VITAMIN D:
SHEDDING LIGHT ON THE SUNSHINE VITAMIN

Presented by
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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

- 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 nmol/L = 0.4 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)

<table>
<thead>
<tr>
<th>LIFE STAGE</th>
<th>RECOMMENDED AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth to 12 months</td>
<td>400 IU</td>
</tr>
<tr>
<td>Children 1–13 years</td>
<td>600 IU</td>
</tr>
<tr>
<td>Teens 14–18 years</td>
<td>600 IU</td>
</tr>
<tr>
<td>Adults 19–70 years</td>
<td>600 IU</td>
</tr>
<tr>
<td>Adults 71 years and older</td>
<td>800 IU</td>
</tr>
<tr>
<td>Pregnant and breastfeeding women</td>
<td>600 IU</td>
</tr>
</tbody>
</table>

- 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
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

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

<table>
<thead>
<tr>
<th>Food</th>
<th>IU per serving</th>
<th>Percent DV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cod liver oil, 1 tablespoon (caution)</td>
<td>1360</td>
<td>340 %</td>
</tr>
<tr>
<td>Sword fish, 3 ounces cooked</td>
<td>566</td>
<td>142 %</td>
</tr>
<tr>
<td>Sockeye salmon, 3 ounces cooked</td>
<td>447</td>
<td>112 %</td>
</tr>
<tr>
<td>Fortified orange juice, 1 cup</td>
<td>137</td>
<td>34 %</td>
</tr>
<tr>
<td>Milk (skim, 2%, and whole)</td>
<td>115-124</td>
<td>29-31 %</td>
</tr>
<tr>
<td>Fortified yogurt, 6 ounces</td>
<td>80</td>
<td>20 %</td>
</tr>
<tr>
<td>Egg, 1 large</td>
<td>41</td>
<td>10 %</td>
</tr>
<tr>
<td>Fortified ready-to-eat cereal, ¾ -1 cup</td>
<td>40</td>
<td>10 %</td>
</tr>
<tr>
<td>Swiss cheese, 1 ounces</td>
<td>6</td>
<td>2 %</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Ergocalciferol (D2)</th>
<th>Cholecalciferol (D3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UV irradiation of yeast</td>
<td>UV Irradiation of lanolin</td>
</tr>
<tr>
<td>Able to cure rickets</td>
<td>Able to cure rickets</td>
</tr>
<tr>
<td>Metabolize and act the same</td>
<td>Metabolize and act the same</td>
</tr>
<tr>
<td>High doses may be less potent</td>
<td>High doses may be more potent</td>
</tr>
</tbody>
</table>
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®, LoCholeste®, 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/