Let the Sunshine In
The evidence, or lack thereof, regarding Vitamin D.
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History of Vitamin D
1923 Harry Steenbock at Wisconsin showed that irradiation increased the vitamin D content of food and that you could cure rickets in rats by irradiating their food. He patented his process, which was then used to fortify milk.

What is Vitamin D?
• Fat-soluble vitamin (ADEX)
• Production evolved over 750 million years ago in phytoplankton
• Produced in the skin in most vertebrates
  – Except the naked mole rat!
  – Furry and feathered secrete oils that make it, that they then ingest while grooming

How do we normally get vitamin D?

Food Sources
• Cod liver oil
• Fatty fish
• Fortified milk and cereals
• Irradiated mushrooms
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**Food Sources**

<table>
<thead>
<tr>
<th>Food</th>
<th>Amount</th>
<th>Vitamin D Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cod liver oil</td>
<td>1.5 oz (1 tbsp)</td>
<td>1360 IU</td>
</tr>
<tr>
<td>Mushrooms, irradiated</td>
<td>3.5 oz</td>
<td>500 IU</td>
</tr>
<tr>
<td>Salmon</td>
<td>3.5 oz</td>
<td>360 IU</td>
</tr>
<tr>
<td>Sardines canned</td>
<td>3.5 oz</td>
<td>250 IU</td>
</tr>
<tr>
<td>Tuna canned in oil</td>
<td>3.5 oz</td>
<td>235 IU</td>
</tr>
<tr>
<td>Lowfat (1%) milk</td>
<td>1 cup</td>
<td>127 IU</td>
</tr>
<tr>
<td>Soy milk</td>
<td>1 cup</td>
<td>100 IU</td>
</tr>
<tr>
<td>Whole milk</td>
<td>1 cup</td>
<td>97 IU</td>
</tr>
<tr>
<td>Fruit loops</td>
<td>3/4 cup</td>
<td>36 IU</td>
</tr>
<tr>
<td>Eggs</td>
<td>1 egg</td>
<td>20 IU</td>
</tr>
<tr>
<td>Mushrooms, regular</td>
<td>3.5 oz</td>
<td>18 IU</td>
</tr>
</tbody>
</table>

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**Supplements**

- **Over-the-counter**
  - D2 vs D3
    - D2 is made by UV irradiation of ergosterol from yeast
    - D3 is made by UV irradiation of 7-dehydrocholesterol from lanolin and appears to be more bio-available
- **Strengths vary from 400 to 5000 IU**

- **Prescription**
  - Ergocalciferol (D2) 50,000 units once to twice weekly
  - Best absorbed if taken with food that contains fat

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**How do we normally get vitamin D?**

Production in skin in response to UV light

- UV wavelengths between 270-300 nm: Peak synthesis at 285-297 nm
- Converts cutaneous 7-dehydrocholesterol to previtamin D3, which becomes D3.

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**Sun Exposure and Sunbathing**

- Need approx 5-30 minutes midday sun twice weekly (we think)
- Need to be in appropriate season and latitude
- One minimal erythematous dose gives you 20,000 IU in a bikini
- Or can go tanning, if booth/bed has at least 2-6% UVB

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**Wait, did she just say go tanning?!**

- Cutaneous production
  - Not adversely impacted by intestinal factors (on, only)
  - Reaches a steady-state, can’t over-dose
- Possible mood benefits
- Risk of skin cancer, accelerated skin aging
  - Avoid burns
  - Protect face and hands/arms
  - Risk/benefit ratio

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**Factors Impacting Cutaneous Production**

- **Latitude**
  - No appreciable synthesis above 42° latitude from Nov-Feb
  - NY/PA border, Boston, Chicago, CA/OR border
  - Year-round synthesis if latitude below 34°
    - Los Angeles, Columbia SC — Phoenix is 30
- **Sun intensity**
  - Cloudy day ↓ by 50%
  - Shade ↓ by 50%
- **Melanin content of skin**
- **Sunscreen**
  - SPF 8 or higher blocks all UVB
  - But most of us don’t put enough on or reapply as we should
- **Glass** — cannot absorb UVB through windows
- **Time of day** — maximal rays between 10 am and 3 pm
Risk factors for deficiency

- Breast-fed infants
- Poor intestinal absorption (celiac, IBD)
- Patients taking steroids, phenytoin, phenobarbital
- Chronic kidney disease patients
- EVERYONE who...
  - lives above 34° latitude
  - wears protective clothing or sun screen
  - doesn't spend much time outside
  - doesn't take cod liver oil

How much is too much?

