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# ACL Prevention

**By Daisy-Scarlett MacCallum, MD**

Anterior cruciate ligament (ACL) injuries continue to be a common and debilitating injury, especially among youth athletes participating in competitive and recreational sports. ACL injuries affect approximately 250,000 individuals in the United States annually (1). While the occurrence of ACL injury is greater among males, the relative risk of injury is two to eight times greater in females per practice or game played(1). ACL injuries occur in a variety of ways, however, low-energy, non-contact injuries are the most common and account for approximately 70 percent of all ACL tears (2-3). These non-contact injuries may be amenable to prevention.

The greatest risk factor for a non-contact ACL injury is a previous ACL injury with up to a 25 percent increase risk of re-injury after surgery. There is also a two to 20.5 percent increased risk of injury to the ACL on the opposite side of the body (3-6). Differences between male and female bony anatomy and knee alignment likely contribute to gender disparities in ACL injuries, though the relationship is not clear (7-9). Furthermore, the higher blood levels of the hormones Estrogen and Relaxin, found in females, is thought to increase risk of injury through their influence on strength and elasticity of soft tissues (9-11).

Modifiable factors that contribute to ACL injury risk include:

- Imbalance between hamstrings and quadriceps strength and flexibility,
- Core muscle weakness,
- Increased Q angle: Angulation of knee during landing so that the knee moves closer to midline
- Weakness of the hip stabilizing muscles

Correcting these factors are the focus of successful ACL injury prevention programs (12-14). These programs increase lower extremity and core muscle control and strength so that athletes avoid the positions that increase their susceptibility to ACL injury. Athletes with more risk factors and more problematic movement patterns are most likely to benefit from participation, but these programs should be implemented widely so that all athletes benefit. Examples of programs aimed at decreasing ACL and other leg injuries include those developed by FIFA (Federation Internationale de Football Association) and the IOC (International Olympic Committee) (15-19).

The Osteoarthritis Action Alliance established six core components of successful ACL prevention programs (20). These include: lower extremity and core strengthening, plyometric exercises, balance training, optimal stretching or agility exercises, continual proper technique feedback (e.g., landing, pivoting), sufficient performance time (at least twice per week) and minimal to no supplementary equipment requirements (14, 21-22). These exercises focus on movements that enhance unconscious movement control by stimulating position sense and central nervous system control to improve unanticipated reactions, and dynamic joint stability. Specific exercises include:

- Lower body strength:
  - Nordic hamstring lowers,
  - Walking lunges,
  - Calf raises,
  - Planks
  - Low- and high intensity plyometric exercises to improve landing mechanics
- Stability workouts:
  - Drop landings,
  - Single and two-legged jump and holds (12,14, 22).

These exercises should be performed at least twice per week as warm-ups prior to sport activity and should be performed during preseason and in-season. The initial volume should be low to allow for the development of proper exercise technique and then gradually increased

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# Recovery from Acute Hamstring Strains

**By Meghan F. Raleigh, MD**

The hamstring consists of three muscles: the biceps femoris, semitendinosis and semimembranosus muscles. Acute hamstring strains are categorized as Type I or Type II, depending on the mechanism of injury. Type I injuries result from sprinting sports and usually involve the biceps femoris. Type II injuries occur from forceful and excessive stretch of the muscle and typically occur with slide-tackling, high-kicking, and dancing activities. Recovery from both types of injuries vary, but generally take several weeks to months. Type II hamstring strains typically take longer to recover than Type I strains. Returning too early can lead to exacerbation of the injury or re-injury. Hamstring injuries can also result from chronic overuse injuries, which are treated similarly.

**Diagnosis**

Diagnosis of an acute hamstring strain is made through history and physical exam. Most athletes describe a sudden sharp pain in the back of the thigh during activity. Commonly the individual will hear a "pop" and develop bruising. Athletes may have difficulty bearing weight or continuing activity immediately following the injury. Imaging with ultrasound or MRI may assist with the diagnosis but are not usually necessary. X-rays can be helpful if there is a concern for an avulsion injury (where the tendon is pulled away from the bone) but also are not necessary in diagnosing a hamstring strain.

**Treatment**

The goal of treatment is to return the athlete to play while minimizing the risk of re-injury. This is done through a rehabilitation program that should be overseen by a physical therapist or

athletic trainer. Typical rehab can be broken down into three phases.

In Phase I, the emphasis is on pain control and decreasing swelling. This is accomplished by using P.R.I.C.E. (protection, rest, ice, compression, elevation). Compression is effective in reducing pain and should be applied soon after the injury. There is no evidence that non-steroidal anti-inflammatory (NSAID) medications are effective in pain relief or recovery from hamstring injury and are therefore not recommended. If the injury is severe, crutches may be needed for a few days until the athlete can walk comfortably. Agility and trunk stabilization exercises may be introduced as allowed by pain during this phase, however no isolated hamstring exercises should be performed yet. The athlete can progress to Phase II once they are walking normally and able to jog at a low intensity without any pain.

