Sports Injuries in Individuals with Disabilities: A Bibliometric Analysis and Visualization

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Abstract

Aim: Sports injuries among athletes with disabilities represent a significant public health concern, directly impacting both individual health outcomes and athletic performance. This study examines the structure and evolution of scientific research on sports injuries in disabled populations through comprehensive bibliometric analysis.

Methods: Using the Web of Science database, we identified 274 records from publications indexed in SCI-Expanded, SSCI, AHCI, and ESCI databases through predetermined keyword combinations. After applying inclusion and exclusion criteria following PRISMA guidelines, 216 articles underwent bibliometric analysis.

Results: The analysis revealed that research in this field emerged in the 1990s and accelerated significantly after 2016. Publication peaks coinciding with Paralympic Games years (2012, 2016, 2020) demonstrate the influence of major sporting events on research priorities. Word cloud analysis identified dominant themes including "prospective cohort studies," "consensus statements," and "Paralympic Games." International collaboration network analysis shows the United States, United Kingdom, and Australia leading in publication output, with South Africa emerging as an unexpected central collaborator. The field demonstrates steady growth and increasingly adopts multidisciplinary approaches.

Conclusion: The study provides one of the first comprehensive bibliometric mappings of disability sports injury literature, revealing global research networks and knowledge production centers while establishing a methodological framework for future studies. Strengthening multidisciplinary approaches and expanding international collaborations are critical for improving the health and performance of athletes with disabilities. These results could offer valuable guidance for researchers, clinicians, and sports administrators working in this specialized field.

Keywords: Disabled persons, sports injuries, Paralympic, bibliometric analysis, visualization.

Engelliler ve Spor Sakatlıkları: Bibliyometrik Analiz ve Görselleştirme

Öz

Amaç: Engelli bireylerde spor sakatlıkları hem bireysel sağlık sonuçlarını hem de sporcu performansını derinden etkileyen önemli bir halk sağlığı sorunudur. Bu kapsamda, bu çalışma engellilerde spor yaralanmaları alanındaki bilimsel üretimin yapısını ve gelişimini bibliyometrik analiz yöntemleriyle inceleyerek alana özgü bir değerlendirme sunmayı amaçlamaktadır.

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Yöntem: Web of Science veri tabanında SCI-Expanded, SSCI, AHCI ve ESCI dizinlerinde taranan yayınlardan, önceden belirlenmiş anahtar kelime kombinasyonlarıyla elde edilen 274 kayıt, PRISMA kurallarına uygun olarak dâhil etme ve hariç tutma kriterleri uygulanmış ve nihai olarak 216 makale ile bibliyometrik analiz gerçekleştirilmiştir.

Bulgular: Analiz sonuçları, engellilerde spor yaralanmalarına ilişkin araştırmaların 1990'lı yıllarda başladığını ve 2016 sonrasında belirgin bir artış gösterdiğini ortaya koymaktadır. Paralimpik Oyunlarının düzenlendiği yıllarda (2012, 2016, 2020) gözlemlenen yayın artışları, büyük spor organizasyonlarının araştırma gündemini şekillendirmedeki etkisini ortaya koymaktadır. Kelime bulutu analizleri, "prospektif kohort çalışmalar", "konsensus bildirileri" ve "Paralimpik oyunları" gibi temaların öne çıktığını göstermektedir. Uluslararası iş birliği ağları incelendiğinde, ABD, Birleşik Krallık ve Avustralya'nın en fazla yayın üreten ülkeler olduğu, Güney Afrika'nın ise beklenmedik şekilde merkezi bir rol üstlendiği görülmüştür. Bununla birlikte, genel eğilimin istikrarlı bir büyüme yönünde olduğu ve alanın multidisipliner bir yaklaşımla geliştiği anlaşılmaktadır.

Sonuç: Bu çalışma, engellilerde spor yaralanmaları literatürünün bütüncül bir bibliyometrik haritasını çıkaran ilk kapsamlı çalışmalardan biri olması nedeniyle önemli bir katkı sunmaktadır. Bulgular, küresel araştırma ağlarındaki iş birliklerini ve bilgi üretim merkezlerini ortaya koyarken, gelecek çalışmalar için metodolojik bir referans çerçevesi sağlamaktadır. Özellikle engelli sporcuların sağlık ve performansının iyileştirilmesi için multidisipliner yaklaşımların güçlendirilmesi ve küresel iş birliklerinin artırılması kritik öneme sahiptir. Bu bağlamda, çalışmanın sonuçları akademisyenler, klinisyenler ve spor yöneticileri için yol gösterici niteliktedir.

