

Original Research

Goal-Scoring Patterns and Their Association with Final League Ranking in South American Professional Football

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Abstract: This study aimed to compare goal-scoring patterns and their association with final league ranking across the five strongest men's professional football leagues affiliated with CONMEBOL during the 2022 season. A total of 96 teams from Brazil's Série A, Argentina's Primera División, Paraguay's Primera División, Colombia's Liga BetPlay Dimayor, and Ecuador's Serie A were analysed. Data were obtained from the BeSoccer and IFFHS databases, considering only regular-season matches and excluding play-off phases, domestic cups, and international competitions to ensure comparability. Goals were analysed across six 15-minute match intervals (0-15, 16-30, 31-45+, 46-60, 61-75, and 76-90+ minutes) using multivariate analysis of variance, orthogonal canonical contrasts, and exploratory principal component analysis. Multiple linear regression models were also performed to examine the association between goal distribution and final league ranking. Significant differences in goal distribution were identified between leagues, particularly from the second to the sixth time intervals. Paraguay exhibited higher goal frequency in the final stages of matches, whereas Brazil reached its peak in the third interval. Across all leagues, a greater number of goals was consistently observed in the second half. Regression analyses indicated that goal distribution across match periods was associated with final league ranking (R^2 range: 0.677-0.834); however, the contribution of specific time intervals varied between leagues. In some cases, such as late-match scoring in Paraguay, these patterns were not significantly associated with competitive outcomes. These findings suggest that goal-scoring patterns differ between South American competitions and may be influenced by temporal and contextual factors. The results provide practical insights for coaches and performance analysts, supporting the design of training strategies and tactical approaches adapted to league-specific goal-scoring dynamics.

Keywords: soccer; performance analysis; South American football; goal-scoring patterns; league ranking



1. Introduction

The fundamental object of football is to score more goals than the opponent in order to secure victory (Sánchez-Flores et al., 2016). Match outcomes determine the number of points accumulated by each team, which ultimately defines their final position in the league table. Points awarded for wins and draws are standardised by the Fédération Internationale Football Association (FIFA, 2022) across federated competitions. Consequently, both goals scored and goals conceded play a central role in determining team performance.

Although scoring is the principal determinant of match outcomes in football, its occurrence is relatively low (≈ 2.5 goals per match) compared with other team sports (Sánchez-Flores et al., 2016). This low frequency increases the impact of each scoring event on competitive performance. Numerous studies have demonstrated that variables such as scoring the first goal, match location, and the timing of goals significantly influence the likelihood of winning (Junior, 2015; Molinuevo & Bermejo, 2012; Sánchez-Flores et al., 2016). In addition, performance indicators such as shot efficiency (goals per shot), shots on target, ball possession, passing accuracy, opponent quality, and match context have been identified as key contributors to goal-scoring and match success (Lepschy et al., 2021).

Most existing research has focused on FIFA World Cup tournaments (Castellano et al., 2012; dos Santos et al., 2022) or on the “Big Five” European leagues (González-García & Martínez-Martínez, 2019; Gonzalez-Rodenas et al., 2020; Li & Zhao,

2021; Martínez & García, 2019). Additionally, studies have examined specific national competitions such as La Liga (Aguado-Méndez et al., 2020; González-Rodenas et al., 2019; Lago-Peñas et al., 2010; Sánchez-Flores et al., 2016), the Norwegian league (Tenga et al., 2010), the Greek league (Stafylidis et al., 2024), and the English Premier League (González-Rodenas et al., 2020). Overall, the literature has predominantly concentrated on European football, particularly UEFA’s top five leagues (Otero-Saborido et al., 2021).

This geographical concentration highlights the need to better understand goal-scoring patterns in other regions, including South America, Africa, Asia, North and Central America, and Oceania, and across their respective confederations (CONMEBOL, CAF, AFC, CONCACAF, and OFC). These regions collectively comprise 135 countries, approximately 128,694 professional players, and 3,986 clubs (FIFA, 2023). Despite South America’s strong football tradition, talent development, and international competitiveness, it remains comparatively underrepresented in scientific research.

Furthermore, South American leagues differ from European competitions in terms of tournament structure, number of teams, and competitive dynamics, which may lead to distinct goal-scoring patterns and performance outcomes. For example, Brazil’s Série A was ranked as the strongest league worldwide in both 2021 and 2022 according to the International Federation of Football History and Statistics (IFFHS, 2022, 2023), highlighting the competitive level of CONMEBOL competitions.

For 2022, the IFFHS identified the five strongest South American leagues as: Brazil's Série A, Argentina's Primera División, Paraguay's Primera División, Ecuador's Serie A, and Colombia's Liga BetPlay Dimayor (IFFHS, 2023). League strength is primarily determined by the performance of top-ranked teams and their results in international competitions. However, despite these rankings, there is still limited empirical evidence regarding the temporal distribution of goals and their association with final league ranking in South American competitions.