- Can only overdose from supplements
  - Would need to take 10,000 IU daily to get to toxic levels
  - No toxicity at 10,000 IU daily for up to 5 months
- Hypercalcemia, nausea, vomiting, poor appetite, constipation, weakness, weight loss, mental status changes, erythrima, metastatic calcifications
- 17% increase in kidney stones when 400 IU taken with 1000 mg calcium in WHI
- Theoretical increased risk of arterial calcifications with D has been disproven
- Patients with granulomatous disorders need to keep levels less than 30 ng/ml (20–30 is recommended) due to risk of hypercalciuria and hyperparathyroidism (macrophages produce 1,25-Vit D)
- U-shaped curve of all-cause mortality and cardiovascular disease

Populations at risk for deficiency

- Breast-fed infants
- Poor intestinal absorption (celiac, IBD)
- Patients taking steroids, phenytoin, phenobarbital
- Chronic kidney disease patients
- EVERYONE who...
  - lives above 34° latitude
  - wears protective clothing or sun screen
  - doesn't spend much time outside
  - doesn't take cod liver oil

How much is enough?

- Good question
  - Evidence is not conclusive (more to come)
  - May not be the same for all groups of people
- Recommended dosages:
  - Prior to 2010 report:
    - 400–600 IU daily over 50 (IOM FNB)
  - Per new IOM RDI report:
    - 400 IU for kids
    - 600 IU for adults
    - 800 IU for adults over 70

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What do we need it for?

- Promotion of calcium absorption in gut
  - Without D, absorb 10–15%, with it absorb 30–40%
- Maintenance of adequate serum calcium and phosphate levels

Sequellae of Deficiency

- Children: rickets
  - Growth retardation, bony deformities
  - Incidence very high during industrial revolution
  - 1893's milk supplementation started and it virtually disappeared until recently
- Adults: osteomalacia
  - Bone pain
  - Usually aching, throbbing
  - Can be localized or generalized
  - Proximal muscle weakness
  - D on skeletal muscle
  - Need level above 40 for maximal strength
ARE WE GETTING ENOUGH?

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**Diagnosis of deficiency**
- Measure 25-OH Vitamin D (not 1-25-OH)
  - ½ life of 25-OH is 15 days (vs 15 hrs for 1-25)
  - 1-25 is tightly regulated by the kidney and will not be decreased unless severely deficient
- Reference ranges
  - Most experts say <20 is deficient
  - Others advocate above 30 ng/ml as normal
  - Levels >200 ng/ml are potentially toxic (can cause hypercalcemia)

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**Prevalence of Deficiency**
  - 42.3% in African-American women
  - 4% in caucasian women
- NHANES (2000-2004) – prevalence increasing
  - age-adjusted mean 2.8 ng/ml lower than ’88-’94
  - 8-36% had levels below 20
  - 50-78% had levels below 30
  - Felt to be due to increased BMI, reduced milk intake, and greater use of sunscreen

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Increasing prevalence of vitamin D deficiency

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**Prevalence of Insufficiency (level <20)**
- 52% of Hispanic and black adolescents in Boston (Gordon et al. Prevalence of vitamin D deficiency among healthy adolescents. Arch Pediatr Adolesc Med 2004; 158:531-7)
- 32% of med students, physicians, and residents aged 18-29 in Boston daily intake correlated with higher values, but milk drinking did not (Duggirala et al. Vitamin D insufficiency among free-living healthy young adults. J Am Coll Nutr 2002;21:459-62)

Slide 24
<table>
<thead>
<tr>
<th>Patient</th>
<th>Sex</th>
<th>Race/Ethnicity</th>
<th>Dementia</th>
<th>Depression</th>
<th>MS</th>
<th>Arthritis</th>
<th>Bone pain</th>
<th>Wrist pain</th>
<th>Wrist pain</th>
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</tr>
</tbody>
</table>


- Sequellae of Deficiency
  - Outpatients aged 10-65, in Minneapolis, with persistent nonspecific MS pain
    - 93% were vitamin D deficient (<20)
    - Deficiency was most severe in those under age 30
    - Given wide variety of diagnoses (fibromyalgia, chronic fatigue, depression, etc.)
  - 5 patients had undetectable levels...


