or wins during home matches, considering all three match outcomes – wins, draws, and losses – provides a more comprehensive and insightful analysis of this important concept. This approach offers a deeper understanding of the home advantage phenomenon.

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Conflict of Interest
The authors declare no conflict of interest.

Supplementary Materials
Supplementary data to this article can be found online at: https://tss.awf.poznan.pl/SuppFile/204043/1/

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