Session Overview (25 minutes)

Youth sports continue to grow in popularity. Participation in youth & adolescent sports has many beneficial effects including teamwork, improved physical fitness, academic success, and scholarship. Regarding scholarship, an increasing number of athletes face an elevated pressure to specialize in one sport at a young age. However, emerging evidence suggests early sport specialization may increase the risk of both overuse and traumatic injury. Further, after injury, many youth athletes have an expectation that they will return to their previous health and level of participation in a relatively short period of time. This expectation may be partially contributing to the risk of recurrent/subsequent injury rates.

This session will provide an overview of participation and injury risk in youth sports, particular at the middle school and high school levels. Special attention will devoted to the theory that specialization in sport at these levels may be contributing to the increase in initial and recurrent/subsequent injury risk. This session will point out the lack of evidence and need to address this growing concern in sport participation at these levels. Further, the session will allude to factors that may be contributing to the specialization in youth sports.

Outline of Session

I. The Problem: Epidemiology of Injury in Competitive Youth & Adolescent Sports
   A. Definition of Injury Rates
      I. Overall
      II. Initial
      III. Subsequent
          1. Reinjury
          2. New Body Part
   B. Middle School Sports
      I. Participation
      II. Initial vs. Subsequent Injury rates
   C. High School Sports
      I. Participation
II. Initial vs. Subsequent Injury rates

II. Specialization of Sport among Youth & Adolescent Athletes
   A. The evidence
   B. The impact of specialization of sport specialization in youth sports

III. Possible Contributors to the Suspected Relationship between Specialization of Sport and Injury in Youth and Adolescent sports.
   A. Suspected contributors to the risk of sports specialization

IV. Recommended Preventative Efforts to minimize the Suspected Relationship between Specialization of Sport and Injury in Youth and Adolescent sports.
   A. The physical therapist’s role in the specialization of sports
   B. Other recommendations for minimizing injury partially related to sports specialization

V. References


VI. **Speaker Biography**

Mitchell J. Rauh, PT, PhD, MPH, FACSM is presently a Professor and the Program Director for the Doctor of Physical Therapy Program at San Diego State University. He is also an adjunct faculty member in the Graduate School of Public Health, San Diego State University, San Diego, CA. He is the Director of Running and Sports Injury Prevention Research Laboratory &Co-Principal Investigator of Project SPIRIT (Sports Injury Research In Teens), a multi-funded grant study that has monitored injuries and the female athlete triad syndrome and its impact on injury and long-term bone health among girls’ high school sports. Dr. Rauh is also a research scientist consultant at the Naval Health Research Center in San Diego where he received funding from the Department of Defense to examine risk factors for stress fracture and other overuse injuries in female recruits. He has authored/co-authored almost 200 original peer-reviewed scientific papers and abstracts. Dr. Rauh is also an active clinical practitioner in the San Diego area. Dr. Rauh is a fellow of the American College of Sports Medicine (ACSM). Dr. Rauh is a member of the Sports Physical Therapy (SPTS) and Research sections of the American Physical Therapy Association. He is presently the Secretary for the SPTS Section and was a former chairperson for the SPTS Female Athlete Special Interest Group. He has presented in symposiums and platform sessions at APTA, ACSM, and NATA professional meetings on high school running and sports injury epidemiology and issues related to the female athlete triad syndrome. Dr. Rauh received the SPTS’s Excellence in Research award in 2010 and 2013, and the Excellence in Education award in 2011.

