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The Uneven Playing Field

By MICHAEL SOKOLOVE

Correction Appended

BY THE TIME JANELLE PIERSON SPRINTED ONTO THE FIELD for the start of the Florida high-school soccer playoffs in January, she had competed in hundreds of games since joining her first team at 5. She played soccer year-round — often for two teams at a time when the seasons of her school and club teams overlapped. Like many American children deeply involved in sports, Janelle, a high-school senior, had traveled like a professional athlete since her early teens, routinely flying to out-of-state tournaments. She had given up other sports long ago, quitting basketball and tennis by age 10. There was no time for any of that, and as she put it: “Even if you wanted to keep playing other sports, people would question you. They’d be, like, ‘Why do you want to do that?’ ”

Janelle was one of the best players on a very good high-school team, the Lady Raiders of St. Thomas Aquinas High School in Fort Lauderdale. A midfielder and a 2007 first-team, all-Broward-County selection, she had both a sophistication and a fury to her game — she could adroitly put a pass right on the foot of a teammate to set up a goal, and a moment later risk a bone-jarring collision by leaping into the air to head a contested ball.

That she was playing at all on this day, though, was a testament not to her talent but rather to her high threshold for pain, fierce independence and formidable powers of persuasion. Janelle returned to action a little more than five months after having an operation to repair a ruptured anterior cruciate ligament, or A.C.L., in her right knee. And just 20 months before that, she suffered the same injury to her other knee.

The A.C.L. is a small, rubber-band-like fiber, no bigger than a little finger, that attaches to the femur in the upper leg and the tibia in the lower leg and stabilizes the knee. When it ruptures, the reconstructive surgery is complicated and the rehabilitation painful and long. It usually takes six to nine months to return to competition, even for professional athletes. But after her second A.C.L. operation, Janelle refused to wait that long. When her teammates were at practice, she felt a longing. What were they doing? Who was playing well? What jokes were they cracking? Just about every girl pictured in her hundreds of photographs from homecoming and other social events was a soccer teammate. She missed her sport, her friends, her life. Whenever she started to feel depressed, she said, “I would just try to rehab harder and get back earlier.”

Janelle’s mother broached the subject with her of whether she should continue playing at all. “I’m afraid for her, and for all these girls,” Maria Pierson told me recently. “What’s it going to be like for them at 40 years old? They’re in so much pain now. Knees and backs and hips, and they just keep going. They’ve been going at this so hard for 10, 11, 12 years, and it’s taking a toll. Are they going to look back and regret it?”

Janelle’s father was concerned, too, but a bit more philosophical. Title IX, the federal law enacted in 1972

mandating equal opportunity in sports, has helped to shape a couple of generations of girls who believe they are as capable and as tough as any boy. With a mix of resignation and pride, Rich Pierson said to me: “We’ve raised these girls to be headstrong and independent. That’s Janelle.”

Janelle told her parents that she was still determined to play soccer in college — and that she would race through her rehab in order to salvage the end of her senior season in high school. Her physical therapist thought that was a bad idea. Her surgeon was reluctant to write a letter to her school stating that she was medically cleared to resume playing, but Janelle persuaded him.

Playing through pain, rushing back from injury — a warrior-girl ethos — was ingrained in Janelle, just as it is in many young women. The more she was hurt, the more routine the injuries felt. Her first A.C.L. operation, she told me, was “monumental. It felt scary. You know, it’s surgery.” Then she added: “The second one was like, O.K., I know what I need to do, let’s just do it. Let’s have the surgery and rehab and get back out there.”

By Janelle’s and her mother’s count, her club team, with 18 players, had suffered eight A.C.L. tears — eight — during her high-school years: Janelle’s two, another player’s two and four other girls with one each. A high-school teammate one class above Janelle endured chronic ankle problems and, according to a Miami Herald article, six ankle operations — three in each leg — over the course of her four years on the varsity soccer team.

This casualty rate was not due to some random spike in South Florida. It is part of a national trend in the wake of Title IX and the explosion of sports participation among girls and young women. From travel teams up through some of the signature programs in women’s college sports, women are suffering injuries that take them off the field for weeks or seasons at a time, or sometimes forever.

Girls and boys diverge in their physical abilities as they enter [puberty](#) and move through adolescence. Higher levels of [testosterone](#) allow boys to add muscle and, even without much effort on their part, get stronger. In turn, they become less flexible. Girls, as their [estrogen](#) levels increase, tend to add fat rather than muscle. They must train rigorously to get significantly stronger. The influence of estrogen makes girls’ ligaments lax, and they outperform boys in tests of overall body flexibility — a performance advantage in many sports, but also an injury risk when not accompanied by sufficient muscle to keep joints in stable, safe positions. Girls tend to run differently than boys — in a less-flexed, more-upright posture — which may put them at greater risk when changing directions and landing from jumps. Because of their wider hips, they are more likely to be knock-kneed — yet another suspected risk factor.

