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## Vitamin D deficiency

Vitamin D is a vitamin and, like all vitamins, it is essential for our health and well-being. Vitamin D is mostly made in the skin by exposure to sunlight.

### What is vitamin D deficiency?

Vitamin D deficiency means there isn't enough vitamin D in your body. Vitamin D is an essential vitamin that your body needs for healthy bones and muscles. Vitamin D deficiency is a common worldwide problem.

Vitamin D helps our body absorb calcium and phosphorus from the gut (bowel) and this is essential for healthy bones and to allow our muscles to function properly. Therefore, vitamin D deficiency mainly causes problems with bones and muscles.

Vitamin D is made in the skin but this needs adequate exposure to sunlight. It can also be obtained from foods (particularly fortified foods) and vitamin D supplements.

Vitamin D has to be converted to an active form, which occurs in the liver and kidneys. This is why some types of liver and kidney disease can affect the way the body handles vitamin D, and so cause vitamin D deficiency.

Vitamin D also plays a role in your nervous system and [immune system](#).

### Why is vitamin D so important?

Getting enough vitamin D is crucial for healthy bones and teeth. In children, being deficient in vitamin D can lead to a condition called rickets, where your bones are weak and soft and can become deformed (with bow legs). In adults, low levels of vitamin D can increase your risk of [osteoporosis](#), or thinning of the bones. This makes you much more prone to breaking a bone.

But vitamin D is important for much more than bone health. Vitamin D may play a role in:

- Improving muscle strength.
- Keeping your immune system strong, helping to fight off infections.
- Protecting you against certain cancers.
- Reducing your risk of falls.
- Helping to stave off depression and low mood.
- Keeping your energy levels up.

## How much vitamin D do I need?

Vitamin D is sometimes known as the 'sunshine vitamin': the natural type of vitamin D is produced in your skin when you're exposed to sunlight.

In the UK, sunshine isn't strong enough to allow you to make your own vitamin D in winter. So it's now recommended that everyone over 1 year old take 10 micrograms (400 International Units) a day from October to March.

Certain groups of people are at higher risk of low vitamin D. It's advised that you take a vitamin D supplement of 10 micrograms (400 International Units) a day all year round if you:

- Are pregnant or breastfeeding.
- Are aged 1-4 years.
- Are over 65 (older adults are less efficient at producing vitamin D).
- Have little exposure to sunlight, because you:
  - Are housebound.
  - Are confined indoors for long periods.
  - Cover your skin for cultural reasons.
- Have darker skin, for example if you are of African, African-Caribbean or South Asian origin (because your body is not able to make as much vitamin D from sunlight).

In addition, your doctor may recommend that you take a supplement all year round if you have certain gut (bowel), kidney or liver diseases.

Babies from birth to 1 year old should have a supplement in the form of vitamin D drops of 8.5 to 10 micrograms a day. Babies having 500 ml or more of formula milk per day do not need supplements, as formula milk already has vitamin D added.

You can buy vitamin D dietary supplements at pharmacies. In the UK they are also available on prescription to certain groups of people.

## **Vitamin D deficiency symptoms**

Many people have no vitamin D deficiency symptoms or may complain of only vague ones such as tiredness or general aches. Because symptoms of vitamin D deficiency are often very nonspecific or vague, the problem is often missed. The diagnosis is more easily reached in severe deficiencies with some of the classical (typical) symptoms and bone deformities.

### **Vitamin D deficiency symptoms in babies**

Babies with severe vitamin D deficiency can get:

- Cramps (muscle spasms).
- Fits (seizures).
- Breathing (respiratory) difficulties.

These problems are related to consequent low levels of calcium.

### **Vitamin D deficiency symptoms in children**

- Children with severe deficiency may have soft skull or leg bones. Their legs may look curved (bow-legged). They may also complain of bone pains, often in the legs, and muscle pains or muscle weakness. This condition is known as rickets.
- Poor growth. Height is usually affected more than weight. Affected children might be reluctant to start walking.
- Tooth delay. Children with vitamin D deficiency may be late teething, as the development of the milk teeth has been affected.

- Irritability in children can be due to vitamin D deficiency.
- Children with vitamin D deficiency are more prone to infections. Breathing symptoms can occur in severe cases. Breathing can be affected because of weak chest muscles and a soft rib cage.
- When rickets is very severe, it can cause low levels of calcium in the blood. This can lead to muscle cramps, fits and breathing difficulties. These need urgent hospital treatment.
- Rarely, an extremely low vitamin D level can cause weakness of the heart muscle (cardiomyopathy).

