1 **What makes the female athlete unique?**

Pamela J Sherman, MD

2 **Participation/Title IX**

Since the 1972 enactment of education amendment requiring equal opportunity for girls and boys in education, female participation in sports has soared.

Females face challenges in sports that differ from that of males, and there are significant health risk behaviors and injury patterns that warrant more unique services for girls.

•

3 **Women in Sports**

1 • Olympics participation
  – 1972: 96 women for USA
  – 1996: 280 women
  – 2008: 42% women
• High School female athletes:
  – 1971: 300,000
  – 2008: 904% increase from initiation of Title IX
  – Over 2.95 million
• 43% college athletic opportunities (57% total college pop)
• 41% high school athletes (49% of total)
•

4 **What is different athletically?**

• much to do with innate characteristics determined by genetics and hormones
• height, weight, muscle mass, body fat and aerobic capacity
• women do not run, jump or swim as fast as men
• more prone to certain types of athletic injuries than men

5 **Increased Estrogen Levels**

• More body fat than men
  – top marathon runners, have body fat of approximately 8 percent, compared with 4 percent for male counterparts.
• Bodies are less muscular
• Joints are more flexible
  – greater range of motion

6 **Testosterone in Men**

• Develop larger skeletal muscles and larger hearts
• Larger proportion of Type 2 muscle fibers
  – generate power, strength and speed.
• Increases the production of red blood cells, which
  – absorb oxygen
  – greater aerobic advantage
    • (Dr. Mark Tarnopolsky, an exercise researcher at McMaster University in Ontario)

7 **The change at puberty**

• By around age 10 to 12, when these physical differences become more prominent, we start to see girls perform differently than boys
• ACL injury rate in adolescents increases linearly after 12 yrs and that adolescents at 17

and 18 yrs have the highest ACL injury rate
- No gender difference in knee injury risk before puberty in athletes
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8 **Injury Risk**
- The difference lies in the interplay between form, alignment, body composition, physiology, and physical performance.
- Military data suggests female recruits 2x more likely for injury than male BCT
- Injuries tend to be overuse
- Lower extremity greater than upper: 80%/20%
- Women lose same number of sick days but nearly 30% higher injury related days
-

9 **Unique hormone challenges**
- From puberty on, female athletes have to cope with shifting of hormones
  - Affect ability to train
- Exercise can counteract the physical perturbation associated with the phases of the menstrual cycle
  - Lessen pelvic and low back pain, decrease fatigue and depression, decrease headaches
- Athletic training can lead to menstrual irregularities
  -

10 **Effects on Cycle Phase**
- Early studies without hormone levels
  - Best performance during "inter" or "post"
  - Worst performance during "pre" menstrual period
- Core body temp without hormones
  - Majority of studies show no significant difference
  - A few slowest swim premenstrual, fastest while menstruating, best performance running during post ovulation and post menstruation
- Luteal Phase
  - Increased muscle glycogen storage
  -
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11 **Oral Contraceptives**
- Mixed reviews with poor control of OCA
  - Progestin, Estrogen, Combination pills
- Those on combined pill had increased cardiac output (not estrogen or progesterone only pills)
- Increased oxygen consumption and minute ventilation
  - Likely shift towards fat metabolism
- Complex effect on metabolism
  - Increase FFA, lower blood glucose levels
- Fewer traumatic injuries in female soccer players on OCA

12 **Miserable Malalignment of Girls**

feet roll inward or pronate, are flat
internal rotation of the thigh
internal rotation also from the weakness in their inner quadriceps and pelvic muscles

Exacerbates force on the patella at the knee

13 **Flexibility**

- Few published studies to support women more flexible than men
- Female athletes have generalized ligamentous laxity greater than male athletes
- Posterior subluxation of the shoulder more common (65% versus 51%) in athletes
- Gender differences in elbow and hip laxity greater in females

