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.

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

- Oily fish (such as sardines, pilchards, herring, trout, tuna, salmon and mackerel).
- Egg yolk, red meat and liver.

Some foods are fortified with vitamin D (this means they have vitamin D added to them). These foods include infant formula milk, most margarines and some cereals. All milk is fortified with vitamin D in some countries but not in the UK.

Vitamin D deficiency symptoms

Many people have no symptoms, or may complaining only of 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.

Symptoms in babies

Babies with severe vitamin D deficiency can get cramps (muscle spasms), fits (seizures) and breathing (respiratory) difficulties. These problems are related to consequent low levels of calcium.

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).

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.

Who gets vitamin D deficiency?

Vitamin D deficiency means that there is not enough vitamin D in your body. This may be 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 breast-feeding 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.
- Breast-fed 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 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 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.

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.

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. 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.

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.

Maintenance therapy after deficiency has been treated

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.

Are there any risks to taking vitamin D supplements?

Care is needed with vitamin D supplements in certain situations:
Further reading & references

- If you are taking certain other medicines: digoxin (for an irregular heartbeat - atrial fibrillation) or thiazide diuretics such as bendrolumbetazine (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.

How can I prevent vitamin D deficiency?

**Vitamin D and sunlight**
For a fair-skinned person, it is estimated that around 20-30 minutes of sunlight on the face and forearms around the middle of the day 2-3 times a week is sufficient to make enough vitamin D in the summer months in the UK. For people with darker skin and for the elderly, the amount of time needed to be exposed to sunlight to make enough vitamin D can be much more than this. The sunlight has to fall directly on to bare skin (through a window is not enough). 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).

For six months of the year (October to April), much of western Europe (including 90% of the UK) lies too far north to have enough UVB rays in sunlight necessary to make vitamin D in the skin. So, many people in the UK are at risk of not getting enough vitamin D unless they get it in their diet.

**Supplements**
Some people are more at risk of vitamin D deficiency and so are recommended to take vitamin D supplements routinely. These include all pregnant and breastfeeding women, all babies and young children aged 6 months to 5 years, people aged 65 years and over, and people who are not exposed to much sun. The dose for anyone over 1 year of age is 10 micrograms (400 International Units) a day. Babies under 1 year should have a lower dose. Babies having 500 ml or more of formula milk per day do not need supplements, as formula milk already has vitamin D added.

In addition, a doctor may advise routine vitamin D supplements for people with certain gut (bowel), kidney or liver diseases, for people prescribed certain medicines and for certain people with darker skin.

In the UK, it’s now recommended that everyone aged 1 year or over should be getting at least 10 micrograms (400 International Units) a day of vitamin D. That means that even people who don’t fall into one of the at-risk groups above might want to consider taking a supplement in the winter months (from October to April).

You can buy vitamin D supplements at pharmacies. In the UK they are also available on prescription to certain groups of people. If you are unsure as to whether you should be taking a regular supplement of vitamin D, or what the appropriate dose is, then your doctor, pharmacist, health visitor or midwife can advise.

What is the outlook?
The outlook (prognosis) 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.

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 and many others. The exact significance of these associations isn’t yet properly understood.

Further reading & references

- Denosumab for the prevention of osteoporotic fractures in postmenopausal women; NICE Technology Appraisal Guidance, October 2010
- Osteoporosis: assessing the risk of fragility fracture; NICE Clinical Guideline (August 2012, updated February 2017)
- Management of osteoporosis and the prevention of fragility fractures - A national clinical guideline; Scottish Intercollegiate Guidelines Network - SIGN, (March 2015)
- Guideline for the diagnosis and management of osteoporosis in postmenopausal women and men from the age of 50 years in the UK; National Osteoporosis Guideline Group (updated 2014)
- Clinical guideline for the prevention and treatment of osteoporosis; National Osteoporosis Guideline group (NOGG) 2017
- Bisphosphonates for treating osteoporosis; NICE Technology Appraisal Guidance, August 2017
- Hip fracture: management; NICE Guideline (June 2011, updated May 2017)
- Management of hip fracture in older people; Scottish Intercollegiate Guidelines Network - SIGN (June 2009)