Original Research Article

Epidemiology of Anterior Cruciate Ligament Injuries in the Top 5 European Football (Soccer) Leagues

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Background: The anterior cruciate ligament (ACL) is one of the most frequently injured structures in different sports, particularly football (soccer). Numerous studies have investigated the mechanisms and risk factors leading to ACL ruptures in this sport; however, most analyses have focused on individual leagues.

Hypothesis: It was hypothesized that pooling data from different football leagues would show that (1) most ACL ruptures occur in noncontact situations, predominantly during the defensive phase and within the initial minutes of play; (2) the number and incidence rate of injuries differ significantly across leagues; and (3) the number of injuries correlates with the team market value.

Study Design: Descriptive epidemiology study.

Methods: An online database was accessed to collect data on ACL ruptures and player characteristics in the top 5 European football leagues between the 2018-2019 and 2023-2024 seasons. Player age, player position, moment of injury during the season and during the match (if applicable), and team market value were initially collected. Then, the video of the moment of injury of those players injured during official matches was searched to classify the injury mechanism.

Results: A total of 272 ACL ruptures were identified, 44.5% involving defenders. Most occurred within the first 15 minutes of play. The mean age of injured players was 25.8 ± 3.9 years. Among the 135 injuries for which video analysis was available, 84 (62.2%) occurred during defensive actions, 66 (48.9%) were classified as noncontact injuries, and 35 (33.3%) happened while pressing an opponent. Differences in the number of injuries (P = .066) and injury rate (P = .225) between leagues, as well as the correlation between team market value and number of injuries (P = .922), were not statistically significant.

Conclusion: Most ACL ruptures occurred through noncontact mechanisms, typically during defensive actions, particularly while pressing an opponent. Most injuries affected defenders and took place within the first minutes of play, with a mean player age of 25.8 years. No significant differences were found in the number or rate of injuries between leagues, nor was any correlation observed between team market value and the number of injuries.

Keywords: knee; injury; football (soccer); ACL

In football, anterior cruciate ligament (ACL) rupture is the most common knee injury,[14] and it implies a long period of absence that could stretch to a whole season.[16] It is a serious injury that may influence the football player's career.[24] Most professional players in Europe can return to football, but only 60% of them play at the same level 5 years after ACL reconstruction.[8] Moreover, the incidence of ACL injuries during matches is higher than during training sessions.[13,20,24] Professional sports scientists must develop effective prevention programs to reduce the number of ACL injuries. To this end, it is important to describe the incidence and number of injuries and their mechanism, type, location, frequency, and severity.[20]

The ACL injury mechanism has been highlighted to generally occur in early knee flexion with dynamic knee valgus loading.[7] Furthermore, a vigorous eccentric contraction of the quadriceps combined with valgus alignment and/or knee abduction moments may increase the stress on the ACL.[2] In particular, in football, most ACL injuries occur without any contact with other players and happen

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while defending, especially during pressing.[3,4,7,26] Regarding the injury distribution during the match, ACL injuries usually occur when the player has participated in <45 minutes of effective gameplay.[7] Relevant studies are usually conducted in particular environments (eg, a particular league); however, injury rates may differ depending on geographical regions, which implies that the same prevention programs are not being used everywhere.[11]

Epidemiological studies have been conducted in order to better comprehend ACL injuries in football. Some of them have analyzed the leagues in different countries such as Spain,[21] England,[10] Italy,[13] and Germany.[23] All of these countries are among the top 5 European leagues according to the official country coefficient ranking from the United European Football Association (UEFA). The country coefficient ranks the collective clubs' performance over the previous 5 years from each UEFA member country.[19] Currently, this ranking is led by England, Spain, Italy, Germany, and France, in that order, according to the official UEFA website. To date, no epidemiological study has made a direct comparison among different leagues, information that could be of great value. Therefore, the aim of this study was to analyze the epidemiological patterns of ACL ruptures in elite male football in the top 5 European leagues (England, Spain, Italy, Germany, and France) in 6 seasons and to describe the mechanisms and situations that led to ACL injuries. Our hypotheses were that pooling of data regarding ACL injuries from different football leagues would show that (1) the majority of injuries occur in noncontact situations, predominantly during the defensive phase and within the initial minutes of play; (2) both the number and incidence rate of injuries differ significantly across leagues; and (3) the number of injuries is correlated with the team's market value.

