

# Vitamin D

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Vitamin functioning as hormone

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# Vitamin overview

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- Vitamins are organic compounds that are essential in small amounts for normal metabolism
  - They are different from minerals (such as calcium and iron), some of which are also essential micronutrients.
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# Vitamin D

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- Vitamin D 1<sup>st</sup> identified in 1921
  - Vitamin D2 Ergocalciferol (dietary sources and supplements)
  - Vitamin D3 Cholecalciferol (skin exposure to UVB radiation in sunlight or oily fish or fortified foods)
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# What function does Vitamin D serve?

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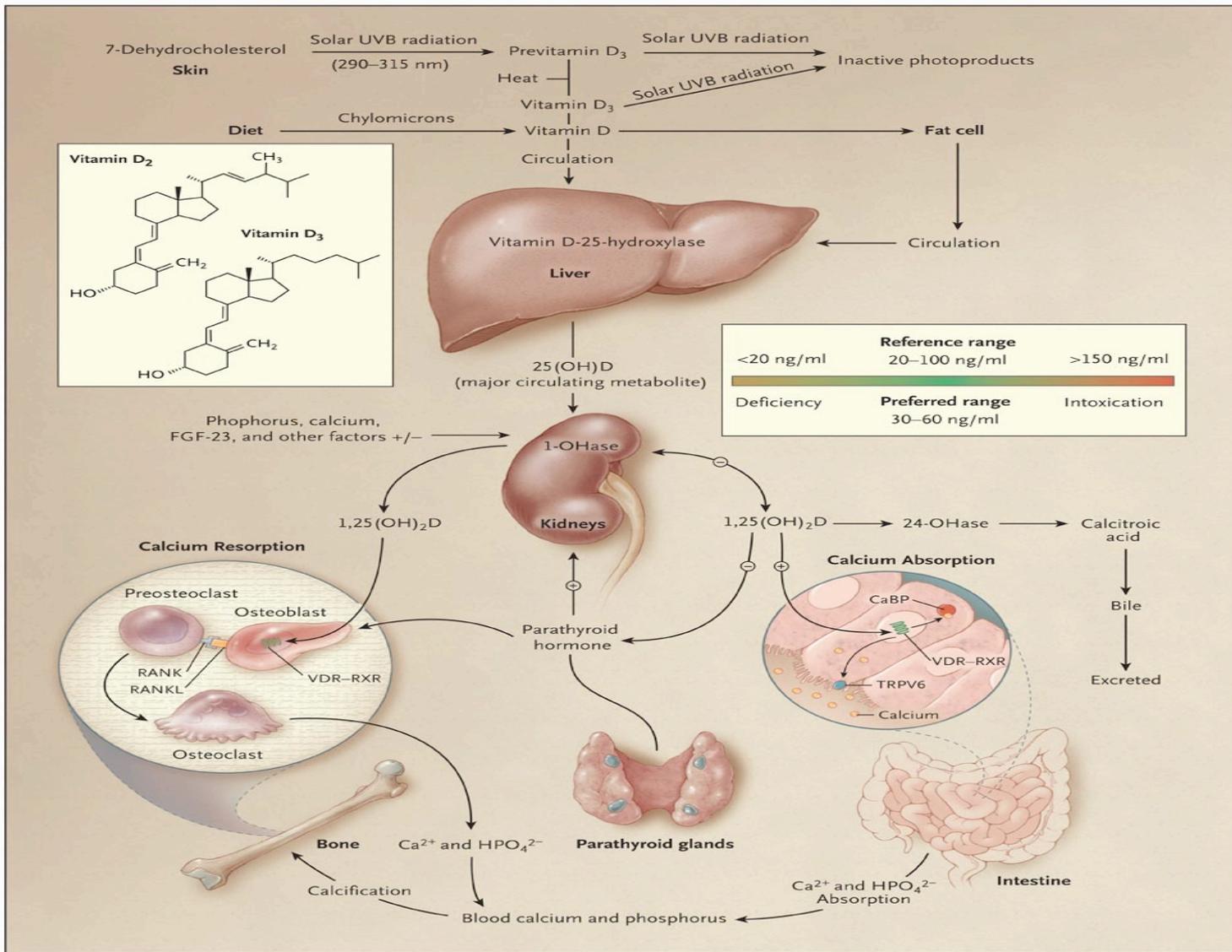
- In patients with functional kidneys and healthy bones, vitamin D and parathyroid hormone (PTH) interact to regulate blood levels of calcium and phosphorus.
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# What function does Vitamin D serve?

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- Without vitamin D, only 10 to 15% of dietary calcium and about 60% of phosphorus is absorbed.
  - The interaction of 1,25-dihydroxy Vitamin D with the vitamin D receptor increases the efficiency of intestinal calcium absorption to 30 to 40% and phosphorus absorption to approximately 80%
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# Synthesis and Metabolism of Vitamin D in the Regulation of Calcium, Phosphorus, and Bone Metabolism



# What function does Vitamin D serve?

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- ❑ Vitamin D and its metabolites help regulate calcium homeostasis and bone metabolism.
  - ❑ Subclinical vitamin D deficiency can contribute to the development of osteoporosis.
  - ❑ Vitamin D deficiency can produce osteomalacia.
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# What function does Vitamin D serve?

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- ❑ Vitamin D deficiency causes muscle weakness.
  - ❑ Skeletal muscles have a vitamin D receptor and may require vitamin D for maximum function.
  - ❑ Performance speed and proximal muscle strength demonstrate continuous improvement as 25-hydroxyvitamin D levels increased to more than 40 ng per milliliter
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# What function does Vitamin D serve?

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Brain, prostate, breast, and colon tissues, as well as immune cells have a vitamin D receptor and respond to 1,25-dihydroxy vitamin D.

