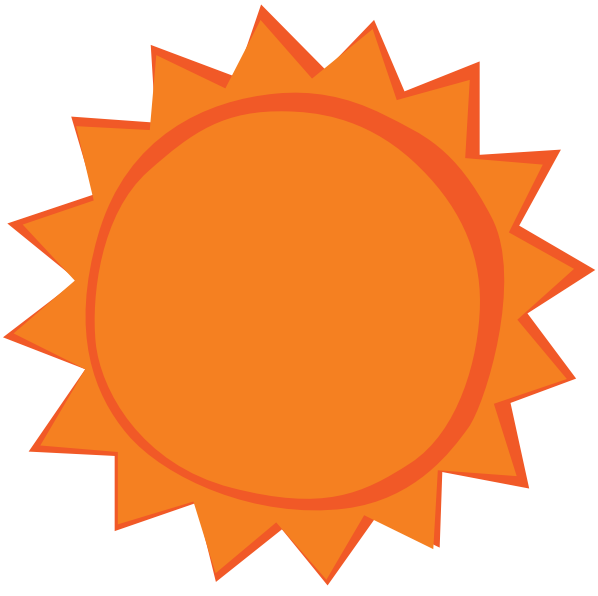
Vitamin D

Your guide to understanding vitamin D

Created by
VITAMIN D COUNCIL



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VITAMIN D COUNCIL

A public health nonprofit

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For more information on vitamin D, visit vitamindcouncil.org.

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What is Vitamin D?

Vitamin D is important for good overall health and strong and healthy bones. It's also an important factor in making sure your muscles, heart, lungs and brain work well and that your body can fight infection.

Your body can make its own vitamin D when you expose your skin to the sun. You can also get vitamin D from supplements and a very small amount comes from a few foods you eat.

The vitamin D that you make in your skin from sunlight and the vitamin D you get from supplements or food has to be changed by your body a number of times before it can be used. Once it's ready, your body uses it to manage the amount of calcium in your blood, bones and gut. It's also used to help cells all over your body to communicate properly.

What does vitamin D do?

Vitamins are chemicals that your body needs for good health. They are vital for everyone and ensure that your body works well, is able to fight illness and heal well.

The link between vitamin D and strong healthy bones was made many years ago. Doctors realized that sunlight, which allows you to produce vitamin D, or taking cod liver oil, which contains vitamin D, helped to prevent a bone condition called rickets in children. Today, vitamin D is seen as a vital part of good health and it's important not just for the health of your bones. Recent research is now showing that vitamin D may be important in preventing and treating a number of serious long term health problems.

Vitamin D isn't like most other vitamins. Your body can make its own vitamin D when you expose your skin to sunlight. But your body can't make other vitamins. You need to get other vitamins from the foods you eat. For example, you need to get vitamin C from fruits and vegetables.

> "VITAMIN D ISN'T LIKE MOST OTHER VITAMINS. YOUR BODY CAN MAKE ITS OWN VITAMIN D WHEN YOU EXPOSE YOUR SKIN TO SUNLIGHT"

Also what makes vitamin D unique compared to other vitamins, is that when your body gets its vitamin D, it turns vitamin D

into a hormone. This hormone is sometimes called “activated vitamin D” or “calcitriol.”

Getting the right amount of vitamin D doesn’t depend on the foods you eat. To get enough vitamin D you need to expose your skin to sunlight regularly and you may also need to take supplements. This makes getting the right amount a little more complex compared to other vitamins and minerals.

“GETTING THE RIGHT AMOUNT OF VITAMIN D DOESN'T DEPEND ON THE FOODS YOU EAT. TO GET ENOUGH VITAMIN D YOU NEED TO EXPOSE YOUR SKIN TO SUNLIGHT REGULARLY AND YOU MAY ALSO NEED TO TAKE SUPPLEMENTS. THIS MAKES GETTING THE RIGHT AMOUNT A LITTLE MORE COMPLEX COMPARED TO OTHER VITAMINS AND MINERALS”

Vitamin D is very important for strong bones. Calcium and phosphorus are essential for developing the structure and strength of your bones, and you need vitamin D to absorb these minerals. Even if you eat foods that contain a lot of calcium and phosphorus, without enough vitamin D, you can’t absorb them into your body.

Vitamin D is also important for general good health, and researchers now are discovering that vitamin D may be important for many other reasons outside of good bone health. Some functions that vitamin D helps with include:

- Immune system, which helps you to fight infection
- Muscle function
- Cardiovascular function, for a healthy heart and circulation
- Respiratory system, for healthy lungs and airways
- Brain development
- Anti-cancer effects

Doctors are still working to fully understand how vitamin D works within your body and how it affects your overall health.

If your body doesn’t get enough vitamin D to keep it healthy, this is called vitamin D deficiency. Severe vitamin D deficiency can sometimes cause a condition called rickets in children and a condition called osteomalacia in adults. Both of these conditions cause soft, thin, and brittle bones.

A lack of vitamin D has also been linked to some other conditions such as cancer, asthma, type-II diabetes, high blood pressure, depression, Alzheimer’s and autoimmune diseases like multiple sclerosis, Crohn’s and type-I diabetes.

Your body gets vitamin D mainly from sunlight, though very small amounts can also be found in a few foods. You can also get vitamin D by taking supplements.

How does vitamin D work?

Vitamin D mainly comes from your skin when it is exposed to sunlight. After that, your body changes the vitamin D so that it can be used.

When your skin is exposed to the sun, it produces vitamin D and sends it to your liver. If you take supplements or eat foods that contain vitamin D, your gut also sends the vitamin D to your liver. From here, your liver changes it to a substance called 25(OH)D. When your doctor talks about your vitamin D levels, he means the amount of 25(OH)D you have in your blood.

This chemical is sent all over your body where different tissues, including your kidney, turn it into activated vitamin D. This activated vitamin D is now ready to perform its duties. From here, it gets a little complicated, but you can think of activated vitamin D working in two ways:

- Manages calcium in your blood, bones and gut
- Helps cells all over your body to communicate properly

As you can see, vitamin D goes a long way from its original form from the skin, supplement or food. But without vitamin D, your body can't perform at its best.

Are you deficient in vitamin D?

