

Vitamin D Sources: Prescriptives, Supplements & Foods

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Vitamin D2 vs. D3 – Food & Supplements

D3 = Cholecalciferol

- Predominant form from fish, sun exposure
- Made by irradiating 7-dehydrocholesterol

Vitamin D2 vs. D3 – Food & Supplements

D2 = Ergocalciferol

- Historically predominant form in prescriptions, supplements & milk fortification
- Made by irradiating ergot mold ergosterol
- More unstable, leading to irregularities in potency
- Although less active biologically, may have greater risk for toxicity

Houghton. Am J Clin Nutr 2006;84:694

- About 30% potency of D3 (Armas, J Clin Endo Metab. 2004;89:5387-91)

DRI Values

- DRI = Dietary Reference Intake
- 2nd generation nutrient requirement guidelines partially replacing RDAs (Recommended Dietary Allowances)
- RDAs originally set to meet the nutrient requirements of “most” (97-98%) people in a given group

DRI Values

- Released 1997-2005
- Reason:
 - Change of intent from “prevent diseases caused by nutrient deficiencies”
 - Added goal of “reduce the risk of chronic diseases”

DRI Values

- New Categories:
 - Estimated Average Requirement (EAR)
 - Recommended Dietary Allowance (RDA)
 - Adequate Intake (AI)
 - Used when RDA not findable
 - Tolerable Upper Intake Level (UL)
 - “Red flag” level, not “toxic”
 - Defined as maximum daily intake that is likely to have no risk of adverse side effects

DRI Values

- New topics: water, electrolytes, phytochemicals
- Complete set of tables can be found at:
<http://www.iom.edu/CMS/3788/21370.aspx>

Vitamin D DRIs

| Age/Gender | RDA/AI μ g/d (IU) | UL μ g/d (IU) |
|--|-----------------------|-------------------|
| Infants 0-12 m | 5 (200 IU) | 25 (1000 IU) |
| μ / 1-8 y | 5 (200 IU) | 50 (2000 IU) |
| μ / 9-50 y | 5 (200 IU) | 50 (2000 IU) |
| μ / 51-70 y | 10 (400 IU) | 50 (2000 IU) |
| μ / > 70 | 15 (600 IU) | 50 (2000 IU) |
| Pregnancy | 5 (200 IU) | 50 (2000 IU) |
| Lactation | 10 (400 IU) | 50 (2000 IU) |
| Conversion: 1 μ g cholecalciferol = 40 IU Vitamin D | | |
| Adapted from Dietary Reference Intakes for Vitamins, National Academies 2001 | | |

Prescription Vitamin D Preparations

Oral Ergocalciferol

- Dosing: 5000-50,000 (or more) units by mouth daily
- One typical dosing regimen: 50,000 IU weekly x8 weeks
- Sample of potential drug-nutrient interactions:
 - Any bile acid binding resins
 - Drugs that interfere with fat digestion/absorption (e.g. Orlistat)

Vitamin D Supplements

| Brand | Potency | Price | Count |
|----------------------|---------|---------|-------|
| Country Life | 1000 IU | \$6.49 | 100 |
| Carlson | 1000 IU | \$5.49 | 100 |
| Carlson | 2000 IU | \$8.99 | 120 |
| NOW | 1000 IU | \$7.99 | 180 |
| NOW | 2000 IU | \$7.99 | 120 |
| Pure Encapsulations* | 5000 IU | \$13.90 | 60 |

All brands surveyed in 3 local health food stores were D3/cholecalciferol, some multivitamin preparations use D2/ergocalciferol. * "Doctor's" product, not available retail.

Vitamin D: Food Sources

| Food | Serving Size | Vitamin D Content |
|------------------------|--------------|-------------------|
| Fish (cod) liver oil | 1 teaspoon | 1-400 IU |
| Pink salmon, canned | 3 ounces | 530 IU |
| Sardines, canned | 3 ounces | 231 IU |
| Salmon, fresh | 3 ounces | 600 IU * |
| Egg Yolk | 1 | 25 IU |
| Unfortified Milk | 1 cup | 1-3 IU |
| Fortified milk | 1 cup | ~100 IU |
| Fortified Orange Juice | 1 cup | ~100 IU |

Adapted from <http://pi.oregonstate.edu/infocenter/vitamins/vitaminD/> * Wild Alaskan sockeye salmon from www.vitalchoice.com

