The impact of home advantage on performance in UEFA Champions League matches

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Abstract:

Home field advantage is a common sports phenomenon, and more scholars focus their research on the home field advantage in football. This article takes 160 sets of technical and tactical data from 80 games in the three seasons of the UEFA Champions League from 2021 to 2024 as the research object and uses data statistical methods to conduct a comparative analysis of 18 technical and tactical indicators of the home and away teams in the event and discusses the impact of home advantage on performance in UEFA Champions League matches. The results show: (1) The winning probability of the home team in the UEFA Champions League in the 2021-2024 season is 61% and more than 50%, indicating home field advantage; (2) The performance of the home team in goal-related variables, offensive organization-related variables and defense-related variables is generally better than that of the away team; (3) Four indicators including two goal-related variables, goals and shot on target percentage, and two offensive organization-related variables, possession percentage and crosses, are significant variables that distinguish the performance of the home and away teams.

Keywords: Home advantage; UEFA Champions League; match performance; impact

1. Introduction

The study of home field advantage in sports competitions has always been a hot topic. It has great practical and theoretical significance for exploring the winning rules of competitive sports. The home field advantage is more obvious in team events, especially in football, which is the research focus of more scholars.

Home advantage refers to the advantage of the home team over the away team in a sports match. Koppet first coined the term "home field advantage" in 1972 as the idea that playing at home improves the home team's chances of winning. American psychologists Courneya and Carron(Courneya & Carron,1992) defined the term home field advantage as: "When the number of home and away games is the same, comparing the schedules of home and away games, it is unanimously found that the home team's winning percentage (HWP) exceeds 50%.". In football matches, home advantage also plays a large role. Studies have shown that home teams outperform away teams because of on-site fans cheering, familiarity with the venue, freedom from travel, players' psychological advantages, and referee bias. (Courneya & Carron, 1992; Carron, Loughhead & Bray, 2005; Pollard, 2008). Domestic and foreign scholars use different methods to analyze the home field advantage from the aspects of winning rate, number of on-site audiences, referee preference, and technical and tactical performance.

Xie Hongguang, Yin Xiaochuan, and others (Xie Hongguang & Yin Xiaochuan, 1998) studied the home field advantage based on technical statistics of The National Football Jia A League and found that The National Football Jia A League has home field advantage and has an important impact on the winning rate. The basic factors that cause the home field effect are the conditional effect of the home field, the competition effect, and the difference in psychological feelings of athletes between home and away games. Ma Hongyu (2001) analyzed the definition, evaluation, and causes of away field disadvantage based on previous research on home field advantage. The away court disadvantage can be effectively evaluated by the away/home losing percentage as base evaluation indicators, the

total losing percentage as reference indicators, and the average losing percentage differential as direct evaluation indicators. The study found that from 1994 to 1999, China's football league had obvious disadvantages on the away side, the possible reasons are travel/time difference, climate, stadium environment, stadium atmosphere, and psychology. Liu Hongyou et al. (2014) used discriminant analysis to screen and identify the indicators that best distinguish the performance of home and away teams in the Champions League, expanding the research perspective. Peng Zhaofang et al. (2016) analyzed the technical and tactical indicators of the Chinese Football Association Super League and verified the home field advantage. They also studied the significance indicators of the home field effect of teams of different strengths to provide theoretical reference and reference for different strength teams to implement technical tactics and strategies in home and away games. Shi Lei et al. (2017) validated the home field advantage by using three standards and identified technical indicators of the home field effect through discriminant analysis, providing a more rigorous perspective for a comprehensive understanding of the home field effect. Jin Chengji et al. (2020) identified the home field advantage of Chinese Football Association Super League teams by using home winning percentage and home winning margin. The study found that the key indicators affecting home winning percentage were the average number of shots per game, the number of goals from set pieces, the number of penalty goals, and the average number of goals conceded per game through t-tests and discriminant analysis. Xu Weiqiang et al. (2021) elected two seasons of English Premier League matches with and without spectators during the COVID-19 pandemic and analyzed the impact of audience absence on home advantage and referee bias. Han Zhe (2023) used logistic regression models and other methods based on the Page and Page's research methods to study the second-leg home advantage in the UEFA Champions League and Europa League. The study found that teams playing the second leg at home had a higher probability of advancing to the next stage, the away goals rule could suppress the second-leg home field advantage, extra time increased the second-leg home advantage effect, and the higher the event quality, the greater the probability of the second-leg home team advancing, making the second-leg home advantage more pronounced. Throughout the research progress of home field advantage, more and more scholars are inclined to quantitative analysis. Therefore, this study takes the UEFA Champions League (later referred to as the Champions League) as the research object and uses quantitative analysis methods to analyze home field advantage in the knockout stages of the UEFA Champions League. This study first examines the results of the game, records the outcomes by the number of points obtained (3 points for a win, 1 point for a draw, and 0 points for a loss), and counts the wins and losses of the Champions League. Secondly, this study uses the game location (home, away) as the dependent variable, and the team's game technical and tactical indicators as the independent variable. This study attempts to analyze the impact of home advantage in the UEFA Champions League on the team's technical and tactical performance. The team's game technical and tactical indicators include a total of 18 indicators. This study refers to relevant literature and divides all indicators into three groups: goal-related variables, offensive organization-related variables, and defense-related variables. (LagoPe.as et al., 2010; Lago-Pe.as & Lago-Ballesteros, 2011; Lago- Pe.as, Lago-Ballesteros & Rey, 2011;Castellano, Casamichana & Lago, 2012).

