

# Identification of the most frequent injuries in a variety of fencing competitors: A cross sectional study of fencing clubs in the Northeast tri-state region

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## Abstract

**Objective:** To identify the most common fencing injuries in variety of competitors.

**Design:** Retrospective cohort study.

**Setting:** Athletic fencing clubs in the Tri-State Area.

**Participants:** A total of 115 fencing athletes were provided a survey questionnaire after signing informed consent form (or by parent or guardian for fencers under 18 years old). These athletes included minors as well as adults of different age groups and different levels of training.

**Interventions:** A survey was conducted at several Athletic Clubs in the Tri-State area with fencing athletes in order to identify: the most common fencing injuries in different levels of competitors, most common weapon used and whether injury is consistent with competitors age.

**Main Outcome measures:** Fencing Survey

**Results:** From 115 survey participants, sixty-two participants considered themselves to be experts, 41 considered themselves to be at an intermediate level, and 12 participants were beginners. Ninety-seven participants reported experiencing pain as a result of injury. Mild injuries suffered: 21 knee, 15 wrist, 14 ankle, 13 elbow, 11 foot, 10 lower back, 10 shoulder, 6 neck, 2 hip, 2 hamstring, 1 heel. Moderate injuries suffered: 25 knee 18 ankle, 11 foot, 10 wrist, 10 elbow, 10 lower back, 9 shoulder, 5 hands, 4 hip, 4 neck, 2 hamstring. Severe injuries suffered: 9 knee, 8 lower back, 7 ankle, 5 elbow, 5 shoulder, 2 foot, 2 wrist, 2 hip, 1 hands, 1 hamstring. From the participants 58-seeked treatment vs. 45 who did not. From participants who sought treatment 45 were from Medical Doctor, 25 were from coach, 13 were self-treated, 3 were by chiropractor, 2 were by trainer and 2 were by physical therapist or in varied combinations. Only 20 participants notified their parents and 64 were educated about their injuries. Out of the participants that received some sort of injury 41 had a setback at practice time or competition and 51 had a reoccurrence of their injury.

**Conclusions:** From 115 participants that participated in the fencing survey the most common injuries whether it was mild, moderate or severe were knee injuries across all 3 categories, followed closely by ankle and elbow. Treatment from medical doctors seemed to be the predominant choice by participants, although a large part of competitors had reoccurrence of injury. Further study will need to focus on what strategies and training are recommended in the prevention of these injuries.

## Introduction

The goal of this retrospective cohort study is to determine the most common injuries suffered by various fencing competitors in order to establish future preventative measures and treatment modalities. Historically, fencing shifted from being used as military training to a competitive sport in the mid-eighteenth century. In 1896 it had been admitted as an open-skilled combat sport to the first modern Olympics held in Athens [1]. In the modern era fencing is one of only four sports to have been included in every Olympiad [2].

The sport is played between two individuals who attempt to score points by having their weapon contact the opponent's target area. An international tournament usually lasts between 9-11 hours, but the effective fighting time between two individual opponents is anywhere from 17 to 48 minutes long. There are three weapons utilized in modern fencing: foil, epee, and sabre. The foil is a light-thrusting weapon with a flexible blade. When athletes use the foil, they may only target the torso, back of neck, and groin. The athlete receives a point only when

he or she hits "on target," the body regions mentioned above. The epee is also a thrusting weapon but notably heavier and stiffer compared to the foil. Of distinction, the athlete may target the opponent's entire body. The last weapon, the sabre, a light cutting and thrusting weapon, targets the entire body above the waist. Since the sabre is a cutting weapon, athletes can score with the edge of their blade as well as their point. The game is simple conceptually in that the athlete who makes contact with the target area is awarded the point; however, if athletes strike each other simultaneously, the referee uses the "right of way"

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rule, in that the point is awarded to whomever began the attack first. At the Olympics, there are 3 three minute matches during which the winner is the first athlete to score 15 points or whomever has the most points after the entire 3 rounds.

Athletes are required to wear protective attire in order to reduce the chance of being injured. These include a mask, helmet that covers the entire head, and a strong mesh on the torso. In addition, athletes wear a fencing jacket, pads, and glove on the weapon hand. With the advancement of protective gear, traumatic acute injury, such as lacerations and punctures are extremely rare. Despite these preventative measures, injuries do occur, though more commonly they are of a chronic nature.

Fencing is an asymmetrical sport in terms of utilizing the upper limb. Fencing produces typical functional asymmetries that emphasize the very high level of specific function, strength, and control required in the sport [1].

