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Spinal injuries in professional football players: a media-based study

Lara Souza Silva

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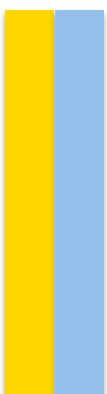

Spinal injuries in professional football players: a media-based study

Dissertação de candidatura ao grau de Mestre em Medicina, submetida ao Instituto de Ciências Biomédicas Abel Salazar – Universidade do Porto

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Maio 2025

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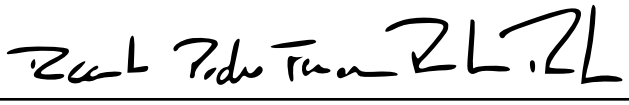

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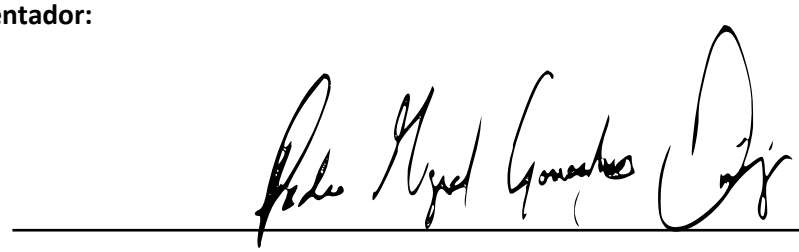

(Professor Doutor Pedro Miguel Gonçalves Diniz)

Porto, Maio de 2025

Declaration of Honour

I, Lara Souza Silva, a student in the Integrated Master's Program in Medicina at the Faculty of Medicina and Biomedical Sciences, University of Porto, hereby affirm that the present dissertation represents the result of my individual academic work and reflects my original research efforts, critical analysis, and interpretation.

In accordance with the University of Porto's Code of Ethical Conduct, paragraph a) of article 14, I declare that this report is an original piece and has not been submitted, in whole or in part, for assessment in another course, degree, curricular unit, or academic context, either at this institution or elsewhere. All sources and contributions from other authors – whether statements, ideas, arguments, or direct quotations – have been properly cited within the text and referenced in alignment with academic attribution standards.

I acknowledge that plagiarism and self-plagiarism are academic misconduct and affirm that this study complies with the principles of academic integrity.

(Lara Souza Silva)

Porto, Maio de 2025

Ao meu avô Pedro, com profunda saudade e eterna admiração

Agradecimentos

Ao meu orientador, Professor Doutor Ricardo Rodrigues Pinto, presto o meu mais sincero reconhecimento. Foi no 5º ano, no decurso das aulas de ortopedia, que me mostrou não apenas uma especialidade, mas um verdadeiro propósito. O Professor Ricardo é, para mim, um exemplo de rigor e dedicação incansável, conjugados com uma notável humanidade, virtudes que almejo na minha trajetória profissional. Esta dissertação constitui apenas uma parte diante de todo o apoio, orientação e estímulo que me dispensou ao longo dos últimos anos.

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Resumo

Introdução: O futebol é o desporto mais popular do mundo e acarreta uma grande diversidade de lesões. Apesar das lesões nos membros inferiores serem as mais prevalentes, as lesões na coluna vertebral podem ser altamente debilitantes, originando longos períodos de recuperação e cronicidade da dor. A região lombar assume particular relevância por ser a principal fonte de queixas entre atletas de alta competição, correspondendo frequentemente a quadros clínicos de dor lombar.

Objetivos: Analisar as lesões mais frequentes da coluna vertebral que se manifestam com a clínica de dor lombar em jogadores profissionais de futebol, avaliando a sua distribuição por posições em campo, divisão e região geográfica, bem como e o seu impacto em termos dos dias de recuperação, recidivas num período de 2 anos e o tempo médio de participação em jogos antes e depois da lesão.

Métodos: O tempo médio de participação em jogos 2 épocas anteriores à lesão (Ano -2), na época anterior à lesão (Ano -1), na época da lesão (Ano 0) e na época seguinte (Ano 1), dias de recuperação e as recidivas da lesão, assim como características dos atletas, ligas, divisões, clubes, e posições que ocupam durante o jogo foram extraídos do Transfermarkt.com, através de um *web scraper* customizado. A informação sobre as lesões foi recolhida manualmente a partir de fontes fidedignas disponíveis na internet. A análise estatística foi realizada com o *IBM SPSS Statistics*, com significância definida em $p < 0.05$.

Resultados: Entre 407 jogadores profissionais de futebol, a lombalgia foi a lesão mais frequente (43,7%), seguida de hérnias discais (14,75%) e das fraturas lombares (13,5%). A distribuição das lesões diferiu significativamente consoante a gravidade ($p < 0.001$), divisões ($p < 0.001$), e regiões geográficas ($p = 0.007$), embora as últimas possam apenas refletir um viés de amostra da sobre representação de jogadores da primeira divisão e europeus. Não foram identificadas diferenças significativas com a posição em campo. As lesões graves representam 44,2%, destacando-se as hérnias discais e fraturas lombares. A recidiva das lesões ocorreu em 9,3% dos casos, sobretudo nas hérnias discais. Não foram identificadas associações significativas nas recidivas. A participação nos jogos diminui entre a época anterior à lesão e a da lesão, e manteve-se reduzida na seguinte. Na época antes da lesão, observaram-se diferenças significativas entre o tipo de lesão e a participação nos jogos ($p = 0.04$), sendo que dentro dessa época os jogadores com fraturas lombares e hérnias discais registaram as médias mais elevadas.

Conclusões: O estudo mostra uma análise ampla das lesões da coluna de jogadores profissionais de futebol através de dados públicos. A lombalgia, a hérnia discal e a fratura lombar foram as lesões mais comuns, apresentando entre si diferenças significativas quanto aos nos níveis de gravidade. Observou-se uma redução na participação nos jogos entre a época anterior e a época da lesão, mantendo-se reduzida após. Estes dados evidenciam o impacto lesões na recuperação e na participação dos atletas em jogos. Além disso, este estudo destaca os dados públicos como uma ferramenta complementar de vigilância de lesões desportivas, reconhecendo, contudo, as limitações relativas ao diagnóstico preciso e possíveis vieses de amostra.

