

## PRIMARY PREVENTION AS A KEY ELEMENT IN INJURY PREVENTION IN SPORTS

Izabella SOCHA

University of Physical Education in Katowice; sochaizabella@gmail.com, ORCID: 0009-0005-7238-6293

**Purpose:** the aim of the article is to analyze the importance of primary prevention in sports, with particular emphasis on methods of injury prevention and the improvement of athletes' overall health. The article seeks to highlight the role of early intervention and education in preventing injuries that may result from athletic exertion. Furthermore, it aims to understand how effective preventive strategies can influence athletes' health, their long-term physical fitness, and minimize the risk of injuries, which is of great importance for their athletic development.

**Design/ methodology/approach:** the article is of a cross-sectional nature. The objective is achieved through a critical literature review.

**Findings:** the analysis indicates that primary prevention is a key element in injury prevention in sports, especially in the context of professional sports. The main areas where primary prevention can significantly reduce injury risk have been examined, such as proper warm-up routines, the consequences of inadequate recovery, and the importance of physiotherapy. Additionally, the study suggests that implementing appropriate preventive measures can bring long-term health benefits, including a reduction in the number of injuries.

**Practical Implications:** effective primary prevention is crucial in reducing the number of injuries in sports and improving athletes' health. Attention to proper warm-up, adequate recovery, and the use of proven, well-selected physiotherapeutic treatments can help decrease the risk of injury. Implementing preventive strategies is essential for maintaining career continuity, improving sports performance, and enhancing athlete safety.

**Social Implications:** an effective primary prevention program contributes to the overall improvement of athletes' health by reducing the number of injuries, which in turn leads to the extension of athletic careers.

**Originality/Value:** this article provides a detailed analysis of primary prevention in sports in the context of injury prevention.

**Keywords:** prevention, primary prevention, injuries, traumas, sport.

**Category of the paper:** literature review.

## 1. Introduction

The term "prevention" is used in various academic disciplines, including pedagogy, social pedagogy, psychology, sociotechnics, and praxeology. It is also commonly encountered in contexts such as school, health, and sports prevention. According to the definition found in the *Polish Language Dictionary*, prevention refers to "actions aimed at preventing adverse phenomena, especially diseases" (<https://sjp.pwn.pl/slowniki>, 2025).

Injuries are an inherent aspect of sports that every athlete must account for. Beyond the pain, physical disability, or prolonged absence caused by injury, financial costs associated with surgery and rehabilitation must also be considered. Sports injury prevention is a complex process that requires collaboration and a multidisciplinary approach involving medical professionals and coaches. Among the primary benefits of injury prevention are the extension of an athlete's career duration, enhancement of their motor potential, and—as mentioned earlier—the reduction of treatment-related costs. Prevention and associated actions can be categorized into three levels:

- primary prevention (Level I),
- secondary prevention (Level II),
- tertiary prevention (Level III) (Grygorowicz et al., 2010).

In modern sports, the immense physical demands placed on athletes often have a destructive effect on the skeletal system, muscles, and nervous system. Athletes learn to ignore pain and adapt to it, which leads to deceiving their own bodies and nervous systems. Such behavior can result in long-term dysfunctions, leading to extended training breaks or, in extreme cases, the premature end of a sports career.

Modern medicine places great emphasis on injury prevention in professional sports. The strongest focus is on primary prevention, whose main goal is to reduce the incidence of injuries and eliminate factors that may cause them. A key element of primary prevention is a comprehensive, functional physiotherapeutic assessment aimed, among other things, at early detection of motor asymmetries and identification of injury susceptibility (Domańska et al., 2021).

## 2. The Importance of Warm-Up in Sport

A warm-up is defined as “a comprehensive, logically connected sequence of training means (physical exercises) aimed at preparing the athlete’s body for physical exertion during training or participation in sports competitions” (Ozimek, Jurczak, 2007).

Proper and comprehensive preparation of athletes for physical exertion and high-level competition, as well as aspects related to pre-competition and competition activity, play a crucial role in achieving top and expected athletic results. Discussions between sports theorists and coaches regarding the positive impact of warm-ups on the athlete's body highlight its multidimensional effects. The following elements are considered and analyzed:

- the duration of the warm-up,
- the intensity of the warm-up,
- its impact on both the physical and psychological spheres,
- the biodynamics of the load,
- the appropriate timing of the warm-up before competition to optimally prepare the athlete for maximum effort during the event (Krupecki et al., 2006).

