

Vitamin D and Rickets:

A patient friendly summary



What is rickets?

Rickets is a condition that affects the development of bones in children. It causes soft weak bones, which can become bowed or curved.

As your child grows up, his or her bones are continually growing and developing. How the bones develop, and how strong they are, depends on the amount of minerals such as calcium and phosphorus, that form the hard outer shell of the bones. This process is called mineralization. Calcium and phosphorus are absorbed from the food and drink your child has and end up in the bones. Your child needs vitamin D too, because it helps the body to use calcium properly, and makes sure it gets to where it's needed (the bones or teeth).

If your child doesn't get enough of the minerals needed to make healthy strong bones, or enough vitamin D, the bones can't form hard outer shells. They become soft and weak and as your child grows and gets heavier, the increase in their weight can cause the bones to become bowed, misshaped and deformed.

If your child has rickets, then he or she is also more likely to develop infections such as pneumonia and gastroenteritis (infection of the stomach and bowel). These can be very serious in babies and young children. Babies and children with rickets may also be more likely to break (fracture) bones.



How common is rickets?

The number of children that develop rickets in the US isn't known. However, research from the UK found that about 1 in every 100 non-Caucasian children has rickets. Rickets is more common in children who have darker skin and in children who are breast fed rather than bottle fed.

Rickets is a condition that only develops in children. It's most commonly diagnosed in children between the age of 3 and 18 months.⁶ Adults can also develop soft bones. This condition is called osteomalacia.

What are the symptoms of rickets?

Rickets causes your child's bones to become soft, weak and malformed, which can lead to bone deformities. The main signs and symptoms of rickets include:

- A misshaped skeleton. This can include thickening of the ankles, wrists or knees ('knock-knees'), legs that curve outwards ('bow legs') or a breastbone that sticks out ('pigeon chest').
- Pain. The bones affected by rickets are often sore and painful, so your child may be reluctant to walk or may get tired easily.
- Fragile bones. The bones become weaker and are more likely to break.
- Poor growth and development. Your child's skeleton doesn't grow and develop properly, so he or she may be short for their age.
- Problems with teeth, including weak tooth enamel and a delay in teeth coming through.
- Soft skull bones and a delay in the closing of the soft spot at the top of your baby's head (the anterior fontanelle).

What causes rickets?

The most common cause of rickets is an extreme lack of vitamin D or a lack of calcium, or both together.

Vitamin D is produced naturally in your child's body when bare skin is exposed to sunlight. Your child can also get vitamin D from most infant milk formulas, supplements and a small number of foods. Calcium comes from the food and drink your child has. Milk and dairy foods are a good source of calcium as well as some green vegetables, tofu, sardines and canned salmon. Some foods such as soya and other non dairy milks, bread and breakfast cereals, have calcium added to them. Both calcium and vitamin D are essential for strong, healthy bones.

If you breast feed your baby, and you don't give a vitamin D supplement, then he or she is more likely to be lacking in vitamin D. When breastfeeding mothers don't have high levels of vitamin D, their breast milk doesn't contain much vitamin D and many breastfeeding women don't get enough vitamin D themselves to pass on to their baby. Therefore children that are breastfed are more likely to develop rickets than children that are bottle fed (infant formula has vitamin D added to it).

If your child eats a vegetarian or vegan diet, he or she may also be more likely to develop rickets, because they may not be getting enough calcium.

Rickets is more common in children with darker skins. Children with African-American, Hispanic and Asian origins need to spend longer in the sun than children with fair skin to get the same amount of vitamin D. However, children with fair skin can also develop rickets if they don't go outside in the sunlight very often, are frequently covered up or have sunscreen on all the time.

There are other types of rickets that are not caused by a lack of vitamin D or calcium, though these types of rickets are rare. Rickets can develop in children that have other health conditions such as liver disease, kidney disease or kidney failure. There is also a type of rickets that is genetic. These types of rickets are not treated with just vitamin D or calcium or both and need care from a doctor.