### **Vitamin D deficiency symptoms in adults**

- Some people complain of a general tiredness, vague aches and pains and a general sense of not being well.
- In more severe deficiency (known as osteomalacia), there may be more severe pain and also weakness. Muscle weakness may cause difficulty in climbing stairs or getting up from the floor or a low chair, or can lead to the person walking with a waddling pattern.
- Bones can feel painful to moderate pressure (often more noticeable in the ribs or shin bones). Not uncommonly, people have a hairline fracture in the bone which is causing tenderness and pain. Bone pain often also occurs in the lower back, hips, pelvis, thighs and feet.

## **What causes vitamin D deficiency?**

A vitamin D deficiency may happen because:

- Your body has an increased need for vitamin D.
- Your body is unable to make enough vitamin D.
- You don't have enough vitamin D in your diet.

### **You have an increased need for vitamin D**

Growing children, pregnant women, and breastfeeding women need extra vitamin D because it is required for growth. So, vitamin D deficiency is more likely to develop in the following groups of people:

- [Pregnant](#) or [breastfeeding](#) women. Vitamin D deficiency is even more likely to develop in women who have had several babies with short gaps between pregnancies.
- Breastfed babies whose mothers are lacking in vitamin D, or with prolonged breastfeeding, as there is little vitamin D in breast milk.

## **Your body is unable to make enough vitamin D**

This can occur for various reasons:

- People who get very little sunlight on their skin are at risk of vitamin D deficiency. This is more of a problem in the more northerly parts of the world (including the UK) where there is less sun. In particular:
  - People who stay inside a lot. For example, those in hospital for a long time, or housebound people.
  - People who cover up a lot of their body when outside.
  - The strict use of sunscreen may increase the risk of vitamin D deficiency, particularly if high sun protection factor (SPF) creams (factor 15 or above) are used. However, there is no evidence that the normal use of sunscreen does actually cause vitamin D deficiency in real life. Everyone, especially children, should **always** be protected from the harmful effect of the sun's rays. [See the separate leaflet called Sun and Health for more information.](#)
- Elderly people are unable to produce as much vitamin D. This leaves older people more at risk of vitamin D deficiency.
- People who have darker skin are not able to make as much vitamin D.
- Some medical conditions can affect the way the body handles vitamin D. People with [Crohn's disease](#), [coeliac disease](#), and some types of liver and kidney disease, are all at risk of vitamin D deficiency.

- Rarely, some people without any other risk factors or diseases become deficient in vitamin D. It is not clear why this occurs. It may be due to a subtle metabolic problem in the way vitamin D is made or absorbed. So, even some otherwise healthy, fair-skinned people who get enough sun exposure can become deficient in vitamin D.
- Vitamin D deficiency can also occur in people taking certain medicines. Examples include: [carbamazepine](#), [phenytoin](#), [primidone](#), barbiturates and some [anti-HIV medicines](#).

### **Not enough dietary vitamin D**

Vitamin D deficiency is more likely to occur in people who follow a strict vegetarian or vegan diet, or a non-fish-eating diet.

## **How common is vitamin D deficiency?**

A lack of vitamin D is very common. One survey in the UK showed that about 1 in 5 adults and about 1 in 5 children in the UK have low vitamin D levels. More people have low vitamin D levels in the winter and spring because of less exposure to sunlight.

## **How is vitamin D deficiency diagnosed?**

It may be suspected from your medical history, symptoms, or lifestyle. A simple [blood test](#) for vitamin D level can make the diagnosis. Blood tests for calcium and phosphate levels and [liver function](#) may also show changes linked to a low level of vitamin D.

Sometimes [a wrist X-ray](#) is done for a child in order to see how the bones are developing. This can assess how severe the problem is by looking for changes in the wrist bones.

## **Vitamin D deficiency treatment**

The main treatment is to take vitamin D supplements. This is a form of vitamin D called [ergocalciferol](#) or [calciferol](#). Vitamin D can be given as an injection or as a medicine (liquid or tablets). Your doctor will discuss the dose and the best treatment schedule, depending on your situation, age, severity of the deficiency, etc. Briefly, one of the following may be advised.

### **High-dose tablets or liquids**

There are different strengths available and a dose may be taken either daily, weekly or monthly. This will depend on your situation and on which particular treatment guideline your doctor is using.

Because vitamin D is a 'fat-soluble' vitamin, your body can store it, so you do not need to take it every day. This is different from water-soluble vitamins such as vitamin C, which you need to consume every day.

With high doses of vitamin D it is even more important to take the medicine correctly. The advantage of the higher-dose treatment is that the deficiency improves quickly, which is very important in growing children or people who have very low levels.

