

Current Panorama and Challenges in Preventing Ankle Injuries in Athletes

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ABSTRACT

Introduction: The review addresses ankle injuries in athletes, highlighting their prevalence and impact on sports performance. Injuries, such as sprains and fractures, result from a variety of factors, including direct trauma and sudden movements. Prevention is crucial and involves specific training, use of appropriate equipment and innovative strategies.

Objective: Check current challenges in preventing ankle injuries in athletes.

Methods: This study constitutes a systematic review, classified as exploratory and descriptive. The preparation of the research was a bibliographical search in electronic databases on methods associated with RSL (Systematic Literature Review) and the applications of SMARTER (*Simple Multi-Attribute Rating Technique using Exploiting Rankings*). The study methodology is a systematic, exploratory and descriptive review, using qualitative and quantitative methods. The bibliographic search covered several databases, with well-defined inclusion and exclusion criteria. Data analysis was conducted by three independent researchers.

Results and Discussion: The results revealed 399 articles, 11 of which were included in the review. Various studies addressed diagnostic, preventive and therapeutic methods. Interventions such as weight-bearing MRI, neuromuscular training programs, low-friction adhesives and proprioceptive training stand out. The understanding of radiographic patterns and the analysis of innovative techniques, which enrich the preventive approach.

Conclusion: The conclusion highlights important insights, highlighting the need for more comprehensive research, standardization and long-term studies. Despite limitations, promising advances indicate a positive shift in ankle injury prevention, requiring a collaborative approach between researchers, healthcare professionals and athletes.

KEYWORDS: Injuries in athletes. Joint injury. Ankle injury.

ARTICLE DETAILS

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INTRODUCTION

Ankle injuries are a common concern in the sporting scenario, affecting athletes from different disciplines (GALLI et al., 2023). The ankle is a complex joint composed of ligaments, tendons and bones, playing a crucial role in the stability and mobility of the foot (ANGIN; DEMIRBÜKEN, 2020). Injuries can occur due to several factors, such as direct trauma, sprain, overload or sudden movements during sports (SÁ et al., 2022).

One of the most common injuries is an ankle sprain, characterized by excessive stretching or rupture of the ligaments that support the joint. (HERZOG et al., 2019). This usually occurs when the foot is twisted inappropriately, resulting in pain, swelling and, in more serious cases, instability (KARLSSON et al., 2023). Athletes who play sports that involve changes of direction and jumping, such as tennis, basketball and football, are particularly susceptible to this type of injury (ŠARABON et al., 2020).

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In addition to sprains, fractures are also common in ankle injuries, especially in contact or high-intensity sports (PRAKASH, 2020). Fractures can vary in severity, from small cracks to more complex fractures that require surgical intervention (MCKEOWN et al., 2020). Symptoms include sharp pain, swelling and difficulty bearing weight on the affected foot (GYFTOPOULOS; WOERTLER, 2021).

Preventing ankle injuries in sports is fundamental and involves implementing specific training programs to strengthen and stabilize the joint (KAMINSKI; NEEDLE; DELAHUNT, 2019). Proper use of protective equipment, such as appropriate sneakers and ankle supports, also plays a significant role in reducing the risk of injury (HODGKINS; WESSLING, 2021).

The scientific literature has witnessed increasing attention to diagnostic, preventive and therapeutic strategies that aim to mitigate the impacts of these injuries and promote the musculoskeletal health of individuals involved in intense physical activities (LEWIS et al., 2019). In this context, this review highlights a series of recent studies that address different approaches to the diagnosis, prevention and treatment of ankle injuries in different populations and sporting scenarios.

METHODS

This study constitutes a systematic review, classified as exploratory and descriptive. The preparation of the research was a bibliographical search in electronic databases on methods associated with RSL (Systematic Literature Review) and the applications of SMARTER (*Simple Multi-Attribute Rating Technique using Exploiting Rankings*). The work carried out is of a qualitative and quantitative nature. Qualitative data analysis was carried out intuitively and inductively during the survey of the theoretical framework. It is also quantitative through the use of the multi-criteria method. In addition, there is also a numerical experimental study in order to simulate an article selection situation based on the observed criteria.

