Objectives

At the conclusion of this lecture you will:

- Understand developmental stages of adolescents
- Understand what is meant by “sports readiness” in children
- Understand general physiology of the young athlete
- Understand how skeletal growth can predict injury patterns in kids
- Have an increased awareness of obesity in our youth
- Be ready to discuss specific injury patterns in the pediatric population
Basics of Adolescent Athletes

- Don’t treat young athletes as little adults
- Children have different physiologic responses to exercise than adults
- Children lack experience to realize they are increasing injury risk
Basics of Adolescent Athletes

• In general children fatigue earlier than adults
• Different nutritional needs
  – Greater protein/Ca++ needs
• Open growth plates (epiphysis)
  – Apophysis (insertion of muscle/tendon)
  – Joint surface (articular cartilage)
• Heat illness risk!
  – Less efficient thermoregulation due to larger surface area to mass ratio
Basics of Adolescent Athletes

- Children have larger heads proportionally
- Appropriate fitting equipment
- Vulnerable growth cartilage
- May not have the complex motor skills needed for certain sports
Adolescent Sports

• Estimated 30 million children in US in organized programs

• Continued increase in acute and overuse injuries

• Yearly cost – 1.8 billion dollars

• 10 million clinic visits/year from pediatric sports injuries

• 40% of ER musculoskeletal injuries are Peds related
Adolescent Sport “Increases”

- Increased participation
- Increased recognition
- Increased competition
- Increased sport specific training
- Increased pressure
Developmental Growth

- Physiological parameters dependent on both sex and age
- Growth occurs along a continuum
Growth

• 95% of the population enters early puberty and progresses to developmental adulthood in 4 years

• Girls progress between 8-14

• Boys progress between 10-15

• Physeal/Apophyseal closure is a late developmental finding
Peak Height Velocity

• Girls
  – Age 8-14
  – Peaks mid puberty
  – Adult stature average at 17.3

• Boys
  – Age 10-15
  – Peak at mid/late puberty with a possible later spurt as well
  – Adult stature at 21.2
Peak Weight Velocity

- Similar in boys and girls until puberty
- Weight follows height velocity in boys
- Weight trails height velocity in girls by ~6 months
Body Composition Changes

- Girls have greater average % body fat than boys throughout childhood
- Active children average lower % body fat
- Adolescent girls 20-25%
  – 16-18% in athletes
- Adolescent boys 12-16%
  – 5-12% in athletes
- Muscle mass boosts during puberty with males secondary to testosterone boost
Obesity in Adolescents

• It is a talk or conference itself
• Increasing in epidemic proportions
• More than 1/3 of kids 12-21 do not participate in regular activity
• PE classes down at schools
• Increased injury rates in obese athletes
• Obese children often = obese adults
• Increased rates of DM, CAD and PVD as adults
• Psychological effects
Prevalence of Overweight and Obesity in U.S.

• Adults:
  - 2/3 are Overweight or Obese (BMI ≥ 25)
  - \( \frac{1}{2} \) of that 2/3 are Obese (BMI ≥ 30)
Prevalence of Overweight and Obesity in U.S.

• If we want to prevent adult obesity, public health must focus on decreasing the number of children who are overweight and obese!

• Children
  • 1/3 Overweight or Obese (BMI ≥85th%ile)
  • ½ Overweight
  • ½ Obese (BMI ≥95th%ile)

• Strong correlation between childhood obesity and adult obesity
Expert opinion suggests: 60 mins of moderate PA/day

Surgeon General Recommendations
- increase physical activity
- promote healthful eating
Can we help???

• Do sports have the potential to help combat obesity?
• 21 children, grades 4-5 with BMI ≥ 85th%ile.
• Randomized to either soccer group/team or control (after school health education)

Results:

• All 9 children in the soccer group had lower BMI z-scores at 3 and 6 months.
  - 5/12 in the control group also had lower BMI z-scores.

Note:

“In addition, we chose not to offer a snack before or after practices or games to help disconnect food from being associated with sports. We found that despite no snack being offered before or after practices or games, children still actively participated throughout practice and games and continued to attend.”