- What do we need it for?
  - Promotion of calcium absorption in gut
    - Without D, absorb 10-15%, with it absorb 30-40%
  - Maintenance of adequate serum calcium and phosphate levels
  - Bone growth and remodeling
  - Neuromuscular function
  - Immune function/Anti-inflammatory action
  - Regulation of cell proliferation and apoptosis

- Conditions Associated with Vitamin D Deficiency
  - Schizophrenia
  - Depression
  - Colon cancer
  - Osteopenia, osteoporosis, & fracture
  - Hypertension and congestive heart failure
  - Muscle weakness
  - Insulin resistance / metabolic syndrome
  - Obesity

- What's your true calling

NIH 2010 DRI Calcium and Vitamin D
- Evaluated the evidence regarding new health claims for Vitamin D
- Also evaluated calcium data, as the two are inextricably combined
- Expert panel, reviewed thousands of studies, made recommendations using a risk assessment framework
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What is the Evidence?

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Remember, epidemiologic studies can only show correlation, not causation!

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Limitations of Epidemiologic Studies of Vitamin D – Dietary Intake

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Limitations of Epidemiologic Studies of Vitamin D – Serum Levels

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RCTs are designed to look for causation. (attempt to control for confounding factors)

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Fuzzy Math
ALL-CAUSE MORTALITY

Epidemiologic data – serum levels

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- NHANES III
- 13,331 adults followed for median 8.7 years
- Vitamin D < 17.8 was associated with a 26% increase in mortality (RR 1.26, CI 1.08-1.46)
- This was after adjustment for obesity, physical activity, renal function, and low SES (before adjustment the RR was 1.78)
Vitamin D and Overall Mortality

- Epidemiologic data shows correlation, but is prone to confounding factors
- But also shows a U-shaped curve: too much is also associated with increased mortality
- RCTs don’t show a very large effect
  - Insufficient dosing?
  - Confounding by ‘toxicity’?

CANCER PREVENTION

Epidemiologic data
• 1179 postmenopausal women
• Nebraska (lat 41.4° N)
• 1400 mg Ca + 1100 IU Vit D vs Ca alone vs placebo
• 4 years
• primary outcome was fracture
• secondary was cancer incidence
• Total of 50 cancers, 13 in year one, 37 thereafter.

Serum levels of D rose to >32 μg/dL after 4 years.

Primary outcome was fracture, secondary was cancer incidence.
Total of 50 cancers, 13 in year one, 37 thereafter.

RR: 0.232 (0.09-0.6, p<0.005)
This is a 75% reduction in the incidence of cancer!

Insufficient power to show difference by individual cancer type, but trends showed reduction for breast, colon, lung, hematologic cancers.

RR of all cancers in Ca+D group was 0.4 (0.2-0.8, p=0.013)
Ca alone group was NS

Breast Cancer and Vitamin D

• In vitro, calcitriol acts on breast cancer cells to cause:
  — Cell cycle inhibition
  — Reduced proliferation
  — Enhanced sensitivity to apoptosis
  — Induction of differentiation markers
• However, achieving these levels in vivo is frequently associated with hypercalcemic toxicity
• Current research ongoing for mutations of the VDR gene in breast cancer

Overall cancer

• One study showed no statistically significant benefit
• One study showed benefit with higher dose of D (1100 IU), and combined with Calcium, in women
Epidemiologic studies of intake/exposure

- Rossi 2009, Case-Control study in Italy of dietary D
  - 2569 cases and 2588 controls
  - Small benefit (RR 0.79) seen in highest decile of intake (approx 143 IU) vs. lowest
  - Benefit significant only in postmenopausal women and those in Southern Italy

- John 1999, NHANES cohort study of sun exposure
  - 190 cases in cohort of 5000 white women
  - Small benefit in women who worked outdoors the most, but didn’t retain statistical significance after multivariate risk adjustment
  - No benefit based on physician-assessed or self-reported sun exposure

- Shin 2002, Cohort from Nurses Health Study
  - 86,691 women, 3482 incident breast cancers
  - Use of Vit D supplements had no relationship to breast cancer
  - Among pre-menopausal women only, high consumption of low-fat dairy products was associated with a slightly lower incidence of breast cancer

- Current total breast cancer in US: 214,000 cases per year
  - This chart assumes that baseline population has a serum level below 30 ng/ml, which is not true
Serum D and Breast CA
- Freedman 2007 – total mortality from Breast CA lower in those in highest stratification, but that was only 8 women, and trend not significant
- Bertone-Johnston 2005, nested case-control in Nurses Health Study – relationship only in women over 60
- Freedman 2008 nested case-control in PLCO Cancer Screening Trial – no relationship

Breast Cancer and Vitamin D
- Conflicting epidemiological data
  - Intake/exposure studies show, at best, small effect
  - Serum studies, with few exceptions, mostly show no effect
- Large RCT did not show a protective effect of 400 IU Vitamin D + Calcium against breast cancer
- More RCTs, with higher doses, and of vitamin D alone, would be useful.

