



## CLINICAL REPORT

# Overuse Injuries, Overtraining, and Burnout in Child and Adolescent Athletes

Joel S. Brenner, MD, MPH, and the Council on Sports Medicine and Fitness

Guidance for the Clinician in Rendering  
Pediatric Care

## ABSTRACT

Overuse is one of the most common etiologic factors that lead to injuries in the pediatric and adolescent athlete. As more children are becoming involved in organized and recreational athletics, the incidence of overuse injuries is increasing. Many children are participating in sports year-round and sometimes on multiple teams simultaneously. This overtraining can lead to burnout, which may have a detrimental effect on the child participating in sports as a lifelong healthy activity. One contributing factor to overtraining may be parental pressure to compete and succeed. The purpose of this clinical report is to assist pediatricians in identifying and counseling at-risk children and their families. This report supports the American Academy of Pediatrics policy statement on intensive training and sport specialization.

## INTRODUCTION

Overuse injuries, overtraining, and burnout among child and adolescent athletes are a growing problem in the United States. Although inactivity and obesity are on the rise, the number of children and adolescents who participate in organized or recreational athletics has grown considerably over the past 2 decades. It is estimated that 30 to 45 million youth 6 to 18 years of age participate in some form of athletics. Sports participation is more accessible to all youth, from recreational play and school activities, to highly organized and competitive traveling teams, to pre-Olympic training opportunities. The variety of available, organized sporting activities has also grown from the typical American favorites, such as football, baseball, and soccer, to include lacrosse, field hockey, rugby, cheerleading, and dance, each with its own list of sports medicine concerns. This report will assist the clinician managing young athletes by first defining the medical, psychological, and developmental concerns of intensive, focused athletic participation. In addition, it will highlight specific overtraining issues such as participation in endurance events, weekend athletic tournaments, year-round training on multiple teams, and the multisport athlete. This clinical report should be used in conjunction with the American Academy of Pediatrics policy statement on intensive training and sports specialization in young athletes.<sup>1</sup> There is currently a very small body of scientific evidence pertaining to these issues. Therefore, some of the recommendations are based on committee opinion and/or expertise.

[www.pediatrics.org/cgi/doi/10.1542/peds.2007-0887](http://www.pediatrics.org/cgi/doi/10.1542/peds.2007-0887)

doi:10.1542/peds.2007-0887

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

### Key Words

overuse, injuries, overtraining, burnout, athlete

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275). Copyright © 2007 by the American Academy of Pediatrics

## Overuse Injuries

An overuse injury is microtraumatic damage to a bone, muscle, or tendon that has been subjected to repetitive stress without sufficient time to heal or undergo the natural reparative process. Overuse injuries can be classified into 4 stages: (1) pain in the affected area after physical activity; (2) pain during the activity, without restricting performance; (3) pain during the activity that restricts performance; and (4) chronic, unremitting pain even at rest.<sup>2</sup> The incidence of overuse injuries in the young athlete has paralleled the growth of youth participation in sports. Up to 50% of all injuries seen in pediatric sports medicine are related to overuse.<sup>3</sup>

The risks of overuse are more serious in the pediatric/adolescent athlete for several reasons. The growing bones of the young athlete cannot handle as much stress as the mature bones of adults.<sup>4,5</sup> For example, a young baseball pitcher who has not yet learned proper throwing mechanics (ie, recruiting the entire kinetic chain—from foot to hand—instead of just the arm) is at risk of traction apophysitis of the medial elbow. A young gymnast who performs repetitive hyperextension activities may develop spondylolysis (ie, a stress fracture of the spine), which is an injury particular to the pediatric age group. In addition, young swimmers may not recognize signs of rotator cuff tendonitis, because they may be unable to cognitively connect vague symptoms, such as fatigue or poor performance, as a sign of injury. Identifying youth at risk of overuse injuries is the first step to prevention. Guidelines for parents, coaches, and athletes need to be developed to provide opportunities for education, injury reduction, and early recognition of overuse injuries.

## Overtraining

A question often asked of the practitioner who cares for young athletes is, “How much athletic training is too much?” There are no scientifically determined guidelines to help define how much exercise is healthy and beneficial to the young athlete compared with what might be harmful and represent overtraining. However, injuries tend to be more common during peak growth velocity, and some are more likely to occur if underlying biomechanical problems are present.

A sound training regimen is essential, recognizing that although repetition is important, it may induce harm. Sport-specific drills that use a variety of modalities, such as water running for the track athlete on alternate days, may provide similar fitness benefits with less stress to the body. The American Academy of Pediatrics Council on Sports Medicine and Fitness recommends limiting 1 sporting activity to a maximum of 5 days per week with at least 1 day off from any organized physical activity. In addition, athletes should have at least 2 to 3 months off per year from their particular sport during which they can let injuries heal, refresh the

mind, and work on strength, conditioning, and proprioception in hopes of reducing injury risk. In addition to overuse injuries, if the body is not given sufficient time to regenerate and refresh, the youth may be at risk of “burnout.”

