Bone Health in Cyclists

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Overview

• Bone physiology
  ➢ How do we build bone?
• Bone density in athletes
  ➢ Are there sport-specific effects?
• Effects of resistance training on bone
  ➢ Does it increase bone density?
• A pitch for not pedaling
  ➢ How do I improve my bone health?

Key Terms

• Bone Mineral Density (BMD)
  ➢ amount of minerals (Ca, P) in volume of bone
  ➢ bone mass, bone density
• D(E)XA scan: Dual-Energy X-ray Absorptiometry
• Osteopenia/Osteoporosis: low bone mass

Bone Health in Cyclists

It’s not about the bike

BMD and DXA Scan

Osteoporosis

Normal bone

Osteopenic
bone

Osteoporotic
bone
**Key Terms**

- **Impact or weight bearing (WB)** = non-weight supported
- **No impact or non-weight bearing (NWB)** = weight supported
- **Resistance training**
  - any method of training used to resist, overcome or bear force (strength training, weightlifting)
- **Ground reaction force (GRF)**:
  - force exerted on body by ground
- **Mechanical strain**:
  - when force is applied to bone, it deforms
  - amount of deformation relative to original length = strain

**Bone Physiology**

**How do we build bone?**

**Building Bone**

**Bone formation ↔ Bone resorption**
- Mechanical strain helps maintain balance ---→ bone remodeling
- **Internal strain**
  - muscular forces
- **External strain**
  - impact or “loading”

**Building Bone**

**Internal strain**
- Pull of muscle at attachment site bends bone
- Stimulates bone formation, if....
  - High magnitude (muscular force)
  - High rate (muscular contraction)
  - Irregular distribution
Building Bone

**External strain**
- GRF produces longitudinal loading or compression of bone
- Strain in WB ↑ proportionally with GRF
- Most important stimulus for bone formation
- Sports that build bone involve:
  - large ground reaction forces
  - jumping, landing, running

Losing Bone

- Bed rest
- Weightlessness
- Sports ?
- Weight-supported sports
  - CYCLING

*Seated pedaling at 250 W and 90 rpm places < ½ body wt on pedals*

Building Bone in Cyclists

- Minimal impact
- Fixed body position
- Repetitive muscular strain pattern
- Lower magnitude (endurance/tempo)
  - Exceptions: standing, sprinting

- Muscle forces in cycling insufficient:
  - to achieve net bone formation
  - to overcome NWB effects on bone

Building Bone: Summary

- BMD adapts
  - positively to loading
  - negatively to lack of loading
- NWB exercise: minimal effect on BMD
- WB exercise: greatest effect on BMD

- Cycling is a poor bone building stimulus

BMD in Athletes

Are there sport-specific effects?

The Runner

- GRF produced during running
  - legs = 2-5 x body weight
  - spine = 1.75 x body weight
- Distance for optimal bone formation in
  - legs = 15-20 miles/week
- Lifetime cumulative bone-loading
- BMD in runners > cyclists
The Triathlete
- Allocation of training time
- Swimming + cycling < or > running
- Same BMD as runners
- No BMD loss over competitive season
- Running is protective

The Cyclist
- Less cumulative bone loading over time
- Total BMD similar to non-exercisers
- Body weight distributed horizontally
- 7 x more likely to have osteopenia of spine compared to runners

The Young (Junior) Cyclist
- BMD ↑ in adolescence, peaks in 20s
- 90% bone mass present at end of skeletal maturation
- Peak bone mass largely determines bone mass in older age
- Must sustain loading to maintain bone mass
- Age at start of training important

The Master Cyclist
- BMD ↓ with age, F>M
- Lower BMD (spine, hip) than non-athletes and younger cyclists
- 2/3 with osteopenia or osteoporosis at spine and hips

The Mountain Biker
- Ground-induced strain from variable terrain
- Two points of contact (hands/feet)
- Changes in body position
- ↑ load at legs via pedals
- BMD in mtn bikers > roadies

The Female Cyclist
- Estrogen important for bone health
- Intense training → amenorrhea
- Amenorrheic women at risk for impaired bone health
- Caution in young female cyclists
- Post-menopausal women
  - Greater risk for osteoporotic fractures
**The Competitive Cyclist**

- Avoid “unnecessary” WB activity during heavy training periods
- Larger training volume = more time spent resting and recovering
- BMD ↓ over competitive cycling season
-Incomplete off-season recovery of BMD
- Sequential years of competitive cycling result in progressive bone loss

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**Tour de France saying:**

“If you are not riding, you should be resting, if you do not have to stand, you should sit, if you do not have to sit, you should lie down.”

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**Resistance Training**

**Does it build bone mass?**

- Positive correlation between muscle strength/mass and BMD
- Effects on BMD studied in:
  - Adolescents
  - Young adults
  - Post-menopausal women*
  - Older men*

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**Resistance Training**

- Low-moderate-high intensity
- Power lifters have higher BMD than recreational lifters
- Weight training more effectively reduces bone loss than NWB endurance exercise
A Pitch for not Pedaling

How can I improve my bone health?

Improving Your Bone Health

- Do not cycle to the exclusion of other WB activity
- Sustain bone-loading activities throughout life
  - Consider DXA to determine BMD
  - Consume adequate Calcium, Vit D

Calcium and Vit D

- Calcium in athletes (1500 mg)
- Vit D ↑ Calcium absorption
- Fortified in foods
  - Cereal flour
  - Milk-based products
  - Fruit juices and drinks

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<tr>
<th>Food</th>
<th>Calcium (mg)</th>
<th>% DV</th>
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<tr>
<td>8 oz Plain yogurt</td>
<td>415</td>
<td>43 %</td>
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<tr>
<td>8 oz Non-fat milk</td>
<td>302</td>
<td>30 %</td>
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<tr>
<td>1.5 oz Cheese</td>
<td>306</td>
<td>31 %</td>
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Time Off The Bike

- Is an important part of training

Take Home Points

- Compressive strain stimulates bone formation
- Cycling is weak stimulus for building bone
- Evidence of low BMD in cyclists of all ages
- Add resistance or WB activity to training
  - For BONE HEALTH
  - Not BIG TROPHIES

References

Questions?