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# Vitamin D: Beyond Bone Health

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## What is vitamin D?

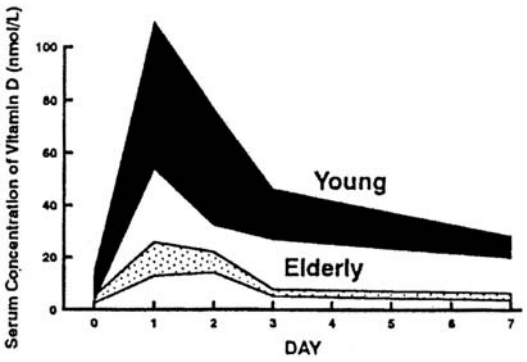
- **Fat-soluble vitamin stored in the body**
- **Also called the "sunshine vitamin" because it is formed in the skin by the action of ultraviolet rays from the sun**
- **The liver and kidney convert vitamin D to the active hormonal form which helps maintain normal blood levels of calcium and phosphorus**

## 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

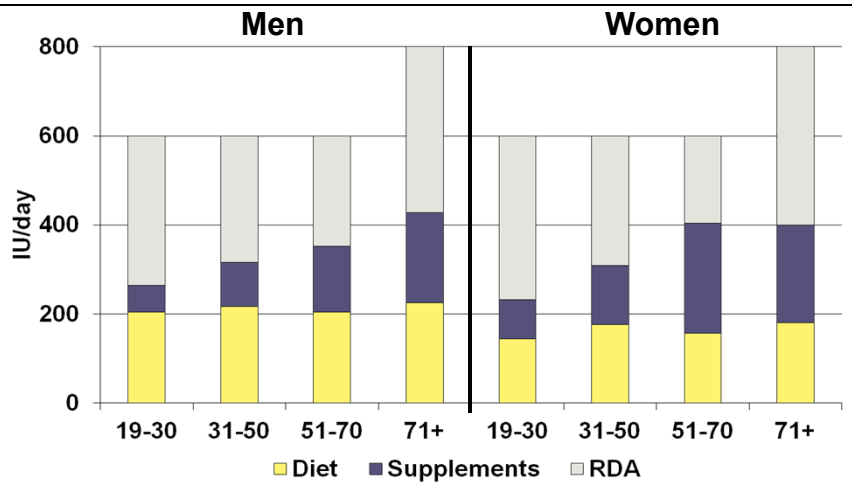



Holick MF, *Am J Clin Nutr* 2004.

## 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$(OH)_2$D
- **Inadequate dietary intake**
  - Vitamin D is found naturally in very few foods (e.g., fatty fish like salmon, tuna, and sardines)

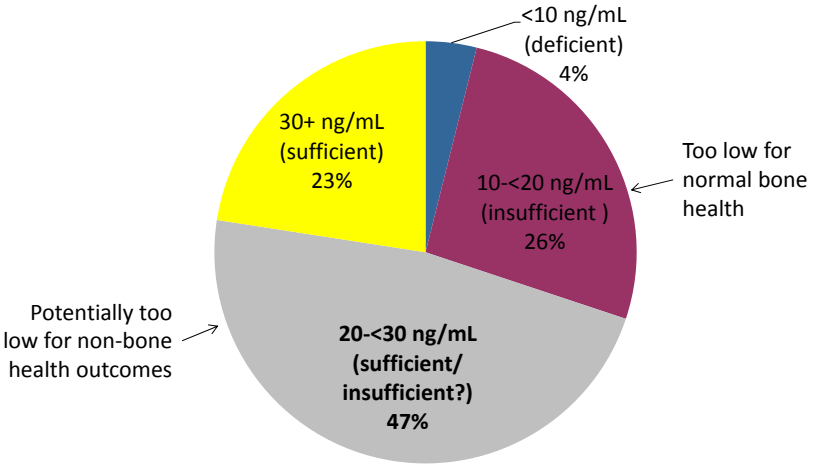
## Vitamin D intake from diet and supplements in the U.S.




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

Bailey RL et al., *J Nutr* 2010.

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




Looker AC et al., *Am J Clin Nutr* 2008.

