

Overuse injuries in children and adolescents

By Tamara Mitchell



Kids love to play and it's really good for them! Exercise is needed for proper growth and development. In addition, children learn many social skills such as cooperation and sharing from playing together with other kids.^{1,2} Children can derive physical and mental benefits from sports including pride, personal fulfillment, fun, and creativity.^{3,4} It's important to distinguish between physical activity and competitive sports.³

When children are left to recreate by themselves, overuse injuries are not much of a problem because kids are in tune with their bodies and their emotions.⁴ They run, jump, hop on their bike and ride a bit, but they don't tend to naturally repeat a physical activity often enough to cause overuse injury.⁴ And they stop when something hurts.

Overuse injury is microtraumatic damage to a bone, muscle, or tendon that has been subjected to repetitive stress without sufficient time to heal.^{2,5} This includes growth-related disorders resulting from repeated trauma and microtrauma to the growth plates of the bones and blood vessels resulting in disturbances to bone growth.³ This type of injury develops gradually over time and if recovery from use is not allowed, it becomes progressively more painful.^{6,7}

Until the past 25 years overuse injuries were extremely rare in children. Although sports injury rates overall have been declining in recent years, overuse injury rates have been increasing.¹³ Today, half of pediatric sports injuries are due to overuse.^{2,6} Competitive sports are now even being marketed for toddlers from age 2-6!⁴ Overuse injuries include traditional team sports like baseball, football, and soccer, but also other sports such as dance, cheerleading, hockey, rugby, etc. and they each have their own unique medical consequences from pushing too far, too fast, without enough rest.^{2,7}

With all this focus on kids sports, it's easy to forget that there are many, many alternatives to organized sports. If your child doesn't like sports or if you feel they are overdoing it in one sport, explore other ways that they can get physical exercise.

Causes of sports overuse injuries in children

Organized sports, specialization and competition. Why has the incidence of overuse injuries in sports increased so quickly? Most sources agree that the primary reasons are the growing number of young people who:^{2,5,6,7,8,9, 10,11,,12}

- participate or specialize in only one sport, especially before puberty
- train year-round
- overtrain
- participate in weekend-long tournaments

Ignoring pain and avoiding treatment. Often, children, parents, and coaches don't take the aches and pains seriously. Pain is an indication that something is being done too often, too quickly or incorrectly and it is not normal in children.³

Adult pressure. The goal of sports should be to promote an enjoyment of physical activity, recreation, dealing with winning and losing, healthy competition, camaraderie, and teamwork.^{2,4} Kids should be the ones deciding what sport they love and want to participate in.⁵ When parents or coaches put extra pressure on kids to compete, to be a star, or to get a college scholarship, there is an increased risk of injury.⁵

Sports idols. Talented and devoted kids or their parents often push themselves beyond their limits and hold themselves to high-intensity practice and participation regimens to emulate a sports idol.¹³ Some kids may even turn to steroids, some may emotionally burn out, some may give up on sports and exercise altogether, and certainly many are developing overuse injuries that require surgery and will likely affect them physically for a lifetime.^{1,13} Having sports heroes is fine, but idolizing and emulating a sports figure can be unhealthy.

Uninformed coaches. 90% of the volunteer coaches in the U.S. have never taken classes designed to enhance their knowledge of the sport they are coaching.¹⁴ Overtraining and improper technique often lead to overuse injuries.^{2,14} Well-trained coaches will make sure children warm up and cool down, learn proper techniques, and do practice drills. They will also make sure that children don't exceed restrictions, such as the limit on the number of innings pitched in one week. Informed coaches notice if someone is hurting, identify an injury, and replace improper or ill-fitting equipment which can aggravate overuse injuries.

Growth spurts. Rapid growth can result in joint tightness, inflexibility, and imbalances in movement.^{7,15} This is associated with an increase in injury, especially for adolescents.² The mean onset of the adolescent growth spurt is approximately 10 years for girls and 12 years for boys, but there is wide variability.¹⁵

Inadequate diet and hydration. Physical activity increases the need for more food and fluids.

