

Selected Questions and Answers on Vitamin D

Joint FAQs of BfR, DGE and MRI, 22 October 2012

Vitamin D promotes the intake of calcium from the gastrointestinal tract as well as the hardening of the bone. It influences muscle power, regulates the calcium and phosphate metabolism and is also involved in other metabolic processes of the body. Vitamin D is formed in human skin under the influence of sunlight. In contrast to the quantity the body produces itself, vitamin D intake via food only accounts for a relatively low percentage of the vitamin D supply. The German Nutrition Society (DGE, Deutsche Gesellschaft für Ernährung e. V.) estimates 20 micrograms of vitamin D per day to be an appropriate intake for children, teenagers and adults if the body does not produce any by itself.

(<http://www.dge.de/pdf/ws/Referenzwerte-2012-Vitamin-D.pdf>)

General enrichment of foods with vitamin D is not recommended. The focus is on the body's own production of vitamin D, hence the recommendation is to produce and store vitamin D by means of exposing the skin to sunlight. The amount the body produces itself varies from person to person and depends on other factors, such as latitude and time of the year. It is recommended to expose the body to the sun for a total of approx. 5 to 25 minutes per day with face, hands and large parts of arms and legs uncovered. The intake of vitamin D preparations is only recommended if a targeted improvement of the supply, especially concerning the supply of risk groups, cannot be achieved by diet or exposure to sunlight.

BfR, DGE and MRI have summarised some frequently asked questions and answers on vitamin D below.

What is vitamin D and why does the body need it?

Vitamin D takes a special position among the vitamins. Unlike other vitamins, vitamin D can be produced from precursors that already exist in the body. The body's own production is triggered by sunshine on the skin (UVB light exposure) and makes a much bigger contribution to the human body's supply with this vitamin compared to vitamin D intake by diet. Vitamin D regulates the calcium and phosphate metabolism, thereby promoting hardening of the bone. Additionally, vitamin D is involved in other metabolic processes of the body and also has an influence on muscle power.

How much vitamin D does the human body need and how can the vitamin D supply be determined?

The reference value for vitamin D intake is 20 micrograms per day if the body does not produce any by itself. This estimated value, which the DGE derived from various studies, applies to all age groups above one year. If a person stays outdoors regularly under the conditions predominant in this country, the body's own (endogenous) production in the skin accounts for 80 to 90 percent of the vitamin D supply.

In contrast to this, vitamin D intake through customary foods only accounts for a relatively low proportion (10 to 20 percent) of the vitamin D supply. Therefore this form of intake is not suitable for assessing the entire supply situation. The concentration of 25-hydroxyvitamin D in blood serum is used as the marker for assessing the supply because it reflects vitamin D intake through the diet and the body's own vitamin D production.

A vitamin D deficiency is defined as a serum 25-hydroxyvitamin D level of < 30 nanomol per litre of serum (30 nmol/l). This equates to 12 nanogram per millilitre of serum (12 ng/ml). A good vitamin D supply concerning bone health is obtained if the blood concentration of this marker equals at least 50 nanomol per litre of serum. This equates to 20 nanogram per millilitre. If the body does not produce any vitamin D by itself, this concentration is achieved with an intake of 20 microgram of vitamin D per day.

As the majority of the German population is not assumed to have a vitamin D deficiency, vitamin D supply should only be determined in high-risk individuals or when there is justified suspicion of a deficiency.

How is the vitamin D supply of the German population? Is there a supply gap?

Although the majority of the population does not have a vitamin D deficiency, almost 60 percent of the German citizens do not reach the desired blood concentration of the marker 25-hydroxyvitamin D of 50 nanomol per litre. This means that a large percentage of the population is not making full use of the preventive potential of vitamin D for bone health and therefore is not sufficiently supplied.

How much sun does the body need to produce sufficient vitamin D by itself? How do autumn and winter compare to summer?

The body's own vitamin D production in the skin through sunlight (UVB radiation) depends on latitude, time of the year and time of the day, weather conditions, clothing, the length of time spent outdoors and skin type as well as the use of sun protection products which inhibit the body's own production. This means that the contribution to the vitamin D supply due to the body's own production can fluctuate strongly from one individual to another. Accordingly, the quantity of the body's own contribution to vitamin D supply cannot be determined for individual persons or the population as a whole.