It involves rapid lunges and retreats, causing increased strain on the legs and as a result, the lower extremity was the most frequent location for fencing injuries. Rapid change of direction and strong lunging place the knee and ankle at risk for injury [2]. The athlete undergoes lengthy periods of extension and quick movements of the weapon using the arm, wrist, and hand. Therefore, some of the most common injuries suffered include overuse injuries, such as sprains and strains, similar to other sports involving rapid change of direction. Traumatic injuries are less common in the sport of fencing, as are time-loss injuries. However, the reports of fencing injuries are scarce in the literature and epidemiological large-scale studies are lacking [1]. Despite a lack of large-scale evidence, it has been found that the majority of fencing injuries include blisters, contusions, and abrasions [2]. In addition tendinopathies and tendon tears, secondary to overuse, are relatively common amongst fencers. However, non-contact injuries, such as ligamentous and muscular strains are the predominant form of injury. Overall, the data indicates that fencing injuries tend to be minor, whether surface trauma (abrasions, contusions) or musculoskeletal damage (sprains, strains), which is expected in any activity with rapid change of direction [2].

Fencing was also found to have one of the lowest rates of time-loss. Athletes were found to be able to return to normal functions and activities rather quickly post-injury. It has been found to be one of the safest sports. Despite this, some fencing athletes do experience recurrence of injury, which can be problematic to future performance.

## Methods

Competitors at various athletic fencing clubs in the New York- Tri-State area were surveyed with a retrospective questionnaire in order to characterize musculoskeletal injuries in competitive fencers. The more competitive fencers were evaluated during both competitions and practice, whereas beginner fencers were evaluated primarily in practice settings. The data that was collected included: age, gender, number of years actively fencing, weapon used, hours of training per week, level of expertise, and if professional medical treatment was sought during or after the time of injury. Age was asked in the questionnaire to determine whether certain injuries are more common in specific age groups or whether certain age groups were more prone to injury. Gender was asked to determine if males or females had a higher disposition to getting specific injuries. Athletes also indicated their weapon preference in order to determine whether use of one type of weapon was associated with greater injury to the athlete wielding it.

In addition, participants were asked if they ever experienced pain due to an injury during or following fencing practice or fencing competition. They were asked to identify the body region and severity of pain, which was classified into three categories: mild, moderate, and severe. Participants were asked if they were under the age of eighteen and whether a parent or guardian was notified. They were asked as to whether the injury kept them from competing and if so, for how long. Finally, they were asked if they had ever experienced the same injury again after recovery.

## Results

Out of 115 survey participants (n=115), the ratio of males to females was 79 to 36. The average age was 30.7 years old. Participants' average years of experience were 11.6, with an average of 8.2 hours of training per week. The weapons of choice were the epee (101, 88%), the foil (17, 15%), and the sabre (4, 3%). Sixty-two participants considered their level of expertise to be expert (53%), followed by forty-one intermediate (36%), and twelve beginners (10%). Ninety-seven participants reported experiencing pain as a result of injury (84%), while eighteen participants (16%) did not experience any pain or setbacks. Injuries were categorized as mild, moderate, or severe. Amongst the mild injuries, there were: knee (21), wrist (15), ankle (14), elbow (13), foot (11), lower back (10), shoulder (10), neck (6), hip (2), hamstring (2), and heel (1). From the mild injuries, twelve participants had 2 or more injuries, seven participants had 3 or more injuries and ten participants had 4 or more injuries. Moderate injuries suffered in decreasing order included: knee (25), ankle (18), foot (11), wrist (10), elbow (10), lower back (10), shoulder (9), hands (5), hip (4), neck (4), and hamstring (2). Out of all the moderate injuries, thirteen participants had 2 or more injuries, eight participants had 3 or more injuries, three participants had 4 or more injuries and one had 5 or more injuries. Severe injuries suffered in decreasing order included: knee (9), lower back (8), ankle (7), elbow (5), shoulder (5), foot (2), wrist (2), hip (2), hands (1), and hamstring (1). From the severe injuries, five participants had 2 or more injuries, one participant had 3 or more injuries and three participants had 4 or more injuries. Fifty-eight participants sought treatment versus forty-five who did not. From participants who received treatment, forty-five were treated by a medical doctor, twenty-five by a coach, thirteen by self, three by chiropractors, two by trainers, and two by physical therapist or in varied combinations. Only twenty participants notified their parents and sixty-four were educated about their injuries. Out of the participants that sustained some sort of injury, forty-one had a setback at practice time or competition ranging from 1 day to 36 years. Fifty-one participants suffered from injury recurrence.

