

Muskuloskeletal Injuries in CrossFit Practitioners: An Integrative Review

Edfranck de Sousa Oliveira Vanderlei ^{1,*}, Antônio Leonardo Freitas dos Santos ¹, Nicholas Dias Carvalho ¹, Nierysson Dias Carvalho ¹, Denise Gonçalves Moura Pinheiro ¹, Eduardo de Almeida e Neves ¹, José Evaldo Gonçalves Lopes Junior ¹

¹ Centro Universitário Ateneu - UNIATENEU, Fortaleza, CE, Brazil.

* Correspondence: edfranck@hotmail.com.

Abstract: In recent years, high-intensity training methods like CrossFit® have gained popularity in Brazil's fitness scene. However, these exercises, if done improperly, can lead to musculoskeletal injuries, particularly in the shoulder. This study examines shoulder injuries among CrossFit® enthusiasts through an integrative review. Using databases like Scielo, Lilacs, Medline, PubMed, and Google Scholar, research from August 2021 to June 2022 was reviewed using keywords like Shoulder joint, High-Intensity Interval Training, and Injuries. Articles in Portuguese from the past five years were included, excluding duplicates and those unrelated to the research theme. After applying these criteria, 10 articles were suitable for the review. Findings showed that among CrossFit® practitioners, the shoulder was more prone to injuries than other areas like the lumbar spine, wrist, or knee. The review identified that overloading the shoulder due to intense exercises, especially Olympic weightlifting, and gymnastics, was the primary cause of these injuries.

Keywords: Injuries; Joints; CrossFit.

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1. Introduction

In recent years, high-intensity training modalities have been gaining more traction in the Brazilian fitness market. High-intensity training offers numerous benefits to physical fitness and health, all within a shorter time frame. The high-intensity physical training method known as Crossfit® has gained popularity within this category in recent times [1]. This sports modality originated in the 1990s in the United States, created by American Greg Glassman. It was initially designed to train American police officers, firefighters, and military personnel to enhance their physical conditioning and overall physical quality. The training method is centered around functional movements executed at high intensity and is based on three main categories: dealing with heavy loads, covering long distances, and performing high-speed movements. Each training session lasts up to an hour and comprises four components: mobility, warm-up, strength, and the main workout known as the *Workout Of The Day* (WOD) [2].

WODs combine cardiovascular exercises, such as running, with Olympic weightlifting (LPO) for strength-building, in addition to gymnastics and activities that integrate aerobic and anaerobic exercises. The repeated performance of these exercises may lead to fatigue, potentially exposing participants to injuries [3,4]. The American College of Sports Medicine (ACSM) highlights the significant risks of injuries in high-intensity training programs like this one. Such programs involve the execution of exercises that, if performed incorrectly or excessively, can result in injuries to the musculoskeletal system, including ligament and muscle injuries. Thus, the correct execution of exercises and the

recognition of the high risk of injuries associated with the intense and repetitive nature of Crossfit® are crucial [5].

Injuries can be attributed to external factors, such as exercise planning and execution, balance, training surface, intensity, and time, or internal factors, such as biomechanics, anthropometric characteristics, bone density, flexibility, and cardiovascular fitness [6]. One of the most injured areas during Crossfit® practice is the glenohumeral joint, a vital joint allowing for extensive range of motion. The shoulder, connecting the upper limb to the axial skeleton and referred to as the shoulder girdle or upper limb girdle, is of particular importance [7]. Among the most frequently performed exercises in Crossfit®, Olympic weightlifting (LPO) stands out. With variations in technique, this exercise imposes intense and repetitive loads on the shoulder in a short duration, demanding high levels of activity from static and dynamic stabilizer muscles throughout the propulsion phase. This high-intensity workload can lead to shoulder injuries due to overuse, including tendinitis, dislocations, joint and muscle blockages, as well as strains, tendon issues, and tendon ruptures [8, 9].

Crossfit® has emerged as a novel form of physical activity gaining popularity among participants in Brazil. Alongside this growth, there has been an increase in the number of injuries associated with its practice. Despite being one of the fastest-growing exercise regimes worldwide in recent years, there remains a scarcity of literature demonstrating the true effectiveness and safety of this modality. The limited research conducted thus far suggests that Crossfit® metabolic conditioning sessions may lead to increased oxidative stress, pronounced elevation of blood lactate concentration, heightened cardiovascular response during training, muscle damage, and shifts in the pro-inflammatory to anti-inflammatory cytokine ratio. The affinity of the group to the sports field, coupled with the need for further studies on this sport, was a determining factor in the choice of the topic. This review has the potential to contribute to athletes, students, and healthcare professionals by aiding in the detection and prevention of shoulder injuries arising from Crossfit®, and by stimulating more studies in this field.