Fish (Cod) Liver Oil Comparisons

| Brand | Serving Size | Vitamin D (IU) | Vitamin A (IU) | Price |
|--------------------------------------|--------------|----------------|----------------|----------------|
| Nordic Naturals Cod liver oil | 1 teaspoon | 1-20 IU | 1500-2950 | \$22.95/8 oz |
| Nordic Naturals Cod liver oil With D | 1 teaspoon | 400 IU | 1500-2950 | \$23.95/8 oz |
| Carlsons | 1 teaspoon | 400 IU | 700-1200 | \$22.99/8.4 oz |
| TwinLab | 1 teaspoon | 462 | 4615 | \$9.99/12 oz |
| Spectrum | 1 teaspoon | 4 | 1250 | \$15.99/8 oz |
| Dr. Ron's Blue Ice Cod Liver Oil | _ teaspoon | 575 | 5750 | \$22.95/8 oz |

Cod Liver Oil

Additional Benefits:

Source of Omega-3 fatty acids (DHA/EPA)

- Cardiovascular: hypertension, hypertriglyceridemia
- Eyes: macular degeneration (DHA), retinal development (DHA)
- Nervous system: brain development, depression

Potential Interactions

- May potentiate effects of anti-coagulant medications – aspirin, warfarin
- May increase bleeding time (platelet effects)

Adapted from Natural Medicines Comprehensive Database

Using Cod Liver Oil

**Yes,
it comes in capsules!**

Using Cod Liver Oil

- Keep bottle in fridge or freezer
- Can take straight off spoon or mixed in liquid
- The Burping Issue
 - Take before largest meal
 - Start with a smaller dose and slowly increase
 - Tends to get better over time
 - Capsules may or may not help, some patients report more burping with capsules
- Buy from a store that has rapid turnover
- Follow dose with lemon slice, raisins, bread cube to kill the taste/oily sensation

Calcium DRIs

| Age/Gender | RDA/AI mg/d | UL mg/d |
|----------------|-------------|---------|
| Infants 0-12 m | 210-270 | ND |
| Children 1-3 y | 500 | 2500 |
| Children 5-8 y | 800 | 2500 |
| _/_ 9-18 y | 1300 | 2500 |
| _/_ 19-50 y | 1000 | 2500 |
| _/_ 51-> 70 | 1200 | 2500 |
| Pregnancy | 1300-1000 | 2500 |
| Lactation | 1300-1000 | 2500 |

Adapted from Dietary Reference Intakes for Vitamins, National Academies 2001

Calcium: Dairy Sources

| Food | Serving Size | Calcium Content |
|--|--------------|-----------------|
| Milk (varies with fat content) | 1 cup | 276-306 |
| Yogurt (varies with fat & sweetener) | 1 cup | 457-275 |
| Cheese – cheddar, swiss, provolone | 1 _ ounces | ~300 |
| Cottage Cheese | 1 cup | 156 |
| Ricotta Cheese (varies with fat content) | 1 cup | 509-669 |

Adapted from USDA national Nutrient Database for Standard Reference Release 20

Calcium: Non-Dairy Sources

| Food | Serving Size | Calcium Content |
|------------------------------|------------------|-----------------|
| Fortified “Complete” Cereals | 6-10 oz | 1000 mg |
| Collard Greens | 1 cup cooked | 357 mg |
| Sardines with bones (canned) | 3 ounces drained | 325 mg |
| Kale | 1 cup cooked | 94 mg |

Adapted from USDA national Nutrient Database for Standard Reference Release 20

Supplemental Calcium

Relevant Forms:

1. Carbonate: most economical, needs good stomach acid to be absorbed, take with meals. Limit dose to 500 mg
2. Citrate: better absorption than carbonate if taken without food. More expensive
3. Malate: Calcium bound to malic acid. A better absorbed form

Supplemental Calcium

Partial List of Potential Drug/Nutrient Interactions

- Bisphosphonates (decreased drug absorption)
- Ceftriaxone (IV Calcium, complexed precipitates)
- Digoxin (Hypercalcemia)
- Levothyroxine (decreased drug absorption)
- Tetracyclines (decreased drug absorption)
- Cholestyramine (reduced absorption via Vitamin D)
- Corticosteroids (Increase excretion, decreased absorption)
- H2 Blockers & Proton pump inhibitors (Decrease calcium solubility via reduced pH)

Adapted from Natural Medicines Comprehensive Database

Choosing a Calcium Supplement

- Match the calcium to the patient
 - Cost & Amount
 - Stomach acid
 - Take with meals?
- Assessing patient needs
- Dosing strategies: max 500 mg, need to divide doses if supplemental intake is high