## Discussion

The majority of research has demonstrated that the lower extremities are the most common site of injury among fencers, particularly the ankle and the knee. In addition, the largest retrospective self-report study to date (N=1603) reported that the knee (17-19%) and ankle (14-14.5%) were cited as the locations of both the worst injury suffered in the previous year and the worst injury suffered in a fencing career [1]. The largest prospective, exposure-based study of fencing injuries (N=78223), it was noted that though the knee was the most commonly injured site (19.6%), a wide variety of pathologies was involved [2]. Particular concerns involved injuries to the anterior cruciate ligament (ACL). This was also noted in our retrospective review. The majority of participants' location of pain was the knee, whether it was mild, moderate or severe. This could be due to the mechanism of motion in the sport of fencing as mentioned above. This necessitates further

research with preventative modalities with an emphasis on the knee joint.

Among specific injuries found, lateral epicondylitis, patellar tendinopathy, and patellofemoral pain syndrome were the most common. Lateral epicondylitis is commonly referred to the injury known as “tennis elbow.” It is an inflammation of the tendons that join the forearm muscles on the lateral aspect of the elbow, which become damaged secondary to overuse. It is found to be more predominant in fencers that use the foil weapon, as that specific weapon requires repetitive use of the wrist during a flicking motion. The muscles that control wrist extension originate on the lateral aspect of the elbow, and as a result, are more prone to overuse injury since the wrist is strongest in a slightly extended position. Ultimately, this overuse leads to pain while gripping and moving the wrist forcefully, and the majority of the moments required to manipulate a fencing weapon, therefore limiting the athletes’ functionality.

Patellar tendinopathy is also common in fencers due to frequent jumping and lunging motions, which specifically activates the patellar tendon while the quadriceps muscles are in use. The patellar tendon allows for extension of the knee, a vital motion in kicking, running, and jumping. These muscles are particularly crucial for this sport to maintain the “en garde”, or a squat position, as well as for initiating, advancing, and recovering from almost all footwork movements. A deeper en garde position, especially with the knee positioned over the foot and not the ankle, will make the fencer more prone to overworking this tendon. Patellofemoral syndrome is caused by a muscular imbalance, leading the kneecap to track improperly to the outside of the knee, or to grind into the knee joint. The tensor fascia latae, attached to the iliotibial band, is a common cause of this mal-tracking. Indeed, given our results, the knee is the most common location of any injury, whether it is mild, moderate, or severe.

In addition, it was surprising that almost half the participants did not seek treatment after the injury. An emphasis on injury education, including prevention and treatment, should be the focus to enhance the athletes’ function and minimize long-term effects. Of note, fifty-one percent of participants suffered injury recurrence, which only emphasizes the point above. Some general principles of injury prevention remain the same as with most sports, which include: periods of rest, icing after muscle use, and proper technique for gripping, stance, and footwork. Technique problems, such as incorrect body alignment, poor coordination executing fencing actions, and ineffective manipulation of the weapon, are all important sources of injury to be aware of Harmer [2]. Attention should be focused on correcting any alignment issues under the supervision of a physical therapist. An interdisciplinary team approach, consisting of physicians, certified athletic trainers, and physical therapists, and/or kinesiologists should be utilized to prevent injury. Since fencing is unilateral and asymmetrical, bilateral and whole body strengthening programs are recommended. This is most important for younger athletes, children and adolescent fencers, to avoid functional musculoskeletal imbalances as they grow older [2].

Environmental factors can be a source of injury. Equipment can play a role with injury, as poor quality weapons can break, leading to lacerations and puncture wounds even through protecting equipment [1]. The actual surface, “piste” on which the athlete competes can exacerbate injuries, as well. Harmer argues that ankle sprains occur when athletes step on the edge of the piste. Hamstring sprains and Achilles tendon ruptures can occur with the same mechanism,

according to Harmer.

Although recommendations and guidelines of the above mentioned injuries have been discussed in some studies, little to no preventive injury intervention studies been tested to date in the literature [1,3-5] except for a 2015 South Korean study of 9 right handed national fencers. In this study by Kim *et al.*, a 3 month program of stretching (dynamic and passive), pilates, and core and lower limb strengthening was used to evaluate if there was any improvement in balance of mediolateral sway of the nondominant limb. A pre-and post-test model was used, and there was a statistically significant improvement noted in mediolateral sway of the non-dominant lower extremity and improvement of balance scores [6]. Despite this benefit, there were no reports if this prevented any of the commonly cited injuries in this sport.

In general, injury prevention may be divided into 3 areas of improvement: “participants (for example warming up, stretching, psycho-physical conditioning and training, and technique), equipment and facilities (for example, surface cushioning, quality of blades, clothing), and administration of competitions (for example, minimum standard for fencing stripes, rules, and medical coverage)” [1]. Of note, the focus has been improving and targeting intrinsic/personal factors to the fencer as “nearly half of all preventable injuries” appears attributable to these factors [5].