Warm-ups are widely used as a component that prepares athletes for both training sessions and competitions. Although many athletes and coaches regard it as an inseparable element preceding training or performance, aimed at achieving the best and most optimal performance, there is actually a lack of substantial scientific evidence confirming its effectiveness. The structure of a warm-up (its duration, intensity, or type), as used by athletes and coaches, is typically not the result of scientific research but rather of their own experience.

The primary goal of a warm-up is to “prepare and accelerate the body's adaptive processes to achieve an optimal psychomotor state during training or competition—in general, to comprehensively prepare the athlete's body for the effort they will face during the event or training” (Sadowski, 2021).

According to J. Chmura, from a physiological point of view, a warm-up should include elements such as:

- improvement of motor coordination,
- reduction of the risk of injuries during competition and training,
- regulation and modification of emotional states before competition,
- improvement of the athlete's mental attitude toward performing specific tasks,
- so-called “pre-activation” of neural pathways involved in the transmission of motor and sensory nerve impulses (these are related to conditioned reflexes),
- preparation of the musculoskeletal system for the correct execution of learned motor habits and movement patterns,
- adjustment of physiological functions from a resting state to an exercise state,
- “achieving optimal arousal of the central nervous system and reaching the threshold of psychomotor fatigue” (Chmura, 2014).

Warm-up can be divided into two basic types: active and passive warm-up. Active warm-up is used in most sports disciplines, and its execution leads to an increase in muscle temperature and initiates various physiological mechanisms. This type of warm-up involves performing physical exercises and may induce greater metabolic and cardiovascular changes compared to passive warm-up. Examples of active warm-up include various gymnastic

exercises and running. Active warm-up may also slightly improve short-term performance (under 10 seconds) more effectively than passive warm-up alone. However, it's important to note that a warm-up protocol that does not allow full recovery or is too intense may weaken its effect due to limited availability of high-energy phosphates before task execution. The goal of passive warm-up, on the other hand, is to increase muscle temperature using external methods such as a hot bath or shower. This type of warm-up allows for an increase in muscle or internal body temperature without using energy substrates. In reality, it is not commonly used in most sports disciplines. However, it may be helpful for maintaining or supplementing elevated body temperature achieved through active warm-up, especially when there is a delay between the warm-up and competition start, or when temperatures are low. Passive warm-up does not affect isometric strength (it does not improve it), although it may influence short-term dynamic strength. However, when it comes to improving the effectiveness of dynamic movements of short duration (under 10 seconds), it is less effective compared to isolated muscle activation (Sadowski, 2021).

Warm-up, including warm-up exercises, has a multidimensional and multifaceted impact on the athlete's body. These effects include, among others:

- a. An increase in muscle and body temperature. Warmed-up muscles result in:
  - greater release of maximum power,
  - increased flexibility and elasticity of muscles,
  - reduced muscle stiffness,
  - decreased viscosity of muscle tissue,
  - increased strength of muscle contraction and relaxation.
- b. Enhanced efficiency of the central nervous system.
- c. Alleviation of pre-competition psychological tension. In addition to the numerous benefits related to physical preparation for competition, warm-up can also influence mental functions. This pertains to pre-competition states such as pressure, anxiety, or tension. The main objectives of warm-up are to relieve psychological stress and reduce hypersensitivity. From a psychological perspective, the warm-up aims to induce a state of alertness and activity, as well as motivation and readiness for effective performance.
- d. Injury prevention. A properly executed warm-up—especially in speed-oriented training—enables effective execution of starts, changes in running direction, sudden jumps, or stops. “It can therefore be said that the better the musculoskeletal system is prepared for specific speed-related loads, the lower the risk of injuries and traumas” (Chmura, 2014).

### 3. Consequences of Inadequate Recovery and the Risk of Injury

Recovery is an extremely important element of an athlete's training process, regardless of whether the athlete is an amateur or a professional. It applies both to the entire season as well as to training cycles or individual training sessions. Its necessity stems primarily from the various changes that occur in the athlete's body during physical exertion, which lead to fatigue.

Fatigue represents a transitional phase between muscle work and recovery (rest) and is considered a desirable state by coaches, as it indicates an effective training session. In reality, achieving good athletic performance depends on maintaining a balance between these two essential components: exertion and recovery (Widłak, 2022).

