

# Vitamin D and chronic diseases

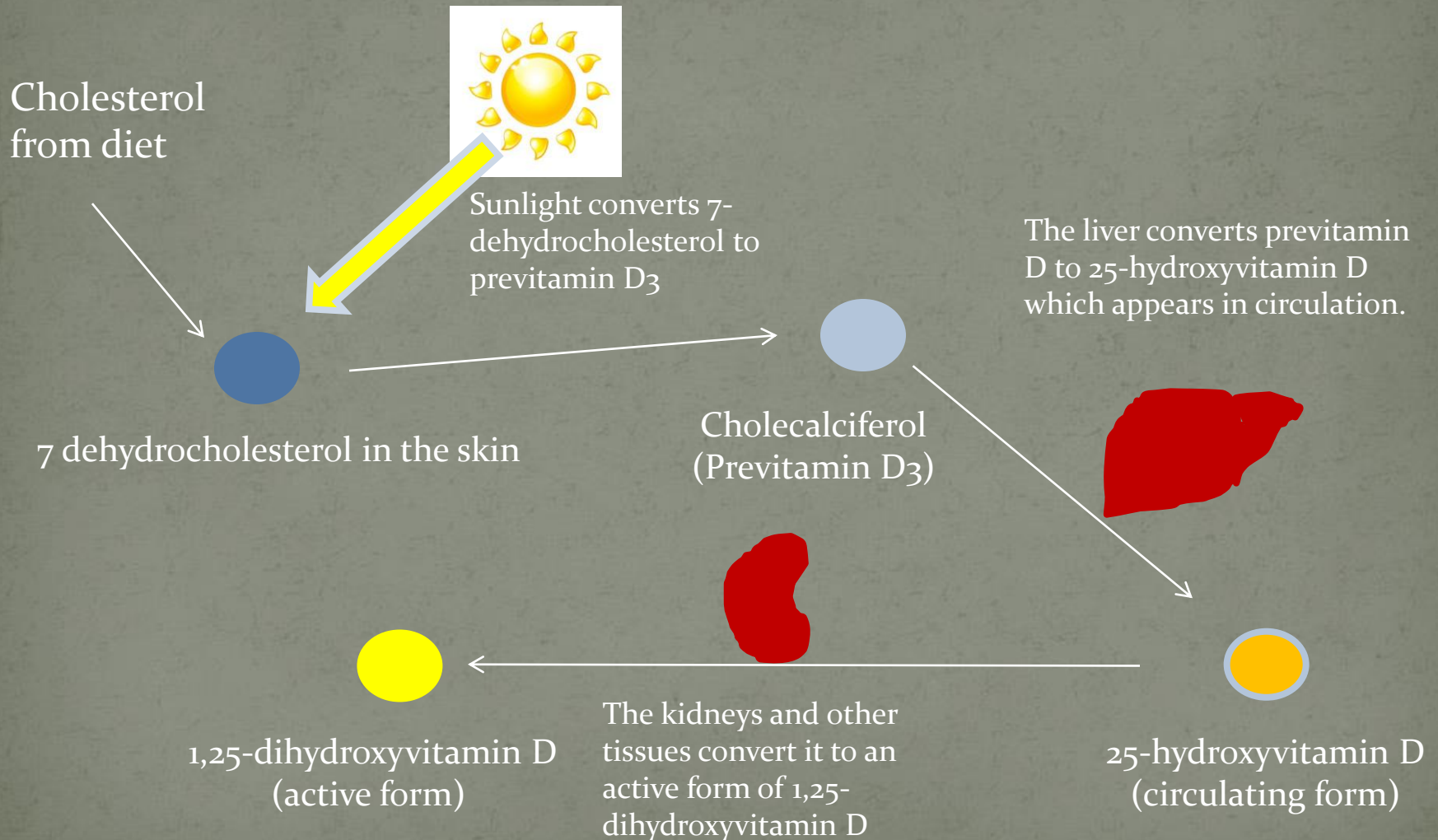


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# What are Super foods?

- Vitamin D has an important role together with calcium in mineral metabolism and bone growth and maintenance.
- Most cells in the body have been found to have receptors for vitamin D, and is therefore now seen as an important nutrient in preventing many chronic diseases.