Any randomized controlled trials?

Calcium Plus Vitamin D Supplementation and the Risk of Breast Cancer

Epidemiologic data – dietary intake
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Colorectal cancer and D, Epi studies

- McCullough, Cancer Cases and Control 2003
  - Cohort study: 127,000 people, 600 incident cases
  - Only association seen was in men who consumed > 525 IU of D daily (diet + supp), who had 30% lower incidence, but barely statistically significant

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Colorectal cancer and D, Epi studies

- Slattery 2004, Int J Cancer
  - 2300 Cases and 2700 controls
  - Correlations seen in women only:
    - highest calcium intake (1275 mg) had 60% lower incidence
    - highest D intake (400 IU) had 40% lower incidence
    - 3+ servings of low fat dairy per day had 40% lower incidence

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Epidemiologic data – serum levels

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Prospective Study of Predictors of Vitamin D Status and Cancer Incidence and Mortality in Men

- Table 1: Relative risk (RR) and 95% confidence interval (95% CI) for colorectal cancer among men in the Preston cohort. chimney/010401710004

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What about Randomized Controlled Trials?

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Colon Cancer and Vitamin D: RCTs

  - WHI: 36,000 women randomized to placebo vs Calcium 500 + D 400 for 7 years
  - 322 confirmed colorectal cancers
  - HR 1.08 [0.86-1.34]
  - No effect of supplementation on development of colorectal cancer in women
Colon Cancer and Vitamin D: RCTs

- Grou et al. 2003 JNCI
- Adenoma recurrence in 803 subjects
- Only found effect when considered Ca + D
  - If vit D at/above mean, calcium supplementation mildly protective
  - If taking calcium supplements, higher serum D also slightly protective

Prostate Cancer and Vitamin D

- In vitro studies suggest protective effect
- Mortality rates from prostate cancer appear to be inversely related to sun exposure
- Epidemiologic studies show no correlation with exception of 1 C-rated study of serum levels
- No RCTs have been performed

Colon Cancer and Vitamin D

- Epidemiologic studies, especially those comparing serum levels, seem to show some protective association. May be confounding due to BMI and physical activity.
- RCTs do not support this hypothesis.
- Further studies are needed, especially with higher doses of vitamin D.

Potential link between D and CVD?

- 2005, Zittermal et al.
- Higher cardiovascular mortality
  - During the winter
  - In regions with less average exposure to sunlight
Epidemiologic data – serum levels

Randomized Controlled Trials?

Vitamin D Deficiency and Risk of Cardiovascular Disease

Table 1: Results of Metaanalysis (n=17,302)

<table>
<thead>
<tr>
<th>Serum Vitamin D</th>
<th>Total Vitamin D</th>
<th>Pooled Vitamin D</th>
<th>Serum 25(OH)D</th>
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</thead>
<tbody>
<tr>
<td>Serum 25(OH)D</td>
<td>25(OH)D</td>
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</table>

Effect of four monthly oral vitamin D3 (cholecalciferol) supplementation on fractures and mortality in men and women living in the community: randomised double-blind controlled trial

Table 5: Identifying subgroups, cardiovascular disease, and serum by death and fracture risk. The 25(OH)D and serum levels were calculated in the participants in the intervention group at the end of the study. Women and men aged 60-80 years, taking or not taking cholesterol-lowering drugs. As of the end of the study, the 25(OH)D levels increased by 10.7 ng/mL and 18.4 ng/mL, respectively. The serum levels of cholesterol and lipid-lowering effect drugs.
Other RCTs on CVD and D

- Major et al. 2007, 400 IU
- Margolis et al. 2008, 400 IU
- Prince et al. 2008, 1000 IU
- Manson et al. 2010, 400 IU
- NONE found a statistically significant treatment-related effect of vitamin D on cardiovascular disease

Diabetes and CVD

- Epidemiologic data look promising
  - But may be confounded by physical activity levels
- Clinical trials show no effect
  - May be insufficient dose of the D
- Concern about potential U-shaped curve, that too much might be harmful

