7.2B: Vitamin D

Vitamin D refers to a group of fat-soluble secosteroids responsible for increasing intestinal absorption of calcium, iron, magnesium, phosphate, and zinc. In humans, the most important compounds in this group are vitamin D3 and vitamin D2. Cholecalciferol and ergocalciferol can be ingested from the diet and from supplements. Very few foods contain vitamin D; synthesis of vitamin D in the skin is the major natural source of the vitamin and is dependent on sun exposure (specifically UVB radiation).

Deficiency: Rickets

A diet deficient in vitamin D in conjunction with inadequate sun exposure causes osteomalacia (or rickets when it occurs in children), which is a softening of the bones. In the developed world, this is a rare disease. However, vitamin D deficiency has become a worldwide problem in the elderly and remains common in children and adults. Low blood calcifediol (25-hydroxy-vitamin D) can result from avoiding the sun. Deficiency results in impaired bone mineralization and bone damage which leads to bone-softening diseases, including rickets and osteomalacia.
Rickets, a childhood disease, is characterized by impeded growth and soft, weak, deformed long bones that bend and bow under their weight as children start to walk. This condition is characterized by bow legs, which can be caused by calcium or phosphorus deficiency, as well as a lack of vitamin D; today, it is largely found in low-income countries in Africa, Asia, or the Middle East and in those with genetic disorders such as pseudovitamin D deficiency rickets. Maternal vitamin D deficiency may cause overt bone disease from before birth and impairment of bone quality after birth. Nutritional rickets exists in countries with intense year-round sunlight such as Nigeria and can occur without vitamin D deficiency.

Vitamin D deficiency remains the main cause of rickets among young infants in most countries, because breast milk is low in vitamin D and social customs and climatic conditions can prevent adequate sun exposure. In sunny countries such as Nigeria, South Africa, and Bangladesh, where the disease occurs among older toddlers and children, it has been attributed to low dietary calcium intakes, which are characteristic of cereal-based diets with limited access to dairy products.

### Synthesis in the Skin

Vitamin D₃ is produced photochemically from 7-dehydrocholesterol in the skin of most vertebrate animals, including humans. The precursor of vitamin D₃, 7-dehydrocholesterol is produced in relatively large quantities. 7-Dehydrocholesterol reacts with UVB light at wavelengths between 270 and 300 nm, with peak synthesis occurring between 295 and 297 nm. These wavelengths are present in sunlight, as well as in the light emitted by the UV lamps in
tanning beds (which produce ultraviolet primarily in the UVA spectrum, but typically produce 4% to 10% of the total UV emissions as UVB). Exposure to light through windows is insufficient because glass almost completely blocks UVB light.

Adequate amounts of vitamin D can be produced with moderate sun exposure to the face, arms and legs, averaging 5–30 minutes twice per week, or approximately 25% of the time for minimal sunburn. The darker the skin, and the weaker the sunlight, the more minutes of exposure are needed. Vitamin D overdose is impossible from UV exposure; the skin reaches an equilibrium where the vitamin degrades as fast as it is created.

Dietary Reference Intakes (USA)

Accordingly, the Dietary Reference Intake for vitamin D assumes no synthesis occurs and all of a person's vitamin D is from food intake. As vitamin D is synthesized in adequate amounts by most mammals exposed to sunlight, it is not strictly a vitamin, and may be considered a hormone as its synthesis and activity occur in different locations. Vitamin D has a significant role in calcium homeostasis and metabolism. Its discovery was due to effort to find the dietary substance lacking in rickets.

Different institutions propose different recommendations concerning daily amounts of the vitamin. The recommended daily intake of vitamin D may not be sufficient if sunlight exposure is limited. According to the United States Institute of Medicine, the recommended dietary allowances (RDA) of vitamin D are (Conversion: 1 µg = 40 IU and 0.025 µg = 1 IU):

<table>
<thead>
<tr>
<th>Age group</th>
<th>RDA (IU/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants 0–6 months</td>
<td>400*</td>
</tr>
<tr>
<td>Infants 6–12 months</td>
<td>400*</td>
</tr>
<tr>
<td>1–70 years</td>
<td>600 (15 µg/day)</td>
</tr>
<tr>
<td>71+ years</td>
<td>800 (20 µg/day)</td>
</tr>
<tr>
<td>Pregnant/Lactating</td>
<td>600 (15 µg/day)</td>
</tr>
</tbody>
</table>

- Asterisk for infants indicates adequate intake (AI) for infants, as an RDA has yet to be established for infants.

For U.S. food and dietary supplement labeling purposes the amount in a serving is expressed as a percent of Daily Value (%DV). For vitamin D labeling purposes 100% of the Daily Value was 400 IU (10 µg), but as of May 2016 it has been revised to 800 IU (20 µg). A table of the pre-change adult Daily Values is provided at Reference Daily Intake. Food and supplement companies have until July 28, 2018 to comply with the change.

Contributors

- Wikipedia