Palavras-chave: Futebol; Jogadores de futebol; Atletas de alta competição; Coluna vertebral; Lesão da coluna vertebral; Lombalgia; Dor lombar; Lesão nas costas; Desporto; Medicina desportiva; Hérnia discal; Fraturas lombares.

Abstract

Introduction: Football is the most popular sport in the world and is associated with a wide range of injuries. Although lower limb injuries are the most prevalent, spine injuries can be highly debilitating in professional athletes, leading to prolonged recovery periods and chronic pain. The lumbar spine is particularly relevant, as it is the most frequent site of complaints among elite athletes, typically presenting as lower back pain.

Objective: Analyze the most common spinal injuries associated with lower back pain in professional football players, examining their distribution by playing position, tier, and world region, as well as assessing their impact in terms of time lost due to injury, injury recurrence over a two-year period, and match participation time before and after the spinal injury.

Methods: Average match participation time 2 seasons before the injury (Year -2), 1 season preceding the injury (Year -1), season of the injury (Year 0) and 1 season after injury (Year 1), time lost due to injury and injury recurrence, along with players' characteristics, leagues, tiers, teams, and playing position data were collected from *Transfermarkt.com* through a customized web scraping framework. Additional data on spine injuries were manually gathered from reliable online sources. The statistical analysis was performed using IBM SPSS Statistics with statistical significance set at $p < 0.05$.

Results: Among 407 professional football players, lumbago was the most reported spinal Injury (43.7%), followed by herniated discs (14.7%) and lumbar fractures (13.5%). Injury distribution differed significantly by severity levels ($p < 0.001$), tiers ($p < 0.001$), and world regions ($p = 0.007$), although the last findings may reflect sample bias due to overrepresentation of the first tier and European players. No significant association was found with playing position. Severe injuries accounted for the highest proportion (44.2%), mainly herniated discs. Injury recurrence occurred in 9.3% of players, most commonly in disc herniation (11.7%), without significant associations. Match participation declined between the seasons preceding injury and season injury and remained reduced one season post-injury. In the season preceding the injury, significant differences were observed between injury types and the match participation ($p = 0.04$), with players with lumbar fractures (52.5 minutes) and herniated discs (48.4) showing the highest averages.

Conclusions: This study provides a comprehensive analysis of spinal injuries in professional football players using media-based data. Lumbago, herniated discs, and lumbar fractures were the most reported injuries, with severity levels differing significantly across injury types. Match participation declined between the seasons preceding injury and season injury and remained reduced one season post-injury. These findings underscore the impact of spinal injuries on recovery and match participation. Our study also highlights the value of media-based data as a complementary tool for injury surveillance in sports injury, while acknowledging of limitations related to diagnostic precision and possible sample biases.

Keywords: Football; Professional football Players; Elite athletes; Spine; Spine injury; Lumbago; Lower Back Pain; Back Injury; Sports; Sports medicine; Herniated disc; Lumbar fracture.

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Introduction

Football is the most popular sport in the world[1] and is associated with a wide range of injuries, particularly trauma-related, due to the mechanical stress, repetitive movements, and high-energy physical interactions[2]. Although lower limb injuries – especially knee and ankle – are the most frequently reported[3,4], spine injuries can be very debilitating in professional athletes, often resulting in prolonged recovery periods, and chronic pain[5].

The spine can be affected by injuries that impact all its various components, including muscles, vertebrae, spinal cord, intervertebral discs, and nerves. As a result, injuries can range from mild muscle spasms to severe neurological damage. The spine itself can be divided into four anatomic regions: cervical, dorsal/thoracic, lumbar, and sacrococcygeal[6]. Among these, the lumbar region holds a particular relevance in elite sports, as lower back pain is one of the most frequent complaints among professional football players[4]. The clinical presentation of lower back pain is frequently associated with herniated discs, muscular injuries, vertebral fractures[7], spondylolisthesis, and spondylolysis[8].

In recent years, publicly available data has been increasingly used for research on sports injuries. Although Transfermarkt.com was originally developed to track player transfers between clubs, it is also a notable resource providing detailed data on injuries, time lost due to injury, physical attributes, among others. Additionally, previous studies confirm that approximately 89% of the injuries listed on the website were accurately reported, supporting its credibility as a source of data[10].

The objective of this study was to analyze the most common spinal injuries, which manifested as lower back pain, in professional football players, examining their distribution by playing position, tier and world region, as well as assessing their impact in terms of time lost due to injury, recurrence of injuries within 2 years and match participation before and after the spinal injury.

Materials and methods

The study gathered data on football athletes who sustained spine injuries. The inclusion criteria were players in the first, second, and third tiers and spine injuries substantiated by medical reports, club news, interviews with coaches and/or players, newspapers, and sports websites from a reliable source. Exclusion criteria were players from the fourth and fifth tiers and spine injuries occurring outside training and football fields.

The dataset was obtained from *Transfermarkt.com* website through a customized web scraping script, a framework designed for acquiring and analyzing data, with details reported elsewhere [9,10]. From March to April 2024, football players' data with low back pain were sourced from Transfermarkt.com. The resulting injury data was filtered for entries containing the following terms: "*lumbar vertebra problems", "sciatica problems", "blockage in the back", "lumbago", "compression of the spine", "back injury", "vertebral injury", "hairline crack in the lumbar region"* (Figure 2).

Following database creation and application of exclusion criteria, each entry was manually verified online using a combination search of terms: "player name" AND "back injury", "back pain", "vertebral injury", "lumbago", OR "lumbar fracture" AND the corresponding year of injury. Searches were conducted in up to three languages: English, the player's native language, and the language of the country where their team was based. In cases where two or more of these languages overlapped, only the distinct ones were used. Since data collection and analysis relied solely on publicly available online content, without any contact or interaction with the athlete, informed consent was not required or obtained.

