



Protecting the ACL in Female Soccer

What Actually Works

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I have spent my career on the sideline and in the operating room with soccer players. The ACL injury is the one I would most like to stop seeing. It costs a player nine to twelve months, it changes the trajectory of a career, and it raises the odds of arthritis in that knee decades later. The most important thing I can tell you is this: a large share of these injuries are preventable, and the tools that prevent them are free, take about fifteen to twenty minutes, and replace a warm-up you are already doing.

WHAT WE ARE UP AGAINST

Female soccer players tear their ACL at roughly two to three times the rate of male players. NCAA surveillance across recent seasons puts the ACL tear rate in women's soccer at about 2.6 per 10,000 athlete-exposures, compared with roughly 0.8 to 0.9 in men's soccer — women's soccer carries the highest ACL rate of any women's collegiate sport. Roughly 70% of these tears happen with no contact at all: a plant-and-cut, a deceleration, a single-leg landing, a change of direction to track a runner.

That last fact is the whole reason this article exists. If the ligament failed because someone slid through your knee, there is not much to train. If it failed because of how your hip, trunk, and knee were organized when you landed, that is trainable.

MODIFIABLE RISK FACTORS — THE ONES WORTH YOUR TIME

Plenty of ACL risk is fixed: notch anatomy, ligament size, generalized laxity, family history, a prior tear. Ignore those. Spend your energy here instead.

Dynamic knee valgus. The knee collapsing inward on landing or cutting is the single most recognizable at-risk pattern. It is usually a hip problem wearing a knee costume — weak gluteus medius and hip external rotators let the femur drop into adduction and internal rotation.



Landing stiffly. Low knee and hip flexion at contact means the ligament absorbs what the muscles should have. Quiet, deep, absorbed landings protect the knee. If you can hear your landings across the field, that is information.

Quad-dominant, hamstring-deficient mechanics. The hamstrings resist anterior tibial translation — they are the ACL's teammates. Low hamstring strength and a poor hamstring-to-quadriceps ratio are consistent risk signals. Nordic curls, Romanian deadlifts, and hip hinge patterns belong in your week.

Trunk control. Poor core and trunk positioning predicts knee injury. If the torso lags or drifts laterally during a cut, the ground reaction force vector moves away from the knee's center and the moment arm on the ligament grows.

Limb asymmetry and prior injury. An incompletely rehabbed ankle, hamstring, or knee is a live risk factor. So is an old ACL — return-to-sport reinjury rates in young cutting-sport athletes are substantial, and that population needs an ongoing program, not a discharge.

Restricted ankle dorsiflexion. A stiff ankle forces the knee to find motion elsewhere, usually into valgus.

Fatigue. Landing mechanics degrade measurably when you are tired, and a disproportionate share of injuries occur late in halves and late in tournaments. Fatigue is not a character flaw; it is a modifiable exposure.

LOAD MANAGEMENT

Most youth soccer players in this country are not undertrained. They are unrecovered.

- **Watch the spikes, not the totals.** Trouble tends to follow a sharp jump in workload — a tournament weekend after a light week, a return from illness straight into two-a-days, a preseason that begins at full volume. Build volume gradually; a rough rule is not more than about a 10% weekly increase.
- **Cap simultaneous teams.** Club, high school, ODP, and a second club at once is a load-management failure with no upside. Pick a primary team and negotiate the rest.
- **Take real rest.** At least one full day off per week, and at least a few weeks fully away from soccer each year.
- **Do not specialize early.** Single-sport specialization in youth athletes is consistently associated with higher injury rates. A reasonable target is fewer than eight months per year in one sport, and weekly organized training hours not exceeding your age in years.
- **Manage tournament congestion.** Three or four matches in a weekend is a known high-risk pattern. Prioritize sleep, fueling, and minutes management across the event rather than treating each match in isolation.



FUELING

Under-fueling is one of the most underappreciated injury risk factors in the women's game, and one of the easiest to fix.

Energy availability comes first. When intake does not cover the demands of training plus normal physiology, the body shuts down what it considers optional: menstrual function, bone remodeling, tissue repair, immune function. This is Relative Energy Deficiency in Sport (RED-S), and it is associated with higher injury rates, bone stress injury, and impaired performance. Warning signs include a missing or irregular period, unexplained fatigue, frequent illness, stagnating performance, and recurrent bone or soft-tissue injury. If any of those describe you, that is a conversation with your physician and a sports dietitian, not something to push through.