What is the link between rickets and vitamin D?

The link between vitamin D and rickets has been known for many years and is well understood by doctors and scientists. In the late 19th and early 20th centuries, doctors realized that taking cod liver oil, which contains vitamin D, helped to prevent and treat rickets in children. In the 1930's vitamin D was added to infant formula milk for the first time. Since then the number of children developing rickets has fallen dramatically and rickets has become a rare disease in the United States.

However, rickets does still develop in some children and the numbers of children affected has started to rise. The reasons why the number of children with rickets is rising aren't clear. It may be because doctors are better at diagnosing it, or because immigrants are moving away from the equator where there is more sun exposure or just more undetected rickets in general.

Vitamin D helps your body to control calcium and phosphate levels. If the blood levels of these minerals become too low, your body produces hormones that cause calcium and phosphate to be released from the bones, so it can have the right amount in the blood. This is what leads to soft and weak bones.

When you get very little vitamin D (severe vitamin D deficiency), your body may not absorb enough calcium. Hormones may start taking too much calcium from your bones; hormones that vitamin D usually keeps under control. This makes your bones soft and weak and rickets develops.

What does the research say about vitamin D and rickets?

The links between vitamin D and rickets are very clear and have been known for a long time, so there has been quite a lot of research in this area, compared to some other conditions. There are also national guidelines for doctors on preventing rickets, produced by the Endocrine Society and the American Academy of Pediatrics.¹⁶ The Endocrine Society also produces guidelines on the treatment of rickets.

Preventing rickets

Research has shown that the type of rickets that is caused by a lack of vitamin D and other minerals can be totally prevented by making sure your child gets enough vitamin D and calcium.

Vitamin D for babies and children

To develop their guidelines on preventing rickets, The American Academy of Pediatrics searched for all of the research carried out in the US, and the rest of the world, about rickets and vitamin D.

Having looked at all the research and analyzed it, the Academy has said that to prevent rickets, infants, children and adolescents need to have at least 400 IU of vitamin D a day.

They recommend that:

- Babies that are being breastfed or partly breastfed should have a vitamin D supplement of 400 IU a day. Babies should keep having a supplement until they are drinking at least one litre of whole milk or formula milk a day (children shouldn't drink whole milk until they are over one year old).
- All babies and children drinking less than one litre of infant for-

mula or whole milk a day should also take a supplement of 400 IU of vitamin D each day.

- Adolescents who don't get enough vitamin D from fortified milk or foods should take a vitamin D supplement of 400 IU a day.

Giving babies and children vitamin D supplements has been preventing rickets for many years. However, there isn't much research that has looked at whether the amount that babies and children are given is actually the right amount.

For example, doctors used to recommend that babies and children should have 200 IU vitamin D a day to prevent rickets, and this worked. Guidelines in Canada recommend that babies should be given 400 IU a day, but that this should increase to 800 IU a day in the winter months for babies living in the north of the country. The Endocrine Society in the US recommends that infants and children should have 400 IU or 600 IU of vitamin D a day, and that to get the best effect from vitamin D, they may need as much as 1,000 IU a day.

What the Vitamin D Council says

The Vitamin D Council recommends that infants have 1,000 IU per day and children have 1,000 IU a day per 25lbs of their body weight. Breast milk can provide most or all of this for infants, if the mother is getting enough vitamin D herself. If she isn't, then breast milk cannot provide much of the 1,000 IU a day requirement.

More research is needed to say exactly how much vitamin D is needed to prevent rickets. However, that research may never come. Something else that researchers and doctors also have to take into account is whether the amount of vitamin D children get is enough to meet other health needs, as well as to prevent rickets. The amount of vitamin D children need for other health reasons may be higher than what is needed to prevent rickets, though again, more research is needed.

Vitamin D in pregnancy

Some researchers have explored whether the amount of vitamin D a mother gets when she is pregnant may help to prevent rickets in her child.

