STRENGTH TRAINING for YOUTH EXERCISE and ATHLETICS

Paul Stricker, MD, FAAP
Youth Sports Medicine
Scripps Clinic
San Diego, CA
www.DrPaulStricker.com

DISCLOSURES

• I have no relevant financial relationships with the manufacturer(s) of any commercial product(s) and/or provider of commercial services discussed in this CME activity

• I do not intend to discuss an unapproved or investigative use of a commercial product or device in this presentation

YOUTH STRENGTH TRAINING
**YOUTH STRENGTH TRAINING**

- Discussion will include:
- Boys and Girls
- Pre-pubertal ages (girls < 11; boys < 13)
- Development
- Safety issues / Risks
- Mechanism of strength gains
- AAP policy statement and research
- Benefits and unknowns

**CONCERNS**

- Injury risk; appropriate supervision
- Youth strength training will stunt growth
- Strength training for body image
- Unrealistic expectations of pre-pubertal youth
- Muscles for muscles, not athletics
- Rise in supplement use and steroid abuse
- Mixed messages—Adults more cavalier about use of growth hormone and hormone replacement

**WHO KNEW?!**
NUMBERS

• > 70%
• 15%
• 15%
• 9%

FACTORS INVOLVED

• Sports pressure
• Family financial concerns
• Keep up with everyone else
• “Good” or “Bad” parent phenomena
• Early specialization
• Inappropriate activities for age of development
FACTORS INVOLVED

- Societal pressure to be in competitive sports
- No room for recreational activities
- Unrealistic expectations for future
- How many firsts out of ~44 million youth in sports?!
- Win at all costs mentality
- Strength training viewed as the only way to improve

QUESTIONS

- When can a youngsters start?
- Is it safe? Does it work?
- When would it be appropriate?
- Why would it be necessary?

CASE 1

- A 9 year old male football player wants to begin a strength training program. His mother is fearful that it is dangerous, but his dad is not worried (it was dad’s idea in the first place).

- What do you advise?
- Is it safe?
- Can a child gain strength without hormones?
DOES AGE MATTER?

- What’s the motive?
- Who is the idea coming from?
- Achieve balance and postural control (age 7-8)
- Gain proficiency in sports skills
- Discipline and follow directions
- Common sense
- Lack of androgenic hormones

EARLY RESEARCH

- Initial studies showed no strength gains
- Did not have adequate controls
- Studies were of short duration
- Studies used low intensity training volumes
- Overall inadequate studies

RESEARCH

- Multiple well done studies show significant gains in strength
- Strength gains between 36%-74%
- No significant injuries
- Strict technique and supervision
- Majority untrained kids
- Implications for trained kids??

RESEARCH: INCREASED STRENGTH

• Johnson, et al. 2011 review of plyometric programs
• Behringer, et al. 2010 meta-analysis of mixed resistance programs
• Behringer, et al. 2011 meta-analysis of mixed resistance programs and performance
• Ratel 2010. No negative effect on growth
• Faigenbaum (numerous). Additional health benefits
• Deley 2011. Electromyostimulation (E-stim) as additional modality
• Etc...

HOW DOES IT HAPPEN?

• Not by muscle hypertrophy (via CT scans)
• Mechanism is neurologic; work by Ozmun et al demonstrated significant increase in EMG amplitude of the trained muscle group


HOW DOES IT HAPPEN?

• Strength gains dependent on increased motor unit activation, coordination, firing, and recruitment
• Minimum 8 weeks duration
• Most methods work for both boys & girls
INJURY CONCERNS

- NEISS reports high # of injuries associated with lifting weights
- Some injuries reported without distinction between strength training, home gym, or competitive weightlifting
- Some injuries reported without distinction between supervised and unsupervised injuries
- Some injuries reported without knowledge if weights were utilized properly
- Difficult to generalize to all strength training programs

INJURY CONCERNS

- 4,111 patients ages 8-13, 14-18, 19-22, 23-30
- Emergency room injury diagnosis code for “weightlifting”
- More accidental injuries in younger ages
- Most due to “dropping” or “pinching” or fractures
- More sprains and strains in older ages
- Majority of youth injuries potentially preventable with strict safety guidelines and supervision


SAFETY ISSUES

- Proper Equipment
- Proper Form
- Proper Supervision
  - Certified or Trained individual
  - Ratio of Adult to Student (1:10)
SAFETY ISSUES

- Well designed studies no effect on growth or epiphyseal plates
- Very low rate of injury
- Dependent on strict supervision and technique

CASE 1

- Can the 9 year old begin a strength training program?
  - What’s the reason?
  - Is there supervision?
  - How long has the child been involved in football?
  - Is it necessary?
  - Is it appropriate?

