



SNS COLLEGE OF ALLIED HEALTH SCIENCES

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TOPIC : PRINCIPLE ELEMENTS



Minerals



- ❖ Minerals are those elements on the earth and in foods that our bodies need to develop and function normally.
- ❖ **Minerals are Inorganic elements**
- ❖ **Not biosynthesized** in human body
- ❖ Widely distributed in nature
- ❖ **Present in foods of Plant and Animal** origin
- ❖ Minerals in human body **serve for various structural and functional roles**



Minerals Characteristics



- **Natural** in Occurrence
- **Solid** in nature
- **Inorganic**
- **Definite chemical composition**
- **Crystal structure due to internal arrangement of atoms**
- **Two Broad Classes Of Minerals**
- **Macro Minerals – 60-80 %**
- **Micro Minerals- 20%**



Macrominerals



- Macrominerals are those minerals which are required in relatively large doses.
- These minerals are vital for the proper functioning and metabolism of the body.
- Our body cannot produce these minerals; hence, they need to be obtained from a food source.
- **Macro/Principle/Chief Minerals**
- **Body needs Macro Minerals relatively in large quantities**
- Minerals present in body tissues at concentrations **>50 mg/kg**
- Requirement of these Minerals is **>100 mg/day**



7 Names Of Macro/Chief Minerals



1. Calcium (Ca)
2. Phosphorus (P)
3. Sulfur (S)
4. Magnesium (Mg)
5. Sodium (Na)
6. Potassium (K)
7. Chloride (Cl)



Microminerals



- Also called **trace minerals**, these are minerals which are required in small amounts.
- Therefore, they are also called **minor minerals**.
- **Micro Minerals /Trace Elements**
- Body needs Micro Minerals **relatively in less amount**
- Present in **body tissues at concentrations <50 mg/kg**
- **Requirement** of these Minerals is **< 100 mg/day**
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Name Of 10 Essential Micro/Trace Elements



- 1. Iron (Fe)**
- 2. Copper (Cu)**
- 3. Cobalt (Co)**
- 4. Chromium (Cr)**
- 5. Fluoride (F)**
- 6. Iodine (I)**
- 7. Manganese (Mn)**
- 8. Molybdenum (Mo)**
- 9. Selenium (Se)**
- 10. Zinc (Zn)**