# Conversion of Vitamin D to the active form



# Vitamin D conversion

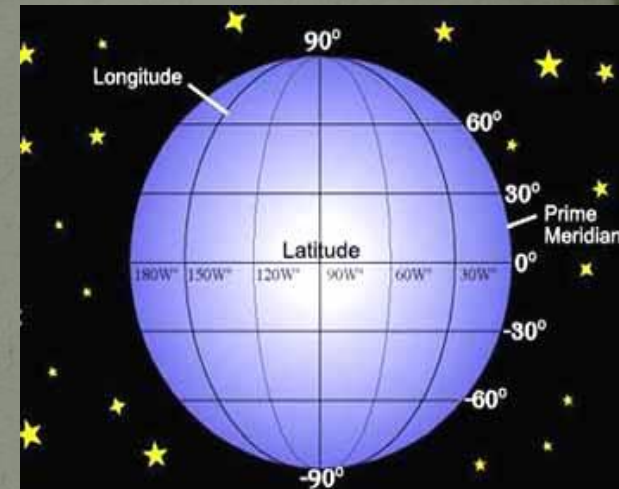
- The conversion of Vitamin D to its active form occurs in the kidneys, but it can also occur in the skin, prostate, brain, pancreas, adipose tissue, skeletal muscle, heart, colon, monocyte/macrophages and in neoplastic tissues.

# Sun exposure

- Solar ultraviolet radiation (UV-B-radiation)
  - beneficial
  - harmful
  - skin cancer
- Vitamin D obtained by UV-B-induced photosynthesis in the skin.
- Sunscreens and sunblocks
  - completely blocks photosynthesis of vitamin D

# Latitude and chronic disease risk

- Vitamin D deficiency and latitude of  $37^\circ$  or more
  - increased risk for many chronic diseases.
- Vitamin D synthesis and serum vitamin D levels
  - negatively correlated with latitude
  - positively correlated with sunlight



# Vitamin D and chronic diseases

1,25-dihydroxyvitamin D plays an important role in:

- Regulating calcium and phosphate metabolism for bone health,
- Autoimmune diseases,
- Atopic dermatitis,
- Cardiovascular disease,
- Chronic respiratory diseases
- Crohn's disease and Inflammatory bowel disease,
- Diabetes, type 1 and type 2
- Kidney disease,
- Osteoarthritis,
- Periodontal disease,
- Rheumatoid arthritis,
- Skin disorders,
- Some cancers,
- Infectious disease,
- Schizophrenia

# Vitamin D receptor

- In most tissues and cells in the body.
- Wide range of biological actions,
  - inhibiting cellular proliferation and inducing terminal differentiation, inhibiting angiogenesis, stimulating insulin production, inhibiting renin production, and stimulating production of compounds that kill bacteria.
  - stimulates its own destruction.

# Macrophages

- Remove dead or dying cells
- Involved in atherogenesis, immune response (remove pathogens, wound healing), inflammation (muscle repair), regeneration (limb)
- Produce many enzymes, proteins, regulatory factors (interleukin-1)
- Adequate vitamin D in macrophages
  - decreases the uptake of oxidized LDL particles,
  - decreases foam cell formation,
  - decreases cholesteryl ester formation,
  - promotes cholesterol to move out of macrophages,
  - suppresses macrophage migration to other sites

# Vitamin D and cancer

- Linked with colon, rectum, breast, ovarian, prostate, stomach, bladder, esophagus, kidney, lung, pancreas, and uterine cancers, as well as for non-Hodgkin lymphoma and multiple myeloma.
- Higher levels of serum 25(OH)D leads to lower incidence of cancers.
- Sunnier latitudes - Lower mortality.
- Black individuals: lower level of active vitamin D.
- Blacks have higher rates of colon, breast, prostate, and ovarian cancers.

# Vitamin D and cancer

- Vitamin D prevents tumor angiogenesis, it allows for effective communication between cells, and it helps to maintain a healthy calcium concentration in the cells.
- Vitamin D also enhances cell death when appropriate.

# Vitamin D and cardiovascular disease

- Plaque results from a chronic low-grade inflammation.
- Endothelial dysfunction, LDL particles accumulation.
- Low level of vitamin D = 2 x risk for cardiovascular incidents.

# Hypertension and Vitamin D

- Hypertension peaks in the winter.
- Short-term (8 wks) supplementation with vitamin D<sub>3</sub> and calcium reduced blood pressure, heart rate, and parathyroid hormone levels in women 70 yrs of age or older.

# Diabetes and vitamin D

- Type 1 diabetes results from beta cell destruction.
- Vitamin D is an immunosuppressive agent.
- Supplementation by vitamin D reduced the risk for diabetes by about 80% in children.
- Vitamin D might protect pancreas.
- Supplementation of mother's diet reduced incidence of type 1 diabetes in children.
- Children who are deficient in vitamin D have a 200% increased risk in developing type 1 diabetes.