Fatigue is understood "as the result of work performed. It is a physiological defensive response that accompanies everyday physical activity, whether spontaneous or planned, including professional or athletic activity. The onset of fatigue affects all aspects of human functioning—physical, psychological, and metabolic—often resulting in a significant reduction in performance capacity" (Widłak, 2022).

Many factors influence the components of sporting success. One of them is a well-planned training program, which consists of successive phases of work and rest. Rest can be defined as the body's effort to restore homeostasis, i.e., a state of functional balance. Two main types of rest are distinguished:

- Active rest, which involves engaging in recreational physical activity different from that typically performed by the athlete. This form of recovery is recommended due to its positive effects on mood and the generation of relaxation. It can also have physiological benefits, including a favorable impact on the respiratory and circulatory systems.
- Passive rest, which involves a complete reduction in physical activity followed by a state of inactivity. Passive rest is a form of recovery that, for some individuals, is desirable and brings many health benefits. The most common form of passive rest is sleep (Widłak, 2022).

Improper recovery and excessive training loads imposed on the athlete may lead to the development of overtraining syndrome. In modern sports, overtraining syndrome is a serious issue because it can result in a decline or even complete loss of athletic performance, negatively affect health, and lead to various types of musculoskeletal injuries. It can also have a negative impact on the athlete's psychological state (Kochański et al., 2015).

Symptoms of overtraining syndrome may include poor well-being, joint and muscle pain, decreased physical performance, sleep disturbances, weight loss, adverse metabolic changes, and a lack of motivation for competition and training. Initially, the symptoms of overtraining syndrome may be difficult to detect because they are non-specific. Modern sports medicine distinguishes two primary types of overtraining syndrome, which share both common and distinguishing characteristics. Common features include fatigue susceptibility, apathy, anxiety,

reduced physical performance, and increased vulnerability to various infections (Kochański et al., 2015).

One of the popular methods used to support the recovery of athletes, who are constantly exposed to damage and injuries, is biological regeneration, which is defined as “the conscious influence on the body using various means (both natural and artificial) and environmental conditions to accelerate physiological recovery processes” (Kunysz-Rozborska, 2017). Due to these positive aspects, biological regeneration has found wide application in sports. Athletes, during training and competitions, experience various injuries and traumas, which in turn lower their physical condition. To speed up the recovery process, various biological and medical treatment methods are used. Biological regeneration, in addition to its therapeutic properties, also plays a preventive role. Athletes regularly use biological regeneration and its treatments to improve their physical and mental health, which ultimately leads to better performance in their disciplines. Biological regeneration mainly relies on thermotherapy, which uses natural stimuli such as saunas, cryotherapy, hydrotherapy, or heating treatments (Ciechanowska et al., 2014).

An increasingly common phenomenon among both professional and amateur athletes is the search for the most optimal and effective recovery methods, which primarily arises from the need to reconcile physical exertion and its effects with daily activities. In such cases, the first and most important factor that should be emphasized is sleep, which is a crucial element in the recovery process. It is also worth noting that chronic fatigue often stems from insufficient quantity or poor quality of sleep.

Dr. Jonathan Leeder, a physiologist for the British track cycling team for three Olympic cycles and an employee of the English Institute of Sport (EIS), claims that sleep is the most effective form of recovery. According to him, a full night of uninterrupted sleep is essential to fully benefit from training. Getting enough sleep improves immune system functioning, and during the deep sleep phase, the secretion of somatotropin (growth hormone) increases, supporting cell repair and growth. The best indicator of proper sleep is waking up naturally, without the need for an alarm clock. If a person is unable to wake up naturally and still feels tired upon waking, going to bed earlier should be considered. Leeder’s research also shows an additional benefit: every hour of sleep before midnight nearly doubles the recovery effect. Research conducted in Canada at Trent University in Ontario has shown that the REM phase (rapid eye movement) plays an important role among athletes. This is due to the fact that during this phase, cognitive functions are enhanced, and information, techniques, and skills acquired during training are consolidated. That is why high-quality sleep contributes to easier learning of complex tasks (Trzebiński, 2017).

#### **4. The Role of Physiotherapy in Preventing Injuries in Athletes**

Physical activity undoubtedly brings many benefits, but it is also inherently linked to the risk of injury. As the frequency and intensity of training increase, the risk of injury also rises. The physiotherapist faces the challenge of determining which structures may be at risk of various kinds of disorders in the future. The ability to predict dysfunction is not a supernatural skill or magic, but the result of extensive knowledge that the physiotherapist possesses in biomechanics, physiology, anatomy, or simply the specifics of a particular sport. This knowledge allows for the early detection of conditions that predispose to injury (Skulska, 2025).