In Phase II, the focus is on increasing range of motion and strength of the hamstrings. Agility and trunk stabilization exercises are continued with progressive intensity. Eccentric exercises (putting a load on the tendon while the muscle is lengthening) should be added in this phase. Prolonged static stretching should be avoided, but controlled dynamic eccentric exercises are encouraged. When the athlete is pain free with the exercises and achieves full hamstring strength, he/she can progress to Phase III.

Phase III consists of progressive agility and trunk stabilization, advanced neuromuscular training, eccentric exercises, and the addition of sport-specific exercises or drills.

There is a lack of evidence for the use steroid injections or platelet rich plasma (PRP) injections in the treatment of acute hamstring strains.

**Return to play**

Return to play is dependent on the hamstring function, not on a specific time frame or imaging result. Typically, Type I injuries return to pre-injury function earlier than Type II injuries. The athlete may return to play after he/she progresses through all three phases of rehabilitation. In addition, he/she should be pain-free, psychologically ready, have recovery of full strength and flexibility, and be able to perform sport-specific movements. The recovery can range from weeks to more than six months.

**Prevention**

There is evidence that performing eccentric exercises called Nordic hamstring curls reduces both new and recurrent acute hamstring injuries. Ensuring that the athlete is fully rehabilitated and does not return to play prematurely is the best way to prevent re-injury.

References

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after the athlete can demonstrate proper technique at the initial prescribed volume and intensity (12,14).

The rate of sports-related ACL injuries increases during adolescence, and the opportunity for reducing injury risk is before abnormal mechanics develop. It is therefore recommended that athletes should begin preventative programs young, as early as age 10 (12, 14, 23-24); however, secondary school, club, college, and professional athletes all benefit from prevention programs and should participate throughout their careers. Additionally, athletes that have sustained prior ACL injury or who participate in high-risk sports (frequent landing, cutting, or direction changes and decelerations) should obligatory participate in ACL prevention programs (3,4, 8,12,14, 19-22).

References

# Hydration and Nutrition before, during, and after long distance events/training

**By Gerardo Miranda-Comas, MD**

Optimal hydration and nutrition enhances performance through helping athletes maintain body temperature, blood volume, and adequate muscle function. Specific nutritional needs are based on sport-specific considerations like distance and environment and individual needs based on sex, body weight, and training regimen. The following will guide athletes on hydration and nutrition before, during and after endurance events.

**Training Hydration and Diet**

*Pre-exercise:*

Prior to the event one should pre-hydrate with approx. 350-600 mL at least four hours before the event. If the individual does not urinate or has dark urine, an additional 200 - 350 ml should be consumed two hours prior to the event. For long distance events, make sure to consume beverages with 20-50 mEq/L of salt or snacks with small amounts of salt to help stimulate thirst and retain the consumed fluids. Overhydrating before or during the event is not recommended as it can lead to low blood sodium, thereby increasing the risk of hyponatremia (low sodium levels), which may lead to confusion, muscle cramps and, if not corrected, can progress to serious medical complications requiring hospitalization.

Using a combination of carbohydrates and protein will help fuel and maintain your muscles during exercise. A meal composed of high carbohydrate (1-4 g/kg of body weight) and protein is suggested one to three hours before a workout. Although, the optimal amount of pre-activity food you need to consume is highly individualized.

Working out on an empty stomach may result in cramping or indigestion. Also, avoid eating high-fiber food or high fat items pre-exercise because they are difficult to digest and may cause gastrointestinal discomfort.

Here are some suggestions for pre-workout meal:

- A peanut butter and banana or PBJ sandwich
- Greek yogurt with berries
- Oatmeal with low-fat milk and fruit
- Apple or banana and almond butter
- About a handful of nuts and raisins (two parts raisins: one part nuts)

Events lasting longer than 90 minutes require higher amounts of carbohydrates starting 36-48 hours prior to the event of approximately 10-12 g/kg per day.

*During exercise:*

The amount of fluid hydration varies depending on the individual's sweating, climate, as well as exercise duration and intensity. For events less than one hour, only water is needed for hydration, For events lasting more than an hour, a good rule of thumb is to drink when thirsty, on average 400-800 mL/hour, depending on the above factors. Fluids consumed should contain 20-30 mEq/L of sodium and 2-5 mEq/L of potassium in order to replace electrolyte losses in sweat. Sweat losses can range from one to two liters per hour for endurance sports, but may exceed two liters per hour during warmer events.