This divergence between the sexes occurs just at the moment when we increasingly ask more of young athletes, especially if they show talent: play longer, play harder, play faster, play for higher stakes. And we ask this of boys and girls equally — unmindful of physical differences. The pressure to concentrate on a “best” sport before even entering middle school — and to play it year-round — is bad for all kids. They wear down the same muscle groups day after day. They have no time to rejuvenate, let alone get stronger. By playing constantly, they multiply their risks and simply give themselves too many opportunities to get hurt.

Janelle’s first-round playoff game in January took place at Lockhart Stadium in Fort Lauderdale; the temperature was in the mid-70s, and there was a light breeze, the kind of weather that inspires people to move to Florida. Janelle, with a bulky black brace on her right knee, dressed for the game against the better

judgment of her parents. “They were like, ‘No, you’re not going to do that,’ ” she said. “And I was like: ‘Yes I am. This is my last year, and I want to win the state championship.’ ”

Her knee was still a little stiff, she said, but she put that in the category of “aches and pains.” She told me after the game: “You have to learn to deal with pain, because if you don’t, you’ll never get to play. It’s not like you ever feel perfect.”

Janelle began the game on the bench because her coach, Carlos Giron, promised her parents to limit her playing time to no more than 25 or 30 minutes of the 80-minute match. She was not in the kind of overall shape to play a whole game, and besides, the contest was not expected to be much of a struggle. Under Giron, the Lady Raiders had already won 10 state titles. But the game started out tighter than expected, and 15 minutes into a scoreless match, he motioned for Janelle. As she came bounding off the bench, her mother, next to me watching from the bleachers, audibly exhaled.

Maria Pierson, the owner of a public-relations firm, loved watching Janelle play over the years and was never bothered much when her daughter was knocked to the ground or even bloodied in collisions. Now, though, she was a total wreck. “Oh, God, I have such a [stomachache](#),” she said. “I can’t stand it.” When Janelle and an opposing player went for a ball at midfield and it looked as if they would arrive at the same moment, her mother emitted a high-pitched yelp, then uttered something like a prayer: “Please don’t kick her in the leg. Please.”

A few minutes later, Janelle collided with an opponent. Her right knee, the one most recently surgically repaired, was extended out in front of her body as she tried to get her foot on the ball. This finally sent Maria Pierson over the edge.

“No! No! Oh, no!” she yelled. She jumped up from her seat and her sunglasses went flying off her head into the row below. Janelle emerged unscathed. Her mother retrieved her glasses and exhaled. For the moment, Janelle was fine.

PARENTS OF TEENAGE GIRLS who play sports have grown accustomed to what seems like entire teams battling injuries — and seeing those who do make it onto the field wrapped in Ace bandages or wearing braces on various body parts. Hannah Cooper, a star soccer player at Bethesda-Chevy Chase High School in Maryland, sat out several games early in the 2007 season with a severe ankle sprain, one of many she has suffered since her years in middle school. “The left one never fully recovers, so I play in a brace,” she told me not long ago. “I also have shinsplints, so that hurts all the time, but I’ve just learned to ignore it. I also tore my [meniscus](#), or I think I did,” she said, referring to knee cartilage. “I’ve probably had [concussions](#) because I’ve had hard collisions where I was disoriented and had headaches afterward, but I’ve never missed a whole game because of one. If I have to sit out, I always come back in.”

David Cooper, Hannah’s father, observed: “I once heard that the injury rate in the [N.F.L.](#) is 100 percent. It looks to me, in girls’ soccer, it’s the same thing.”

On a night soon after Hannah returned to action last fall against crosstown rival [Walt Whitman](#) High School, two of her teammates sat out because of their own ankle [sprains](#). But that was nothing compared with the injuries on the Whitman team, which competed without five key players — two were finished for the season with ruptured A.C.L.’s, two were sidelined with concussions, and one was out with an injured back.

Whitman's senior captain, Rachel Haas, did play, and was her team's most visible player because of her remarkable, almost freakish throw-ins. Whenever her team was deep in its attacking end, Rachel was able to fling the ball all the way into the goal area — a potent offensive tactic made possible by the extreme flexibility of her spine. When she took the ball back behind her head to throw, and arched her back, she looked like one of those old Gumby dolls you can bend in any direction. Rachel's mother said her daughter regularly visited a [chiropractor](#), and that chronic back pain had cut short each of her previous three school seasons.

Rebecca Demorest, a sports-medicine pediatrician, told me that it is common for her to treat young women with injuries from head to toe. "They ache and they hurt and they use pain medicine and try to keep on playing," she said. "When they finally get to the point they can't play, they come in to see me. . . . They have a series of nonspecific, overuse injuries that comes down to being worn out. Don't get me wrong. There's a chain of events with boys too. But I see it more with the girls." (I spoke with Demorest when she was based at Children's Hospital in Washington; she has since moved to the Women's Sports Medicine Center at the Hospital for Special Surgery in New York.)