CASE 2

- 14 yo male basketball player wants to begin the “clean and jerk” and “snatch” to increase his explosive power. He is a freshman so this is his first strength training experience with the team. He has just started his growth spurt and has grown 3 inches in the past 7 months.

- Should this be a concern?
GENERAL METHODS

• Free weights
• Weight Machines
• Weight plates
• Hydraulics
• Bands/Balls
• Body weight
• All for “resistance” or “strength” training
• For kids--Issues for free weights versus machines?

COMPETITIVE WEIGHTLIFTING

• Also known as Olympic Weightlifting
• Competitive sport that involves maximum lifting ability
• Includes ballistic, explosive lifts such as “clean-and-jerk” and “snatch”
• Significant injury risk if done improperly

EXPLOSIVE LIFTS

• What are concerns during rapid growth of puberty?
• Pubertal kids at greater risk for injury
• Rapid growth often produces decreased flexibility
• Stronger muscle / tendon unit overpowers bony attachment
• Bone avulsion fractures or apophyseal separation can occur
• Technique often lost with explosive lifts or one rep maximum lifts
• Skill level and coordination also important risk factors
INJURY RISKS from IMPROPER LIFTING

- Bilateral distal radial & ulnar fractures
- Disc herniation
- Spondylolysis and Spondylolisthesis
- AIIS pelvic avulsion fx
- Other apophyseal fx
- Scaphoid fracture
- Tendon rupture
- Exertional rhabdomyolysis
- Death

COMPETITIVE WEIGHTLIFTING

- Data suggests safety in well supervised settings
- Study at the USA Weightlifting Development Center: increased lift performance/strength with no injuries
- Other resources: National Strength & Conditioning Association

COMPETITIVE WEIGHTLIFTING

- Elite junior weightlifters had more improvement in clean & jerk, and squat with moderate intensity training > low or high intensity training for 10 week program
  - Spanish Olympic Committee
AAP Policy Statement 2008
*Pediatrics* 121:835-840, 2008

- Although safe in well-controlled studies with proper technique...
- Need longer term injury data
- Concerns regarding improper technique and injury risk in general youth population
- Can’t generalize and justify other youngsters adding these lifts to their workouts
- **Do NOT yet recommend for general population or youth prior to skeletal maturity**

CASE 2

- What’s the difference between strength training and competitive weightlifting?
- Why the distinction when recommending participation for children and youth?

CASE 3

- Parents of a 12 year old female soccer player want to know if a strength training program can:
  - Prevent an ACL tear or other injuries?
  - Improve sports performance?
  - Provide permanent strength gains?
INJURY PREVENTION

- Some data, some anecdotal
- Many practitioners adopt sports-specific plan for hopeful reduction of common overuse injuries by correcting deficits
- Shoulder/Scapular programs for throwers, swimmers
- Ankle programs for volleyball, soccer
- Core programs for all
- Evaluation of kinetic chain and foot pronation

INJURY PREVENTION

- Strengthening programs incorporated into more comprehensive conditioning and programs for preventing ACL injuries
- Integrating neuromuscular training in youth to improve health, and reduce injury

PERFORMANCE

- Area of great interest
- Study results variable and inconsistent
- Some variables improve, some do not
- **Translation of improved variables into actual improved athletic performance is not always conclusive (ie. Increased squat strength does not equate to faster sprint speed)
- Many studies with adolescents rather than pre-pubertal children proved, but no other measures of anaerobic power
PERFORMANCE