For a number of reasons, many people aren't getting enough vitamin D to stay healthy. This is called vitamin D deficiency. You may not get enough vitamin D if:

- You don't get enough sunlight. Your body is usually able to get all the vitamin D it needs if you regularly expose enough bare skin to the sun. However, many people don't get enough sunlight because they spend a lot of time inside and because they use sunscreen. It's also difficult for some people to get enough vitamin D from the sun during the winter.

- You don't take supplements. It's very difficult to get enough vitamin D from the foods you eat.

- Your body needs more vitamin D than usual, for example if you're obese or pregnant.

Are certain people more likely to be vitamin D deficient?

There are some groups of people that are more likely to have vitamin D deficiency. The following people are more likely to be lacking in vitamin D:

- People with darker skin. The darker your skin the more sun you need to make the same amount of vitamin D as a fair-skinned person. For this reason, if you're Black, you're much more likely to have vitamin D deficiency than someone who is White.
- People who spend a lot of time indoors during the day. For example, if you're housebound, work nights or are in a hospital for a long time.
- People who cover their skin all of the time. For example, if you wear sunscreen or if your skin is covered with clothes.
- People that live far north, like Boston, London or Toronto. This is because there are fewer hours of overhead sunlight the further away you are from the equator.
- Older people. They tend to have thinner skin than younger people and this may mean that they can't produce as much vitamin D.
- Infants that are breastfed and aren't given a vitamin D supplement. If you're feeding your baby on breast milk alone, and you don't give your baby a vitamin D supplement or take a supplement yourself, your baby is more likely to be deficient in vitamin D.
- Pregnant women.
- People who are very overweight (obese).

What are the symptoms of vitamin D deficiency?

The symptoms of vitamin D deficiency are sometimes vague and can include tiredness and general aches and pains. Some people may not have any symptoms at all.

If you have a severe vitamin D deficiency you may have pain in your bones and weakness, which may mean you have difficulty getting around. You may also have frequent infections. However, not everyone gets these symptoms.

If you think you may have vitamin D deficiency, you should see your physician, or have a blood test to check your vitamin D levels.

How do I know if I'm deficient in vitamin D?

The way doctors measure if you're deficient in vitamin D is by testing your 25(OH) D level, but most doctors just call this a vitamin D test. Getting this blood test is the only accurate way to know if you're deficient or not. The level will be presented as a number in units of ng/ml in the United States (in units of nmol/l elsewhere). Here is how different organizations interpret your levels.

25(OHD) GUIDLINES FROM VARIOUS ORGANIZATIONS

	Vitamin D Council	Endocrine Society	Food and Nutrition Board	Testing Laboratories
Deficient	0-30 ng/ml	0-20 ng/ml	0-11 ng/ml	0-31 ng/ml
Insufficient	3-39 ng/ml	21-29 ng/ml	12-20 ng/ml	———
Sufficient	40-80 ng/ml	30-100 ng/ml	>20 ng/ml	32-100 ng/ml
Toxic	>150 ng/ml	———	———	———

Live elsewhere? To convert these into nmol/l, multiply these numbers by 2.5. Now you're in nmol/l.

How to get the vitamin D your body needs

The way doctors measure if you're deficient in vitamin D is by testing your 25(OH) D level, but most doctors just call this a vitamin D test. Getting this blood test is the only accurate way to know if you're deficient or not. The level will be presented as a number in units of ng/ml in the United States (in units of nmol/l elsewhere). Here is how different organizations interpret your levels.

The two main ways to get vitamin D are by exposing your bare skin to sunlight and by taking vitamin D supplements. You can't get the right amount of vitamin D your body needs from food.

> "THE TWO MAIN WAYS TO GET VITAMIN D ARE BY EXPOSING YOUR BARE SKIN TO SUNLIGHT AND BY TAKING VITAMIN D SUPPLEMENTS. YOU CAN'T GET THE RIGHT AMOUNT OF VITAMIN D YOUR BODY NEEDS FROM FOOD"

The most natural way to get vitamin D is by exposing your bare skin to sunlight (ultraviolet B rays). This can happen very quickly, particularly in the summer. You don't need to tan or burn your skin to get vitamin D. You only need to expose your skin for around half the time it takes for your skin to turn pink and begin to burn. How much vitamin D you produce from sun exposure depends on the time of day, where you live in the world and the color of your skin. The more skin you expose, the more vitamin D is produced.

You can also get vitamin D by taking supplements. This is a good way to get vitamin D if you can't get enough sunlight, or if you're worried about exposing your skin. Vitamin D3 is the best kind of supplement to take. It comes in a number of different forms, such as tablets and capsules, but it doesn't matter what form you take, or what time of the day you take it.

Different organizations recommend different amounts of vitamin

D supplement to take each day. The Vitamin D Council recommends taking larger amounts of vitamin D each day than other organizations, because smaller amounts aren't enough to give you what your body needs. Most people can take vitamin D supplements with no problems. However, if you have certain health problems or take certain medicines, you may need to take extra care.

Your body gets most of the vitamins and minerals it needs from the foods that you eat. However, there are only a few foods that naturally contain vitamin D. Most foods that contain vitamin D only have small amounts, so it's almost impossible to get what your body needs just from food.

Because there are only small amounts of vitamin D in food there are only two sure ways to get enough vitamin D:

- Exposing your bare skin to sunlight to get ultraviolet B (UVB)
- Taking vitamin D supplements

Exposing your bare skin to sunlight (ultraviolet B)

Your body is designed to get the vitamin D it needs by producing it when your bare skin is exposed to sunlight. The part of the sun's rays that is important is ultraviolet B (UVB). This is the most natural way to get vitamin D.

You don't need to tan or to burn your skin in order to get the vitamin D you need. Exposing your skin for a short time will make all the vitamin D your body can produce in one day. In fact, your body can produce

> "HUMAN SKIN CAN MAKE LARGE AMOUNTS OF VITAMIN D WHEN LOTS OF SKIN IS EXPOSED AND THE SUN IS HIGH IN THE SKY"

Large amounts of vitamin D3 (cholecalciferol) are made in your skin when you expose all of your body to summer sun. This happens very quickly; around half the time it takes for your skin to turn pink and begin to burn. This could be just 15 minutes for a very fair skinned person, yet a couple of hours or more for a dark skinned person.

10,000 to 25,000 IU of vitamin D in just a little under the time it takes for your skin to turn pink. You make the most vitamin D when you expose a large area of your skin, such as your back, rather than a small area such as your face or arms.

