

# Diet for Kidney Stone Prevention

*National Kidney and Urologic Diseases Information Clearinghouse*



U.S. Department  
of Health and  
Human Services

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NATIONAL INSTITUTE OF  
DIABETES AND DIGESTIVE  
AND KIDNEY DISEASES

## How does diet affect the risk of developing kidney stones?

Diet is one of several factors that can promote or inhibit kidney stone formation. Other factors include heredity, environment, weight, and fluid intake. The body uses food for energy and tissue repair. After the body uses what it needs, waste products in the bloodstream are carried to the kidneys and excreted as urine. Certain foods create wastes that may form crystals in the urinary tract. In some people, the crystals grow into stones. For people who have had a kidney stone, preventing another will be a priority. In addition to dietary changes, a person may need medicine to prevent kidney stones. The first step in preventing kidney stones is to learn what kind of stones a person's body typically makes.

## What are the types of kidney stones?

- **Calcium oxalate stones** are the most common. They tend to form when the urine is acidic, meaning it has a low pH. Some of the oxalate in urine is produced by the body. Calcium and oxalate in the diet play a part but are not the only factors that affect the formation of calcium oxalate stones. Dietary oxalate is an organic molecule found in many vegetables, fruits, and nuts. Calcium from bone may also play a role in kidney stone formation.

- **Calcium phosphate stones** are less common. Calcium phosphate stones tend to form when the urine is alkaline, meaning it has a high pH.
- **Uric acid stones** are more likely to form when the urine is persistently acidic, which may result from a diet rich in animal proteins and purines—substances found naturally in all food but especially in organ meats, fish, and shellfish.
- **Struvite stones** result from infections in the kidney. Preventing struvite stones depends on staying infection free. Diet has not been shown to affect struvite stone formation.
- **Cystine stones** result from a rare genetic disorder that causes cystine—an amino acid, one of the building blocks of protein—to leak through the kidneys and into the urine to form crystals.

## Why is knowing which type of stone a person has important?

Knowing the chemical makeup of the stone helps the doctor identify why the patient is prone to stone formation. The kind of stone a person's body makes determines what dietary changes may be needed. For example, limiting oxalate in the diet may help prevent calcium oxalate stones but will do nothing to prevent uric acid stones. Some dietary recommendations may apply to more than one type of stone. Most notably, drinking enough water helps prevent all kinds of kidney stones.

## How does a doctor determine the type of kidney stone?

If a person can catch a kidney stone as it passes, the doctor can send the stone to a laboratory for analysis. For stones that are causing symptoms, the doctor may also retrieve a stone surgically or with a scope inserted through the urethra into the bladder or ureter.

The doctor will also order tests to look for unusual levels of chemicals such as calcium, oxalate, magnesium, and sodium in the blood and urine to help design a prevention strategy.

## How much fluid should a person drink to prevent stone formation?

The amount of fluid a person needs to drink depends on the weather and the person's activity level. People who have had a kidney stone should drink enough water and other fluids to produce at least 2 quarts of urine a day. Some doctors have their patients collect urine for 24 hours so the volume can be measured. The doctor can then advise the patient about increasing fluid intake, if necessary. People who work or exercise in hot weather need more fluid to replace the fluid they lose through sweat. Drinking enough water helps keep urine diluted and flushes away materials that might form stones and is the most important thing a person can do to prevent kidney stones.

A person at risk for cystine stones should drink enough water each day to dilute the concentration of cystine that escapes into the urine, which may be difficult. More than a gallon of water may be needed every 24 hours.

## What fluids protect against kidney stone formation?

Water is an inexpensive and calorie-free protection against kidney stones.

Some studies suggest citrus drinks like lemonade and orange juice protect against stones because they contain citrate, which stops crystals from growing into stones. But no large-scale trials have been conducted to confirm these findings. While citrus drinks may be helpful in preventing calcium oxalate stones and uric acid stones, they might be harmful for people who form calcium phosphate stones.

