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Title
Let’s Talk About Sex!: Female Runner Biomechanics, Injuries, and Rehabilitation

Speakers:
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Fact or Fiction: Are Female Runners at Greater Risk of Injury than Male Runners: Introduction/Epidemiology of Running-Related Injuries from Adolescence to Middle Age
Mitchell J. Rauh, PT, PhD, MPH, FACSM

Disclosure
I have nothing to disclose.

Presentation Outline
Upon the conclusion of this lecture, participants will be able to:
1. Understand the effects of gender and maturation on running injury incidence and running gait mechanics.
2. Identify risk factors for incurring a running-related injury and develop evidence-based interventions to address these risk factors.

Middle School
1. Participation data: Cross Country & Track.
   b. Injury type data—Rauh & Beachy. JOSPT. 2009

High School
1. Participation data: Cross Country & Track
   a. Body Region injury data
   b. Injury type data
   c. Injury severity data
3. Injury risk factors in-depth

This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture
a. Extrinsic Risk factors
   i. Training Error
b. Intrinsic Risk factors
   i. Anatomic
   ii. BMI
   iii. Prior Injury
   iv. Female Athlete Triad

Collegiate:
1. Participation data: Cross Country & Track
   a. Body Region injury data
   b. Injury type data
   c. Injury severity data
3. Injury risk factors in-depth
   a. Extrinsic Risk factors
      i. Training Error
   b. Intrinsic Risk factors
      ii. Anatomic
      iii. BMI
      iv. Prior Injury
4. Female Athlete Triad—In-Depth
   a. Evolution of definition
   b. Identification of at-risk populations
   c. Discussion on disordered eating, energy availability, bone density, and bone stress injury

Adult Populations:
1. Participation data
2. Injury risk factors—men vs. women
   a. Body Region injury data
   b. Injury type data
   c. Injury severity data
3. Injury risk factors in-depth
   a. Extrinsic Risk factors
      i. Training Error
   b. Intrinsic Risk factors
      i. Anatomic
      ii. BMI
      iii. Prior Injury
      iv. Running Experience
      v. Age

References:

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The Effect of Gender and Maturation on Neuromuscular Control and Performance on Functional Movement Screening Tools
Kathryn Lucas, PT, DPT, SCS, OCS, CSCS

Disclosure
I have nothing to disclose.

Presentation Outline
Upon the conclusion of this lecture, participants will be able to:
– Identify pertinent screening questions for runners based on sex and maturation.
– Critically analyze appropriate objective tests and findings for runners.
– Start to tie screening questions and objective findings into the running assessment.

Middle School to Middle Age...
“Change is the Only Constant in Life” -Heraclitus
• Middle School to Adolescence
  – Puberty: changes in height, weight, hormones, body composition
• High School and College
  – Potential changes in competitiveness
  – Changes in training schedule, sleep schedule, lifestyle
• Young Adult to Middle Age
  – Changes in work or school schedule, training plans
  – Potential changes with pregnancy

Subjective Assessment
This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture.
• Within the subjective assessment, there are important questions to ask your athlete specific to their age, gender, experience, and background.
  – Running History
  – Nutritional History
  – Current Running Status
  – Gender Specific Questions for Females
  – Youth/Maturation Specific Questions

Objective Assessment
• Cardiovascular Screen
  – Heart rate, blood pressure
• Anthropometric Measures
  – Height, weight, BMI
• Postural Alignment
  – Standing
  – Prone
  – Supine
• Strength & Endurance
  – Trunk
  – Hips
  – Knees/Ankles/Feet
• Flexibility
• Range of Motion
• Special Tests
• Functional Movements
  – FMS
  – Y balance test
  – Single leg squat
  – Single leg balance
  – Single leg heel raise
  – Single leg hop

Putting it All Together

References


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**The Effect of Gender & Maturation on Running Biomechanics: Apply 3D Gait Findings to the Clinic**

D. S. Blaise Williams III, Ph.D., MPT

**Disclosure**

I have nothing to disclose.