### **Standard-dose tablets, powders or liquids**

These are taken every day for about 12 months so that the body can catch up on the missing vitamin D. This is a rather slow method of replacing vitamin D, but is suitable if the deficiency is mild, or for prevention.

### **Injection**

A single small injection of vitamin D will last for about six months. This is a very effective and convenient treatment. It is useful for people who do not like taking medicines by mouth, or who are likely to forget to take their tablets. It is not widely used any more as most people prefer to take tablets.

### **Maintenance therapy**

Once vitamin D deficiency has been treated, the body's stores of vitamin D have been replenished. After this, **maintenance** treatment is often needed long-term, to prevent further deficiency in the future.

This is because it is unlikely that any risk factor for vitamin D deficiency in the first place will have completely resolved. The dose needed for maintenance may be lower than that needed to treat the deficiency.

## **How to get vitamin D naturally**

If you have fair skin, around 20-30 minutes of sunlight on the face and forearms around the middle of the day 2-3 times a week is enough to make enough vitamin D in the summer months in the UK. The sunlight has to fall directly on to bare skin (through a window is not enough).

If you have darker skin, you can still make some vitamin D through exposure to sunshine. However, you may not be able to make enough from sunshine and diet alone, so you should consider taking a vitamin D supplement all year round.

Too much exposure to the sun's rays can be damaging. [Sunburn](#) should be avoided at all costs (mainly because it can increase your risk of skin cancer).

You can also get some vitamin D from foods that either contain it naturally or have it added to them.

## What foods contain vitamin D?

Most foods contain very little vitamin D naturally. Foods that naturally contain a source of vitamin D include:

- Oily fish (such as sardines, pilchards, herring, trout, tuna, salmon, mackerel and kippers).
- Egg yolk, red meat and liver.
- Cod liver oil (although this should be avoided if you're pregnant).

Some foods are fortified with vitamin D (this means they have vitamin D added to them). These fortified foods include infant formula milk, most margarines and some cereals - you can check on the packet.

In some countries (but not in the UK) all milk is fortified with vitamin D.

## Are there any risks to taking vitamin D supplements?

Care is needed with vitamin D supplements in certain situations:

- If you are taking certain other medicines: [digoxin](#) (for an irregular heartbeat - atrial fibrillation) or [thiazide diuretics](#) such as [bendroflumethiazide](#) (commonly used to treat high blood pressure). In this situation, avoid high doses of vitamin D, and digoxin will need monitoring more closely.



- If you have other medical conditions: kidney stones, some types of kidney disease, liver disease or hormonal disease. Specialist advice may be needed.
- Vitamin D should **not** be taken by people who have high calcium levels or certain types of cancer.
- You may need more than the usual dose if taking certain medicines which interfere with vitamin D. These include: carbamazepine, phenytoin, primidone, barbiturates and some medicines for the treatment of HIV infection.

Multivitamins are not suitable for long-term high-dose treatment because the vitamin A they also contain can be harmful in large amounts.

## Complications of vitamin D deficiency

The complications of severe deficiency have been mentioned. **Rickets** can occur in children, and **osteomalacia** in adults. These diseases affect the strength and appearance of bones, and can lead to permanent bone deformities if untreated or if treatment is delayed.

As well as bone and muscle health, vitamin D deficiency is associated with a number of different conditions. These conditions include:

- [Diabetes.](#)
- [Coronary heart disease.](#)
- [Breast cancer.](#)
- [Bowel cancer.](#)
- [Alzheimer's disease.](#)

The exact significance of these associations isn't yet properly understood.

## What is the outlook?

The outlook (prognosis) of vitamin D deficiency is usually excellent. Both the vitamin levels and the symptoms usually respond well to treatment. However, it can take time (months) for bones to recover and for symptoms such as pain to improve.

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## Further reading

- [Avenell A, Mak JC, O'Connell D](#); Vitamin D and vitamin D analogues for preventing fractures in post-menopausal women and older men. *Cochrane Database Syst Rev.* 2014 Apr 14;4:CD000227. doi: 10.1002/14651858.CD000227.pub4.
- [Sunlight exposure: risks and benefits](#); NICE Guidance (February 2016)
- [Vitamin D and health](#); Scientific Advisory Committee on Nutrition (July 2016)
- [Mark J Bolland, PhD et al](#); Effects of vitamin D supplementation on musculoskeletal health: a systematic review, meta-analysis, and trial sequential analysis, *The Lancet*, October 2018.
- [Nair R, Maseeh A. Vitamin D: The "sunshine" vitamin. J Pharmacol Pharmacother.](#) 2012 Apr-Jun; 3(2): 118–126. doi: 10.4103/0976-500X.95506

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