There are a number of factors that

affect how much vitamin D your body produces when your skin is exposed to sunlight. The amount of vitamin D you get from exposing your bare skin to the sun depends on:

- The time of day– your skin produces more vitamin D if you expose it during the middle of the day
- Where you live– the closer to the equator you live, the easier it is for you to produce vitamin D from sunlight all year round.
- The color of your skin– pale skins make vitamin D more quickly than darker skins
- The amount of skin you expose– the more skin your expose the more vitamin D your body will produce

THE TIME OF YEAR AND TIME OF DAY

When the sun's rays enter the Earth's atmosphere at too much of an angle, the atmosphere blocks the UVB part of the rays, so your skin can't produce vitamin D. This happens during the early and later parts of the day and during most of the day during the winter season.

The closer to midday you expose your skin, the better this angle and the more vitamin D is produced. A good rule of thumb is if your shadow is longer than you are tall, you're not making much vitamin D. In winter, you'll notice that your shadow is longer than you for most of the day, while in summer, your shadow is much shorter for a good part of the middle of the day.

WHERE YOU LIVE

The equator is an imaginary line on the Earth's surface halfway between the North Pole and South Pole, which divides the Earth into the Northern Hemisphere and Southern Hemisphere. The further away you are from the equator, the more of an angle the sun will hit the atmosphere at, and the less UVB there will be available for you to produce vitamin D, particularly during the winter time.

In the summer, when the Earth rotates, the angle improves and more UVB reaches the places far away from the equator, allowing you to produce vitamin D outside of winter months.

For example, in the southern United States, in places like Florida, your body can produce vitamin D most of the year, while in more northern places, like New York City or Boston, you can't produce much vitamin D from November through March. If you

WHAT ABOUT THE SOUTHERN HEMISPHERE?

In Buenos Aires, you can't produce vitamin D in June. In Cape Town, you can't produce much vitamin D between mid-May and August. If you live as far south as the bottom tip of Chile and Argentina, you can't produce vitamin D April through October! If you're skin is darker, these windows are even longer by a month or two.

Live in Johannesburg? You can produce vitamin D all year round.

live even further north, like in Edmonton, Canada, you can't produce vitamin D from October through April. These times are even longer (by a month or two) if you're skin type is darker.

YOUR SKIN TYPE

Melanin is a substance that affects how light or dark your skin color is. The more melanin you have, the darker your skin color. The amount of melanin you have in your skin affects the amount of vitamin D you can produce.

Melanin protects against skin damage from too much UVB exposure, so darker skins with more melanin allow less UVB to enter the skin. With less UVB getting through the skin, less vitamin D is produced each minute. This is why if you're dark skinned, you need more sun exposure to make vitamin D than if you're fair skinned.

The paler your skin type the more easily your skin can produce vitamin D. So, if you have skin type I to III, you produce vitamin D more quickly than if you have skin type IV to VI. For example, if you have skin type I, it might take around 15 minutes of sun exposure to get the vitamin D you need, while if you have skin type V or VI, it might take up to six times longer (even up to 2 hours).

The table below shows the different skin types:

DIFFERENT SKIN TYPES

Skin Type	Skin color	Skin characteristics
I	White; very fair; red or blond hair; blue eyes; freckles	Always burns, never tans
II	White; fair; red or blond hair; blue, hazel, or green eyes	Usually burns, tans with difficulty
III	Cream white; fair; with any eye or hair color; very common	Sometimes mild burn, gradually tans
IV	Brown; typical Mediterranean Caucasian skin	Rarely burns, tans with ease
V	Dark Brown; mid-eastern skin types	Very rarely burns, tans very easily
VI	Black	Never burns, tans very easily

Because of all these factors – your skin type, where you live and the time of day or season – it can be difficult to work out how much time you need to spend exposing your skin to the sun in order to get the vitamin D you need. A good rule of thumb is to get half the sun exposure it takes for your skin to turn pink to get your vitamin D and expose as much skin as possible.

IT CAN GET COMPLICATED

Specific recommendations are not easy! Skin types are different and depending on the day of year, place and time of day, recommendations vary. Let's see how complicated it can get if we expose a quarter of our body to the sun:

- At noon in Miami, an individual with skin type III would probably need about 6 minutes of exposure to the sun to make 1,000 IU of vitamin D in summer and 15 minutes in winter.
- Someone with skin type V would probably need around 15 minutes in summer and 30 minutes in winter to make 1,000 IU
- At noon in Boston during summer, an individual with skin type III would probably need about 1 hour of sun exposure to make 1,000 IU of D.
- Someone with skin type V would probably need about 2 hours of exposure.
- During the winter months in Boston, it's not possible for anyone to make vitamin D from the sun, no matter their skin type.

And that's assuming you're exposing a quarter of your body. As you can see, there are lots of things that factor into vitamin D production. The best recommendation is to get half the sun exposure it takes for your skin to turn pink.

OTHER FACTORS

There are other factors which can affect the amount of vitamin D your body makes from exposure to the sun. These are:

- The amount of skin you expose. The more skin you expose, the more vitamin D you can produce.
- How old you are. As you get older, your skin has a harder time producing vitamin D.
- Whether you're wearing sunscreen. Sunscreen blocks a lot of vitamin D production.
- The altitude you're at. The sun is more intense on top of a mountain than at the beach. This means you make more vitamin D the higher up you are (at higher altitudes).
- Whether it is cloudy. Less UVB reaches your skin on a cloudy day and your skin makes less vitamin D.
- Air pollution. Polluted air soaks up UVB or reflects it back into space. This means that if you live somewhere where there is lots of pollution, your skin makes less vitamin D.
- Being behind glass. Glass blocks all UVB, so you can't make vitamin D if you're in sunlight, but behind glass.
- The amount of skin you expose. The more skin you expose, the more vitamin D you can produce.

INDOOR TANNING

Your skin can also make vitamin D if you use an indoor tanning bed. As with natural sunlight, making the vitamin D you need from a tanning bed happens within minutes. You don't need to tan your skin, or use a tanning bed for a long time to get the vitamin D you need.

If you choose to use a tanning bed, the Vitamin D Council recommends using the same common sense you use in getting sunlight.