2. Research objects and research methods

2.1 Research object

The Champions League knockout round consists of 16 teams. Except for the final, it adopts a double-round knockout system. That is, there are 16+8+4=28 games in the double-round knockout round of the Champions League each season. This study includes all double-round knockout data in the two seasons from 2021 to 2023, as well as double-round match data in the 16-to-8 and 8-to-4 stages in 2024, with a total of 80 games and 160 sets of technical and tactical data. The data comes from the FbRef football statistics website, and the reliability and validity of the data have been tested and verified.

2.2 study variables

This study uses match location (home, away) as the dependent variable, and the team's match technical and tactical indicators as the independent variable. An attempt was made to analyze the impact of home advantage in the UEFA Champions League on the team's technical and tactical performance. The team's game technical and tactical indicators include a total of 18 indicators. This study refers to relevant literature and divides all indicators into three groups: goal-related variables, offensive organization-related variables, and defense-related variables. The

variable grouping results are shown in Table 1 below.

Table 1. Grouping of technical and tactical indicators of competition

variable group	indicators
Goal related variables	Goals scored, goals conceded, shots, shots on target, shot on target percentage
Offensive organization related variables	Possession percentage, Successful passes, Successful passes percentage, Cross, Long passes, Through ball, Offside, Corner kick
defense related variables	Tackle, Successful tackle percentage, fouls, Yellow cards, Red cards

2.3 Research methods

All 160 sets of data from 80 games were imported into JASP 0.18.3.0 for statistical analysis.

First, the outcomes of the game were statistically analyzed to examine home advantage in the Champions League.

Next, the technical and tactical performance in the Champions League was analyzed. The normal distribution test was carried out for each technical and tactical indicator. Since the number of samples was less than 2000, the W test (Shapiro-Wilk Test) was adopted. The test standard was: P>0.05, which was consistent with the normal distribution; P≤0.05, which was not consistent.

Subsequently, compare the mean values of various technical and tactical indicators of the home and away teams. The independent samples T-test was used for indicators that conformed to the normal distribution and the Mann-Whitney U test was used for the indicators that did not conform to the normal distribution. P<0.05 was defined as a significant difference.

Finally, the discriminant analysis was conducted on various technical and tactical indicators of the home and away teams. Through discriminant analysis, the discriminant function can be established for the technical and tactical indicators of the home and away teams, so that the relative contribution of each indicator to the discriminant function can be found. It is generally believed that indicators whose absolute value of the standard typical discriminant function coefficient is greater than 0.3 have a significant contribution to the composition of the discriminant function (Sampaio et al., 2004; Sampaio et al., 2006;Reilly, 2001).

3. Research results and analysis

3.1 UEFA Champions League home advantage analysis

To explore the home field advantage in the Champions League, this study calculated the winning and losing percentage of 80 games in the Champions League from 2021 to 2024 season. Research results are shown in Table 2. As can be seen from the table, when the number of home and away games is the same, the home team's winning percentage is 61% and more than 50%, so it can be considered that there is a home field advantage in the Champions League.

Table 2. The winning and losing percentage of 80 games

	Number of games	result		total
		win	lose	
Home	80	36 (61%)	23 (39%)	59
Away	80	23 (39%)	36 (61%)	59
total	160	59	59	128

3.2 Comparison of the average technical and tactical indicators of home and away teams

It can be seen from Table 3 that among the 18 game technical and tactical indicators, five indicators including possession percentage, number of completed passes, long passes, steal success percentage, and fouls conform to the

normal distribution.