The data extraction framework also provided the following information: players' date of birth, height, playing position, league, tier, and team at the time of injury. Additionally, it collected data on the number of days missed due to the injury and match participation, measured in minutes played during the season of injury (Year 0), the two preceding seasons (Year -2 and Year -1), and the season following injury (Year 1). The "age at the time of injury" was manually calculated, based on "date of birth" and the injury onset date. Time lost due to injury was then categorized, according to the UEFA consensus, into injury severity, as minor (1-7 days of absence), moderate (8-28 days of absence), and severe (>28 days of absence)[11,12,13]. Injury recurrence within two years was assessed manually by analyzing the duplicated players in the entries as well as their injury onset dates. Only recurrences occurring within two years after the index injury were considered. Recurrence rate was calculated by the following equation:

$$\frac{\text{Number of recurrences of each spinal injury, OR playing position, OR world region}}{\text{Total number of each spinal injury OR playing position, OR world region}}$$

For match participation data, forty players (9.8%) had missing values, as no data was given by the framework. Therefore, those players were excluded, and, for match participation analysis, only 367 players were considered. The excluded players consisted of 7 (1.7%) retirements, 5 (1.2%) career changes, and 6 (1.5%) players did not participate in any official matches Year 1, 6 (1.5%) were transitioning to professional football in Year -2 and the remaining 16 (3.9%) did not have information about the missing values

Statistical analysis

All statistical analysis was performed using IBM SPSS Statistics® for macOS version 30.0.0.0. The chi-square test was used to examine the associations between total spinal injuries with the following

variables: positions, tier, world region, and severity of injuries. A chi-square test was also performed to assess the relationship between injury recurrence and spine injuries, playing position, tier, and world region. For analytical purposes, “unspecified back injury”, “Lumbar joint inflammation”, “Intervertebral joint injury”, and “Lumbosacral joint inflammation” were grouped into a single injury category as “others”. Additionally, regions “Africa” and “Asia” were combined into another single group within the world region variable to enable statistical analysis. Two different correlation tests were used to analyze match participation across Year -2, Year -1, Year 0 and Year 1, to ensure that each correlation test was appropriately matched to the distribution characteristics of the data. Pearson correlation coefficients were applied to variables pairs that met the assumption of normality, while Spearman’s rank correlation were used when normality assumptions were violated. The Spearman’s rank correlation was used in overall spine injuries, to examine the match participation time between Year -2 to Year -1, Year 0 to Year 1, and Year -1 to Year 1. It was also applied in lumbago, between Year -2 to Year -1, Year -1 to Year 0 and Year -1 to Year 1; in herniated disc, between Year -1 and Year 1; in “others” between Year -1 and 11. The Pearson correlation was used for; lumbar fracture between all Year-pain comparisons as well as for lumbago, between Year 0 to Year 1, herniated disc between Year -2 to Year -1 and Year -1 to Year 0, and for “others” between Year -1 and Year 1. The Kruskal-Wallis test was performed to examine the distribution of average minutes played at Year -1 and Year 1 across the specific spinal injuries. The threshold for statistical significance was established at $p < 0.05$.

Results

The *Transfermarkt.com* framework retrieved 789 entries related to lower back injuries from a pool of 169,299 injuries, relating to 737 players. After applying the exclusion criteria, 330 players were excluded, and 407 players with spinal injuries were selected to conduct the study. These players represented 250 different teams, 62 leagues, and 66 countries. The framework also retrieved 76,329 entries for the number of matches played, after removing the entries related to excluded players, 72,939 entries remained, relating to 59,886 matches.

Player demographics and baseline characteristics

Our dataset was primarily composed of defenders (30.7%) and forwards (28.3%) as the most common playing positions. First-tier players predominated, accounting for 328 players (78.6%), while second and third-tier players represented a small proportion (15.2% and 6.1%, respectively). The majority of injured players were from the European continent (70.8%), followed by those from America (19.0%), and minimal representation from Africa (3.4%) and Asia (5.9%). Data related to player demographics and baseline characteristics can be found in Table 1.

Distribution of spinal injuries reported in the dataset

Lumbago was the most frequently diagnosed injury, accounting for 178 players (43.7%). Herniated disc was the second most common injury, with 60 players (14.7%) being diagnosed with this injury. Lumbar fractures accounted for 55 players (13.5%), where 20 players had transverse process fractures (4.9%), 19 spondylolysis (4.7%), and 4 spondylolisthesis (1.0%). The remaining lumbar fractures were categorized as “unspecific lumbar fracture”, as no specified type of fracture was found, and it accounted for 12 players (2.9%). Three single injuries were also recorded: lumbar joint inflammation (0.2%), intervertebral joint injury – lumbar facet syndrome (0.2%), and lumbosacral joint inflammation (0.2%). One hundred eleven players (27.3%) had unspecified back injury back injuries, as the only information found for those players was “back injury” with no specific diagnosis available. (Table II).

Analysis of spinal injuries in the dataset

For each specific spinal injury, lumbago, herniated disc, and lumbar fractures, players’ characteristics, such as age, height, and world region as well as tier during the injury, and injury severity were detailed, according to player playing position, and can be found in Table III, Table IV, and Table V.

Regarding players’ playing position, lumbago was identified as the most prevalent spinal injury among forwards (10.8%), midfielders (13.3%), goalkeepers (6.4%), and defenders (13.3%). However, no significant association was found in the distribution of spinal injuries across different playing positions ($p = 0.2$). Further details about spinal injuries distributed by different playing positions can be found in Table VII.

Across all professional tiers, the first tier recorded the highest proportion of spinal injuries (78.6%). First-tier and third-tier players with lumbago represented 35.9% and 3.7% of all spinal injuries, respectively, making the lumbago the most frequent spinal injury across each tier. For the second-tier players, lumbar fracture represented the most common injury accounting for 4.7% of all injuries. Furthermore, statistical analysis revealed a statistically significant difference in the distribution of spinal injuries across the tiers ($p < 0.001$). Table VI provides further details about spinal injuries distributed by the different tiers.

Among all world regions, Europe had the highest number of spinal injuries, with 288 (70.8%) injured players. Lumbago emerged as the most frequently reported specific spinal injury across all regions. European players with lumbago represented 30.2% of total injured players, Americans 10.8%, Africans 1.5%, and Asians 1.2%. Additionally, statistical analysis indicated a statistically significant difference in the distribution of spinal injuries across world regions ($p = 0.007$). Detailed information about spinal injuries distributed by different world regions can be found in Table VI.

Across all severity levels, severe injuries accounted for the highest proportion of injuries (44.2%), followed by moderate (34.3%) and minor (21.4%) injuries. Despite the high prevalence of "unspecified back injury" (14.0%), herniated discs (10.8%) and lumbar fractures (10.8%) were the most observed specific spinal injuries categorized as severe. In the moderate and minor categories, lumbago was the most reported condition, accounting for 17.7% and 17.9%, respectively, of spinal injuries. Moreover, statistical analysis revealed a statistically significant difference in the distribution of spinal injuries across severity levels ($p < 0.001$). Further details about spinal injuries distributed by severity can be found in Table VI.

