

VITAMIN D: SHEDDING LIGHT ON THE SUNSHINE VITAMIN

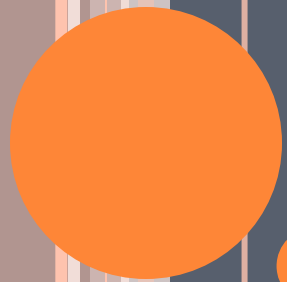


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WHAT IS VITAMIN D ?

- It is a fat-soluble vitamin and a hormone
- Humans, most animals, phytoplankton and zooplankton exposed to sunlight can make vitamin D
- It is critically important for the development, growth, and maintenance of a healthy body





VITAMIN D FUNCTIONS

ROLE OF VITAMIN D

- Promotes calcium absorption in the gut
- Promotes normal bone mineralization
- Promotes bone growth and bone remodeling
- Prevents rickets in children
- Prevents osteomalacia in adults



ROLE OF VITAMIN D

- Together with calcium it protects older adults from osteoporosis
- Modulates cell growth
- Modulates neuromuscular and immune function
- Helps reduce inflammation



DISEASE PREVENTION

- Osteoporosis
- Cancer
- Autoimmune diseases
 - Insulin-dependent diabetes mellitus, Multiple sclerosis, Rheumatoid arthritis
- Hypertension
- Mental illness



WHAT IS VITAMIN D?

- Vitamin D is measured in International Units (IU)
- There are several forms of vitamin D
 - That formed in skin from sun exposure
 - Supplemental vitamin D
 - Vitamin D's metabolites that exist in the body
 - Pharmaceutical vitamin D



SUPPLEMENTAL VITAMIN D

○ Vitamin D₃—Cholecalciferol

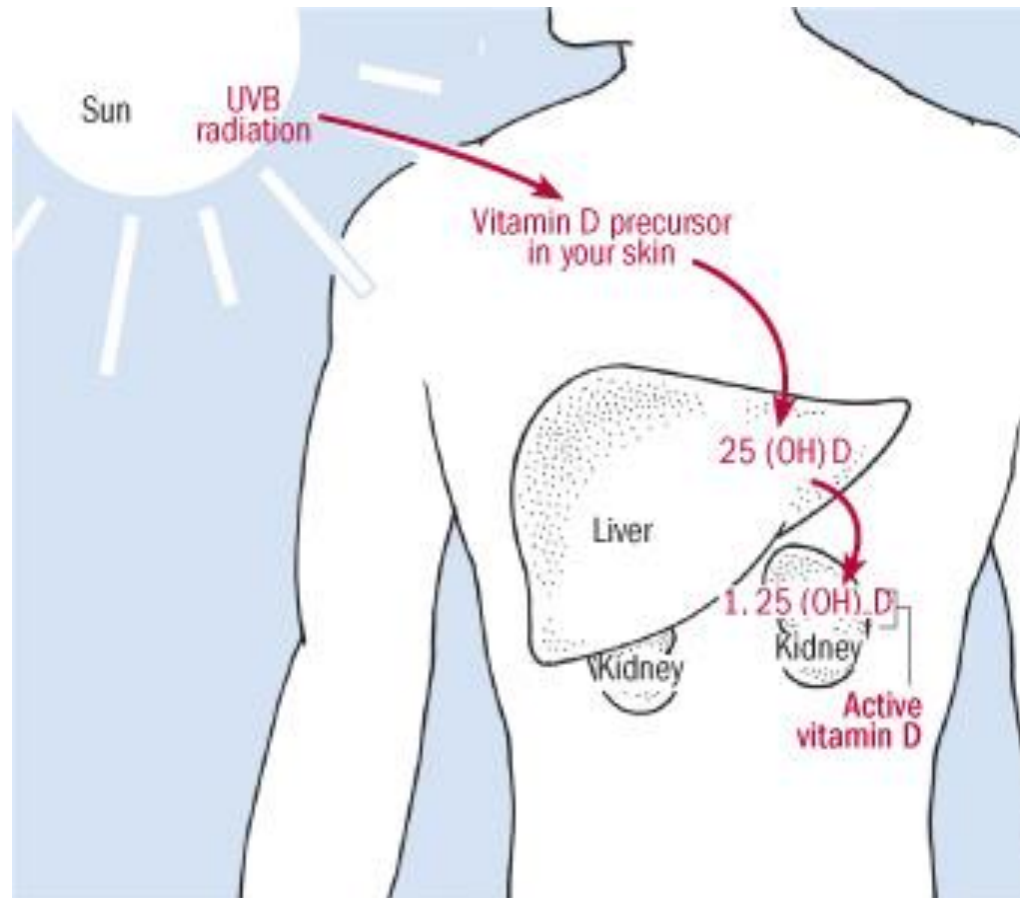
- Same as that produced in human skin in response to sun exposure.
- Derived from either lanolin or cod liver oil extract
- Form of vitamin D that most effectively treats vitamin D deficiency

