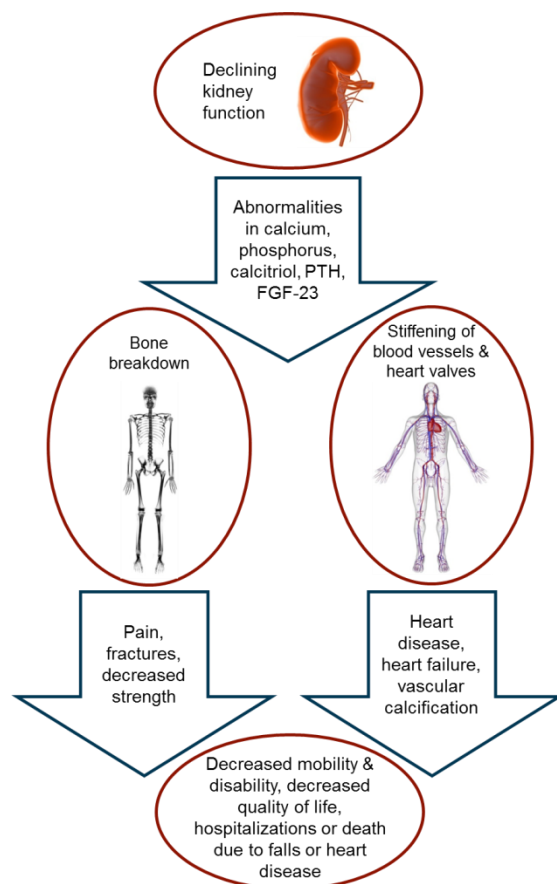


Vital Information About CKD-MBD

What Is CKD-MBD?

Chronic kidney disease-mineral and bone disorder (CKD-MBD) affects many people who have reduced kidney function. The disorder is characterized by disturbances in the regulation of calcium, phosphate, and vitamin D, and abnormalities in blood levels of two important hormones: *parathyroid hormone* (PTH), which is released by tiny glands found behind the thyroid gland, and *fibroblast growth factor-23* (FGF-23), which is released by the bones. Over time, these changes can affect the strength and quality of the bones and cause damage to the blood vessels and valves of the heart.

The information in this fact sheet should help you better understand CKD-MBD and enable you to work with your doctor, dietitian, and other members of your health care team to prevent or treat the disorder and its complications.



What Causes CKD-MBD?

CKD-MBD results from complex changes that take place as kidney disease worsens (Figure). Normally the kidneys work, with help from PTH and FGF-23, to maintain a balance of calcium and phosphorus in the body. The kidneys also convert dietary vitamin D to *calcitriol*, which is an active form of vitamin D that helps the bones absorb minerals and remain strong. As kidneys fail, they become increasingly less able to perform these vital tasks. PTH and phosphorus levels rise, calcium levels become imbalanced, and calcitriol levels fall.

How Does CKD-MBD Affect My Health?

If CKD-MBD is not effectively treated, your bones can lose strength and become brittle. You may have pain, and you may be more likely to fracture a bone, especially if you fall. In addition, excess calcium in your blood (which may come from your bones, as a result of high PTH levels, or from oral calcium supplements) may build up in the walls of your blood vessels and heart.

This buildup, called *calcification*, can cause stiffening that may markedly increase your risk for heart failure and heart attacks (Figure). Calcification in the blood vessels of the legs and feet can also increase your risk of limb amputation. Levels of FGF-23, which tend to increase as kidney function declines, may worsen both kidney disease and cardiovascular disease.

How Is CKD-MBD Diagnosed?

To determine if you have CKD-MBD, your kidney doctor will take blood samples to test for calcium, phosphate, PTH, and vitamin D. These tests are ordered regularly at intervals that vary depending on your CKD stage. Sometimes the doctor will order a test for *alkaline phosphatase* (ALP), which can help determine if there are any problems with your bones. Other, less common tests may include a bone biopsy; an abdominal radiograph to look for calcification of

your aorta (a major blood vessel); and an echocardiogram to look for calcification of your heart valves.

How Is CKD-MBD Treated?

Dietary changes

As a first step, the doctor will likely recommend a diet low in phosphorus. This can be quite challenging, because phosphorus is found in almost all foods, and is especially high in many processed foods.