Comprehensive statistics on total sports injuries are in short supply. The [N.C.A.A.](#) compiles the best numbers, but even these are based on just a sampling of colleges and universities. For younger athletes, the numbers are less specific and less reliable. Some studies have measured sports injuries by emergency-room visits, which usually follow [traumatic events](#) like broken bones. A.C.L. and other soft-tissue injuries often do not lead to an E.R. visit; the initial examination typically occurs at the office of a pediatrician or an orthopedic surgeon. Studies of U.S. high-school athletics indicate that, when it comes to raw numbers, boys suffer more sports injuries. But the picture is complicated by football and the fact that boys still represent a greater percentage of high-school athletes.

Girls are more likely to suffer chronic [knee pain](#) as well as shinsplints and stress fractures. Some research indicates that they are more prone to ankle sprains, as well as hip and back pain. And for all the justifiable attention paid to concussions among football players, females appear to be more prone to them in sports that the sexes play in common. A study last year by researchers at [Ohio State University](#) and Nationwide Children's Hospital in Columbus, Ohio, reported that high-school girls who play basketball suffer concussions at three times the rate of boys, and that the rate for high-school girls who play soccer is about 1.5 times the rate for boys. According to the N.C.A.A. statistics, women who play soccer suffer concussions at nearly identical rates as male football players. (The research indicates that it takes less force to cause a concussion in girls and young women, perhaps because they have smaller heads and weaker necks.)

But among all the sports injuries that afflict girls and young women, A.C.L. tears, for understandable reasons, get the most attention. No other common orthopedic injury is as debilitating and disruptive in the short term — or as likely to involve serious long-term consequences. And no other injury strikes women at such markedly higher rates or terrifies them as much. Rachel Young, a former soccer player at [Virginia Tech](#) who had to stop playing after two A.C.L. ruptures and substantial cartilage damage in her right knee, told me that young women she knew feared the injury but rarely talked about it. "A.C.L. is like a curse word," she said. "You just cringe when you hear it."

AN A.C.L. DOES NOT tear so much as it explodes, often during routine athletic maneuvers — landings from jumps, decelerations from sprints — that look innocuous until the athlete crumples to the ground.

After the A.C.L. pulls off the femur, it turns into a viscous liquid. The ligament cannot be repaired; it has to be replaced with a graft, which the surgeon usually forms by taking a slice of the patellar tendon below the kneecap or from a hamstring tendon. One reason for the long rehabilitation is that the procedure is really two operations — one at the site of the injury and the other at the donor site, where the tendon is cut.

Janelle suffered her first A.C.L. injury at practice with her club during a routine drill. When she planted her left leg to shoot, the knee buckled. Her mechanics felt no different than they had thousands of times before: Decelerate. Fix on the target. Kick. There were few things in her life she did with more ease or joy. Her second A.C.L. injury occurred the following summer at the annual Texas Shootout in Houston, a prestigious event that attracted 300 teams and 360 college coaches as well as major corporate sponsorship, including Adidas, Gatorade and the Texas Sports Medicine Center. In the first game, she ruptured the A.C.L. in her other knee. “This time I was pretty sure what it was,” she said. “I was chasing after this girl, trying to cut to stop her. And it just went out on me.”

She stayed down on the field, screaming. A trainer came out and tried to calm her, assuring her the pain would subside. But her screams came more from anger than pain. She instantly understood that most of her senior season of high-school soccer would be wiped out and worried that no college coach would want to recruit her. (What she did not realize was that if college coaches shunned girls with a history of serious knee injuries, they would struggle to put quality teams together.)

The nature of both her A.C.L. injuries — occurring, as they did, without contact and seemingly in the absence of any extraordinary circumstances — is the very thing that perplexes A.C.L. researchers. It takes 2,000 Newtons (a measure of force) to rip an A.C.L. apart. (Researchers know this from intentionally snapping cadaver knees.) The mystery is why a knee works properly for many years — through game after game, practice after practice, long season after long season, for tens of thousands of repetitions — and then, without warning, a tiny but crucial component suddenly malfunctions.

Steve Marshall, a professor at the [University of North Carolina](#)’s School of Public Health, leads a large A.C.L. study financed by the [National Institutes of Health](#) that is following students at the three major U.S. military academies. The idea is to take a series of measurements — as well as to study digitized images of a student’s form when landing from jumps — and then to build an “injury group” from among those who go on to tear their A.C.L.’s. What traits did they have in common? And which of those traits can be modified so that the rates of injuries can be lessened?

