The Female Athlete

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Overview

• Exercise Benefits for Females
• Gender Differences: Anatomy & Physiology
• Orthopedic Concerns
  – Anterior Cruciate Ligament Tears
  – Stress Fractures
• Medical Concerns Concussions
  – Female Athlete Triad
  – Iron Deficiency Anemia
  – Stress Urinary Incontinence
  – Depression

Objectives

• Appreciate the growth of female participation in sports worldwide.
• Review physiologic difference between female and male athletes.
• Identify which injuries female athletes are at risk for.
• Describe the 3 components of the Female Athlete Triad.
History

- First modern Olympics, Athens 1896
  - Baron Pierre de Coubertin, founder of the modern Olympics, says, "It is indecent that the spectators should be exposed to the risk of seeing the body of a women being smashed before their very eyes. Besides, no matter how toughened a sportswoman may be, her organism is not cut out to sustain certain shocks."

Olympics

- Paris Olympics 1900
  - 1.9% female
- London Olympics 2012
  - > 40% female
- Los Angeles 1984
  - First Olympic Marathon for Women
- No women on the IOC until 1981.
- International view of females

London 2012

- All countries are represented by male & female athletes for the first time.
- 1st Olympics for female boxers
- >40% of all athletes are female Team USA: 269 females & 261 males
- Japan & Australia fly male athletes business class but female athletes fly coach!
Women’s Ski Jumping

- In 2005, Gian Franco Kasper, FIS president and a member of the IOC, said he didn't think women should ski jump because the sport "seems not to be appropriate for ladies from a medical point of view."

Exercise

- Women exercise less than men
- Women benefit from exercise!
  - Benefits far outweigh risks
  - Decreased cardiovascular disease, cancer, osteoporosis, diabetes, HTN, cholesterol

Girls who play sports ...

- are more confident
- have higher self-esteem
- have better body images
- are less likely to get pregnant or be involved with drugs
- are more likely to graduate from high school
- in high school: earn 14% higher wages for women
Physiologic Parameters: Women compared to Men

- Percent body fat: More
- Strength: Less
  - Muscle fiber size: Smaller
  - Proportion of muscle fiber types: Similar
- Aerobic capacity: Less
  - Stroke volume: Smaller
  - Lung volumes: Smaller
  - Left ventricular mass: Smaller
  - Mitochondrial density: Less
- Anaerobic capacity: Less
- Thermoregulation: Similar

Orthopedic Concerns

- ACL Tears
  - 250,000 ACL injuries/yr in USA (1 in 3000)
    - $1.5 billion annual cost
  - > 70% ACL injuries are NON-contact
  - 80 - 90% return to previous level of play
  - Season ending injury
  - Recovery 6-9 mo
  - Women at higher risk
ACL Tears in Women

- 2-8x ↑ risk as male athletes in same sports
  - Non-contact ACL tears
- Arendt AJSM 1995
  - College soccer & basketball
  - 2.4 & 4.1 times greater chance of incurring ACL injury compared males in soccer & basketball

Why are women at risk?

- Biomechanics
- Hormonal influences
- Notch width
- Alignment

Biomechanics

- Poor ham:quad strength
- Activate hamstrings more slowly
- Land with knees slightly bent
  - Boys land with knees more bent
ACL Injury Prevention Programs

- Sportsmetrics
- Mykelbust
- Knee Ligament Injury Prevention Program ("KLIP")
- Prevent Injury Enhance Performance ("PEP")
- FIFA 11+

<table>
<thead>
<tr>
<th>Program</th>
<th>Training</th>
<th>Duration</th>
<th>Balance</th>
<th>Agility</th>
<th>Speed</th>
<th>Power</th>
<th>Stamina</th>
<th>Reaction</th>
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<td>Druing</td>
<td>60-90 min</td>
<td>Yes</td>
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<tr>
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<td>&quot;11&quot;</td>
<td>Druing</td>
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**ACL Injury Prevention Programs**

- 1995-2011: 57 studies (42 programs)
- Only 5 published data regarding effects on injury reduction and performance testing
- Sportsmetrics and PEP: statistically significant decreases in ACL injury incidence rates in HS females in basketball, soccer
- PEP approached significance in collegiate athletes

