



Key Messages

- Vitamin D is unique because our bodies can produce it when our skin is exposed to sunlight. In a northern country where climate and clothing limit skin exposure for most of the year, it is important that we get vitamin D through our diet – or by taking supplements.
- Breastfed babies are at risk of developing vitamin D deficiency because the vitamin D content of human milk is low. Daily supplementation of 400 IU (10 µg) should begin at birth and continue until the child's diet includes enough vitamin D from other dietary sources or until the child is one year old.
- Preliminary research shows that vitamin D may have a role in the prevention of certain chronic diseases including musculoskeletal weakness and pain and in high blood pressure, multiple sclerosis, type 1 diabetes, rheumatoid arthritis, schizophrenia, and colon, prostate, and breast cancer.
- Recent studies have shown that the Adequate Intakes (AIs) set in 1997 are not high enough. Researchers recommend at least 800 IU/day (20 µg) in conjunction with calcium, to prevent osteoporosis, in adults.⁽¹⁾

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All About Vitamin D

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Introduction

Vitamin D's major function is to maintain serum calcium and phosphorus concentrations within normal range by enhancing the efficiency of the small intestine to absorb these minerals from the diet.⁽²⁾ Adequate vitamin D status is essential for the efficient utilization of calcium and the adaptation of intestinal calcium absorption to variations in calcium intakes and calcium needs.⁽³⁾

Vitamin D is unique among essential nutrients because we can make our own when our bare skin is exposed to the UV rays in sunlight. It is estimated that for each 5 per cent of skin surface exposed, approximately 435 IU of vitamin D can be manufactured.⁽⁴⁾

Although we can make our own vitamin D, researchers have recently focused attention on the vitamin D needs of those in northern countries – where climate and clothing limit skin exposure for most of the year. In Edmonton (52 degrees N) from October through March, exposure to sunlight will produce little, if any, vitamin D in the skin.⁽⁵⁾ A study in Calgary, the sunniest city in Canada, found that more than one-third of subjects had vitamin D insufficiency.⁽⁶⁾

The elderly and those with dark skin have limited ability to self produce vitamin D. Aging decreases the capacity of the skin to produce vitamin D.⁽²⁾ Melanin acts as a natural sunscreen; adults with highly pigmented skin require 10 to 20 times more sun exposure to make the same amount of vitamin D₃ as white-skinned adults.⁽⁷⁾ The risk of skin cancer also precludes the production of adequate vitamin D by sun exposure.

The impact of reduced sun exposure and self-production is complicated by the limited number of natural food sources: cold-water fish (salmon, herring, and mackerel) and egg yolks.⁽⁴⁾ Since 1975, fluid milk in Canada has been fortified with vitamin D, making it our most important food source.

Vitamin D Deficiency

Vitamin D deficiency causes inadequate bone mineralization in children or bone demineralization in adults. Vitamin D deficiency in children causes rickets, characterized by widening at the end of the long bones, deformations in the skeleton, bowed legs and knock-knees.⁽²⁾ A Canadian Pediatric Society (CPS) study, done over a two year period,

has confirmed more than 79 cases of nutritional rickets in Canada, predominantly among infants and toddlers – and children of recent immigrants.⁽⁸⁾ The researchers found that fair-skinned children who are breast-fed without vitamin D supplementation and darker-skinned children are at increased risk for nutritional rickets.⁽⁸⁾

In adults, vitamin D deficiency leads to demineralization of the skeleton causing osteomalacia.⁽²⁾ If there is too little vitamin D, the bone resorbing hormone, parathyroid hormone (PTH), is increased causing mobilization of calcium from the skeleton, resulting in porotic bone.⁽²⁾

Adequate Intakes

The current official recommended intakes for vitamin D are expressed in adequate intakes (AI). Adequate

intakes are scientifically based recommendations for nutrients for which the evidence is insufficient to generate a Recommended Dietary Allowance (RDA). The following chart was taken from the Dietary Reference Intakes.⁽²⁾

Life Stage	mcg/day (IU/day)
Babies 0-1 years	At least 10 mcg (400 IU)
1 – 50 years	5 mcg (200 IU)
Adults 51-70 years	10 mcg (400 IU)
Adults 71 years and older	15 mcg (600 IU)
Pregnancy	5 mcg (200 IU)
Breastfeeding	10 mcg (400 IU)

Vitamin D and Disease Prevention

Preliminary evidence from animal models and epidemiologic studies suggest that sufficient vitamin D may lower the risk of a surprising variety of chronic diseases including: high blood pressure, autoimmune diseases, various cancers, and schizophrenia, as well as the chronic condition of musculoskeletal weakness and pain.

It has been known for years, that vitamin D deficiency causes musculoskeletal weakness and pain in children and adults.^(9, 10) Now, placebo-controlled trials of 800 IU/day in the elderly show that vitamin D not only increased muscle strength but

decreased the risk of falling by almost 50% when compared to supplementation with calcium alone.⁽¹¹⁾

Research has shown that adequate vitamin D levels may be important for decreasing the risk of high blood pressure.⁽¹²⁻¹⁴⁾

Type 1 diabetes, multiple sclerosis (MS), and rheumatoid arthritis (RA) are autoimmune diseases that may be affected by vitamin D. Autoimmune diseases occur when the body mounts an immune response to its own tissue, rather than a foreign pathogen.

Epidemiological studies have found that their prevalence increases as latitude increases, suggesting that lower exposure to UVB radiation and consequent decreases in vitamin D synthesis may play a role in the pathology of these diseases. Treatment with vitamin D has beneficial effects in animal models of all three diseases.⁽¹⁵⁻¹⁷⁾ It is important to note that there is no evidence that supplemental vitamin D for people with these conditions will improve or alter their symptoms.

