Prevention of Pediatric Overuse Injuries

Tamara C. Valovich McLeod, PhD, ATC, FNATA
John P. Wood, D.O., Endowed Chair for Sports Medicine
Professor and Director, Athletic Training Programs
Research Professor, School of Osteopathic Medicine in Arizona
Director, Athletic Training Practice-Based Research Network
Overview

• Pediatric sports participation and overuse injuries
• Role of sports medicine professionals
• Position/Consensus Papers
• Recommendations
• Conclusions
Sports Participation

• ~30 million children and adolescents participating in organized sports in the US (Hergenroder, 1998; NIH, 1992)

  – 4,519,312 males and 3,287,735 females
  – Over half of all enrolled students are competing in high school activities
Enhanced physical and psychosocial development

- Cardio-respiratory fitness
- Blood lipids
- Selected psychological measures
- Body comp
- Bone mineral density

Establish good health habits at an early age
Bigger, faster, stronger: The rising cost of youth sports

Costs for youth sports set to spiral ... again

Kelley Holland | @KKelleyHolland

The Rising Costs of Youth Sports, in Money and Emotion

JAN. 16, 2015
Wealth Matters

By PAUL SULLIVAN
The Pyramid of Sports Medicine and Child Health

- Physical Activity Promotion
- Energy Balance
- Non-Violence in Sports
- Injury Prevention

- Advocate and Organize
- A Voice of Reason
- Injury Treatment

- Physical Well-being
- Emotional Well-being

- Child Health

Stovitz, BJSM, 2010
## Long-Term Athletic Development

Long-term athletic development pathways should accommodate for the highly individualized and non-linear nature of the growth and development of youth.

### Youth of all ages, abilities and aspirations should engage in long-term athletic development programs that promote both physical fitness and psychosocial wellbeing

All youth should be encouraged to enhance physical fitness from early childhood, with a primary focus on motor skill and muscular strength development.

Long-term athletic development pathways should encourage an early sampling approach for youth that promotes and enhances a broad range of motor skills.

Health and wellbeing of the child should always be the central tenet of long-term athletic development programs.
# Long-Term Athletic Development

Youth should participate in physical conditioning that helps reduce the risk of injury to ensure their on-going participation in long-term athletic development programs.

Long-term athletic development programs should provide all youth with a range of training modes to enhance both health- and skill-related components of fitness.

Practitioners should use relevant monitoring and assessment tools as part of a long-term physical development strategy.

Practitioners working with youth should systematically progress and individualize training programs for successful long-term athletic development.

Qualified professionals and sound pedagogical approaches are fundamental to the success of long-term athletic development programs.
Pediatric Sport-Related Injury

• >3 million injuries annually that cause time lost from organized sport (Hergenroeder, 1998)
  – More than 35% of all medical visits in 5-17 year olds and
  – More than 20% of all emergency department visits in 5-24 year olds
  – Estimated cost (1996) of these visits was over $1.3 billion annually

• 12 million student athletes between the ages of 5-22 will suffer a sports related injury this year (Janda, 2004)
  – Resulting in 20 million lost days of school
Overuse Injuries

• 52% of injuries presenting to a sports medicine center were overuse injuries
  – Tennis, swimming, soccer, dance, track, runner, gymnastics, and cheerleading
• Females higher rate (63% vs. 40%)
• Males on team sports 5.3x higher rate of overuse than non-team sports
• High-overuse sport = 10x male and 3.6x female risk for overuse

Stracciolini, CJSM, 2015
Overuse Injuries

<table>
<thead>
<tr>
<th></th>
<th>Overuse</th>
<th>Traumatic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>62.5%</td>
<td>37.5%</td>
</tr>
<tr>
<td>Males</td>
<td>41.9%</td>
<td>58.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Upper Extremity</th>
<th>Spine</th>
<th>Lower Extremity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Females</td>
<td>15.1%</td>
<td>11.3%</td>
<td>65.5%</td>
</tr>
<tr>
<td>Males</td>
<td>29.8%</td>
<td>8.2%</td>
<td>53.7%</td>
</tr>
</tbody>
</table>

- Children (5-12) vs. Adolescents (13-17)
  - Children more traumatic (UE)
  - Adolescents more overuse (54.5% vs. 49.2%)

Stracciolini, AJSM, 2014
Stracciolini, AJSM, 2013
Overuse

Untreated
No rest
No rehab

Progress to other injuries
The Downside of Injuries

- Lost participation time
- Physician visits
- Lengthy rehabilitation
- Stopping participation
- Concerns with growth
- HRQOL