How much vitamin D a woman has in her body decides how much vitamin D her baby will have when he or she is born. If you're very deficient (lacking) in vitamin D when you're pregnant, then your child is more likely to develop rickets. Women who have darker skin and women who don't expose their skin much to the sun are more likely to be deficient in vitamin D.

Research now shows that getting enough vitamin D during pregnancy is important for the health of your baby. Therefore, the American Academy of Paediatrics recommends that doctors and midwives should consider giving vitamin D supplements to pregnant women who might be deficient. The Endocrine Society and the Vitamin D Council suggest that all pregnant women need to take vitamin D supplements.

Vitamin D and calcium

Researchers have also explored the role of calcium and vitamin D in preventing rickets. Vitamin D helps calcium to work properly in your body and your body needs both to develop strong healthy bones. Research shows that babies and children who don't get enough calcium from the food and milk they have, are more likely to develop rickets.

Treating rickets

Rickets has been treated successfully with vitamin D since at least the 1930s, when doctors gave children one very large amount of vitamin D to treat the condition. Now, there is agreement among doctors that rickets should be treated with vitamin D supplements. This can either be given as one large amount, as weekly amounts or as small amounts given every day for two to three months.

More recent research has also looked at whether giving children a large amount of vitamin D just once is effective at treating rickets. Researchers have given children large amounts such as 200,000 or 600,000 IU vitamin D in one day and found that it was a safe and effective treatment. This type of treatment is called Stoss Therapy.

Some scientists suggest that rickets should be treated with 5,000 to 15,000 IU of vitamin D a day for three to four weeks and then a smaller dose thereafter.

Talk to your doctor about which type of treatment is best for your child; one large supplement, weekly or daily supplements. As well as giving vitamin D, doctors may also prescribe calcium supplements to treat rickets.

Key points from research

- The links between vitamin D and rickets are very clear and have been known for a long time.
- There are many national guidelines, including a number in the US, which tell doctors how to prevent rickets. These guidelines have been developed by reading and analyzing all of the research on vitamin D and rickets.

- Rickets can be prevented by making sure your child gets enough vitamin D and calcium.
- Babies that are breastfed or partly breastfed should be given a vitamin D supplement, unless the breastfeeding mother gets good amounts of vitamin D herself.
- Doctors and researchers haven't come to a definite answer about how much vitamin D supplement is enough to prevent rickets and ensure good bone health. However, it is likely at least 400 IU a day.
- It's important for the health of a baby for the mother to get enough vitamin D while she is pregnant.
- Research suggests that women who are more likely to be deficient in vitamin D during their pregnancy should take a vitamin D supplement to prevent rickets in their child.
- Babies and children who don't get enough calcium from the food and milk they have, are more likely to develop rickets
- Rickets can be treated successfully with vitamin D, calcium or sometimes both.



What does this mean for me?

If you're pregnant you should consider taking a vitamin D supplement, particularly if you have darker skin or get little sunshine on your skin. The Vitamin D Council recommends taking 4,000 IU to 6,000 IU of vitamin D every day if you're pregnant. Other organizations in the United States have set different recommended daily amounts, usually much lower. For example, the Food and Nutrition Board recommend 600 IU of vitamin D every day because they feel there is not enough research at this time to recommend higher amounts.

If you're breastfeeding your baby, either fully or in part, you may need to give your baby a vitamin D supplement every day. If you're getting enough vitamin D, your baby should be getting enough vitamin D from your milk. However, many women don't get enough vitamin D and if that is the case, you will need to give your baby a supplement. Not all organizations recommend the same amount of supplement for babies each day. Here is a list of the current recommendations from organizations in the United States:

- Vitamin D Council 1,000 IU/day
- Endocrine Society 400-1,000 IU/day
- Food and Nutrition Board 400 IU/day

If you're giving your baby only infant formula, which contains vitamin D, you may not need to give a supplement.

Older children and adolescents also need enough vitamin D to keep their bones healthy and prevent rickets. If your child isn't able to get vitamin D from being out in the sun, you should give him or her vitamin D supplements.

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