## "Classical" actions of vitamin D

- **Intestinal calcium and phosphorous absorption**
- **Bone formation and resorption**

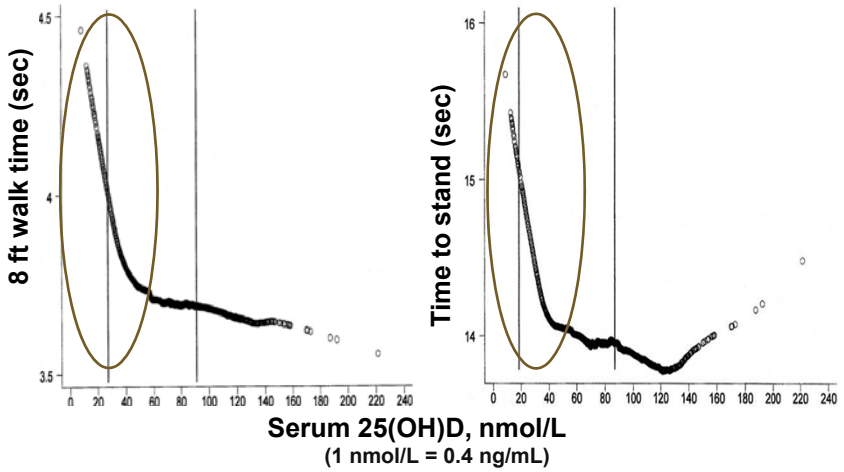
Rickets


Osteoporosis

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

## Vitamin D status and physical function

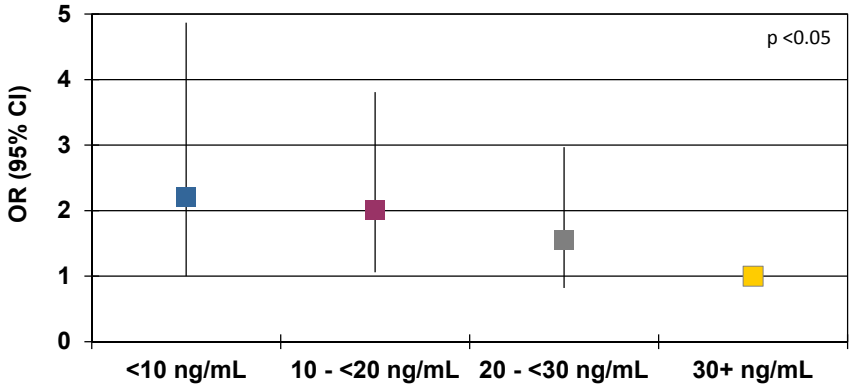
Older adults with lower 25(OH)D levels had slower walk speeds and sit-to-stand times




NHANES III; Bischoff-Ferrari HA et al., *Am J Clin Nutr* 2004.

## Vitamin D status and decline in physical function

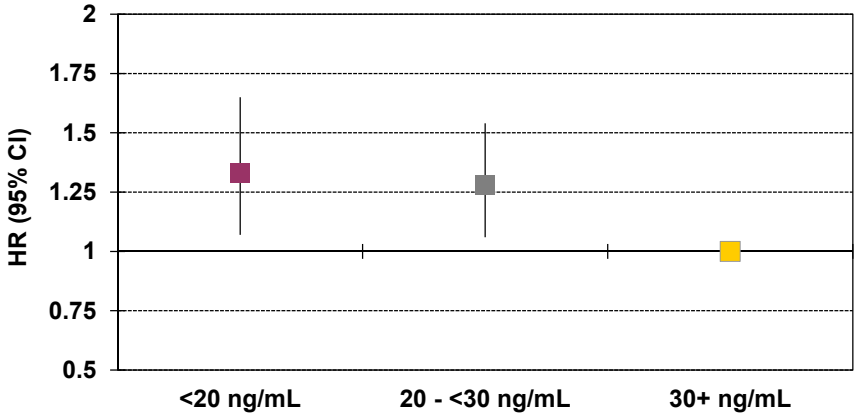
Low 25(OH)D levels were associated with ~ 2-fold higher odds of decline in physical performance over 3 years