## “Burnout” or Overtraining Syndrome

Burnout, or overtraining syndrome, has been well described in the literature for adult athletes, but little is found regarding its applicability in youth. The overtraining syndrome can be defined as a “series of psychological, physiologic, and hormonal changes that result in decreased sports performance.”<sup>6</sup> Common manifestations may include chronic muscle or joint pain, personality changes, elevated resting heart rate, and decreased sports performance.<sup>6,7</sup> The pediatric athlete may also have fatigue, lack of enthusiasm about practice or competition, or difficulty with successfully completing usual routines. Burnout should be recognized as a serious sequela of overtraining syndrome. Prevention of burnout should be addressed by encouraging the athlete to become well rounded and well versed in a variety of activities rather than 1 particular sport. The following guidelines are suggested to prevent overtraining/burnout:

1. Keep workouts interesting, with age-appropriate games and training, to keep practice fun.
2. Take time off from organized or structured sports participation 1 to 2 days per week to allow the body to rest or participate in other activities.
3. Permit longer scheduled breaks from training and competition every 2 to 3 months while focusing on other activities and cross-training to prevent loss of skill or level of conditioning.
4. Focus on wellness and teaching athletes to be in tune with their bodies for cues to slow down or alter their training methods.<sup>6</sup>

## Endurance Events

Endurance athletic events (triathlons, marathons, and half-marathons) are becoming more popular in the United States, and legitimate concerns have been raised for the safety of youth participating in these events. The American Academy of Pediatrics has stated that triathlons for children and adolescents are reasonably safe as long as the events are modified to be age appropriate.<sup>8</sup> Specifically, such events should be of shorter duration/length, and careful attention should be given to safety and environmental conditions.<sup>8,9</sup> Children and adolescents must be properly trained to avoid hypothermia or hyperthermia, overtraining, overuse injuries, and burnout.

Recent concerns regarding the participation of children in marathon running has led to different opinions being expressed in the literature.<sup>10-12</sup> There is, at present, no scientific evidence that supports or refutes the safety of children who participate in marathons. There are no recorded data on injuries sustained by children who run marathons. Marathon training requires a gradual increase in total weekly mileage, which may be less than or equal to the total weekly distance that is generally logged by high school cross-country teams (35–40 miles). Regardless, a clearly devised weekly plan, ensuring that safe running conditions are in place, and the provision of proper education on endurance activities (including environmental conditions and appropriate hydration) should all be part of the training process. A critical environmental safety concern is the ambient temperature and relative humidity, because a child is less able than an adult to handle heat stress.<sup>13</sup> Weather-related guidelines have been set for all marathons, and these guidelines should be strictly enforced by the medical director for all youth endurance events.<sup>14</sup> Ultimately, there is no reason to disallow participation of a young athlete in a properly run marathon as long as the athlete enjoys the activity and is asymptomatic.<sup>15</sup>

#### **Weekend Athletic Tournaments**

Weekend-long sports tournaments for soccer, baseball, or tennis are common across the country. Often, these athletes are actively participating at least 6 hours each day in their sport and are exposed to the associated weather elements for an additional 2 to 3 hours. The risks associated with these events include heat-related illness, nutritional deficiencies, overuse injuries (eg, pitching in multiple games over a 48-hour span), and burnout from having a lack of “free time.” Research examining the possibility of fatigue contributing to an increased injury risk in the tournament situation does not exist, but the general overtraining-prevention guidelines outlined earlier should also apply.

#### **Year-Round Training on Multiple Teams**

Single-sport, year-round training and competition is becoming more common for children and adolescents. A focus on participating in 1 sport, or single-sport specialization, to improve, advance, and compete at the highest level may drive youth to participate for long hours daily on 1 or more teams at a time. This is common in soccer, baseball, and gymnastics. The motivation behind this overinvolvement may be induced by the child or parent. As more young athletes are becoming professionals at a younger age, there is more pressure to grab a piece of the “professional pie,” to obtain a college scholarship, or to make the Olympic team. Most young athletes and their parents fail to realize that, depending on the sport, only 0.2% to 0.5% of high school athletes ever make it to the professional level.<sup>16</sup> Yet, youth continue to specialize in 1

sport while participating on multiple teams and risk overuse and/or burnout if there is no break from athletics during the year. Young athletes who participate in a variety of sports have fewer injuries and play sports longer than those who specialize before puberty.<sup>1</sup>