**Early Sport Specialization in the Cutting & Pivoting Athlete: Risks, Benefits, and Evidence-Based Care Recommendations**

Mark V. Paterno PT, PhD, MBA, SCS, ATC  
Acting Scientific Director, Division of Occupational Therapy and Physical Therapy  
Associate Professor, Division of Sports Medicine  
Cincinnati Children’s Hospital Medical Center,  
Cincinnati, OH

**Session Overview (30 minutes)**

Participation in pivoting and cutting sports often starts at a very young age. Coinciding with this trend is a movement towards specialization in these sports at a young age. Concentrated participation in these sports can result in increased injury rates. This session will investigate the evidence on the effects of youth sports specialization on acute injury rates in pivoting and cutting sports. Specifically, issues related to biomechanics of movement, the effect of injury on movement and the effects of compensatory movement in these populations will be discussed. This section will conclude with a discussion of the role of Physical Therapy in primary and secondary injury prevention in this population.
Outline of Session

VII. The Problem: Risk of Injury in Single Sport Pivoting and Cutting Athletes
   A. Discussion of Acute Injury Rates
      I. How does specialization effect acute injury rates in pivot/cutting sports
         1. Soccer
         2. Basketball
         3. Volleyball
         4. Others
      II. Relationship of athletic exposure to injury
   B. Biomechanics of Movement: Does technique improve or breakdown in the absence of diverse sports participation?
   C. Compensatory Movement Patterns after Return to Sport
      I. How do athletes compensate as they RTS after injury?
      II. Do these compensations result in increased risk of future injury?

VIII. References


IX. Speaker Biography

Mark V. Paterno, PT, PhD, MBA, SCS, ATC is a physical therapist, Associate Professor in the Division of Sports Medicine, and Acting Research Director for the Division of Occupational Therapy and Physical Therapy at Cincinnati Children's Hospital Medical Center in Cincinnati, OH. Dr. Paterno also serves as faculty for the Sports Physical Therapy Residency program. He graduated from Ithaca College with a Master's Degree in Physical Therapy in 1994. Mark then went on to become a Certified Athletic Trainer and an APTA Board Certified Specialist in Sports Physical Therapy. Mark obtained his Masters of Business Administration from Troy State University and his PhD from Rocky Mountain University of Health Professions. Mark has numerous publications which focus on the area of outcomes after ACL reconstruction and pediatric sports medicine and has lectured internationally on these topics. He currently serves as a manuscript reviewer for several orthopaedic and sports publications as well as a member of the ROCK group, which is an international, multi-disciplinary group, dedicated to researching juvenile osteochondritis dissecans.

Early Sport Specialization in the Youth Runner: Risks, Benefits, and Evidence-Based Care Recommendations

Jeffery A. Taylor-Haas, PT, DPT, OCS, CSCS
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Speaker Biography:

Jeffery A. Taylor-Haas, PT, DPT, OCS, CSCS is a Physical Therapist at Cincinnati Children’s Hospital Medical Center. He earned his Doctor of Physical Therapy degree from Temple University in 2013. He earned an Honor’s BS in Exercise Science in 2002 and a Master’s degree in Physical Therapy in 2004 from Saint Louis University. He is a certified specialist in orthopedic physical therapy from the American Board of Physical Therapy Specialties. He is also a Certified Strength & Conditioning Specialist from the National Strength & Conditioning Association and an Adjunct Faculty member at Mount Saint Joseph University in Cincinnati, Ohio for the department of physical therapy. He is currently involved in research on overuse injuries in adolescent long-distance runners. He treats runners and athletes of all ages and all levels of competitiveness. He specializes in performing 2-D and 3-D running video gait analysis, fabricating orthotics, performing a functional lower extremity biomechanical examination and providing all patients with a comprehensive, evidence-based treatment approach. An avid runner, Dr. Taylor-Haas has completed multiple marathons and half-marathons and has a special interest in running injury prevention.