Analysis of injuries recurrence rate within two years

Among the 407 injured players, 38 (9.3%) experienced a recurrence of the previous injury within two years. Herniated disc demonstrated the highest recurrence rate (11.7%), followed by lumbago (10.1%), unspecified back injury (9.0%), and lumbar fractures (5.5%). For playing position, forwards exhibited the highest recurrence rate (10.4%), followed by midfielders (9.3%), defenders (8.9%), and goalkeepers (8.3%). Furthermore, by competitive level, the third showed the highest recurrence rate (13.0%), followed by the first (9.5%), and the second tier (4.8%). In terms of geographic distribution, American players had the highest recurrence rate (13.3%), followed by those from Europe (9.4%). Moreover, no statistically significant differences were found in injury recurrence across injury type ($p = 0.7$), playing position ($p = 1.0$), tiers ($p = 0.7$), or with world region ($p = 0.06$). Further details on recurrence data are presented in Table VII.

Analysis of match participation data

Data from 59,886 matches were analysed. Forty players were excluded due to missing values, resulting in a final sample of 367 players with spinal injuries. Of these, 165 players had lumbago (45.0%), 51 (13.9%) herniated disc, 50 (13.6%) lumbar fractures, and 99 (27.0%) unspecified back injury. Additionally, 1 case (0.3%) with intervertebral lumbar joint injury (Lumbar Facet Syndrome) and 1 case (0.3%) with lumbar joint inflammation were also identified.

The average minutes played per match for all spine injuries combined was 44.7 in Year -2, 45.5 in Year -1, 38.8 in Year 0, and 38.9 in Year 1. Statistically significant correlations were observed when comparing Year -2 to Year -1 ($\rho = 0.5$, $p < 0.001$), Year -1 to Year 0 ($\rho = 0.3$, $p < 0.001$), and Year 0 to Year 1 ($\rho = 0.3$, $p < 0.001$). No significant correlations were found between Year -1 to Year 1 ($\rho = 0.09$, $p = 0.08$)

When analyzed by injury type, the average minutes played per match for lumbago was 43.4 in Year-2, 42.7 in Year-1, 40.7 in Year 0, and 41.6 in Year 1. Statistically significant correlations were observed when comparing Year -2 and Year -1 ($\rho = 0.5$, $p < 0.001$), Year -1 to Year 0 ($R=0.3$, $p < 0.001$), and Year 0 to Year 1 ($R = 0.3$, $p < 0.001$). No significant correlation was found between Year -1 to Year 1 ($\rho = 0.1$, $p = 0.2$).

For herniated disc, the average minutes played per match was 49.5 in Year -2, 48.4 in Year -1, 35.6 in Year 0, and 35.8 in Year 1. Statistically significant correlations were observed when comparing

Year -2 to Year-1 (R = 0.4, p = 0.002) and Year -1 to Year 0 (R = 0.3, p = 0.005). No significant correlations were found between Year 0 to Year 1 (ρ = 0.3, p = 0.06) and Year -1 to Year 1 (ρ = 0.3, p = 0.05).

For lumbar fracture, the average minutes played per match was 44.6 in Year -2, 52.5 in Year -1, 42.7 in Year 0, and 40.4 in Year 1. Statistically significant differences were observed between Year -2 to Year-1 (R = 0.3, p = 0.03) and Year 0 to Year 1 (R = 0.4, p = 0.006). No significant correlations were found between Year -1 to Year 0 (R = 0.3, p = 0.07) and Year -1 to Year 1 (R = - 0.01, p = 0.9).

For the category "others", the average minutes played per match was 44.4 in Year -2, 45.0 in Year -1, 35.5 in Year 0, and 35.6 in Year 1. Statistically significant correlations were observed between Year -2 to Year-1 (ρ = 0.4, p < 0.001), Year -1 to Year 0 (ρ = 0.4, p < 0.001) and Year 0 to Year 1 (ρ = 0.3, p < 0.001). No significant correlations were found between Year -1 to Year 1 (R=0, p = 0.7).

Analysis of the association of match participation at Year -1 and Year 1 and the spinal injuries

A statistically significant difference in match participation across injury types was found in Year -1 (p = 0.04). Players with lumbar fractures had the highest average minutes played (52.5), followed by those with herniated discs (48.4) and lumbago (42.7).

In Year 1, no statistically significant differences were observed between injury types and match participation (p = 0.1).

Discussion

This study aimed to analyze the most common spinal injuries manifesting as lower back pain in professional football players. It examined their distribution by playing position, tier, and world region, and assessed their impact in terms of time lost due to injury, recurrence of injuries within 2 years and average match participation along the period of two seasons preceding the injury 1 season after.

Our findings showed that the most common spine injuries were lumbago (43.7%), herniated disc (14.7%), and lumbar fracture (13.5%). Those findings align with the literature as numerous studies confirm that lumbago is highly prevalent in sports with high physical demands[4,14,15], such as football, due to cumulative overuse and muscular imbalances[2,15]. The physical demands – rapid changes in direction, sprinting, and repetitive kicking – expose players to mechanical stress and contribute to muscle strain and ligament lesions, which are common mechanisms behind lumbago[2,16]. Herniated disc, as a degenerative change in the lumbar spine, is prevalent among professional football players. A cross-sectional study using MRI found that 92.5% of professional football players had at least one degenerative spinal condition, with herniated disc presence in 82.5% of cases[17]. In this study, lumbar fractures were a significant source of lower back pain, where transverse process fractures, spondylolysis, and spondylolisthesis played a major role. Despite this, a higher frequency of spondylolysis was expected since previous reports focus on it as a common source of lower back pain [17,18] due to biomechanical movements involving torsion against resistance and lumbar spine hyperextension[19]. One of the explanations is that athletes with a spondylolysis injury can continue to compete at high levels without major functional limitations[20] since asymptomatic spondylolysis is common and MRI findings do not necessarily correlate with symptomatic presentation or performance impairment. A large percentage, 27.3%, of spinal injuries fell into unspecified back injuries. This number highlights the limitation in obtaining an accurate diagnosis, even from reliable sources. Another explanation is that lower back pain in professional football players often arises from a combination of factors rather than a single identifiable cause, which can have led to a high proportion of unspecified back injuries [22].