In the summer months, it is possible to reach the desired serum concentration of 25-hydroxyvitamin D of 50 nmol/l by means of the body's own production. The body's own production due to sunlight exposure depends on the geographical location. The following table gives orientation values for the duration of exposure to sunlight for a good vitamin D supply at latitudes 50 to 75 °N.

Thus it is sufficient for adults in Germany, a country which extends from latitudes 47 to 55 °N, to expose a quarter of the surface area of the body (face, hands and parts of the arms and legs) to the sun every day for roughly half of the year between 12 noon and 3 pm for 5 to 25 minutes.

Table 1: Duration of exposure to sunlight recommended for vitamin D production with various skin types depending on the time of the year

	Duration of exposure to sunlight for skin type I/II (light to very light skin colour, light red or blond hair, blue or green eyes)	Duration of exposure to sunlight for skin type III (medium skin colour, dark hair, brown eyes)
March to May	10 to 20 minutes	15 to 25 minutes
June to August	5 to 10 minutes	10 to 15 minutes
September to October	10 to 20 minutes	15 to 25 minutes

The duration of exposure to sunlight can be doubled between 10 am and 12 noon and between 3 pm and 6 pm.

Unlike the summer months, solar radiation in Germany is not strong enough from October to March to guarantee a sufficient vitamin D production. However, vitamin D can be stored in the body. These deposits contribute to the vitamin D supply in winter. The deposits, which are depleted over the winter months, are then refilled during springtime.

How is the body able to store vitamin D?

Vitamin D is mainly stored in the fat and muscle tissue of the human body with smaller quantities in the liver. Overall, the storage capacity is relatively large and contributes to vitamin D supply in winter.

How much vitamin D is contained in foods?

There are only a few foods, most of them of animal origin, which contain vitamin D in significant quantities. These include in particular fatty fish (e.g. salmon, herring, mackerel) and to a considerably lesser extent liver, margarine (enriched with vitamin D), egg yolk and several edible mushrooms. In Germany, vitamin D intake via customary food is only 2 to 4 microgram per day.

Table 2: Vitamin D concentrations of several customary food (according to Souci/Fachmann/Kraut, 2008)

Food	Vitamin D (microgram per 100 gram)
Herring	7.80 - 25.00
Salmon	16.00
Hen egg yolk	5.60
Mackerel	4.00
Hen egg, overall	2.90
Margarine	2.5 – 7.5*
Chanterelle mushrooms	2.10
Button mushrooms	1.90
Beef liver	1.70
Gouda cheese, 45% fat i.d.m.	1.30
Butter	1.20
Calf's liver	0.33
Full-fat milk, 3.5% fat	0.09

* Exceptional permission for up to 7.5 microgram per 100 gram has been granted

What are the consequences of a vitamin D deficiency?

If a vitamin D deficiency occurs during infancy and childhood, the mineralisation of the bones is insufficient, which means that they remain soft and can deform (rickets). Disorders of the bone metabolism can result in adults. Due to the demineralisation of the bones, they can become soft (osteomalacia). Especially among the elderly, a vitamin D deficiency can contribute to the occurrence of osteoporosis. The condition of an inadequate supply of vitamin D with which the preventive potential of the vitamin for bone health is not used to a sufficient extent has to be differentiated from an actual vitamin D deficiency with clinical symptoms. This means that the benefits of an adequate vitamin D supply – a reduced risk of falls and fractured bones in the elderly – are eliminated.

What groups are at risk of a vitamin D undersupply?

The risk groups for an undersupply include people who (can) hardly or never go outdoors or who – often for cultural or religious reasons – only go outdoors with their body completely covered. They also include people with a dark skin (high melanin concentration), because they cannot produce as much vitamin D as people with a light-coloured skin. Older people constitute another important risk group because vitamin D production reduces significantly with age and the problems of restricted mobility, chronic illness and care dependency also increase among elderly people who (can) hardly or never go outdoors. Breast-fed babies are another risk group for vitamin D undersupply because on the one hand, the vitamin D content of breast milk is very low on the other hand, babies generally should not be exposed to direct sunlight because the protection mechanism of their skin still has to develop.

Does the body's own vitamin D production remain sufficient in older people?