Therefore, there is a clear need to provide empirical evidence on the temporal distribution of goals in CONMEBOL leagues and to examine their relationship with competitive outcomes. Such knowledge may contribute to a better understanding of performance dynamics and support decision-making processes for coaches, analysts, and practitioners in professional football (Junior, 2015).

Based on these considerations, it was hypothesised that goal-scoring patterns would differ between South American leagues due to variations in competition format, match intensity, and team tactical approaches.

Accordingly, the aim of this study was to compare the number and timing of goals in the five strongest South American leagues (Brazil, Argentina, Colombia, Paraguay, and Ecuador) during the 2022 season and to examine their association with the final league ranking in each championship. This study provides a novel contribution by extending the analysis of goal-scoring patterns beyond European contexts and

offering insights applicable to performance analysis, tactical planning, and training design in professional football.

2. Materials and Methods

The sample comprised the five highest-ranked South American first-division leagues in 2022, as defined by the International Federation of Football History and Statistics (IFFHS) (Table 1). In total, data from 96 teams (Appendix 1) were included, covering Brazil's Série A, Argentina's Primera División, Paraguay's Primera División, Colombia's Liga BetPlay Dimayor, and Ecuador's Serie A.

To ensure comparability across competitions with different formats, only regular-season matches were considered. Final phases involving play-offs (e.g., semi-finals or finals, as in Colombia, Paraguay, and Ecuador), domestic cup competitions (e.g., national cups involving first- and second-division clubs), and international tournaments (e.g., Copa Libertadores and Copa Sudamericana) were excluded. This standardisation enabled all leagues to be analysed under comparable competitive conditions by restricting the analysis to the regular season, thereby reducing structural differences derived from play-off systems and tournament formats.

This study followed an observational, comparative, and retrospective design aimed at characterising goal-scoring patterns and their association with final league ranking across the five strongest men's professional football leagues affiliated with CONMEBOL.

Table 1. Number of leagues, matches, and goals analysed in 2022

Position (points)	League	Teams	Matches	Goals	Goals/match
1 (1406)	Brazil (Brasileirão Serie A)	20	380	905	≈ 2.38
2 (770.5)	Argentina (Campeonato de Primera División)	28	378	826	≈ 2.19
3 (630.5)	Paraguay (Primera División)	12	264	659	≈ 2.50
4 (723.5)	Colombia (Apertura & Clausura)	20	400	903	≈ 2.12
5 (630.5)	Ecuador (Serie A)	16	240	586	≈ 2.44
Total (n)	5	96	1662	3879	≈ 2.33

Note: Points, matches, and goals were calculated based exclusively on the regular season. Final stages of domestic competitions (e.g., play-offs, semi-finals, and finals) were excluded to ensure comparability and standardisation across leagues.

The study considered several key variables related to match performance and league outcomes. The main variable, goals, represented the total number of goals scored in each match, disaggregated by team and across six 15-minute intervals (0–15, 16–30, 31–45+, 46–60, 61–75, and 76–90+). For analytical purposes, these values were aggregated to obtain the average goal frequency per team within each time interval.

The dependent variable, *final league ranking*, referred to the final position of each team at the end of the regular season. Match duration was defined as two halves of 45 minutes each, plus stoppage time. Temporal analysis was conducted using standardised 15-minute intervals, allowing the examination of goal distribution patterns throughout the match.

The unit of analysis varied according to the statistical procedure. For descriptive analyses and multivariate analysis of variance (MANOVA), data were aggregated at the league level using mean goal values per time interval. For regression analyses, the unit of analysis was the team. Goal-scoring variables were standardised as goals

per match and expressed as average values for each team across the regular season.

Final league ranking was then modelled as a function of these team-level goal-scoring indicators. This distinction ensured consistency between the research objective (inter-league comparison) and the analytical approach.

Data were extracted from the BeSoccer-Pro Football DB platform (<https://es.besoccer.com/competicion/clasificacion/primera-division-argentina/2022>), recognised as one of the most comprehensive football databases in the Spanish language, containing records of over 190,000 teams and 40,000 competitions worldwide, as well as more than 100 player attributes (e.g., speed, passing, acceleration, endurance, shooting, weight) (Delgado, 2020). This platform has been previously employed in academic studies on football performance and tactical analysis, supporting its validity as a reliable resource for scientific research (Delgado, 2020; Otero-Saborido et al., 2021). BeSoccer is supported by 30 partner teams at both national and international levels.

