v. 5, n. 3, 2025

International Journal of Health Science

Acceptance date: 09/01/2025

INCIDENCE OF INJURIES IN RESISTANCE TRAINING: RISK FACTORS AND MOST AFFECTED BODY AREAS

Marcos Vinicius Nascimento da Silva
Medical student at the Universidade de Vassouras (UNIVASSOURAS), Vassouras-Rio de Janeiro

Bruno Coutinho de Noronha
Professor at the Faculdade de Medicina de Petrópolis (FMP), Petrópolis-Rio de Janeiro

Ana Júlia Ayres Souza
Medical student at the Faculdade de Medicina de Petrópolis (FMP), Petrópolis-Rio de Janeiro

João Luiz Ribeiro Caffaro
Medical student at the Faculdade de Medicina de Petrópolis (FMP), Petrópolis-Rio de Janeiro

Maria Eduarda Lopes Cedeçari
Medical student at the Faculdade de Medicina de Petrópolis (FMP), Petrópolis-Rio de Janeiro

Mariana Hanna Fialho Santos
Medical student at the Faculdade de Medicina de Petrópolis (FMP), Petrópolis-Rio de Janeiro

Introduction: Resistance training, popularly known as bodybuilding, is widely recognized for its benefits in improving muscle strength, density and metabolic control. However, the increase in its practice has led to an increase in musculoskeletal injuries, especially in areas such as the shoulders, lumbar spine and knees, which are associated with overload, inadequate technique and lack of warm-up. *Objective: To* identify injuries associated with resistance training, focusing on mechanisms, affected areas and risk factors. *Method:* A systematic review of the literature was carried out using the Medline, BVS and SciELO databases, applying descriptors such as "Trauma in Athletes" and "Resistance Training". Primary studies published between 2019 and 2023 were included, and articles that were not full--text, out of period or not related to the topic were excluded. *Results:* The search resulted in 517 records, of which, after applying the exclusion criteria, 4 studies were included. These studies identified that the most common resistance training injuries occur in the shoulder, lumbar spine and knees. Movements such as squats and deadlifts were the most associated with injuries. *Discussion:* We analyzed studies on frequent injuries in resistance training practitioners, occurring especially when the technique is inadequate or rehabilitation is not followed. Sheikh et al. (2021) say that lack of proper recovery can cause functional deterioration and persistent symptoms. Batterson et al. (2020) observed a high rate of injuries in HIFT practitioners, with emphasis on the knees and back, while Teixeira et al. (2020) correlated longer practice time and competitions with a higher risk of injury. Chen et al. (2023) showed that functional training has a lower injury rate compared to traditional strength training. *Conclusion:* Adopting a preventive approach, including technique correction and proper periodization, is essential to minimize the risk of injury in resistance training. More studies are needed to develop guidelines that promote practitioner safety.
Keywords: Resistance training; Injuries; Trauma in athletes; Strength exercises.

INTRODUCTION

Resistance training, also known as bodybuilding, has become a fundamental practice for both physical conditioning and health promotion, and is widely recommended for improving muscle strength, bone density, body composition and metabolic control. With the popularization of this form of exercise, especially among individuals seeking to increase muscle mass and athletic performance, there has been a proportional increase in the incidence musculoskeletal injuries associated with this practice (Smith et al., 2019). Understanding the most common types of injuries and the mechanisms involved is essential for the prevention and effective management of these problems, both for health professionals and practitioners.

Injuries in resistance training are generally related to excessive overload, poor execution technique, lack of adequate warm-up and muscle imbalances (Brown & Lee, 2021). Among the most frequent injuries are muscle strains, tendinopathies, ligament injuries and joint problems, particularly in the shoulder, lumbar spine and knee areas (Anderson et al., 2020). In addition, the inappropriate use of high loads and the lack of periodization in training can aggravate the risk of overtraining injuries, where the muscle or joint is overloaded beyond its recovery capacity (Sharma & Roberts, 2020).

Studies suggest that the most common injuries vary according to the type of exercise performed, with compound exercises such as squats and deadlifts posing a greater risk to the lumbar spine, while upper limb exercises such as bench presses and developmental exercises have a higher prevalence of shoulder injuries (Hibbert et al., 2018). Understanding

these injury patterns allows for the implementation of more effective preventive strategies, such as improving technique, making adjustments to periodization and strengthening stabilizing muscles.