Based on bibliographical research, they were located in the following databases: *US National Library of Medicine* (PubMed), Web of Science; Science Direct (Elsevier); Wiley; SpringerLink; Taylor and Francis and EBSCO. In addition, searches were carried out using bibliographic references of studies that relevantly addressed the topic on the *Google Scholar search platform* (Google, USA).

The search in the databases was carried out using the terminologies registered in the Health Sciences Descriptors

created by the Virtual Health Library developed from the *Medical Subject Headings of the US National Library of Medicine*, which allows the use of common terminology in Portuguese, English and Spanish. The present study sought to investigate the literature on the main challenges in preventing ankle injuries in athletes. To this end, the descriptors "Prevention; Ankle Injury and Athletes", initially in English, and additionally in Spanish and Portuguese.

As a tool to support decision-making in the selection and prioritization of articles, a set of criteria were considered essential to represent the state of the art of the topic under study. This method has the following characteristics: (i) rigorous logic allows the method to be accepted as a decision support tool; (ii) simple to understand and apply with easy-to-interpret results.

References from selected works were also searched for other documents of potential interest. Once qualified for full-text review, articles were included in the qualitative review if they met the following inclusion criteria: a) contained data on ankle injury prevention; b) that occur in athletes. Articles were excluded if they were reports, banners or conference abstracts.

Three independent researchers extracted data from articles that met the inclusion criteria and recorded them in a "Data Extraction Form" generated in Microsoft Excel about the challenges in preventing ankle injuries in athletes. From this form, the authors and year of publication, title, abstract, population, sample size (n), methods and outcome of the studies were included, which will be shown in the results in table 1. There was no review of confidential health information and the study was non-interventional. Therefore, ethics committee approval was not necessary. In the end, the result obtained totaled 11 articles that covered the desired characteristics for the study.

RESULTS

A comprehensive systematic search of the literature yielded a total of 399 articles pertaining to key challenges in preventing ankle injuries in athletes. From this, the SMARTER method (*Simple Multi-Attribute Rating Technique using Exploiting Rankings*) was chosen. Of these studies, 90 articles were suitable for full-text screening and 52 articles were included for data extraction. Of these, 15 studies were excluded due to data overlap. Here, 11 articles were included for systematic review. Figure 1 describes the strategy for selecting articles on the topic in question, summarized in Table 1.