Anahtar sözcükler: Engelliler, spor sakatlıkları, paralimpik, bibliyometrik analiz, görselleştirme.

Introduction

Individuals with disabilities often lead sedentary lifestyles with reduced levels of physical activity due to their physical, sensory, or intellectual limitations. Over time, this pattern may contribute to various health risks such as increased body weight, impaired metabolic functioning, decreased cardiovascular endurance, and weakened musculoskeletal strength[1]. However, contemporary approaches offer a wide range of implementation options to support the participation of people with disabilities in physical activity. These options range from low-intensity exercises involving activities of daily living to recreational activities and Paralympic sports requiring high performance[2,3].

The landscape of sport for individuals with disabilities has undergone a significant paradigmatic shift, evolving from its origins as a therapeutic intervention toward a sophisticated framework that emphasizes competitive excellence and athletic achievement[4]. Such a fundamental transformation represents a broader reconceptualization of disability sport as a legitimate athletic pursuit. The evolution of the Paralympic Games is a compelling testament to this change—while the inaugural 1960 Games in Rome hosted merely 400 athletes, establishing a modest foundation for a global phenomenon, the Tokyo 2020 Games attracted over 4,400 athletes, demonstrating not only exponential growth in participation but also the increasing legitimacy of Paralympic sport on the international stage (International Paralympic Committee [IPC], 2021). Indeed, this competitive focus has led to remarkable gains in athletic performance— contemporary research documents that Paralympic athletes are

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now achieving performance levels increasingly comparable to those of their non-disabled counterparts, thus challenging traditional assumptions about the limitations associated with disability in competitive sport[5].

Increased sport participation often correlates with heightened injury risk. Sports injuries may result in not only physical health complications but also disruptions to educational and occupational activities, reduced training capacity, and diminished quality of life[6]. Research indicates that injury rates and patterns among athletes with disabilities appear to be largely comparable to those of their non-disabled counterparts[7]. However, certain injuries or medical conditions may occur more frequently in specific populations, potentially due to anatomical and functional characteristics associated with particular disability types[8,9]. For instance, wheelchair athletes commonly experience shoulder girdle injuries, rotator cuff tendinopathies, and nerve entrapments, while athletes with lower extremity amputation frequently encounter skin lesions, prosthesis-related complications, and trauma from falls[10,11], which suggest that disability-specific factors may influence injury susceptibility and distribution in Paralympic sport populations.

These disability-specific injury patterns carry particularly significant implications, as injuries among athletes with disabilities may impact not only athletic performance but also fundamental independent living skills and activities of daily living. This dual impact distinguishes Paralympic athletes from their non-disabled counterparts in meaningful ways. For instance, while a non-disabled javelin thrower with an upper extremity injury faces limitations primarily in training and competition, a wheelchair user with a similar injury may encounter substantial difficulties in essential daily functions such as transfers and wheelchair use[8,9]. Given these unique considerations, comprehensive pre-participation medical evaluation is essential for athletes with disabilities. Sports physicians should conduct thorough assessments that include detailed inquiries about current health status, chronic medical conditions, medications, assistive device usage, and immunization status, particularly the tetanus vaccination[12]. Additionally, obtaining informed consent from both the athlete and family members represents both an ethical and legal requirement in this population[4]. Such preventive measures may enhance participation safety while simultaneously supporting the preservation and development of independent living capabilities, thereby addressing the dual concerns inherent in disability sport participation[6].

It is of particular importance for individuals with disabilities that sport serves not only as an activity to improve physical capacity, but also as a multidimensional tool that supports mental health, increases social participation, and reinforces individual self-confidence[1]. Regular physical activity and participation in sports are reported to positively affect psychosocial well-being, self-efficacy, and social acceptance beyond improving motor skills such as muscle strength, balance, flexibility, and endurance[13]. As evidenced by Paralympic athletes, participation in sports at the professional level may offer important gains in terms of individuals' independent living skills, mental health, and social visibility[6,9]. The effects of injuries could extend beyond the physical level, encompassing psychological and social dimensions. Damage to athlete identity, reduced

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motivation, social isolation, and uncertainties during the rehabilitation process are among the potential negative psychosocial consequences[11,12]. Therefore, developing protective strategies to reduce injury risk in disabled athletes will be an increasingly important research area in the literature[8]. However, although studies examining the performance parameters, injury mechanisms, and post-injury adaptation processes of Paralympic athletes are increasing, there is a limited number of bibliometric analyses that systematically address this field[14]. This study aims to examine the existing literature on sports injuries in individuals with disabilities through bibliometric analysis methods.

