What is vitamin D?

- Fat-soluble vitamin stored in the body
- Also called the "sunshine vitamin" because it is formed in the skin by the action of ultraviolet rays from the sun
- The liver and kidney convert vitamin D to the active hormonal form which helps maintain normal blood levels of calcium and phosphorus
Older adults are at greater risk for vitamin D insufficiency

- Decreased exposure to sunlight
- Decreased capacity of the skin to produce vitamin D
  – decreased 7-dehydrocholesterol in the skin

Skin’s capacity to produce vitamin D

Older adults produce ~1/4 of vitamin D compared to young adults with the same amount of exposure to sunlight

Older adults are at greater risk for vitamin D insufficiency

- Decreased exposure to sunlight
- Decreased capacity of the skin to produce vitamin D
- Decreased kidney function
  - Limits conversion of 25(OH)D to active 1,25(OH)₂D
- Inadequate dietary intake
  - Vitamin D is found naturally in very few foods (e.g., fatty fish like salmon, tuna, and sardines)

Vitamin D intake from diet and supplements in the U.S.

Recommended Dietary Allowance (RDA):
- 19-70 yrs, 600 IU/day
- 71+ yrs, 800 IU/day

Prevalence of vitamin D insufficiency in older adults in the U.S.

- <10 ng/mL (deficient) 4%
- 10–20 ng/mL (insufficient) 26%
- 20–30 ng/mL (sufficient/insufficient?) 47%
- 30+ ng/mL (sufficient) 23%

Too low for normal bone health
Potentially too low for non-bone health outcomes


"Classical" actions of vitamin D

- Intestinal calcium and phosphorous absorption
- Bone formation and resorption

Rickets
Osteoporosis
Vitamin D Status – Beyond Bone Health: Physical Function, Falls and Fractures

Vitamin D status and physical function

Older adults with lower 25(OH)D levels had slower walk speeds and sit-to-stand times

**Vitamin D status and decline in physical function**

Low 25(OH)D levels were associated with ~ 2-fold higher odds of decline in physical performance over 3 years

![Graph showing odds ratio (OR) and 95% CI for different 25(OH)D levels](image)

*LASA: Wicherts IS et al., J Clin Endocrinol Metab 2007.*

**Vitamin D status and mobility limitation**

Low 25(OH)D levels were associated with a 30% increased risk of mobility limitation* over 6 years

![Graph showing hazard ratio (HR) and 95% CI for different 25(OH)D levels](image)

*Health ABC; Houston DK et al., J Gerontol:Med Sci 2012. *

*Any difficulty walking ¼ mile or up 10 stairs*
Vitamin D status and falls

Low vitamin D levels were associated with ~1.8-fold higher odds of falling two or more times over 1 year

LASA; Snijder MB et al., J Clin Endocrinol Metab 2006.

Vitamin D status and fractures

Low vitamin D levels were associated with ~1.7 fold higher risk of hip fracture over 7 years

WHI-OS; Cauley et al., Ann Intern Med 2008
Vitamin D Supplementation –
Beyond Bone Health: Physical Function, Falls and Fractures

Vitamin D supplementation and physical performance

Randomized controlled trials of vitamin D supplements show a ~20% improvement in balance/sway and Timed Up and Go

Balance/Sway

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Vitamin D supplementation</th>
<th>Control</th>
<th>Std. Mean Difference</th>
<th>IV, Fixed, 95% CI</th>
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<tr>
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<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>Mean</td>
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<tr>
<td>Bunout 2006</td>
<td>119.8</td>
<td>38.3</td>
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<td>Chmle 2004</td>
<td>0.0899</td>
<td>0.046</td>
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<td>0.0999</td>
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<td>Pfeifer 2009</td>
<td>81</td>
<td>32</td>
<td>121</td>
<td>86</td>
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<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>207</strong></td>
<td><strong>206</strong></td>
<td>100.0%</td>
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</table>

Timed Up & Go

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Vitamin D supplementation</th>
<th>Control</th>
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<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>Mean</td>
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<td>Pfeifer 2009</td>
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<td>Zhu 2010</td>
<td>8.1</td>
<td>3.9</td>
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<td>7</td>
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<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>274</strong></td>
<td><strong>277</strong></td>
<td>100.0%</td>
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</tr>
</tbody>
</table>

Vitamin D supplementation and falls

Randomized controlled trials of vitamin D supplements ≥700 IU/day show a ~20% reduction in falls

- Pfeifer et al (2009)
- Bischoff et al (2009)
- Pfeifer et al (2010)

Bischoff-Ferrari HA et al., BMJ 2009.

Vitamin D supplementation and fractures

Randomized controlled trials of vitamin D supplements ≥792 IU/day* show a ~30% reduction in hip fractures

- Chapuy 1992
- Flicker 2005
- Grant A 2005
- Grant B 2005
- Jackson 2006
- Bischoff-Ferrari 2010

Pooled RR: 0.72
(95% CI: 0.59–0.89)

* Lower vitamin D supplement doses were not associated with reduced risk of hip fractures

The effect of improving vitamin D status on physical function and bone health

25(OH)D > 20-30 ng/mL

Muscle strength
Lower extremity function
Balance

Intestinal calcium absorption
Bone mineral density

Falls
Fractures

Thank you!