Couch-potato kids. Kids are much more sedentary today than in previous generations.³ They don't walk to school or play outside as much. Physical education classes at school have been reduced and much more time is spent watching TV or playing video games.⁸ The combination of a more sedentary life combined with intense, competitive games where the goal is to win is a pretty good recipe for overuse injuries.^{1,3,8}

Nature and dangers of overuse injuries in children

Overuse injuries in sports occur from repetitive actions that put too much stress on the body, including stress fractures, strains, sprains, tendonitis, torn cartilage, bursitis and shin splints.¹⁴ Overuse injuries can happen to people of any age, but they are especially problematic in children and adolescents because they can affect bone growth.

One type of overuse injury unique to children is injury to the growth plate of the bone.^{7,15} The growth plate is an area of developing cartilage at the end of long bones, such as the arm or leg bones.⁷ The growth plates do not finish closing until age 15-17 in boys and 13-15 in girls. Damage to the growth plate is a type of stress fracture, but most heal without any lasting effects. Stress overload can impair calcification (ossification) and, when prolonged, can result in a widening of the growth plate or permanently unfused closure of the growth plate (that is, the cartilaginous growth plate never closes and fuses with the bone).¹⁵

A second type of overuse injury is related to growth.^{14,15} The speed at which the long bones of the arms and legs bones grow is faster than the muscles and tendons, which cause a loss of flexibility, imbalances during movement and an increased chance of overuse injury.^{14,15} Injuries that occur without changes to training or other contributing factors may be due to this type of injury associated with growth.¹⁵

Prevention of overuse sports injuries

Prevention of overuse injuries is far better than dealing with pain, healing, and suspension of activity.³ A comprehensive and multidimensional approach to injury prevention should include:⁸

- improved observation and understanding of overuse injury
- identification of anatomical and psychological risk factors
- thorough Pre-participation Physical Evaluations
- proper supervision and education of coaches and medical teams
- alteration in sports
- improved training and conditioning programs
- delayed specialization

Adult expectations and pressure. Be realistic about the child's physical ability and help them set realistic goals.¹⁴ Letting young athletes set their own goals and progress at their own pace is a good way to avoid overuse injury. Parents and coaches are prime culprits in promoting a highly competitive environment in sports.^{4,1} Parents often lust for their child to become an Olympic athlete or develop skills warranting a large college scholarship.^{1, 13} Coaches may treat kids like military recruits, drilling them, making kids take the game too seriously, and encouraging them to play when they are feeling pain or are injured.¹ In fact, when adults push kids too hard, the kids often resist and lose motivation to play, so a child with talent may drop out of sports to get rid of the pressure and stress they are feeling.¹ Kids may learn to suppress their "body sense" when pressured by adults to perform.⁴ Body sense is a whole network of neurons including emotions, fight-or-flight response, sense of the body's muscles, balance, internal organs, survival, and breathing that monitors, regulates, and maintains the body's ability to locate, regulate, and repair stresses and strains.⁴ When we suppress this sense, we override the ability to maintain a healthy response to overuse and it will lead to potential damage to the self-regulatory neural circuits and a lifetime of problems with muscles and joints.⁴ Kids naturally tend to pay attention to this body sense and allow it to regulate when it's time to quit doing something and when playing sports, adults need to let kids have more control over when they need to stop and encourage kids to listen to their bodies.⁴

If a child really hates a sport, they should be allowed to quit. At the same time, a bit of encouragement can help them develop skills to become more proficient because nobody gets better without practice.¹ Sports and recreation should be fun for the child.¹ If it becomes a chore or a source of stress, the kid will be miserable, feel like a failure, or drop out.

There are many reasons certain children may dislike organized sports. They may be an introvert, very sensitive to criticism by coaches or other kids, they dislike competition, they aren't especially gifted in physical abilities, or are younger and less physically developed than peers at school.¹⁶ Considering the risks involved since organized sports have become so prevalent, perhaps kids who shun them are the fortunate ones! It is still very important to get kids off the couch, away from the computer, gaming console, and ebooks.¹⁶ Kids need to learn that exercise is fun and that it makes them feel good. Many of these activities involve playing with other kids, but they can also be great activities that parents and kids do together as they grow up and

maintain a close relationship.¹⁶ Playing with friends is definitely a legitimate form of exercise. Here are some ideas for kids that don't want to participate in traditional sports teams:^{16,17}

- Martial arts including judo, taekwondo, karate, aikido, etc.
- Swimming
- Yoga or fitness
- Tennis
- Golf
- Bicycling
- Hiking
- Skateboarding
- Horseback riding
- Fencing
- Gymnastics
- Running
- Ultimate Frisbee
- Inline skating
- Dance
- Scouts
- Free play including playing tag, jumping rope, shooting hoops, riding bikes, playing whiffleball, playground and park equipment, and running around doing what kids have traditionally done!