Material and Methods

This bibliometric study was designed and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines[15-17]. The literature selection process is visualized in a PRISMA flow diagram (see Figure 1).

Literature Search and Selection

Primary data were sourced from the Web of Science (WoS) Core Collection, encompassing the SCI-Expanded, SSCI, AHCI, and ESCI indexes. A comprehensive search was conducted on June 13, 2025, with no date restrictions. The following search string was executed in the "Topic" field, targeting titles, abstracts, and keywords: ("disability" OR "disabled persons" OR "persons with disabilities" OR "physical impairment" OR "paralympic") AND ("sports injury" OR "sports injuries" OR "athletic injuries" OR "exercise-related injuries" OR "sport-related trauma"). The initial query yielded 274 records. The results were refined by filtering for "Research Article" document types, which reduced the sample to 226. A final filter for English-language publications resulted in 216 articles that were included in the final analysis.

Eligibility Criteria

Inclusion and exclusion criteria were established to ensure the relevance and quality of the literature, guided by the Population, Intervention, Comparators, Outcomes, Study Design (PICOS) framework[18].

Inclusion Criteria: (1) Original research articles; (2) Indexed within the WoS Core Collection; (3) Published in the English language; (4) Directly addressing the topic of sports injuries in individuals with disabilities.

Exclusion Criteria: (1) Non-journal documents, such as conference proceedings, book chapters, and letters; (2) Studies related to non-sports trauma or accidents (e.g., traffic accidents, congenital disorders).

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Data Analysis

Bibliometric analysis was conducted via Biblioshiny, a graphical interface for the Bibliometrix package in R (Version 4.5.0)[15]. The analysis was structured into two components to map the field's intellectual landscape:

Performance Analysis: This involved quantifying scientific output by examining the most productive authors, journals, institutions, and countries, along with the most cited works.

Science Mapping: This involved visualizing the conceptual and social structure of the field through analyses of keyword co-occurrence, thematic evolution, author and country collaborations, and co-citation networks.

Results

The PRISMA flow diagram detailing the systematic selection process of studies from the WOS database is presented in Figure 1. The PICOS criteria were used to determine the eligibility criteria as the research strategy (Table 1).

Figure 1. PRISMA flow chart

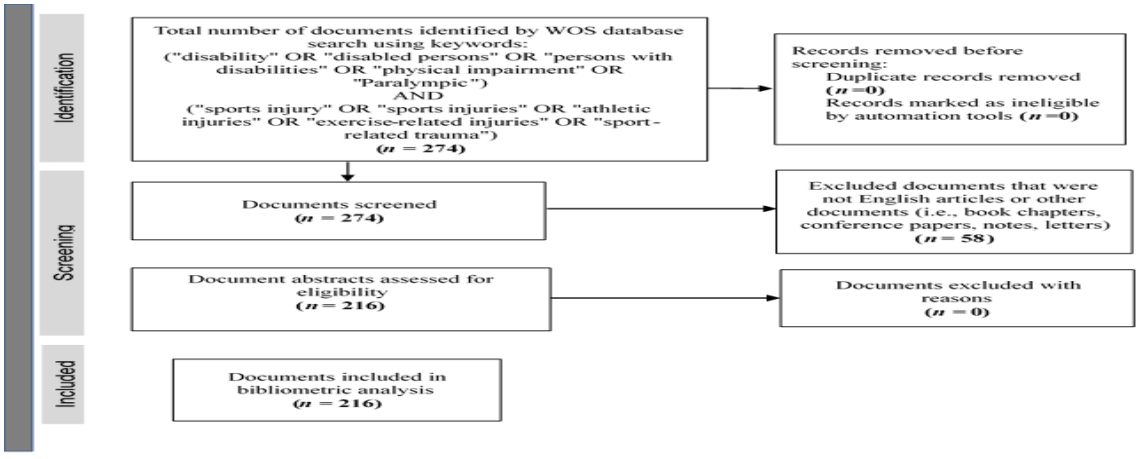

Table 1. Research Strategy Eligibility Criteria (PICOS)

PICOS	Definition
Population	Individuals with disabilities, physical disability, Paralympic athletes, sports injuries, exercise-related injuries. Studies were selected from around the world.
Intervention	Academic approaches to the diagnosis, prevention, and rehabilitation of sports injuries in individuals with disabilities, the relationship between exercise and performance.