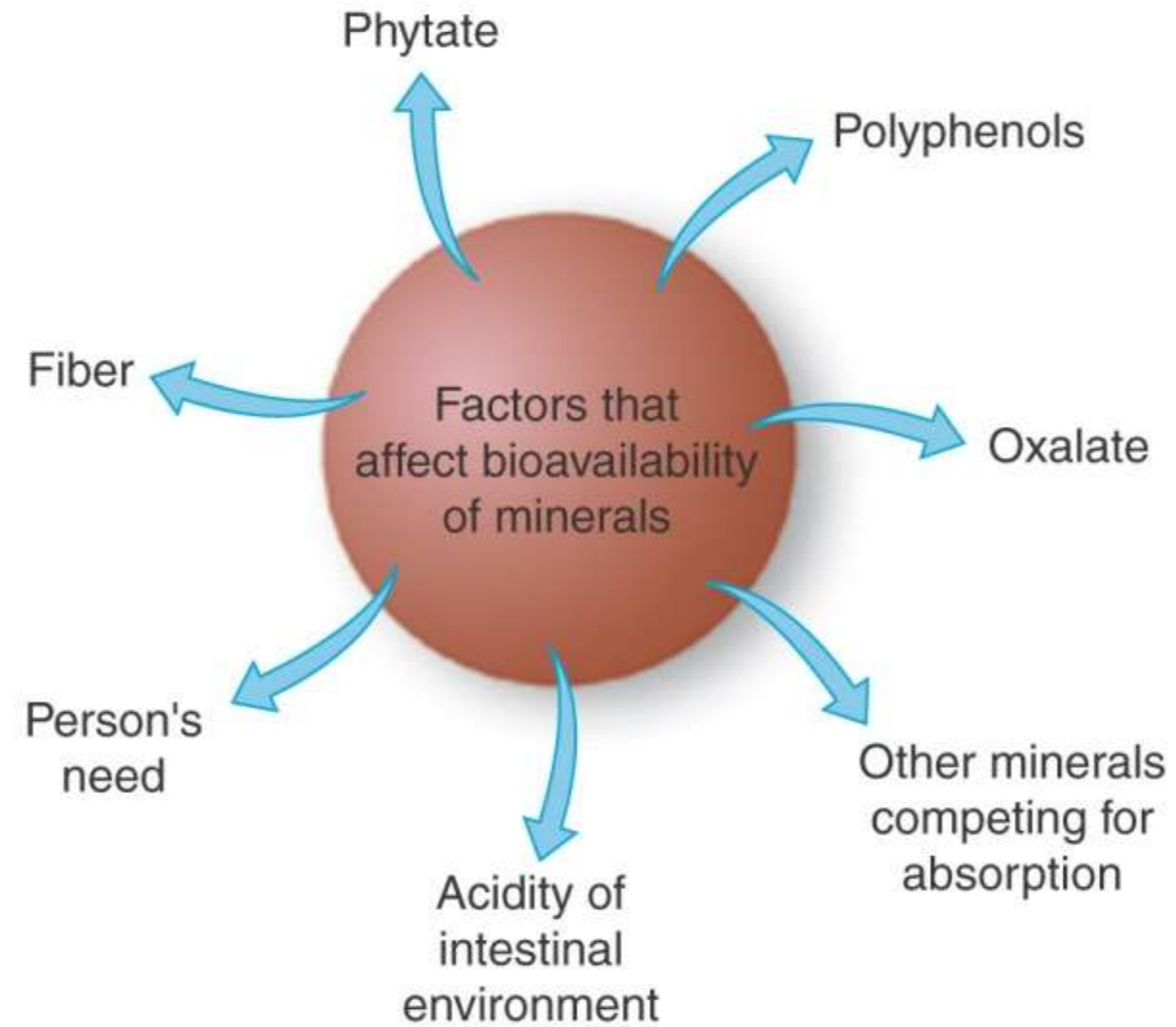
Mineral Bioavailability



- The GI tract absorbs a much smaller proportion of minerals than vitamins.
- Once absorbed, excess minerals are difficult for the body to flush out.
- The body adjusts mineral absorption in relation to needs.
- Phytate (a component of whole grains) binds minerals and carries them out of the intestine unabsorbed.
- Oxalate (found in spinach and rhubarb) binds calcium, reducing its absorption.