200 overweight subjects with mean Vit-D 12 ng/ml in a weight loss program
- Randomized to Vit-D 3332 IU or placebo x 12 mo
- Findings:
  - No impact on weight loss
  - Vit-D levels increased to mean of 34 ng/ml (vs 17, p<0.0001)
  - Greater decrease in TGs (-27% vs -19%, p=0.014)
  - Greater decrease in TRF (+1.1% vs -1%, p=0.049)
  - Increased LD (Δ1.5% vs -2.5%, p=0.001)
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**Calcium Plus Vitamin D Supplementation and the Risk of Incident Diabetes in the Women’s Health Initiative** (Diabetes Care 33:785-797, 2000)

- 33,951 women, mean age 62, w/o DM at baseline
- 400 IU of D + 1000 mg Ca daily vs placebo x 7 yrs
- Hazard ratio for DM was 1.01 (CI 0.94-1.10)
- NO effect on incident diabetes

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**Asthma and Vitamin D**

- Asthma is more common at higher latitudes, New England has the highest prevalence
- Epidemiologic studies of maternal D on kids:
  - 3 studies show that higher maternal intake of during pregnancy is associated with slight lower risk of wheezing in childhood
  - 1 study of cord blood Vit D showed decreased risk of wheezing with higher levels
  - 1 study of maternal serum levels showed no protection against asthma and in fact showed an increased risk of both eczema and asthma with Vit D levels above 37.5 ng/ml

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- 7 other RCTs have been performed re DM/IR
- Doses ranged 400-8000 IU/day
- NONE show an effect of vitamin D on glycemic control
  - Exception – Pittas et al 2007, subgroup of those with IFG had a small net decrease in FPG of 3 mg/dl, p=0.042

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**IDDM and Vitamin D**

- Type 1 DM is caused by autoimmune destruction of beta cells in the pancreas
- Genetic and environmental factors
  - Identical twins have only 50% chance of both having the disease
  - Incidence varies with region/latitude, and time of birth
  - Incidence also appears to be increasing

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**Immune Function**

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**Vitamin D and IDDM in children**

- Children who received Vit D supplements had, overall, a 29% reduction in risk of IDDM (OR 0.71, CI 0.60-0.84)
- Greater risk reduction (RR 0.22, CI 0.05-0.89) with regular use of higher dose (2000 IU)
- No studies attempted to identify total D exposure (including diet or sun exposure) nor actual status (serum levels)
- These are all case-control and cohort studies, no randomized controlled trials

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**Inflammatory Bowel Disease**

- Mice who are vitamin D deficient or have a polymorphism in the Vdr gene have a higher risk of developing IBD
- Patients who have IBD are often vitamin D deficient (cause vs effect?)
- No case-control studies, no prospective studies, no RCTs have been done

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**Multiple Sclerosis and Vitamin D**

- Administration of calcitriol to rodents exposed to Experimental Allergic Encephalitis (the animal model for MS) can prevent and treat clinical symptoms and pathologic findings
- Low D levels in adolescence are associated with an increased risk of MS, whereas higher outdoor activity is associated with risk reduction
- MS prevalence increases with distance from the equator, also with decreased solar radiation scores
- MS flares often occur at the ends of seasons when people are mostly indoors

No phase-controlled studies have been done, but some very small pilot studies (of high-to ultra-high doses, 4000-40,000 IU per day, leading to serum levels of 35-1000 IU) show potential benefits

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**Rheumatoid Arthritis**

- In mouse model, calcitriol reduces symptoms and halts progression of arthritis
- Iowa Women’s Health Study, 29,000 post-menopausal women, supplements of ~400 IU were associated with a 34% lower risk, but barely attained statistical significance (RR 0.66, CI 0.43–1.0, p=0.03) Merlino et al.
- No randomized controlled trials for prevention or treatment

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**MOOD AND WELL-BEING**

- Suicide rates are highest in early spring
- Suicide rates are also higher with increasing latitude
- Seasonal Affective Disorder – is it vitamin D deficiency?
Mood and Well-Being - SAD

  - 15 patients with SAD randomized to either phototherapy or 50,000 IU vitamin D
  - Administered HAM-D, SIGH-SAD, and SAD-8 at baseline and 3 months
  - Both groups had improved vitamin D levels, but more so in the Vit D group
  - All subjects in Vit D group improved in all outcome measures
  - Phototherapy group had no significant improvement on depression measures

Mood and Well-Being

  - 441 subjects w/BMIs 28-47
  - All subjects had borderline mean baseline Vit D status
  - Randomized to placebo, 20,000 IU Vit D per week, or 40,000 IU Vit D per week for 1 year
  - Administered Beck Depression Inventory