50% present for chronic injuries
Growth and Development

• Children and adolescents physiologic status is defined by growth
  – Onset of puberty occurs at ~ 10.5 years for girls and ~ 12.5 years for boys
• Injuries in this age group occur in patterns distinct from adults
• Due to growth, may be susceptible to overuse injuries
Physeal Injuries

12 studies
- Baseball pitchers

12 studies
- Stress-related changes

10 studies
- 8 = Physeal widening
- 2 = Osteochondritis & radiographic widening

Caine, BJSM, 2006
Dropping Out

• 8% annual drop out rate from sports due to injuries in Australia (Grimmer, 2000)

• Elbow OCD in elite female gymnasts (Jackson, 1989)
  – Only one still participating after 3 yr follow-up

• Gymnasts with spine injury (Katz, 2003)
  – All ceased or reduced participation due to back pain

• Athletes with ACL injury retire from active participation at a higher rate than athletes without this injury (Thelin, 2006)
Overtraining - Burnout

<table>
<thead>
<tr>
<th>Overtraining Syndrome/Burnout $^{180,187,188}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
</tr>
<tr>
<td>Depression</td>
</tr>
<tr>
<td>Bradycardia or tachycardia</td>
</tr>
<tr>
<td>Loss of motivation or interest</td>
</tr>
<tr>
<td>Hypertension</td>
</tr>
<tr>
<td>Sleep disturbances</td>
</tr>
<tr>
<td>Insomnia</td>
</tr>
<tr>
<td>Irritability</td>
</tr>
<tr>
<td>Agitation</td>
</tr>
<tr>
<td>Decreased self-confidence</td>
</tr>
<tr>
<td>Anxiety</td>
</tr>
<tr>
<td>Nausea</td>
</tr>
<tr>
<td>Loss of appetite</td>
</tr>
<tr>
<td>Weight loss</td>
</tr>
<tr>
<td>Lack of mental concentration</td>
</tr>
<tr>
<td>Heavy, sore, stiff muscles</td>
</tr>
<tr>
<td>Restlessness</td>
</tr>
<tr>
<td>Frequent illness</td>
</tr>
</tbody>
</table>

(DiFiori, CJSM, 2014)
<table>
<thead>
<tr>
<th>History</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased performance persisting despite weeks to months of recovery</td>
<td></td>
</tr>
<tr>
<td>Disturbances in mood</td>
<td></td>
</tr>
<tr>
<td>Lack of signs/symptoms or diagnosis of other possible causes of</td>
<td></td>
</tr>
<tr>
<td>underperformance</td>
<td></td>
</tr>
<tr>
<td>Lack of enjoyment participating in sport</td>
<td></td>
</tr>
<tr>
<td>Inadequate nutritional and hydration intake</td>
<td></td>
</tr>
<tr>
<td>Presence of potential triggers: (a) increased training load with</td>
<td></td>
</tr>
<tr>
<td>adequate recovery, (b) monotony of training, (c) excessive number of</td>
<td></td>
</tr>
<tr>
<td>competitions, (d) sleep disturbance, (e) stressors in family life</td>
<td></td>
</tr>
<tr>
<td>(parental pressure), (f) stressors in sporting life (coaching</td>
<td></td>
</tr>
<tr>
<td>pressure and travel demands), (g) previous illness.</td>
<td></td>
</tr>
<tr>
<td>Testing (if indicated by history)</td>
<td></td>
</tr>
<tr>
<td>Consider laboratory studies: complete blood count, comprehensive</td>
<td></td>
</tr>
<tr>
<td>metabolic panel, erythrocyte sedimentation rate, C-reactive protein,</td>
<td></td>
</tr>
<tr>
<td>iron studies, creatine kinase, thyroid studies, cytomegalovirus and</td>
<td></td>
</tr>
<tr>
<td>Ebstein-Barr virus titers.</td>
<td></td>
</tr>
<tr>
<td>Profile of Mood States (POMS): A psychometric tool for a global</td>
<td></td>
</tr>
<tr>
<td>measure of mood, tension, depression, anger, vigor, fatigue, and</td>
<td></td>
</tr>
<tr>
<td>confusion.</td>
<td></td>
</tr>
</tbody>
</table>

(DiFiori, CJSM, 2014)
How Does Recent Sport-Related Injury Affect HRQOL?