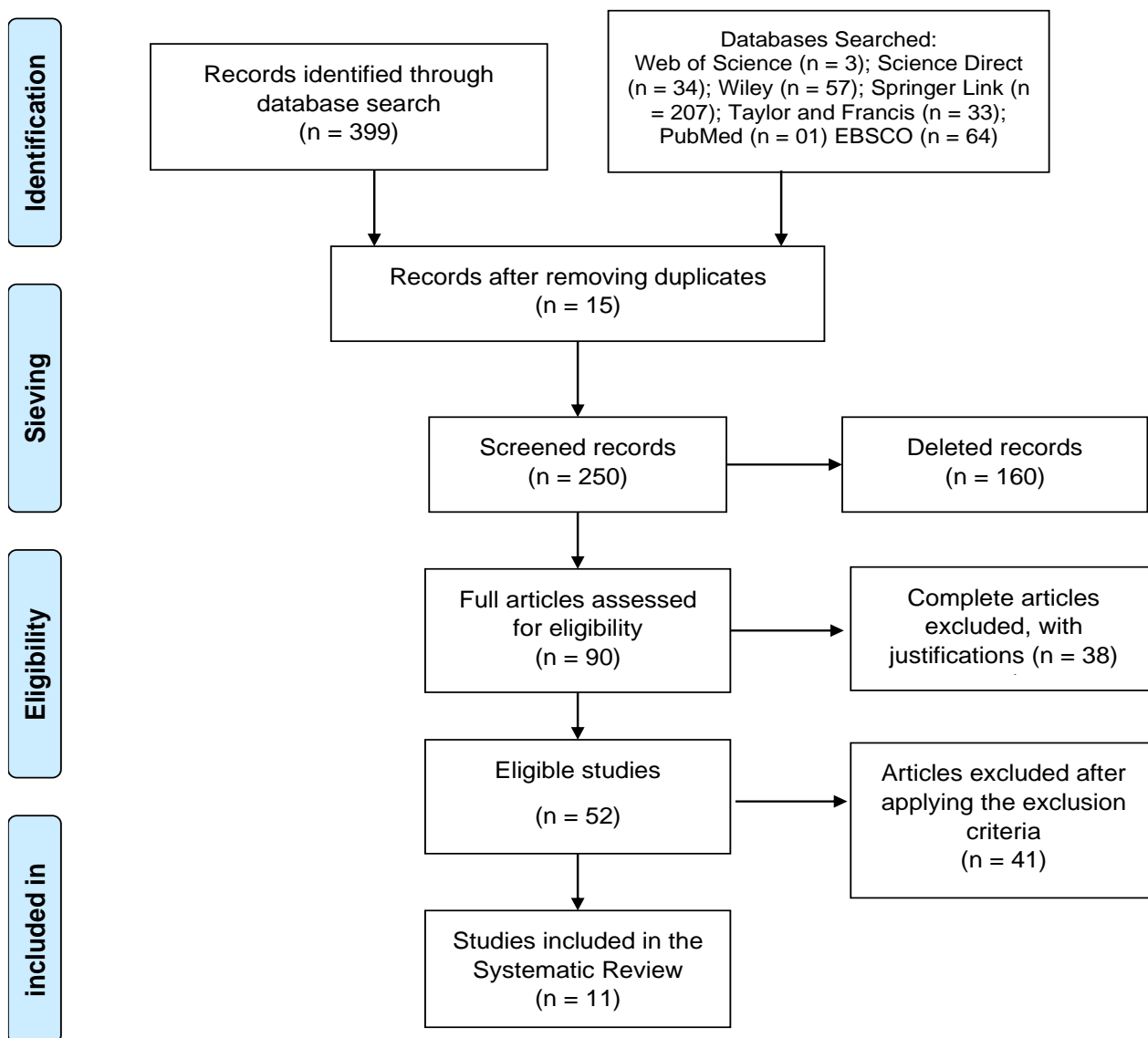


Figure 1. Article search strategy

Author	Title	Summary	Population	Sample size	Methods	Outcome
CAMPBELL et al. (2023)	Augmented Stress Weight-Bearing CT for Evaluation of Subtle Tibiofemoral Syndesmotom Injuries in the Elite Athlete	Syndesmotom stress weight-bearing MRI can help diagnose syndesmotom injuries in elite athletes, potentially preventing late adverse sequelae.	Men's college soccer player, 21 years old	1	Case report	Usefulness of CT with syndesmotom stress in the diagnosis of dynamic instability of the syndesmosis in athletes
TAFTI; DAVIS; RUSSELL (2020)	Radiographic Imaging of Parachuting-Related Ankle Fractures: Case Series	Ankle braces have decreased the incidence of ankle injuries among skydivers, and	Patients who have suffered landing-related bone fractures during skydiving.	10	Randomized clinical trial	Ankle fracture radiographic patterns

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			understanding radiographic fracture patterns can aid in the initial assessment of ankle injuries.				
DEWAR et al. (2021)	EMG Activity with Use of a Hands-Free Single Crutch vs a Knee Scooter		The hands-free crutch (HFSC) demonstrated increased peak EMG activity in most muscle groups tested compared to the knee scooter.	Uninjured young adults	30	Randomized clinical trial	Maximum and average muscle activity, device preference, perceived exertion
EMERY et al. (2022)	The "SHRed Injuries Basketball" Neuromuscular Training Warm-up Program Reduces Ankle and Knee Injury Rates by 36% in Youth Basketball		The Shred Injuries Basketball program was associated with a 36% lower rate of ankle and knee injuries in youth basketball players.	Youth basketball players ages 11 to 18 in Calgary, Canada	94	Randomized clinical trial	High rate of ankle and knee injuries
FALLAHI FARRASH; SHEIKHHOSEINI; BABAKHANI, (2020)	Effect of 8 Weeks of Functional Exercise on Soft Surfaces on Balance and Electromyographic Activity of Selected Muscles in Female Taekwondo Athletes		Eight-week functional taekwondo training on soft surfaces increased balance and improved electrical activity of the medial gastrocnemius muscle, potentially preventing ankle injuries.	Female taekwondo athletes	16	Randomized clinical trial	Improved balance, electromyographic activity of various muscles
CHOI; LEE (2020)	Immediate Effect of Balance Taping Using Kinesiology Tape on Dynamic and Static Balance after Ankle Muscle Fatigue		ABT can help prevent ankle injuries in individuals who experience muscle fatigue around the ankles after sports and daily activities.	Adults (men and women)	31	Randomized clinical trial	Immediate improvements in dynamic and static balance after ankle balance taping.
LYSDAL et al. (2021)	Does the Spraino low-friction shoe patch prevent lateral ankle sprain injury in indoor sports? A pilot randomized		Spraino, a low-friction adhesive attached to athletic shoes, reduced the risk of lateral	Sub-elite indoor sports athletes with anterior lateral ankle sprain	510	Randomized clinical trial	Incidence rate and severity of lateral ankle sprains, lost time due to injury, minor damage resulting from the use of Spraino.