**Presentation Outline**

This is a preliminary handout. Full handout will be posted on SPTS website on the CSM handout page on the day of the lecture.
By the end of this presentation the learner should be able to:

1. Understand the effects of gender and maturation on running injury incidence and running gait mechanics.
2. Identify the root causes of common gait abnormalities as well as evidence-based treatment techniques

The Pronated Lower Extremity

- Anterior Pelvic Tilt
  - Imbalance between muscles surrounding and controlling the pelvis
  - Weak abdominals and hamstrings
  - Tight hip flexors and low back
  - Risk factor for hamstring strains (Opar et al, 2012)
  - Questionable whether static hip flexibility relates to dynamic hip extension/pelvic tilt (Franz et al, 2009; Schache et al, 2000)
  - Tight hip flexors create an ER bias at the hip
  - Weak abductors and ER result in IR under load
  - This places increased stress on the tight hip flexors

- Hip Internal Rotation
  - Women demonstrate greater static hip internal rotation than men (Nguyen & Schultz, 2007)
  - Does not seem to be related to gluteus medius and maximus activity during a single leg squat (Nguyen et al, 2011)
  - Activation may need to be similar or increased in order to maintain similar hip position at midstance
  - Anteversion is a predictor of hip impingement and pain (Miguel et al, 2012)
  - Women more likely to be anteverted
  - Hip Adduction
  - May be related to wider hips in females
  - Injuries not likely to occur at the lateral hip in younger runners (trochanteric bursitis)
  - Changes the position and movement of the knee
  - Patients with increased hip adduction are more likely to develop patellofemoral pain (Noehren et al, 2012)

- Knee Valgus
  - Strong relationship to patellofemoral pain (Salsich &Long-Rossi, 2010)
  - Difference between Q angle and F-Tangle
  - Tibial Internal Rotation
  - Relationship between tibial position and rearfoot eversion
  - Top-down or bottom-up cause of tibial rotation?
  - Both seem to be related in PFP patients (Barton et al 2012; Noehren et al, 2012)
  - Increased tibial IR may be present in order to decrease knee ER due to hip IR
  - Rearfoot Pronation
  - No evidence to suggest difference in pronation between males and females
  - As females age (10-18 yrs), the foot becomes more supinated (Shultz et al, 2008)

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Younger athletes may need orthotics but not need later

Evidence supports pronated foot posture related to ERLLP and MTSS (Willems et al, 2007; Tweed et al, 2008)

Medial Longitudinal Arch
- Males have a lower medial longitudinal arch than females (Pauk et al, 2012)
- However, increased activity levels are related to lower arches in both males and females (Pauk et al, 2012)
- EXTREMES of arch position AND mobility are likely more important than slight deviations for injury (Williams et al, 2001)

Hamstring Length
- Increased length decreases knee stability (Boden et al, 2000)
- After puberty, females remain very flexible compared to males (Hewett et al, 1996)
- Increased hamstring flexibility may lead to increased external tibial rotation (Nyland et al, 1999)

Ligament Laxity
- Females have greater ligament laxity than males (Boden et al, 2000)
- Must rely on muscle stabilization
- May cause a decrease in proprioception (Rozzi et al, 1999)

Running Mechanics
- Running is a series of single leg landings
- Important to understand the difference in landing mechanics between men and women
- Most of these data come from the ACL literature
- Consider treating all adolescent female athletes with training programs focused on ACL injury

Single Leg Landing
- Restrictions proximally & distally may predict increased valgus knee motion in female soccer players
- < hip external rotation explained 16% of variance
- < ankle dorsiflexion explained 10% of variance (Sigward et al, 2008)
- Excessive knee valgus discriminates between men and women when landing from a jump (Hewett et al, 2005; Ford et al, 2005)
- Controlled by hip and exercises focused on jumping and landing
- Femoral IR may compensate for increased tibial IR as the demands of the task increase (Tillman et al, 2005)
- Bottom up or top down?
- Women appear to have less transverse plane control (Wojtys et al, 2003)
- Women utilize greater rectus femoris and less gluteus maximus muscle activity during landing (Sell et al, 2004; White et al, 2003)
- Men utilize their hips and land softer (Hewett et al, 2005)
- Women have more rigid movement patterns than men (Pollard et al, 2005)
- Landing Mechanics
- Women have more quadriceps activity and higher quad to hamstring ratios than men (Hewett et al, 1996)
- With inc quad activity and poor alignment of the knee in the frontal plane, compressive forces at the PFJ greatly inc

