Modern American Journal of Medical and Health Sciences
ISSN (E): 3067-803X
Volume 01, Issue 07, October, 2025
Website: usajournals.org

INJURIES IN KARATE: STRUCTURE, CAUSES, AND PREVENTION AT DIFFERENT STAGES OF SPORTS TRAINING

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Abstract
This article presents a review of current scientific data on injuries in karate. It examines the structure and mechanisms of sports injuries depending on the discipline (kumite and kata), the conditions of occurrence (competition and training), and the age and skill level of athletes. Based on an analysis of prospective studies, systematic reviews, and international consensus documents, it is shown that injuries in karate are predominantly mild to moderate in nature, but are distinguished by a specific profile with a predominance of contact injuries to the head, face, and upper extremities in kumite and non-contact overuse injuries to the musculoskeletal system in kata and training activities. Particular attention is paid to the causes and risk factors of injuries, and the role of World Health Organization (WHO) regulatory requirements. Karate Federation (WKF) and the importance of a stage-differentiated approach to prevention.

Keywords: karate, kumite, kata, sports injuries, epidemiology, prevention, neuromuscular training, concussion, WKF equipment.

Introduction

The scientific novelty of the article lies in the comprehensive analysis of injuries in karate, taking into account the disciplinary specifics (kumite and kata) and the stages of long-term sports training, as well as in the substantiation of a stage-differentiated preventive approach that integrates epidemiological data, WKF requirements and practical aspects of organizing the training process.

Karate, as a martial art, combines high-speed movements, abrupt changes in direction, explosive punches and kicks, and (in the discipline of kumite)

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controlled contact. This combination makes injuries in karate a multifaceted problem: some injuries are caused by direct contact (punches/blocks/collisions), while others are caused by non-contact mechanisms (foot twists, knee overload, impaired core control due to fatigue). Modern data show that minor soft-tissue injuries are most common in competitive karate; however, kumite itself produces a unique injury profile with a significant proportion of head and facial injuries, as well as upper extremity injuries. This has been confirmed both in classical prospective observations at world championships, where bruises, nosebleeds, and cuts predominated, while punches caused the majority of injuries, and in more recent studies [1].

The relevance of this topic has increased with the development of the Olympic karate format (WKF) and the increased intensity of training at the national team level. A systematic review and meta-analysis of "Olympic" karate emphasizes that injury rates in competition vary significantly between studies due to differences in injury definitions, approaches to recording, and exposure calculations, but the general pattern of injury profile (a predominance of minor injuries and a significant proportion of head/facial injuries) remains [2].

Moreover, for sports medicine and coaching practice, it is crucial that a significant portion of injuries occur not only at competitions but also during training. Epidemiological studies of training injuries in karate indicate the leading role of sparring/combat practice in the development of injuries, while warm-ups and kata contribute less [3].

Head injuries, including concussions, occupy a special place in the risk structure. Although the incidence of concussions in karate is generally lower than the incidence of mild facial and soft tissue injuries, their potential consequences require strict recognition and management protocols. The international consensus on concussion in sport sets the current standard: immediate withdrawal from participation if a concussion is suspected, clinical assessment, a gradual return to activity, and an emphasis on prevention [4].

Injury prevention development traditionally relies on a "prevention sequence": first, the scale of the problem is measured, then the causes and mechanisms are identified, followed by implementation of measures and their impact evaluation.

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This approach has been widely used in sports traumatology since van Mechelen et al. [5]. In recent years, the need for uniform definitions and recording standards has been further enshrined in the 2020 International Olympic Committee (IOC) consensus on recording and reporting data on injuries and illnesses in sport, which is particularly important for the correct comparison of karate studies and the evaluation of the effectiveness of prevention programs [6].

Finally, an important feature of karate is the role of safety regulations: mandatory protective equipment and contact restrictions (especially in youth) are not just a formality, but an element of primary prevention that directly impacts injury rates. The WKF rules for kumite stipulate a list of mandatory protective equipment (e.g., mouth guards, gloves, body protectors, shin/foot guards, etc.) [7] .

The purpose of this study is to systematize data on the structure of injuries in karate, identify key causes and risk factors, and substantiate preventive measures taking into account the stages of long-term sports training (from basic training to the stage of high sports mastery), based on the results of prospective observations, systematic reviews, and international consensus documents.

The study was conducted in the format of a narrative review of the scientific literature on injuries in karate. Publications indexed in the PubMed, Scopus, and Web databases were analyzed. of Science and Google Scholar, for the period primarily 2000–2024. The search was carried out using keywords and their combinations: karate injuries, karate trauma, combat sports injuries Prevention, kumite, kata. Sources were selected based on scientific significance, peer-reviewed quality, and relevance to the research topic. The data were analyzed, followed by a qualitative systematization of the injury pattern, injury mechanisms, and preventive measures at various stages of athletic training.

