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I have no disclosures or conflicts of interest

Exercise and Physical Activity for Older Adults – ACSM Position Stand (2009)
3 Evidence Statements
Normal human aging is...
Associated with physiologic changes that result in reductions in functional capacity and altered body composition
Associated with declines in physical activity volume and intensity
Associated with increased risk for chronic diseases

What I have learned
Physiological Changes
- Advancing age is associated with physiological changes that result in reductions in functional capacity and altered body composition
  - Decreased VO2 max
  - Metabolic cost of work increases
  - Pulmonary function decreases
  - Total muscle mass decreases
  - Muscle strength and power decline
  - Bone mineral density decreases

What I have learned

Age-related anaerobic energy system changes

- With age, anaerobic energy systems (peak anaerobic power, peak anaerobic capacity) decline faster than aerobic energy system

What I have learned

Age-related tendon changes

- Material and structural properties of tendon increase birth to maturity and decrease through old age
- Tendon vascularity can be compromised at junctional zones and at sites of friction, torsion, or compression
- Sequelae of overstimulation or understimulation may result in apoptosis and subsequent tendinosis

Learned

Lived
What I have learned
Age-related ligament changes

- Collagen fiber disorientation most prevalent change
- Subject to compositional changes that alter a normal response to mechanotransduction, biology, healing capacity, and biomechanical function

What I have learned
Age-related articular cartilage changes

- Increasing surface fibrillation
- Fewer chondrocytes
- Decreased functional activity
- Decreased cellularity → diminished ability to repair
- Progressive senescence of chondrocytes

Age-related cartilage changes

<table>
<thead>
<tr>
<th>Compartment</th>
<th>Structural Integrity</th>
<th>Functional Integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collagen</td>
<td>Increased stiffness, decreased flexibility, increased stiffness of type II collagen</td>
<td>Increased stiffness, decreased flexibility, increased stiffness of type II collagen</td>
</tr>
<tr>
<td>Proteoglycans</td>
<td>Increased proteoglycan content, decreased proteoglycan content</td>
<td>Increased proteoglycan content, decreased proteoglycan content</td>
</tr>
<tr>
<td>Chondrocytes</td>
<td>Increased chondrocyte activity, decreased chondrocyte activity</td>
<td>Increased chondrocyte activity, decreased chondrocyte activity</td>
</tr>
</tbody>
</table>

What I have learned
Osteoarthritis

- OA is not a cartilage problem
- OA is not a degenerative disorder
- OA is joint failure rather than a disease
- Joint failure is driven by abnormal joint loading.
- OA is not always a progressive disease process.
What I have learned
Age-related muscle changes (sarcopenia)

- Muscle mass decreases with age, men > women; greatest after age 70
- Strength declines 10-15% per decade up to age 70, then accelerates to 25-40% per decade
  - Muscle protein synthesis (affects turnover and repair)
  - \( \Delta \) delivery decreases
  - \( \Delta \) percentage type I fibers, loss of type II fibers
  - Aerobic energy production decreases
- Endurance capacity declines 10% per decade


And here's the proof

What I have learned
Age-related competitiveness

- Learned
- Lived

(Labeled Diagram: Model of how relative age influences performance and competitiveness in masters-level sport.)
What I have learned

Age-related brain changes

- Exercise training or physical activity benefits executive function in older adults
- Participating in a regular exercise regimen can improve cognitive function and reduce risk of dementia/neurodegenerative diseases
- Exercise helps maintain brain fitness by preserving hippocampal volume and white matter tract integrity (important for memory processing)

Where are we headed?

- Magnitude of improvements in athletic performance is greater in older age groups
- Athletic performance in Masters athletes aged 45 and older continue to improve to this day

What I have learned

- Physiological changes
  - Regular fitness program slows age-related changes
- Muscle/tendon changes
  - Regular activity stimulates mechanotransduction
- Articular cartilage changes
  - Motion is critical for articular cartilage repair and homeostasis
- Sarcopenia
  - Old muscles are trainable

Where are we headed?

- 30% aging based on genetics
- 70% of aging is based on lifestyle

Summary

It’s all about...