14 **Site Specific Athletic Injuries**

15 **Knee Injuries**

- Patellofemoral syndrome
  - kneecap is pulled towards the outside of the knee and does not track properly
  - resulting in rubbing and pain that can limit form and function
  - can also lead to other injuries including patella dislocation or subluxations
  - 33.2% women versus 18.1% men presenting with knee pain with PF disease
- Question of injury rates tied to hormones and the menstrual cycle, but this has not been proven
- Women on OC have lower rate of injury
- Soccer player more susceptible to traumatic injury during premenstrual and menstrual period compared with rest of cycle

16 **Knee Injuries**

- ACL Injuries
  - 2-10 times higher rate of ligament injuries than men in same sport
- Occurs during landing from a jump or making a lateral pivot while running
- neuromuscular control of the lower extremity

17 **ACL mechanism**

- Female athletes demonstrate greater valgus collapse of the lower extremity, primarily in the coronal plane
- high knee abduction
- lateral trunk motion with the body shifted over one leg
- the plantar surface of the foot fixed flat on the playing surface and displaced away from the trunk
- low knee flexion

18 **Can you fix the problem?**

- Neuromuscular Training
- Assess Other Injuries
  - Ankle Sprains
  - Abdominal Fatigue
- Power can increase within 6 weeks of training
  - may reduce peak impact forces
  - Reduce knee abduction torques
  -

19 **Summary of programs**

- teach how to land in less vulnerable positions
  - maintain proper knee alignment and knee flexion during cutting maneuvers
- more neuromuscular control

  - accelerated rounded turns
  - decelerate with a multi-step stop
- strengthening due to the laxity of women's joints
  - hamstring strengthening that is vital for controlling deceleration
  - increasing gluteus maximus, gluteus medius (hip extension and abduction) strength and reactivity
  -

20 **Financial Result**

- In the United States, 100,000 to 300,000 total ACL injuries occur each year
  - treatment costs exceed $1 billion annually in female varsity athletics alone
- Strong association exists between ACL injury and development of posttraumatic knee osteoarthritis at a relatively young age
  - occurs with much greater incidence in females than males

21 **Shoulder Injuries**

22 **Shoulder**

- Suggestion that women more commonly have shoulder injuries
- Alpine skiing
  - Male: Female injury of shoulder 3:1
  - RC: 1.7:1
  - AC sep and GH dislocations: 5:1
  - Clavicle Fx: 7:1
- Danish Volleyball: 15% shoulder similar M:F
  - Predominantly overuse
- MDI: proprioceptive feedback loss w/ capsular stretch
  - Nonoperative
  - Surgical when all else fails

23 **Shoulder Injuries**

- Weak shoulder muscles, including the rotator cuff and periscapular muscles
- loose supporting tissues can lead to instability in the shoulder
- Strengthening programs exist to help cut down on such injuries
- Preference of sport related to laxity
  - Swimming, gymnasts, cheer

24 **Ankle**

- Ankle sprains most common injury
- Women in pro basketball 1.6 x more likely to be injured, ankle most common
- 25% more likely to have grade 1 ankle sprain
  - Risk of ankle injury doubles at intercollegiate level basketball from interscholastic
- Elevated eversion to inversion strength ratio had higher rate of inversion injury than those with greater plantar flexion strength and smaller dorsi to plantar-flexion ratio
  -

25 **Foot Injuries**

1 Women more likely

2
- Hallux valgus
- Neuroma

- Metatarsalgia
- Posterior Tibialis tendonitis
-

3 Unclear contribution to injury

4
- Different anatomy
- Different alignment
- Laxity
- Ballet Specific
-

26 **Stress Fractures**
- Fatigue or insufficiency fx
- Increase in frequency
- Overuse
- 3.5-4x more likely for female athlete than male
- Lower extremity most common

27

28 **Female Athlete Triad**
- Performance athletes
  - Appearance a factor for activity
  - Lean, low body fat content
  - Usually independent sport
- Not just adolescent girls
  - Boys in certain sports
- Increase with increased participation with girls and sports
- Stress Fractures may be first sign
-
-

29 **Triad Risk Profile**

- Young female under high societal pressure
- Significant biological stress
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30 **Disordered Eating**
- Restrictive Eating Patterns
- Preoccupation of thought patterns with food
- Distorted body image
- Overly concerned with body shape and weight
- Anorexia/Bulemia are extremes of the spectrum
-
-