Outline of Presentation: 20 minutes
I. Running is the Foundation of most youth sports: soccer, basketball, football

II. Trend toward earlier participation in competitive running-related events (Malina RM. Current Sports Medicine Reports 2010)
   a. Jayanthi et al. AJSM 2015 Pressure to specialize comes from:
      i. Coach
      ii. Media
      iii. Financial—scholarships

III. Early sport specialization in running = increased running exposure
   a. Increases exposure to a repetitive movement pattern
      i. Positive effects
         1. Decreases likelihood of childhood obesity
         2. Improves:
            a. Cardiovascular fitness
            b. Response to vaccines
            c. Attention
      ii. Negative effects
         1. Lack of diversity of neuromuscular stimulation
         2. Lack of diversity of bone loading
            a. Running, by itself, does not lead to increase in BMD
         3. Increases risk of burn-out, isolation & drop-out

IV. Youth Athletes ≠ Young Adults:
   a. During growth spurts—bones grow—lever arms increase, but muscle strength/length may be slow to increase
      i. Increased ability to generate force/torque with reduced ability to absorb shock, control movements
      ii. Increases susceptibility to injury
   b. Growth Plates—a source of RRI in youth runners—Hoang QB & Mortazavi M ‘12
      i. Sever’s
      ii. Osgood’s
      iii. SLJ
   c. During maturation, muscle strength asymmetries become more pronounced in girls
      i. Quad-HS Ratio changes pre-puberty to puberty: Quatman-Yates et al ’13,
         1. Girls: Quadriceps strength increases, HS strength stays the same
         2. Boys: Quad strength increases and HS strength increases: Hewett et al ’04
            a. Result: post-maturation girls have higher quadriceps/HS ratio than boys
      ii. Hip Abductor strength changes pre-puberty to puberty: Quatman-Yates et al ‘13
         1. Hip Abductor strength reduction
   d. During maturation, motor control gender asymmetries become more pronounced—Hewett et al JBJS ’04
      i. Pre-Maturation Boys vs. Girls: Jump and land similarly
      ii. At maturation and post-maturation boys vs. girls:
         1. Girls: more medial knee motion, higher valgus angle at IC, higher maximum knee valgus angle
   e. Running Mechanics & shock attenuation in youth runners may differ from adult runners (Mercer JATA 2010)
      i. Shock attenuation—comes from passive structures & active movements (i.e. knee/hip flexion)
1. Known to be affected by speed, stride length, and fatigue
2. Kids vs. Adults: Hard to compare b/c adults preferred speed is naturally faster vs. kids
   a. Adults: leg peak impact acceleration range from 2.0 to 11.3
   b. Children (boys, girls ages 9-11): Leg peak impact acceleration range from 3.3–10.5g

V. Running-Related Injuries—highlighted by Mitch Rauh, PhD
   a. Stress fractures—
      i. Debilitating injury for youth runners
      ii. Long recovery
      iii. Inability to participate in sport
   b. High Recurrence rate—
      i. #1 risk factor for a stress fracture is diagnosis of a previous stress fracture (Tenforde et al. Med Sci Sports Ex 2013)

VI. Treatment, Prevention, & Risk Mitigation:
   a. Graded Exposure—only guidance is adult literature--10% rule. Is it Evidence-Based?
      i. Buist AJSM 2008: No effect of graded training program vs. standard training program on RRI in novice adult runners
      ii. Nielsen et al JOSPT 2014—No difference in RRI in adult runners increasing mileage by 10% per week vs. 10%-30% per week.
      iii. Bredeweg et al BJSM 2012—4-week preconditioning program with walking and hopping exercises does no influence the incidence of RRI in novice adult runners
   b. Running to the exclusion of other activities may lead to neuromuscular fatigue. The effect of fatigue on running kinematics:
      i. Dierks et al ’08—adult, uninjured runners—
         1. Fatigue leads to increases in peak RF EV, Peak Knee IR, peak tibial IR, & peak hip ADD velocity
      ii. Dierks et al ’08—adult, runners with PFPS
         1. Runners with PFPS demonstrate increased hip adduction toward end of run
   c. Stress Fracture: Tenforde, Fredericson, & Milgrom—participation in ball sport is protective against incurring a stress fx
      i. Tenforde (2013)—protective for male HS runners, not protective for female HS runners
      ii. Fredericson (Clin J Sport Med 2005)—protective for elite male & female collegiate track runners
      iii. Milgrom (AM J Sports Med 2000)—protective for male infantry during basic training
      iv. Ball sports—provide 3D neuromuscular training and bone loading—
         1. 360 degree playing field means enhanced coordination, strength, and motor control in the planes of movement most associated with running-related injury: frontal & transverse