○ Vitamin D₂—Ergocalciferol

- Derived from fungal sources activated with ultraviolet light.
- Not naturally present in the human body
- Not as effective for treating vitamin D deficiency



VITAMIN D PATHWAY IN THE BODY



VITAMIN D'S METABOLITES

○ 25-hydroxyvitamin D—Calcidiol

- Made in the liver
- Blood level determines Vitamin D status

○ 1,25-dihydroxyvitamin D—Calcitriol

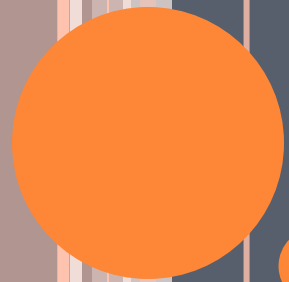
- Made from calcidiol in the kidneys and other organs
- Most potent **steroid hormone** in the human body
- Referred to as “*activated vitamin D*”
- Major player in DNA gene expression
- Not good indicator of vitamin D status



PHARMACEUTICAL VITAMIN D

- Synthetic calcitriol
- Vitamin D analogs
 - synthetic compounds based upon variations of the naturally-occurring vitamin D metabolites
- High dose calcitriol
 - Increases risk of hypercalcemia
 - Vitamin D analogs achieve the beneficial effects of calcitriol without this risk
- Pharmaceutical vitamin D should never be used to treat vitamin D deficiency





VITAMIN D DEFICIENCY

VITAMIN D DEFICIENCY

- World-wide epidemic
- Recent estimates indicate greater than 50% of the global population is at risk
- Prevalent across all age groups in all populations around the globe



ARE YOU GETTING ENOUGH VITAMIN D?

- The best measure of vitamin D status is blood levels of the form known as **25-Hydroxyvitamin D (calcidiol)**
- Levels are described in either nanomoles per liter (nmol/L) or nanograms per milliliter (ng/mL), where $1 \text{ nmol/L} = 0.4 \text{ ng/mL}$



HOW MUCH VITAMIN D IS ENOUGH?

- Levels below 30 nmol/L (12 ng/mL) are too low for bone or overall health
- Levels above 125 nmol/L (50 ng/mL) are probably too high
- Levels of 50 nmol/L or above (20 ng/mL or above) are sufficient for most people



VITAMIN D DEFICIENCY

- Calcidiol cut off point of 30 ng/mL (70 nmol/L) may be outdated for determining deficiency
- Recent evidence reveals beneficial effects of vitamin D at blood levels around 50 ng/mL (125 nmol/L) or higher
- Beneficial effects not seen at levels below 40 ng/mL (120 nmol/L)
- Need for upward revision of the deficiency reference cut off point



RISK FACTORS FOR DEFICIENCY

- Exclusively breast-fed infants
- Dark skin
- Aging
- Covering exposed skin and/ or using sunscreen
- Fat malabsorption syndromes
 - Cystic fibrosis, cholestatic liver
- Inflammatory bowel disease
- Obesity



RECOMMENDED DIETARY ALLOWANCE (RDAs)

LIFE STAGE	RECOMMENDED AMOUNT
Birth to 12 months	400 IU
Children 1–13 years	600 IU
Teens 14–18 years	600 IU
Adults 19–70 years	600 IU
Adults 71 years and older	800 IU
Pregnant and breastfeeding women	600 IU

- Developed by the Food and Nutrition Board at the Institute of Medicine of the National Academies



OTHER RECOMMENDATIONS

○ *Linus Pauling Institute*

- Generally healthy adults → 2,000 IU/ day
- Infants → 400-1,000 IU/ day
- Children and adolescents → 600-1,000 IU/ day

○ *Vitamin D Council*

- Healthy children under the age of 1 years → 1,000 IU
- Healthy children over the age of 1 years → 1,000 IU per every 25 lbs of body weight.
- Healthy adults and adolescents → at least 5,000 IU.
- Pregnant and lactating mothers → at least 6,000 IU



A decorative vertical bar on the left side of the slide, featuring a gradient from dark blue to light blue and several thin vertical lines. To the right of this bar are five orange circles of varying sizes, arranged in a descending staircase pattern from top-left to bottom-right.

SOURCES OF VITAMIN D

SUN EXPOSURE

- About 10,000 IU of Vitamin D3 is synthesized in response to full body summer sun exposure.