Photo courtesy of Vail.net

Organized sports, sports specialization, and free play. Children should avoid specializing in one sport prior to puberty.^{1,7,11} Experimentation with different sports allows children to develop fitness and motor skills, enjoy the social aspects of sport, learn to enjoy physical activity, and choose the sports they prefer.^{1,2,15} Kids who play different sports throughout the year are much less likely to suffer overuse injuries.² They should participate in a variety of activities with other children who are matched in age, ability and interest.

Alternating sports that use the upper body, such as gymnastics, with sports that use the lower body, like soccer can help avoid overuse injuries by distributing the use of body parts.² Specialization is a problem, but multisport athletes are also at risk if the same body part is used, such as softball pitching and swimming, which stress the shoulders.² Specialization should be saved until the late teens. There are many outstanding athletes who didn't become involved in their specific sport until mid- to late-teens.¹⁵

Coaching. Find out about the coaches for your child's team.^{14,15}

What emergency plan do they have in case of injury? Find out what is to be expected of your child physically at practice and make sure that your child is in proper physical condition before participating.¹⁴ Respect the coaches, but communicate openly with them if you disagree with their approach and discuss it with them.¹⁴ Ask for a

copy of the coach's conditioning plan and certification.¹⁴ Organizations sponsoring interscholastic and club-based athletics are responsible to ensure that coaches and medical supervision is adequate and educated.⁸ Determine if coaches are educated about the signs and symptoms of overuse injuries and ask for the certifications or credentials of the coach related to sports safety, sports techniques and skills, and psychosocial aspects of children or adolescents in sports.⁸ Look for coaches with a commitment to safety and injury prevention, who enforce all rules, and ensure that equipment is safe and maintained.¹² Avoid coaches with a highly competitive attitude that may encourage a child to play through pain and injury and develop unsportsmanlike attitudes.¹²

Proper training in technique is very critical because improper technique is a major source of overuse injury in children as well as adults.³ It is the responsibility of the coach to instruct children on proper technique so they learn skills that will become part of the muscle memory in performing the sport.

Modifications in specific sport rules may help reduce overuse injuries in children.⁸ Reducing the time of play, distance between bases, etc. can make the game safer for children.⁸

Sports Equipment. Ensure that equipment fits properly, is up-to-date, and is approved by the organizations that govern each particular sport.^{3,12,14} Ask the child's coach about appropriate equipment and shoes for the sport.¹² All equipment needs to be cared for so it stays effective.¹² The type of playing surface is important. Playing surfaces should be maintained properly without holes and ruts, and surfaces should be made of resilient materials that reduce ground impact.¹² Dirt, synthetic, or natural turf are preferred. Avoid hard surfaces like concrete.¹² Footwear needs to fit properly and it needs to be appropriate to the playing surface. Children's feet can grow quickly, so make sure to check foot size every few months and replace shoes and socks that no longer fit.¹⁸ Never use hand-me-down shoes. Take the child shopping, make sure fit is good, there are no spots with slipping or abrasion, and that the shoes can be worn without a break-in period.¹⁸

Pre-participation physical evaluation (PPE). Pre-participation screening by a sports physician or chiropractor is recommended to determine whether your child is physically able to meet the demands of the sport chosen.^{6,14,15} The screening should be used to identify risk factors, injury



Photo courtesy of theparentingdailytimes.wordpress.com

history, stature, anatomical factors, maturity, joint stability, strength, and flexibility.⁸ The best time for the PPE is 4-6 weeks prior to the beginning of the season.⁶ Additionally, kids should see their doctor or chiropractor for regular health checkups.⁶ This alone could reduce overuse injuries by 50% according to the American College of Sports Medicine.¹⁵ If there are underlying biomechanical problems present, injury is more common.²

Developmental considerations. Starting a child in sports too young does not benefit the child physically. Children grow and mature at different rates, so it's important to look at more than just age. What is their athletic ability and coordination level? Are they eating properly and sleeping enough?

