Calcium, vitamin D and musculoskeletal health in the elderly

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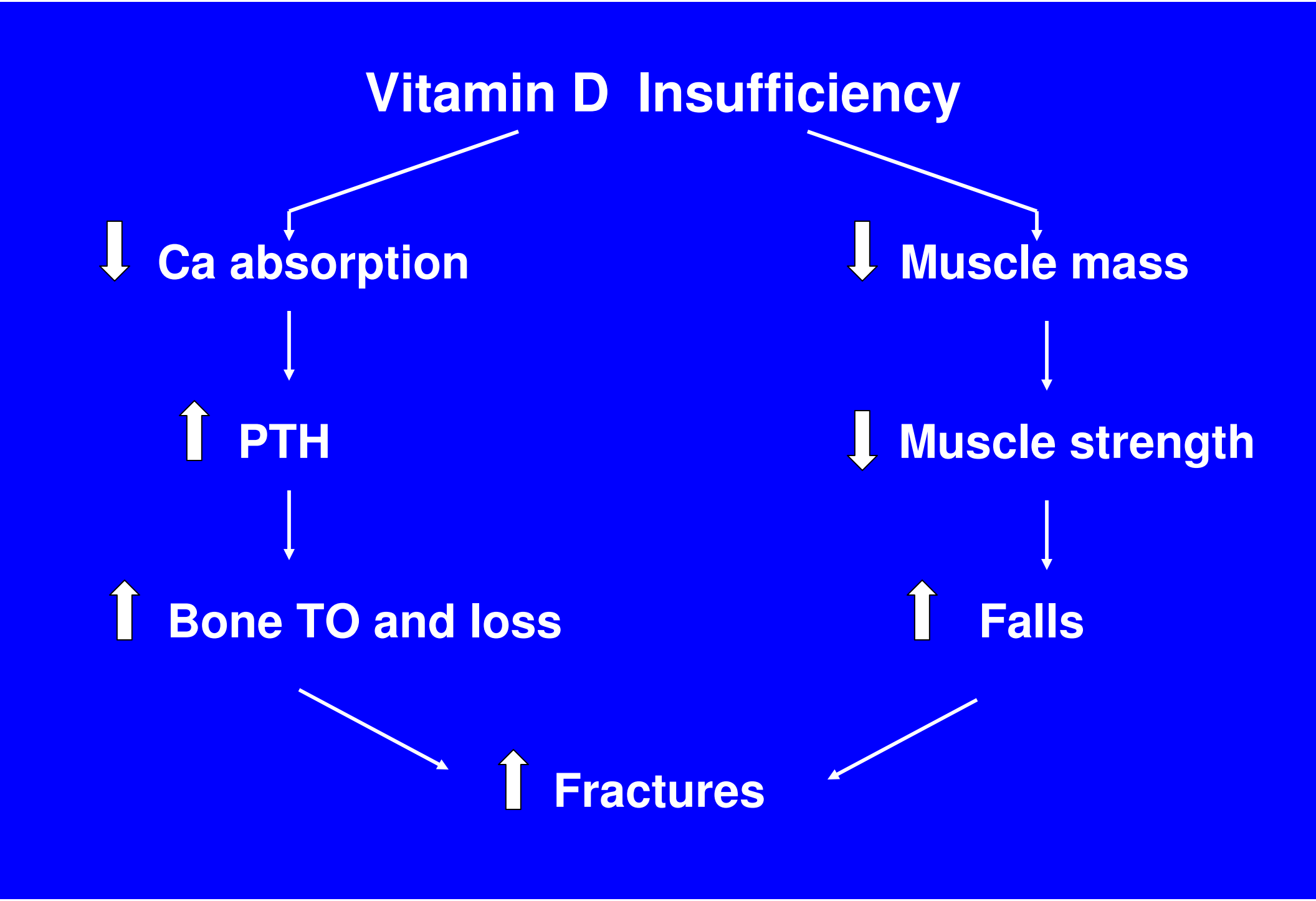
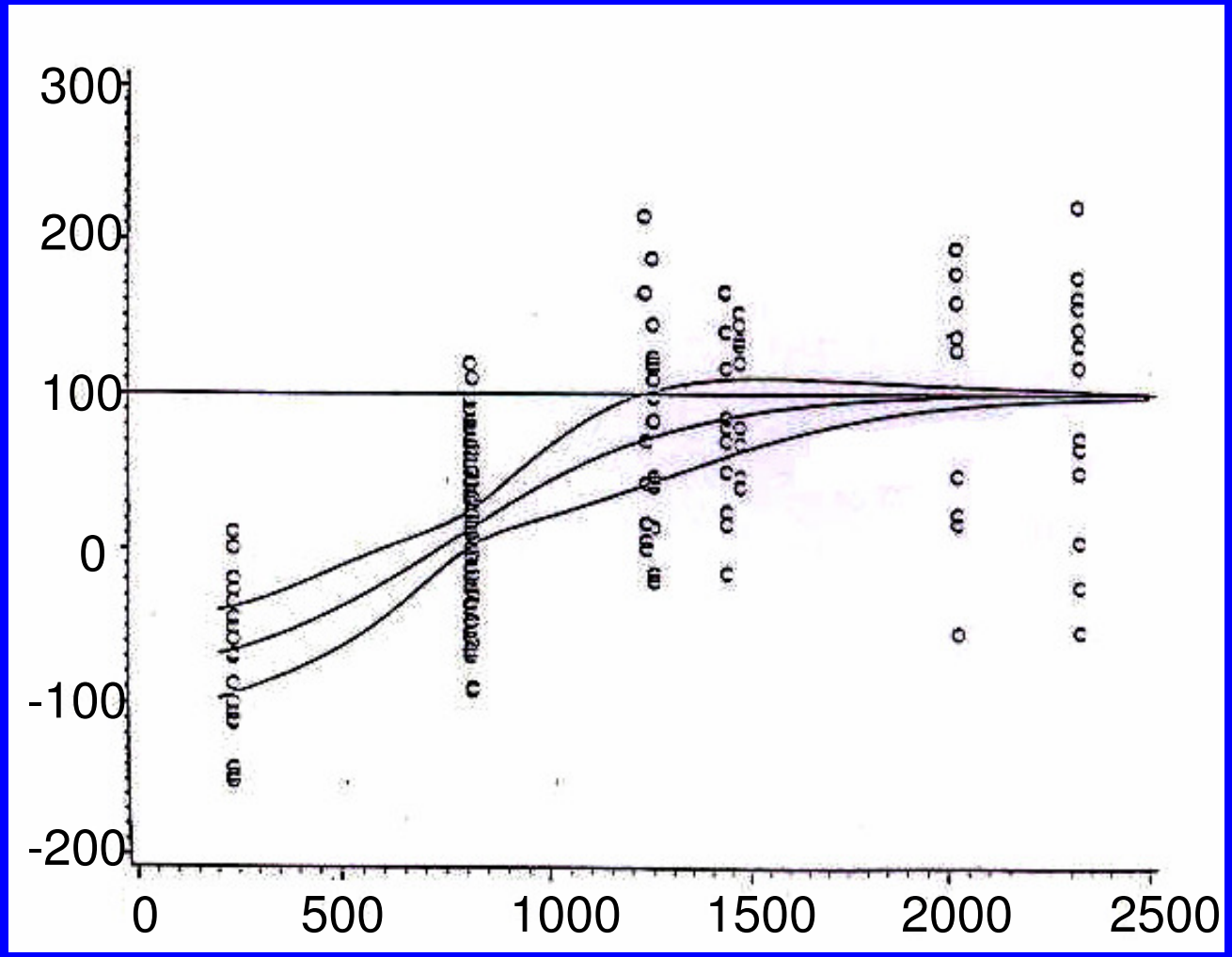