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

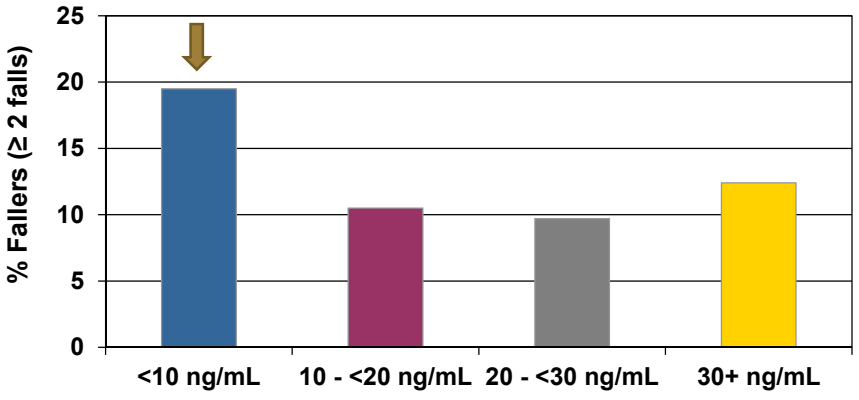



Health ABC; Houston DK et al., *J Gerontol:Med Sci* 2012.

* Any difficulty walking ¼ mile or up 10 stairs

## Vitamin D status and falls

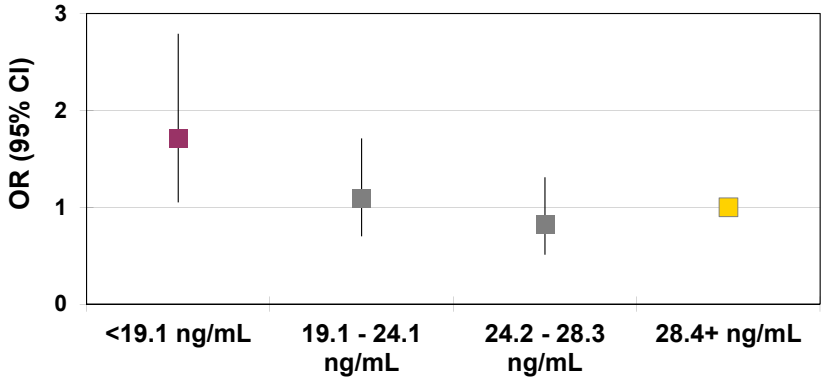
Low vitamin D levels were associated with ~1.8-fold higher odds of falling two or more times over 1 year




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

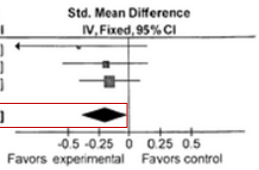
# Vitamin D Supplementation – Beyond Bone Health: Physical Function, Falls and Fractures

## 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

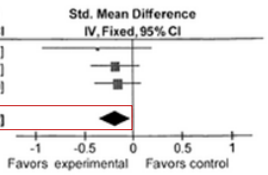
**Balance/Sway**

| Study or Subgroup | Vitamin D supplementation Mean | SD | Total | Control Mean | SD | Total | Weight | Std. Mean Difference IV, Fixed, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Bunout 2006 | 119.8 | 38.3 | 24 | 134.7 | 31.9 | 24 | 11.4% | -0.42 [-0.99, 0.16] |
| Dhesi 2004 | 0.0899 | 0.046 | 62 | 0.0999 | 0.057 | 61 | 29.8% | -0.19 [-0.55, 0.16] |
| Pfeifer 2009 | 81 | 32 | 121 | 86 | 30 | 121 | 58.8% | -0.16 [-0.41, 0.09] |
| **Total (95% CI)** | | | **207** | | | **206** | **100.0%** | **-0.20 [-0.39, -0.01]** |