The injury pattern in karate is determined by a combination of the discipline (kumite or kata), the skill level of the athlete, the age of the athlete, and the context (competition or training). Most studies indicate that karate injuries are generally classified as mild to moderate, but their location and mechanisms have distinct characteristics that distinguish this sport from non-contact disciplines.

According to a systematic review and meta-analysis on Olympic karate, soft tissue injuries are the most frequently recorded injuries, with severe injuries

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leading to long-term disability (time - loss) Injuries (such as injuries) are relatively rare. However, it is repetitive minor injuries and microtraumas that significantly impact athletes' performance and can impact athletic longevity. Prospective studies at the WKF World Championships show that the majority of injuries occur in competitive bouts, not kata, highlighting the key role of the contact component of kumite in the development of injuries .

Most studies note a similar distribution of injuries across anatomical regions. The most vulnerable areas are: the head and face (bruises, cuts, nosebleeds); the upper extremities (hand, fingers, wrist, forearm); and the lower extremities, primarily the ankle and knee joints. This pattern has been confirmed both in early prospective studies of world championships and in modern observations of European and national tournaments.

In terms of the nature of injuries, the most common types in karate are: bruises and superficial soft tissue injuries; sprains and ligament injuries; and, less commonly, fractures and dislocations.

In kumite, the leading mechanism is a direct strike (with a hand or foot), whereas in kata and training, non-contact injuries associated with sharp turns, landings, and static-dynamic loads in stances are more common.

Some studies emphasize that when calculating injury per unit of exposure, the risk is higher in competitions. However, the absolute number of injuries is often higher during training, due to the greater volume of sparring and cumulative fatigue. This makes training a key focus for preventative measures.

Table 1 - Main characteristics of the injury structure in karate

Indicator	Kumite	Kata
The predominant mechanism	Contact (hit, block, collision)	Non-contact (overload, abrupt changes of stance)
The most common localization	Head/face, hand, wrist	Knee, ankle, lumbar region
Typical injuries	Bruises, cuts, nosebleeds	Strains, tendinopathies , myalgias
Severe (time-loss) injuries	Relatively rare	Rare
Main place of origin	Competitions and sparring	Workout

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Thus, the injury pattern in karate is characterized by a predominance of minor contact injuries in kumite and non-contact overuse injuries in kata and training. These characteristics must be taken into account when developing preventative programs differentiated by discipline and stage of athletic training.

Injuries in karate are influenced by a combination of biomechanical, physiological, and organizational factors, the contribution of which varies depending on the discipline (kumite /kata), age, and skill level. Modern research identifies several key causes and risk factors that have the greatest practical significance.

In kumite, the leading causes of injuries are direct strikes (punches or kicks) and contact during blocking or closing with an opponent. Prospective observations at WKF World Championships show that punches account for the largest proportion of recorded injuries, particularly to the head, face, and upper extremities.

The kata and training process are dominated by non-contact mechanisms associated with abrupt changes in direction of movement, rotations, and deep stances, which increases the load on the knee and ankle joints.

The most significant individual factors include:

- insufficient level of neuromuscular control and strength of stabilizers, which increases the risk of lower limb injuries;
- previous injuries, especially to the ankle and knee joints, which significantly increase the likelihood of recurrent injuries;
- age and level of training: young athletes have an increased risk due to the immaturity of the musculoskeletal system, while highly qualified athletes have an increased risk due to the high speeds and intensity of the fights;
- fatigue, leading to deterioration of technique and slowing of defensive reactions.

The conditions of preparation and conduct of classes have a significant impact on injuries:

- the volume and nature of sparring, especially with insufficient control of intensity;
- the density of the competition calendar and insufficient recovery;
- failure to comply with or weakened control of rules, including requirements for protective equipment;

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- quality of tatami surface and training environment.

Systematic reviews highlight that differences in injury rates between tournaments and age categories are largely explained by external factors and regulations, rather than solely by the level of athletes.

Restrictions on head contact for cadets and juniors, as well as the mandatory use of protective equipment in WKF competitions, are considered important risk-reducing factors that influence the structure and frequency of injuries. This confirms that injuries in karate are a manageable process and can be significantly reduced by adhering to regulations and a rationally organized training process.