- For maximum production, sun exposure should be midday between the hours of approximately 10am-2pm
- 15-90 minutes of skin exposure depending on skin phototype



SKIN PHOTOTYPES

Skin Type	Skin Color	Characteristics
I	White; very fair; red or blond hair; blue eyes; freckles	Always burns, never tans
II	White; fair; red or blond hair; blue, hazel, or green eyes	Usually burns, tans with difficulty
III	Cream white; fair with any eye or hair color; very common	Sometimes mild burn, gradually tans
IV	Brown; typical Mediterranean caucasian skin	Rarely burns, tans with ease
V	Dark Brown; mid-eastern skin types	Very rarely burns, tans very easily
VI	Black	Never burns, tans very



FOOD SOURCES OF VITAMIN D

- Fatty fish—Salmon, Tuna, and Mackerel
- Fortified milk
- Beef liver, cheese, and egg yolks
- Mushrooms provide some vitamin D
- Other fortified foods: breakfast cereals, some brands of orange juice, yogurt, margarine, and soy beverages

Check the food labels!



SELECTED FOOD SOURCES OF VITAMIN D

Food	IUs per serving	Percent DV
Cod liver oil, 1 tablespoon (caution)	1360	340 %
Sword fish, 3 ounces cooked	566	142 %
Sockeye salmon, 3 ounces cooked	447	112 %
Fortified orange juice, 1 cup	137	34 %
Milk (skim, 2%, and whole)	115-124	29-31 %
Fortified yogurt, 6 ounces	80	20 %
Egg, 1 large	41	10 %
Fortified ready-to-eat cereal, $\frac{3}{4}$ -1 cup	40	10 %
Swiss cheese, 1 ounces	6	2 %



SUPPLEMENTS

- Most contain **Cholecalciferol (Vit D3)**
- Multivitamin typically provides 400 IU
- Single ingredient supplements may provide from 400 IU to 2000 IU
- **Vitamin D2 vs Vitamin D3**



VITAMIN D2 vs VITAMIN D3

Ergocalciferol (D2)

- UV irradiation of yeast
- Able to cure rickets
- Metabolize and act the same
- High doses may be less potent

Cholecalciferol (D3)

- UV Irradiation of lanolin
- Able to cure rickets
- Metabolize and act the same
- High doses may be more potent





IS TOO MUCH VITAMIN D HARMFUL?

TOXICITY

- Vitamin D intoxication is extremely rare
- Excessive sun exposure does not result in toxicity
- Intake from foods that are high enough to cause toxicity are unlikely
- **Toxicity is most likely to occur from high intake of dietary supplements containing vitamin D**



TOXICITY

- Potential signs of toxicity include:
 - Nausea
 - Vomiting
 - Poor appetite
 - Constipation
 - Weakness
 - Weight loss
 - With raising blood levels of calcium, too much vitamin D can cause confusion, disorientation, and problems with heart rhythm
 - Kidney damage



TOXICITY

- Serum levels of 25-hydroxyvitamin D from 75-120nmol/L may be associated with
 - Increased risk of pancreatic cancer
 - Greater risk of cardiovascular events
 - More falls and fractures among the elderly



TOLERABLE UPPER LIMIT FOR VITAMIN D

- 1,000 to 1,500 IU/day for infants
- 2,500 to 3,000 IU/day for children 1-8 years
- 4,000 IU/day for children 9 years and older, adults, and pregnant and lactating teens and women
- Vitamin D toxicity almost always occurs from overuse of supplements



INTERACTIONS WITH VITAMIN D

- **Steroid** medicines can reduce calcium absorption and impair vitamin D metabolism leading to bone loss over time
- **Orlistat** (brand names Xenical® and Alli®) and the cholesterol-lowering drug **cholestyramine** (brand names Questran®, LoCholest®, and Prevalite®) reduce the absorption of vitamin D and other fat-soluble vitamins (A, E, and K)
- **Phenobarbital** and **phenytoin** (brand name Dilantin®) increase the breakdown of vitamin D and reduce calcium absorption



ADDITIONAL PRECAUTIONS

- People with high blood calcium or phosphorus levels, heart problems and kidney disease should be careful when considering taking Vitamin D supplements



RESOURCES

- Office of Dietary Supplements, National Institutes of Health
<http://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/>
- Holick, MF. Vitamin D:a D-Lightful Health Perspective. *Nutrition Reviews* ol. 66 (suppl.2):S182-S194
- Linus Pauling Institute Micronutrient Information Center
<http://lpi.oregonstate.edu/infocenter/vitamins/vitaminD/>
- Vitamin D Council, <http://www.vitamindcouncil.org/>