Vitamin D Insufficiency
Ca absorption
PTH
Bone TO and loss
Muscle mass
Muscle strength
Falls
Fractures

Calcium intake required for maximal calcium retention is 1200 mg/d



Spencer H, 1984
Jackman L, 1997

Impact of Supplemental Calcium on Fracture Risk (a meta-analysis)

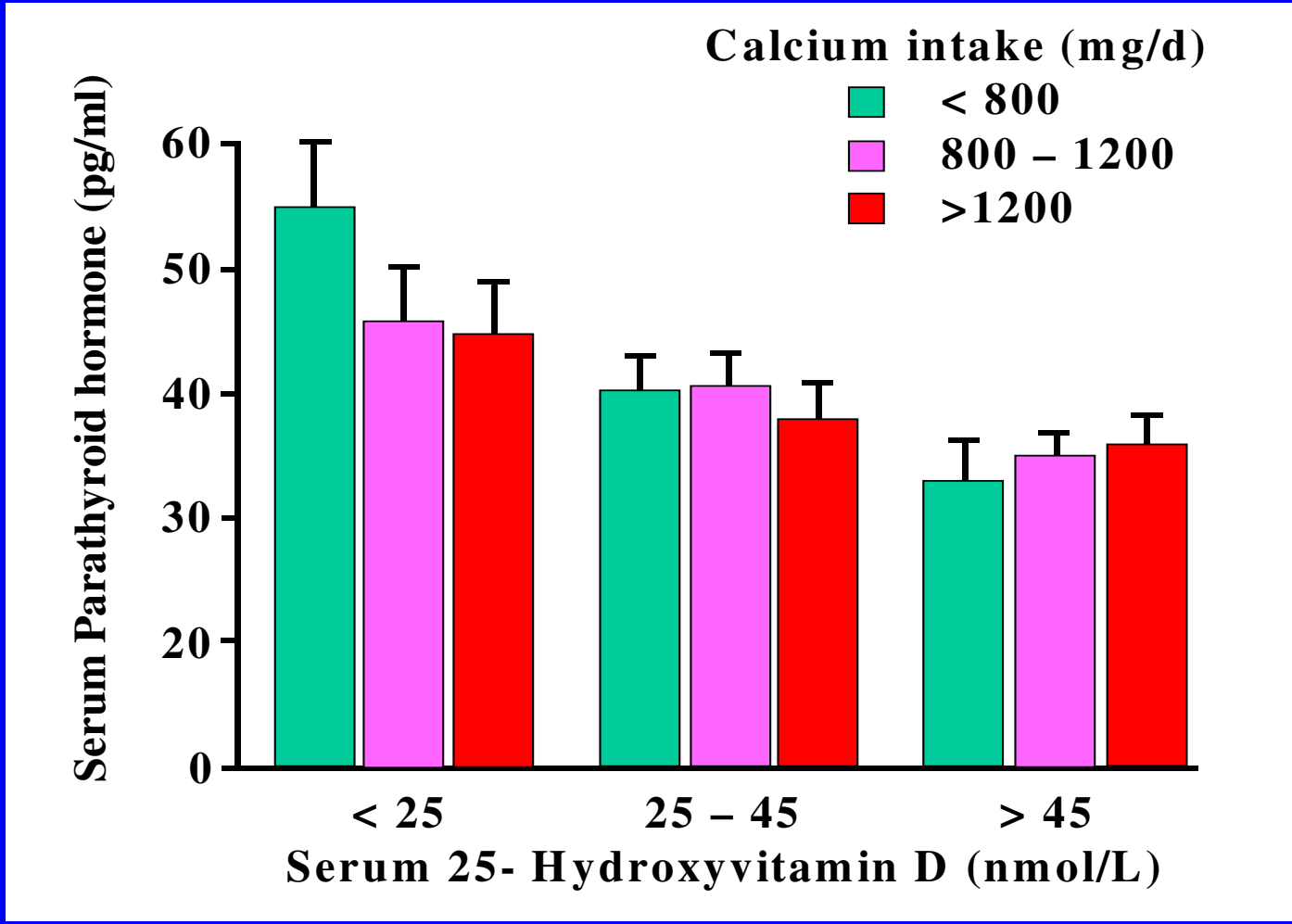
- Supplementation with calcium did not alter hip fracture risk in men or women.
- Supplementation with calcium showed a non-significant trend toward lowering non-vertebral fracture risk (RR = 0.92 [0.61, 1.05]).

