Calcium and Vitamin D: How do they fit in the practice of 2012?

Laura E. Ryan, M.D.
Center for Women’s Health
Division of Endocrinology, Diabetes and Metabolism
Objectives

- Review the indications and goals for calcium and vitamin D supplementation in a postmenopausal or elderly patient
- Discuss recent articles and data challenging our traditional approach to calcium and vitamin D supplements
- Differentiate the use of vitamin D and calcium in the setting of sufficiency from insufficiency
- Improve our ability to discuss these timely issues with our patients
55yo Postmenopausal Woman

- Presents for yearly evaluation – menopause age 51
- Wonders about bone health and need for ‘vitamins’
- Never a fragility fracture or height loss
- + Strong family history of hip fracture in both parents
- Never smoker, no steroid requirement
- ROS is negative, denies bone pain or muscle weakness
- You order bone density
- You counsel her on calcium and vitamin D supplementation:
Which of these is consistent with your practice?

- Calcium carbonate 500mg TID + women’s silver multivitamin daily
- 8oz yogurt twice daily + 1000 units vitamin D
- One Viactive chew daily + 20 minutes of sunlight onto 20% of skin daily
- Nothing: I’ll get some labwork and if it looks good, then no further supplementation is necessary
- Other?
Let’s Review the physiology of Calcium:
Total Body Calcium Balance

Bone (99%)

Blood (8.6-10.4 mg/dl)

Ionized Ca\(^{2+}\) (4.4-5.6 mg/dl)

Bound Ca\(^{2+}\)

Alb

Intracellular

Ca\(^{2+}\)
Physiologic Functions of Extracellular Ca\(^{2+}\)

- Skeletal mineralization for structural integrity
- Enzyme cofactors:
  - Eg. Coagulation cascade proteins (prothrombin, VII, IX, X)
- Plasma membrane permeability to Na
  - Reduced ion Ca $\rightarrow$ enhanced Na permeability $\rightarrow$ increased excitability of muscle and nerve cells
Calcium Balance

Diet 1000 mg

Gut

Small Intestine

Feces 825 mg

300 mg

175 mg

125 mg

ECF Ca++

900 mg

9,825 mg

10,000 mg

Urine 175 mg

Bone

500 mg

500 mg

Bone

500 mg
Factors that impact calcium balance

- Healthy adults on average require about 400mg to maintain calcium balance – this accounts for urinary calcium loss and minor skin losses.

- In children, a much higher daily calcium intake is necessary for bone modeling.

- In adults age >65, intestinal calcium absorption is much less efficient, kidneys are less efficient at reabsorbing calcium, and there may also be a deficiency in activation of vitamin D, renally.

- Typical American diets that are high in sodium contributes to hypercalciuria with an increased daily calcium intake.

- Soda and loop diuretics also contribute to hypercalciuria.
Individual intestinal dietary calcium absorption varies widely, but is directly related to the amount of dietary calcium intake. Intestinal calcium absorption is mainly driven by active absorption, due to 1,25(OH)2vit D, but 10% of intestinal calcium absorption is passive, driven by calcium gradient between intestinal lumen and blood.
UVB 

Cutaneous Formation of Vitamin D

SKIN

Vitamin D3

7-DHC, provitamin D3

SKIN

Vitamin D3

KIDNEY

VitD-25-hydroxylase

LIVER

25(OH)VitD

1-α hydroxylase

1,25(OH)2 Vitamin D

Wexner Medical Center
Actions of $1,25(\text{OH})_2\text{D}$

- Stimulates intestinal calcium absorption
- Stimulates bone resorption at very high levels - via osteoclastogenesis
- No evidence that it enhances bone formation directly
- ↓ PTH gene expression
Normal Activated Vitamin D Physiology

**PTH**

- ++ Intestinal calcium absorption
- + Inhibition of PTH

Hypophosphatemia +

Hyperphosphatemia -

CrCl <30 -

1,25(OH)₂Vit D

VDR

RANKL on osteoblast

RANK on Pre-osteoclasts
First Question:

Is Calcium good for us?
How Much Calcium is Enough?