Coffee and tea can add to a person's total fluid intake and have been shown to reduce the risk of stone formation, but they do contain oxalate. Moderate intake of beer and wine may also protect against stone formation.

## What fluids should be avoided?

Grapefruit juice and dark colas have been found to increase the risk of stone formation and should be avoided by people who are prone to calcium oxalate stone formation. Although cranberry juice is often promoted as useful for preventing urinary tract infections, it contains oxalate and may be harmful to stone formers.

## How does salt in the diet affect kidney stone formation?

Salt is made up of sodium and chloride. The sodium in salt, when excreted by the kidneys, causes more calcium to be excreted into the urine. High concentrations of calcium in the urine combine with oxalate and phosphorus to form stones. Reducing salt intake is preferred to reducing calcium intake.

The U.S. recommended daily allowance (RDA) of sodium is 2,400 milligrams (mg), but Americans' intake averages 3,300 mg, according to the National Heart, Lung, and Blood Institute. The risk of kidney stones increases with increased daily sodium consumption. Limiting salt to the U.S. RDA goal of 2,400 mg is an important step for people who form calcium oxalate or calcium phosphate stones. People taking medications—such as hydrochlorothiazide, chlorthalidone, or indapamide—to prevent stones still need to limit salt intake.

## How can a person limit sodium intake?

Learning the sodium content of foods can help people control their sodium intake. Food labels provide information about sodium and other nutrients. Keeping a sodium diary can help a person limit sodium intake to 2,400 mg. When eating out, people should ask about the sodium content of foods they order.

Some foods have such large amounts of sodium that a single serving provides a major portion of the daily allowance. Foods that contain high levels of sodium include

- hot dogs
- canned soups and vegetables
- processed frozen foods
- luncheon meats
- fast food

People who are trying to limit their sodium intake should check labels for ingredients and hidden sodium, such as

- monosodium glutamate (MSG)
- sodium bicarbonate, the chemical name for baking soda
- baking powder, which contains sodium bicarbonate and other chemicals
- disodium phosphate
- sodium alginate
- sodium nitrate or nitrite

## How does animal protein in the diet affect kidney stone formation?

Meats and other animal proteins—such as eggs and fish—contain purines, which break down into uric acid in the urine. Foods that are especially rich in purines include organ meats, such as liver. People who form uric acid stones should limit their meat consumption to 6 ounces each day.

Nondairy animal proteins may also increase the risk of calcium stones by increasing the excretion of calcium and reducing the excretion of citrate into the urine. Citrate prevents kidney stones, but the acid in animal protein reduces the citrate in urine.

### **How does calcium in the diet affect kidney stone formation?**

Calcium from food does not increase the risk of calcium oxalate stones. Calcium in the digestive tract binds to oxalate from food and keeps it from entering the blood, and then the urinary tract, where it can form stones. People who form calcium oxalate stones should include 800 mg of calcium in their diet every day, not only for kidney stone prevention but also to maintain bone density. A cup of low-fat milk contains 300 mg of calcium. Other dairy products such as yogurt are also high in calcium. For people who have lactose intolerance and must avoid dairy products, orange juice fortified with calcium or dairy with reduced lactose content may be alternatives. Some studies indicate that calcium supplements increase the risk of calcium oxalate stone formation. Researchers theorize that calcium must be taken at the same time as dietary oxalate to protect against stone formation. Calcium supplements taken with meals may have the same protective effect as dietary calcium.

### **How does oxalate in the diet affect kidney stone formation?**

Some of the oxalate in urine is made by the body. But eating certain foods with high levels of oxalate can increase the amount of oxalate in the urine, where it combines with calcium to form calcium oxalate stones.

### **How can a person limit oxalate in the urine?**

Many foods and beverages contain oxalate, but only a few have been shown to increase the amount of oxalate in urine:

- spinach
- rhubarb
- nuts
- wheat bran

Avoiding these foods may help reduce the amount of oxalate in the urine. Eating foods containing calcium also reduces oxalate in the urine. Calcium binds oxalate in the digestive tract so it is not excreted into the urine.