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# What function does Vitamin D serve?

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Both prospective and retrospective epidemiologic studies indicate that levels of 25-hydroxyvitamin D below 20 ng per milliliter are associated with a 30 to 50% increased risk of incident **colon, prostate, and breast cancer**, along with higher mortality from these cancers.

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# What function does Vitamin D serve?

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Women who ingested more than 400 IU of vitamin D per day had a 42% reduced risk of developing **multiple sclerosis**.

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# What function does Vitamin D serve?

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- ❑ 10,366 children in Finland were given 2000 IU of vitamin D3 per day during their first year of life and followed for 31 years;
  - ❑ The risk of **type 1 diabetes** was reduced by approximately 80%.
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# What function does Vitamin D serve?

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Patients with hypertension who were exposed to ultraviolet B radiation three times a week for 3 months, 25-hydroxyvitamin D levels increased by approximately 180%, and **blood pressure became normal** (both systolic and diastolic blood pressure reduced by 6 mm Hg).

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# What function does Vitamin D serve?

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Directly or indirectly, 1,25-dihydroxy vitamin D controls more than 200 genes

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# Vitamin D

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In studies using doses of 700 to 800 IU of vitamin D3 per day, the relative **risk of hip fracture** was reduced by **26%** and the relative **risk of nonvertebral fracture** by **23%** with vitamin D3 as compared with calcium or placebo

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How common is vitamin D deficiency?

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It has been estimated that **1 billion people** worldwide have vitamin D deficiency or insufficiency.

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# “Hypovitaminosis D in medical inpatients”

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- NEJM 1998
  - A total of 164 patients (57 %) were considered vitamin D-deficient
  - 69% of the patients who consumed < the RDA of vitamin D
  - 43 % of the patients with vitamin D intakes > the RDA were vitamin D-deficient.
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# Sensible sun exposure

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- ❑ Sun exposure can provide an adequate amount of vitamin D3, which is stored in body fat.
  - ❑ Exposure of arms and legs for 5 to 30 minutes (depending on time of day, season, latitude, and skin pigmentation) between the hours of 10 a.m. and 3 p.m. twice a week is often adequate
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# Sun exposure and Vitamin D

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Even with regular sun exposure, the elderly produce 75% less cutaneous Vitamin D3 than young adults.

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# “Low vitamin D status despite abundant sun exposure”

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- Journal of Clinical Endocrinology and Metabolism 2007
  - 93 adults
  - Their self-reported sun exposure was 28.9 h/wk
  - Using a cutpoint of 30 ng/ml, 51% of this population had low vitamin D status.
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# How do we assess deficiency?

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- ❑ Blood testing determines 25-hydroxy vitamin D levels.  $< 30$  ng/mL defines deficiency.  $< 10$  ng/mL defines severe deficiency
  - ❑ Serum 25-hydroxy vitamin D concentrations are related inversely to parathyroid hormone (PTH) concentrations
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# Dietary, Supplemental, and Pharmaceutical Sources of Vitamins D<sub>2</sub> and D<sub>3</sub>

**Table 1.** Dietary, Supplemental, and Pharmaceutical Sources of Vitamins D<sub>2</sub> and D<sub>3</sub>.<sup>\*,‡</sup>

Source	Vitamin D Content
<b>Natural sources</b>	
Salmon	
Fresh, wild (3.5 oz)	About 600–1000 IU of vitamin D <sub>3</sub>
Fresh, farmed (3.5 oz)	About 100–250 IU of vitamin D <sub>3</sub> or D <sub>2</sub>
Canned (3.5 oz)	About 300–600 IU of vitamin D <sub>3</sub>
Sardines, canned (3.5 oz)	About 300 IU of vitamin D <sub>3</sub>
Mackerel, canned (3.5 oz)	About 250 IU of vitamin D <sub>3</sub>
Tuna, canned (3.6 oz)	About 230 IU of vitamin D <sub>3</sub>
Cod liver oil (1 tsp)	About 400–1000 IU of vitamin D <sub>3</sub>
Shiitake mushrooms	
Fresh (3.5 oz)	About 100 IU of vitamin D <sub>2</sub>
Sun-dried (3.5 oz)	About 1600 IU of vitamin D <sub>2</sub>
Egg yolk	About 20 IU of vitamin D <sub>3</sub> or D <sub>2</sub>
Exposure to sunlight, ultraviolet B radiation (0.5 minimal erythemal dose) <sup>†</sup>	About 3000 IU of vitamin D <sub>3</sub>
<b>Fortified foods</b>	
Fortified milk	About 100 IU/8 oz, usually vitamin D <sub>3</sub>
Fortified orange juice	About 100 IU/8 oz vitamin D <sub>3</sub>
Infant formulas	About 100 IU/8 oz vitamin D <sub>3</sub>
Fortified yogurts	About 100 IU/8 oz, usually vitamin D <sub>3</sub>
Fortified butter	About 50 IU/3.5 oz, usually vitamin D <sub>3</sub>
Fortified margarine	About 430 IU/3.5 oz, usually vitamin D <sub>3</sub>
Fortified cheeses	About 100 IU/3 oz, usually vitamin D <sub>3</sub>
Fortified breakfast cereals	About 100 IU/serving, usually vitamin D <sub>3</sub>
<b>Supplements</b>	
Prescription	
Vitamin D <sub>2</sub> (ergocalciferol)	50,000 IU/capsule
Drisdol (vitamin D <sub>2</sub> ) liquid supplements	8000 IU/ml
Over the counter	
Multivitamin	400 IU vitamin D, D <sub>2</sub> , or D <sub>3</sub> <sup>‡</sup>
Vitamin D <sub>3</sub>	400, 800, 1000, and 2000 IU



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