Therefore, early identification of signs of overload and the development of injury prevention programs are essential to ensure the safety of resistance training . In addition, an integrated approach that includes biomechanical assessments, postural corrections and education on the importance of proper recovery can minimize the occurrence of injuries and improve the athletic performance of individuals involved in this type of training (Rivas et al., 2019).

OBJECTIVES

Injury research identifies and analyzes the most frequent injuries associated with resistance training, addressing their mechanisms, the areas of the body most affected and the risk factors related to inadequate practice. In addition, through this identification, we aim to provide information that will help adjust and improve training programs in order to minimize the risk of injury, improve the performance of practitioners and promote safety in sports practice.

METHOD

This is a systematic review of the literature (SR), carried out through six stages: Identification of the topic and formulation of the research question; Bibliographical research and sampling; Categorization of studies; Evaluation of studies; Interpretation of results and synthesis of knowledge.

The guiding question was formulated using the acronym PICOS to obtain greater sensitivity in retrieving studies that answered the research question: P (patients/context): individuals who practice resistance training; I (intervention): refers to the analysis of the different types of exercises and loads used during training; C (comparison): other training methods or with groups that don't follow structured exercise protocols; O (outcome): incidence and types of injuries identified; S (type of study): Experimental or quasi-experimental studies. Thus, the following guiding question was formulated: "What are the most frequent injuries in individuals who practice resistance training?".

To search for articles in the literature, the following databases were searched: Medical Literature Analysis and Retrieval System online (Medline) and Virtual Health Library (BVS). The Scielo portal was also used for the same purpose. The following descriptors and their combinations in Portuguese and English were used to search for the articles: "Trauma in Athletes", "Resistance Training", while the keywords were "Injuries" and "Strength Exercises". The inclusion criteria defined for the selection of articles were: articles published in Portuguese and English; full articles that include courses in the medical field and indexed in the databases in the years 2019 to 2023, being primary articles. The exclusion criteria defined were: articles that do not have a full text; articles in summary; articles that do not address the topic; articles that fall outside the time frame of 2019 to 2023, duplicate articles and review articles.

RESULTS

The bibliographic search was conducted using specific descriptors and keywords to identify studies on the most frequent injuries in resistance training practitioners. The Virtual Health Library (VHL) used the descriptors "Trauma in Athletes" and "Resistance Training" from DECS/MeSH in Portuguese and English, combined with the Boolean operator AND. On the SciELO portal, the search used the keywords "Injuries" and "Strength Exercises", also with the Boolean operator AND in Portuguese.