This includes:

- Getting half the amount of exposure that it takes for your skin to turn pink
- Using low-pressure beds that has good amount of UVB light, rather than high-intensity UVA light

Exposing your skin to UVB and the risk of skin cancer

Exposing your skin to the sun for too long, so that your skin starts to burn can be dangerous. This is because it can increase your risk of developing skin cancers. Research to date shows that moderate but frequent sun exposure is healthy but overexposure and intense exposure can increase your risk of skin cancer.

After you have exposed your skin for half the time it takes for you to turn pink, cover up with clothing and go into the shade. Using sunscreen is not recommended over shade and clothing to protect your skin, because it hasn't consistently been shown to prevent all types of skin cancers. But if you do want to use sunscreen, use a sunscreen that blocks both UVA light and UVB light.

PROTECTING THE SKIN

While covering up to prevent too much sun exposure is an important step in protecting yourself from skin cancer, research has not always shown that sunscreen is the safest and most effective method.

Research has shown that sunscreen helps prevent squamous cell carcinoma, but has no effect in preventing basal cell carcinoma. For melanoma, research has been contradictory. Some research shows that sunscreen prevents melanoma, while other research shows that it increases your chance of getting melanoma.

For these reasons the Vitamin D Council believes that covering up with clothing and/or going into the shade (after you get a little bit of sun exposure), is a safer way to protect yourself from too much sun exposure.

Infants have delicate skin which burns more easily, so it's important to use extra care with your baby. This is why most doctors recommend giving your infant vitamin D supplement and not exposing your baby's skin to the sun at all.

For older children, the advice is the same as for adults. You can expose your child's skin for half the time it takes to burn in order to get the vitamin D they need. After that, make sure they cover up with clothes, shade and if you wish, sunscreen.

If you have had skin cancer or if you're worried about exposing your skin to the sun, or that of your child, you can take vitamin D supplements instead.

Vitamin D supplements

In the 21st century, it's hard to get daily full body sun exposure. On the days that you can't get enough sun exposure, taking a supplement is an effective way to get the vitamin D your body needs.

HOW MUCH VITAMIN D DO I NEED TO TAKE?

Different organizations recommend different daily intakes. Below are the recommendations from some organizations in the United States.

The Food and Nutrition Board recommended daily intakes are the official recommendations by the United States government.

Why are the recommendations so different? Some researchers believe that there isn't enough evidence to support taking higher amounts of vitamin D yet. On the other hand, some researchers believe that research is proving, or will prove, that taking lower amounts isn't enough, and so they recommend much higher amounts.

RECOMMENDED DAILY INTAKES

	Vitamin D Council	Endocrine Society	Food and Nutrition Board
Infants	1,000 IU/day	400-1,000 IU/day	400 IU/day
Children	1,000 IU/day per 25lbs of body weight	600-1,000 IU/day	600 IU/day
Adults	5,000 IU/day	1,500-2,000 IU/day	600 IU/day, 800 IU/day for seniors

CAN YOU TAKE MORE THAN THE RECOMMENDED AMOUNTS?

Yes, you can, but attention and care is needed if you choose to take more supplement than in the recommendations above. Here are the safe maximums set by the same organizations:

UPPER LIMITS SET BY VARIOUS ORGANIZATIONS

	Vitamin D Council	Endocrine Society	Food and Nutrition Board
Infants	2,000 IU/day	2,000 IU/day	1,000-1,500 IU/day
Children	2,000 IU/day per 25lbs of body weight	4,000 IU/day	2,500-3,000 IU/day
Adults	10,000 IU/day	10,000 IU/day	4,000 IU/day

Vitamin D is fat-soluble, which means your body has a hard time getting rid of it if you take too much. The Vitamin D Council recommends taking no more than the upper limit, meaning do not take any more than 10,000 IU/day for adults.

While these amounts seem like a lot, keep in mind that your body can produce 10,000 to 25,000 IUs of vitamin D after a little bit of full body sun exposure. Vitamin D toxicity, where vitamin D can be harmful, usually happens only if you take 40,000 IU a day or more for a couple of months or longer. However to be safe, we recommend taking no more than 10,000 IU/day unless you work with a doctor.

In some diseases, researchers have studied the safety and benefits (if any) of these types of high doses of vitamin D. If you would like to consider taking more than 10,000 IU/day, the Vitamin D Council recommends taking the following precautions:

- Work with your doctor
- Test your vitamin D [25(OH)D] levels every 3 months and make sure that your blood levels are within the safe and healthy range

WHAT FORM OF VITAMIN D SHOULD I TAKE AND HOW SHOULD I TAKE IT?

The Vitamin D Council recommends taking vitamin D3 rather than vitamin D2. Vitamin D3 is the type of vitamin D your body produces in response to sun exposure, while vitamin D2 is not. In the United States, most over-the-counter vitamin D supplements are D3, but check to make sure. Vitamin D2 is sometimes prescribed by doctors because that is what pharmacies have available. If your doctor prescribes you D2, ask them if you can take vitamin D3 instead.

Vitamin D3 supplements aren't vegetarian and some parts of the production in making them occur outside the United States. If you have ethical concerns with

taking vitamin D3, then sun exposure is a good option and vitamin D2 can be an alternative.

Other than that, it doesn't matter what form of vitamin D you take, whether it's in a capsule, tablet or liquid drop. For most people, vitamin D is easily absorbed in the body and you don't need to worry about what time of day you take it or whether you take it with meals.

Cod liver oil contains vitamin D. However, the Vitamin D Council recommends against taking cod liver oil because of the high amount of vitamin A there is in cod liver oil compared to vitamin D. Vitamin A is also a fat-soluble vitamin, so your body has a hard time getting rid of it. Too much vitamin A can be harmful.

> "RESEARCH SHOWS THAT VITAMIN D3 IS THE BETTER TYPE OF VITAMIN D COMPARED TO VITAMIN D2"

WHAT IF I'M HAVING TROUBLE ABSORBING VITAMIN D SUPPLEMENTS?

Some people get tested for vitamin D and find, despite taking vitamin D regularly, that they're still not getting enough vitamin D. This means your body is having a hard time absorbing your vitamin D supplements. The Vitamin D Council recommends that if you're having this problem, you can try these options:

- Take vitamin D under your tongue rather than swallowing it (sublingually)
- Try relying on more sun exposure
- Increase your intake

Be sure to test your vitamin D [25(OH)D] levels to make sure your new regimen is safe and effective. The Vitamin D Council recommends testing every 3-6 months if you're trying different regimens.