Bischoff-Ferrari, H. Am J Clin Nutr 2007;86:1780-90.

The impact of calcium appears to depend in part upon the circulating 25(OH)D concentration.

Calcium and Vitamin D Intakes and Serum PTH

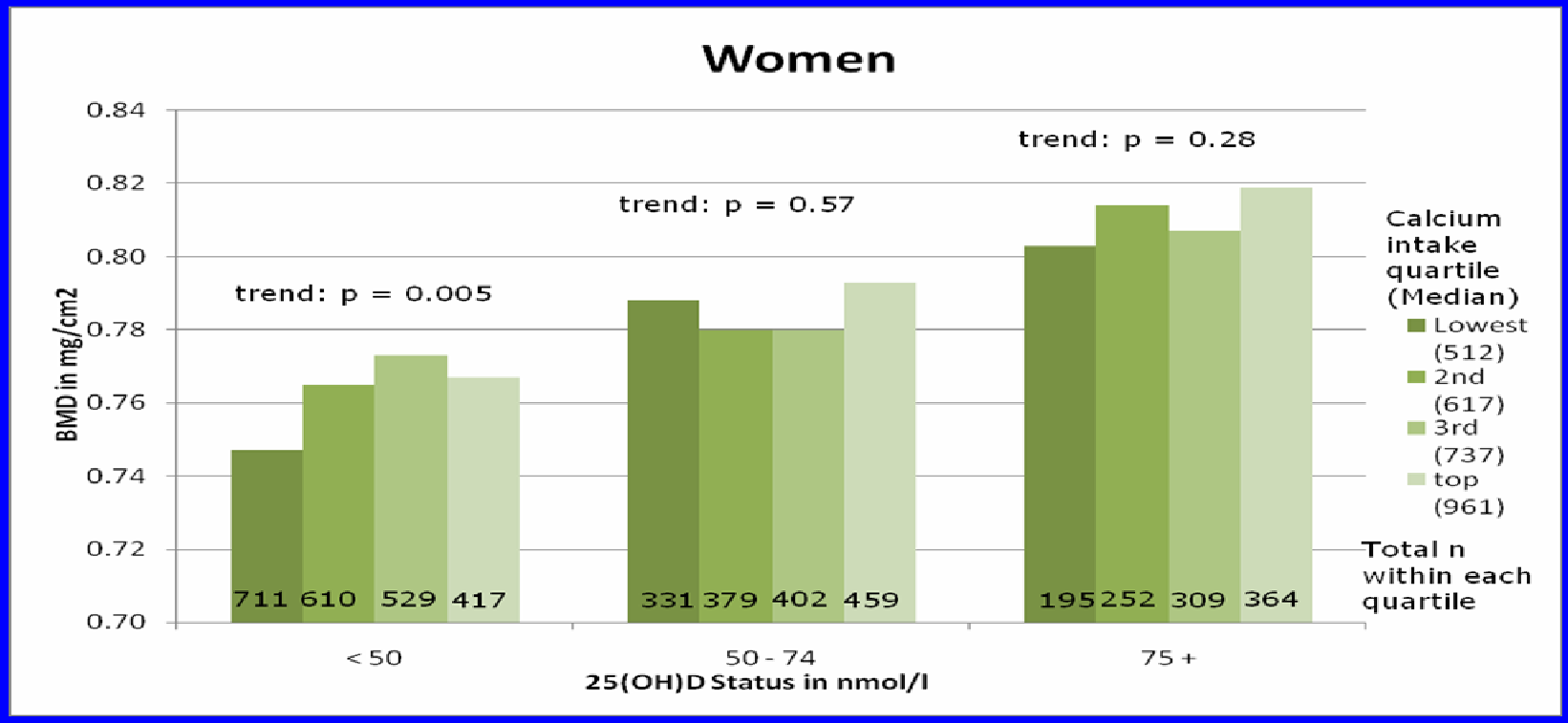
Icelandic population, males (58 ± 14 yrs) and females (54 ± 16 yrs)



Steingrimsdottir, JAMA 2005; 294:2336-2341

Relative importance of 25(OH)D status and calcium intake with respect to hip BMD

(n=4958)



P-value for trend across categories of 25(OH)D levels: < 0.0001

Adjustments: calcium intake, age, race/ethnicity, body mass index, height, total calorie intake, estrogen use among women, physical activity, smoking, and socio-economic status.