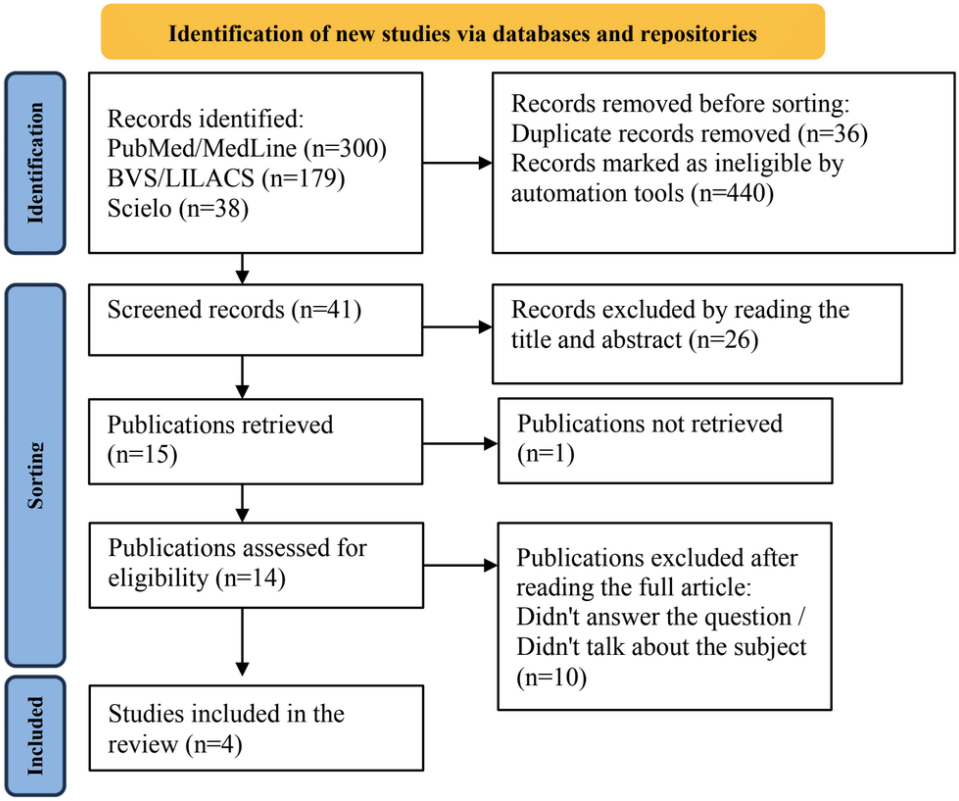

Figure 1: PRISMA flowchart

Source: Own elaboration

The search resulted in the identification of the following records: 300 in PubMed/MedLine, 179 in BVS/LILACS and 38 in SciELO, totaling 517 records. After the inclusion and exclusion criteria were met, the following records remained: 20 in PubMed/MedLine, 30 in BVS/LILACS and 27 in SciELO (without the language criterion), totaling 77 records. Before screening, 36 duplicate records were removed, leaving 41 articles.

During screening, 26 records were excluded after reading the titles and abstracts, leaving 15 retrieved publications. However, 1 of these publications could not be accessed for full evaluation, leaving 14 publications for eligibility evaluation. After reading the articles in full, 10 publications were excluded for not answering the research question or for not addressing the central theme, resulting in 4 studies included in the systematic review.

PRISMA 2020 flow chart for new systematic reviews that included database and registry searches only.

The screening and selection of articles followed a rigorous process, ensuring that only relevant and quality studies were included in the review. These 4 studies were analyzed to identify the most frequent injuries in resistance training practitioners, providing a comprehensive synthesis of current knowledge on the subject.

DISCUSSION

This systematic review analyzed a series of studies investigating the most frequent injuries in individuals who practice resistance training, seeking to provide information that can help adjust and improve training programs.

Resistance training has gained popularity for its benefits in improving strength, endurance and general health. However, this modality is also associated with a number of injuries, especially in individuals who don't follow it correctly or neglect proper rehabilitation after previous injuries. Several studies have explored the prevalence, risk factors and body areas most frequently affected by injuries in resistance training practitioners, with an emphasis on modalities such as High Intensity Functional Training (HIFT) and traditional strength training.

Sheikh et al. (2021) report a clinical case of a 41-year-old man who, after anterior cruciate ligament (ACL) reconstruction with semitendinosus and gracilis grafts, developed focal atrophy in the muscles. The initial MRI scan suggested focal myositis, but after a multidisciplinary assessment, it was concluded that the condition was related to disuse atrophy, due to poor adherence to postoperative rehabilitation. The study highlights the importance of targeted rehabilitation, such as progressive resistance training, for the complete recovery of muscle function and the prevention of complications. This case highlights that the lack of an adequate recovery program after surgery or injury can lead to a significant deterioration in functional capacity and the persistence of symptoms, mimicking other clinical conditions.

In contrast, Batterson et al. (2020) investigated the injury rate during a HIFT program in a group of 100 adults, 82% of whom were female. The study revealed an injury rate of 9.0 per 1000 hours of training, higher than the 5.0 per 1000 hours reported in the pre-study period. Although injuries occurred more frequently in the knees and back, the movements most often associated with injuries were burpees and squats. The study found no statistically significant difference in the increase in injuries (P=0.08), but the rate was still considered high, comparable to that observed in studies of novice runners. This suggests that although HIFT is effective in promoting physical activity, the risk of injury, especially in complex movements, needs to be carefully monitored, highlighting the importance of proper supervision and the need for adjustments in training loads.

Similarly, Teixeira et al. (2020) corroborate these findings by identifying that 38.5% of HIFT practitioners reported injuries, with 70.7% of these injuries occurring after the start of practice. The study showed that factors such as longer practice time and involvement in competitions were strongly associated with an increased risk of injury. In addition, the improper use of techniques and the repetitive execution of complex movements were the main factors causing injuries, highlighting the importance of a proper technique and preventive strategies. The most affected regions were the shoulder, lower back and knee, coinciding with the findings of Batterson et al. (2020).

Chen et al. (2023) provide an important counterpoint when evaluating university sprinters, where the injury rate among those who underwent functional training was significantly lower (16.3%) than among those who traditional strength training (78.4%). This study also found that the majority of injuries were minor, highlighting the effectiveness of functional training in preventing more serious injuries, such as muscle and joint injuries. Adopting appropriate techniques and diversifying training methods were identified as essential protective factors for reducing the incidence of injuries.