To ensure data reliability, records were independently extracted twice per week

(Tuesdays and Wednesdays), with approximately 35 match records per day over a four-month period, by two researchers, and subsequently verified by a third reviewer, following established quality control procedures. In addition, all data were cross-checked against official classifications published by the IFFHS to ensure consistency across sources. Final league classifications were obtained from the IFFHS database.

A descriptive-comparative analytical approach was applied. Six 15-minute intervals were evaluated in relation to the number of goals scored in each league (Argentina, Brazil, Colombia, Ecuador, and Paraguay).

A MANOVA with orthogonal canonical contrasts was conducted within the framework of the General Linear Model to identify differences between leagues across all time intervals. Additionally, an exploratory principal component analysis (PCA) with biplot representation was used to identify patterns, similarities, and relationships between leagues and time intervals. Finally, multiple linear regression models were performed separately for each country, in which the dependent variable was the final league ranking and the independent variables were the average number of goals scored in each of the six 15-minute intervals. The coefficient of determination (R^2), standard error, and confidence intervals were estimated for all regression coefficients to improve the

interpretability and robustness of the estimates.

Both the multivariate analysis of variance and the multiple linear regression models were based on the complete dataset corresponding to each professional football league season. Each regression model included all teams from the corresponding league ($N = 12\text{--}28$ teams, depending on the competition) and assumed a conventional significance level ($\alpha = 0.05$). All statistical analyses were conducted using SAS University Edition and Python.

3. Results

The unidimensional descriptive analysis revealed distinct goal-scoring patterns across the professional leagues analysed (Table 2). In the first (P1) and second (P2) intervals, Paraguay registered the highest average number of goals, whereas Brazil exhibited the highest goal frequency in the third interval (P3). In the later stages of the match (P4, P5, and P6), Paraguay consistently showed the highest goal averages, particularly in P6 (1.06 ± 0.35), reflecting a marked increase in goal-scoring frequency during the final minutes of play. Across all leagues, the second half of matches was more productive than the first half, with higher average goal values observed consistently across competitions (Table 2). Variability between leagues was also evident across all intervals, as indicated by the corresponding standard deviations.

Table 2. Descriptive analysis (mean $\pm$ SD) of goals scored per time interval

Period	Argentina	Brazil	Colombia	Ecuador	Paraguay
P1	0.32 $\pm$ 0.13	0.29 $\pm$ 0.14	0.30 $\pm$ 0.12	0.29 $\pm$ 0.16	0.38 $\pm$ 0.17
P2	0.34 $\pm$ 0.19	0.34 $\pm$ 0.13	0.29 $\pm$ 0.11	0.30 $\pm$ 0.10	0.45 $\pm$ 0.13
P3	0.39 $\pm$ 0.18	0.46 $\pm$ 0.15	0.45 $\pm$ 0.16	0.47 $\pm$ 0.17	0.36 $\pm$ 0.14
P4	0.35 $\pm$ 0.14	0.35 $\pm$ 0.13	0.33 $\pm$ 0.11	0.35 $\pm$ 0.17	0.43 $\pm$ 0.21
P5	0.33 $\pm$ 0.17	0.36 $\pm$ 0.14	0.36 $\pm$ 0.16	0.41 $\pm$ 0.19	0.62 $\pm$ 0.17
P6	0.43 $\pm$ 0.18	0.55 $\pm$ 0.17	0.51 $\pm$ 0.16	0.60 $\pm$ 0.26	1.06 $\pm$ 0.35
1st Half	1.05 $\pm$ 0.29	1.10 $\pm$ 0.34	1.05 $\pm$ 0.21	1.07 $\pm$ 0.29	1.06 $\pm$ 0.35
2nd Half	1.12 $\pm$ 0.31	1.27 $\pm$ 0.32	1.20 $\pm$ 0.29	1.36 $\pm$ 0.40	1.43 $\pm$ 0.41
Total	2.18 $\pm$ 0.45	2.38 $\pm$ 0.55	2.25 $\pm$ 0.39	2.44 $\pm$ 0.62	2.49 $\pm$ 0.79

Figure 1 illustrates goal-scoring trends across the six match periods (P1–P6). These visual patterns are consistent with the statistically significant inter-league differences identified by the MANOVA (Table 3), particularly in the later match periods (P5–P6). Paraguay demonstrates a clear increase in goal frequency in the final stages (P5 and P6), whereas Brazil reaches its peak in P3. Overall, all leagues exhibit a consistent pattern of increased goal-scoring in the second half compared with the first half.