“I’m an injury epidemiologist, and I’ve been doing this for a while now,” Marshall says. “This is the first time I’ve studied something where I can’t show you what did the damage. If we were reconstructing an incident where a child fell down a staircase, I could say, ‘O.K., he got a [laceration](#) here because of where he hit the handrail.’ Or he rolled his ankle, or whatever. If it’s a car crash, you say, ‘O.K., the road was slick, a crash occurred and a loose object in the car came up and hit someone on the head.’

“But here, you can look at a video of an injury all day long, and what you see is people in the air. People landing. People cutting. What we can’t actually see is what tears the thing apart.”

If girls and young women ruptured their A.C.L.’s at just twice the rate of boys and young men, it would be notable. Three times the rate would be astounding. But some researchers believe that in sports that both

sexes play, and with similar rules — soccer, basketball, volleyball — female athletes rupture their A.C.L.'s at rates as high as five times that of males.

Anthony Beutler, a major in the U.S. Air Force and a professor at the School of Medicine of the Uniformed Services University in Bethesda, Md., is among the cadre of doctors, scientists and researchers trying to crack the code of A.C.L. injuries. In 2001-2, he was a sports-medicine fellow at the Naval Academy, where he served as the physician for the women's soccer team. Seven women were lost that season to A.C.L. ruptures. Beutler, already immersed in A.C.L. research, was still stunned. "I thought to myself, What in the heck is going on here?" he said. Last season, the women's team at Navy suffered three torn A.C.L.'s. "They thought that was great, a fortunate year," he told me. "Think about that. Just three. It's bizarre."

Men also tear their A.C.L.'s, most frequently in football and from direct blows to the leg. But even football players, according to N.C.A.A. statistics, do not rupture their A.C.L.'s during their fall seasons at the rates of women in soccer, basketball and gymnastics. The N.C.A.A.'s Injury Surveillance System tracks injuries suffered by athletes at its member schools, calculating the frequency of certain injuries by the number of occurrences per 1,000 "athletic exposures" — practices and games. The rate for women's soccer is 0.25 per 1,000, or 1 in 4,000, compared with 0.10 for male soccer players. The rate for women's basketball is 0.24, more than three times the rate of 0.07 for the men. The A.C.L. injury rate for girls may be higher — perhaps much higher — than it is for college-age women because of a spike that seems to occur as girls hit puberty.

If you are the parent of an athletic girl and live in a community that bustles with girls playing sports — especially the so-called jumping and cutting sports like soccer, basketball, volleyball and lacrosse — it may seem that every couple of weeks you see or hear about some unfortunate young woman hobbling off the field and into the operating room. The first time, you think: What a stroke of bad luck. But you figure it won't happen to your daughter because, after all, what are the odds?

After a couple of more A.C.L. tears in the neighborhood, you get worried and think, Gosh, we must be in a really bad cluster for these injuries. Why here? But in all likelihood, what you are witnessing is not a freakish run of misfortune but the law of averages playing out.

The Injury Surveillance reports include commentary as well as data, and in 2007 the authors stated that an A.C.L. rupture is "a rare event" and advised against making too much of the tears sustained by male and female collegiate athletes across a range of sports. But a young woman playing college soccer can easily generate 200 exposures a year between her regular season in the fall, off-season training in the spring and club play in the summer. Plenty of younger players, girls in their early through late teens, will accrue well in excess of that number between their high-school seasons, their club seasons — which often run year-round — and multigame tournaments on weekends and soccer camps in the summer. (The same is true in other sports in which girls play school and club seasons, including basketball, lacrosse, volleyball and field hockey.)

So imagine a hypothetical high-school soccer team of 20 girls, a fairly typical roster size, and multiply it by the conservative estimate of 200 exposures a season. The result is 4,000 exposures. In a cohort of 20 soccer-playing girls, the statistics predict that 1 each year will experience an A.C.L. injury and go through reconstructive surgery, rehabilitation and the loss of a season — an eternity for a high schooler. Over the course of four years, 4 out of the 20 girls on that team will rupture an A.C.L.

Each of them will likely experience “a grief reaction,” says Dr. Jo Hannafin, orthopedic director of the Women’s Sports Medicine Center at the Hospital for Special Surgery in New York. “They’ve lost their sport and they’ve lost the kinship of their friends, which is almost as bad as not being able to play.”

Marshall says he feels a sense of urgency, because without a better understanding of the injury, the situation will get worse in coming years with the great numbers of girls playing sports — and the frequency and intensity of their play. In 1972, at the dawn of Title IX, about 300,000 girls participated in high-school sports. The number is now three million. Thirty thousand women played college sports pre-Title IX; about 205,000 now play.

“We’re studying an elite population at the service academies, but the big concern for me is the girl down the street who wants to play soccer on the rec team or the travel team,” Marshall told me. “They’re ripping their knees up, and they shouldn’t be. There’s got to be a way to prevent it. And we’re really on the up curve of this, because it’s still relatively recent that girls played sports in these large numbers. . . . So if you think we have a problem now, 10 years from now we’ll have a much bigger problem.”