When analyzing spinal injury distribution by playing position, it was found that defenders were the most affected players (30.7%). Additionally, it was also the most common playing position in each specific spinal injury. However, no statistically significant association was found between the distribution of spinal injuries across the different playing positions. These results differ from previous studies, which reported a higher prevalence of lower back pain in midfielders and goalkeepers, suggesting these positions may be more vulnerable due to specific biomechanical demands placed on the musculoskeletal system during play[3,5,23].

Our study found that first-tier players accounted for the highest proportion of players with spinal injuries (78.6%). This finding is consistent with previous research indicating that first-tier athletes often compete in multiple competitions throughout the season, leading to cumulative physical loads and increased risk of overuse injuries, including those affecting the spine[24]. Lumbago emerged as the most frequently reported spinal injury across first- and third-tier players. Similarly, European players represented the largest group of affected players (70.8%), with lumbago as the predominant diagnosis. According to the FIFA 2023 report, European athletes make up a substantial proportion of the global professional football population[25]. Therefore, although statistical analysis revealed statistically significant differences in the distribution of spinal injuries across tiers and world regions, the result may have been influenced by sample bias, as the predominance of first-tier and European players in our dataset may reflect their overall higher representation in the professional football population, rather than a true tier- or region-specific predisposition to certain spinal injuries.

This study analysis demonstrated a statistically significant spinal injuries distribution across severity levels. Despite a broad clinical spectrum, Lumbago predominantly presented as a minor or moderate injury, while severe cases were relatively uncommon. This agrees with reports which state that most cases of lumbago are self-limiting and do not need extended periods away from the fields[26,27,28]. Most herniated disc cases were classified as severe injuries, with minor cases being relatively rare. This is in agreement with studies that indicate that herniated disc often lead to a median return-to-play of approximately 5.19 months in athletes who underwent lumbar discectomy and 4.11 months in athletes with conservative treatment[29,30], which underscores the severity of such injuries. Lumbar fractures had no representative players with minor injuries, with most injuries being severe. A previous review reported that major lumbar fractures often need 3 months before return-to-play, which aligns with the information that this injury requires a long recovery[31,32].

In our study, herniated disc exhibited the highest recurrence rate (11.7%), which aligns with existing literature indicating that lumbar disc herniation has a recurrence rate ranging between 5%-15%, particularly in athletes returning to high-intensity activities[33], like football. Regarding playing position, forwards demonstrated the highest recurrence rate (10.4%), which may be attributed to the high physical demands and repetitive stress with this position[34,35]. In terms of tiers, the third-tier players showed the highest recurrence rate (13.0%), which may reflect the disparities observed in medical support across tiers[36,37]. Geographically, American players had the highest recurrence rate (13.3%). Additionally, statistical analysis revealed no statistically significant association between recurrence and injury type, playing position, tier, or world region. These results probably suggest that, while some trends are present, the recurrence of spinal injuries in professional football players may need further research with larger and more diverse data to elucidate those relationships.

In addition, this study also analysed match participation over 4 seasons, revealing a slight increase in average minutes played from 44.7 in Year -2 to 45.5 in Year -1, followed by a general decline to 38.8 in Year 0, remaining low at 38.9 in Year 1. When analyzing specific spinal injuries, lumbago and herniated disc, there was a general decline in Year -2 to Year 0, followed by a slight increase in Year 1. These trends were supported by statistically significant correlations between Year -2 to Year -1 and Year -1 to Year 0. However, no significant correlations were found when comparing Year -1 to Year 1, suggesting that players' match participation in the season following the injury remained inconsistent or influenced by additional variables. Interestingly, for lumbar fractures, average minutes played increased from Year -2 to Year -1 and then progressively declined to Year 1. This verified increase in Year -1, particularly in lumbar fractures, may reflect the cumulative effects of overload and mechanical stress as the key contributors to these fractures[21], a return to full fitness following an earlier injury-related absence[38], or could be influenced by a small sample size or potential outliers such as individual variability in match loads. In contrast, the decline in Year -2 to Year -1 observed in lumbago and herniated disc is in agreement with previous findings that indicate that elite athletes often continue playing despite discomfort potentially exacerbating their condition[39,40], and leading to less match participation. The further decline from Year -1 to Year 0 may reflect the impact of the injury before a formal diagnosis. Moreover, existing research suggests that recovery and reintegration into competitive play often lag clinical recovery, as athletes may face ongoing symptoms, psychological barriers, or cautious reintegration[40]. This may explain low match participation in Year 1, particularly given the absence of significant correlation between Year -1 to Year 1 across most of injury types. When stratified by specific injuries, a statistically significant difference in match participation was observed in Year -1 across injury types, with players who sustained lumbar fractures demonstrating the highest average match participation (52.5 minutes), followed by herniated discs (48.4 minutes). This finding may be attributed to the effect of cumulative axial loading and repeated microtrauma that can predispose to overuse lumbar injuries, such as

spondylolysis[40,41,42]. No significant differences between injury types were found in Year 1. However, previous studies report that herniated disc lead to significantly reduced match participation and performance metrics at least up to 12 months post injury[43] whereas players with lumbago typically return to normal playing levels by Year 1 as no significant long-term reduction in match participation after recovery has been found in the literature[11]. While some studies suggest that athletes with lumbar fractures often return full participation by Year 1[44], a reduction in average minutes played was observed from Year -1 to Year 1, which may reflect variability in recovery timelines or more conservative return-to-play protocols[45].

Media-based studies have emerged as a valuable tool in sports medicine research, particularly in elite-level sports, where access to medical records is restricted due to privacy concerns or other restrictions. Previous reports demonstrated that the main strength of this approach is the ability to gather large datasets across extended periods, making it possible to identify trends, recurrence rates, and risk factors in professional sports[46,47,48,49,50]. The main limitation of this study is the inability to confirm the diagnosis since, in most cases, there is a lack of clinical details seen in medical records or imaging, and the variability of terminology used in the media. Although all included cases were manually checked in English and in a maximum of two other distinct languages, to avoid exclusion or misclassification of injuries. Unlike epidemiological studies, media-based sports medicine research also has the limitation of not allowing inferences of real-world spinal injury prevalence in the broader professional football players population. As a result, we are limited to describing the cases that were reported, rather than concluding spinal injuries' actual prevalence[50]. Despite limitations, media-based data remains a powerful complementary tool in sports medicine[51], especially in sports like football, where injuries are routinely reported and closely followed by the media.