Bischoff-Ferrari HA, et al.; JBMR 2009; 24:935-942.

Vitamin D, muscle performance, and falls

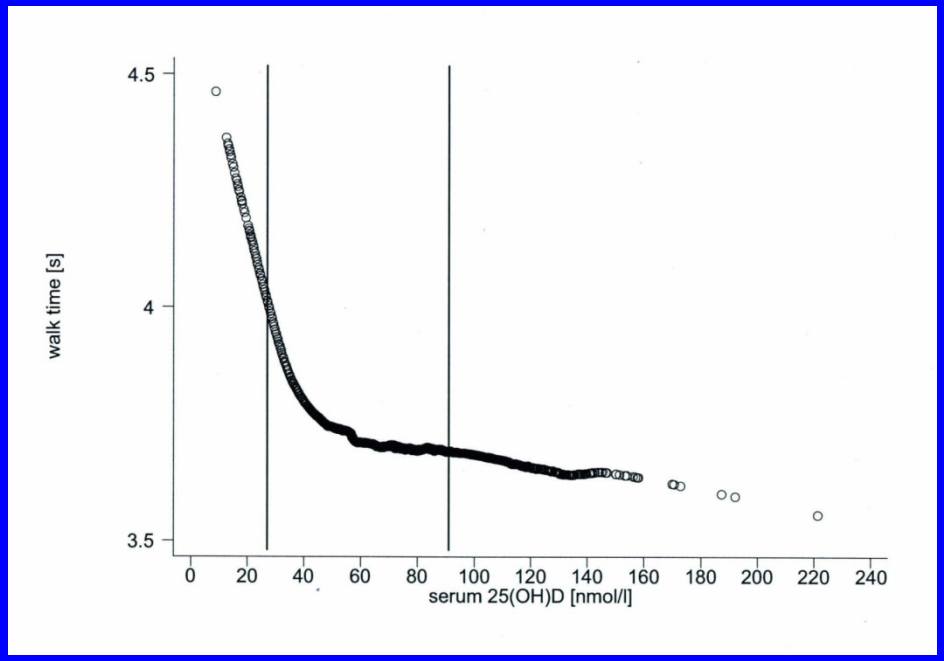
Effect of Treatment with Vitamin D on Muscle Fibers

- Treatment with 1-α-hydroxyvitamin D (1-2 μg daily) for 3 months increased the cross-sectional area and relative number of type IIa muscle fibers in 9 elderly women (Sorensen 1979).

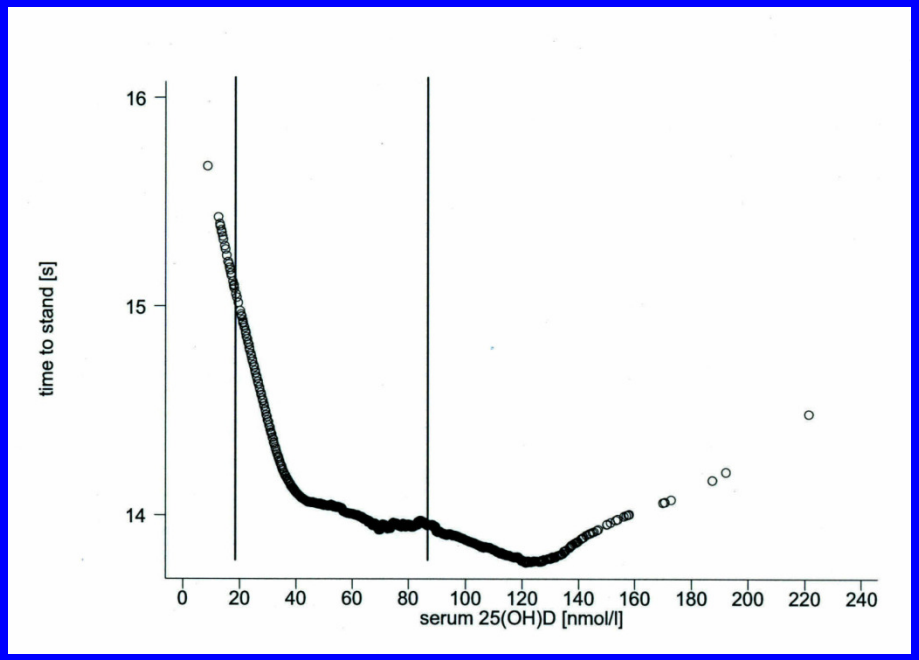
- In RCT of stroke survivors, treatment with ergocalciferol (1000 IU/day) for 2 years increased the diameter and relative number of type II muscle fibers (Sato 2005).