A MANOVA including all time intervals simultaneously revealed statistically significant differences between leagues (Wilks' Lambda = 0.068, $F(36, 312) = 9.11$; $p < 0.0001$; Pillai's Trace = 1.099, $F(36,$

344) = 3.62, $p < 0.0001$; Hotelling-Lawley Trace = 11.31, $F(36, 214) = 25.7$, $p < 0.0001$; Roy's Greatest Root = 11.10; $F(9, 86) = 106.1$, $p < 0.0001$). The orthogonal canonical contrast indicated that Paraguay differed significantly from the other leagues whereas Brazil and Colombia did not differ significantly. Argentina showed the lowest goal-related values across most intervals. No statistically significant differences were observed in P1; however, differences emerged from P2 onwards, particularly in the later match periods (P5 and P6). The large effect size (partial eta squared, $\eta^2p = 0.9319$) indicates that a substantial proportion of variance in goal-scoring variables was associated with league differences within the model (Table 3).

Table 3. Comparative analysis of variance (MANOVA and canonical contrast)

Period	Argentina	Brazil	Colombia	Ecuador	Paraguay
P1	a	a	a	a	a
P2	ab	ab	b	b	a
P3	a	a	a	a	a
P4	a	a	a	a	a
P5	b	b	b	b	a
P6	b	b	b	b	a
1st Half	a	a	a	a	a

2nd Half	c	b	b	a	a
Total	c	b	b	a	a
Multivariate Analysis of Variance (MANOVA)					
Test	Value	Num DF	Den DF	F-value	p-value
Wilks' Lambda	0.068	36	312	9.11	<0.0001
Pillai's Trace	1.099	36	344	3.62	<0.0001
Hotelling-Lawley Trace	11.31	36	214	25.7	<0.0001
Roy's Greatest Root	11.10	9	86	106.1	<0.0001
Orthogonal canonical contrast					
League	Comparative letter				
Argentina	d				
Brazil	c				
Colombia	c				
Ecuador	b				
Paraguay	a				
Partial Eta Square (η^2_p)	0.9319				
Test Power	0.9999				

Notes: P = Period; different letters indicate statistically significant differences ($p < 0.05$)

Multiple linear regression analysis indicated that goal-scoring variables were strongly associated with final league ranking (Table 4). In Argentina, periods P1, P4, and P5 showed statistically significant associations with team ranking. In Brazil, only P1 was significant, whereas in Colombia, periods P2, P3, and P6 were significantly associated with ranking. In Ecuador, only P4 reached statistical significance, and in Paraguay, no time intervals showed statistically significant associations, suggesting a more homogeneous distribution of goals across match periods in this league.

The proportion of variance in final league ranking accounted for by the regression models was high across all leagues ($R^2 = 0.677$ – 0.834), with Brazil ($R^2 = 0.834$) and Colombia ($R^2 = 0.833$) showing

the strongest associations, followed by Ecuador ($R^2 = 0.782$) and Paraguay ($R^2 = 0.768$). These findings indicate that goal distribution across match periods was strongly associated with final league ranking; however, the strength and significance of specific time intervals varied between leagues. Negative regression coefficients indicate that higher goal values were associated with better league positions (i.e., lower numerical ranking values).

Importantly, the relationship between descriptive goal-scoring patterns and regression results was not uniform. For example, although Paraguay exhibited the highest goal frequency in the final match periods (P5–P6), these intervals were not significantly associated with final league ranking, suggesting that elevated late-

match scoring does not necessarily translate into improved competitive outcomes.