Currently, there is a lack of media-based studies with a focus on spinal injuries, as most of the previous reports address hamstring and ankle strains, and general injuries[9,10]. Previous studies report the challenge of verifying spinal injury diagnosis, emphasizing that media-based data often miss less frequent injuries or injuries of complex nature, like spinal injury[52,53].

In conclusion, this study offers a comprehensive overview of spinal injuries in professional football players, identifying the most frequently reported spinal injuries in our media-based data. While no statistically significant association was found between spinal injuries and playing position or in injury recurrence and the analysed variables, the distribution of spinal injury across severity was statistically different between the injuries, reflecting the recovery demands imposed by different spinal injuries. Notably, analysis of match participation revealed a decline in playing time in the season before the injury and sustained a reduction in the first season post-injury, highlighting the impact of spinal injuries on players' participation in matches and their recovery timelines. Despite inherent limitations, this research emphasizes the value of media-based data in injury surveillance, particularly in underrepresented areas like spinal injuries in football players and supports their ongoing role in sports medicine research.

Future research should aim to establish a control group comprising players matched by playing position tier and world region, to enable a comparative analysis of match participation between injured and non-injured players during injury season (Year 0) and the two season prior to injury (Year -2 and Year -1).

Tables

	Forward	Midfield	Goalkeeper	Defender	Total
N (%)	115 (28.3)	108 (26.5)	59 (14.5)	125 (30.7)	407 (100)
Age at time of injury, years	27.5	28.0	30.8	27.3	28.0
Height, cm	180.8	180.2	188.9	185.0	183.1
Tier (%)					
First	91 (22.4)	82 (20.1)	50 (12.3)	97 (23.8)	328 (78.6)
Second	13 (3.2)	20 (4.9)	7 (1.7)	22 (5.4)	62 (15.2)
Third	1 (2.7)	6 (1.5)	2 (0.5)	6 (1.5)	25 (6.1)
World region (%)					
Europe	80 (19.7)	79 (19.4)	38 (9.3)	91 (22.4)	288 (70.8)
America	22 (5.4)	17 (4.2)	16 (3.9)	26 (6.4)	81 (19.0)
Africa	6 (1.5)	5 (1.2)	0 (0)	3 (0.7)	14 (3.4)
Asia	7 (1.7)	7 (1.7)	5 (1.2)	5 (1.2)	24 (5.9)

Table I Players demographics and baseline characteristics. Data are presented as counts (*N*), percentages (%) or means. Values are represented as percentage of total values.

	***N* (%)**
Lumbago	178 (43.7)
Herniated disk	60 (14.7)
Lumbar fracture	55 (13.5)
Transverse process	20 (4.9)
Spondylolysis	19 (4.7)
Spondylolisthesis	4 (1.0)
Unspecified	12 (2.9)
Lumbar joint inflammation	1 (0.2)
intervertebral joint injury	1 (0.2)
Lumbosacral joint inflammation	1 (0.2)
Unspecified back injury	111 (27.3)
Total	407 (100)

Table II Frequency and percentage distribution of injuries from database. Values are represented as percentage of total value.

	Forward	Midfield	Goalkeeper	Defender	Total
N (%)	44 (24.7)	54 (30.3)	26 (14.6)	54 (30.3)	178 (100)
Age at time of injury, years	28.1	28.6	31.1	27.8	28.6
Height, cm	181.8	181.2	188.3	184.2	183.3
Tier (%)					
First	37 (20.8)	42 (23.6)	22 (12.4)	45 (25.3)	146 (82.0)
Second	2 (1.1)	6 (3.4)	3 (1.7)	6 (3.4)	17 (9.6)
Third	5 (2.8)	6 (3.4)	1 (0.6)	3 (1.7)	15 (8.4)
World region (%)					
Europe	32 (18.0)	39 (21.9)	17 (9.6)	35 (19.7)	123 (69.1)
America	10 (5.6)	10 (5.6)	8 (4.5)	16 (9.0)	44 (24.7)
Africa	2 (1.1)	2 (1.1)	0 (0)	2 (1.1)	6 (3.4)
Asia	0 (0)	3 (1.7)	1 (0.6)	1 (0.6)	5 (2.8)
Severity (%)					
Minor	19 (10.7)	24 (13.5)	10 (5.6)	20 (11.2)	73 (41.0)
Moderate	18 (10.1)	21 (11.8)	11 (6.2)	22 (12.4)	72 (40.4)
Severe	7 (3.9)	9 (5.1)	5 (2.8)	12 (6.7)	33 (18.5)

Table III Players demographics and baseline characteristics, and severity classification for lumbago injury. Data are presented as counts (*N*), percentages (%), or means. Values are represented as a percentage of the total value.

	Forward	Midfield	Goalkeeper	Defender	Total
N (%)	14 (23.3)	10 (16.7)	13 (21.7)	23 (38.3)	60 (100)
Age at time of injury, years	29.9	29.2	30.8	28.3	29.4
Height, cm	183.4	181.1	190.5	184.7	185.1
Tier (%)					
First	12 (20.0)	8 (13.3)	12 (20.0)	19 (31.7)	51 (85.0)
Second	1 (1.7)	2 (3.3)	1 (1.7)	2 (3.3)	6 (10.0)
Third	1 (1.7)	0 (0)	0 (0)	2 (3.3)	3 (5.0)
World region (%)					
Europe	13 (21.7)	9 (15.0)	9 (15.0)	17 (28.3)	48 (80.0)
America	1 (1.7)	1 (1.7)	2 (3.3)	2 (3.3)	6 (10.0)
Africa	0 (0)	0 (0)	0 (0)	1 (1.7)	1 (1.7)
Asia	0 (0)	0 (0)	2 (3.3)	3 (5.0)	5 (8.3)
Severity (%)					
Minor	3 (5.0)	0 (0)	0 (0)	3 (5.0)	6 (10.0)
Moderate	3 (5.0)	2 (3.3)	3 (5.0)	2 (3.3)	10 (16.7)
Severe	8 (13.3)	8 (13.3)	10 (16.7)	18 (30.0)	44 (73.3)

Table IV: Player's demographics and baseline characteristics, and severity classification for herniated disc injury. Data are presented as counts (*N*), percentages (%), or means. Values are represented as a percentage of the total value.