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Comparator	Only article-level data comparisons were made: Country of origin of authors, institutional affiliations, keywords, year of publication, most frequently cited journals, keyword co-occurrences, and trend topics.
Outcomes	The relationship between disability and sports injuries, scientific production density, key themes, citation networks, and bibliometric patterns were analyzed.
Study design	Only research articles were included in the analysis.

Table 2. Characteristics of the dataset used for bibliometric analysis

Description	**Results**
Publication Years	1992–2025
Publication Sources	114
Documents	216
Annual Growth Rate (%)	4.29
Average Document Age (Years)	10
Average Citations per Document	31.94
References Analyzed	5,596
Keywords Plus (ID)[a]	594
Author's Keywords (DE)[b]	459
Total Authors	1,062
Single-Authored Documents	13
Average Co-Authors per Document	6.24
International Co-Authorships (%)	28.7

Note. The dataset was compiled from the Web of Science Core Collection.

[a] ID refers to "Identification" keywords indexed by the database.

[b] DE refers to "Descriptor" keywords provided by the authors.

The final dataset created for bibliometric analysis, with descriptive statistics provided in Table 2, consists of 216 articles published between 1992 and 2025 from 114 different sources. The dataset includes only article-type publications ($N = 216$), showing an annual growth rate of 4.29% and an average of 31.94 citations per document. Additionally, the

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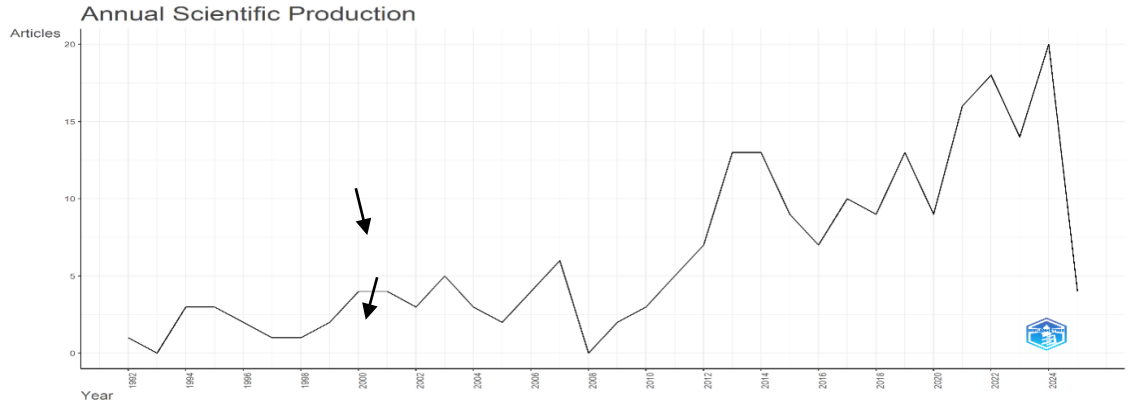
articles included in the analysis contain 5,596 references, as well as 594 Keywords Plus and 459 author-specified keywords.

Figure 2. Annual scientific production



As shown in Figure 2, academic interest in sports injuries among athletes with disabilities has shown steady growth since the first publication in 1992. A total of 86% of the publications have appeared in the last decade (2014-2024), peaking in 2021 with 38 publications. This growth trend reflects increasing academic interest in the topic, triggered by the greater inclusion of para-athletes in competitive sports and the development of disability sports policies.