A thorough physiotherapeutic assessment of athletes from different sports disciplines should be the basis for primary prevention. Despite the fact that the athlete's special or physical preparation level is usually monitored, sports officials and coaches rarely consider the need to assess the cooperation of the neuromuscular system, the correctness of performing typical and specific movement patterns for a given sport, or the diagnosis of soft tissue conditions. Failure to take these factors into account when assessing an athlete's motor preparation and health status can lead to injuries, which may result in the athlete being excluded from competitions and/or training, as well as a long-term decline and limitation of their athletic potential and motor abilities (Grygorowicz et al., 2010).

The aforementioned physiotherapeutic assessment of the athlete's condition should be conducted before the start of the preparation period, which precedes the period of intensive and high training loads imposed on the athlete. The purpose of this assessment is to ensure both the athlete and their coaches that their participation in training does not carry unnecessary risk of injury. It is a mistake to think that the purpose of assessing an athlete's condition is to exclude them from the training process (Grygorowicz et al., 2010).

An important element of the diagnostic process should be the interview conducted with the athlete. Next, the physiotherapist performs a physical examination, meaning they carry out comprehensive functional tests and specific functional assessments, which include, among others, measurements of joint range of motion and limb circumference and length. The physiotherapeutic evaluation also includes elements such as the assessment of postural stability, proprioception, strength potential, as well as the athlete's nervous system endurance, which is assessed through the athlete's "multitasking" ability. However, it must be remembered that each athlete is different, and when selecting diagnostic tools, it is crucial to take an individualized approach to the athlete (Skulska, 2025).

One classification of injuries distinguishes acute injuries, which occur suddenly, and chronic injuries, which are related to the accumulation of numerous micro-injuries. In injury prevention therapy, the main goals are primarily: correction of posture defects and improper movement patterns, increasing the athlete's motor potential, improving cardiovascular

and respiratory system functioning, and reducing all dysfunctions in the musculoskeletal system. The physiotherapist, considering the individual needs of the athlete associated with the specifics of the sport they practice, prepares a therapy program using various techniques, such as functional training, massage, physical therapy, manual therapy, or methods like deep tissue massage or dry needling. Moreover, an increasing number of physiotherapists apply a holistic approach in their practice, which involves looking at the patient as a whole and considering both the physical and mental aspects. This often requires cooperation with other specialists in psychology, psychotherapy, or dietetics. Additionally, elements such as stress management, visualization, and concentration training can significantly impact the results achieved by the athlete (Skulska, 2025).

Preventive actions depend on many factors that increase the risk of injury, which are related to the specifics of the sport practiced, the awareness of athletes and coaches, as well as the knowledge and experience of physiotherapists and doctors who collaborate with a specific athlete or team. Tools used to assess the causes that may lead to musculoskeletal injuries should be sufficiently sensitive to detect functional deficits of clinical significance. The more thorough the assessment, the better, because the diversity of analyses and the results obtained can help identify and define the so-called "weak links" in the biomechanical chain. The effectiveness of preventive actions, or their lack, depends on many factors. In reality, it is difficult to determine, especially in the case of failures, which element of the entire preventive process turned out to be insufficient. The literature on the subject provides evidence showing that the implementation of appropriate preventive measures can lead to a reduction in the risk of injuries and accidents. Based on correctly performed musculoskeletal diagnostics (referring to identifying the factors that may have led to the injury), specific exercises were introduced in a group of athletes from various sports disciplines, which resulted in a decrease in injuries (e.g., anterior cruciate ligament damage) (Grygorowicz et al., 2010).

## 5. Summary

Primary prevention plays a key role in preventing sports injuries. This article discusses the importance of proper warm-up before training, which prepares the body for exertion and minimizes the risk of injury. The role of physiotherapy in maintaining proper body biomechanics and preventing overloads is also emphasized. An important aspect is proper recovery, with a particular focus on sleep, which allows for the rebuilding of the body and reduces the risk of injuries caused by, among other factors, fatigue. A comprehensive approach to primary prevention is essential for maintaining the health and high performance of athletes and helps extend their sports careers, which are often hindered by numerous injuries.



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