The following factors should be considered when deciding whether a child should participate in a particular sport:³

- age
- weight
- build
- physical development
- emotional development
- child's interest in the sport

Fitness, training, overtraining, and burnout.

Overall fitness should be maintained year-round and preseason training should allow time for general and sport-specific conditioning.^{6,8} Training should be carefully monitored during the adolescent growth spurt, possibly modifying training during this period, because growth-related factors can predispose children to injury especially if there are underlying biomechanical problems.^{2,14,15}

Sports-specific drills may do more harm than good to the body if repetition is excessive. It is possible to do drills in water or through some other method that will place less stress on the body, but still give similar benefits.² Crosstraining is important to include many activities that will build endurance, but not stress the same body parts, such as bicycling, swimming, or using elliptical trainers.⁶

Burnout is a series of psychological, physiologic, and hormonal changes that result in decreased sports performance.² Chronic pains, changes in attitude, fatigue, lack of enthusiasm, elevated resting heart rate, poor grades in school, and problems performing are all signs that a child is burning out. If this is observed, vary sports activities by participating in another sport or taking time for free recreation.² Keep practice fun and age appropriate.⁶

There are no hard and fast rules regarding how much training is too much because it is so dependent upon each individual. Training should be increased by no more than 10% each week.^{2,8,6} Marathon running, weekend-long athletic tournaments, etc. that require many hours of extensive participation over and above playing sports during the week should be considered with extreme caution especially because they may also involve heat-related illness, nutritional deficiencies, overuse injury, and burnout from lack of free time for the child.² For weekend



Photo courtesy of blog.drstankovich.com

tournaments, parents should press for a medical advisory board to educate the kids about heat/cold illness, overparticipation, overuse injuries, and burnout.²

A general guideline is that a child should not participate in any one sport more than 5 days per week with at least 1 day off per week and at least 2-3 months completely off per year to allow recovery, healing, cross-conditioning, strength training, and proprioception training.^{2,7,8} Somewhat less is sometimes recommended.¹¹ When kids spend about twice as much time playing organized sports as they do in free play injury rates go up.¹¹ And when children spend more hours per week than their age doing physical activity of all types, injury rates go up.¹¹ So if your child is 12, the maximum number of hours of activity should be 12 hours.¹¹

Heed pain and get treatment. Sometimes kids won't admit to being sore and they just drop out of the sport, often for life. Many young athletes play through pain and disability because they fear being removed from activity or disappointing parents and coaches.⁴ Organized sports have a 20% re-injury rate that is attributed to inadequate rehabilitation and returning to play too soon.¹⁴ Playing through pain even slows the body's ability to repair itself and to grow due to the chemistry of the stress response.⁴

Parents and coaches need to listen and respect a child's complaint about pain.⁴ Children need to feel that their needs are being attended to, and they shouldn't develop the habit of pushing through physical pain. Make sure your child knows not to play or train when they are in pain and to tell you if they have pain after playing.¹⁴ Pain is not normal for children, so if there is a complaint of pain, limit activity until a doctor has determined if it's safe to continue playing.¹²

Some types of injury have generalized pain that is hard to pinpoint and others are easily identified by the child.³ It's important to deal with overuse injuries early to prevent them from becoming larger, chronic problems.¹² The progression of pain is divided into four phases for purposes of diagnosis.^{2,3,6}

- Stage 1: Pain after physical activity
- Stage 2: Pain during physical activity with no impact on function or the ability to continue participation.
- Stage 3: Pain during physical activity that lasts all day and impacts the ability to participate.
- Stage 4: Pain during all physical activities, even basic activities.