Figure 3. Corresponding author's countries

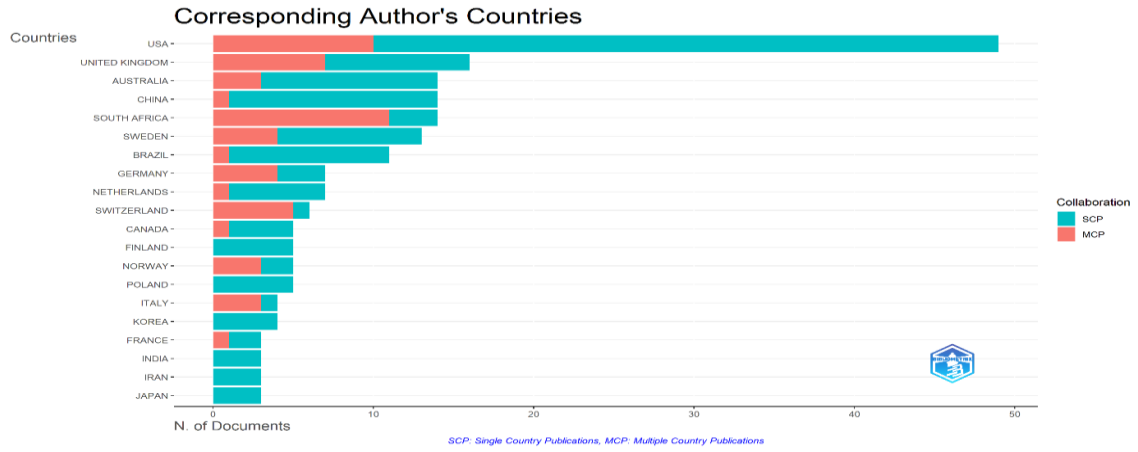


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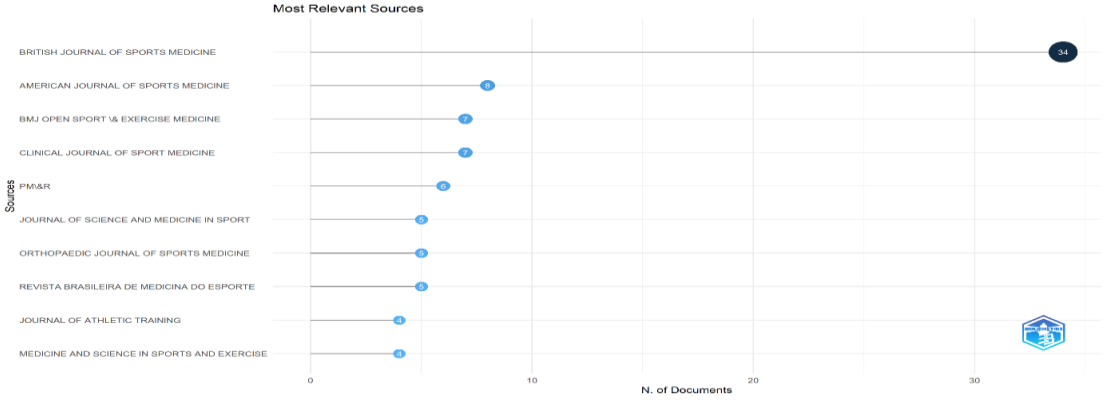
Table 3. Frequency distribution of inter-country collaborations

From	To	Frequency
USA	United Kingdom	20
South Africa	United Kingdom	14
United Kingdom	Canada	13
USA	South Africa	12
South Africa	Germany	11
USA	Germany	11
Switzerland	Norway	10
United Kingdom	Germany	10
United Kingdom	Netherlands	10

Analysis of the corresponding authors' countries (Figure 3) revealed intense academic production from developed nations. The United States (32.4%), the United Kingdom (18.1%), and Australia (11.6%) play a dominant role in this output. International collaborations account for 28.7% of the publications, while single-country publications have a 71.3% share.

Figure 4. Most relevant sources



Source analysis of academic publications in the field of sports injuries in individuals with disabilities indicates a clear concentration in knowledge production. According to the "Most Relevant Sources" data presented in Figure 4, the *British Journal of Sports Medicine*, *American Journal of Sports Medicine*, and *BMJ Open Sport & Exercise Medicine* were among the journals producing the most publications.

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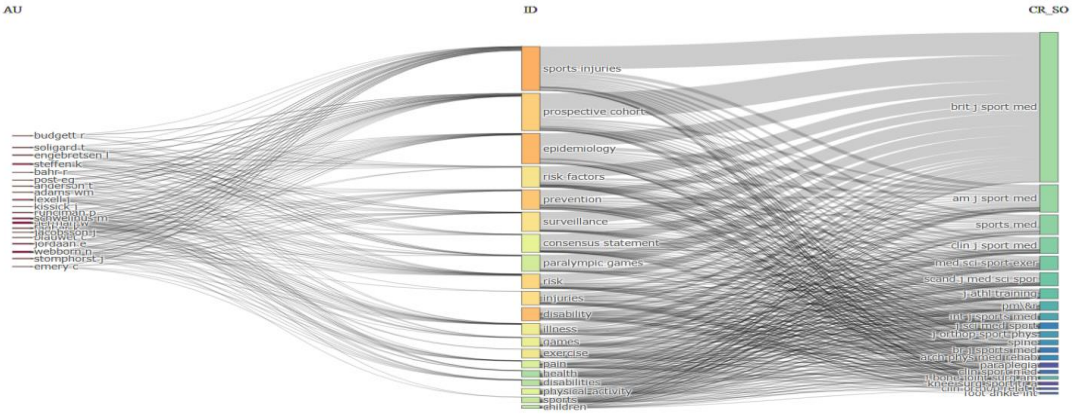
Figure 5. Keywords plus word cloud