- Adolescents with a self-reported recent injury demonstrated lower HRQOL compared to their uninjured peers
  - Physical functioning
  - Pain
  - Social functioning
  - Global HRQOL

- Indicate injuries affect areas outside the expected physical component of health

(Valovich McLeod, *J Athl Train*. 2009)
National Athletic Trainers’ Association Position Statement: Prevention of Pediatric Overuse Injuries

Tamara C. Valovich McLeod, PhD, ATC*; Laura C. Decoster, ATC†; Keith J. Loud, MDCM, MSc‡; Lyle J. Micheli, MD§; J. Terry Parker, PhD, ATC ||; Michelle A. Sandrey, PhD, ATC¶; Christopher White, MS, ATC #

Position Statement

Overuse Injuries and Burnout in Youth Sports: A Position Statement from the American Medical Society for Sports Medicine

John P. DiFiori, MD,* Holly J. Benjamin, MD,† Joel Brenner, MD, MPH,‡ Andrew Gregory, MD,§ Neeru Jayanthi, MD,¶ Greg L. Landry, MD,|| and Anthony Luke, MD, MPH**

(Clin J Sport Med 2014;24:3–20)

(Emery et al., 2006)
Overuse Injuries

- Growth-related
  - Apophyseal injuries
- Repeated microtrauma
  - Chronic submaximal loading of tissue
  - Stress fractures
  - Tendinopathies
- Combined mechanisms
  - Repetitive submaximal loading when rest is not adequate for adaptation to take place
  - Muscle-tendon unit, bone, bursa, NV, physis
  - Apophyseal and physeal stress injuries unique to youth athlete
High Vs. Low Risk

- **High Risk**
  - Can result in significant time loss
  - Stress fx
  - Physeal stress injuries
  - OCD
  - Apophyseal injuries
  - Effort thrombosis (TOC)

<table>
<thead>
<tr>
<th>Location</th>
<th>High Risk</th>
<th>Low Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip/Pelvis</td>
<td>Femoral neck (tension-sided)</td>
<td>Femoral shaft stress fracture</td>
</tr>
<tr>
<td>Back (lumbar spine)</td>
<td>Pars interarticularis stress fracture</td>
<td>Congenital spondylolysis, pedicle stress fracture</td>
</tr>
<tr>
<td>Leg</td>
<td>Anterior cortical tibial stress fracture</td>
<td>Medial tibial stress fracture, fibular shaft stress fracture</td>
</tr>
<tr>
<td>Ankle</td>
<td>Medial malleolar stress fracture, talar dome osteochondral defect, talar neck stress fracture</td>
<td>Distal fibular stress fracture</td>
</tr>
<tr>
<td>Foot</td>
<td>Tarsal navicular stress fracture, fifth metatarsal proximal diaphyseal stress fracture, sesamoid stress fracture</td>
<td>Second, third, fourth metatarsal stress fractures, cuboid</td>
</tr>
<tr>
<td>Knee</td>
<td>Patellar stress fracture, osteochondritis dissecans of femoral condyle or patella</td>
<td>Tibial tubercle and inferior patellar pole apophysitis</td>
</tr>
<tr>
<td>Shoulder/am</td>
<td>Effort thrombosis</td>
<td>Proximal humeral physeal stress fracture</td>
</tr>
<tr>
<td>Elbow</td>
<td>Osteochondral dissecans capitellum, apophyseal non-union of medial epicondyle</td>
<td>Medial epicondyle apophysitis</td>
</tr>
<tr>
<td>Wrist</td>
<td>Distal radial physeal stress injury</td>
<td></td>
</tr>
</tbody>
</table>

DiFiori, CJSM, 2013
Preventative Approach

• Advocated by several prominent sports and healthcare organizations
  – American College of Sports Medicine (1993)

• **50%** of overuse injuries in active children and adolescents are *preventable* (Smith et al, 1993)
Prevention

- Improved injury surveillance
- Identification of risk factors
- Thorough PPE
- Proper supervision and education
- Improved training and conditioning
- Delayed specialization

Sport alterations

Valovich McLeod, JAT, 2011
Injury Surveillance

• Improved understanding of prevalence, incidence and economic cost
• Increased funding and support
• Participation in surveillance efforts by all athletic healthcare providers
• Development of resources and training improved surveillance

EC= C

(Mountjoy, 2008; FIMS, 1998; Almquist, 2008; DiFiori, 2013)
Preparticipation Physical Examination

• Screening process
  – Injury history
  – Risk factors
  – Stature/maturity
  – Joint stability
  – Strength
  – Flexibility

Identification of Risk Factors

(ACSM, 1993; Dalton, 1992; Hergenroeder, 1998; Caine, 2006; PPE Working Group, 2005)
Risk Factors for Overuse Injuries

Growth-Related

Intrinsic
Extrinsic

Overuse Injury
Growth-Related Risk Factors

- Growth plate cartilage
- Growth spurt
- Age
- Height
- Tanner stage