#### **Multisport Athlete**

Well-rounded, multisport athletes have the highest potential to achieve the goal of lifelong fitness and enjoyment of physical activity while avoiding some of the pitfalls of overuse, overtraining, and burnout provided that they participate in moderation and are in tune with their bodies for signs of overuse or fatigue. Many youth will play multiple sports throughout the year either simultaneously or during different seasons. They may do this because they enjoy multiple sports or because their coach or parent pushes them to participate in other sports to condition them for their primary sport or in hopes of being noticed by college or professional scouts. There may be additional pressures from other coaches who wish to better their team by calling on well-rounded athletes from other sports. Multisport athletes are at risk of overuse injuries if they do not get sufficient rest between daily activities or if they do not get a break between seasons. Multisport athletes who participate in 2 or more sports for which the major emphasis is the same body part (eg, swimmers and baseball pitchers) are at higher risk of overuse injuries than are those who participate in sports that have a different emphasis (eg, track and golf).

#### **What Is the Goal of the Athlete?**

The ultimate goal of youth participation in sports should be to promote lifelong physical activity, recreation, and skills of healthy competition that can be used in all facets of future endeavors. As providers of care for youth, it is important to obtain a physical activity history (type of activity, frequency, duration) and take the opportunity to promote healthy participation and preventive care measures. Education of parents, athletes, and coaches must be part of the plan to promote fun, skill development, and success for each individual athlete. Skilled young athletes must be mentored carefully to prevent overparticipation, which may affect them physically as well as psychologically. The parent or pediatrician may wonder how hard a child should be pushed to train and compete. Ultimately, it is important for the practitioner to discuss the underlying motivation for sport participation with the athlete, the parent, and, possibly, the coach. Unfortunately, too often the goal is skewed toward adult (parent/coach) goals either implicitly or explicitly. The parent often hopes the child will get a scholarship, become a professional athlete, or fulfill the parents’ unfulfilled childhood dreams. It is best to identify and focus on the child’s motivation and goals to provide guidance.

## GUIDANCE FOR THE CLINICIAN

1. Encourage athletes to strive to have at least 1 to 2 days off per week from competitive athletics, sport-specific training, and competitive practice (scrimmage) to allow them to recover both physically and psychologically.
2. Advise athletes that the weekly training time, number of repetitions, or total distance should not increase by more than 10% each week (eg, increase total running mileage by 2 miles if currently running a total of 20 miles per week).
3. Encourage the athlete to take at least 2 to 3 months away from a specific sport during the year.
4. Emphasize that the focus of sports participation should be on fun, skill acquisition, safety, and sportsmanship.
5. Encourage the athlete to participate on only 1 team during a season. If the athlete is also a member of a traveling or select team, then that participation time should be incorporated into the aforementioned guidelines.
6. If the athlete complains of nonspecific muscle or joint problems, fatigue, or poor academic performance, be alert for possible burnout. Questions pertaining to sport motivation may be appropriate.
7. Advocate for the development of a medical advisory board for weekend athletic tournaments to educate athletes about heat or cold illness, overparticipation, associated overuse injuries, and/or burnout.
8. Encourage the development of educational opportunities for athletes, parents, and coaches to provide information about appropriate nutrition and fluids, sport safety, and the avoidance of overtraining to achieve optimal performance and good health.
9. Convey a special caution to parents with younger athletes who participate in multigame tournaments in short periods of time.

## COUNCIL ON SPORTS MEDICINE AND FITNESS, 2005–2006

Eric W. Small, MD, Chairperson  
David T. Bernhardt, MD  
Joel S. Brenner, MD, MPH  
Joseph A. Congeni, MD  
Jorge E. Gomez, MD  
Andrew J. M. Gregory, MD  
Douglas B. Gregory, MD  
Teri M. McCambridge, MD  
Frederick E. Reed, MD  
Stephen G. Rice, MD, PhD, MPH

Paul R. Stricker, MD  
Bernard A. Griesemer, MD

## LIAISONS

Claire M. A. Le Blanc, MD  
Canadian Paediatric Society  
James Raynor, MS, ATC  
National Athletic Trainers Association