METHODS

Study Design

A descriptive epidemiological study was conducted to examine the incidence of ACL ruptures in the top 5 European male football leagues. Data were retrieved from an online soccer database, Transfermarkt (Transfermarkt, Hamburg, Germany), during 6 seasons (2018-2019 to 2023-2024) in the first division of the 5 best leagues in Europe (England, Spain, Italy, Germany, and France).

Screening Process

The English, Spanish, Italian, and French leagues (until the 2022-2023 season) were composed of 20 teams, whereas the German league, and the French league in the 2023-2024 season, were composed of 18 teams. However, the competition formats were similar and have been explained elsewhere.[5]

Every team that participated in the first division of each league during seasons 2018-2019 and 2023-2024 was selected from the publicly available database platform Transfermarkt to identify their ACL ruptures. Then, each player was searched on the same platform to analyze his injury history. This is a method that has been used before in similar studies,[7,13,21] and Transfermarkt has been validated to identify injuries in professional football.[17] Once an ACL injury was encountered in this database, an individualized search was made. Before an injury was considered eligible to be included in this study, official statements were searched to confirm the injury. The players who met all of these criteria were included in the study. Only ACL ruptures that occurred during an official match were further analyzed. Friendly matches were established as "in training."[13] Every competition in which the team participated was included (League, European tournament, and National Cup) as well as whether the player was injured during a competition with his national team. Last, every match in which an ACL rupture occurred was searched to complete a further analysis.

Data and Video Extraction

For every player for whom an ACL injury was confirmed during an official match, the following items were analyzed via Transfermarkt: age, position, season, month of the injury, and minutes played before the ACL injury occurred.[7,21] The league in which the player was playing was also recorded. The age and the market value (ie, expected value based on demand for the player, performance, experience, level, and status of the league where playing, among other factors) of each player who participated in these leagues were extracted. Last, the minutes and matches played during the week, month, and year before the injury were calculated for each injured player during official matches because the exact date could be determined.

The risk exposure during the matches was calculated following a previously used method.[24] First, the individual time of exposure of each player was determined (ie, the number of hours each player had played).[15] Next, to calculate the risk of exposure or injury rate per 1000 hours, the total number of ACL injuries occurring during a match was multiplied by 1000 and divided by the total time of exposure in hours.

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All data were first analyzed together to determine the global result of the best teams in European football during these seasons. An analysis was conducted comparing all 5 leagues to determine whether there were any differences among them.

Videos of the injuries were obtained from online digital platforms: publicly available platforms (ie, the official websites of the teams and leagues) and the Wyscout Platform (wyscout.com). Once each video had been extracted, the video analysis was divided into 2 parts. First, the playing phase was determined based on ball possession and playing situation as defensive or offensive. Second, the injury mechanism was categorized as noncontact, indirect contact, or direct contact. Noncontact injuries were defined as those where the injured player did not experience any contact before the injury; in indirect contact injuries, the player received an external force applied to any region of the body other than the injured knee; and in direct contact injuries, an external force was directly applied to the player's injured knee. For indirect contact and noncontact injuries, a further analysis was made to discover the situational pattern, which consisted of describing the situation that led to the injury.[7]

Statistical Analysis

The statistical analysis was performed with IBM SPSS Statistics 28.0. Continuous variables were reported as mean ± standard deviation, and categorical variables were expressed as raw numbers and percentages of the total. Comparisons of the number of ACL ruptures and the injury rate between leagues were performed with the Kruskal-Wallis test. One-way analysis of variance (ANOVA) was conducted to compare the number of matches and minutes played before ACL injury across the different injury mechanisms (noncontact, indirect contact, and direct contact). Spearman correlation was applied between the number of ACL ruptures and the market value of the teams. The level of significance was set at $P < .05$.