Diet and Hydration

Parents and coaches should press for developing educational opportunities for learning about proper nutrition and hydration, sport safety, and avoiding overtraining.²

As important as nutrition is, hydration is perhaps even more important and it often gets overlooked.^{19,20} Kids get dehydrated more quickly than adults and many have been found to show up for practice dehydrated even though parents thought they had enough to drink.²⁰ Every individual has a different sweat rate and some lose more salt than others.²¹ Many things can affect how much water is lost including bulky clothing, protective equipment, fitness level, temperature and humidity, and children with higher percentage of body fat.²¹ Water is used by the body to cool it down through sweating. If sports are played more than 45 minutes, the activity is intense, and/or the weather is very hot and humid, minerals can replace the salts lost through sweat and a little sugar maintains energy levels throughout play.^{21,20} Hydration should actually begin the day before by increasing water intake.²⁰ Kids should drink water before the game or practice, every 20 minutes throughout playing, and afterwards.²⁰ For kids 6-12 years old, 4-8 oz. of water is

recommended both a couple of hours before playing and again 10-15 minutes before playing.¹⁹ For kids 13 years or older, 8-16 oz. of water is recommended both a couple of hours before playing and again 10-15 minutes before playing.¹⁹ During play, 5-10 oz. of water is recommended every 20 minutes.¹⁹ After sports, kids should drink at least 24 oz. of water within 2 hours.¹⁹ If properly hydrated, urine should be pale colored, like lemonade, not dark.²¹

Water should be served cold to optimize absorption.²¹ Many kids find plain water boring to drink, but sodas and sports drinks are amazingly unhealthy and contain high-fructose corn syrup, artificial colors and flavors, and sometimes even chemical sweeteners.^{22,23, 24, 17} Fruit juices and sodas can lead to bloating and abdominal cramping and energy drinks can pose a risk of heart or heat illness problems because they may contain caffeine, ephedrine, or other stimulants and labeling is not regulated by the FDA.²¹ Coconut water is a really good alternative beverage, though it can get pricey.²³

It is incredibly easy to mix up a batch of natural sports drink and keep it on hand. Adding flavor to water helps kids want to drink more. Here are some recipes:^{22, 24}



Photo courtesy of theyummlylife.com

Honey Citrus Sports Drink

3 cups filtered water
 $\frac{1}{4}$ raw unfiltered local honey
 $\frac{1}{4}$ tsp unrefined sea salt
 1/3 cup mixed lemon and lime juice
 (or any other fruit juice)

Pomegranate-Cranberry Sports Drink

2 cups Cranberry-pomegranate sports drink
 1.5 packets Stevia powder
 $\frac{1}{4}$ tsp unrefined sea salt
 2 qts. water

If your child plays organized sport, the availability of healthy food is probably non-existent.²⁵ Candy, ice cream, pizza, nachos, salty, greasy snacks, soda, and sports drinks are commonly sold at concession stands and kids want what everybody else is eating.²⁵ After-game parties and meals on the road during tournaments generally involve eating at fast-food restaurants that serve very unhealthy foods.²⁵ Combatting this smorgasbord of junk food may seem like an impossible battle partly due to attitudes of concessionaires that profits will suffer if they switch to healthier foods. But recent research has found that profits can actually increase when healthier food options are offered.²⁵ Offering apples, carrots and dip, chicken sandwiches, granola bars, pickles, soft pretzels, string cheese and trail mix in addition to eliminating trans-fats in existing snacks, substituting coconut oil for unhealthy fats on popcorn, and using real cheese on nachos resulted in increased profits from the year before at football games, volleyball matches, and swim meets.²⁶ It's up to parents and booster clubs to work together to make the change. Adding at least 5 healthy food and drink options to concession offerings was found to be the magic number for a critical mass in shifting sales, though adding 10 healthy options was even better.²⁶ A poster and

marketing campaign with the slogan “Great taste, more variety” was used in the study. Drawing people’s attention to the new choices in a fun and enticing manner helped to generate sales.²⁶

Parents and coaches should press for developing educational opportunities for learning about proper nutrition and hydration, as well as sport safety, overuse injury, and overtraining.² As part of this training, popular healthy food choices at concessions and at team parties is all a part of developing an appreciation and taste for quality food and beverage choices, good nutrition, and taking care of your body.²⁵ Professional athletes are very careful about getting proper nutrition because they realize how important it is to their performance and kids can learn good lifetime habits early, too.¹⁷



Photo courtesy of advocatesforhealthinaction.org

Overall nutrition guidelines. It is important that kids eat a complete nutritional diet every day. Children ages 6-12 need between 1,600 and 2,200 calories a day, but athletic kids and those going through puberty will require more.¹⁷ Dieting is not generally a good idea for children, but if a kid is overweight, they may be eating an unbalanced diet, unhealthy foods, or too much food for the activity level.¹⁷ Exact amounts are less important than making sure they eat plenty from each of these groups daily:^{27,17}