Randomized comparison of the effects of the vitamin D, adequate relative versus 600 IU vs 4000 IU per day on biochemical responses and the well-being of subjects

- 82 subjects with baseline Vit D < 24 ng/DL in summer
- Supplemented with either 600 or 4000 IU daily
- Serum levels increased to 32 and 45 ng/dL respectively
- Well-being score, out of 16
  - Both groups improved, but the higher dose group had greater improvement

Mood and Well-Being

- Arvold et al, Correlation of symptoms with vitamin D deficiency and symptom response to cholecalciferol treatment: a randomized controlled trial. Endocr Pract. 2009 Apr;15(3):203-12
  - 100 patients with mild-moderate deficiency (10-25 ng/ml)
  - Randomized to 50,000 IU weekly or placebo x 8 weeks
  - Patients in RCT treatment group showed significant improvement in fibromyalgia assessment scores (p<0.03)
  - 38 severely deficient (5) patients were treated but did not show improvement at 8 weeks
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5200 female Navy recruits
Randomized to 800 IU D plus 2000 mg Calcium
20% reduction in stress fractures (5.3% vs 6.6%, \( p = 0.0029 \))

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Vit D levels and Bone Mineral Density

- Observational studies: some association between higher D levels and increased bone density or content.
- RCTs of Vitamin D alone, however, at doses of 200-1000 IU per day, conducted for an average of one year, have not shown an increase in bone density compared with those treated with placebo. In many, the baseline levels of D and of calcium intake were quite low.
- RCTs of calcium plus D do show some small increase in BMD.

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Whew!

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What’s the Conclusion?
How much Vitamin D do average, healthy people need?
Institute of Medicine DRI Calculations

- Insufficient data to consider anything other than skeletal health for developing the DRI
- Skeletal Health Studies
  - Most studies show that levels of 15-20 ng/ml are associated with optimal calcium absorption
  - Children are at risk for rickets if Vit D <12 ng/dL
  - Adults are at risk for osteomalacia if Vit D <20-30 ng/ml
- The RDA, estimated to provide sufficiency for 97.5% of the population, therefore targets 20 ng/mL, which requires a daily intake of 600 IU

New DRI from IOM FNB

<table>
<thead>
<tr>
<th>2010 Recommended Daily Allowance</th>
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<tbody>
<tr>
<td>Children</td>
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<tr>
<td>Adults</td>
</tr>
<tr>
<td>Adults over 70</td>
</tr>
</tbody>
</table>

- These are for healthy individuals and assumes no sun exposure
- Very hard to get this much D from diet, need supplements
- Calculated to meet the skeletal health needs of 97.5% of the population
- Beware the EAR (Estimated Average Requirement), which is 400 IU and is calculated to be the mean requirement, i.e. it will meet the needs of about 50% of the population (and not meet the needs of the other 50%)
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Take Home Messages

• Vitamin D deficiency is common (as high as 50%) and so, probably, is osteomalacia.
• Consider testing levels in patients with
  – Fatigue or weakness
  – Insomnia
  – Depressed mood
  – Low back or nonspecific musculoskeletal pain
  – Weird paresthesias (this is my anecdote based on 3 patients)

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Take Home Messages

• There is some evidence to suggest protective effect of Vitamin D against total mortality and cancer, and efficacy in treatment of depressive symptoms.
• Vitamin D 800 IU and Calcium 2000 mg in female athletes helps to prevent stress fractures.
• There is some epidemiologic evidence to suggest a protective role of maternal D in childhood asthma and of vitamin D supplementation in IDDM

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My Strategy

• If patient found to be deficient (<20 ng/dL)
  – Treat
    • 5-10,000 IU ergocalciferol once to twice weekly for 8-12 weeks or
    • 15-30 minutes of midday sunshine per day as much body as possible or
    • Tanning once to twice weekly (no burn)
  – Then recheck level after 8-12 weeks
• If insufficient (20-30 ng/dL), or just at 30 at end of summer
  – 2000 IU daily, or treat as above if potentially symptomatic
• If level is normal but need maintenance, consider 600-1000 IU daily
• Consider taking a supplement yourself, or getting more sun (natural or artificial)

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Thank you!

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Prevalence at Cornell, among students in whom the test was ordered

• Sept 1, 2009 – Aug 31, 2010
• 356 tests ordered (diagnostic, not screening)
• 234 were abnormal (less than 32)
• That’s 66%

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