RESULTS

ACL Ruptures

A total of 272 ACL ruptures were recorded during the 6 seasons in the top 5 European leagues. Of these, 173 occurred in official matches (63.6%), 84 in training (30.9%), and 15 in friendly matches (5.5%). Most injuries occurred during official matches across all leagues (76.1%, 67.8%, 63.6%, and 62.3% in England, Spain, Italy, and France, respectively), except in Germany, where a lower proportion was observed (47.9%). Table 1 shows the distribution of ACL ruptures through these seasons in official matches and training with the demographic characteristics and incidence rates specified in each league. The total time of exposure in matches was 430,090.8 hours, resulting in a match ACL rupture rate of 0.40 per 1000 hours. A mean of 45.3 ± 5.2 (95% CI, 39.9-50.8) ACL ruptures occurred each year in the top 5 European football leagues. The mean ACL ruptures in each league were 7.7 ± 2.5 (95% CI, 5.0-10.3) in England, 9.8 ± 2.8 (95% CI, 6.9-12.8) in Spain, 11.0 ± 1.9 (95% CI, 9.0-13.0) in Italy, 8.0 ± 1.7 (95% CI, 6.2-9.8) in Germany, and 8.8 ± 1.0 (95% CI, 7.8-9.9) in France. No significant differences were found between leagues in the number of injuries ($P = .066$) or in the injury rate ($P = .225$). No correlation was found between the number of ACL ruptures and the market value of the team (Spearman $r = -0.01$, $P = .922$).

Playing Phase, Injury Mechanisms, and Situational Pattern

Of the total 173 ACL injuries that occurred during official matches, 135 (78.0%) ACL injuries were selected and included for video analysis. The playing phase and injury mechanism are shown in Table 2, whereas Table 3 displays the situational pattern of indirect and noncontact injuries.

Players' Characteristics

Figure 1 shows the distribution of injured players by age. The mean age of the players who had an ACL rupture was 25.8 ± 3.9 years, and most ruptures occurred between the ages of 24 and 26 years. The mean age of the players who had been part of the teams during these seasons was 25.1 ± 1.0 years.

Defenders had the largest number of ACL ruptures, with a total of 121 ACL ruptures (44.5%). The center-backs were the most affected, with 58 ruptures (47.9% of defenders). After defenders, the players who had the most ACL ruptures were forwards, with 75 ACL ruptures (27.6%), followed by midfielders with 66 ACL ruptures (24.2%) and goalkeepers with 10 ACL ruptures (3.7%).

Injury Distribution During the Season

Figure 2 displays the month in which each ACL rupture occurred. We observed the lowest number of ACL injuries in June, whereas the rest of the months had a similar trend. March presented the greatest number of injuries, and it was followed by a gradual decline until the season ended.

Injury Distribution During the Match

The exact moment of ACL rupture for 9 of the 173 players who were injured during official matches could not be confirmed. Therefore, Figure 3 shows the minutes played in the match before the injury of 164 players. A total of 110 ACL ruptures (67.0%) occurred during the first 45 minutes of effective match time, and most ruptures took place in the first 15 minutes (n = 43; 26.2% of the total) and between the first 30 and 45 minutes played (n = 40; 24.4% of the total). In addition, 51.1% of the injuries occurred when

TABLE 1
Anterior Cruciate Ligament Injury Distribution and Incidence Rate Through 6 Seasons in the Top 5 European Football Leagues (England, Spain, Italy, Germany, and France)[a]