Calcium Supplements

| Brand | Form | Dose/Tab | Price |
|---|------------------------------|----------|-------------------------|
| NOW | Citrate | 500 mg | \$9.99/100 |
| Oscal | Carbonate | 500 mg | \$26.99/250 |
| Nature's Way | Carbonate/ Citrate/Malate | 500 mg | \$18.99/250 |
| Viactive Chews | Carbonate | 500 mg | \$11.29/120 @ Costco |
| Trader Joe's | Carbonate/ Citrate/Malate | 333 mg | \$6.99/100 |
| Kirkland | Citrate | 250 mg | \$10.69/300 |
| Pure Encapsulations* | Citrate | 150 mg | \$17.60/180 |
| Prices from 10/2007. * "Doctor's" product, not available retail | | | |

Supplement Quality Issues

- Purity – some historical concern of lead contamination, may be trace amounts, best to use good quality brand with traceable source materials
- Potency
 - An issue for calcium is rate at which supplement dissolves in stomach. Easiest for average consumer buying retail: look for USP verified products – identity, purity, potency & dissolution tested

Supplement Quality Issues

Sources of information (some are subscription):

- Consumer Lab (<http://www.consumerlab.com/>)
- Consumer Reports
- Natural Medicines Comprehensive Database (<http://www.naturaldatabase.com>)
- USP (<http://www.usp.org/USPVerified/dietarySupplements/>) for verified dietary supplements
- “Doctor’s products” sold by physicians and others often have strict quality control, so assays and quality testing reports are readily available

Patient Assessment: Calcium

Purpose: Assess daily calcium intake and determine if and how much supplemental calcium is needed

Procedure:

1. Calculate 300 mg calcium for every 8 oz serving of milk, yogurt, ricotta cheese or 2 cups of cottage cheese, or 1 _ oz of cheese
2. Add in 200 more mg calcium to cover the rest of the diet
3. Total those amounts, then subtract that number from daily requirement to get amount needed of supplemental calcium. Divide that # into doses if necessary.

Patient Assessment: Calcium

Example #1:

Janet, 52 yo female

1. Intake: 8 oz milk (300 mg), 200 mg (rest of diet) = 500 mg
2. How much supplemental calcium does she need? 700 mg.
3. Possible supplementation: 150 mg calcium citrate, 5 caps in 2 doses or one 333 mg calcium citrate tab twice daily or 1 _ 500 mg tabs

Patient Assessment: Calcium

Example #1a:

Janet, 52 yo female is taking omeprazol for GERD

1. What form(s) of calcium would you recommend?
2. How would you dose it?

Patient Education: Calcium

Example #2:

Claire, 45 yo female

Intake: 8 oz milk (300 mg), 6 oz yogurt (200 mg), 1 _ oz cheddar cheese (300 mg), 200 mg (rest of diet) = _____ mg

1. How much supplemental calcium does she need?
2. How would you dose it?

Adequate Calcium Intake: Food, Supplements or Both?

Study: Examined 1 week of calcium intake for 183 post-menopausal women

- 3 groups of calcium intake (with average daily intake):
 1. 70% intake from supplements (1030 mg)
 2. 70% intake from diet (830 mg)
 3. Diet + supplements (1620 mg)

Napoli; Am J Clin Nutr 2007;85:1428-33

Adequate Calcium Intake: Food, Supplements or Both?

- Tested: spinal & hip bone mineral density and urinary estrogen metabolites
- Outcomes:
 - Highest bone density: Diet + supplements
 - Next highest: 70% intake from diet
 - Lowest: 70% intake from supplements
 - Diet and diet + supplement groups had highest ratios of active to inactive estrogenic urinary metabolites

Napoli; Am J Clin Nutr 2007;85:1428-33

Adequate Calcium Intake: Food, Supplements or Both?

Conclusions/Thoughts:

- Dairy calcium may be (overall) better absorbed than supplemental calcium, and it may influence estrogen metabolism
- Dairy products probably contribute estrogenic compounds that influence calcium/bone metabolism
- Dairy foods may contribute other substances (Vitamin D, other hormonal factors) that influence bone and/or estrogen metabolism
- Dairy consumers may have more bone-healthy habits: exercise, lower sodium and fizzy drink intake, non-smokers

What About Kidney Stones?

- Nephrolithiasis risk increased in people with elevated urinary calcium – mostly a physiological, not dietary issue
- Dietary calcium associated with *decreased* risk (binds stone-forming oxalates)
- Supplemental calcium associated with *increased* risk in women, large study (Jackson 2006) saw same effect
- Why? Perhaps low intake from food plus supplements taken away from food; more dietary oxalate goes unbound, increasing risk.

See <http://lpi.oregonstate.edu/infocenter/minerals/calcium/> for general discussion, also Jackson in NEJM 2006;354:669-83