Relation between calcium intake and calcium balance

Plot of the regression lines relating calcium balance to calcium intake in premenopausal or estrogen-treated postmenopausal women (top line) and untreated postmenopausal women (bottom line). Positive calcium balance was achieved with calcium intakes above 1000 mg/day in the former group and 1500 mg/day in the latter group.

Does calcium supplementation prevent fracture?

- In adults <65yo, calcium has not been definitively proven to prevent fracture
- Small meta-analysis in 2002 showed a small decrease in vertebral fractures with calcium alone
1000mg/day calcium carbonate vs. placebo in postmenopause

p=0.005 at year 2

Reid, et al, 1993 NEJM 328:460
Does Calcium Supplementation Prevent Fracture?

- WHI: 36,282 postmenopausal women age 50 – 79 were given calcium 1000mg daily (divided) + 400 units vitamin D vs. placebo
  - 7 year follow up
  - Hip bone density was 1.06 percent higher in the calcium group than the placebo group
  - No evidence of fracture prevention
  - 12% reduction in hip fracture not statistically significant; also, no stat sig reduction in total fractures, vertebral fractures, wrist fx or nonvertebral fx
  - At baseline, only 7.2% of participants had daily intake of calcium of <400mg by FFQ
  - Looking only at those participants with excellent adherence, there was a reduction in hip fracture by 4/10,000, or 29%
  - Risk of kidney stones was higher in the calcium group

Calcium + D in older adults, age ≥65

- OSTPRE-FPS trial: 3432 women aged 65 – 71 were randomized to 1000mg calcium (500mg calcium carbonate BID) + 800u vitamin D daily x 3 years- followed fractures
  - Free-living participants in Scandinavia, latitude 62 – 64 degrees
  - Telephone-report of fracture every 6 months, then validated by x-ray
  - “morphometric” vertebral fractures not assessed; only clinical
  - Serum vitamin D levels measured yearly- increased by 49% from baseline, indicating good compliance

- Risk of any fracture decreased by 17%
- Nonvertebral fractures decreased by 13%
- Radius fractures decreased by 30%
- None of these findings reached statistical significance
  - Question of enough power (1600 women in treatment group); placebo group likely getting a fair amount of supplementation in foods as baseline vitamin D levels were not exceedingly low, averaging 20 – 22ng/mL

Salovaara K et al, JBMR July 2010; 25(7)1487-95
Meta-analyses of trials comparing Calcium, vitamin D or both