Safety in competitive karate is largely determined by the regulatory requirements of the World Karate The WKF (West Karate Federation) aims to reduce the incidence and severity of injuries, primarily in the discipline of kumite . The WKF rules enshrine the principle of controlled contact, where the impact is not judged by the force of the blow, but by technical precision and tactical advantage, which significantly distinguishes karate from full-contact martial arts.

The most important element of primary prevention is the mandatory use of protective equipment (mouth guard, gloves, shin and foot protection, body protector, chest protection for women, etc.), the presence of which reliably reduces the risk of damage to soft tissues and the musculoskeletal system.

Age restrictions on contact are particularly important. The WKF rules for cadets and juniors strictly regulate and effectively prohibit hand contact to the head, face, and neck, aimed at protecting growing bodies and preventing head and central nervous system injuries.

Thus, the WKF rules serve not only a competitive but also a medical and preventative function, and their strict adherence by coaches, athletes, and judges is a key factor in injury management in karate.

Injury prevention in karate should be staged and differentiated, as injury mechanisms and risk factors change significantly as athletes gain skill and increase training volume. Effective preventive measures aim to reduce both contact and non-contact injuries and should be integrated into the training process.

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Initial training phase. At the initial stage, the primary focus is on developing safe movement techniques and basic physical skills. Priority is given to learning the correct biomechanics of strikes and defenses, developing coordination and balance, and limiting contact during sparring. The use of protective equipment and strict adherence to safety rules are mandatory.

The educational and training phase and the initial specialization phase. At this stage, training volume and the intensity of fights increase, requiring load management and the prevention of overuse injuries. Systematic strength and neuromuscular training aimed at stabilizing the knee and ankle joints is recommended, as well as rational sparring planning that takes fatigue into account.

The stage of athletic development. For high-level athletes, monitoring their condition and recovery processes is crucial. Prevention is aimed at reducing the risk of recurrence, monitoring the volume of competition and training loads, and strictly adhering to head injury protocols, including a phased return to training and competition.

The stage of highest athletic mastery. At the stage of highest athletic mastery, prevention is focused on maintaining athletic longevity. Individualized strength training and recovery programs, medical monitoring, competitive activity analysis, and competition calendar optimization are used to minimize injuries without reducing athletic performance.

Table 2 - Basic injury prevention measures in karate at different stages of sports training

Preparation stage	Main risks	Key preventive measures
Basic training	Violation of technique, coordination errors	Teaching safe techniques, developing balance, limiting contact, and wearing protective equipment
Educational and training / specialization	Overuse, ankle and knee injuries	Load management, strength and neuromuscular training, sparring dosage
Sports improvement	Repeated trauma, head trauma	Fatigue Monitoring, Concussion Protocols, Recovery
Supreme craftsmanship	Cumulative and chronic injuries	Individualized training, medical monitoring, and optimization of the competition calendar

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Thus, a systematic and step-by-step approach to injury prevention can significantly reduce the risk of injury in karate and ensure sustainable development of athletic performance throughout athletes' long-term training.

Effective injury prevention in karate requires a systematic and organizationally structured approach, in which safety measures are not one-time events, but an ongoing part of the training process.

A key element is injury tracking and analysis. It's a good idea for a club or national team to maintain an injury log, documenting the location, mechanism of occurrence, and time of loss of training. This allows for the identification of typical injury-prone situations and the adjustment of training plans.

A mandatory component of the prevention system is the standardization of the training process: the presence of a regulated warm-up with elements of neuromuscular training, clear rules for conducting sparring (level of contact, selection of partners), as well as the mandatory use of protective equipment in accordance with WKF requirements.

Collaboration between the coaching staff and medical specialists plays a crucial role. Medical monitoring should include clearance for training and competition, support for recovery from injuries, and adherence to protocols for head injuries. Athletes' return to activity should be based on functional criteria , not just a timeline.

Consequently, the organization of a preventive system in a club or national team is based on a combination of injury monitoring, regulated training, compliance with safety standards, and medical support, which can significantly reduce the risk of injury and improve the sustainability of the training process.

Injuries in karate are predominantly mild to moderate, but have a unique pattern due to a combination of contact and non-contact mechanisms. The greatest risk of injury is associated with kumite and sparring, while kata is more often associated with overuse injuries to the musculoskeletal system.

An analysis of the causes and risk factors shows that injuries in karate are a manageable process, dependent on the athletes' level of training, the organization of training, and adherence to safety regulations. Effective prevention should be staged and differentiated, including training in safe techniques, neuromuscular

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and strength training, load monitoring, the use of protective equipment, and medical support.

The implementation of systematic prevention in clubs and national teams helps reduce the incidence of injuries, increase athletic longevity, and ensure sustainable performance development at all stages of long-term athletic training.

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