League and Season	No. of ACL Ruptures			Time of Exposure, h	Incidence Rate of ACL Ruptures (per 1000 match hours)
	Total	Training	Match		
England					
2023-2024	12	4	8	15,878.0	0.50
2022-2023	7	4	3	15,669.0	0.19
2021-2022	5	0	5	15,854.7	0.32
2020-2021	6	1	5	15,884.9	0.31
2019-2018	9	2	7	15,894.2	0.44
2018-2019	7	0	7	15,779.2	0.44
Total	46	11	35	94,960.0	0.37
Spain					
2023-2024	12	3	9	15,176.0	0.59
2022-2023	11	3	8	15,204.7	0.53
2021-2022	7	2	5	15,354.7	0.33
2020-2021	6	4	2	15,302.6	0.13
2019-2018	10	4	6	15,101.5	0.40
2018-2019	13	3	10	15,551.3	0.64
Total	59	19	40	91,690.8	0.44
Italy					
2023-2024	9	1	8	14,953.2	0.53
2022-2023	13	3	10	15,082.2	0.66
2021-2022	10	2	8	14,671.3	0.55
2020-2021	9	5	4	14,640.6	0.27
2019-2018	13	5	8	14,456.0	0.55
2018-2019	12	8	4	14,458.0	0.28
Total	66	24	42	88,261.3	0.48
Germany					
2023-2024	11	8	3	12,115.2	0.25
2022-2023	6	3	3	12,393.4	0.24
2021-2022	8	3	5	12,236.2	0.41
2020-2021	8	3	5	12,086.0	0.41
2019-2018	8	5	3	12,356.5	0.24
2018-2019	7	3	4	12,211.6	0.33
Total	48	25	23	73,399.0	0.31
France					
2023-2024	7	2	5	12,146.5	0.41
2022-2023	9	3	6	14,384.7	0.42
2021-2022	9	4	5	14,489.5	0.35
2020-2021	10	3	7	14,080.4	0.50
2019-2018	9	3	6	11,717.8	0.51
2018-2019	9	5	4	14,960.7	0.27
Total	53	20	33	81,779.5	0.40
Top 5 leagues, total	272	99	173	430,090.8	0.40

[a]ACL, anterior cruciate ligament.

the score was equal, 34.8% when there was a difference of only 1 goal, 8.9% with a difference of 2 goals, and 5.2% with a difference of ≥3 goals.

The mean number of minutes played in official matches before ACL injury was 49.7 ± 50.7 minutes, 235.3 ± 156.6 minutes, and 2507.8 ± 965.4 minutes during the week, month, and year preceding the injury, respectively. The mean number of matches played was 0.71 ± 0.61 matches, 3.37 ± 1.87 matches, and 35.4 ± 10.9 matches during the same time periods. Table 4 presents these values stratified by ACL injury mechanism (noncontact, indirect contact, direct contact). One-way ANOVA revealed no significant differences in matches or minutes played across injury mechanisms during the week (matches: $F = 3.031$, $P = .052$; minutes: $F = 2.420$, $P = .093$), month (matches: $F = 0.330$, $P = .720$; minutes: $F = 0.670$, $P = .513$), or year (matches: $F = 1.106$, $P = .334$; minutes: $F = 1.456$, $P = .237$).

TABLE 2
Playing Phase and Injury Mechanism Analysis of Anterior Cruciate Ligament Injuries Through 6 Seasons in the Top 5 European Football Leagues (England, Spain, Italy, Germany, and France) (n = 135)

Variable	Result, n (%)
Playing phase before injury	
Defensive	84 (62.2)
Offensive	51 (37.8)
Injury classification	
Direct contact	30 (22.2)
Indirect contact	39 (28.9)
Noncontact	66 (48.9)

TABLE 3
Situational Pattern of Indirect and Noncontact Anterior Cruciate Ligament (ACL) Injuries Through 6 Seasons in the Top 5 European Football Leagues (England, Spain, Italy, Germany, and France) (n = 105)

Category	ACL Injuries, n (%)
Pressing	35 (33.3)
Duel	10 (9.5)
Regaining balance	9 (8.6)
After kicking	5
After controlling the ball	1
After a duel	1
After being tackled	1
After tackling	1
Landing from a jump	8 (7.6)
Cutting without ball	8 (7.6)
Dribbling	7 (6.6)
Reaching ball	7 (6.6)
Protecting ball	6 (5.7)
Tackling	5 (4.8)
Tackled	4 (3.8)
Kicking	3 (2.9)
Jumping, take off	1 (1.0)
Running backward	1 (1.0)
Running forward	1 (1.0)

DISCUSSION

The aim of this study was to analyze the epidemiological patterns of ACL ruptures in elite male football across the top 5 European leagues (England, Spain, Italy, Germany, and France) over 6 consecutive seasons (2018-2019 to 2023-2024) and to describe the mechanisms and situational patterns leading to these injuries. The main finding was that 272 ACL ruptures occurred during this period. The most common injury mechanism was noncontact, typically occurring during pressing actions in the defensive phase. Accumulated fatigue before the match did not appear to be related to the injury mechanism, as most injuries occurred within the first 15 minutes of play, and their distribution throughout the season remained relatively stable, except for a decrease during the off-season months. Defenders were the most frequently affected players, with a mean age of 25.8 years. No significant differences were observed in either the number or rate of injuries among the 5 leagues, and no correlation was identified between the number of injuries and team market value.