The skin's ability to produce vitamin D diminishes significantly the older a person gets and can be reduced to less than half compared to younger people. If less time is spent outdoors at the same time, so that skin exposure to the sun is limited, the body's own vitamin D production is further reduced. This occurs particularly often with older people with restricted mobility, chronic illness and care dependency (elderly people in nursing homes, geriatric patients). They are often diagnosed with a vitamin D deficiency. This generally does not apply to (older) people who spend a lot of time outdoors.

Should people go to the solarium to improve their vitamin D supply?

It is not useful to visit a solarium in order to improve the vitamin D supply. According to a recommendation issued by the Federal Office for Radiation Protection (Bundesamt für Strahlenschutz), children and teenagers in particular should not go to the solarium at all. Due to the opinion of the Federal Office for Radiation Protection, visits to a solarium can increase the risk of skin cancer.

Is an oversupply of vitamin D possible through the body's own synthesis?

Vitamin D overdoses and the undesired effects connected with them are only possible through excessive oral intake (> 100 microgram per day over a longer period) and not through overexposure to sunlight.

What should be considered with frequent exposure to sunlight?

Too much exposure to sunlight increases the risk of developing skin cancer and for this reason, frequent and intensive exposure to solar radiation in summer at noontime is not recommended (in compliance with the recommendations of the German Cancer Aid (Deutsche Krebshilfe)). However, a recommendation to completely avoid the sun is not reasonable or necessary either. Outdoor physical activity is highly recommended, whereas sunburn should be avoided in any case by taking suitable measures.

Is the consumption of vitamin D preparations or foods enriched with vitamin D necessary?

The enrichment of foods with vitamin D is not recommended. The main focus is on the body's own production of vitamin D, hence the recommendation is to produce it through the exposure of the skin to sunlight. The intake of vitamin D preparations (i.e. additional intake through foods) is only recommended if an insufficient supply has been diagnosed and if a targeted improvement of the vitamin D supply cannot be achieved either by diet or the body's own vitamin D production through sunlight exposure. The risk groups include people who hardly or never go outside when the sun is shining or who only go outside with their body completely covered as well as dark-skinned persons. Groups who do not expose themselves to the sun regularly and sufficiently include in particular older people with restricted mobility, chronic illness and care dependency (elderly people in nursing homes, geriatric patients, elderly people with a risk of osteoporosis and falling). Compared to other groups, serious incidences of vitamin D undersupply or deficiency requiring treatment occur more frequently in these groups. On top of this, the skin's ability to produce vitamin D decreases significantly with age and the body's own contribution to vitamin D supply is further reduced when exposure to sunlight is insufficient. With breast-fed and non-breast-fed babies, a sufficient vitamin D intake is ensured by giving them a vitamin D tablet from the first week to the end of the first year of their lives to prevent rickets.

Does a vitamin D oversupply have any effects on health?

Vitamin D overdoses and the possible side-effects connected to them are only possible through excessive oral intake and not through overexposure to sunlight. In case of additional intake of vitamin D through vitamin D preparations, it should be taken into account that the European Food Safety Authority (EFSA) has derived a tolerable total intake quantity of 100 microgram of vitamin D per day for adults and children aged 11 and over, and 50 microgram per day for children aged up to 10. These tolerable total intake quantities per day relate to a vitamin D intake from all foods (including vitamin D preparations and enriched foods). A regular daily intake of over 100 microgram of vitamin D, which, considering normal eating habits, is only achievable by means of excessive intake of vitamin D preparations, could lead to undesired effects such as the formation of kidney stones or calcification. Higher vitamin D intake quantities can be prescribed for medical reasons, however.

Does the intake of vitamin D preparations protect against cancer or other diseases?

Current findings confirm that a good vitamin D supply in older people can lower the risk of falling, broken bones, loss of strength, mobility and balance impairments as well as premature death. Yet there is no clear evidence that vitamin D lowers the risk of developing cancer, cardiovascular diseases or diabetes mellitus type 2.

What can consumers do?

Consumers should get out into the fresh air as often as possible in both summer and winter. Along with sports, physical exercise and activities in the open air strengthen the muscles and bones. The consumption of fatty fish, which contain n-3 fatty acids and iodine in addition to vitamin D, is recommended once or twice a week. A good vitamin D supply can be achieved without the additional intake of vitamin D preparations by staying outdoors for sufficient periods with appropriate exposure to sunlight and by maintaining a balanced diet.