ONE WEEKEND IN THE FALL OF 2007, I watched a soccer match involving two teams of 13-year-old girls in Southern California with Holly Silvers, a physical therapist and the director of research at the Santa Monica Orthopaedic and Sports Medicine Research Foundation. These were elite players, but from one end of the field to the other, Silvers pointed out girls she judged to have insufficient core muscle strength, balance or overall coordination to play safely. Their movement patterns put their knees — and probably their ankles, hips and backs — at risk.

“Look at the girl on the left back with the ponytail,” she said as we stood on the sideline of a game at the Home Depot Center, a vast complex of fields in Carson, Calif., where the men’s and women’s national soccer teams train. “She really concerns me.” At first I couldn’t pick out whom she meant; there were lots of ponytails out there. “No. 8,” she clarified, and I fixed my attention on a tall, stiff-legged girl whose upper and lower bodies seemed not to be in communication with each other. She ran bolt upright, with very little bend in her trunk. Her knees seemed not to flex. When she came to a stop or slowed to change directions, she landed flat-footed. “She’s got really poor form,” Silvers said. “She won’t hold up running like that.”

She pointed out another girl with possibly even worse form. She was one of the better players on the field, but Silvers said her advanced skills masked serious physical flaws. I asked her if she could fix the girl, given the opportunity. “Yes, I could,” she said. “In four to six weeks I could improve her a lot. In three months, I could get the job done. I would educate the muscles, educate the nerves. She could build strength and change her patterns.”

Silvers directed my attention to one more player, a girl who seemed light on her feet, quick and springy. When she changed directions, she stayed in what generations of gym teachers have called “the athletic position” — knees bent, butt low to the ground. Even when walking casually during stoppages in play, she seemed more lithe than the other girls. “She moves more like a boy,” Silvers said. “Believe me, that’s a good thing.”

Silvers, along with a Santa Monica orthopedic surgeon, Bert Mandelbaum, designed an A.C.L.-injury-prevention program that has been instituted and studied in the vast Coast Soccer League, a

youth program in Southern California. Teams in a control group did their usual warm-ups before practices and games, usually light running and some stretching, if that. The others were enrolled in the foundation's "PEP program," a customized warm-up of stretching, strengthening and balancing exercises. An entire team can complete its 19 exercises — including side-to-side shuttle runs, backward runs and walking lunges — in 20 minutes. One goal is to strengthen abdominal muscles, which help set the whole body in protective athletic positions, and to improve balance through a series of plyometric exercises — forward, backward and lateral hops over a cone. Girls are instructed to "land softly," or "like a spring."

There is nothing complicated about the program. And nothing really exciting about it either — which, as with many preventive routines, is one of its challenges. As essential as it may be, it's not as interesting as kicking a soccer ball around.

The Santa Monica Orthopaedic and Sports Medicine Research Foundation published results of its trial in the American Journal of Sports Medicine. The research was nonrandomized and therefore not the highest order of scientific research. (The coaches of teams doing the exercises made a choice to participate; the control group consisted of those who declined.) Nevertheless, the results were attention-grabbing.

The subjects were all between 14 and 18. In the 2000 soccer season, researchers calculated 37,476 athletic exposures for the PEP-trained players and 68,580 for the control group. Two girls in the trained group suffered A.C.L. ruptures that season, a rate of 0.05 per 1,000 exposures. Thirty-two girls in the control group suffered the injury — a rate of 0.47. (That was almost twice the rate for women playing N.C.A.A. soccer.) The foundation compiled numbers in the same league the following season and came up with similar results — a 74 percent reduction in A.C.L. tears among girls doing the PEP exercises.

The program has direct parallels with the research taking place at the military academies. Both are focused on biomechanics — the way athletes move — in no small part because gait patterns can be modified, unlike anatomical characteristics like wider hips. Marshall has been encouraged by information taken from the sensors attached to his subjects as they jump. "Women tend to be more erect and upright when they land, and they land harder," he said. "They bend less through the knees and hips and the rest of their bodies, and they don't absorb the impact of the landing in the same way that males do. I don't want to sound horrible about it, but we can make a woman athlete run and jump more like a man."

Silvers stressed the importance of training girls as young as possible, by their early teens or even younger. "Once something is learned neurally, it is never unlearned," she said. "It never leaves you. That's mostly good. It's why motor skills are retained even after serious injuries. But ways of moving are also ingrained, which makes retraining more difficult with the older athletes. The younger girls are more like blank slates. They're easier to work with."

The PEP program, and others like it around the country, are not without their skeptics, who ask how you can try to solve a problem before you are even confident of its cause. Donald Shelbourne, an Indianapolis orthopedic surgeon and researcher, is perhaps the most vehement of the critics. "It's like me taking antioxidants," he says. "I don't have [cancer](#) yet, so it's working, right? These retraining programs play on emotions without data. They're unproven. Jumping and landing is something that everyone knows how to do, and now we've got people saying, 'We can teach you to do it better.' I don't buy it."