## How does alcohol affect kidney stone formation?

Although drinking alcohol may promote purine production in the body, studies have not shown more stones in people who drink beer and wine. People should have no more than two drinks—two 12-ounce servings of beer or two 5-ounce servings of wine or two 1.5-ounce servings of hard liquor—a day.

## How do supplements affect kidney stone formation?

Supplements containing vitamin C or D may contribute to stone formation. Vitamin C is ascorbate and can be turned into oxalate by the body. Doctors recommend no more than 500 milligrams each day for people who have had kidney stones. Calcium supplements should be taken with meals so the calcium can bind with the oxalate in food. A person who has a tendency to form kidney stones should consult a doctor or dietitian before taking large doses of vitamins or minerals.

## How does a person's weight affect kidney stone formation?

Studies have shown that being overweight increases the risk of uric acid and calcium kidney stones. Scientists don't know whether losing weight by itself can reduce the risk of kidney stones. Maintaining a healthy weight through healthy food choices and exercise may help reduce the risk of kidney stones.

## Can a dietitian help a person prevent kidney stones?

Yes. After a doctor has completed an evaluation and determined the causes of a person's stones, a dietitian can help a person plan meals that lower the risk of forming stones. People who form stones can ask their doctor or nurse to help them find a dietitian who specializes in kidney stone prevention or renal, or kidney, nutrition.

### Questions to Ask the Doctor

- What kind of kidney stone do I have?
- How much fluid should I drink every day?
- How much protein and what type of protein should I eat every day?
- Am I getting enough calcium in my diet?
- Can you recommend a dietitian who specializes in kidney stone prevention or renal nutrition?
- Do I need to take medication to prevent kidney stones?

## Points to Remember

- Diet is one of several factors that can promote or inhibit kidney stone formation.
- Different kinds of kidney stones require different prevention diets.
- Drinking water and other fluids is the most important thing a person can do to prevent kidney stones.
- People who have had a kidney stone should drink enough water and other fluids to make at least 2 quarts of urine each day.
- Diets high in salt, or sodium, can increase the excretion of calcium into the urine and thus increase the risk of calcium containing kidney stones. Reducing salt intake is preferred to reducing calcium intake.
- Foods rich in animal proteins—such as meat, eggs, and fish—contain purines and can increase the risk of uric acid stones and calcium stones.
- Calcium from food can help prevent kidney stone formation and help maintain bone density.
- Avoiding foods rich in oxalates, such as spinach and rhubarb, may help prevent calcium oxalate stones.
- After a doctor has completed an evaluation and determined the causes of a person's stones, a dietitian can help a person plan meals that lower the risk of forming stones.

## Hope through Research

The Division of Kidney, Urologic, and Hematologic Diseases of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) funds research on the causes, treatments, and prevention of kidney stones. The NIDDK is part of the National Institutes of Health in Bethesda, MD. NIDDK-sponsored researchers are working to answer the following questions:

- What dietary factors promote or protect against stone formation?
- How can doctors predict, or screen, those at risk for getting stones?
- Do genes play a role in stone formation?
- What is the natural substance(s) found in urine that blocks stone formation?

Participants in clinical trials can play a more active role in their own health care, gain access to new research treatments before they are widely available, and help others by contributing to medical research. For information about current studies, visit [www.ClinicalTrials.gov](http://www.ClinicalTrials.gov).

## For More Information

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### **National Kidney Foundation**

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### **Oxalosis and Hyperoxaluria Foundation**

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## Acknowledgments

Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This fact sheet was reviewed by Gary Curhan, M.D., Harvard Medical School, and David Goldfarb, M.D., New York University School of Medicine.

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U.S. DEPARTMENT OF HEALTH  
AND HUMAN SERVICES  
National Institutes of Health

NIH Publication No. 09-6425  
May 2009