Table 3. Normal distribution test (W test: Shapiro-Wilk Test) results for 18 technical and tactical indicators

variable group	indicator	Statistics	df	Sig.
Goal related variables	Goals	0.831	160	0.000**
	Goals conceded	0.831	160	0.000**
	Shots	0.979	160	0.016**
	Shots on target	0.951	160	0.000**
	Shots on target percentage	0.981	160	0.027*
Offensive organization related variables	Possession percentage	0.992	160	0.509
	Successful passes	0.991	160	0.384
	Successful passes percentage	0.941	160	0.000**
	Crosses	0.944	160	0.000**
	Long passes	0.989	160	0.226
	through ball	0.819	160	0.000**
	Offside	0.887	160	0.000**
	Corner kick	0.934	160	0.000**
defense related variables	Tackle	0.966	160	0.001**
	Successful tackle percentage	0.992	160	0.534
	fouls	0.983	160	0.054
	Yellow cards	0.929	160	0.000**
	Red cards	0.307	160	0.000**

*p<0.05 **p<0.01 *p>0.05Normal distribution

From the results in Table 4, we can see that there are significant differences between the home and away teams only in three indicators: shots (p=0.000), crosses (p=0.000), and corner kicks (p=0.002). There are no significant differences in the other 15 indicators. The home team is higher than the away team in 13 indicators including shots, possession percentage, successful passes, long passes, fouls, goal, shots on target, successful passes percentage, cross, through ball, offside and corner kick, and the five indicators of shot-on-target percentage, successful tackle percentage, goals conceded, tackle, yellow cards and red cards are lower than those of the away team, proving that the performance of the home team is generally better than that of the away team, which is similar to previous research results.

Table 4. Comparison of the mean technical and tactical indicators of home and away teams (mean ± standard deviation)

variable group	indicator	home team	away team	Sig.
Independent Sample T Test)				
Offensive organization related variables	Possession percentage	51.35%±11.338%	48.65%±11.338%	0.134
	Successful passes	461.81±143.739	433.45±134.342	0.199
	long passes	60.54±13.654	58.73±13.320	0.397
defense related variables	Successful tackle rate	61.65%±13.208%	60.06%±12.653%	0.439
	fouls	11.78±3.586	11.81±4.177	0.951
Mann-Whitney U test (Mann-Whitney UT est)				
Goal related variables	Goals	86.86	74.14	0.071
	Goals conceded	74.14	86.86	0.071
	Shots	93.44	67.56	0.000**
	Shots on target	85.95	75.05	0.134
	Shots on target percentage	76.94	84.06	0.331
Offensive organization related variables	Successful passes rate	82.79	78.21	0.530
	Cross	93.36	67.64	0.000**
	Through ball	82.19	78.81	0.630
	Offside	81.83	79.17	0.710
	Corner kick	91.93	69.07	0.002**
defense related variables	Tackle	79.44	81.56	0.710
	Yellow cards	75.88	85.12	0.195
	Red cards	80.04	80.96	0.792

*p<0.05 **p<0.01

3.3 Discriminant analysis of technical and tactical indicators of home and away teams

As shown in Table 5, the discriminant function composed of 18 game technical and tactical indicators can effectively distinguish the game performance characteristics of home and away teams. The indicators that contribute significantly to the composition of the discriminant function include two goal-related variables: goals (0.483) and shots on target percentage (-0.507); and two variables related to offensive organization variables: possession percentage (-0.489) and crosses (0.788).

Table 5. Discriminant analysis results of technical and tactical indicators for home and away teams

variable group	indicators	Function
		1
Goal related variables	Goals	0.483[*]
	Goals conceded	-0.259
	Shots	0.150
	Shots on target	0.289
	Shots on target percentage	-0.507[*]

Offensive organization related variables	Possession percentage	-0.489[*]
	Successful passes	-0.115
	Successful passes rate	-0.010
	Cross	0.788[*]
	Long passes	0.023
	Through ball	0.025
	Offside	0.149
	Corner kick	0.040
defense related variables	Tackle	-0.214
	Successful tackle percentage	0.157
	fouls	-0.071
	Yellow cards	-0.226
	Red cards	0.173
Eigenvalue		0.191
Wilks'Lambda		0.840
Canonical Correlation		0.400
Chi-square		26.048
DF		18
Sig.		0.099
% of Variance		100.0
Classification Results(%)		55.6

*|SCDFC|≥0.300

4. Conclusion and discussion

The study found that the home team of the games of UEFA Champions League had a higher winning rate in the three seasons from 2021 to 2024, and the phenomenon of home court advantage has emerged. Over the course of three seasons, home field advantage has been clear. The performance of home teams in goal-related variables, offensive organization-related variables, and defense-related variables is generally better than that of away teams. Through discriminant analysis, this study found that the four indicators of goals, shot on target rate, possession percentage, and crosses are significant variables that distinguish the performance of home and away teams.

Future studies can have a deeper understanding of the characteristics of home and away performance by using a larger sample size, taking into account the strength of the team itself, the strength of the opponent, weather conditions, schedule, and other factors.

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