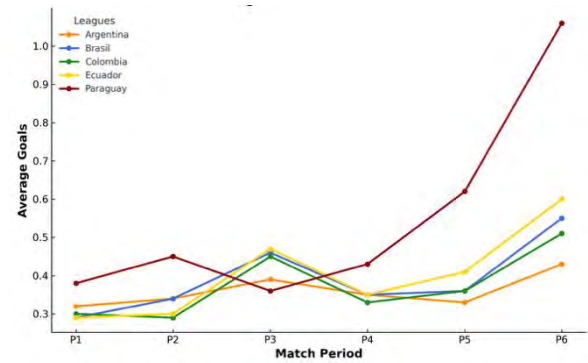


Figure 1. Goal-Scoring Trends Across Match Periods

Table 4. Multiple Regression Analysis by Country

Variable	Argentina β (SE) [95% CI]	Brazil β (SE) [95% CI]	Colombia β (SE) [95% CI]	Ecuador β (SE) [95% CI]	Paraguay β (SE) [95% CI]
Intercept	46.32 (5.45)*** [35.64, 57.01]	31.06 (3.09)*** [25.00, 37.13]	42.47 (4.85)*** [32.96, 51.97]	25.06 (3.38)*** [18.43, 31.70]	17.84 (4.45)* [9.11, 26.56]
P1	-23.19 (7.44)* [-37.78, -8.60]	-22.59 (6.06)** [-34.48, -10.70]	-8.76 (5.59) [-19.71, 2.19]	-7.23 (4.96) [-16.95, 2.48]	12.18 (27.28) [-41.29, 65.65]
P2	-11.30 (5.54) [-22.15, -0.44]	-11.53 (6.47) [-24.21, 1.15]	-14.72 (6.75)* [-27.95, -1.50]	-10.87 (7.84) [-26.23, 4.48]	9.01 (25.69) [-41.35, 59.37]
P3	-9.25 (5.93) [-20.86, 2.36]	2.15 (5.70) [-9.01, 13.32]	-20.87 (4.63)*** [-29.95, -11.80]	-6.57 (5.19) [-16.75, 3.59]	3.43 (8.48) [-13.18, 20.04]
P4	-23.69 (7.44)** [-38.28, -9.10]	-10.80 (5.78) [-22.13, 0.53]	-12.12 (6.66) [-25.17, 0.91]	-15.26 (4.97)* [-25.00, -5.53]	-3.34 (9.36) [-21.69, 15.00]
P5	-19.41 (6.78)** [-32.69, -6.12]	-9.38 (5.72) [-20.59, 1.83]	-7.59 (4.92) [-17.22, 2.03]	-3.34 (4.11) [-11.40, 4.71]	-10.88 (13.54) [-37.42, 15.66]
P6	-4.39 (6.35) [-16.84, 8.06]	-6.49 (4.84) [-15.97, 2.98]	-17.10 (4.53)** [-25.98, -8.23]	-2.01 (3.82) [-9.49, 5.46]	-12.30 (20.98) [-53.43, 28.79]
N	1512	1480	1600	960	528
R²	0.677	0.834	0.833	0.782	0.768

Notes: β = beta; SE = Standard errors; CI = confidence interval (95%); P = Period; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The PCA revealed that the first two principal components explained a moderate-to-substantial proportion of the total variance across leagues (Table 5). The interpretation of the biplot should therefore be considered in light of this variance, which

ranged from 47.9% to 62.9% across leagues, indicating a moderate representation of the multidimensional structure. In Argentina, PC1 and PC2 together accounted for 47.9% of the total variance (27.2% and 20.7%, respectively). In Brazil, the first two

components explained 62.9% of the variance, while in Colombia and Ecuador they explained 52.3% and 56.6%, respectively. In Paraguay, the first

component alone accounted for 66.0% of the total variance, indicating a more homogeneous structure across time intervals.

Table 5. Principal Component Analysis by Country

Component	Argentina	Brazil	Colombia	Ecuador	Paraguay
Factor 1 (Proportion)	0.2719	0.4081	0.2756	0.3284	0.6603
Factor 2 (Proportion)	0.2072	0.2156	0.2475	0.2380	0.1437
Factor 3 (Proportion)	0.1694	0.1617	0.1686	0.1673	0.0853
Factor 4 (Proportion)	0.1596	0.0844	0.1347	0.1130	0.0607
Cumulative (F1-F4)	0.8081	0.8699	0.8264	0.8468	0.9501
Explained variance (F1)	1.6315	2.4485	1.6537	1.9706	3.9600
Explained variance (F2)	1.2434	1.2937	1.4851	1.4281	—
Explained variance (F3)	1.0161	—	1.0113	1.0030	—
Explained variance (F4)	0.9574	—	—	—	—
Main contributing variables (F1)	P5, P6	P1, P2, P3, P5	P2, P3, P6	P3, P6	P1–P6
Main contributing variables (F2)	P3	P6, P4	P4, P5	P1, P2, P4	—
Main contributing variables (F3)	P1	—	P1	P5	—
Main contributing variables (F4)	P2	—	—	—	—

Notes: Proportion indicates the share of variance explained by each principal component. Cumulative values correspond to the total variance explained by the first four components. Dash (—) indicates not reported or not retained components. P = Period.

The PCA results also showed that specific match periods contributed differently across leagues. In Argentina, periods P5, P6, and P3 contributed most to variability. In Brazil, periods P1, P2, P3, and P5 were most influential. In Colombia, periods P2, P3, and P6 contributed most strongly, whereas in Ecuador, P3 and P6 were the dominant contributors. In Paraguay, all periods contributed similarly to the overall variance, reflecting a more uniform distribution of goal-scoring patterns.

The biplot representation, derived from the PCA, enabled the simultaneous visualization of leagues and match periods (Figure 2). In this representation, vector direction and magnitude indicate the contribution of each time interval, while the spatial proximity of leagues reflects similarities in goal-scoring patterns. Paraguay appears associated with the final match periods (P5 and P6), suggesting a tendency towards higher goal frequency in later stages. Brazil and Colombia cluster closer to intermediate periods (P3–P4), whereas Argentina is positioned separately,

consistent with its comparatively lower scoring values. These patterns should be interpreted cautiously, as PCA is an exploratory technique, and the first two components explain only a moderate proportion of total variance.