Mineral Bioavailability





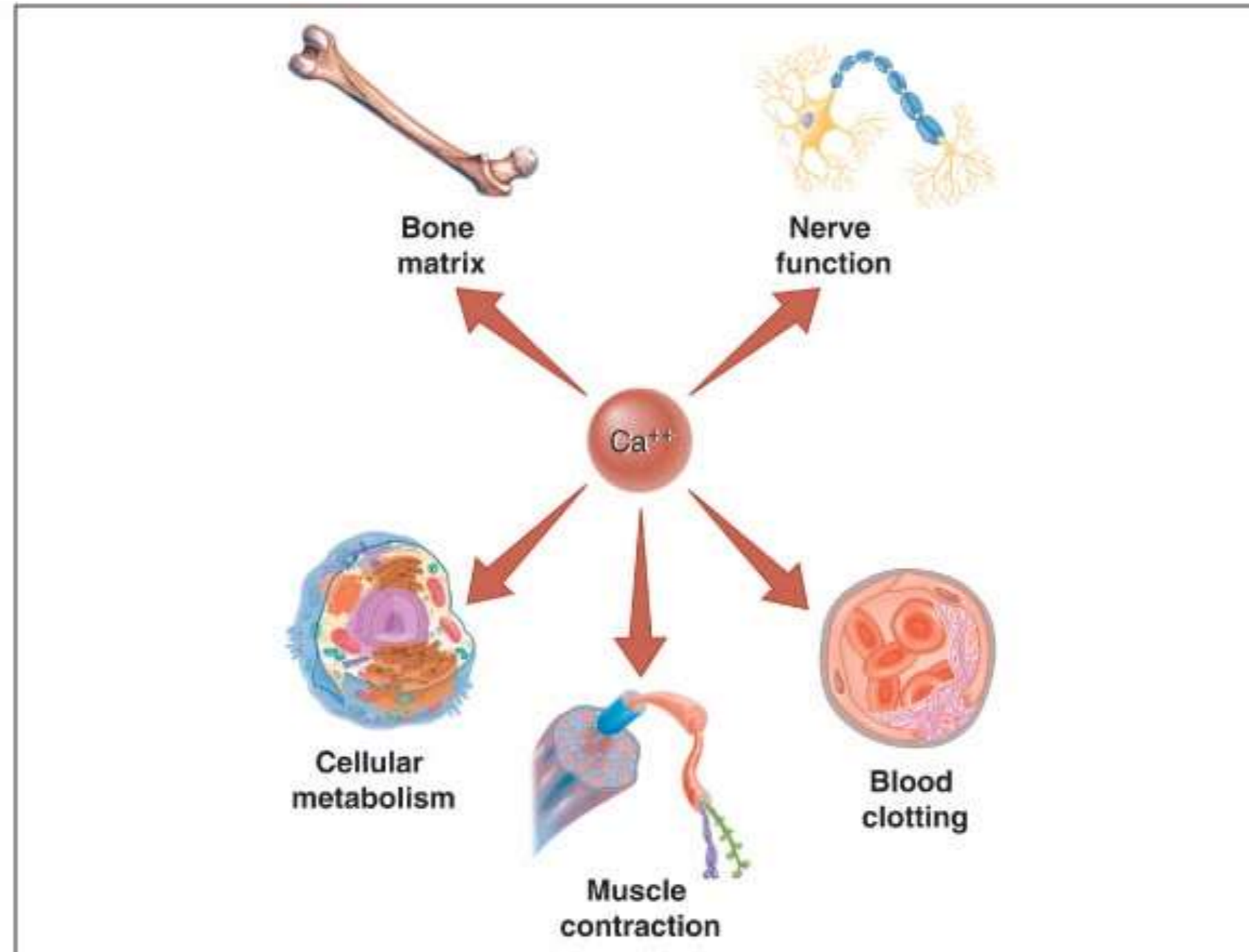
Calcium



- About 1.5 to 2% of total body weight.
- Essential for healthy bones and teeth.
- Bones and tooth structure (99%) of calcium.
- Remaining 1% in blood and soft tissues.
 - Muscle contraction.
 - Nerve impulse transmission.
 - Blood clotting.
 - Cell metabolism.



Calcium Functions





Bone Structure



- Bone is made up of cells and an extracellular matrix.
- Osteoblasts and osteoclasts continually remodel our bones.
- Osteoblasts secrete the collagen protein matrix that forms the framework.
- Minerals in the form of hydroxyapatite (calcium and phosphorus) surround the collagen fibers.



Calcium Food Sources



- Dairy products.
- Almonds, Carrots, Milk, Broccoli, Canned Fish, Papaya, Garlic, and Cashew
- Green leafy vegetables such as spinach have high levels of calcium, but it is mostly bound to oxalate and therefore cannot be absorbed.
- Chinese cabbage, kale, and turnip greens have significant amounts of bioavailable calcium.
- Some food products are fortified with calcium.



Regulation of Blood Calcium



- Circulating blood calcium performs many essential functions; therefore, the body will demineralize bone tissue to prevent even minor changes in blood calcium.
- Three hormones regulate blood calcium:
 - Calcitriol (active form of vitamin D)
 - Parathyroid hormone
 - Calcitonin
- These hormones control intestinal absorption of calcium, bone calcium release, and calcium excretion by the kidneys.
- Inadequate calcium intake, high sodium intake, excess caffeine, and other diuretics can effect calcium balance by altering the excretion of calcium in the urine.



Vitamin D (calcitriol – active form)

- Increases absorption of calcium into the intestine.
- Increases the production of calcium binding proteins in the small intestine.