Coaches rarely like to give up precious practice time for injury prevention, and often have to be pushed by parents. As Diane Watanabe, an athletic trainer who is part of the Santa Monica research team, puts it: “Coaches have to see a performance boost. Otherwise, they won’t do it. That’s the only way we can sell them on this program.”

The bigger barrier, though, may be political. Advocates for women’s sports have had to keep a laser focus on one thing: making sure they have equal access to high-school and college sports. It’s hard to fight for equal rights while also broadcasting alarm about injuries that might suggest women are too delicate to play certain games or to play them at a high level of intensity. There are parallels in the workplace, where sex differences can easily be perceived as weakness. A woman must have maternity leave. She may ask for a quiet room to nurse her baby or pump [breast milk](#) and is the one more likely to press for on-site child care. In high-powered settings like law firms, she may be less likely, over time, to be willing to work 80 hours a week. She does not always conform to the model of the default employee: a man.

Mary Jo Kane, director of the Tucker Center for Research on Girls and Women in Sport at the [University of Minnesota](#), voices that sort of concern. “I’m not in any way suggesting that this topic should not be taken seriously,” she says. “We need to do everything we can do to prevent injuries. But when you look at the stories that get told, that those who cover women’s sports are interested in telling . . . it does seem that so little coverage focuses on women’s accomplishments, on their mental toughness and physical courage. There is a disproportionate emphasis on things that are problematic or that are presented as signs of women’s biological difference or inferiority.”

Sandra Shultz, an A.C.L. researcher who teaches graduate courses in athletic training and sports medicine at the University of North Carolina at Greensboro, said she was more willing to focus on sex difference. “It depends on what side of the fence you’re on,” she told me recently. “If your job is to encourage inclusion of more women in sport, maybe you are not going to accentuate the negative. You don’t want to paint women in a negative light and tell a girl that if you play sports, your knees, by the time you are 30 or 35, may be in bad shape. But intuitively, people know it. As a researcher and a clinician, I’m willing to talk about these things so we can do something about them.”

Shultz and other researchers say that A.C.L. research and the training programs spawned by it may end up protecting women from a range of injuries — all of them stemming from poor form and underdeveloped muscle. “Just because a kid is good at a sport does not mean she has the foundational strength or movement patterns to stand up to constant play,” she says. “What I’d like to be able to say is: ‘Before you engage in a sport, I am going to teach you how to move. And I am going to give you strength.’ ”

JANELLE, WHO TURNED 18 LAST MONTH, told me that her teachers would consider her quiet but that she’s a chatterbox with her friends. She is pretty, but not fussy about her appearance. She rolls out of bed in the morning, brushes her teeth, pulls up her hair and goes off to school. “Ten minutes,” she says. “That’s all I need. That’s from the time I get up until I’m in the car.”

She has a teenager’s sardonic wit, and sometimes even her mother is not sure when she’s serious. She went to a private Christian school when she was younger and now attends a Catholic high school. After taking a comparative-religion class this year, she told her mother that she might consider becoming a Buddhist, which Maria Pierson took as sort of a joke. “No, I meant it,” Janelle told me. “I’ve been Catholic all my life. I

don't know if it's the best religion. I told her I might go shopping for a new one, and I'm still actually planning on doing that."

Rich and Maria Pierson never had to push Janelle into soccer or to reach for higher-level teams, and they certainly never berated her after bad games. These types do exist, stereotypical "Little League parents," but it is far more difficult than some imagine to push a reluctant child into sports, especially at a level that demands great commitment. Children may acquiesce for a while, but all but the most passive or abused will eventually rebel and shut down.

I found a different syndrome: parents of highly motivated, athletic children who are supportive of their kids' sports but bewildered by the culture. The children, often as not, are the ones leading the way, and the whole family gets pulled along in ways it never anticipated. "We had no idea what we were getting into," Rich Pierson said. "You just feel your way as you go. She started playing with a local team, just once or twice a week, then began with the travel team, and after that it just builds on up."

Rich, a self-employed investor, told me his own childhood revolved around his parents' country club. The kids splashed in the pool, learned to golf, played baseball. "For my generation, this is the new country club," he said, referring to his deep involvement in youth sports. "It's where all your leisure time goes. It becomes your social set." (The Piersons have one other child, a son, now in college, who was also an athlete.)

In many sports, a youth athlete's paramount relationship is now with a club rather than a school team. Annual fees and travel to tournaments often run into the thousands of dollars. Parents pay for camps and private sports tutors. The guiding principle is that childhood sport is too important to be left to volunteers and amateurs. The quality of coaching, in terms of skills and tactics, is probably better than in past generations, but it is also narrower. Rather than being coached by educators who see them during the school day and have some holistic sense of them as children, young athletes are now mentored by coaches who cultivate only their athletic side.