CAN ANYONE TAKE VITAMIN D SUPPLEMENTS?

Most people can take vitamin D supplements with no problems. However, care is needed in a few situations. These situations include:

- If you're taking certain other medicines: digoxin for an irregular heartbeat (atrial fibrillation) or thiazide diuretics such as hydrochlorothiazide or bendroflumethiazide (commonly used to treat high blood pressure). In this situation, don't take high doses of vitamin D. You should also have your digoxin level monitored more closely if you're taking vitamin D.
- Don't take vitamin D if you have high blood calcium levels, unless under the care of your physician.
- If you have one of these medical conditions: primary hyperparathyroidism, Hodgkin's or non-Hodgkin's lymphoma, a granulomatous disease, kidney stones, some types of kidney disease, liver disease or hormonal disease, you should get advice from a specialist.
- You may need more than the usual dose of vitamin D if you're taking certain medicines which interfere with vitamin D. These include: carbamazepine, phenytoin, primidone, barbiturates and some medicines used for the treatment of HIV infection.

CAN I GET SUN EXPOSURE AND TAKE SUPPLEMENTS?

Yes! In fact, that is the Vitamin D Council's recommendation. On days that you do not get enough full body sun exposure, it is important to take a supplement. For most people on the Monday-Friday indoor work schedule, that means taking a supplement 5-6 days a week and getting sun exposure on a day or two during the weekend.

> "ON DAYS THAT YOU DO NOT GET ENOUGH FULL BODY SUN EXPOSURE, IT IS IMPORTANT TO TAKE A SUPPLEMENT"

Can I get vitamin D from my diet?

There are small amounts of vitamin D in a few foods, which makes it nearly impossible to get what you need from food. However, these foods include:

- Fatty fish
- Beef liver
- Egg yolks
- Fortified milk and orange juice
- Fortified cereals
- Instant formula

Fatty fish can have 400-1,000 IU per serving. Other foods listed have much smaller quantities, like 100-200 IU per serving.

> "THE VITAMIN D COUNCIL BELIEVES THAT TRYING TO GET ENOUGH VITAMIN D FROM YOUR DIET IS UNLIKELY TO GIVE YOU THE VITAMIN D YOU NEED"

Testing for vitamin D

While having healthy sun exposure and supplementation habits can ensure you're getting good amounts of vitamin D, the only way to truly know if you're getting enough is by getting a blood test for vitamin D. The blood test you need is called a 25(OH)D blood test.

You can get a blood test at your doctor's or you can do an in-home test or get a test at a laboratory. All of these methods of testing should give you acceptable results.

Your tests result will show whether you're getting enough vitamin D or not, and whether you may need to take supplements or expose your skin to the sun more. Different organizations in the United States recommend different ideal vitamin D levels. The Vitamin D Council suggests that a level of 50 ng/ml is the ideal level to aim for.

How do I get tested?

There are three ways to get tested:

1. ASK YOUR DOCTOR FOR A VITAMIN D TEST

Be specific and ask for a 25(OH)D test. There is another type of blood test for vitamin D, called a $1,25(OH)_2D$ test, but the 25(OH)D test is the only one that will tell you whether you're getting enough vitamin D. If your health insurance covers a 25(OH)D test, this is a good way to work with your doctor to get tested.

2. ORDER AN IN-HOME TEST

These tests are sent to your home. You prick your finger and put a drop of blood on to some blotter paper. You send the paper to a laboratory to be tested. These are an alternative if you don't want to go to your doctor just for a vitamin D test, or if your insurance doesn't cover a test. There are a few companies online that sell these tests.

3. ORDER A TEST ONLINE AND GET BLOOD WORK DONE AT A LABORATORY

In the United States, there are a few websites that allow you to bypass your doctor and go straight to the testing laboratory. You can buy a 25(OH)D test from these companies and have the test itself done at your nearest LabCorp. These tests are a little more expensive than in-home tests.

All three ways of getting tested should give you an accurate result.

What do your results mean?

When you get your test results you will see a number in units of ng/ml, for example, 50 ng/ml. These are the units that health professionals in the United States use. Elsewhere in the world, vitamin D blood test results are given in units of nmol/l.

These are the ranges that different organizations in the United States use to say whether you're severely lacking in vitamin D (deficient), mildly lacking in vitamin D (insufficient) or whether you're getting enough vitamin D (sufficient):

CONVERTING FROM NMOL/L TO NG/ML

To convert a test result measured in nmol/l to one measured in ng/ml, divide the nmol/l number by 2.5. For example, 50 nmol/l is the same as 20 ng/ml (50÷2.5).

To convert a test result measured in ng/ml to one measured in nmol/l, multiply the ng/ml number by 2.5. For example, 20 ng/ml is the same as 50 nmol/l (20 x 2.5).

25(OH)D GUIDELINES FROM VARIOUS ORGANIZATIONS

	Vitamin D Council	Endocrine Society	Food and Nutrition Board	Testing Laboratories
Deficient	0-30 ng/ml	0-20 ng/ml	0-11 ng/ml	0-31 ng/ml
Insufficient	31-39 ng/ml	21-29 ng/ml	12-20 ng/ml	———
Sufficient	40-80 ng/ml	30-100 ng/ml	>20 ng/ml	32-100 ng/ml
Toxic	>150 ng/ml	———	———	———

This table was also shown on page 10.

The Vitamin D Council suggests that a level of 50 ng/ml is the ideal level to aim for. This is why the Council recommends that adults take 5,000 IU/day of vitamin D supplement in order to reach and stay at this level.

"THE VITAMIN D COUNCIL SUGGESTS THAT A LEVEL OF 50 NG/ML IS THE IDEAL LEVEL TO AIM FOR"

The Endocrine Society recommends taking a vitamin D supplement of around 2,000 IU/day to reach and stay above a level of 30 ng/ml. Lastly, the Food and Nutrition Board recommends 600 IU/day of vitamin D supplement because they believe 20 ng/ml is the ideal level to aim for.

What should you do based on your test results?