- Whole grains for carbohydrates, vitamins, minerals, and fiber.
 - Whole grain breads, crackers, muffins, and bagels
 - Rice
 - Whole grain pasta
 - Other whole grains like barley, millet, quinoa, oats
- Fruits and vegetables for vitamins, minerals, other nutrients essential to growth, development and overall body functioning.
- Dairy foods for calcium and Vitamin D for strong bones and muscle contraction. 3-4 servings per day.
 - Milk
 - Yogurt
 - Cheese
- Protein foods for energy and healthy muscles. Red meats and dried beans supply needed iron.
 - Meat, poultry, fish
 - Eggs
 - Dry beans
 - Legumes
 - Nuts

Healthy fats are good in extreme moderation including olive oil, nut butters, coconut oil, flax seed oil, etc. Unhealthy saturated fats such as butter, palm oil, lard, vegetable shortening, etc. should not be encouraged even in childhood because they are not only high in calories, but clog the

cardiovascular system over the years and it's best to develop a habit of avoiding them early in life.

Rare occasions may call for sugars and sweets like cakes, cookies, candy and soft drinks, but they are devoid of nutrition and do not help build strength for sports.²⁷

Fueling exercise. Energy for exercise comes primarily from the body's stores of glycogen and from dietary carbohydrates.²⁸ Glycogen is used up quickly, so eating carbohydrates just prior to exercise and during activity is the best way to keep energy levels up.²⁸ Incorporating fluids with the pregame meal will ensure proper hydration.²⁷ During prolonged exercise, studies indicate that consumption of some healthy fats like nuts, avocado, and seeds may increase the body's ability to use fats for energy.²⁸ It's best to eat a full meal 2-4 hours before exercising so the stomach isn't full, energy is not spent digesting while exercising, and stomach distress is avoided. But a snack before exercise will ensure adequate energy.¹⁷ And if exercise is done first thing in the morning, eating a good low fiber meal at bedtime will fuel the body through the night and supply energy for early morning exercise.²⁹ The foods listed below are good for fueling the body when exercising, but they are too heavy on carbohydrates to be healthy for overall nutrition.²⁸



Photos courtesy of fit.webmd.com

Packing your own foods that can be eaten in the car on the way to and from games or other activities saves a lot of money, it's healthier, and it's quick. Many of them can be kept ready to go and need no refrigeration. Feeling creative and ambitious? There are lots of healthy snack recipes you can make that are fun and many are portable.³⁰ Carbohydrates are important for energy, a little protein is good, but keep fat and fiber low to avoid digestive distress and don't try new foods that might not agree with the child's digestion.²⁷

Some pre-exercise foods that can make up a meal prior to exercise include:²⁸

- Bananas
- Cold cereal

- Toast or bagel with jam
- Milk
- Pasta
- Bread
- Apple juice
- Pancakes
- Honey
- Oatmeal with fruit, honey, and nuts
- Scrambled eggs
- Fruit
- Yogurt smoothie

Some snacks that are good during exercise:²⁸

- Apples, grapes, oranges, pears, banana
- Fruit leather
- Whole grain crackers
- Applesauce
- Bread or mini-muffins
- Granola Bars

Good foods after exercise:^{28,27}

- Flavored milks
- Yogurt with fruit
- Apples and cheese
- Peanut butter and crackers

Treatment of overuse sports injuries

It is critical that diagnosis and treatment be performed by a sports physician or chiropractor who is knowledgeable about pediatric sports injuries. All information regarding diagnosis, treatment and rehabilitation should be obtained and followed from this type of professional rather than attempting to self-diagnose or self-treat children. What may act like a simple sprain may actually be a growth plate injury. In general, overuse injuries in children heal quickly, but they can have long-term physical consequences and affect normal growth and development.⁸



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The main treatment for overuse injury is to stop participating in activities along with physical therapy in some cases.^{3,8} Gradual return to movement as the injury heals is usually suggested along with adequate time to warm up and cool down before and after play.¹² Make sure the injury is fully healed prior to returning to the game.¹² Again, it is critical to follow the guidance of the physical or chiropractor in rehabilitation to avoid re-injury and potential damage to your child's development.

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