ESSENTIAL ELECTROLYTES

Overview

Electrolytes are essential ions in the human body for proper electrical activity. Maintaining the concentration of electrolytes is crucial for proper fluid balance, nerve function, muscle contraction, and other physiological processes in the body. Some of the main electrolytes in the human body include sodium, potassium, calcium, and magnesium. The intake of electrolytes is primarily through fluids and foods, while the output of electrolytes is mostly from physical exercise, sweating, and urination. It is important to note that water does not contain electrolytes, so electrolyte replacements are necessary to remain properly hydrated. The flow of water in the body follows the concentrated areas of electrolytes. Sodium, potassium, calcium, and magnesium are all lost from the body in sweat. These electrolytes work together to maintain homeostasis and water equilibrium. An imbalance of electrolytes can be harmful, and can lead to sickness or even death. This white paper examines the roles of major electrolytes in the body, the importance of maintaining the right concentrations, and the daily requirements.

Sodium

Sodium is a mineral in the human body that is necessary for it to function properly. Sodium is necessary for nutrient absorption, muscle contraction, and fluid volume and pressure. Most regulation of sodium in the body is done by the kidneys, and imbalances can lead to muscle cramps, decreased appetite, and lightheadedness. The minimal daily requirement of sodium, according to the National Heart Lung and Blood Association, is 500mg per day. For perspective, one teaspoon of salt is about 2300mg of sodium. The average American consumes around 3400mg of sodium per day. The American Heart Association suggests that 2300mg of sodium is the most that should be consumed per day. The recommended intake of sodium is 1500 mg of sodium per day, but this does not include salty sweaters. Salty sweaters include athletes, workers exposed to high heat, and people with a medical predisposition. To determine individual sodium requirements, it is suggested

to consult with a trained health care professional. Most of the salt in the American diet comes from processed foods, not from salt shakers and natural foods. Food examples that are high in sodium are soups, cold cuts, salad dressings, and bread. High sodium diets put people at risk for high blood pressure, or a blood pressure that is consistently elevated above 120/80 mm Hg. High blood pressure is caused by sodium pulling water into the blood vessels resulting in an increased blood pressure and harder pumping by the heart. High blood pressure can cause an increased risk of heart attack, stroke, vision problems, and irregular kidney function. Sodium imbalances also occur when the sodium in the blood is too high or low. Hypernatremia is when the serum sodium level is too high. It is typically caused by not consuming enough water or a problem with a person's thirst sensation.

Hypernatremia can also occur because of extreme sweating or high sodium intake with inadequate water. Indicators of hypernatremia include headaches, confusion, seizure, and coma. Hyponatremia is when there is not enough sodium in the blood. This can occur from drinking too much water, taking diuretics, or from other causes of dehydration such as diarrhea and vomiting. Symptoms of Hyponatremia include fatigue, muscle cramps, seizure, and coma. It is important to consult with a healthcare provider to determine the cause of sodium imbalances, and to get proper treatment plans.

Potassium

Potassium is a necessary electrolyte in the human body for muscle contraction, carbohydrate metabolism, fluid balance, cognition and heart function to prevent high blood pressure. The recommended daily intake of potassium for an adult is about 4700mg per day. Most Americans do not consume the minimum amount of potassium suggested in their diet. Foods that are rich in potassium are bananas, meat, soy, citrus fruit, and nuts. Dietary potassium is absorbed in the small intestine, regulated primarily by the kidneys, and lost by sweating and urinating. If potassium levels in the body are out of balance, it can lead to irregular heart rates, confusion, and weakness. Since the kidney is the primary regulator of potassium levels, it is unlikely that potassium levels will be too high. If the potassium becomes too high in the blood, termed hyperkalemia, it is likely that there is a renal dysfunction, or intestinal absorption issue.

Hyperkalemia can lead to irregular heartbeats, paralysis, and can even cause the heart to quit. It is more common in potassium deficiencies to see low serum potassium, or hypokalemia. Hypokalemia can be caused by alcoholism, diuretics, laxatives, insufficient diet, and prolonged sweating. Diets that have high sodium or sugar intakes can also cause potassium levels to be depleted. Hypokalemia typically presents with fatigue and cramps, but in severe cases can cause problematic heart rates, irregular blood pressure, and even death. Deficiencies in potassium can be very critical, and should be supplemented or treated specifically for each person by a licensed physician.

Calcium

Calcium is a major mineral in the body for muscle contraction, blood circulation, and for healthy bones and teeth. The body does not produce calcium, so calcium intake must be in the diet. Also, dietary calcium cannot be sufficiently absorbed

without vitamin D. Salmon and egg yolks are sources of vitamin D, as well as exposure to sunlight. For adults it is suggested to have 1000mg of dietary calcium a day, and 600IU of vitamin D per day. Foods that are good sources of calcium are dairy products, dark vegetables, and white beans. Most calcium in the body is in the bone, with only about 1% in the blood. Calcium deficiencies can lead to osteoporosis and muscle spasms. High calcium levels can lead to extreme thirst, constipation, and gas.

Hypercalcemia can occur when calcium in the blood becomes too high. This can lead to fragile bones, kidney stones, and in extreme cases can be fatal. Low blood calcium, hypocalcemia, is often asymptomatic in patients. Hypocalcemia can be caused by vitamin D deficiencies as well as parathyroid dysfunction. Long term hypocalcemia can lead to numbness, cramps, and even seizures or death. Monitoring proper calcium consumption is important to avoid a mineral deficiency in the body.

Magnesium

Magnesium is a key electrolyte that is needed in the body for proper energy production, metabolism control, and a healthy cardiovascular system. The recommended daily intake of magnesium is 420mg for men, and 320mg for women. Significant dietary sources of magnesium include seeds, nuts, shrimp, leafy greens, and whole grains. Imbalances in magnesium in the body can cause issues with blood sugar levels and muscle cramps. High magnesium in the body from foods is unlikely because properly functioning kidneys will excrete the excess out in the urine. If magnesium levels in the blood are extremely high, called hypermagnesemia, it is most likely due to over supplementation or medications with magnesium along with kidney damage. Alcoholism, chronic malnutrition of magnesium, and untreated diabetes can all lead to low levels of magnesium. Low magnesium can lead to nausea, muscle spasms, and heart problems. If the blood levels of magnesium are too low it is termed hypomagnesemia. When not corrected with proper intake of magnesium, this can lead to impaired breathing, seizures, and coronary spasms. Monitoring the intake of main minerals of the body, such as magnesium, is critical to maximize the function of the body.

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