A large number of ACL injuries occur in professional football, and the injury rate has remained similar since the 2000s.[24] In line with our findings, the mean numbers of injuries per season in different leagues previously reported were 12.0 in Italy,[13] 11.0 in Spain,[21] and 9.6 in Germany.[23] Our results of match injury rate are similar to those reported in the literature, as the data range from 0.34 to 0.42 injuries per 1000 hours of gameplay.[13,20,24] Additionally, no differences appeared in the injury rate between leagues. These results reveal that despite the development of new preventive strategies, the number of injuries is not declining. Therefore, a new approach to the prevention of ACL ruptures should be considered in order to reduce the number of ACL injuries. Prevention programs are important but so is the equipment used, because the configuration of the outsole and its interaction with the playing surface may increase the risk of ACL injury.[18] Hence, the shoe used for the matches should be chosen depending on the surface. Considering that this injury involves a substantial financial burden for the team,[23] teams with smaller budgets are especially interested in reducing the number of ACL injuries. Market value, as extracted from Transfermarkt, represents the expected value of a player. This includes demand for the player, performance, experience, level, and league status, among other factors. Because the total number of players is similar between teams in the different leagues, it could be assumed that teams with a lower market value have less money. Therefore, it seems relevant that there was no correlation between the number of ACL ruptures and the market value of the team.

The ACL injury rate is higher in matches than in training,[24] but the training injury rate was not calculated because it was not possible to determine the training exposure of each team. It seems logical to think that there are more exposure hours in training because there are more training sessions than matches. However, the hours of training exposure of high intensity should be considered, because some training sessions are only meant for recovery from fatigue. Additionally, the minutes played by each player should be counted in order to analyze the training exposure, as substitute players are exposed to a lower workload than starters, even after doing compensatory training sessions, which could increase the risk of injury.[6] Nevertheless, it is clear that more injuries occur during matches, and our results are within the range of previous studies (ie, between 59.5% and 66.4% in official matches).[13,20,21] When we analyzed each league individually, the Spanish, Italian, and French leagues showed results in accordance with the literature and our overall results (67.8%, 63.6%, and 62.3% of the injuries happened in official matches, respectively). In England, we found a higher number of injuries during official matches (76.1%), in accordance with a recent study in the English league[10] that found a higher percentage than studies in