<table>
<thead>
<tr>
<th>Study</th>
<th>Relative risk (95% CI)</th>
<th>Combined vitamin D and calcium supplementation</th>
<th>Vitamin D IU/d</th>
<th>Calcium mg/d</th>
<th>Fracture definition</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institutionalized</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Chapuy et al</td>
<td>0.74 (0.56–0.97)</td>
<td>80/1387</td>
<td>111/1403</td>
<td>800</td>
<td>1200</td>
<td>Hid</td>
</tr>
<tr>
<td>Chapuy et al</td>
<td>0.62 (0.36–1.07)</td>
<td>27/363</td>
<td>21/190</td>
<td>800</td>
<td>1200</td>
<td>Hid</td>
</tr>
<tr>
<td>Flicker et al</td>
<td>0.71 (0.44–1.16)</td>
<td>25/313</td>
<td>35/312</td>
<td>1:100</td>
<td>1000</td>
<td>NS</td>
</tr>
<tr>
<td>Subtotal (I² = 0 percent; $P_\text{Q} = 0.86$)</td>
<td>0.71 (0.37–0.89)</td>
<td>132/2093</td>
<td>166/1903</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Community-dwelling</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Komulainen et al</td>
<td>0.37 (0.23–1.31)</td>
<td>8/116</td>
<td>14/116</td>
<td>300</td>
<td>300</td>
<td>NV</td>
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<tr>
<td>Jackson et al</td>
<td>0.97 (0.92–1.03)</td>
<td>2162/18 176</td>
<td>2158/18 106</td>
<td>400</td>
<td>1000</td>
<td>Total</td>
</tr>
<tr>
<td>Dawson-Hughes et al</td>
<td>0.46 (0.23–0.90)</td>
<td>11/187</td>
<td>26/202</td>
<td>700</td>
<td>500</td>
<td>First</td>
</tr>
<tr>
<td>Pfeifer et al</td>
<td>0.48 (0.12–1.84)</td>
<td>3/70</td>
<td>6/67</td>
<td>800</td>
<td>1200</td>
<td>Total</td>
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<tr>
<td>Porthouse et al®</td>
<td>0.46 (0.61–1.91)</td>
<td>24/70</td>
<td>22/602</td>
<td>800</td>
<td>1000</td>
<td>Total</td>
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<tr>
<td>Porthouse et al®</td>
<td>0.36 (0.64–1.43)</td>
<td>34/71</td>
<td>59/1391</td>
<td>800</td>
<td>1000</td>
<td>Total</td>
</tr>
<tr>
<td>Salovaara et al</td>
<td>0.84 (0.63–1.13)</td>
<td>78/1586</td>
<td>94/1609</td>
<td>800</td>
<td>1000</td>
<td>Total</td>
</tr>
<tr>
<td>Subtotal (I² = 27 percent; $P_\text{Q} = 0.22$)</td>
<td>0.80 (0.76–1.04)</td>
<td>2260/21 456</td>
<td>2389/22 093</td>
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<tr>
<td>Community-dwelling with a history of fracture</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Grant et al</td>
<td>1.02 (0.90–1.17)</td>
<td>387/2649</td>
<td>377/2543</td>
<td>800</td>
<td>1000</td>
<td>Total</td>
</tr>
<tr>
<td>Henwood et al</td>
<td>0.37 (0.15–2.22)</td>
<td>3/35</td>
<td>5/37</td>
<td>800</td>
<td>1000</td>
<td>Hip</td>
</tr>
<tr>
<td>Subtotal (I² = 0 percent; $P_\text{Q} = 0.46$)</td>
<td>1.02 (0.89–1.16)</td>
<td>390/26885</td>
<td>382/2980</td>
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<tr>
<td>Overall (I² = 35 percent; $P_\text{Q} = 0.11$)</td>
<td>0.08 (0.79–0.99)</td>
<td>2762/26 237</td>
<td>2937/26 678</td>
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</tr>
</tbody>
</table>

Some reported a beneficial reduction in fracture with calcium, calcium + vitamin D, but not with vitamin D alone. Doses of calcium ranged from 500 – 1200mg daily
New Recommendations for Calcium and Vitamin D supplementation, 11/30/2010:

<table>
<thead>
<tr>
<th>Life Stage Group</th>
<th>Estimated Average Requirement (mg/day)</th>
<th>Recommended Dietary Allowance (mg/day)</th>
<th>Upper Level Intake (mg/day)</th>
<th>Estimated Average Requirement (IU/day)</th>
<th>Recommended Dietary Allowance (IU/day)</th>
<th>Upper Level Intake (IU/day)</th>
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<tbody>
<tr>
<td>Infants 0 to 6 months</td>
<td>*</td>
<td>*</td>
<td>1,000</td>
<td>**</td>
<td>**</td>
<td>1,000</td>
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<tr>
<td>Infants 6 to 12 months</td>
<td>*</td>
<td>*</td>
<td>1,500</td>
<td>**</td>
<td>**</td>
<td>1,500</td>
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<tr>
<td>1-3 years old</td>
<td>500</td>
<td>700</td>
<td>2,500</td>
<td>400</td>
<td>600</td>
<td>2,500</td>
</tr>
<tr>
<td>4-8 years old</td>
<td>800</td>
<td>1,000</td>
<td>2,500</td>
<td>400</td>
<td>600</td>
<td>3,000</td>
</tr>
<tr>
<td>9-13 years old</td>
<td>1,100</td>
<td>1,300</td>
<td>3,000</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>14-18 years old</td>
<td>1,100</td>
<td>1,300</td>
<td>3,000</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
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<tr>
<td>19-30 years old</td>
<td>800</td>
<td>1,000</td>
<td>2,500</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>31-50 years old</td>
<td>800</td>
<td>1,000</td>
<td>2,500</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>51-70 year old males</td>
<td>800</td>
<td>1,000</td>
<td>2,000</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>51-70 year old females</td>
<td>1,000</td>
<td>1,200</td>
<td>2,000</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>&gt;70 years old</td>
<td>1,000</td>
<td>1,200</td>
<td>2,000</td>
<td>400</td>
<td>800</td>
<td>4,000</td>
</tr>
<tr>
<td>14-18 years old, pregnant/lactating</td>
<td>1,100</td>
<td>1,300</td>
<td>3,000</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>19-50 years old, pregnant/lactating</td>
<td>800</td>
<td>1,000</td>
<td>2,500</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
</tbody>
</table>