Practical targets

- **Carbohydrate** is the fuel for repeated high-intensity efforts. Two-a-day and tournament periods require more, not less. Do not train hard on an overnight fast.
- **Protein** roughly 1.6–2.0 g/kg/day, spread across the day rather than concentrated at dinner, supports tendon, ligament, and muscle repair.
- **Iron.** Iron deficiency is common in female athletes and degrades endurance and recovery long before it causes anemia. Ask for ferritin, not just hemoglobin.
- **Vitamin D and calcium** support bone and muscle function; deficiency is widespread, and easy to check and correct.
- **Hydration and post-match refueling.** The window after a match matters most during congested schedules.

MENSTRUAL CYCLE TIMING — WHAT THE EVIDENCE ACTUALLY SUPPORTS

You will hear strong claims in both directions here, so let me be precise.

There is biologic plausibility and some epidemiologic signal that ACL injury risk varies across the cycle, with several reviews favoring the preovulatory (first half) phase, when estrogen rises and knee laxity increases. Other work implicates the ovulatory window, and still other work implicates the late luteal phase when relaxin peaks. The most rigorous recent review of hormonally verified studies concluded the question remains unsettled, largely because most earlier studies relied on self-reported cycle dates without hormone confirmation.

What that means practically:

1. **Track your cycle.** Not to predict injury, but because it is core health data. Cycle changes are the earliest signal of under-fueling and excessive load.



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2. **Do not bench yourself, and do not let anyone bench you, based on cycle phase.** The evidence does not support it, and the downstream message — that female physiology is a liability — is both wrong and harmful.
 3. **Do not use hormonal contraception as an ACL prevention strategy.** A large systematic review found combined hormonal contraceptives were not protective against musculoskeletal injury. Contraception decisions should be made on their own merits with your physician.
 4. **Do adjust around symptoms.** Heavy bleeding, cramping, poor sleep, and iron loss are real and worth managing. That is a fueling, sleep, and symptom-control conversation.

RECOVERY

Sleep is the highest-yield recovery intervention available to you. Adolescent athletes sleeping under eight hours per night carry roughly 1.7 times the injury risk of those sleeping eight or more, and subsequent meta-analysis has supported the association. Target eight to ten hours. Phones out of the bedroom. Consistent timing, including weekends.

The rest, in rough order of value:

- **Post-match refueling** within the first hour after a match, particularly with another match coming.
- **Active recovery** — easy movement the day after competition beats complete inactivity.
- **Planned deloads** every third or fourth week during heavy blocks.
- **Psychological load matters.** High life stress and academic stress are associated with injury risk. Recovery includes time that is not soccer.
- **Cold water immersion** is reasonable between matches in a congested tournament. Avoid it routinely after strength sessions, where it may blunt the training adaptation you are trying to build.
- **Compression and soft tissue work** help you feel better and probably help you train the next day. They are comfort measures, not structural protection. Do not let them substitute for sleep and food.

DO PREVENTION PROGRAMS WORK?

Yes. This is one of the better-supported interventions in all of sports medicine.

PEP (Prevent injury and Enhance Performance). In a two-year study of youth female soccer players, PEP was associated with an 88% reduction in ACL injury in year one and



74% in year two. In the subsequent randomized controlled trial across 61 NCAA Division I women's soccer teams (1,435 athletes), the intervention group had a 41% lower overall ACL rate and a 70% lower non-contact ACL rate. Those two headline figures did not reach conventional statistical significance in a study limited by ACL injury being a relatively rare event — but zero ACL injuries occurred in practice among intervention athletes versus six among controls, and athletes with a prior ACL injury were significantly protected.

Sportmetrics. The original neuromuscular training program built on jump training and landing mechanics, and the first to demonstrate reduced serious knee injury in female athletes. It remains the template for the plyometric component that nearly every later program adopted.

FIFA 11+. In a cluster randomized trial of 1,892 female footballers aged 13 to 17, the 11+ produced a 32% reduction in overall injury, a 45% reduction in severe injury, and a 53% reduction in overuse injury. Notably, the primary endpoint — all lower extremity injury — narrowly missed significance, while the secondary endpoints were clearly reduced. Later trials across collegiate and adult populations have shown reductions in the range of 30% to 46% in overall injury, with knee injury reduction driven by the same neuromuscular mechanisms.

The pooled picture. The most useful summary is the meta-analysis of meta-analyses: across the whole literature, ACL prevention programs cut the risk of all ACL injuries by about half (OR 0.50), and cut non-contact ACL injuries in female athletes by about two-thirds (OR 0.33). More recent meta-analyses continue to land in the same range, with pooled relative risks around 0.46 and non-contact reductions around 60%.