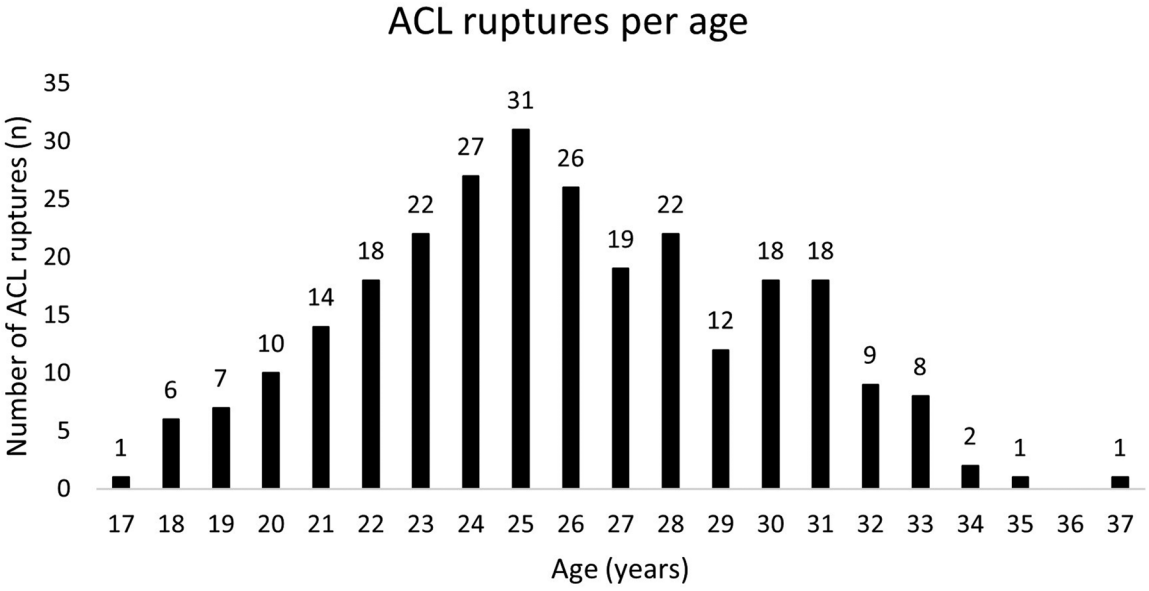

Figure 1. Anterior cruciate ligament (ACL) rupture distribution by player age (N = 272).

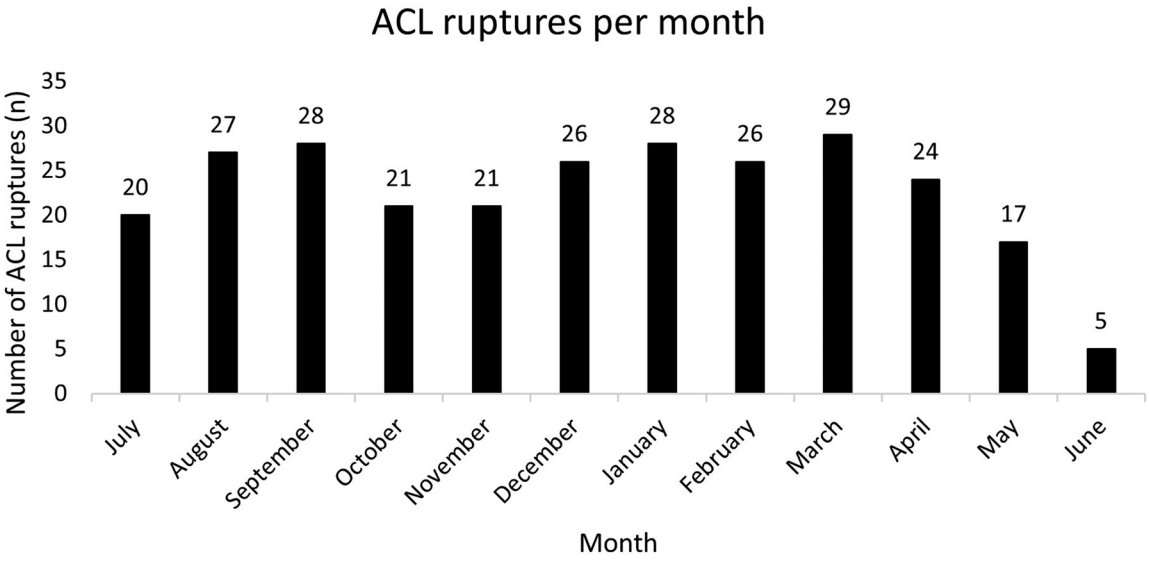

Figure 2. Distribution of anterior cruciate ligament (ACL) ruptures during the season (N = 272).

other leagues. Those authors found that 93.2% of the injuries in the first 2 divisions occurred during official matches. Because we analyzed only the first division, the differences in our results could be explained because the injuries in the second division increased the total number of injuries in official matches. However, in contrast with these results, the German league had more ruptures in training sessions/friendly matches than in official matches (52.1% vs 47.9%, respectively). This league is composed of fewer teams, which implies fewer league matches, and league play stops for a period during the winter. This could result in more training sessions, including a second period of a return to the competitive level, similar to the preseason, after the winter break. Because the training exposure could not be established in this study, it is not possible to confirm this hypothesis. Future studies should consider the total time exposure in matches and training in each league to compare the results.