## STAFF

Jeanne Lindros, MPH  
Anjie Emanuel, MPH

## REFERENCES

1. American Academy of Pediatrics, Committee of Sports Medicine and Fitness. Intensive training and sports specialization in young athletes. *Pediatrics*. 2000;106:154–157
2. Mellion MB, Walsh WM, Madden C, Putukian M, Shelton GL. *Team Physician's Handbook*. 3rd ed. Philadelphia, PA: Hanley & Belfus Inc; 2002
3. Dalton SE. Overuse injuries in adolescent athletes. *Sports Med*. 1992;13:58–70
4. Maffulli N, Chan D, Aldridge M. Overuse injuries of the olecranon in young gymnasts. *J Bone Joint Surg Br*. 1992;74:305–308
5. Carter SR, Aldridge MJ, Fitzgerald R, Davies AM. Stress changes of the wrist in adolescent gymnasts. *Br J Radiol*. 1988;61:109–112
6. Small E. Chronic musculoskeletal pain in young athletes. *Pediatr Clin North Am*. 2002;49:655–662
7. Budgett R. Fatigue and underperformance in athletes: the overtraining syndrome. *Br J Sports Med*. 1998;32:107–110
8. American Academy of Pediatrics, Committee of Sports Medicine and Fitness. Triathlon participation by children and adolescents. *Pediatrics*. 1996;98:511–512
9. USA Triathlon. Juniors. Available at: [www.usatriathlon.org/AthleteFocus/Junior.aspx](http://www.usatriathlon.org/AthleteFocus/Junior.aspx). Accessed March 30, 2006
10. Rice SG, Waniewski S; American Academy of Pediatrics, Committee on Sports Medicine and Fitness; International Marathon Medical Directors Association. Children and marathoning: how young is too young? *Clin J Sport Med*. 2003;13:369–373
11. Roberts W. Children and running: at what distance safe? *Clin J Sport Med*. 2005;15:109–110
12. Mohtadi N. Children and marathoning. *Clin J Sport Med*. 2005;15:110
13. American Academy of Pediatrics, Committee of Sports Medicine and Fitness. Climatic heat stress and the exercising child and adolescent. *Pediatrics*. 2000;106:158–159
14. Armstrong L, Epstein Y, Greenleaf L. American College of Sports Medicine position stand: heat and cold illnesses during distance running. *Med Sci Sports Exerc*. 1996;28:i–x
15. American Academy of Pediatrics, Committee on Sports Medicine and Fitness. Risks in distance running for children. *Pediatrics*. 1990;86:799–800
16. National Collegiate Athletic Association. Fact sheet. Available at: [www.ncaa.org/about/fact\\_sheet.pdf](http://www.ncaa.org/about/fact_sheet.pdf). Accessed March 30, 2006

## Overuse Injuries, Overtraining, and Burnout in Child and Adolescent Athletes

Joel S. Brenner

*Pediatrics* 2007;119;1242

DOI: 10.1542/peds.2007-0887

### Updated Information & Services

including high resolution figures, can be found at:  
<http://pediatrics.aappublications.org/content/119/6/1242>

### References

This article cites 12 articles, 6 of which you can access for free at:  
<http://pediatrics.aappublications.org/content/119/6/1242.full#ref-list-1>

### Subspecialty Collections

This article, along with others on similar topics, appears in the following collection(s):

#### **Current Policy**

[http://classic.pediatrics.aappublications.org/cgi/collection/current\\_policy](http://classic.pediatrics.aappublications.org/cgi/collection/current_policy)

#### **Council on Sports Medicine and Fitness**

[http://classic.pediatrics.aappublications.org/cgi/collection/council\\_on\\_sports\\_medicine\\_and\\_fitness](http://classic.pediatrics.aappublications.org/cgi/collection/council_on_sports_medicine_and_fitness)

#### **Adolescent Health/Medicine**

[http://classic.pediatrics.aappublications.org/cgi/collection/adolescent\\_health:medicine\\_sub](http://classic.pediatrics.aappublications.org/cgi/collection/adolescent_health:medicine_sub)

#### **Sports Medicine/Physical Fitness**

[http://classic.pediatrics.aappublications.org/cgi/collection/sports\\_medicine:physical\\_fitness\\_sub](http://classic.pediatrics.aappublications.org/cgi/collection/sports_medicine:physical_fitness_sub)

### Permissions & Licensing

Information about reproducing this article in parts (figures, tables) or in its entirety can be found online at:  
<https://shop.aap.org/licensing-permissions/>

### Reprints

Information about ordering reprints can be found online:  
<http://classic.pediatrics.aappublications.org/content/reprints>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since . Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2007 by the American Academy of Pediatrics. All rights reserved. Print ISSN:

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™



# PEDIATRICS®

OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

## **Overuse Injuries, Overtraining, and Burnout in Child and Adolescent Athletes**

Joel S. Brenner

*Pediatrics* 2007;119;1242

DOI: 10.1542/peds.2007-0887

The online version of this article, along with updated information and services, is located on the World Wide Web at:

<http://pediatrics.aappublications.org/content/119/6/1242>

Pediatrics is the official journal of the American Academy of Pediatrics. A monthly publication, it has been published continuously since . Pediatrics is owned, published, and trademarked by the American Academy of Pediatrics, 141 Northwest Point Boulevard, Elk Grove Village, Illinois, 60007. Copyright © 2007 by the American Academy of Pediatrics. All rights reserved. Print ISSN:

American Academy of Pediatrics

DEDICATED TO THE HEALTH OF ALL CHILDREN™