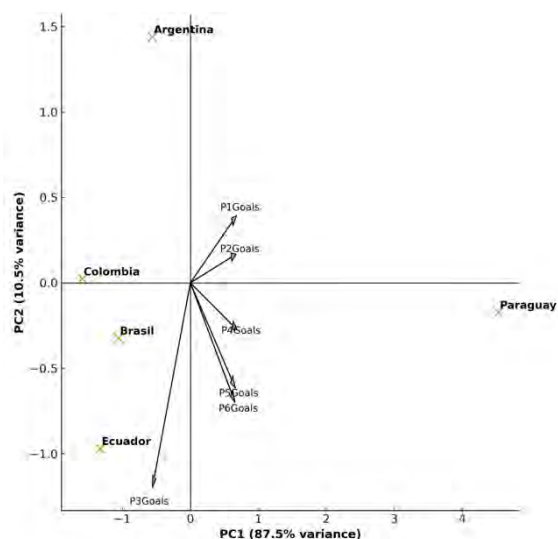


Figure 2. Biplot: Leagues vs Match Periods (P1-P6)

4. Discussion

The aim of this study was to compare the number and temporal distribution of goals scored across the five strongest South American leagues and to examine their association with final league ranking during the 2022 men's first division season. The results revealed significant differences in goal distribution between leagues, particularly from the second to the sixth time intervals, indicating that goal-scoring patterns are not uniform across competitions.

These findings contrast partially with those reported by González-García and Martínez-Martínez (2019), who found no significant differences between time intervals in European leagues. However, their study also showed that most goals

were scored in the second half, particularly between the 75th and 90th minutes, which is consistent with the present results and reinforces the importance of the final stages of matches for goal-scoring events.

Similarly, Martínez and García (2019) demonstrated that contextual variables such as scoring the first goal and match location strongly influence match outcomes. Their findings highlight that not only the quantity but also the timing and context of goals are relevant factors associated with competitive performance.

Across all leagues, higher-ranked teams generally exhibited greater goal averages than lower-ranked teams, supporting previous evidence that offensive performance indicators are associated with competitive success. However, this relationship was not entirely linear. For example, in Colombia, lower-ranked teams displayed relatively high goal-scoring values compared to their counterparts in other leagues, suggesting that goal quantity alone does not fully explain final league ranking. This reinforces the multifactorial nature of football performance, in which defensive effectiveness and contextual variables also play a decisive role (González-Rodenas et al., 2020; Kubayi & Larkin, 2022; Lago-Peñas et al., 2010).

Importantly, the relationship between descriptive goal-scoring patterns and regression results varied across leagues. In Paraguay, despite high goal frequencies across several match intervals, particularly in the later stages, no time interval showed a significant association with final ranking, reinforcing the non-linear relationship

between scoring patterns and competitive success.

The overall increase in goal frequency during the final stages of matches observed across all leagues is consistent with previous studies (Aguado-Méndez et al., 2020; Campos et al., 2016; Li & Zhao, 2021). This pattern may be explained by a combination of physiological and tactical factors. From a physiological perspective, fatigue-related declines in high-intensity performance, neuromuscular efficiency, and recovery capacity have been widely reported (Bradley et al., 2009; Mohr et al., 2003; Rampinini, 2007). These changes may reduce defensive organisation and increase the likelihood of errors. From a tactical perspective, match status, increased offensive risk-taking, and strategic adjustments such as substitutions may further contribute to the higher incidence of goals in the final minutes (García-Aliaga et al., 2023; González-Rodenas et al., 2020; Lago, 2009; Lago-Peñas et al., 2010; Morgans et al., 2024).

Previous research has identified several offensive indicators that differentiate successful from less successful teams, including total goals, shots, shooting efficiency, and attacking actions in advanced zones (González-García & Martínez-Martínez, 2019; Gonzalez-Rodenas et al., 2020; Kubayi & Larkin, 2022; Lago-Peñas et al., 2010; Stafylidis et al., 2024). Tactical approaches such as fast attacking sequences and shorter possessions have also been associated with higher goal-scoring probability (Tenga et al., 2010). In line with this, González-Rodenas et al. (2019) reported considerable variability in offensive strategies, highlighting that goals can

emerge from different types of attacking play depending on the competitive context.

Despite the general trend of increased goal-scoring in the second half, the present findings also revealed league-specific patterns. For instance, successful teams in Colombia showed higher scoring frequencies in later intervals, whereas in Argentina, leading teams tended to score earlier in matches. This suggests that successful teams may adopt different temporal scoring strategies depending on league characteristics and competitive context. In contrast, lower-ranked teams tended to score more frequently in the final stages, possibly reflecting reactive strategies or reduced defensive organisation when attempting to recover from unfavourable situations.