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	controlled trial with 510 participants with previous ankle injuries	ankle sprains and lost time, with only some minor damage reported.				
MAROTTA et al. (2023)	Efficacy of Proprioceptive Training on Plantar Pressure and Jump Performance in Volleyball Players: A Proof-of-Principle Study	Proprioceptive mat training can improve jumping performance and reduce heel fat microtrauma and the rate of ankle injuries in volleyball players.	Adult semi-professional volleyball players	19	Randomized clinical trial	Barefoot Plantar Pressure, Countermovement Jump Performance, Squat Jump Performance
MONSOUR et al. (2021)	Fibularis Intersection Syndrome - A Rare Cause of Lateral Foot Pain in Runners: A Case Report	POCUS is important for accurately diagnosing and treating ankle injuries as it helps determine appropriate treatment and management.	Young male runner with side ankle pain	1	Case report	Accuracy of Point-of-Care Ultrasound (POCUS) in Diagnosing Foot and Ankle Injuries
YU (2022)	Effect of Ankle Proprioception Training on Preventing Ankle Injury of Martial Arts Athletes	Proprioceptive ankle training can improve the dynamic and static balance of martial arts athletes, effectively preventing the occurrence of ankle injuries.	Martial arts athletes, men and women.	16	Randomized clinical trial	Dynamic and static balance of martial arts athletes, occurrence of ankle injury, stability index in the anterior and posterior directions.
AYYADURAI et al. (2021)	Effectiveness of Single Platelet-rich Plasma Injection and Rehabilitation in the Management of Calcaneocuboid Syndrome: A Case Series	Single injection of platelet-rich plasma (PRP) combined with rehabilitation is effective in treating calcaneocuboid syndrome.	Patients with calcaneocuboid syndrome, including athletes and non-athletes.	6	Case report	Visual analog scale (VAS) scores, Foot and Ankle Disability Index (FADI) scores

Source: The author, 2023.

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DISCUSSION

Ankle injuries present a significant challenge for athletes, especially those involved in high-impact sports. In this context, several studies have explored diagnostic strategies and preventive interventions. We will highlight some of these studies and discuss their contributions to understanding and preventing ankle injuries.

The study by Campbell et al. (2023), investigated the effectiveness of weight-bearing and syndesmotic stress MRI in detecting syndesmotic injuries in elite athletes. The results suggest that this approach may be crucial for diagnosing dynamic instability of the syndesmosis, potentially preventing late adverse sequelae. This study highlights the importance of advanced imaging techniques in the evaluation of specific injuries in high-performance athletes, with an advanced MRI approach standing out as a valuable tool in the early identification of injuries, potentially preventing late adverse sequelae and optimizing the process of rehabilitation.

In contrast, Tafti's work ; Davis; Russell (2020), addressed ankle injuries among skydivers, focusing on reducing the incidence through the use of ankle braces. The study highlighted the relevance of understanding radiographic fracture patterns in the initial assessment of these injuries, contributing to more effective interventions.

Dewar et al. (2021), compared the use of hands-free crutches with knee scooters, showing an increase in EMG activity with the crutches, suggesting benefits in terms of muscular activity. This study provides valuable insights for choosing supportive devices during rehabilitation.

The "SHRed Injuries Basketball" program developed by Emery et al. (2022), demonstrated a 36% reduction in ankle and knee injury rates in youth basketball players. This result highlights the effectiveness of specific neuromuscular training programs in reducing injuries in high-risk populations.