At what age should a young athlete begin traveling to out-of-town tournaments? How many days a week should she be playing? When should she give up her other sports? The professional coach is usually not equipped to know what's best, but he wields tremendous influence all the same, sometimes by threat. He makes the schedules and sets the rules, and a child who does not go along risks losing her place on the team.

"Parents' hearts are usually in the right place," says Colleen Hacker, a sports-[psychology](#) consultant who has worked with athletes from the preadolescent up through the college, Olympic and professional ranks. "I don't think anybody's saying, 'Honey, how do we screw them up tomorrow?' But the attention, judgment and objectivity that parents bring to their work lives and other spheres of importance, they don't bring to their kids' sports."

The club structure is the driving force behind the trend toward early specialization in one sport — and, by extension, a primary cause of injuries. To play multiple sports is, in the best sense, childlike. It's fun. You move on from one good thing to the next. But to specialize conveys a seriousness of purpose. It seems to be leading somewhere — even if, in fact, the real destination is burnout or injury.

Anson Dorrance, the women's soccer coach at the University of North Carolina, is a fierce critic of the tournament system, which he says began when the women's game was young and good teams had to travel

to find strong competition. “But now,” he told me, “everybody’s got a tournament. There’s the Raleigh Shootout, the Surf Cup in Southern California, and ding, ding, ding, they’re everywhere.” Dorrance was animated, his words coming out in a rush. “So now girls are going somewhere every two or three months and playing these inordinate number of matches. And you know what? They’re playing to survive. And the survival is not just the five games in three days. It’s the two or three weeks following. They’ve got a niggling this and niggling that — sprained ankles, swollen knees, aching backs. They were overplayed and they never rested. But part of what’s developing is this question of who’s tough enough, who can play through it?”

Janelle suffered her second A.C.L. rupture, the one in Houston, while playing in her third tournament in three weekends with her club team, the Weston Fury. Each was a multigame tournament. The demands of a schedule like that — a dozen or more hotly contested matches over the course of three weeks (in three different states) — are beyond what is ever asked of any professional or collegiate team.

In Houston, she was among several players on her team still trying to attract the attention of college coaches. “There was maybe a little sense of panic,” Rich Pierson says. “They were on the move, trying to be seen.”

His daughter’s injuries have caused him to reassess the intensity of youth sports. “There are worse problems, but this catches you completely by surprise,” he says. “You don’t see it coming. There’s accountability all the way down the line. The coaches. The parents.”

JANELLE’ HIGH SCHOOL, St. Thomas Aquinas, is the alma mater of the tennis immortal Chris Evert and the former football star [Michael Irvin](#). It places a high value on attracting and developing young athletes, and on keeping them healthy enough to go on and play in college. “I get more compliance from the boys,” the school’s athletic trainer, Dwayne Owens, told me. “Boys are actually willing to sit if that’s what I tell them. The girls want to get back out there. They want me to tape them up and let them play.” I repeatedly heard similar sentiments from doctors, coaches and others: Girls are more likely to put themselves at risk. If they’ve played through a lot of pain in the past, they may be inured to it.

There is a fascinating parallel in research on injury rates in U.S. Army basic training, a two-month regimen that pushes recruits to their physical limits. In numerous studies going back more than two decades, women are shown to suffer injuries at substantially higher rates than men, with stress fractures to the lower legs a particular problem. But one large study also suggests that the women are both more frequently injured and tougher. It takes a bigger injury to knock them out of the service. The men, by comparison, are wimps; they leave with more minor ailments.

In sports, just as in the military, women are relative newcomers. In both venues, there may be an element of “toughing it out” to prove they belong. “From the earliest levels in girls’ sports, up through the elite and Olympic level, how one plays the sport, how one comports oneself, is talked about in specific ways that transcend technical or tactical expertise,” Colleen Hacker says. “It is more overt with the girls than the boys. Character counts. Physical toughness, mental toughness and handling adversity count.”

When I was with Janelle, I could not help thinking of Amy Steadman, who was going to be one of the great American soccer players of her generation. In her junior year in high school, in Brevard, N.C., Parade magazine named her the top high-school-age defensive player in America, “the best of the best.” She was a

captain of the U.S. women's under-19 team, a future star of the women's national team. She played for Anson Dorrance at U.N.C., and while I was talking to him one day, he pointed out beyond his office door to a gallery where the uniforms of his all-time greats, including [Mia Hamm](#), were displayed. "She would have been one of those jerseys out there," he said, referring to Amy.

But by the time I met her, Amy was 21 and had torn the A.C.L. in her right knee four times. The first time was when she was training for the under-19 World Cup. "That was my ultimate goal at the time," she told me. "I just wanted it so bad. I had 10 months to recover and get back to close to 100 percent, or I wasn't going to make the team. . . . I worked out like three or four hours a day. I was really determined, and being so young, I didn't know anything about patience."