*For infants, Adequate Intake is 200 mg/day for 0 to 6 months of age and 260 mg/day for 6 to 12 months of age.

**For infants, Adequate Intake is 400 IU/day for 0 to 6 months of age and 400 IU/day for 6 to 12 months of age.

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Wexner Medical Center
Calcium and Vitamin D DRIs: Viewpoints

- Higher levels of both nutrients have not been shown to confer greater benefit, and in fact they have been linked to other health problems, challenging the concept that ‘more is better’.\(^a\)

- As North Americans take more supplements and eat more of foods that have been fortified with calcium and vitamin D, it becomes more likely that people consume high amounts of these nutrients.\(^a\)

- We conclude that combined vitamin D (300 – 1100 IU) and calcium supplementation (500 – 1200mg/d) can reduce the fracture risk in older adults.\(^b\)

- Future trials of dietary supplements need to consider the myriad differences between nutrients and drugs, especially when the background exposure to a nutrient (such as vitamin D) cannot be reliably ascertained.\(^b\)

- Not everyone agrees with these viewpoints.\(^c\)

\(^a\)www.iom.edu 11/30/10 Report on Dietary Reference Intake for Calcium and Vitamin D

\(^b\)Chung M et al, Ann of Intern Med, U.S. Preventive Services Task Force on Vitamin D and Calcium Supplementation Dec 2011. 155;827-838

\(^c\)Heaney RP, Holick MF. Why the IOM Recommendations for Vitamin D are Deficient. JBMR, March 2011, 26;455-457.
Wait – is calcium actually bad for us?

- Recently, calcium has been highlighted as a possible risk factor for the development or progression of cardiovascular disease.

- Calcium has been shown in prior studies to aid in weight loss, to lower LDL by 20% by binding fatty absorption in the gut, and more than one study demonstrated a reduction in SBP.

- Iowa Women’s Health Study, those taking the highest quartile of calcium was associated with reduced ischemic heart disease mortality in elderly women versus those taking the lowest quartile of calcium (<500).  

- Observational studies show that communities with calcium rich water have lower rates of cardiovascular events.

- On the other hand, calcium certainly causes constipation.

- Calcium supplementation accelerates vascular calcification and increase mortality in patients with renal failure in dialysis and pre-dialysis populations.
Calcium and vascular events

- 1471 postmenopausal women, >55yo, mean age 74
  - 732 randomized to calcium citrate 1000mg/day divided
  - 739 placebo
  - NO vitamin D
  - Food frequency questionnaire followed

- Followed for five years
- Self-reported/hospital records events of MI, stroke, sudden death or combined
- Verified myocardial infarction
  - 21 women (24 events) in calcium group
  - 10 (10) in placebo group
  - P value 0.047
Reid IR, Boland MJ  Effect of calcium supplements on risk of myocardial infarction and cardiovascular events: meta-analysis. *BMJ* 2010 July;341:c3691