- If you tested low and want a higher level, you need to get more sun exposure or take a daily supplement with more vitamin D.
- If you tested and are right where you want to be, continue your supplement and sun exposure routine. Keep in mind that your level in the summer is probably higher than in the winter, with more sun and UVB. So you may need to supplement more in the winter than in the summer to have the same vitamin D level.
- If you tested high and want a lower level, you need to take a smaller daily supplement with less vitamin D.

You do not want to have a level over 100 ng/ml, and in fact, anything over 150 ng/ml is considered toxic.

"KEEP IN MIND THAT YOUR LEVEL IN THE SUMMER IS PROBABLY HIGHER THAN IN THE WINTER, WITH MORE SUN AND UVB. SO YOU MAY NEED TO SUPPLEMENT MORE IN THE WINTER THAN IN THE SUMMER TO HAVE THE SAME VITAMIN D LEVEL"

Am I getting too much vitamin D?

Although most people take vitamin D supplements without any problems, it's possible to take too much. This is called vitamin D toxicity. Vitamin D toxicity, where vitamin D can be harmful, usually happens if you take 40,000 IU per day for a couple of months or longer, or take a very large one-time dose.

Vitamin D is fat-soluble, which means your body has a hard time getting rid of it if you take too much. When you take large amounts of vitamin D, your liver produces too much of a chemical called 25(OH)D.

When your 25(OH)D levels are too high, this can cause high levels of calcium to develop in your blood. High blood calcium is a condition called hypercalcemia.

The symptoms of hypercalcemia include:

- Feeling sick or being sick
- Poor appetite or loss of appetite
- Feeling very thirsty
- Passing urine often
- Constipation or diarrhea
- Abdominal pain
- Muscle weakness or pain
- Feeling confused
- Feeling tired

How do I know if I have taken too much?

A blood test to measure your 25(OH)D levels can tell you whether you have too high of vitamin D levels. If your 25(OH)D levels are above 150 ng/ml, this is considered potentially toxic and potentially harmful to your health. You know if your 25(OH)D levels are toxic by a blood test to measure calcium. If calcium is high and 25(OH)D is high, then you are getting too much vitamin D.

Very high levels of 25(OH)D can develop if you:

- Take more than 10,000 IU/day (but not equal to) everyday for 3 months or more. However, vitamin D toxicity is more likely to develop if you take 40,000 IU/day everyday for 3 months or more.
- Take more than 300,000 IU in a 24 hour period.

If you have taken this much vitamin D, seek medical attention. Your health care providers will get your calcium and 25(OH) D levels tested.

The current recommended daily allowances for vitamin D set by the Food and Nutrition Board are conservative, so you don't need to feel worried about toxicity if you take more than their recommended daily allowance.

What should I do if I think I have taken too much vitamin D?

Have you taken more than 300,000 IU in the past 24 hours OR have you been taking more than 10,000 IU/day for the past three months or longer?

- If yes, check to see if you have symptoms of toxicity (listed on previous page); symptoms like feeling sick, feeling thirsty, constipation or diarrhea, poor appetite and feeling confused. If so, you may have hypercalcemia and need medical attention.
- If you do not have any symptoms, you likely do not have hypercalcemia. However, you should get a blood test for 25(OH) D and make sure that you do not have a level above 150 ng/ml. Consider lowering your vitamin D dose.
- If no, you likely do not have hypercalcemia and are not toxic. If you are still concerned, you may choose to get a blood test to measure 25(OH)D to see what your levels are.

WHAT ABOUT CHILDREN?

The more you weigh, the more vitamin D your body can handle; the less you weigh, the less vitamin D your body can handle. The cutoffs (listed on page 28) of 300,000 IU in 24 hours or more than 10,000 IU/day for three or more months apply to average adult weight (125-200 lbs).

So, how do you know if your child has gotten too much vitamin D?

- For children that weigh 25 lbs or less, more than 50,000 IU in 24 hours or 2,000 IU/day for over three months is too much and potentially toxic.
- For children that weigh between 25 and 50 lbs, more than 100,000 IU in 24 hours or 4,000 IU/day for over three months is too much and potentially toxic.
- For children that weigh between 50 and 75 lbs, more than 150,000 IU in 24 hours or 6,000 IU/day for over three months is too much and potentially toxic.
- For children that weigh between 75 lbs and 100 lbs, more than 200,000 IU in 24 hours or 8,000 IU/day for over three months is too much and potentially toxic.

If your child has taken too much vitamin D, seek medical attention.

I ALREADY TESTED MY 25(OH)D. IS MY LEVEL TOO HIGH?

If your level is greater than 150 ng/ml, this is considered too high and potentially toxic. Seek medical attention if you have symptoms of hypercalcemia (listed above). If you do not have symptoms, consider lowering your level.

If your level is not greater than 150 ng/ml, then you are not potentially toxic in vitamin D.

The vitamin D debate

You may have noticed in your reading that recommendations for vitamin D are all over the place. You might be asking, why does the Food and Nutrition Board recommend 600 IU of vitamin D per day, the Endocrine Society recommend 1,500-2,000 IU of vitamin D per day and the Vitamin D Council recommend 5,000 IU of vitamin D per day? That's quite the range! What's safe? What's too low? Who can I trust?

The reason why recommendations are so different is that right now, there is quite the debate going on in how much vitamin D you need. This debate probably won't be resolved for another ten years, until we have a little more research. We'll explain.

While vitamin D was discovered in the early part of the 20th century, how much you need hasn't been well understood for almost a hundred years. Before 1997, the recommended daily allowance was set based on what we call "anecdotal evidence," meaning evidence from small, sometimes personal observations.

When children got rickets, a common treatment was to give cod liver oil, which contains vitamin D. Most cod liver oil had 400 IU of vitamin D and since it seemed that cod liver oil both treated and prevented rickets, 400 IU seemed like a good recommendation for children and adults.

In 1997, the Food and Nutrition Board commissioned an organization called the Institute of Medicine to review research on vitamin D and set national recommendations for the United States and Canada. What they found: we need more research. So they left the recommendation alone.

Since then, we have seen an explosion in vitamin D research. Enough new research where there is now a debate on how the research should guide us.