- Effects on strength training on motor performance skills in children and adolescents: a meta-analysis
- Combined positive effect for running, jumping, throwing
- Positive response with greater work intensity
- Younger kids and non-athletes with greater gains (back to neurologic phenomenon)


PERFORMANCE

- Increased throwing velocity in baseball players after 4 weeks resistance tubing, 2010
- Untrained children improved running and jumping with plyometric program, 2011
- 10 week plyometric program improved explosive strength compared to controls. Sprint speed and kicking speed improved at 8 & 10 weeks, 2011

PERFORMANCE

- 12 week scapular training program in swimmers: strength and endurance programs both improved scapular protraction & retraction strength, 2011
- 10 week heavy squat resistance training improved strength, sprint time, and jump height in young basketball players, 2010
- How do all these translate into actual performance on the field, court, track, or pool?
- Other studies increase strength in variables that do not replicate actual sport requirements
DETRAINING

- Recommended frequency for strength training in children is 2 x per week
- 1 x per week not enough; 4 x per week without added benefit and increased risk of overuse

DETRAINING

- Sports participation is not effective in maintaining strength gains
- Detraining—loss of strength about 3% per week despite sports participation

CASE 3

- Strength training is not the only factor required for sports participation and performance
- Just one component of various training methods
- “Prehabilitation” strengthening may have some promise in injury prevention
- Performance benefit results are variable at this time
- Must also focus on technique, conditioning, flexibility, nutrition, recovery, etc
CASE 4

• A 15 year old girl with a past medical history of childhood leukemia wants to begin a strength training program for her participation in water polo
• What are the implications, and is there any evaluation required prior to participation?

GENERAL PREPARTICIPATION CLEARANCE

• Conditions that are withheld until intervention, treatment, or clearance from a specialist:
  • Uncontrolled seizure disorder
  • Underlying neuromuscular disorder (such as Cerebral Palsy, Multiple Sclerosis)

• Hypertrophic cardiomyopathy
• Moderate-severe pulmonary hypertension
• Uncontrolled hypertension
• Marfan’s Syndrome with a dilated aorta
• Previous treatment with Anthracycline chemotherapeutic agents (adriamycin, daunomycin, idarubicin)
**CHILDHOOD ONCOLOGY HISTORY**

- Patient’s treated with high dose (500 mg/M²) anthracycline therapy are at risk for acute cardiac decompensation with initiation of weight training
- Cardiology/Oncology input required prior to starting strengthening program

Steinherz, et al. Cardiac toxicity 4 to 20 years after completing anthracycline therapy. *JAMA* 266:1672-1677, 1991

**OTHER PREPARTICIPATION ISSUES**

- Level of conditioning
- Previous injuries with or without rehabilitation
- Previous surgeries
- New injuries or surgeries since last PPE
- Recent illnesses
- Recent growth
- Equipment updates, supplement use

**CASE 4**

- Usual pre-participation guidelines exist
- Be aware of recommendations for special groups, such as for young cancer survivors
CASE 5
- The parents of a 12 year old want to enroll their child in a strength training program. Their questions include:
  - Guidance on a proper strength training program
  - How to evaluate a trainer's credentials
  - List of respected sports training facility in your area

STRENGTH TRAINING
- Need awareness of unique differences from children to later adolescents
- Guidelines do exist
- AAP, ACSM, AOSSM, NSCA
- 2008 AAP updated statement
- 2009 NSCA updated statement
- Many strength, agility, & conditioning programs nationwide

STRENGTH TRAINING
- Pre-participation medical evaluation
- Mandatory qualified adult supervision
- Strict monitoring of technique
- Safe training environment
- Individualized training
- Proper clothing and footwear
- Determine appropriateness of activity for each child
**GENERAL RECOMMENDATIONS**

- 10 minutes warm-up and cool down
- Program should include 8-15 reps of 6-8 exercises with strict supervision
- Include all muscle groups, including the core
- Focus on technique and proper form
- Recommend 2-3 non-consecutive training sessions per week for 20-30 min
- Increase resistance gradually
- Vary program over time

**MANY EXERCISE TYPES**

- Body weight exercises
- Resistance bands
- Pulleys
- Dumbbells
- Single joint, multi joint
- Plyometrics
- Core strengthening
- Sports-specific replication