One very interesting, but controversial study found that vitamin D supplementation in the first year of life significantly lowered the risk of developing Type 1 diabetes, while children suspected of developing rickets during the first year of life had a significantly higher risk of developing Type 1 diabetes.⁽¹⁵⁾

Nutrition file™

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Nutrition File is a free quarterly research newsletter for health professionals, funded by the dairy farmers in Alberta.

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Vitamin D supplementation has been associated with a significant reduction in the risk of developing MS.⁽¹⁷⁾ Similarly, high vitamin D intakes significantly lowered the risk of developing RA. More research is needed.⁽¹⁶⁾

Research indicates that high vitamin D levels may be linked to a reduced risk of colon, prostate and breast cancer.⁽¹⁸⁻²⁴⁾

Preliminary research from Australia found that doses of vitamin D in early life could help reduce the onset of schizophrenia in men; however, for females there appeared to be no association.⁽²⁵⁾

Are the “Adequate Intake” Recommendations for Vitamin D adequate?

Most of the 1997 Adequate Intakes (AI) for vitamin D were set at the same levels as 1990 or twice as high. However, many researchers believe that they were set much too low.⁽¹⁾ For adults aged 19-50, the current recommendation of 200 IU (5µg) may prevent osteomalacia in the absence of sunlight, but more is needed to help prevent osteoporosis and secondary hyperparathyroidism.⁽²⁶⁾ A recent consensus of experts in the field argue that the adult requirement should be at least 800 IU/day (20 µg) in conjunction with calcium, to prevent osteoporosis, in adults.⁽⁶⁾

How much is too much? Vitamin D and Toxicity

Vitamin D toxicity (hypervitaminosis D) induces abnormally high serum calcium levels (hypercalcemia). If untreated over a long period of time, it can result in bone loss, kidney stones, and calcification of organs like the heart and kidneys.

Because of the severe consequences and limited amounts of available research, the Food and Nutrition Board established an Upper Limit (UL) of 2,000 IU/day (50µg/day) for children and adults and 1000 IU for infants from birth to one year.⁽²⁾ Newer research suggests the UL for adults is overly conservative and that toxicity is unlikely in healthy people at intake levels lower than 10,000 IU/day.⁽²⁶⁻²⁸⁾ Vitamin D toxicity has not been observed from sun exposure. Because of the unique solar regulation the skin can never generate quantities of vitamin D₃ excessive enough to cause vitamin D₃ intoxication.⁽²⁴⁾

The Needs of Breast-Fed Infants

Since the vitamin D content of human milk is low (4-40 IU/L), breastfed babies are at risk of developing vitamin D deficiency.⁽⁷⁾ Therefore, despite the AI recommendations of at least 200 IU/day, Health Canada recommends a supplement of

400 IU/day (10µg/d) for all breastfed, full-term infants beginning at birth and continuing until the child’s diet includes at least 200 IU/day (5µg/d) of vitamin D from dietary sources or until the child is one year old.⁽⁷⁾

Dark-skinned infants are at greater risk for rickets. Therefore, the Canadian Pediatrics Society goes even further and recommends 400 IU/day for Aboriginal bottle-fed babies and up to 800 IU/day for Aboriginal breastfed infants living north of 55° latitude (just North of Grande Prairie) especially between the months of October to April.⁽²⁹⁾

Summary

Scientific evidence has demonstrated the critical role of vitamin D in maximizing bone health. Exciting new research around vitamin D indicates that it may also decrease the risk of chronic diseases.

This issue of *Nutrition File™ for Health Professionals* was reviewed by Gail Ewan, P.Dt (Dairy Farmers of Canada); Helen Bishop MacDonald, RD, MSc, FDC, Nutrition Consultant (Nutrishpere Consulting); Joan Silzer MSc, RD, IBCLC, Nutrition Specialist (Children and Women’s Health Calgary Regional Health Authority); and Reinhold Vieth, PhD, Pathology and Laboratory Medicine (Mount Sinai Hospital, Toronto, ON).

Their contributions are greatly appreciated.

Q and A's

Can my skin make vitamin D with the light that passes through a glass window?

UV light does not pass through window glass.

Does using a tanning bed allow your skin to produce vitamin D?

Yes. A study found a large increase in blood levels of vitamin D in people after they used a tanning bed. However, it is important to consider the risks of skin cancer when thinking about using indoor tanning as a method to reach your vitamin D requirements.

Is sun block lotion also a vitamin D block lotion?

Yes. Adults using a SPF 8 sunscreen reduce their skin production of vitamin D by almost 98 per cent.

Can I consume too much vitamin D from food or pills?

Not likely. Problems are likely after continual daily intake of about 2 000 IU a day. It is almost impossible to get this much from food. Even with supplements it would be difficult to have this amount everyday over a long period of time.

Should I take cod-liver oil capsules to get more vitamin D in my diet?

The use of cod-liver oil is not advised as a way to get your higher amounts of vitamin D because the vitamin A that goes along with it is present in amounts that actually increase the risk of osteoporotic fractures.

Can I count on all milk products to get my vitamin D?

No. "Fluid" milk is fortified with vitamin D but other milk products (cheese, yogurt, ice cream, butter) are not. There is one yogurt on the market made with fortified milk but it contains relatively little vitamin D.

How much milk do I need to meet my daily needs?

The official recommendations for vitamin D vary with age. There is 90 IU of vitamin D in 250 mL (one cup) of milk. Two glasses of milk will meet the current AI of 200 IU for Canadians up to age 50. Adults over 70, and those that do not drink this much milk need a vitamin D supplement. According to the Osteoporosis Society of Canada, if osteoporosis prevention is of concern, Canadians should aim for 800 IU/day of vitamin D through milk and supplements.

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A complete list of references is available on request.