- 11 studies involving 11,921 women reviewed
  - Only calcium vs. placebo – no vitamin D studies included
  - Males and females included, age over 40
- In the studies with patient-level data:
  - 143 on calcium developed MI vs. 111 on placebo – P value 0.035
- In the studies with trial-level data
  - 166 on calcium with MI vs. 130 on placebo – P=0.038
- No significant increase in incidence of stroke, sudden death or death
- “A reassessment of the role of calcium supplements in the management of osteoporosis is warranted.”
Calcium supplements with or without vitamin D and risk of cardiovascular events: reanalysis of the Women’s Health Initiative limited access dataset and meta-analysis.
Boland MJ, Reid IR et al. *BMJ* 2011;342:d2040

- Initially reported were the Ca + D results of the trial involving 36,282 women, with no difference in outcome. However, it is noted that there were many taking personal supplements; 46%, 16,718, were not taking personal calcium supplements, and this group was reanalyzed.

- Four other trials were also evaluated in this meta-analysis.

- In women who were taking personal calcium supplements at the start of the trial, combined calcium and vitamin D supplements did not alter their cardiovascular risk.
So, what to do about calcium?

ASBMR panel sites concern about the use of meta-analyses and retrospective review for the development of policy

They site two other recent studies with original study data and >80% compliance that did NOT show cardiovascular risk

One thing is sure: this is a difficult topic to cleanly study, as confounders are so frequent

Conclusions:

Further studies, prospectively designed, are needed.

Consider using guidelines outlined by IOM

Consider increasing % of daily calcium intake as a dietary/dairy source vs. supplements.

Evidence of harm is unconvincing. Prince RL, Zhu K. BMJ 2011;342:d3541

Consider improving Daily Calcium Intake, dietary

- Potential regimen for postmenopausal patients: 2-3 eight ounce servings dairy/day plus vitamin D 1000 units
- Intestinal calcium absorption studies site a improved efficiency of dietary calcium absorption vs. supplements

<table>
<thead>
<tr>
<th>Food</th>
<th>Calcium, milligrams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk (skim, 2 percent, or whole, 8 oz)</td>
<td>300</td>
</tr>
<tr>
<td>Yogurt (6 oz)</td>
<td>250</td>
</tr>
<tr>
<td>Orange juice (with calcium, 8 oz)</td>
<td>300</td>
</tr>
<tr>
<td>Tofu with calcium (1/2 cup)</td>
<td>435</td>
</tr>
<tr>
<td>Cheese (1 oz)</td>
<td>195-335 (hard cheese = higher calcium)</td>
</tr>
<tr>
<td>Cottage cheese (1/2 cup)</td>
<td>130</td>
</tr>
<tr>
<td>Ice cream or frozen yogurt (1/2 cup)</td>
<td>100</td>
</tr>
<tr>
<td>Soy milk (1 cup)</td>
<td>100</td>
</tr>
<tr>
<td>Beans (1/2 cup cooked)</td>
<td>60-80</td>
</tr>
<tr>
<td>Dark, leafy green vegetables (1/2 cup cooked)</td>
<td>50-135</td>
</tr>
<tr>
<td>Almonds (24 whole)</td>
<td>70</td>
</tr>
<tr>
<td>Orange (1 medium)</td>
<td>60</td>
</tr>
</tbody>
</table>
Sources of Calcium

Google: ‘NIH Check Up on Your Bones’

Supplement Facts
Serving Size 1 tablet • Servings Per Container 120

<table>
<thead>
<tr>
<th>Amount Per Serving</th>
<th>%DV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin D3 (as cholecalciferol)</td>
<td>100 IU 25%</td>
</tr>
<tr>
<td>Vitamin K1 (as phytonadione)</td>
<td>15 mcg 19%</td>
</tr>
<tr>
<td>Calcium (as microcrystalline calcium hydroxyapatite)</td>
<td>250 mg 25%</td>
</tr>
<tr>
<td>Phosphorus (as microcrystalline hydroxyapatite)</td>
<td>120 mg 12%</td>
</tr>
<tr>
<td>Boron (as boron amino acid chelate)</td>
<td>0.5 mg *</td>
</tr>
</tbody>
</table>