31 **Excessive Exercise**

- Excessive training without adequate recovery
- Compulsive exercise schedule: many hours at gym
- No rest days
- Continue exercise *with* pain and injury
- Feel guilty/fat on days don't exercise
-

32 **Menstrual Irregularities**

Increased training schedules
  increased load
Altered dietary intake
Altered body composition
Confounding variables often not well controlled
Athletic women tend to have irregularities
  Relative risk of stress fracture 2 to 4 fold higher
  More likely to have multiple stress fractures

33 **Menstrual Irregularities**

- Lack of estrogen increases bone breakdown
- Decrease in rate of bone deposition
- Lower bone density in women without normal cycles
- Unclear if this loss is reversible
-

34 **Bone Health**

- Pubertal gain in bone mass largest percentage increase next to 1st year of life
- Bone "Bank:
- Peak bone mass ages 20-30 yo
- 60% of variable risk of OP contributed to maximum peak bone mass
- Rapid bone loss at menopause
-

35 **Conquering Female Athlete Triad**

- Requires team of health professionals
- Address all aspects
- Lifestyle change
- Early intervention
- Don't ever think "too young" or "too old"
- Creates a problem for life
- Adolescence is key to building bone
- Any concern should lead to referral to MD for evaluation and DXA
-

36 **Depo-Provera and Adolescents**

- Suppression of estradiol levels
- Use in first two years of menstruation
  - Significant decrease in spine and hip INSTEAD of increase

- Suggests that reversible increase when off the drug
- Oral Contraceptives not have same effect

37 **Healthcare numbers**

- 308.7 million people in the United States
  - 157 million were female (50.8 percent)
  - 151.8 million were males (49.2 percent)
  - life expectancy for a woman 81.2 years
  - life expectancy for men is 75.9 years
- World Health Organization's (WHO) Disability Adjusted Life Expectancy (DALE) calculations
  - Men in the US: 67.5 years of full health
  - Women: 72.6 years of healthy life
  - Basically shorter life with more disability

38 **Health Benefits of Exercise**

- Breast cancer risk reduction
  - 20 to 30% with 1to 3 hours exercise/week
  - 60% with more than 4 hours/week
- A pattern of exercise established as a young person leads to healthy patterns throughout a woman's lifetime
-

39 **Unequal Numbers**

- Female college athletes
- 36% sports operating dollars
  - $1.55 billion less than male
- 45% college athletic scholarship dollars
  - $166 million fewer scholarship $ than male
- 33% of athletic team recruitment spending
  - $50 million less recruiting female athletes than male
- WSF

40 **Teenage Female Athletes**

- less likely than non-athlete to engage in sexual intercourse
  - 54% versus 41%
- More likely to begin sex later and to have fewer partners
- More likely to use contraceptives
- Far less likely to get pregnant
-

41 **Performance improvement**

- Athletes compared to non-athletes
  - Improved grade point average
  - Decreased dropout rate
  - Improved graduation rate
- Better budget of time, mental ability and capacity
- Enhance body image, self-esteem, confidence and scholastic performance
- Decreases the risk of obesity and depression
- Less likely to do drugs, join gangs

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-
-

42 **Sports are great!**

- Fun
- Friends
- Accomplishment
- Teamwork
- Fitness and health
- Pride, confidence, leadership
- More likely to graduate
- Less high-risk behaviors

43 **Decrease in participation**

- Inevitable time when they will not do well in sports
- Internal control of sports performance are lost or difficult, turn to other aspects they can control, weight
- Focus becomes weight loss will improve performance and eventually lead to winning
- Puberty, gaining height and weight and changing body shape
- More self-conscious
-

44 **Decrease in participation**

- Marked decline (as much as 30%) in preadolescent and adolescent girls compared to elementary school
- More self-conscious
- Inevitable time when they will not do well in sports
- True especially when they derive identity from her sport
  - Focus on sport and performance
  - Doesn't value other aspects of her personality
-

45 **Female Athletes**

- Healthy Habit
- Encourage participation
- Lifelong benefits
-

46 **Thank You**