Refueling with carbohydrates is recommended when exercising over an hour. Approximately 30 to 60 grams per hour (g/hr) for exercise sessions 1-2.5 hours in duration, and up to 90 g/hr for longer sessions (>2.5 hours). To make digestion easier, divide food into smaller portions. For athletes who do not have the time to eat during an event, sports drinks may be used as an alternative to fulfill nutrient needs. If doing this, ideally drink 150-300mL of a 6% carbohydrate sports drink every 15-20 minutes. It is not necessary to consume fat during exercise.

*Post-exercise/ Recovery:*

Effective rehydration following exercise in the heat, requires replacing all losses. Some athletes choose to weigh themselves to track and replace their losses more closely. The rehydration beverage should contain moderately high levels of sodium (at least 50 mEq/L), and possibly also some potassium. The volume of beverage consumed should be greater than the volume of sweat lost to provide for the ongoing urine and respiratory losses. Approximately 1.5 liters of fluid for every kilogram of body weight lost should be consumed to achieve rapid and complete recovery from dehydration. Intravenous fluid replacement after exercise is warranted if the individual has lost >7% body weight or presents nausea, vomiting, or diarrhea.

It is important to replenish your storage of carbohydrates after exercise. If your workout lasts for less than an hour, there is no need to increase your normal carbohydrate consumption post exercising. If your workout lasts for longer than 60 to 90 minutes hrs, eat or drink a ratio of approximately 4:1, carbohydrate to protein within 30 minutes of ending the work-out.

Some examples include:

- Oatmeal with bananas
- Fruit and almonds
- Sports bars
- Smoothy with protein and carbohydrates

For longer recovery, consume 10-20 g of protein approximately two hours post-exercise.

# How Kickboxing Has Empowered Me as an Athlete and Physician

**By April Lynn Barnum, DO**

Jab! Cross! Left body hook! Right front kick! Left side kick! Right roundhouse kick! Beads of sweat drip down my face, and I am exhausted. The sense of accomplishment is palpable. Not only have I made it through one hour of high intensity exercise after a long day of work in the office, but I have learned a few valuable life lessons along the way.

When I walked into my first class three years ago, I didn't know what to expect. I had watched my younger brother earn his black belt in karate when we were in high school and wondered if hitting that punching bag would be as painless as he made chopping a block of wood look. I began by wrapping my hands and wrists with the colorful red wraps and the endorphins started kicking in. The music began to pump loudly through the speakers. How exhilarating! We started with laps around the room, followed by various combinations of shuffles, burpees, push-ups, sit-ups, leg raises, and exercises with names that I had never heard of before. Next came the stretches. We practiced an array of poses reminiscent of yoga stances to warm up our muscles.

Then, it was time. I strapped on my kickboxing gloves. I was assigned an instructor to guide me each step of the way. We began our first round, in which I learned how to "jab" and "cross." My muscles ached but each time I started to tire and lower my gloves, my instructor was cheering me on. "You can do it. Don't give up. You've got this!" I learned another important lesson: "Never take your gloves away from your face." I put my gloves back up in front of my face and repositioned myself into the "fight" stance. This was a challenge, and I loved every minute of it.

With every round of kickboxing my memorization skills enhanced through repetition and practice. I learned different combinations of punches and kicks with each new round and found my everyday memory became increasingly strengthened. I paid more attention to detail, particularly where it mattered – when I spent time listening to my patients. Kickboxing also taught me the skills of quick thinking and decision making. I learned how to think on my feet, literally and figuratively.

In addition, I acquired a skill that seems to be increasingly important in this day and age: self-defense. Every time I kickboxed, I felt confident and empowered. I brought family, including my twin sister, my boyfriend, and other friends to try kickboxing, because I wanted them to feel empowered and confident, too. Kickboxing made me feel strong physically and mentally.

Kickboxing taught me the value of respect for others. Every session would conclude with partner drills, whereby I would practice punches with a new individual each time. We introduced ourselves, shook hands, motivated each other with positive words, and talked each other through the drills, wanting to improve each other's skills. I partnered with both male and female athletes, individuals of my skill level and those who were more advanced than me, so that I could challenge myself.

Kickboxing has inspired me to take on new leadership roles in both my professional and personal life. I became Chief of my residency program. Outside of work, I started coaching, training, and providing first aid for Special Olympics athletes in soccer and basketball. I also completed my first half marathon during my residency and played as the only female on an all men's indoor soccer team. Finally, I became a licensed Grade 8 United States soccer referee and currently referee U6 to U19 level games. I am one of only a few female referees at the soccer club, and one of only a few women there to referee men's soccer games.

Kickboxing has truly been a gift. Not only is it the best workout I've ever encountered, but it is a sport and an art that has helped shape the person I am today. I feel strong. I feel confident. I feel capable. I want others to feel the same way. Through my own fitness endeavors, I hope I can be an inspiration to my patients. With hard work, dedication, endurance, persistence, and willpower, anything is achievable, if only you believe in yourself.