Taken together, these findings indicate that goal-scoring patterns are associated with final league ranking, although this relationship is complex and influenced by multiple interacting factors. Therefore, the temporal distribution of goals should be interpreted alongside tactical, physical, and contextual variables rather than as an isolated determinant of success.

Differences between leagues may be partially influenced by structural and contextual factors, including competition format, number of matches, and geographical conditions (Castellano et al., 2012; González-Rodenas et al., 2019; Lago-Peñas et al., 2010). However, the present results suggest that these factors alone do not fully explain the observed variability, but rather interact with tactical and physiological demands to shape competition

dynamics (Bradley et al., 2009; Rampinini, 2007).

Environmental conditions such as altitude may also contribute to differences in match intensity and performance. Nevertheless, professional players are typically adapted to these conditions through training and competition exposure, which may attenuate their direct impact on goal-scoring outcomes (Chapman, 2013; Gore et al., 2007).

From an applied perspective, practitioners should consider the increased likelihood of goal-scoring in the final stages of matches when designing training programmes and match strategies. Emphasis should be placed on maintaining physical performance, tactical organisation, and decision-making under fatigue, as well as on preparing teams to manage critical match moments effectively.

A methodological consideration relates to the structural dependency between goals scored and final league ranking, given that goals directly influence match outcomes and points accumulation. Therefore, the regression results should be interpreted as associations rather than causal relationships.

Finally, although data were collected at the team level, the primary objective of this study was to compare goal-scoring behaviour across leagues. For this reason, the main analyses focused on aggregated league data to facilitate inter-league comparisons. Additional team-level results are provided as supplementary material to allow further exploration of intra-league variability.

5. Practical Applications

From an applied perspective, the findings of this study provide relevant insights for performance analysts, coaches, and football federations. Understanding the temporal distribution of goals across different leagues allows practitioners to design more context-specific training strategies, tactical approaches, and match preparation routines.

The consistent increase in goal frequency observed in the second half highlights the importance of maintaining physical performance, neuromuscular capacity, and tactical organisation throughout the match. In particular, the higher goal incidence in the final stages (P5 and P6) suggests that fatigue-related and contextual factors may increase the likelihood of scoring opportunities. Accordingly, training programmes should prioritise the development of fatigue resistance, repeated high-intensity efforts, and decision-making under physically demanding conditions, especially in scenarios that replicate late-match contexts.

In practical terms, this may include the use of small-sided games with temporal constraints, repeated sprint training with limited recovery, and tactical drills performed under accumulated fatigue, with the aim of preserving defensive organisation and decision-making accuracy during critical match periods.

Furthermore, recognising league-specific goal-scoring patterns provides useful benchmarks for performance optimisation. For example, the higher goal

frequency observed in Paraguay during the final match intervals, and the peak scoring period identified in Brazil (P3), indicate that teams competing in different leagues may require tailored tactical and physical preparation strategies. These contextual differences can inform the development of competition-specific performance models.

Importantly, although Paraguay exhibited the highest goal frequency in the final match periods, these intervals were not significantly associated with final league ranking in the regression model. This suggests that a higher volume of goals in specific periods does not necessarily translate into improved competitive success, reinforcing the need to consider goal-scoring patterns alongside other performance indicators.

From a performance analysis perspective, the results support the integration of Key Performance Indicators (KPIs) aligned with temporal goal patterns, including variables such as shot frequency, shooting accuracy, possession dynamics, transition speed, and ball recovery in advanced areas. Monitoring these indicators in relation to specific match periods may enhance the identification of critical moments that influence match outcomes and final league ranking.

Overall, practitioners should interpret goal-scoring patterns within a broader performance framework that includes tactical, physical, and contextual variables, rather than considering them as isolated determinants of success.

6. Limitations

Despite the strengths of this study, several limitations should be acknowledged. The data were obtained from the BeSoccer–Pro Football DB platform, which, although widely used and previously validated in football research, relies on external data providers and may contain minor discrepancies compared with official federation records.

Structural differences between leagues, such as the number of teams, total matches, and competition format, may introduce heterogeneity into cross-league comparisons. Although only regular-season matches were analysed to improve comparability, these variations cannot be fully eliminated.

In addition, the absence of physical and tracking data limits the ability to directly link goal-scoring patterns with locomotor demands and player movement behaviour.

Finally, given that goals directly influence match outcomes and, consequently, league ranking, a degree of structural dependency between predictor and outcome variables should be considered. Therefore, regression results should be interpreted as associations rather than causal relationships.