Fallahi Farrash; Sheikhhoseini; Babakhani (2020) investigated the effect of functional training on soft surfaces in taekwondo athletes, observing improvements in balance and electromyographic activity of several muscles. This innovative approach may be a promising strategy for preventing ankle injuries.

The study by Lysdal et al. (2021), introduced Spraino, a low-friction adhesive for athletic shoes, which has been shown to reduce the risk of lateral ankle sprains. This method can be considered a simple but effective intervention in preventing injuries in sub-elite athletes.

The research by Marotta et al. (2023), focused on proprioceptive training in volleyball players, showing improvements in jumping performance and the reduction of microtraumas of heel fat. This intervention can be crucial for volleyball athletes, whose performance often involves intense jumping.

Studies like Choi's; Lee (2020), highlighted the immediate effectiveness of balancing with kinesiology tape

after muscle fatigue, providing a practical intervention to prevent ankle injuries in specific situations.

Yu (2022) and Monsour et al. (2021), addressed the importance of proprioceptive training and ultrasound in the diagnosis and prevention of ankle injuries, respectively, in martial arts athletes and runners.

Finally, the study by Ayyadurai et al. (2021), evaluated the effectiveness of a single injection of platelet-rich plasma combined with rehabilitation in the treatment of calcaneocuboid syndrome.

Tafti et al. (2020), in turn, explore the radiographic patterns of fractures related to landing during skydiving, aiming to contribute to a more effective initial assessment of ankle injuries among skydivers. Detailed understanding of these radiographic patterns not only expands knowledge about the specific injuries associated with skydiving, but also highlights the importance of personalized treatment and prevention strategies.

Furthermore, therapeutic and preventive interventions are also explored in recent literature. Studies such as that by Farrash et al. (2020) and Emery et al. (2022), investigate the effectiveness of functional and neuromuscular training programs in reducing ankle injury rates in taekwondo athletes and youth basketball players, respectively. Findings from this research not only highlight the importance of implementing preventative strategies specific to each sport modality, but also underscore the need for comprehensive, personalized approaches to optimize performance and reduce the risk of injury.

Other studies, such as that by Hyun-su Choi et al. (2020), examine the immediate impact of techniques such as balance taping on dynamic and static balance following muscle fatigue around the ankles. The immediate and targeted approach not only enhances understanding of the role of these interventions in the management of ankle injuries, but also highlights the importance of rapid and effective interventions to optimize post-injury recovery.

Drawing on this diverse research landscape, this review seeks to understand the latest trends, knowledge gaps, and potential future directions in the management of ankle injuries, offering a comprehensive overview of the current state of research in this specific field. The compilation and critical analysis of these studies contribute not only to a deeper understanding of existing strategies, but also to the identification of gaps and the definition of future agendas, aiming to continually improve the multidisciplinary approach to the care of ankle injuries.

In summary, the reviewed literature highlights a variety of innovative and effective approaches to the prevention and treatment of ankle injuries. These studies offer valuable knowledge for healthcare professionals, coaches and athletes, contributing to more comprehensive strategies for managing these injuries.

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FINAL CONSIDERATIONS

The studies reviewed offer insights important information on innovative strategies to prevent ankle injuries in athletes, emphasizing personalized and multidisciplinary approaches. Weight-bearing and syndesmotic stress MRI, proposed by Campbell et al. (2023), stands out as a promising technique for early diagnosis of syndesmotic injuries in elite athletes, mitigating possible complications.

However, limitations such as diversity in samples and methodologies, as well as the lack of long-term studies, highlight the need for standardization and more comprehensive research. Despite this, innovations such as the neuromuscular programs of Emery et al. (2022) and low-friction adhesives from Lysdal et al. (2021), point to a positive change in the prevention of ankle injuries.

To move forward, a comprehensive approach is crucial and collaborative, integrating clinical data, biomechanics and psychosocial factors. Long-term follow-up studies are essential to assess the sustained effectiveness of these interventions. Therefore, continued collaboration between researchers, healthcare professionals and athletes are critical to driving significant advances in preventing ankle injuries and promoting lasting health and athletic performance.

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