**TRAINING PROGRESSION**

Gradually increase
- Resistance
- Repetitions
- Number of sets
- In youngsters, safe progression relies on tissue adaptations to exposure of progressive loads
SPECIAL CONSIDERATIONS

- Evaluate program for each individual child
- Discuss the expectations of the strengthening program
- Consider decreasing training volume and intensity during rapid growth
- Emphasize flexibility
- Stress importance of proper lifting techniques not amount of weight
- Recommend against competitive weight lifting, power lifting, and body building until skeletally mature
- Understand unique developmental issues in children

STRENGTH TRAINING CREDENTIALS

- Is the person’s program NCCA certified?
- Do they require re-certification and CEU’S?
- Are there minimum requirements (degree, CPR, work experience)?
- Is the exam proctored and does it have a practicum?
- How long have they been certified?

CREDENTIALS

- National Strength and Conditioning Association (NSCA)
  - 1st nationally accredited certification program
  - NSCA Certified Strength & Conditioning Specialist
  - NSCA Certified Personal Trainer
- American Council on Exercise (ACE)
  - ACE Personal Trainer
  - ACE Clinical Exercise Specialist
- American College of Sports Medicine (ACSM)
  - ACSM Health Fitness Instructor
  - ACSM Exercise Specialist
CASE 6

- Are there special patient populations that can benefit from a strength training exercise prescription?
  - Overweight or “At Risk” for overweight
  - Cerebral Palsy
  - Bone density issues
  - Other effects?

OVERWEIGHT ISSUES

- Cardiovascular fitness
- Body composition
- Blood lipid profile
- Mental Health (anxiety, self-esteem)

OVERWEIGHT

- Strength training advantages:
  - Non impact
  - Can be initiated readily with proper instruction
  - Can see improvement quickly
  - Some aerobic benefit
  - Increases metabolic rate
  - Better than “just go jog” (high rate of overuse injuries and unsuccessful outcome)
OVERWEIGHT

- 8 week program significantly reduced body fat and increased lean muscle mass (via DEXA) along with increased strength in overweight and obese children, 2009


CEREBRAL PALSY

- Area of research with high interest
- Increased strength
- Improved overall function
- Improved mental well-being


CEREBRAL PALSY

- Results of increased strength but no improvement in mobility or spasticity, 2010
- Increased strength, but not walking ability, 2012
- Improved strength improved walking function in those whose weakness played a major role in their gait deficits, 2010
CEREBRAL PALSY

- Eccentric strengthening may help some with spasticity, 2010
- Australian systematic review of 5 studies showed strengthening program without an effect on strength, & walking speed but slight effect on Gross Motor Function Measure (GMFM), 2009
- Korean study with 5 week program of strength vs physical therapy: increased strength, squat to stand, GMFM, gait speed and stride length, 2008

BONE MINERAL DENSITY

- Growing bone is responsive to the osteogenic stimulus of resistance training
- Bone density of junior Olympic weightlifters greater than age matched controls and normal adult bone density, 1993
- Exercise during pre-pubertal years increases BMD, 2002

BONE MINERAL DENSITY

- Additional BMD of spine after 9 month jumping program was maintained 1 year after end of training, 2002
- Review of controlled trials, 2007
  - 9 pre-pubertal children, 8 early puberty, 5 pubertal
  - Strength training increased BMD in all the studies, but unclear as to the most optimal type of exercise program to make the best gains
OTHER EFFECTS?

• No negative change in cardiovascular performance during additional resistance strength training program, 2011

• Decreased C-Reactive Protein with endurance training and resistance training which may have implications for children with rheumatological conditions, 2011

STRENGTH TRAINING?

• Where does it fit?
• Parental pressures?
• Improve looks?
• How does it work?
• Improved performance?
• Multiple applications?
• What is the goal?
• Can children strength train?
• Should they?

THANK YOU
STRENGTH TRAINING for YOUTH
EXERCISE and ATHLETICS

Paul Stricker, MD, FAAP
Youth Sports Medicine
Scripps Clinic
San Diego, CA
www.DrPaulStricker.com