Amy said that she had "a lot of complications" with the first one. But what she described in her understated way sounded more like a nightmare than complications. She briefly became addicted to her pain pills. She lost weight and became so dehydrated she had to be hospitalized and hooked up to an IV. She received a "huge lecture" from the nurses on how to take better care of herself.

But she achieved her goal and made the under-19 team, the highlight of her too-brief career. As Amy walked toward me the first time we met, her right leg was stiff and her whole gait crooked. She moved like a much older woman. If I hadn't known her history, I would never have believed she had been an athlete, let alone an elite one. She had undergone, by her count, five operations on her right knee. Her mother counted eight, and believed that Amy did not put certain minor cuttings in the category of actual operations. She was done playing. She had been told she would need a [knee replacement](#), maybe by the time she turned 30.

Amy told me about her final operation, recalling that when she came out of [anesthesia](#), the surgeon seemed as if he was going to cry. He looked at her in silence for what seemed like a long time, trying to compose himself. Finally, he told her, "Amy, there was nothing in there left to fix."

JANELLE MADE IT THROUGH that first playoff game, a 2-1 victory. But I sensed I was watching a shell of the player she had been and, with continued health, might be again. She was like an adult on the field — a supersmart, clever-passing, organizing presence — but she had no speed or explosiveness. Twice she passed up scoring chances because she would not plant on her surgically repaired knee to shoot with her left foot.

The next game, another victory, was on the Gulf Coast, but Janelle barely played. She did all that work to make it back so she could help her team in her senior year, but the game was fast and rough, and her coach went with younger players. On the long ride home across Alligator Alley, Janelle sat with a teammate in the back of her parents' S.U.V. but said hardly a word.

Later I asked if having so little playing time bothered her. "Yeah, of course," she said. "But those girls have been together for like 25 games without me. It's hard to break back into the lineup, and I have to try to understand that." I pointed out that she had been a first-team, all-Broward-County selection. "That was last year," she said.

Janelle played much more the next game, but the Lady Raiders lost — two games short of the state championship. Other girls cried. Janelle stoically walked off the field, unstrapped her knee brace and accepted hugs from her parents.

The next week, she began training at a privately owned gym. She had never before had anything that she construed as A.C.L.-injury-prevention training — and this was not labeled as such — but now she was working on her core muscles and doing exercises to improve her balance and her form when landing from jumps. From among the several colleges that vigorously recruited her, she settled on Lafayette, an academically select, Division 1 school in Easton, Pa.

In February, she competed again with her club team in the Score at the Shore College Showcase tournament in Tampa, an event that turned out to be a macabre example of the warrior-girl ethic — and a bizarre illustration of how youth sport exists within its own closed universe. On the first night of that tournament, a player on a team that had traveled down from Queens was struck and killed by a car as she crossed a busy highway to a convenience store for a snack. A teammate walking with her was hospitalized in serious condition. Their team decided to stay at the tournament and compete. The players wrote the dead girl's name on the sleeves of their jerseys and gathered in prayer on the field before the next game, which they won. The game goes on, no matter what.

In the semifinals, though, the Queens girls were shut out by the Weston Fury, Janelle's team. Janelle and her teammates were too emotionally drained to celebrate. Both teams just stayed on the field and cried. "It was horrible," Janelle said. "It was crazy. I don't even know why we were playing."

A couple of weeks later, Janelle suffered another injury — to her left knee, the site of her first A.C.L. rupture. She stepped awkwardly during a game, thought she heard something crack and felt a sense of panic. "I thought, I cannot believe I did this again," she said. An [M.R.I.](#) revealed a less dire diagnosis: she had "nicked" her cartilage, which would heal on its own after she rested for a few weeks. Her 18th birthday was coming up, and she felt as if she had just received an early present.

After three weeks' rest, Janelle planned to resume her physical training and not compete again until her college's first game late in the summer. But then again, her club team was entered in the State Cup in Florida. If the Weston Fury won enough games, it might still be playing into late May. Janelle figured she would be fully recovered by then. "If I felt like I could help my team," she said, "I might try to play."

That was still Janelle's mind-set: Rehab hard. Get back on the field. Compete fiercely. And hope not to be injured.

Michael Sokolove is a contributing writer for the magazine. This article is adapted from "Warrior Girls: Protecting Our Daughters Against the Injury Epidemic in Women's Sports," which will be published in June.

This article has been revised to reflect the following correction:

Correction: May 10, 2008

An article on Page 54 of The Times Magazine this weekend, about injuries in girls' sports, misstates the results of an Ohio study of the frequency of injuries sustained by student athletes. The rate of concussions sustained by high school girls who play soccer is 1.5 times the rate for boys who play soccer — not 1.5 percent greater.