**Stress Fractures**

- Common injury in sports
  - Approx 10% of all injuries seen in sports med clinics
- Females at increased risk
  - Females suffered 65% of stress fx over 5 yrs in UCLA track and field athletes
- May be a tip of the iceberg
  - Overuse
  - Poor mechanics
  - Poor bone health
- Assess for other symptoms & signs of the Triad
Medical Concerns

Concussions in Women

- Women may have more concussions and worse symptoms than men
- HS females (in sports played by both sexes) had an increased incidence of concussions (40% more than men)
  - Female basketball players had 240% more concussions
  - Women had prolonged symptoms compared to men

1997
Energy Availability

- Amount of dietary energy remaining to support other physiologic functions after subtracting out exercise training
Energy Availability

- EA = Dietary Energy Intake – Exercise Energy Expenditure
  Fat Free Mass

Example:
2000 kcal/d – 600 kcal/d / 51 kg =
27.5 kcal/kg FFM / d

What is Low EA?

- 45 kcal/kg of FFM per day = energy balance
  - Healthy, adequately nourished, sedentary, young adult females
  - Amenorrheic athletes restrict EA by 44-67%
- 30 kcal/kg of FFM per day
  - Near resting metabolic rate
  - 33% below energy balance
  - Disrupted LH pulsatility
  - Impaired bone turnover

Loucks et al; 2003 & 2004
LH Pulsatility

- LH pulsatility is disrupted within 5 days after decreased EA by 33% in young women
- Exercise suppression of LH plasticity can be restored with increasing caloric intake alone
  - Exercise is not the culprit!
- Some women may be less susceptible to low energy availability

Amenorrhea: So what??

- BMD ↓ as the # of missed cycles ↑
- ↓ bone formation markers in amenorrheic athletes
- ↑ risk of stress fx 2-4x > than eumenorrheic athletes
- Negative effect on cholesterol
- Decreased artery dilation
Iron Deficiency Anemia

- Common problem for women
- Anemia impairs performance
- Unclear if athletes need more iron than non-athletes
- Assess for other causes of anemia
- Dietary counseling
- Iron supplements

Screening

<table>
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<tr>
<th>Risk Factor</th>
<th>Low Risk = 0 points each</th>
<th>Moderate Risk = 1 point each</th>
<th>High Risk = 2 points each</th>
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<tr>
<td>Food iron &lt; 10 mg/day</td>
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<tr>
<td>Ferritin &lt; 50 ng/mL</td>
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<tr>
<td>Serum iron &lt; 50 µg/dL</td>
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<tr>
<td>Transferrin saturation &gt; 50%</td>
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<tr>
<td>Degree of anemia</td>
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<tr>
<td>10 mg/dL</td>
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<td>5 mg/dL</td>
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<tr>
<td>2 mg/dL</td>
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Magnitudes of Risk

- None
- Some dietary iron; adequate history of use
- Mark DMD 9 months of EEF

- Normal DMD 15 months
- Normal DMD 18-20 months
- Normal 21-30 months
- Normal 31 months
- Normal 31+ months

Dietary counseling

Iron supplements
Stress Urinary Incontinence

- Common but not well recognized problem in female athletes
  - 300 elite female athletes: 40% leaked urine while exercising!
  - Jumping activities
- Increased intra-abdominal pressure & failure to engage the pelvic floor muscles
- PT w/ therapist specialized in rx this problem

Depression

- Women suffer more depression than males
- Male & female athletes increased rates of depression following injuries
  - Females increased risk
- Screen for depression
- Work with a mental health treatment team

References

- General:
  - Calcium recommendations: http://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/

- Anterior Cruciate Ligament:
References

- **Concussions:**
  - Center for Disease Control Concussions: [http://www.cdc.gov/concussion/sports/facts.html](http://www.cdc.gov/concussion/sports/facts.html)

- **Female Athlete Triad:**
  - Female Athlete Triad Coalition: [http://www.femaleathletetriad.org](http://www.femaleathletetriad.org)

- **Stress Fractures:**