*Daily Value not established.
What about vitamin D?
62yo female with gluten sensitivity and stress fracture of metatarsal

- GI symptoms have completely resolved on gluten-free diet, but she also finds that she might be lactose intolerant and avoids dairy
- Stress fracture of the foot occurred after she had been walking around the Ohio State Fair for 8 hours
  - No other history of fractures
- She doesn’t smoke, no height loss, no family history of fractures
- Takes “burst” of steroids 1-2 x per year for asthma exacerbations, especially in the spring
- Takes one prenatal vitamin daily
35th Latitude – significant vitamin D deficiency is likely to occur 8-9 months of the year in more northern regions
By the way – our patient does live in central Ohio – sigh . . .
Evaluation of our patient:

- Calcium (total) 9.2 (8.6 – 10.0 mg/dL)
- Albumin 3.8 (3.4 – 4.8 g/dL)
- Magnesium, phos 1.8, 3.2
- BUN/creat Creat 0.92 (0.6 – 1.1 mg/dL)
- 25(OH)vitamin D 23 (30 – 100 ng/mL)
- PTH 81 (14.0 – 72.0 pg/mL)
- TSH 1.67 (0.55 – 4.78 μIU/mL)
- DXA LS T-score -1.6
  - TH T-score -1.5
  - FN T-score -2.4
Hypovitaminosis D Osteopathy

• First introduced by Parfitt in 1990
• Highlighting the pathophysiologic change in bone before the development of the definition of osteomalacia
• Three stages, based upon histomorphometric analysis of adult bone samples
• Links the connection of Vit D to osteoporosis
Hypovitaminosis D Osteopathy, cont

• Stage 1:
  – Reduced intestinal absorption of calcium
  – Decreased skeletal calcium reserves
  – Osteoporosis
  – No biopsy evidence of osteomalacia
Hypovitaminosis D, cont

• Stage 2:
  – Decreased intestinal Ca absorption and bone mass (Stage 1)
  – No clinical or lab evidence of osteomalacia
  – Biopsy consistent with early osteomalacia:
    • Increased surface coverage by osteoid
    • Decreased mineral apposition rates
Hypovitaminosis D, cont

• Stage 3:
  – Osteomalacia is finally evident:
    • Clinically
    • Biochemically
    • histologically
Vitamin D Deficiency Prevalence

- Hospitalized patients: Thomas et al found 25(OH)vitD <25 in 57% of 290 pts on a medical service
- Holick et al studied 1536 community dwelling women, mean age 71: 52% with 25(OH)vitD <30
- 79% of 80+yo women living in retirement homes in Netherlands
Fracture Prevention

- Trevedi, 2003: 2686 participants, 65-85yo, community dwelling
- Given 100,000 IU orally q4mo (average 800IU/day) for 5 years
- Placebo group 25(OH)D: 21.2 ng/mL
- Treated group: 29.6 ng/mL
- 22% reduction in all fractures; 33% reduction in fragility fractures
Vitamin D Fracture Prevention Meta-analysis

• Pooled all double-blind RCT’s that studied vitamin D supplementation
• Must include hip and nonvertebral fracture data with followup of at least one year
• Mean age ≥60
• Must include 25(OH)vitD measurement
• Most studies included calcium in control and treatment groups

Bischoff-Ferrari et al, May 11, 2005, JAMA 293(18)2257-2264
Vitamin D Results
Meta-analysis of 7 RCT’s

Bischoff-Ferrari et al, May 11, 2005, JAMA 293(18)2257-2264
Significant Fracture Reduction

Bischoff-Ferrari et al, May 11, 2005, JAMA 293(18)2257-2264
Fracture Reduction with Vitamin D

• Significant reduction only observed in the studies where treatment dose was 700-800IU/day

• Greater fracture reduction was achieved with higher serum 25(OH)vitD levels
  – 26% reduction in hip fractures
  – 23% reduction in non-vertebral fractures

• 35% reduction in falls with improvement in muscle strength
How much Vitamin D is enough?