NHANES III – Serum 25(OH)D and Performance

Walk time



Sit-to-stand



Bischoff-Ferrari HA. Am J Clin Nutr 2004;80:752-8.

Meta-analysis of vitamin D and falls
Aims

- To examine the efficacy of supplemental vitamin D in preventing falls
- Only double-blind RCTs among older individuals (mean age 65+) with sufficient fall assessment were included in the primary analysis

Sufficient fall assessment:

1) falls as a primary or secondary endpoint defined at the onset of the trial

2) definition of falls and how they were assessed

3) assessment of falls for the entire trial period

Vitamin D and Fall Prevention

A meta-analysis of RCTs

- **8 double-blind RCTs were included in the primary analysis (n = 2376 individuals)**
- **Heterogeneity was seen among studies (Q-test: p = 0.05) and benefit was demonstrated only in higher dose trials.**

Bischoff-Ferrari, Dawson-Hughes, et al. BMJ 2009; DOI: 10.1136/bmj.63692.

Meta-analysis of vitamin D and falls

- In lower dose trials (up to 400 IU/d), vitamin D did not lower fall risk (RR = 1.10 [0. 89-1.35].

- In higher dose trials (700-1000 IU/d), vitamin D lowered risk of falls by 19% (RR = 0.81 [0.71 - 0.92]

Bischoff-Ferrari, Dawson-Hughes, et al. BMJ 2009; DOI: 10.1136/bmj.63692.

Vitamin D and Fractures
A meta-analysis of RCTs

- **Men and women age 65+**
- **Non-vertebral fractures**
  12 RCTs (n = 42,279)
- **Hip fracture**
  8 RCTs (n = 40,886)
- **There was significant heterogeneity for non-vertebral and hip fractures – related to dose. We therefore examined lower and higher dose trials separately**

Bischoff-Ferrari HA. Arch Int Med 2009;169:551-61.

Lower Dose Vitamin D Trials: RR of Fracture
(340-380 IU/d received dose; n = 9,014 from 3 trials)

- Non-vertebral fracture

  pooled RR = 1.02 (95% CI; 0.92-1.15)

- Hip fracture

  pooled RR = 1.09 (95% CI; 0.90-1.32)

Bischoff-Ferrari HA. Arch Int Med 2009;169:551-61.

Higher Received Dose Vitamin D and Non-vertebral Fracture Risk– subgroup analyses

Primary analysis of higher dose RCTs	- 20%*
Subgroup analysis of higher dose	
D3 only	- 23%*
D2 only	- 10%
Age 65-74	- 33%*
Age 75+	- 17%*
Vitamin D	- 21%*
Vitamin D + calcium	- 21%*

*p<0.05

Bischoff-Ferrari HA. Arch Int Med 2009;169:551-61.

Conclusions

- In subjects with calcium intakes averaging ~700 mg/d, the impact of added calcium on PTH suppression and bone mineral density is apparent largely at lower vitamin D concentrations.
- In trials using doses of 700 to 1000 IU/d of vitamin D versus placebo, both fall and fracture risk is reduced by an average of 20%. Little benefit has been observed at lower doses of vitamin D.
- The musculoskeletal effects of doses >1000 IU/d should be evaluated.
- The mean level of 25(OH)D needed for optimal muscle performance and for reduction in risk of falls and fractures in older adults appears to be no lower than 75 nmol/L (30 ng/ml).