• At 6 months, 8/9 in the soccer group said that they would like to continue playing on a soccer team.
Sports and Obesity

• Some sports encourage obesity
  – Football lineman
  – Obese kids can at first be dominant

• We don’t always help
  – Snacks
  – Fast food
  – Sports drinks
Readiness to Participate in Sports

- Must look at a variety of developmental issues:
  - Cognitive
  - Social
  - Motor
Social Readiness!!
Readiness to Participate in Sports

• Attempts to play at “up” a level are often frustrating
• Can be unsuccessful and dangerous
• Health care providers should advocate appropriate activities and advise
  – Parents
  – Coaches
  – Programs
Physical Growth

• Obvious
• Can perform the skills of sports
• Easier to group kids appropriately
• Young athletes don’t always understand concepts of the sport
Cognitive Growth

• Less obvious growth on the field of play
• Responding to coaching
• Teammate interaction
• Understanding strategies and the game
• Getting away from “beehive soccer”
  – Physical skills there/Little concept of the game
Motor Development

- Needs to match the demands of the sport
- Usually follows a developmental sequence
- Different kids are at different stages at the same age
Motor Development

- Many Motor skills
  - Throwing
  - Kicking
  - Running
  - Jumping
  - Catching
  - Hopping
  - Skipping
Motor Development

- Have some motor skills in pre-school – more in early elementary
- This is the reason why 5-6 years of age is the usual start of organized sports
- Some social sporting prior to this age (often ends in flower picking)
Motor Development

• Varies amongst kids like other childhood developmental milestones
• Innate process
• Independent of gender, age, size, weight or strength
• Can accelerate by practice if the child is “ready” (repetition improves motor function)
• No evidence to pushing toddlers to become future stars
Development –
What we need to do

• Modifications can be made to make organized sports fun and developmentally appropriate for kids
  – Smaller balls
  – Smaller fields
  – Shorter games/practices
  – Frequent subs
  – Not keeping score
  – Fewer players on the field
Training in Children

• Goal is to stimulate adaptive physiologic responses to increase speed, strength and/or endurance

• Can enhance performance if done right and monitored closely

• Beneficial when applied to certain limits
Young Athletes Response to Training

• Difficult to measure gains.

• Speed, Endurance and Strength are increasing anyway with development.
Aerobic Training

• Less increase in VO2 Max with aerobic training than adults
Anaerobic Training

• Short burst activities
  – Sprints
  – Jumping
  – Downhill skiing/snowboarding

• Don’t rely on the aerobic O2 release
Anaerobic Training

- Difficult to assess adaptations
- No simple marker like VO2 max
- 40 yard dash difficult to test in kids
- Few studies on anaerobic training in kids
- Most show failure to improve times
Strength Training

- Studies have shown increased strength with weight training in pre-pubertal kids similar to adults

- The strength gains not associated with increased muscle size/bulk

- May be neural adaptations not increased fiber size

- Similar increases for boys/girls
Strength Training

- Proper technique and supervision are the keys to weight training being unsafe for kids
- Can actually help protect against injury and enhance performance
Overtraining

• We must not push young athletes too far!
• Overuse injuries can result.
• Delayed menarche/secondary amenorrhea – bone health issues.
• Burn out!!
• Believe it or not – Sports should be fun!
Single Sport Specialization

- Pros and cons
- Long term issues??
Musculoskeletal Differences in Children

- Growing bones
- Growth plates
- Vulnerable cartilage
3 Sites of Potential Injury

- **Epiphysis**
  - Salter Harris Fractures

- **Apophysis**
  - Site of muscle and tendon origin or insertion
  - Avulsion fractures

- **Articular Cartilage**
  - osteochondritis dissecans
Specific Injury Patterns

- Salter Harris Fractures
- Torus/Greenstick Fractures
- Avulsion Fractures
  - Hip Pelvis
  - 5\textsuperscript{th} Metatarsal
  - Tibial Tuberosity
- Apophysitis
  - Osgood Schlatter
  - Sinding-Larsen-Johannson
  - Sever’s
  - Iselin’s
Specific Injury Patterns

• SCFE
  – Obesity
• Osteochondritis Dissecans
  – Panner’s Disease
• Avascular Necrosis
  – Keinbock’s Disease
  – Legg-Calve-Perthes
  – Kohler’s
• Little League Shoulder
• Little League Elbow
Specific Injury Patterns

• Our next talk will go into detail on some of these specific pediatric musculoskeletal concerns.
Conclusion

• Kids are not simply little adults.

• Youth obesity is a major medical issue.

• We must look at cognitive and social readiness to participate as well as motor readiness.

• There are sports medicine concerns and injuries specific to children.

• Lots more in our next talks on specific injury patterns in the pediatric population as well as weight issues.
Thank You!
Bibliography

- Metz JD. Strength training and nutritional supplement use in adolescents. Curr Opin Pediatrics. 1999 Aug;11(4);292-6