The word cloud analysis based on Keywords Plus data (Figure 5) reveals the main research focuses and conceptual structure in the literature on sports injuries in individuals with disabilities. Terms such as "cruciate ligament reconstruction" and "low-back-pain risk-factors" highlight that clinical research in the field is predominantly focused on musculoskeletal injuries.

Figure 6. Three-fields analysis of authors, keywords, and journals



The three-fields analysis in Figure 6 (authors, keywords, and sources) reveals the structural dynamics of the literature on sports injuries in individuals with disabilities. The analysis indicates a strong leadership role for prominent European authors, including Kathrin Steffen and Lars Engebretsen, who are at the forefront of both clinical research—featuring keywords like "prospective cohort"—and epidemiological studies highlighted by terms such as "risk factors" and "Paralympic games."

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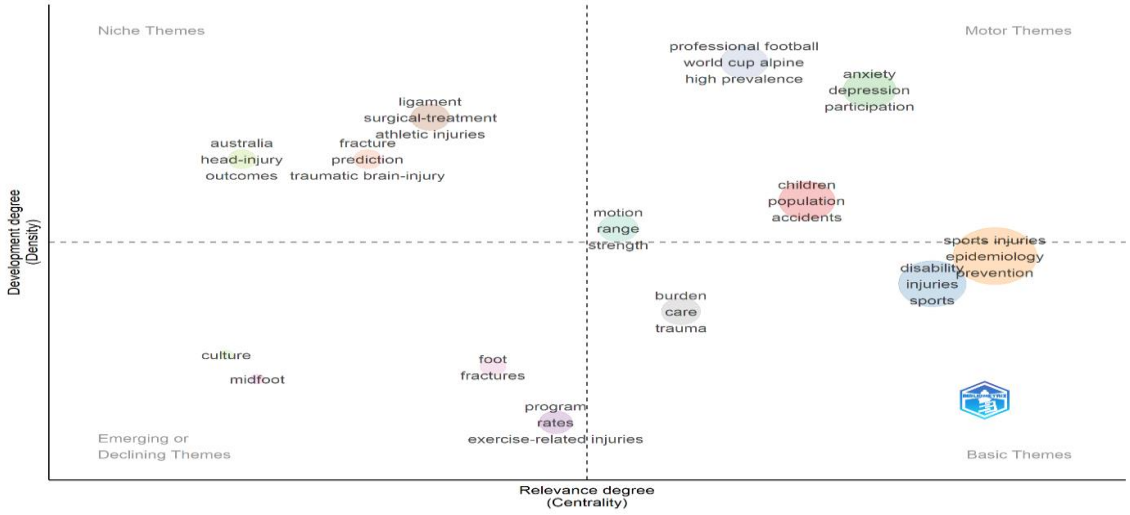
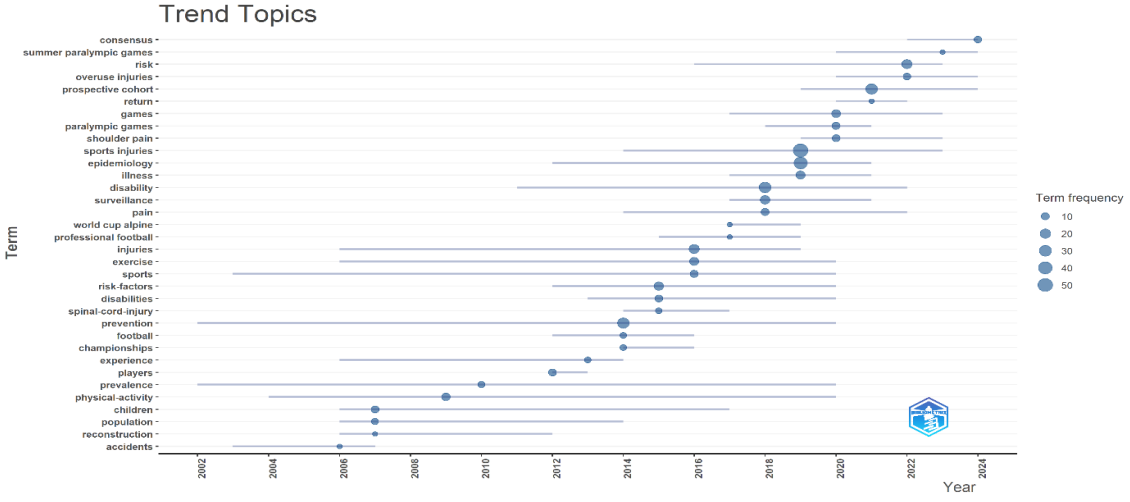
Figure 7. Thematic analysis



