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RISKS AND BENEFITS OF BOXING TRAINING - A LITERATURE REVIEW

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ABSTRACT

Introduction and purpose: Boxing, despite significant advancements in protective measures, remains a sport with a high risk of injury. Regular exposure of athletes to powerful blows, especially to the head, poses a serious health threat, both in the short and long term. This study aimed to analyze the most common injuries and complications associated with boxing and the potential benefits derived from training.
A brief description of the state of knowledge: The most frequent injuries in boxing affect the head and upper limbs. Neurological injuries, including concussions and their accumulation, can lead to chronic conditions such as chronic traumatic encephalopathy (CTE). Changes in brain activity observed in EEG confirm the impact of trauma on brain function. Injuries to the limbs mainly include fractures and overuse injuries of the hand and wrist joints. An additional threat is the spread of infectious diseases resulting from intense physical contact and weakened immunity. Despite the risks, boxing training promotes improvements in coordination, strength and stress reduction, so it is used in the therapy of mental health disorders.
Conclusions: Boxing carries a significant risk of injury; however, with appropriate protective measures and conscious training, it is possible to minimize its adverse effects. The sport can simultaneously bring substantial benefits to physical and mental health, provided that a rational approach to load and recovery is maintained.

KEYWORDS

Boxing Injuries, Martial Arts, Boxer's Knuckle, Boxer's Fracture, Chronic Traumatic Encephalopathy, Boxing Health Benefits

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1. Introduction and purpose

Boxing is one of the oldest sports disciplines, dating back to antiquity, it was included in the Olympic Games as early as 688 BCE. Since then, new protective measures have been continuously introduced, such as gloves, headgear, and mouthguards, along with modified fight rules aimed at increasing participants' safety. Despite these numerous improvements, it is impossible to eliminate strong blows to the head, which can reach forces up to 5000 N. Such punches are associated with overloads reaching even 50 g, each representing a serious threat to the boxer's health.

A typical boxing match consists of three rounds, each lasting three minutes and separated by a one-minute break. During a single round, a competitor may receive 60 to 80 punches, meaning that a boxer participating in numerous fights over a career receives hundreds or even thousands of strong and potentially dangerous blows.

At such high force and overload values, even the most technologically advanced protective gear provides only limited protection, mainly against superficial injuries. Unfortunately, they are not effective in protecting brain structures from concussions, which can lead to serious neurological consequences.

Therefore, it is not surprising that boxers are a group of athletes particularly vulnerable to injuries, both in the head and upper limbs. Moreover, these injuries may not only be short-term but also lead to long-term neurological complications, the effects of which may manifest many years after the end of a sports career [1,2,3,4].

This paper aimed to list and describe the most common risks as well as benefits associated with boxing training.

2.Description of the state of knowledge

Most injuries sustained during boxing occur in young men aged 15 to 20. They happen very frequently, approximately one injury every 2.5 hours of competition or 772 hours of training. Although injury rates have declined significantly in Europe recently, wrist injuries decreased by 33% between 2012 and 2016. Nevertheless, there is still a considerable need to improve protective measures to make this sport safer [5,6,7].

Neurological Injuries

The most common head injuries include skull fractures and concussions [6]. Laboratory studies on cells from various parts of the nervous system indicate that the regularity of received trauma plays a key role in damage formation. The worst results were obtained when simulating training every 24 hours with blows repeated at short intervals, such as every 2 minutes. Damage accumulates due to the lack of recovery time. This simulation closely corresponds to the typical training schedule of boxers. [13]

Concussions account for the majority of fatal accidents during competition. Although fatal incidents have been significantly reduced in recent times, mainly due to the introduction of rapid and modern medical care directly at the ring - they still occur. Repeated subconcussive impacts, whose significance has only recently been appreciated and studied in greater depth, appear to play a key role. Therefore, the number of reliable studies on this topic remains limited [8,9].

Studies conducted on patients and post-mortem examinations of individuals who practiced boxing in the past have shown a strong correlation between the number of training sessions and fights and the frequency and severity of chronic traumatic encephalopathy (CTE). Although the condition progresses slowly, the environmental and traumatic etiology is evident, and the symptoms are severe. The pathogenesis of this disorder is not fully understood, but damage is most often observed in the cerebral hemispheres, medial temporal lobe, thalamus, mammillary bodies, and brainstem, with enlargement of the ventricles and septum pellucidum. Recent studies also indicate increased deposition of Tau protein may be a contributing factor to the condition. Diagnosis is mainly based on recognizing characteristic symptoms such as personality, behavioral, and speech disorders, as well as neurological deficits, memory loss, and Parkinsonism [9,10,11,23,24].