**Timed Up & Go**

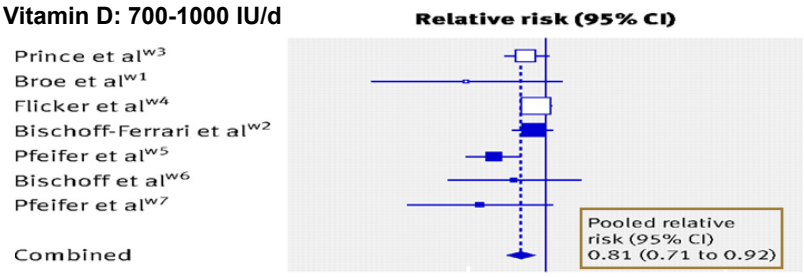
| Study or Subgroup | Vitamin D supplementation Mean | SD | Total | Control Mean | SD | Total | Weight | Std. Mean Difference IV, Fixed, 95% CI |
|---|---|---|---|---|---|---|---|---|
| Bunout 2006 | 13.8 | 2.5 | 24 | 15.2 | 4.7 | 24 | 8.6% | -0.37 [-0.94, 0.21] |
| Pfeifer 2009 | 7.5 | 3.4 | 121 | 8.3 | 5.1 | 121 | 44.0% | -0.18 [-0.44, 0.07] |
| Zhu 2010 | 8.1 | 3.9 | 129 | 9 | 7 | 132 | 47.4% | -0.16 [-0.40, 0.09] |
| **Total (95% CI)** | | | **274** | | | **277** | **100.0%** | **-0.19 [-0.35, -0.02]** |




Muir SW & Montero-Odasso M, *J Am Geriatr Soc* 2011.

## Vitamin D supplementation and falls

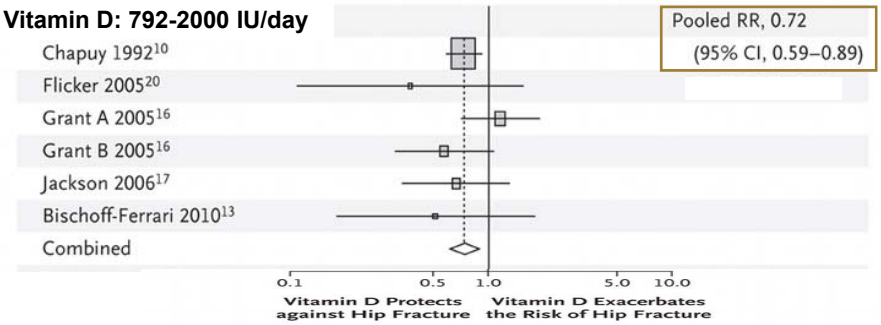
Randomized controlled trials of vitamin D supplements
≥700 IU/day show a ~20% reduction in falls




Bischoff-Ferrari HA et al., *BMJ* 2009.

## Vitamin D supplementation and fractures

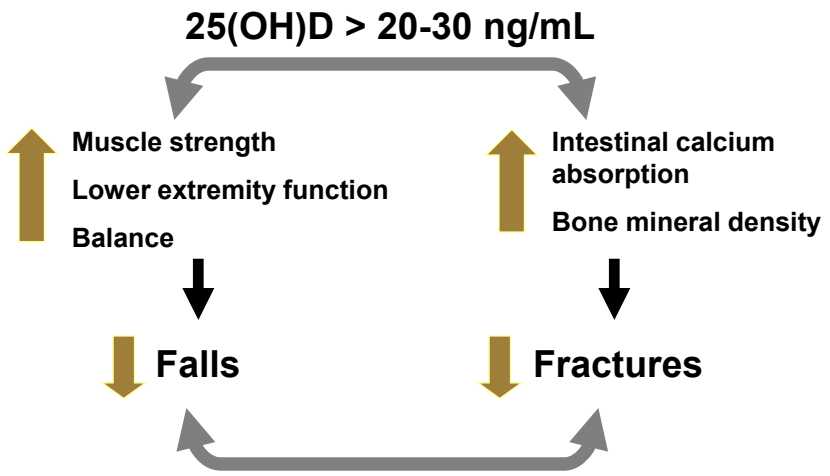
Randomized controlled trials of vitamin D supplements
≥792 IU/day* show a ~30% reduction in hip fractures




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

Bischoff-Ferrari HA et al., *N Engl J Med* 2012.

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

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**Thank you!**