The thematic map analysis presented in Figure 7 classifies the research themes in the literature on sports injuries in individuals with disabilities according to their development degree (density) and relevance degree (centrality). The map reveals four main categories: motor themes, niche themes, emerging/declining themes, and basic themes.

In the Motor Themes (Developed Themes) section, high-density topics such as "ligament surgical treatment" and "skull fractures" are seen to represent mature areas of clinical research. The central position of the "outcome prediction in athletic injuries" theme reflects the critical role of prognostic research in the field. The high density and centrality values of these themes indicate that research in these areas is well-developed both quantitatively and qualitatively.

Figure 8. Trend topics



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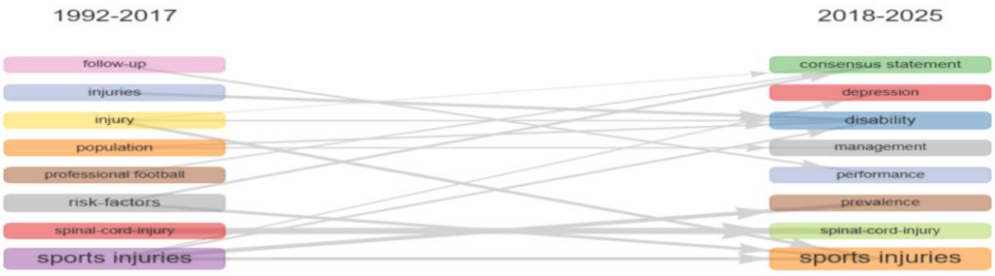
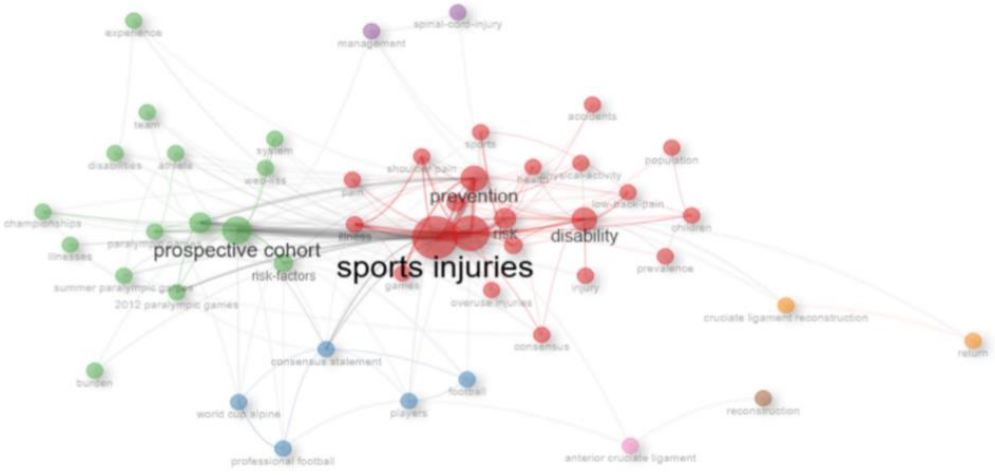
The trend analysis in Figure 8 details the prominent research trends in the field of sports injuries in individuals with disabilities in recent years. The analysis results show that major sporting events such as the "summer Paralympic games" and "professional football" provide important data sources for injury research. Data from the 2012 and 2016 Paralympic games, in particular, are frequently referenced in studies on injury epidemiology in athletes with disabilities.

Figure 9. Thematic evolution analysis



The thematic evolution analysis in Figure 9 shows how research focuses in the field of sports injuries in individuals with disabilities have changed over time. In the 1992-2017 period, research primarily focused on basic clinical topics such as "follow-up studies," "risk-factors," and "spinal-cord-injury." During this period, the intensive study of injury patterns in specific sports like "professional football" is apparent.