Defending was the action where most ACL injuries appeared,[3,26] and defenders were the most affected players.[13,21] These players may be more exposed to ACL injury due to the nature of their role in a match. Not only does the defensive action involve risk, but many times defenders have to perform maneuvers with little time for observation

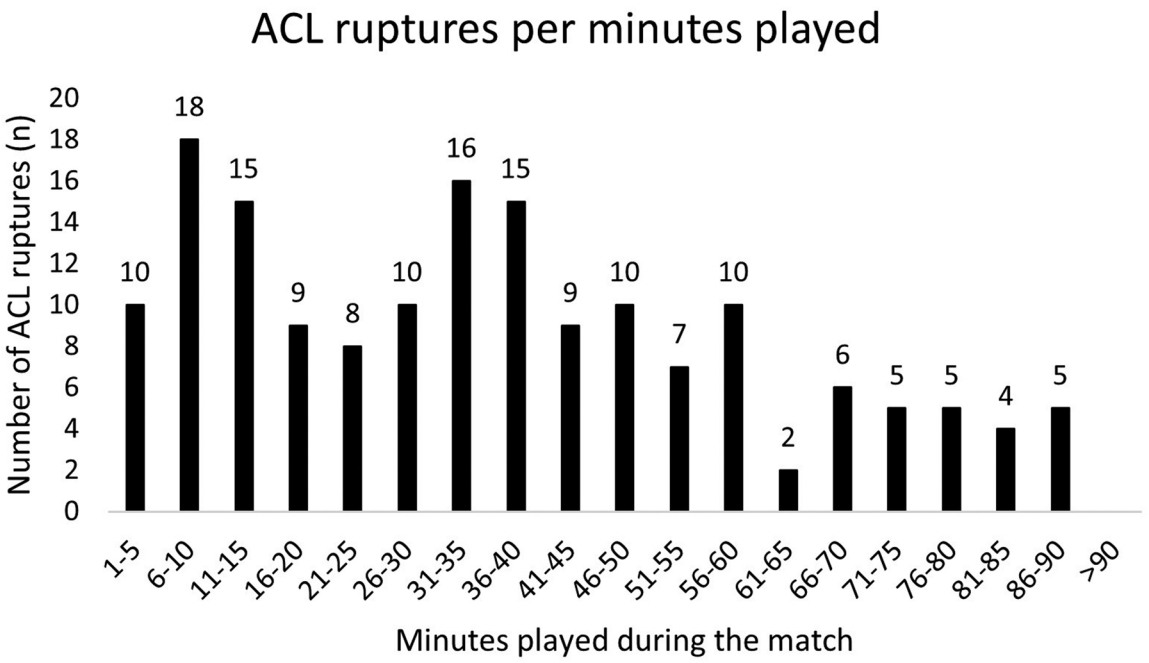

Figure 3. Minutes played in the match before anterior cruciate ligament (ACL) rupture (n = 164).

TABLE 4
Number of Matches and Minutes Played in Official Competitions During the Week, Month, and Year Before Anterior Cruciate Ligament Injury, Stratified by Injury Mechanism[a]

	Week	Month	Year
Matches, n			
Noncontact	0.80 ± 0.64	3.50 ± 1.83	36.7 ± 10.7
Indirect	0.51 ± 0.56	3.21 ± 1.84	34.4 ± 10.3
Direct	0.77 ± 0.57	3.30 ± 2.02	33.6 ± 11.8
Minutes played			
Noncontact	58.3 ± 53.1	247.1 ± 153.7	2633.5 ± 1013.1
Indirect	36.1 ± 44.3	237.0 ± 160.2	2472.9 ± 815.0
Direct	48.3 ± 50.8	207.2 ± 160.1	2276.4 ± 1021.2

[a]Data are expressed as mean ± SD.

and motor planning.[9] Joint mechanics are affected by unplanned movements and may predispose to knee injuries such as ACL ruptures.[12] Defenders' actions depend on the movements made by the opposing player, which could explain why there are more ACL ruptures in this position. Therefore, prevention programs that include unexpected tasks should be implemented to prepare players for these injury risk situations. Regarding the injury mechanism, in football, most of the injuries occurred without any contact with other players.[4,7,26] Almost half of the injuries analyzed happened in noncontact situations (48.9%), and when we combined noncontact injuries with indirect contact injuries, we found that 77.8% of the total injuries happened without contact at the moment of injury. In noncontact and indirect contact injuries, the most common situation that led to injury was pressing,[4,7,26] up to a third of the total (33.3%). Moreover, we found that 59.4% of the noncontact pressing injuries occurred to defenders. Because aggressive playing style is a modifiable factor,[8] teams that play with a pressing style should analyze their players for possible injury risks factors in the pressing movement pattern. In these cases, not only the defenders are at risk, but so is every player who is doing the pressing action (ie, forwards and midfielders).