VII. Encourage Free Play in Elementary School Runners, Ball Sports in Adolescent Runners
   a. Free Play = Diverse sporting experiences (Jayanthi et al. Sports Health 2012)
      i. Enhances motivation
      ii. Less sport-specific practice needed to gait sport expertise
         1. Secondary to transfer of pattern recall skills from one sport to another
b. Free Play = Deliberate Play (Malina Current Sports Medicine Reports 2010)
   i. Implicit learning via trial/error, experimentation, repetition
   ii. Sporting skills, including running skills, are learned without explicit knowledge

c. Fransen et al. J Sports Sciences ’12:
   i. 6-8 year-old boys: hours spent on learning a new sport/task equated with better performance on that specific task/sport
      1. Suggests early sport specialization beneficial for sports requiring precise movements and an early age of peak performance: gymnastics, figure skating
   ii. 10-12 year-old boys participating in multiple sports at an early age scored better on tests of power and gross motor coordination than boys specializing in a single sport
      1. Suggests accumulated benefit of diverse neuromuscular inputs

VIII. Summary:
   a. Trend toward earlier sport specialization in long-distance running
      i. No specific studies exist examining this phenomenon
   b. Children and adolescents are not young adults:
      i. Growth spurts = time of increased risk for overuse injury
      ii. Maturation leads to bifurcation of risk:
         1. Girls—increased Quad/HS ratio, relative reduction in Hip ABD strength compared to body weight, altered movement patterns vs. boys
         2. Boys—neuromuscular spurt may improve speed, stamina but lead to increased risk of injury vs. pre-maturation time-frame
      iii. No clear understanding of the effect of maturation on running kinematics, kinetics—needs further study
   c. Graded exposure doesn’t appear to affect RRI rate in adults
      i. But—running in an exerted/fatigued state alters kinematics and may increase RRI risk
   d. Treatment & Prevention should be centered around:
      i. Increasing free play (pre-teens)
      ii. Continued participation in ball sports into early-mid adolescence
      iii. Delaying sport specialization until post-maturation

IX. References

Rest, Cross Training, and Physical Therapy: Evidence-Based Recommendations to Reduce the Risk of Early Sport Specialization in the Youth Athlete

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Speaker Bio:
Christin Zwolski, PT, DPT, OCS holds a Doctorate degree in Physical Therapy from Marquette University. She is a graduate of the accredited Orthopedic Physical Therapy Residency Program at Cincinnati Children’s Hospital Medical Center in Cincinnati, Ohio. She is a Certified Orthopedic Specialist and a current Orthopedic Residency mentor. Her specialty topics of focus include the female athlete, the soccer player, return-to-sports rehabilitation following ACL reconstruction, and injury prevention. She is the program developer for the Soccer Outreach Program at Cincinnati Children’s and also co-chairs the Female Athlete Special Interest Group within the Sports Section of the APTA. Additionally, Christy’s background includes soccer playing experience at the Division-1 collegiate, semi-professional, and professional levels.

Outline of Presentation: 15 minutes
Key Principles of Injury Prevention for the Young Athlete

1. Long-Term Athlete Development (LTAD)
   a. Early initiation of physical literacy
   b. Optimizing windows of accelerated adaptation to training for the child, preadolescent, and the adolescent

2. Injury prevention for the early sports specializer vs. diversifier vs. engager vs. sampler

3. Evidence- and theory-based interventions in use (or not) today
   a. CGS (centimeters/grams/seconds) sports vs. dynamic team sports
   b. Implementing Integrative Neuromuscular Training (INT)
      i. Harnessing, enhancing, or generating the “Neuromuscular Spurt”
      ii. Appropriate timing of training: chronological age vs. biological age vs. cognitive age vs. training age
      iii. Sufficient training dosage

References