• Physiologic response to vitamin D: PTH
  – Expected inverse relationship between serum 25(OH)vitamin D and PTH
  – PTH reaches suppressed plateau at vitamin D concentrations of 28-44 ng/mL
  – Elevated PTH associated with high bone remodeling rate and osteoporotic bone fragility
Intestinal Calcium Absorption

Compiled from Bischoff et al, Heaney et al, Barger-Lux et al
Vitamin D Deficiency

- IOM currently recommends that 25(OH)vit D 20ng/mL sufficient

- However, intestinal calcium absorption is maximized with a vitamin D level of 30-32, and a plateau of PTH has been repeatedly shown to occur with a vitamin D around 30-32

- No clear benefit of vitamin D >50 and few small reports that those levels may increase pancreatic cancer

- Vitamin D \( \leq 10 \text{ ng/mL} \) deficient

- Vitamin D 11 – 29 – insufficient
Foods with Vitamin D

How many of your patients eat 3 ounces salmon a day? Unlike calcium, dietary vitamin D is often an inadequate source for our daily needs.
Vitamin D supplementation

- My own practice:
  - PM Women with low bone mass and vitamin D >30: 1000-1200IU/day
  - 25(OH)D level 25-30
    - 2000 IU/day, recheck 3-4mo
  - 18 – 25
    - 50,000 IU weekly x 6weeks
    - 2000IU daily; recheck 3-4mo
  - 12-18
    - 50,000IU 2x/week x 6weeks
    - Likely will need high dose weekly indefinitely
    - Daily 1200 – 2000 units OTC
  - <12
    - See above, but also look for the cause of the malabsorption

Goal: normalize vitamin D, but possibly more importantly, normalize parathyroid hormone.
73 yo female presents with thigh pain and recent pelvic ramus Fx

- Hx Roux-en-Y gastric bypass surgery 18 years ago, with successful weight loss; she now weighs 160 lbs.
- Does take 500mg calcium citrate BID and one MVI daily
- Has had multiple falls over the last couple of years – recently fell down 4 back steps resulting in pelvic pain – to ER
- Admits to a sense of muscle weakness, causing her falls
- All of the bones of her legs hurt: “if my cat walks over my legs I scream in pain”
- Has lost 4” in height; broke wrist after falling onto the grass 2 summers ago
Evaluation

- Calcium 8.2
- PTH 185
- Phos 1.9
- Alk phos 224
  - Normal 38 - 126
- Creat – 0.60
- TSH – 2.1
- Vitamin D – 6
- 1,25(OH)\textsubscript{2}vitamin D: 110
  - Normal 23 – 67

Diagnosis? Osteomalacia
Treatment of Osteomalacia:  
\textit{Calcium and Vitamin D}_3 \textit{Prevent Hip Fractures}

- 3270 women, 69 to 106 years
- Nursing homes / Apartments
- Ambulatory
- Follow-up 18 month
- Vitamin D deficient

<table>
<thead>
<tr>
<th>Number of Fractures by Prescription Group</th>
<th>Placebo</th>
<th>CaD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hip</td>
<td>110</td>
<td>80</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Non-vertebral</td>
<td>215</td>
<td>160</td>
<td>&lt; 0.004</td>
</tr>
</tbody>
</table>

Chapuy et al.  \textit{NEJM} 1992;327:1637-42.
Summary

- Reviewed the most up to date recommendations on calcium and vitamin D supplementation
- Differentiated between supplementation in a healthy postmenopausal person versus that in someone who is insufficient or deficient
- Highlighted some controversy in the literature regarding these nutrients
- Improved our ability to discuss these issues with our patients, as they stand in 2012