7. Future Research

Future research should incorporate additional variables, such as physical performance data, contextual match variables (e.g., match status and opposition quality), and tracking-based metrics, to provide a more comprehensive understanding of goal-scoring behaviour in professional football.

8. Conclusions

On average, differences in the number of goals scored between the first- and last-placed teams were not consistent across the five strongest South American leagues, highlighting variability in competitive dynamics between competitions. Nevertheless, clear temporal patterns in goal distribution were identified across all leagues.

A higher number of goals was consistently observed in the second half, particularly during the final time intervals. This temporal pattern was associated with final league ranking; however, its influence varied across competitions. For example, although Paraguay exhibited a pronounced increase in goal frequency in the final stages of matches, these periods were not significantly associated with final league ranking, indicating that late-match scoring alone does not necessarily translate into competitive success.

Furthermore, goal-scoring behaviour differed between leagues, with Argentina and Colombia showing lower average goals per match compared with the other competitions analysed. These findings suggest that goal distribution is influenced not only by temporal factors but also by league-specific characteristics, including tactical approaches, competitive structure, and contextual conditions.

Overall, the present study demonstrates that goal-scoring patterns are associated with competitive performance in South American football; however, this relationship is complex,

league-dependent,

and should be interpreted within a broader tactical and contextual framework rather than as an isolated determinant of success.

From a methodological perspective, this study provides a comprehensive inter-league comparison by integrating descriptive analysis, multivariate modelling (MANOVA), regression analysis, and exploratory PCA, offering a multidimensional approach to understanding goal-scoring patterns.

These findings extend the current literature beyond European contexts and provide a structured basis for future research incorporating physical, tactical, and contextual performance variables.

Supplementary Materials:

The supplementary materials include team-level tables for each league, reporting total goals, goals per match for each 15-minute interval, first- and second-half goal averages, and final league position.

They also include PCA biplots illustrating the distribution of clubs in relation to match periods within each league. These materials provide additional club-level analyses for the five strongest CONMEBOL leagues examined in this study (Brazil, Argentina, Colombia, Ecuador, and Paraguay), highlighting variability in goal-scoring patterns across the six 15-minute match intervals.

Overall, these materials allow readers to explore intra-league differences and identify teams that deviate from general league trends.

Data Availability Statement:

The data supporting the findings of this study are publicly available. Raw match statistics

were obtained from the Pro Football DB database through the BeSoccer platform (<https://es.besoccer.com>) and from the International Federation of Football History and Statistics (IFFHS, <https://www.iffhs.com/>). Additionally, the dataset is openly available in the Open Science Framework (OSF) at <https://doi.org/10.17605/OSF.IO/YKVWC>.

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Appendix 1.

Position	Brazil	Argentina	Paraguay	Colombia	Ecuador
1	Palmeiras	Boca Juniors	Cerro Porteño	Millonarios	SD Aucas
2	Internacional	Racing Club	Olimpia	Independiente Medellín	Universidad Católica
3	Fluminense	River Plate	Libertad	Atlético Nacional	Independiente del Valle
4	Corinthians	Huracan	Club Nacional	Deportes Tolima	LDU de Quito
5	Flamengo	Atlético Tucumán	Club Guaraní	Junior FC	Barcelona SC
6	Atlético Paranaense	San Lorenzo	Tacuarí	Independiente Santa Fe	Emelec
7	Atlético Mineiro	Tigre	General Caballero JLM	Atlético Bucaramanga	Deportivo Cuenca
8	Fortaleza	Argentinos Juniors	Guaireña FC	La Equidad	Delfín
9	Sao Paulo	Gimnasia de la Plata	Sportivo Ameliano	Águilas Doradas	Orense SC
10	America Mineiro	Patronato	Resistencia SC	Envigado FC	Guayaquil City
11	Botafogo	Newell's Old Boys	Sol de América	Once Caldas	Gualaceo SC
12	Santos	Defensa y Justicia	12 de Octubre	Deportivo Pereira	Técnico Universitario
13	Goiás	Talleres de Cordoba		América de Cali	Cumbaya
14	Bragantino	Independiente		Deportivo Pasto	Mushuc Runa
15	Coritiba	Godoy Cruz		Jaguars de Cordoba	Macará
16	Cuiabá	Central Cordoba SdE		Alianza Petrolera	9 de Octubre
17	Ceará	Barracas Central		Unión Magdalena	
18	Atlético GO	Estudiantes de la Plata		Patriotas	
19	Avai	Platense		Deportivo Cali	
20	EC Juventude	Rosario Central		Cortulua	
21		Sarmiento Junin			
22		Unión de Santa Fe			
23		Arsenal de Sarandí			
24		Banfield			
25		Colon de Santa Fe			
26		Velez Sarsfield			
27		Lanús			
28		Aldosivi			