For starters, we now have a very good idea of how

RECOMMENDED INTAKE AND BLOOD LEVELS IN 2013

	Daily intake	25(OH)D Levels
Food and Nutrition Board	600 IU/day	> 20 ng/ml
Endocrine Society	1,500-2,000 IU/day	> 30 ng/ml
Vitamin D Council	5,000 IU/day	> 40 ng/ml

much vitamin D humans traditionally got, before we became a more agricultural and urban society. Scientists looked at the vitamin D levels of hunter gatherers in Africa who were getting year-round full-body sun exposure. What did they find? They found that these hunter gatherers had average 25(OH)D levels of 46 ng/ml, levels twice that of the average American!

Many organizations (including the Vitamin D Council) believe this tells us how much vitamin D we should be getting. For whatever reason, the human body was designed to make lots of vitamin D (if given adequate sun exposure), and we say probably for good reason. To achieve the same vitamin D levels of traditional living hunter-gatherers, it takes most indoor-living adults a supplement of 4,000-5,000 IU/day to achieve the same levels. That is why you often see recommendations this high, to mimic how much vitamin D humans traditionally got, before we shifted to an indoor society.

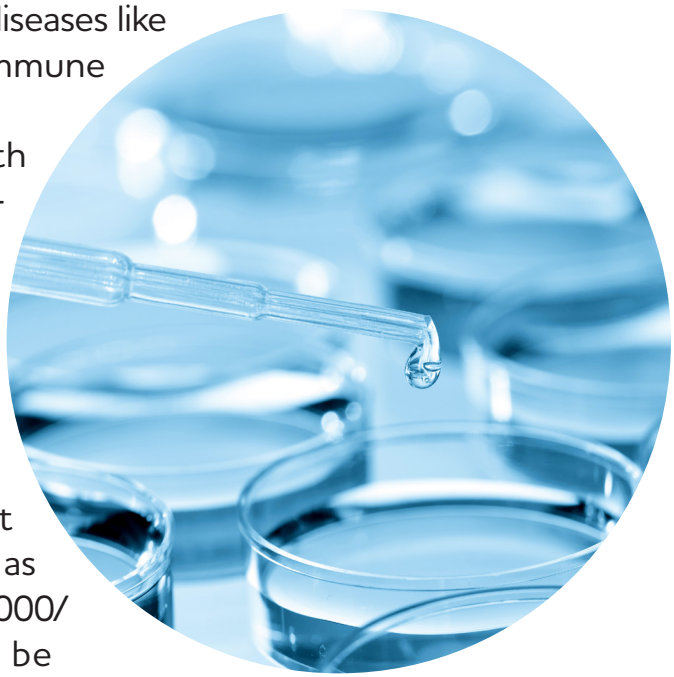
However, some public health officials say not so fast. In medicine, scientists and doctors usually like to see what are called phase III randomized controlled trials before they approve a drug for use. A phase III randomized controlled trial is a study that involves thousands of people. The people in these studies either take the drug or take a dummy pill, to see if the drug is better and reasonably safe compared to a dummy pill.

Although vitamin D is no drug, policy makers have decided that we need to put vitamin D to the test, too, before we can start recommending it in larger amounts. These tests are underway. There are several trials in progress where they are giving thousands of participants either vitamin D or a dummy pill. They will follow these participants for many years, seeing which ones develop cancers, heart disease and more, to see what the specific benefit of vitamin D is.

Until then, the Food and Nutrition Board says there isn't enough evidence to publicly recommend higher intakes. In 2010, they set a recommendation of 600 IU/day for adults.

Their reasoning: there is sufficient evidence you need this much for bone health, but there isn't enough evidence to see if

vitamin D helps for a variety of other diseases – diseases like cancers, cardiovascular disease, diabetes, autoimmune disorders and more.



While many organizations disagreed with this recommendation (the Endocrine Society recommends you need at least 1,500-2,000 IU/day for bone health), it looks like public recommendations aren't going to change anytime soon. Most trials looking at higher amounts of vitamin D won't be complete until 2020.

However, some scientists and organizations – including the Vitamin D Council – say that until research proves that we don't need as much as hunter gatherers, intakes in the range of 4,000-5,000/day should be the recommendation.

Still wondering what is safe? The upper limit is widely considered 10,000 IU/day, meaning that as long as you take 10,000 IU/day or less, you're taking a safe amount.

VITAMIN D TRIALS UNDERWAY

Name	Place	Participants	Amount of vitamin D	Outcomes	Year of results
VITAL	USA	20,000	2,000 IU/day	Cancer and heart disease	2017
FIND	Finland	18,000	1,600 IU or 3,200 IU	Cancer, heart disease & diabetes	2020
VIDAL	UK	20,000	60,000 IU/month	Longevity and others	2020

The trials underway that public health officials are waiting for.

Vitamin D during pregnancy and breastfeeding

Getting the right nutrients and eating well when you're pregnant or breastfeeding is important for your baby's growth and development. Vitamin D helps you to develop strong and healthy bones and it does the same for your developing baby.

If you don't get enough vitamin D when you're pregnant, your baby's bones can become soft. This means that they are more likely to break, and your baby is also more likely to develop a bone condition called rickets. Getting enough vitamin D when you're pregnant helps your baby get enough vitamin D too, and also increases your chances of having an uncomplicated pregnancy.

Breastfeeding helps you to bond with your baby, but it also provides your baby with most food and nutrients that he or she needs to grow and develop, including most vitamins and minerals. The foods you eat are important, as the nutrients from these pass from you to your baby in your breast milk.

> "IF YOU'RE NOT GETTING ENOUGH VITAMIN D YOURSELF, THEN IT'S VERY IMPORTANT TO GIVE YOUR BABY A VITAMIN D SUPPLEMENT"

Depending on how much vitamin D you're getting as the breastfeeding mother, your breast milk may or may not provide vitamin D for your baby. If you're not getting enough vitamin D yourself, then it's very important to give your baby a vitamin D supplement.

Please read this section carefully so you understand vitamin D nutrition during pregnancy and then whether you need to supplement your baby or not with vitamin D, and whether your breast milk has any vitamin D in it.

How much vitamin D do I need during pregnancy?

Many women in the United States don't get enough vitamin D when they are pregnant. You may be more likely to be deficient in vitamin D if you:

- Are obese (overweight)
- Spend a lot of time indoors, or are covered up when you're in the sun
- Have dark skin

How much vitamin D you need when you're pregnant is a complicated subject and one which doctors and scientists have yet to agree on. Not all organizations recommend the same amount of supplement each day.

Below is a list of the current recommendations for pregnant women from organizations in the United States.