Therefore, the aim of this study was to analyze the incidence of musculoskeletal injuries among Crossfit® practitioners through an integrative review.

2. Methodology

2.1 Study Type

The research was conducted through an integrative literature review.

2.2 Study Period

The study was conducted between August 2021 and June 2022.

2.3 Descriptors

To establish the theoretical framework for this work, the following databases were utilized: Medline (PubMed), Scientific Electronic Library Online (SciELO), and Google Scholar. The search was conducted using the following Health Science Descriptors (DeCS): joints; High-Intensity Interval Training; Injuries and Lesions or their equivalents in Portuguese or English. However, to encompass all the relevant research on the topic in the selected databases, due to the recent creation and development of Crossfit®, the sole term used for article retrieval, in addition to the descriptors, was "Crossfit®," in the same manner as conducted in Dominski et al.'s [5] review study.

2.4 Inclusion and Exclusion Criteria

For article selection, the inclusion criteria consisted of full-text publications with open access that addressed the incidence of musculoskeletal injuries in Crossfit® athletes, published in either Portuguese or English, between 2016 and 2021. Exclusion criteria in-

cluded review articles, duplicate articles, or articles involving athletes who had undergone surgery and/or suffered musculoskeletal injuries unrelated to Crossfit® practice.

2.5 Data Analysis Procedure

The results pertaining to the literature findings on the subject were presented in the form of tables using the Microsoft Word software.

3. 3. Results and Discussion

From the initial research using the mentioned descriptors, a total of 66 indexed articles were identified (SciELO = 17; Lilacs = 1; Medline = 0; PubMed = 31; Google Scholar = 17), as outlined in the flowchart in Figure 1. After the application of inclusion and exclusion criteria, the 10 selected articles for analysis are all included in Table 1.

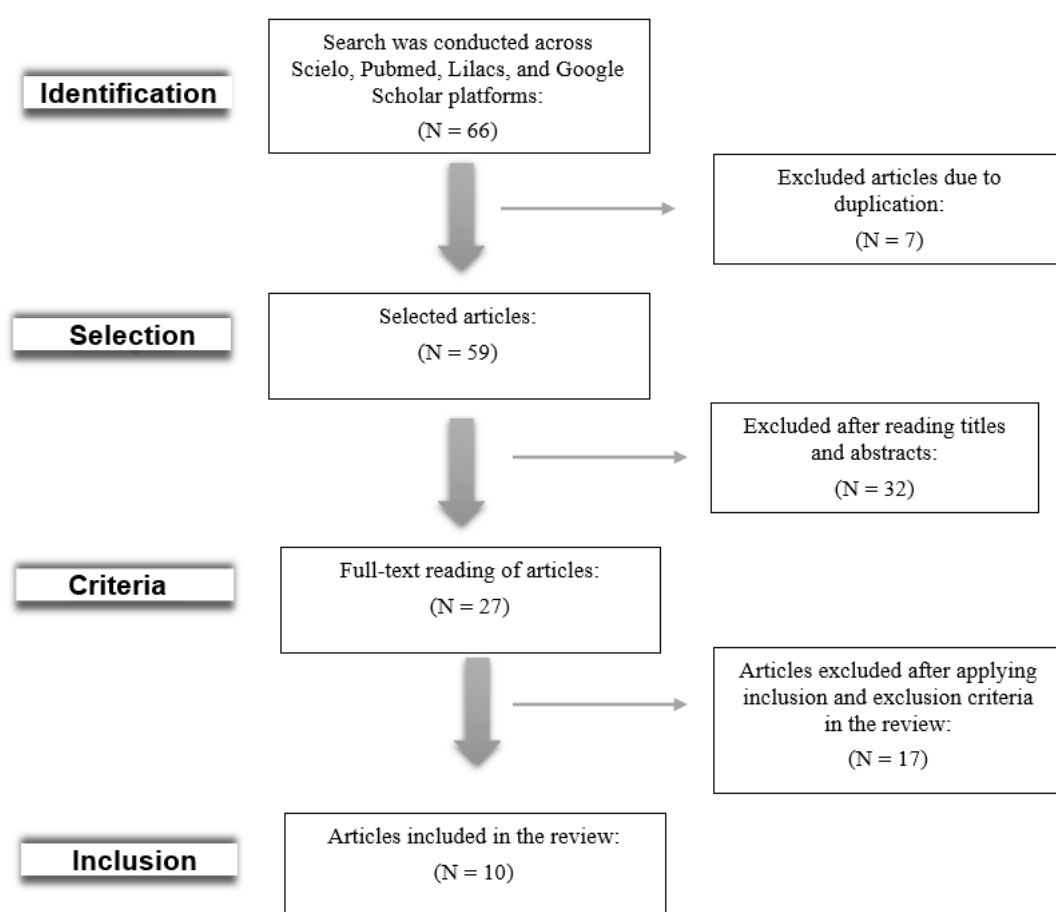


Figure 1: Flowchart depicting the selected articles.