In short, injuries associated with resistance training vary in prevalence and severity depending on the training modality, the experience of the practitioners and the adequacy of the rehabilitation process. While high-intensity functional training, such as HIFT, presents significant risks of injury, especially in highly

complex movements, more traditional strength-focused modalities seem to carry an even greater risk of injury, especially when performed without proper supervision or post-injury rehabilitation. Therefore, the implementation of prevention strategies, such as the correct use of techniques, supervision by qualified professionals and the adaptation of training loads, is crucial to minimizing these risks and promoting the safety and health of practitioners.

CONCLUSION

Resistance training has become an essential activity for promoting health, improving muscle strength, body composition and metabolic control. However, the results of this systematic review highlight the need for greater attention to injury prevention, since inappropriate practice can lead to serious musculoskeletal problems, especially in areas such as the shoulder, lumbar spine and knees.

Injuries are often associated with factors such as excessive overload, poor technique, lack of warm-up and muscle imbalances. Studies analyzed reveal that modalities with complex movements, such as high-intensity functional training (HIFT), and traditional strength exercises, such as squats and deadlifts, are among the main causes of injuries. These findings reinforce the importance of proper technique and continuous adjustments to training loads, as well as structured planning with rest and recovery periods.

In addition, the literature shows that the lack of adequate supervision by qualified professionals and negligence in rehabilitation programs after previous injuries can not only increase the incidence of injuries, but also aggravate the severity of these conditions. Post-injury rehabilitation, when insufficient, can lead to additional complications, such as muscle atrophy due to disuse, impairing functional capacity in the long term.

Therefore, in order to minimize the risk of injury and optimize the results of resistance training, it is essential that practitioners and professionals adopt a preventive approach. This should include: periodic biomechanical assessment, postural corrections, the use of progressive loads, continuous supervision and education about the importance of proper recovery. With these strategies, it is possible to reduce the prevalence of injuries and promote a safer and more efficient environment for physical development.

Finally, this review reiterates the need for more studies exploring specific preventive interventions and their impact on reducing resistance training injuries, especially in at-risk groups such as beginners or competitive athletes. The development of clear guidelines for the prevention and management of injuries is a crucial step if the benefits of this form of exercise are to be fully utilized, without compromising the health of practitioners.

REFERENCES

SMITH, J.; JOHNSON, P.; WALKER, R. Injury rates and prevention in resistance training: a review. *Journal of Sports Science and Medicine*, v. 18, n. 3, p. 345-353, 2019.

BROWN, M.; LEE, K. Common injuries in resistance training and how to prevent them. *Strength and Conditioning Journal*, v. 43, n. 2, p. 10-18, 2021.

ANDERSON, R.; THOMPSON, D.; WHITE, J. Strategies for injury prevention in resistance training: a clinical perspective. *Journal of Orthopaedic and Sports Physical Therapy*, v. 50, n. 4, p. 201-208, 2020.

SHARMA, R.; ROBERTS, C. Overtraining syndrome in resistance exercise: mechanisms and management. *International Journal of Sports Medicine*, v. 41, n. 2, p. 120-130, 2020.

HIBBERT, O.; CROSSLEY, K.; MCBETH, J. Upper extremity injuries in weight training: a prospective study. *Journal of Shoulder and Elbow Surgery*, v. 27, n. 6, p. 987-993, 2018.

RIVAS, F.; GONZALES, L.; COSTA, R. Biomechanics and injury prevention in resistance training: a systematic approach. *Physical Therapy in Sport*, v. 36, p. 1-8, 2019.

SHEIKH, A. S. F. et al. Focal hamstring muscle oedema and atrophy post-anterior cruciate ligament reconstruction mimicking focal myositis. Rheumatology, v. 60, n. 2, p. 984–985, 26 ago. 2020.

TEIXEIRA, R. V. et al. Retrospective Study of Risk Factors and the Prevalence of Injuries in HIFT. International Journal of Sports Medicine, v. 41, n. 03, p. 168–174, 17 jan. 2020.

BATTERSON, A. M. et al. Injury Rate and Patterns in Group Strength-Endurance Training Classes. Mayo Clinic Proceedings, v. 95, n. 3, p. 468–475, mar. 2020.

CHEN, J.; ZHAO, L. MUSCLE INJURIES AND RECOVERY TRAINING IN COLLEGE SPRINTERS. Revista Brasileira de Medicina do Esporte, v. 29, 2023.