	Forward	Midfield	Goalkeeper	Defender	Total
N (%)	15 (27.3)	17 (30.9)	5 (9.1)	18 (32.7)	55 (100)
Age at time of injury, years	25.3	26.4	32.8	25.6	26.4
Height, cm	178.1	175.2	186.8	186.8	180.9
Tier (%)					
First	11 (20.0)	9 (16.4)	4 (7.3)	12 (21.8)	36 (65.5)
Second	5 (7.3)	8 (14.5)	1 (1.8)	6 (10.9)	19 (34.5)
Third	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
World region (%)					
Europe	7 (12.7)	10 (18.2)	2 (3.6)	13 (23.6)	32 (58.2)
America	4 (7.3)	5 (9.1)	3 (5.5)	5 (9.1)	17 (30.9)
Africa	2 (3.6)	0 (0)	0 (0)	0 (0)	2 (3.6)
Asia	2 (3.6)	2 (3.6)	0 (0)	0 (0)	4 (7.3)
Severity (%)					
Minor	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Moderate	4 (7.3)	3 (5.5)	0 (0)	4 (7.3)	11 (20.0)
Severe	11 (20.0)	14 (25.5)	5 (9.1)	14 (25.5)	44 (80.0)

Table V Player's demographics and baseline characteristics and severity classification for lumbar fracture injury. Data are presented as counts (*N*), percentages (%) or means. Values are represented as percentage of total value.

	Lumbago	Herniated disc	Lumbar fractures	Lumbar joint inflammation	intervertebral joint injury	Lumbosacral joint inflammation	Unspecified back injury	Total
N (%)	178 (43.7)	60 (14.7)	55 (13.5)	1 (0.2)	1 (0.2)	1 (0.2)	111 (27.3)	407 (100)
Player position								
Forward	44 (10.8)	14 (3.4)	15 (3.7)	1 (0.2)	0 (0)	0 (0)	41 (10.1)	115 (28.3)
Midfielder	54 (13.3)	10 (2.5)	17 (4.2)	0 (0)	0 (0)	0 (0)	27 (6.6)	108 (26.5)
Goalkeeper	26 (6.4)	13 (3.2)	5 (1.2)	0 (0)	0 (0)	0 (0)	15 (3.7)	59 (14.5)
Defender	54 (13.3)	23 (5.7)	18 (4.4)	0 (0)	1 (0.2)	1 (0.2)	28 (6.9)	125 (30.7)
Tier								
First	146 (35.9)	51 (12.5)	36 (8.8)	0 (0)	0 (0)	0 (0)	87 (21.4)	320 (78.6)
Second	17 (4.2)	6 (1.5)	19 (4.7)	1 (0.2)	1 (0.2)	1 (0.2)	17 (4.2)	62 (15.2)
Third	15 (3.7)	3 (0.7)	0 (0)	0 (0)	0 (0)	0 (0)	7 (1.7)	25 (6.1)
World region								
Europe	123 (30.2)	48 (11.8)	32 (7.9)	1 (0.2)	0 (0)	1 (0.2)	83 (20.4)	288 (70.8)
America	44 (10.8)	6 (1.5)	17 (4.2)	0 (0)	0 (0)	0 (0)	14 (3.4)	81 (19.9)
Africa	6 (1.5)	1 (0.2)	2 (0.5)	0 (0)	0 (0)	0 (0)	5 (1.2)	14 (3.4)
Asia	5 (1.2)	5 (1.2)	4 (1.0)	0 (0)	1 (2.6)	0 (0)	9 (2.2)	24 (5.9)
Severity								
Minor	73 (17.9)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	8 (2.0)	87 (21.4)
Moderate	72 (17.7)	11 (2.7)	0 (0)	0 (0)	0 (0)	1 (0.2)	46 (11.3)	140 (34.3)
Severe	33 (8.1)	44 (10.8)	1 (0.2)	1 (0.2)	1 (0.2)	0 (0)	57 (14.0)	180 (44.2)

Table VI Player position, tier, world region, severity, and stratified by spinal injuries. Data are presented as counts (*N*) or percentages (%). Values are represented as a percentage of the total value.

	Recurrence within two-year period
N	38
Previous injury	
Lumbago	18
Herniated disc	7
Lumbar fracture	3
Lumbar joint inflammation	0
Intervertebral joint injury	0
Lumbosacral joint inflammation	0
Unspecific back injury	10
Playing position	
Forward	12
Midfielder	10
Goalkeeper	5
Defender	11
Tier	
First	31
Second	4
Third	3
World region	
Europe	27
America	11
Africa	0
Asia	0

Table VII Recurrence of previous spinal injuries distributed by player position, tier and world region. Data are presented as counts (*N*).

	Year -2 / Year -1	Year -1 /Year 0	Year 0 / Year 1	Year -1 / Year 1
Spinal injuries				
Lumbago	ρ = 0.5, $p < 0.001$	R = 0.3, $p < 0.001$	R = 0.3, $p < 0.001$	ρ = 0.1, $p = 0.2$
Herniated disc	R = 0.4, $p = 0.002$	R = 0.3, $p = 0.005$	ρ = 0.3, $p = 0.06$	ρ = 0.3, $p = 0.05$
Lumbar fracture	R = 0.3, $p = 0.03$	R = 0.3, $p = 0.07$	R = 0.4, $p = 0.006$	R = - 0.01, $p = 0.9$
Others	ρ = 0.4, $p < 0.001$	ρ = 0.4, $p < 0.001$	ρ = 0.3, $p < 0.001$	R = 0, $p = 0.7$

Table VIII: *p*-value and Pearson correlation coefficient (R) or Spearman's rank correlation coefficient (ρ) for the various associations of match participation across spinal injuries.