**Intervention**

- General approach
- Hip ER ROM and DF ROM
- Strengthen muscles around core and hips
- Strengthen hamstrings
- Balance muscles around the knee
- Ankle stability and strength
- Functional training for landing and running
- Intervention
- ROM
- Important to have both static and dynamic stretches (Sekir et al, 2010)
- Strength
- Functional activities for runners
- Single leg stance
- Compliance
- Gait
- Knee flexion/extension
- Intervention
- Hip Range of motion
- Static=Pigeon pose
- Static=High kneel stretch
- Dynamic=Diagonal leg swings
- Dynamic=Sagittal leg swings
- Intervention
- DF Range of motion
- Static=Gastroc, soleus and joint
- Dynamic=Plank alternating steps
- Intervention
- Core strength
- Alternating lower extremity with abdominal activities
- Intervention
- Hip strength
- Side steps with knees flexed and extended
- Clam shells
- Single leg band abduction
- Single leg bridges with weight through midfoot/forefoot
- Monster walks

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○ Intervention
○ Hamstring strength
○ Single leg forward bends
○ Without rotation
○ With rotation
○ Single leg knee flexion at end range
○ Single leg bridges with weight through heels
○ Butts kicks
○ Switch lunges
○ Intervention
○ Balance
○ Single leg stance
○ Eyes open
○ Eyes closed
○ Head back
○ Single leg stance with reciprocal leg motion
○ Single leg stance on unstable surface
○ Single leg stance with rebounder
○ Intervention
○ Perturbation-enhanced neuromuscular training (Hurd et al, 2006)
○ Intervention
○ Neuromuscular training
○ Jump training
○ (Myer et al, 2008)
○ Sportsmetrics
○ FIFA 11+ (sport-specific)
○ Intervention
○ Ankle stability and strength
○ Posterior tibialis (Kulig et al, 2006)
○ Two up one down
○ Jump rope
○ Y balance
○ Alternate jumps onto Bosu ball
○ Summary
○ Adolescent female runners have different structural limitations than male runners
○ Flexible and weak hamstrings
○ Anterior pelvic tilt and weak core
○ Adolescent female runners have different running mechanics than male runners
○ Hip adduction and knee valgus
○ Quad dominant and weak hip extensors
○ Exercises and training should match the needs of the female runner and focus on mechanics related to single leg landing

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Presentation Outline:

Objectives:
1. Identify intensity thresholds necessary for inducing muscle strengthening
2. Identify exercises and techniques, specific to runners, to improve strength to the hip musculature
3. Determine the effects of strength on running mechanic

Gluteal Anatomy & Running – Specific Function

Gluteal Muscle Weakness & Association with Injury in:
1. Adolescents
2. Young Adults
3. Older Adults

Gluteal Strength & Effects on Running Mechanics

Exercise Prescription:
1. Neuromuscular Activation
   a. Sub-Strengthening Threshold Exercises: Gluteus Medius & Gluteus Maximus
2. Isolated Strengthening
   a. Above-Strengthening Threshold Exercises: Gluteus Medius & Gluteus Maximus
3. Integrated Strengthening
   a. Closed Kinetic Chain Strengthening. Progressing from Double to Single Leg
4. Neuromotor Control
   a. Definition
   b. Treatment Principles
   c. Anticipated vs. Unanticipated movement patterns
5. Running-Specific Strengthening
   a. Incorporation of plyometric training
6. Gait Retraining & different application utilizing motor learning theory
   a. Step Rate Manipulation
   b. Visual Gait Retraining
   c. Other types of gait retraining:
      i. Step Width
      ii. Trunk Lean

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20. Nakagawa, T.H., et al., Trunk, pelvis, hip, and knee kinematics, hip strength, and gluteal muscle activation during a single-leg squat in males and females with and