The dose is the whole ballgame

The programs work. The reason ACL rates in women's soccer have not fallen as much as they should have is that most teams do not actually run them.

- **Compliance drives effect size.** Teams with high adherence see substantially larger reductions than teams that do it sporadically. Doing the 11+ once a week and skipping it in season is close to doing nothing.
- **Dose:** roughly 15–20 minutes, at least two to three sessions per week, starting in preseason and continuing all season long. This replaces your existing warm-up — it does not get added to an already full week.
- **Multi-component beats single-component.** Programs combining plyometrics, strength, balance, and agility outperform balance-only or stretching-only approaches.
- **Younger is better.** The effect is largest in mid-teen athletes, smaller in late teens, and unclear in adults. The window to install movement quality is before the deficits consolidate — start at 12 to 14, not at 19.



- **Technique must be coached.** A sloppy squat jump trains a sloppy landing. Somebody has to watch and correct knee position, not just count reps.

THE BOTTOM LINE

If you take one thing from this: **replace your warm-up with a structured neuromuscular program, run it two to three times a week all season, and sleep eight hours.** That combination is supported by better evidence than almost anything else we offer athletes, it costs nothing, and it makes you faster and more powerful on top of protecting the knee.

If you have already torn an ACL, the same principles apply with more urgency — reinjury risk in young female cutting-sport athletes is high, and a structured program should be a permanent part of your training, not something you finish and graduate from.

I am always glad to talk with players, parents, coaches, and clubs about implementing this. It is the part of my job I would most like to make obsolete.

SELECTED PEER-REVIEWED LITERATURE

Webster KE, Hewett TE. Meta-analysis of meta-analyses of anterior cruciate ligament injury reduction training programs. *J Orthop Res.* 2018;36(10):2696-2708.

Pooled across eight meta-analyses, the authors report conclusive evidence that prevention programs “reduce the risk of all ACL injuries by half in all athletes” (OR 0.50, 95% CI 0.41–0.59), with a 67% reduction in non-contact ACL injuries in female athletes (OR 0.33, 95% CI 0.27–0.41).

Soligard T, Myklebust G, Steffen K, et al. Comprehensive warm-up programme to prevent injuries in young female footballers: cluster randomised controlled trial. *BMJ.* 2008;337:a2469.

In 1,892 female players aged 13–17 across 125 Norwegian clubs, the investigators concluded that although the primary lower-extremity endpoint did not reach significance, “the risk of severe injuries, overuse injuries, and injuries overall was reduced” — by 45%, 53%, and 32% respectively.

Gilchrist J, Mandelbaum BR, Melancon H, et al. A randomized controlled trial to prevent noncontact anterior cruciate ligament injury in female collegiate soccer players. *Am J Sports Med.* 2008;36(8):1476-1483.

Across 61 NCAA Division I teams, the authors concluded that a program focused on neuromuscular control “appears to reduce the risk of anterior cruciate ligament injuries” in collegiate female soccer players, with the effect most pronounced among those with a prior ACL injury.

Dos’Santos T, Stebbings GK, Morse C, et al. Effects of the menstrual cycle phase on anterior cruciate ligament neuromuscular and biomechanical injury risk surrogates in eumenorrheic and naturally menstruating women: a systematic review. *PLoS One.* 2023;18(1):e0280800.



Restricting analysis to studies with biochemically verified cycle phase, the authors found it inconclusive whether any phase confers greater non-contact ACL risk, advising that “practitioners should be cautious manipulating their physical preparation, injury mitigation, and screening practises” on current evidence.

Milewski MD, Skaggs DL, Bishop GA, et al. Chronic lack of sleep is associated with increased sports injuries in adolescent athletes. *J Pediatr Orthop.* 2014;34(2):129-133.

Adolescent athletes averaging under eight hours of sleep per night carried 1.7 times the injury risk of those sleeping eight or more (95% CI 1.0-3.0; P = .04), independent of training volume.

Mandelbaum BR, Silvers HJ, Watanabe DS, et al. Effectiveness of a neuromuscular and proprioceptive training program in preventing anterior cruciate ligament injuries in female athletes: 2-year follow-up. *Am J Sports Med.* 2005;33(7):1003-1010.

The foundational PEP cohort, demonstrating an 88% reduction in ACL injury in year one and 74% in year two relative to matched controls.

This article is for general education and does not replace individual medical evaluation. Athletes with knee pain, instability, a prior ACL injury, menstrual irregularity, or recurrent injury should be evaluated by a physician.