In 2024, a study was conducted to identify changes in brain electrical activity in individuals with Repetitive Mild Traumatic Brain Injury (rmTBI) using EEG. It showed reduced activity in several brainwave frequency bands: theta, beta and gamma, in individuals who regularly train in boxing. This suggests significantly decreased functional network efficiency [12].

Upper Limb Injuries

The second most common category of injuries during boxing training is upper limb trauma. The introduction of protective equipment, such as boxing gloves, significantly reduced the risk of damage to anatomical structures, as confirmed by studies showing a relationship between glove size and injury frequency [18].

Today, the vast majority of upper limb injuries originate from improper punching technique. The most frequent injuries involve the hand and wrist joint, accounting for approximately 53% of all cases. A significant portion of injuries also affect the shoulder joint (27%) and the elbow joint (19%) [14].

Analyzing hand injuries more closely, the thumb is most commonly affected, accounting for 39% of all injuries in this area. Metacarpal fractures occur at a similar rate, while phalangeal injuries are slightly less frequent, with a rate of 26% [15].

Among amateur and professional boxers, the most frequently diagnosed condition in the upper limb is instability of the carpometacarpal and metacarpophalangeal joints, known as "boxer's knuckle." It results from damage to the joint capsule and excessive stretching or rupture of the radial collateral ligaments. Consequently, displacement or dislocation of the extensor tendon of the finger is observed [16,17,25].

During sparring sessions, in addition to soft tissue injuries, bone injuries may also occur. The most common fracture in this group of athletes is a fracture of the neck of the fifth metacarpal. In the event of such an injury, it is crucial to promptly report to the emergency department for imaging diagnostics, which confirm the diagnosis and assess the degree of bone fragment displacement. Treatment includes stabilization of the fracture through immobilization in a cast or, in cases of greater displacement, with a Kirschner wire to maintain proper alignment [27,28,29,30].

Recent studies suggest new treatment options for such fractures using taping instead of a plaster cast [31,32]

Infectious Diseases

Boxing training, due to its intensity and frequency, can lead to temporary suppression of the immune system function. This phenomenon increases an athlete's susceptibility to various infections, making boxers a particularly vulnerable group to infectious diseases. Among the most commonly observed infectious conditions are upper respiratory tract infections; however, with physical overload and insufficient recovery, more severe complications such as pericarditis or myocarditis may occur.

Boxing, as a high-contact discipline, also creates favorable conditions for the transmission of pathogens through the skin. Particularly concerning are dermatophyte and viral infections, including those caused by the herpes simplex virus (HSV) and the human papillomavirus (HPV). Direct skin contact with opponents and sharing training equipment contribute to their spread.

An additional risk factor is the use of injectable doping substances. In cases of poor hygiene, there is a significant danger of transmission of blood-borne viruses - primarily hepatitis B (HBV), hepatitis C (HCV), and the human immunodeficiency virus (HIV) [19].

Health Benefits

Despite the considerable risks, boxing training also offers numerous benefits, such as significant improvements in coordination, physical strength, and concentration, which contribute to increased discipline and self-confidence. It also allows for stress relief and relaxation. For these reasons, it is used in the therapy of schizophrenia, depression, PTSD, and anxiety [20,21,22].

3. Conclusions

Boxing, as a highly contact-oriented sport, involves a significant risk of various injuries, including both acute and chronic ones. Some of these are temporary and can be completely healed with appropriate treatment in a relatively short time. However, some injuries, especially repeated head trauma and overuse injuries of the musculoskeletal system, can lead to permanent health consequences, including irreversible neurological or structural changes.

Despite its high injury potential, a proper approach to training, including the use of adequate protective measures, appropriate technical preparation, control of exercise intensity, and reduction of sparring can significantly reduce the risk of injury. Furthermore, regular physical activity practiced in a safe and conscious manner can have a positive effect on overall physical fitness and support mental health by reducing stress and enhancing athletes' well-being.

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