Some prevention techniques already in use include taping to prevent injury from friction and torsional stress on the body. Foil fencers are known to tape the fingers, hand, and wrist of the weapon side, whereas epee fencers are more likely to only tape the wrist [2]. Fencers can also use specialized taping for overuse injuries such as those involving the Achilles tendon, medial tibial, plantar fascia, and lateral epicondyle of the humerus. Correction of incorrect postural alignments, effective wrist and hand manipulation of the weapon, and coordination of fencing attacks [2,7] are other important factors in decreasing injury incidence. The most important body part to address is the knee, as discussed above. Athletes with unstable knees may be well-suited for a brace; however, in fencing participants are prohibited from wearing anything outside of the protective clothing. External knee braces are therefore not an option; however, the brace can be modified to fit under the clothing. In addition, those with prior knee injuries have a greater need for prophylactic strengthening and/or proprioceptive training of the knee musculature, specifically vastus medialis [2]. Incorporating core strengthening, lumbopelvic stabilization, and proprioception training would be of benefit as well [2,8]. Given the asymmetrical nature of the sport, proper prevention and stabilization can significantly prevent an athlete from experiencing injury recurrence.

## Conclusion

Given the data obtained from this cohort, the knee seems to be the most commonly injured site, whether it was injured mildly, moderately, or severely. A high number of these athletes also suffered from more than one injury, and a surprising amount of athletes did not seek treatment. Based on figure 1 below, 39% of athletes refused to seek treatment at the time of their injury and following their injury. The other 10% declined to answer. Additionally, a significant amount of athletes suffered career setbacks as a result of their injuries, and many had recurrences of their injuries. There is the possibility to investigate whether seeking treatment after injury could prevent potential reoccurrence. This is one of the areas that can be emphasized when educating fencing athletes about injury prevention [9-14].

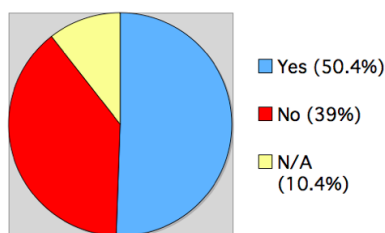


Figure 1. Patients seeking treatment post-injury.

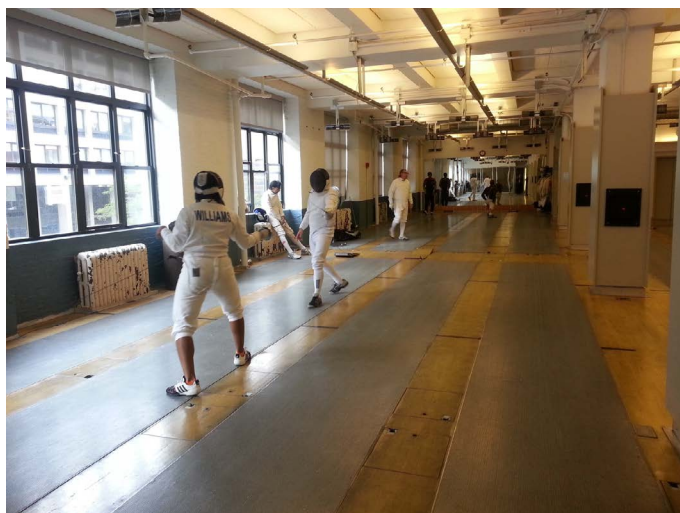
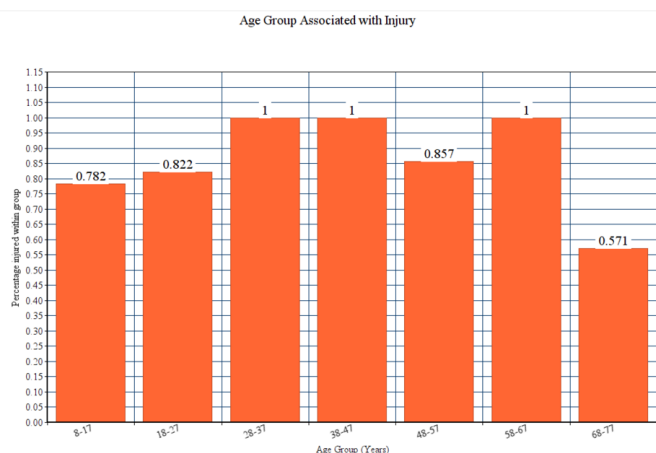


Figure 2. Age group associated with injury.

Although fencing has a long history, an international scope, there are relatively few injury studies that have been conducted to date. Information related to the rate and risk factors of practice and training-related injuries will require additional research to accurately capture rate-based data. These results may lead to improved data on fencing injury prevention, effective treatment and recovery, and ultimately improved performance.

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