In two recent studies from the University of South Carolina, a group of researchers found that pregnant women need to take 4,000 IU of vitamin D everyday to make sure that their newborn child has enough when he or she is born.

The researchers also found that women who took 4,000 IU everyday during pregnancy were more likely to have an uncomplicated birth. Whereas women taking less vitamin D than this were more likely to have a baby born early (before the due date) or to develop gestational diabetes, preeclampsia, or infections. Women taking less vitamin D were also more likely to have a c-section.

This research is the reason why the Vitamin D Council recommends taking 4,000 IU to 6,000 IU of vitamin D every day if you're pregnant. This will ensure that you're getting enough vitamin D as a pregnant mother, and getting enough vitamin D to your unborn child.

RECOMMENDED DAILY INTAKE FOR PREGNANT WOMEN

Vitamin D Council	4,000-6,000 IU/day
Endocrine Society	1,500-2,000 IU/day
Food and Nutrition Board	600 IU/day

How much vitamin D do I need if I breastfeed and how much does my baby need?

Here vitamin D gets a little more complicated! The question is whether you should give your baby a vitamin D supplement or whether if you're getting enough vitamin D, your baby can get the vitamin D he or she needs from your breast milk. You can do either, but it's important to make sure that you're getting the right amount of vitamin D, or if you're giving your baby vitamin D, that he or she is getting enough.

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:

RECOMMENDED DAILY INTAKE FOR BABIES

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

The Vitamin D Council's recommendation comes with a condition — that if your breast milk is full of vitamin D, your baby doesn't need a supplement.

So, how do you know if your breast milk has vitamin D? Let us explain:

HOW DO I GIVE MY BABY VITAMIN D?

If you're giving your baby a vitamin D supplement, liquid vitamin D drops are the way to go! They are very easy to give — you can add them to food and drink or give them with a spoon.

A group of researchers from the University of South Carolina found that mothers who took a supplement of 6,400 IU every day gave their babies over 800 IU of vitamin D in each liter of breast milk! This was enough vitamin D to give their babies what they needed.

In the same study, mothers who took a supplement of 400 IU of vitamin D every day gave their babies only around 50 IU of vitamin D in each liter of breast milk. This was not enough to give their babies what they needed, so these women had to give a supplement to their baby every day as well.

SO THE VITAMIN D COUNCIL RECOMMENDS THAT:

- If you take a supplement of 6,000 IU of vitamin D each day you shouldn't need to give your baby any vitamin D supplement. Your breast milk has enough vitamin D for your baby.
- If you aren't taking a supplement or getting a good amount of sun exposure, or if you're taking less than 5,000 IU/day of vitamin D, you should give your baby a vitamin D supplement.

MAKING SURE YOU, THE BREASTFEEDING MOTHER, ARE GETTING ENOUGH VITAMIN D

There are two ways to get your vitamin D as a breastfeeding mother; by exposing your bare skin to the sun or by taking supplements.

On days that you get full body sun exposure, you don't need to take a supplement. However, if you don't get full body sun exposure on any given day, you need to take 6,000 IU of vitamin D to make sure your breast milk is rich in vitamin D. For most mothers in the 21st century, this means taking a supplement 5-6 days a week.

Be sure not to miss a day of sun exposure or taking your supplement! Breast milk will clear itself of vitamin D very quickly unless you're regularly getting enough.

Can I take too much vitamin D or can I give my baby too much?

Yes you can. Vitamin D is fat-soluble, which means your body has a hard time getting rid of it if you take too much. Here are the upper limits set for babies – the safe maximum amounts of daily supplement:

UPPER LIMIT FOR DAILY INTAKE FOR BABIES

Vitamin D Council	2,000 IU/day
Endocrine Society	2,000 IU/day
Food and Nutrition Board	1,000-1,5000 IU/day

Here are the upper limits for pregnant or breastfeeding mothers set by the same organizations:

UPPER LIMIT FOR DAILY INTAKE FOR PREGNANT WOMEN

Vitamin D Council	10,000 IU/day
Endocrine Society	10,000 IU/day
Food and Nutrition Board	4,000 IU/day

Upper limit means the most you can take per day and not expect any problems getting too much.

How much vitamin D is in baby formula?

Depending on the formula milk, there are between 40 and 100 IUs of vitamin D per 100 calories in baby formula. If your baby is 6-months old, depending on how much they weigh, he or she may be getting between 500 to 1,000 calories in a day. What does this come out to? It means a 6-month old baby can be getting anywhere from 200 to 1,000 IU per day, which is quite a range!

It's best to keep track of how much vitamin D your baby is getting by adding up how much formula he or she has a day and then working out how much vitamin D is in that formula. Based on this result, you can decide if you need to give your baby a vitamin D supplement or not.

CAN MY BABY GET VITAMIN D FROM THE SUN?

Exposing your skin to the sun is a great way to get the vitamin D your body needs, providing you're sensible about how much time you spend in the sun and take care not to burn. However, your baby's skin is extra-sensitive. For this reason, the American Academy of Pediatrics recommends that babies under six months old should stay out of the sun completely.

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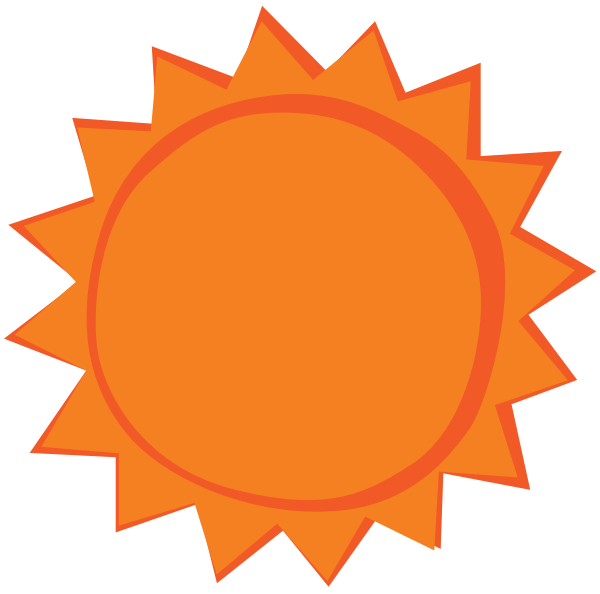

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