Table 1. Results of the selected articles for the research.

References	Tipo de estudo	Principais resultados
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[10]	National cross-sectional study	This sample included 121 Crossfit® practitioners. Of the evaluated practitioners, 35.5% reported a history of some Crossfit®-related injury. The most frequent locations were the shoulder and elbow (60.5%), lower back (30.3%), and wrist and hand (16.3%). Participants who engaged in intense weightlifting were more prone to injuries than those who underwent light or moderate training.
[11]	Descriptive cross-sectional study	The sample consisted of 12 practitioners, 10 of whom (83.3%) experienced moderate-intensity pain. The onset of pain occurred after training (more than 1 hour later) for the majority. Additionally, 66.6% of the participants engaged in over 5 trainings sessions per week, had been practicing for more than 1 year, and had a previous shoulder injury (58.3%).
[12]	This is a field study, cross-sectional, descriptive in nature, employing a quantitative analysis strategy for the presented results. Data was collected using a semi-structured questionnaire.	Out of the questionnaires, 61.9% were from men and 38% from women, with an average age of 32 years. 30.2% of the participants reported having been injured during Crossfit® practice. Among these individuals, regarding the anatomical location of the injuries, 42% mentioned the lower back, 35% the wrist, 28% the shoulder, and 25% the knee.
[13]	This study is characterized as a qualitative-quantitative and descriptive approach.	The study comprised 70 participants, out of which 44% were male and 56% were female. Among the 70 participants, 9 of them experienced some form of musculoskeletal injury.

The substantial rise in the popularity of CrossFit® has brought about increased concern regarding injuries related to the sport, with the shoulder joint being one of the most affected regions due to the potentially injurious nature of many Olympic weightlifting (OLW) movements. These movements pose a greater risk of subacromial injuries. Studies have shown a high incidence of injuries, particularly in the shoulder joint, attributed to repetitive exercises that strain this joint. In the study by Lopes et al. [12], where 61.9% of the respondents were male and 38% were female, with an average age of 32 years, the results indicated that 42% of the injuries were in the lower back, 35% in the wrist, 28% in the shoulder, and 25% in the knee. CrossFit® involves a variety of movements that significantly engage the shoulder joint, and movements involving lifting weights above the head, such as overhead squats, snatches, push presses, thrusters, and push jerks, are particularly stressful on this region. Often, heavy weights are used, especially when aiming to achieve Personal Records (PRs), leading to increased strain on the shoulder joint [13].

According to Paiva et al. [14], in their sample of 121 CrossFit® practitioners, 65.3% described themselves as physically active (regular exercisers) before starting the CrossFit® program, while 34.7% were sedentary. The most common injury sites among participants with a history of CrossFit®-related injuries were the shoulder/elbow (60.5%), lower back (30.3%), and wrist/hand (16.3%). Participants engaging in intense weightlifting had a higher incidence of injuries compared to those who lifted weights with mod-

erate or light intensity. In the study by Amorim et al. [11], 12 participants (9 male and 3 female) aged between 22 and 45 reported shoulder pain lasting over a week. 83.33% of them reported moderate-intensity pain on the visual analog pain scale. In 75% of cases, the pain occurred a few hours after the workout, not during the training. However, only 25% mentioned discomfort while performing daily activities and work-related tasks involving the shoulder.

According to Hak et al. [13], one characteristic of CrossFit® box practices is the pursuit of personal records, particularly in weightlifting exercises. The individuals aim to perform movements with the heaviest loads possible, which drives them to increase the weight as their training time progresses, aiming to enhance their records. This pursuit, while promoting progress, also escalates the risk of injury. The authors suggest that proper execution technique should take precedence over speed and repetition count. Many practitioners reported muscle fatigue, which can be attributed to exercise intensity and volume coupled with limited rest time. Hak et al. [13] also observed a high prevalence of shoulder injuries, highlighting that in CrossFit® practice, gymnastic and weightlifting movements are often performed with high repetitions and intensity, often accompanied by significant weights.

9. Conclusion

Through this review, it has been observed that overloading the shoulder region due to the intensity and volume of training involving various types of exercises, including Olympic weightlifting (OLW) and gymnastic movements, places significant demands on the shoulder joints. With this study, we can provide valuable insights for individuals engaged in the sport of CrossFit®, demonstrating that the primary cause of these shoulder injuries in the practice of the sport arises from repetitive overhead movements with heavy loads. These exercises impose a considerable strain on the shoulder joint, resulting in a high incidence of shoulder injuries, particularly in the glenohumeral joint and rotator cuff.

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Supplementary Materials: None.

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