Foods High in Phosphorus

- Bacon
- Beans (dried or canned)
- Bran cereal
- Canned or fresh tuna or salmon
- Cream-based soups
- Dark colas
- Hard cheeses (eg, parmesan, cheddar)
- Ice cream
- Lentils and chickpeas (dried or canned)
- Milk
- Nuts and peanut butter
- Oatmeal
- Organ meats (eg, liver, kidneys)
- Tofu and other soy products

Foods Low in Phosphorus

- Clear soups
- Chicken (not flavored or moisture-enhanced)
- Cream cheese
- Hot porridge-type cereals (eg, wheat and rice)
- Egg whites
- Fruits
- Ginger ale
- Light-salt, low-fat popcorn
- Nondairy creamer
- Orange roughy fish
- Pork (not flavored or moisture-enhanced)
- Sherbet
- Rice cereal

Phosphorus is often added to foods as a preservative or stabilizer. Microwaveable meals, deli meats, and “moisture-enhanced” chicken, turkey, and pork all contain these additives. Recognizing *phosphate* as a word or part of a word on food labels can help you identify added phosphorus. Common phosphate additives include monocalcium phosphate, dicalcium phosphate, tricalcium phosphate, phosphoric acid, polyphosphate, sodium phosphate, and sodium aluminum phosphate. Avoiding foods with these additives can help you reduce blood phosphate.

Phosphorus is also found in foods generally considered to be healthy, such as bran cereals, fish, and beans. Importantly, however, natural sources of phosphorus—especially plant-based sources, such as beans and nuts, and some animal-based sources, such as chicken—have much less effect on blood phosphate compared with processed foods. This is because phosphorus additives are absorbed at higher levels than is phosphorus from natural sources. The list at left provides examples of foods at both ends of the phosphorus spectrum.

Medications and supplements

Although diet is central, it may not be enough. Phosphate levels may remain high because PTH is high, and many patients will eventually require treatment with *phosphate binders*. Examples of available binders are found in the table below. If your doctor thinks you may benefit these drugs, he or she will discuss your options, along with their advantages and disadvantages. To work

effectively, phosphate binders must be taken with meals and snacks, or within 10 to 15 minutes of eating.

Phosphate Binders Used in the Treatment of CKD-MBD

| Phosphate Binder | Available Forms | Prescription required |
|-------------------------|--|----------------------------------|
| Calcium acetate* | Capsule or tablet | Prescription and nonprescription |
| Calcium carbonate* | Liquid, tablet, capsule, chewable, gum | No |
| Lanthanum carbonate | Wafer, chewable | Yes |
| Sevelamer hydrochloride | Tablet | Yes |
| Sevelamer carbonate | Tablet, powder | Yes |

*May increase risk of calcification.

If phosphate and PTH levels are still too high for your stage of CKD despite diet and treatment with phosphate binders, your doctor may prescribe vitamin D in forms other than calcitriol, which can increase FGF-23. If you are on dialysis, drugs called *calcimimetics* can help control PTH while lowering blood calcium and phosphate. The choices and combinations of treatments used to manage your CKD-MBD will differ according your CKD stage and your blood levels of calcium and phosphate. Rarely, if diet, medications, and other strategies for reducing PTH and phosphate are unsuccessful, surgery may be recommended to remove the glands that release PTH.

What Can I Do to Help Prevent Bone and Heart Damage Caused by CKD-MBD?

- Work actively with your dietitian to keep track of foods that might be high in phosphate.
- If you are struggling with taking your medications, tell your doctor or another member of your health care team. They can provide tools, tips, and reminders, as well as strategies for avoiding any side effects.
- Know what recommended ranges are for blood calcium, phosphate, and PTH, and work with your doctor and dietitian to achieve levels within those ranges.
- Take steps to keep your CKD from worsening and reduce your risk for cardiovascular disease:
 - Lose weight if you are overweight or obese.
 - Maintain normal blood sugar levels if you have diabetes.
 - Achieve and maintain normal blood pressure.
 - Achieve and maintain target blood lipid and cholesterol levels.
- Talk to your doctor about any other medications, supplements, or natural remedies you may be taking or are considering taking.
- Work with your doctor or another health care professional to establish an exercise regimen that can boost strength and energy.

For More Information

These organizations provide a wealth of additional information and support to help you understand and manage your CKD-MBD.

- American Association of Kidney Patients: <http://www.aakp.org>
- National Kidney and Urologic Diseases Information Clearinghouse: <http://kidney.niddk.nih.gov/>
- National Kidney Disease Education Program: <http://nkdep.nih.gov>
- National Kidney Foundation: <http://www.kidney.org/>
- Renal Support Network: <http://www.rsnhope.org/>