

# Electrolyte Balance

## Overview

Electrolytes are electrically charged minerals and compounds that help your body do much of its work — producing energy and contracting your muscles, for example. Sodium, chloride, potassium, and calcium are all types of electrolytes. (See chart below). We get them from what we eat and drink. Fluids and electrolytes are both essential for our cells, organs, and body systems to work properly. Electrolyte levels are measured in blood tests, and their levels must stay within a fairly small range, or serious problems may arise.

## The role of water

Over half of your body weight is water. About 65% is *intracellular fluid (ICF)*, fluid inside cells that is full of potassium and phosphates. Other fluids are *extracellular (ECF)*. They are located between cells and in the liquid part of blood (plasma). Sodium and chloride are most common here.

The fluid inside the cells (ICF) and outside the cells (ECF) are separated by the membranes that surround each cell. Water moves freely across most cell membranes. It naturally moves from areas of high concentration to areas of low concentration. Electrolytes can't get through the cell membrane on their own; they are carried across by the cell's proteins. Some, like sodium, even have to be pumped out of the cell (so potassium can come in). All this work at the cellular level requires energy. Collectively, the cellular chemical processes that occur in our cells is called our *metabolism*.

## What electrolytes do

- Regulate the fluid levels in your blood plasma and your body
- Keep your blood pH (acid/alkaline measure) in the normal range (7.35-7.45, slightly alkaline)
- Enable muscle contractions, including the beating of your heart
- Transmit nerve signals from heart, muscle, and nerve cells to other cells
- Help blood to clot
- Help build new tissue

## Causes of electrolyte imbalance

An electrolyte imbalance can be caused by:

- ✓ losing fluids as a result of persistent vomiting or diarrhea, sweating, or fever
- ✓ not drinking or eating enough
- ✓ chronic respiratory problems, such as emphysema
- ✓ higher-than-normal blood pH (a condition called *metabolic alkalosis*)
- ✓ medications such as steroids, diuretics, and laxatives

To ensure that you have enough electrolytes, stay hydrated and eat foods rich in electrolytes such as spinach, turkey, potatoes, beans, avocados, oranges, soybeans (edamame), strawberries, and bananas.

With the exception of sodium, it's not likely that you'll get too much of any electrolytes from your diet. (The risk may be higher if your kidneys are not working well.) However, supplements can cause problems. For example, too much calcium can increase your risk of kidney stones — so always talk to your doctor before you start to take them.

## Electrolyte Profiles

### Sodium (Na<sup>+</sup>) Normal Range\*: 135-145

Low sodium, also called *hyponatremia*, causes water to move into cells. High sodium, or *hypernatremia*, causes fluid to move out of the cells. When either of these things happens in brain cells, it can cause personality changes, headache, confusion, and lethargy. If the sodium drop is severe, it can result in seizures, coma, and death. A key symptom of hypernatremia is thirst. Older folks with chronic illness who have low sodium will have more symptoms than younger, healthy people with the same low sodium level.

### Chloride (Cl<sup>-</sup>) Normal Range\*: 96-106

Low chloride (*hypochloremia*) may be due to excessive vomiting, suctioning of stomach contents, or “loop” diuretic medications, often used to treat fluid retention caused by heart or kidney problems or high blood pressure. High chloride (*hyperchloremia*) often results from diarrhea or kidney disease. May not have symptoms unless level changes are severe. Since it is closely tied to sodium, some people have symptoms of hyponatremia.

### Potassium (K<sup>+</sup>) Normal Range\*: 3.5-5.5

Low potassium (*hypokalemia*) may not cause symptoms, but it may affect how your body stores glucogen (your muscles' source of energy) or cause abnormal heart rhythms. A level under three can cause muscle weakness, spasms, cramps, paralysis, and respiratory problems. If it continues, kidney problems may occur. High potassium (*hyperkalemia*) may not cause any symptoms, although you may experience muscle weakness or abnormal heart rhythms. If the level goes very high, the heart can stop beating. Potassium works with sodium to maintain water balance and acid/base balance. It works with calcium to regulate nerve and muscle activity.

### Magnesium (Mg<sup>+2</sup>) Normal Range\*: 1.7-2.2

Low magnesium (*hypomagnesemia*) may cause symptoms similar to low potassium or calcium. An extremely low level can be life-threatening. High magnesium (*hypermagnesemia*) may cause low blood pressure, breathing problems (slow, ineffective breathing) and heart problems (cardiac arrest). Most magnesium is in the bones, with about 1% in extracellular fluid (ECF). Magnesium is important for enzyme reactions.

## Calcium (Ca<sup>2+</sup>) Normal Range\*: 8.5-10.2 (Ionized calcium level range is 4.7-5.28)

Low calcium (*hypocalcemia*) may not cause symptoms, but chronically low levels can cause changes in skin, nails, and hair; yeast infections; and cataracts. As levels drop, muscle irritability and cramps (particularly in legs and back) may develop. Calcium under 7 causes changes in your reflexes (*hyperreflexia*), muscle spasms, spasms of the larynx (voice box), and seizures. High calcium (*hypercalcemia*) may not cause symptoms. As calcium rises, constipation, loss of appetite, nausea, vomiting, abdominal pain, neuromuscular symptoms, and bowel obstruction (*ileus*) may occur. Above 12, emotional swings, confusion, delirium, and stupor occur. Above 18, it may result in shock, kidney failure and death. Persistent or severe hypercalcemia can damage kidneys and cause heart problems, including rhythm changes and heart attack. Most calcium (99% ) is in the teeth and bones. Calcium in the blood is ionized (carries a charge) and helps regulate cell function, heart rate, and blood clotting. The body needs vitamin D to absorb calcium.

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## Phosphate/Phosphorus (PO<sub>4</sub><sup>-</sup>) Normal Range\*: 2.5 – 4.5

Low phosphate (*hypophosphatemia*) can cause muscle weakness, respiratory failure, heart failure, seizures, and coma. It may be caused by very poor nutrition, certain diuretic medications, diabetic ketoacidosis/DKA, alcoholism and severe burns. (DKA is a serious complication of diabetes in which cells burn fat instead of glucose. This creates ketones, which enter the blood and turn it acidic. Normal blood is slightly alkaline.) High phosphates (*hyperphosphatemia*) may not cause symptoms. It may be due to [tumor lysis syndrome](#), overwhelming infection, chronic kidney disease, parathyroid gland disorder, or acidosis (blood pH more acidic than normal). Blood tests measure inorganic phosphate. About 85% of phosphate is in the bones, most of the rest is inside cells. Phosphate helps build and repair bones and teeth, stores energy, contracts muscles, and enables nerve function. Your body needs vitamin D to absorb phosphorus.

\* Note: Normal ranges are provided for general information. Your lab may use a different “normal range”. Ranges should be listed along with your blood test results.