# Multiple sclerosis

- Lower incidence of MS in countries with more sunlight.
- Vitamin D intake is associated with lower incidence of MS and slower rate of progression of the disease.

# RDA

| Recommended Dietary Allowances (RDAs) for Vitamin D |                    |                    |                    |                    |
|-----------------------------------------------------|--------------------|--------------------|--------------------|--------------------|
| Age                                                 | Male               | Female             | Pregnancy          | Lactation          |
| 0–12 months*                                        | 400 IU<br>(10 mcg) | 400 IU<br>(10 mcg) |                    |                    |
| 1–13 years                                          | 600 IU<br>(15 mcg) | 600 IU<br>(15 mcg) |                    |                    |
| 14–18 years                                         | 600 IU<br>(15 mcg) | 600 IU<br>(15 mcg) | 600 IU<br>(15 mcg) | 600 IU<br>(15 mcg) |
| 19–50 years                                         | 600 IU<br>(15 mcg) | 600 IU<br>(15 mcg) | 600 IU<br>(15 mcg) | 600 IU<br>(15 mcg) |
| 51–70 years                                         | 600 IU<br>(15 mcg) | 600 IU<br>(15 mcg) |                    |                    |
| >70 years                                           | 800 IU<br>(20 mcg) | 800 IU<br>(20 mcg) |                    |                    |

\* Adequate Intake (AI)

Institute of Medicine, and Endocrine Society Recommended Vitamin D intake (2011)

## Vitamin D intake recommendations

- Obese children and adults, and children and adults on anticonvulsant medications, glucocorticoids, antifungals such as ketoconazole, and medications for AIDS be given at least two to three times more vitamin D for their age group to satisfy their body's vitamin D requirement.
- The maintenance tolerable upper limits (UL) of vitamin D, which is not to be exceeded without medical supervision, should be 1000 IU/d for infants up to 6 months, 1500 IU/d for infants from 6 months to 1 yr, at least 2500 IU/d for children aged 1–3yr, 3000 IU/d for children aged 4–8yr, and 4000 IU/d for everyone over 8 yr.
- Higher levels of 2000 IU/d for children 0–1 yr, 4000 IU/d for children 1–18yr, and 10,000 IU/d for children and adults 19 yr and older may be needed to correct vitamin D deficiency.

# Food Sources of Vitamin D

| <b>Food</b>                                                                   | <b>IUs per serving</b> | <b>Percent DV</b> |
|-------------------------------------------------------------------------------|------------------------|-------------------|
| <b>Cod liver oil, 1 tablespoon</b>                                            | <b>1,360</b>           | <b>340</b>        |
| <b>Swordfish, cooked, 3 ounces</b>                                            | <b>566</b>             | <b>142</b>        |
| <b>Salmon (sockeye), cooked, 3 ounces</b>                                     | <b>447</b>             | <b>112</b>        |
| <b>Tuna fish, canned in water, drained, 3 ounces</b>                          | <b>154</b>             | <b>39</b>         |
| <b>Orange juice fortified with vitamin D, 1 cup</b>                           | <b>137</b>             | <b>34</b>         |
| <b>Milk, nonfat, reduced fat, and whole, vitamin D-fortified, 1 cup</b>       | <b>115-124</b>         | <b>29-31</b>      |
| <b>Yogurt, fortified with 20% of the DV for vitamin D, 6 ounces</b>           | <b>80</b>              | <b>20</b>         |
| <b>Margarine, fortified, 1 tablespoon</b>                                     | <b>60</b>              | <b>15</b>         |
| <b>Sardines, canned in oil, drained, 2 sardines</b>                           | <b>46</b>              | <b>12</b>         |
| <b>Liver, beef, cooked, 3 ounces</b>                                          | <b>42</b>              | <b>11</b>         |
| <b>Egg, 1 large (vitamin D is found in yolk)</b>                              | <b>41</b>              | <b>10</b>         |
| <b>Ready-to-eat cereal, fortified with 10% of the DV for vitamin D, 1 cup</b> | <b>40</b>              | <b>10</b>         |

# Recommendations

- Increase consumption of foods that have been fortified with vitamin D
- Sensible sun exposure limits
- Vitamin D supplementation during the winter and in those who use sun block during the summer
- Assess vitamin D levels in the blood at annual check ups

# References

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