Figures

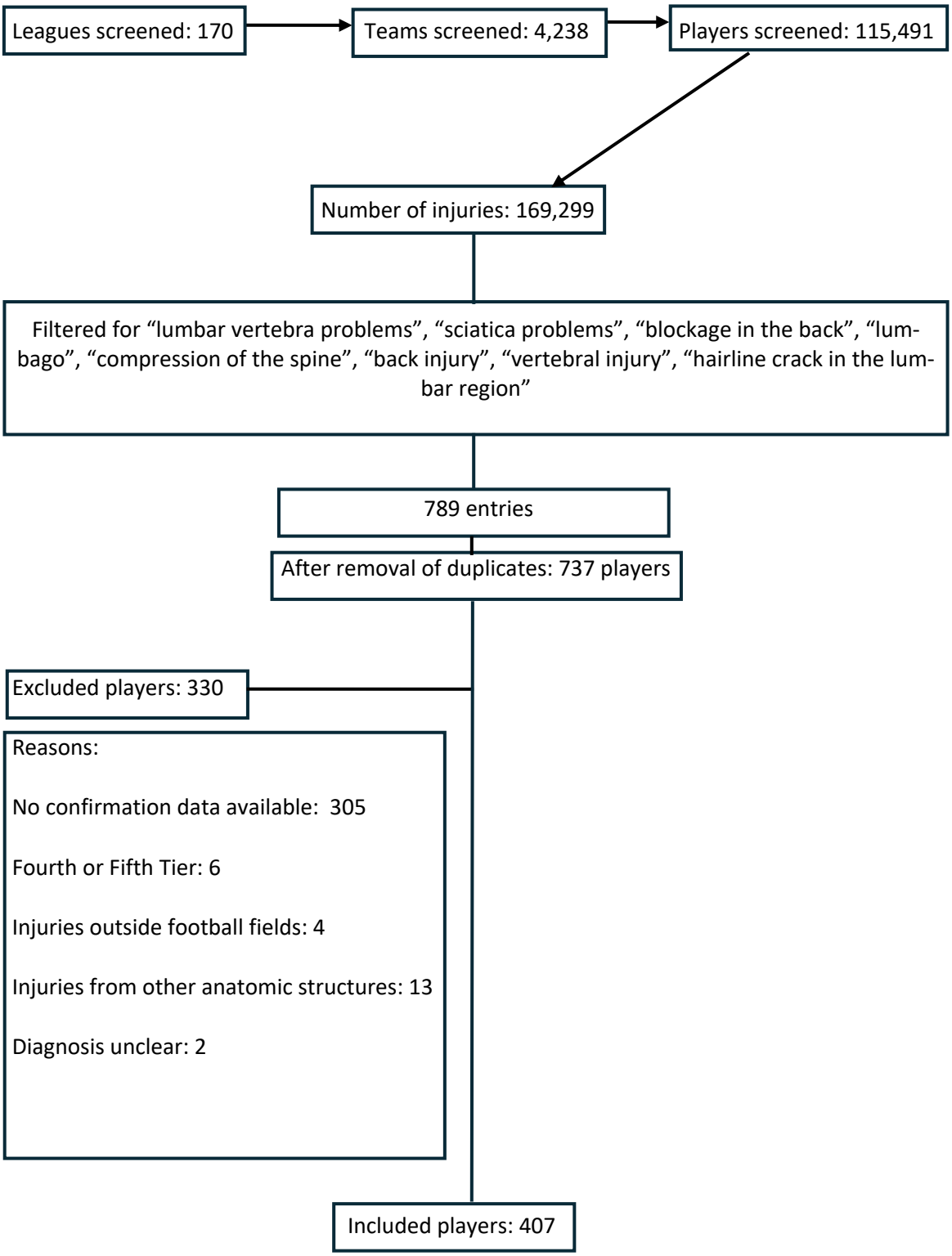

Figure 1: Player screening and selection flowchart, with exclusion criteria.

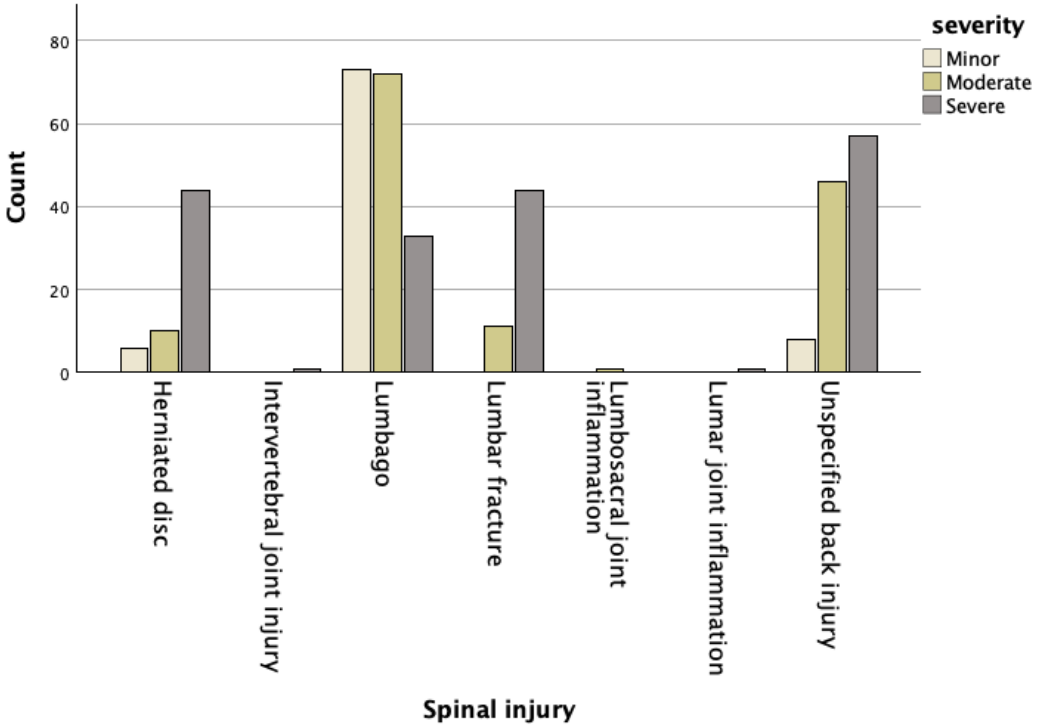

Figure. 2 Bar chart illustrating the distribution of spinal injuries by severity categories

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