Figure 10. Keyword co-occurrence network



The keyword co-occurrence network analysis in Figure 10 systematically reveals the conceptual relationships in the literature. When examining the network structure, three main research clusters clearly stand out. The first, the clinical management and

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rehabilitation cluster, is characterized by strong connections between the terms "anterior cruciate ligament," "ligament reconstruction," and "reconstruction." These findings reflect the central importance of the clinical management of musculoskeletal injuries in the field. The terms "management" and "prevention" within the same cluster indicate a growing academic interest in preventive strategies alongside treatment approaches.

The epidemiological and public health cluster is characterized by the co-occurrence of terms such as "prevalence," "risk factors," "overuse injuries," and "sports injuries." This structure points to the intensity of research aimed at quantitatively assessing the injury burden in athletes with disabilities. The central position of the term "prospective cohort" is an important indicator of the increasing methodological quality of studies in the field. It is also observed that research on the long-term health outcomes of athletes with disabilities is developing within this cluster.

The sports organizations and performance cluster is noteworthy for the dense network of connections formed by terms like "summer Paralympic games," "2012 Paralympic games," "championships," and "professional football." This structure highlights the critical role of major sporting events in providing research data. The terms "performance" and "team" within the cluster reflect the growing academic interest in performance optimization for athletes with disabilities. These findings are important as they show that interest extends not only to the health problems of athletes with disabilities but also to their athletic success.

Discussion

The bibliometric analysis performed in this study reveals the dynamics of scientific production in the field of sports injuries in individuals with disabilities and offers important insights into the field's development. The findings show that the first studies in this area began in the 1990s and that the number of publications has steadily increased over time, with this growth becoming more pronounced after 2016. An examination of the annual fluctuations in publication numbers shows relative increases during Paralympic years (2012, 2016, 2020)—while research in the field is influenced by major sporting events, it demonstrates more of a continuous and stable development.

Geographical distribution analyses reveal that knowledge production is centered in the USA (32.4%), the United Kingdom (18.1%), and Australia (11.6%), while also showing that South Africa unexpectedly plays a central role in international collaborations, suggesting that developing countries can make significant contributions to global research networks in specific areas of expertise. However, the 71.3% rate of single - nation publications also indicates a need to increase international collaborations.

Thematic analyses have shown that the research focus has evolved over time from a clinical perspective to more holistic approaches. Keyword co-occurrence network analyses, in particular, revealed three main research clusters: (1) The clinical management and rehabilitation cluster ("anterior cruciate ligament," "ligament reconstruction"), (2) The epidemiological and public health cluster ("prevalence," "risk

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factors"), and (3) The sports organizations and performance cluster ("Paralympic games," "professional football"). This clustering reflects the multidisciplinary nature of research in the field. The central position of the term "prospective cohort" is an important indicator of increasing methodological quality.

Conclusion

This bibliometric study provides one of the first systematic mappings of the sports injury literature in individuals with disabilities, covering 216 articles published between 1992 and 2025. The findings demonstrate a field in steady growth, shaped by major Paralympic events, led by a small number of high-income countries, and organized around three coherent thematic clusters. The analysis, however, also illuminates notable research gaps. Topics such as preventive strategies, gender-specific issues, and particularly the pediatric population have been considerably under-researched, a conclusion reinforced by the thematic isolation of the keywords "disability" and "children." These findings point to several critical directions for future inquiry. Specifically, there is a need to develop and evaluate injury prevention programs tailored to athletes with disabilities through randomized controlled trials. Furthermore, detailed investigations into the unique injury risk factors for pediatric and female athletes with disabilities are required to address these demographic gaps. To ensure a more globally representative understanding, it is also essential to strengthen research capacity in developing countries and foster greater international collaboration. Finally, to bridge the gap between research and practice, efforts must be made to create and disseminate clear implementation guidelines that translate clinical findings into practical application.

By providing a detailed trajectory of research on sports injuries in individuals with disabilities, this study constitutes a structured reference point that may guide future inquiries. Fostering robust multidisciplinary and international collaborations is essential and could play a pivotal role in improving the long-term health and athletic success of this population.

Ethics Approval and Consent to Participate

The present research is based on the analysis of documents contained within a database, which is accessible online via a software program. Consequently, the protocol for obtaining Ethics Committee approval was not followed.

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