The mean age of players sustaining an ACL injury ranged between 24 and 26 years,[13,19,21,23,25] consistent with our findings and with the overall mean age of professional players (~25 years). Given that these injuries occur at a relatively young age and can shorten career length[8,19] or even prevent return to play,[8,24] this population warrants particular attention in injury prevention strategies.

Consistent with previous studies, most ACL injuries occurred within the first 45 minutes of play,[7] with 2 peaks—during the first 15 minutes and between 30 and 45 minutes. During matches, players cover more distance, and except for the central defender, there are more high-intensity actions (ie, number and distance of sprints) in the first half than in the second half.[22] Additionally, substitute players who play <15 minutes perform more physically demanding actions than the rest of the players.[6] This suggests that accumulated match fatigue is unlikely to be a major factor, whereas inadequate neuromuscular readiness at the start of play combined with high-intensity actions may contribute to injury risk.[1,4,7] Therefore, ensuring optimal neuromuscular activation during warm-up could help reduce early-match injuries. Despite temporal variations, seasonal injury distribution

remained relatively stable, except for a clear decrease during the off-season.

This study is not free of limitations. The main limitation is its retrospective nature combined with the fact that data were not received directly from the medical personnel of each team. This leads to another major limitation: The exact time of exposure in training sessions could not be calculated, making it impossible to compare the injury rate between matches and training in the different leagues. Additionally, it must be considered that this study represents elite male football players in Europe. Therefore, some of these results may be similar in different populations, such as amateur players or leagues in different continents, but they should be considered for the targeted population included in the study. We could not control the changing formats of the leagues, as the French league was composed of 20 teams until the beginning of the last season when it started to be composed of 18 teams. This resulted in fewer matches per season and may have affected the results in this league. The video analysis did not include every injury because it was not possible to find the video of every moment of injury. Finally, more contextual variables could be analyzed to better understand the moment in which the ACL injuries occurred: for example, result of the last matches or position of the opponent (eg, direct rival in the classification or a theoretically superior or inferior opponent).

CONCLUSION

A total of 272 ACL ruptures were recorded across the top 5 European football leagues (England, Spain, Italy, Germany, and France) over 6 consecutive seasons (2018-2019 to 2023-2024), with an incidence rate of 0.40 ACL ruptures per 1000 match hours. Although the Italian league presented the highest number of injuries and the English league the lowest, no statistically significant differences were found in either the number or the incidence rate of ACL ruptures among leagues. Most ACL injuries sustained during official matches were noncontact in nature (48.9%) and occurred predominantly during defensive phases of play (62.2%), particularly while pressing the opponent (33.3%). The mean age of affected players was 25.8 $\pm$ 3.9 years, with defenders accounting for the largest proportion of ruptures (44.5%). No correlation was identified between the number of injuries and the market value of the respective teams. Furthermore, the majority of ACL ruptures occurred within the first 15 minutes of match-play (26.2%) with no apparent association between the timing of the injury (in minutes or matches played prior) and the underlying injury mechanism. Finally, the temporal distribution of injuries remained relatively consistent across seasons, except for a noticeable decrease during the off-season months.

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Author Contributions

D.O-S., A.B-S., and M.R-d. were responsible for the conception and design of the study and data collection; C.G-S., P.A., and J.A-V. were involved in the processing and statistical analysis of data; D.O-S., A.B-S., and J.A-V. were involved in the drafting of the manuscript; and all authors contributed to the interpretation of the data for the work and revising it critically for important intellectual content. All the authors approved the final manuscript. J.A-V. was responsible for obtaining project funding and takes responsibility for the integrity of the work as a whole. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement

The data presented in this study are available in Zenodo at doi:10.5281/zenodo.10824782, upon reasonable request.

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