Parathyroid Hormone

- Parathyroid Hormone (PTH) is secreted when plasma calcium levels fall too low.
- PTH activates osteoclasts, which break down bone and release calcium and phosphorus into the blood.
- Increases kidney reabsorption of calcium.
- Increases phosphorus excretion.
- Stimulates calcitriol production.



Calcitonin



- The thyroid gland secretes calcitonin when plasma calcium is too high.
- Acts in opposition to PTH.
- Weak effects on blood calcium.
- Inhibits formation and activity of osteoclasts.
- High calcitonin concentrations decreases PTH production and thus decreases calcitriol production.



Calcium Absorption



- Phytates (in nuts, seeds, grains) decrease absorption.
- Oxalates decrease absorption.
- High levels of phosphorus and magnesium decrease absorption.
- Wheat bran decreases absorption (other dietary fibers do not seem to decrease absorption).
- Low estrogen levels after menopause decrease absorption.
- Calcium from supplements taken between meals and at lower doses of 500 milligrams or less assists in absorption.



Hypocalcemia



- Hypocalcemia – deficiency of calcium in the blood - because the body uses bone calcium to maintain blood levels.
- Caused by kidney failure, parathyroid disorders, and vitamin D deficiency.
- Can cause muscle spasms, facial grimacing, and convulsions.
- Chronic dietary deficiency causes osteoporosis.
- Increased risk of hypertension, colon cancer, and preeclampsia.



Hypercalcemia



- Major Causes
 - Cancer
 - Overproduction of PTH by the parathyroid gland
- Clinical Signs and Symptoms
 - Fatigue
 - Confusion
 - Loss of appetite
 - Constipation
 - Calcium may be deposited in the soft tissue where it can impair organ function.



Phosphorus



- Widespread in the food supply.
- Phosphorus is the most abundant intracellular anion.
- Helps the body store and use energy.
- Works with calcium in the formation of strong, healthy bones and teeth.

- Phosphorus plays an important role in bone as part of the mineral complex hydroxyapatite.
- Helps activate and deactivate enzymes in a process known as phosphorylation.
- Essential component of ATP.
- Component of DNA, RNA, and phospholipids in cell membranes and lipoproteins.



Phosphorus Food Sources and Recommended Intake



- Phosphorus is abundant in the food supply.
- Foods rich in protein (milk, meat, eggs) are also rich in phosphorus.
- Mushrooms, Meat, Cashews, Oats, Fish, Beans, Squash, Pecans, Carrots, and Almonds
- Food additives in processed meats and sodas contain phosphorus.
- RDA for adults is 700 milligrams per day. Adolescents need about 1,250 milligrams per day.



Hypophosphatemia



- Underlying disorders affect absorption or excretion and cause hypophosphatemia.
 - Hyperparathyroidism (often due to a tumor)
 - Vitamin D deficiency
 - Overuse of aluminum, magnesium, or calcium
- Clinical Signs and Symptoms
 - Anorexia
 - Dizziness
 - Bone pain
 - Muscle weakness



Hypophosphatemia



- Chronic
 - Affects the musculoskeletal system causing muscle weakness and damage including respiratory problems due to poor diaphragm function.
- Long-standing
 - Can cause rickets and osteomalacia



Hyperphosphatemia



- Causes
 - Kidney disease
 - Underactive parathyroid gland
 - Too many vitamin D supplements
 - Overuse of phosphorus containing laxatives
 - Excessive dietary intake (i.e. too much soda)
- Clinical signs and symptoms
 - Excessive phosphorus can bind calcium
 - Excess phosphorus and not enough calcium can lead to increased bone loss.
 - Increased phosphorus intake may lead to osteoporosis later in life.



Magnesium



- Magnesium (Mg)
- 50 – 60% is in bone, remainder distributed between muscle and other soft tissues.
- Most resides in cells. Only 1% is extracellular.
- Participates in more than 300 types of enzyme-mediated functions.
- Assists in DNA and protein synthesis.
- Assists in energy production in the ETS and glycolysis.
- Participates in muscle contraction and in blood clotting.



Magnesium Food Sources and RDA



- Whole grains and vegetables such as spinach and potatoes are good sources.
- Honey, Almonds, Seafood, Tuna, Chocolates, Pineapple, Pecans, Artichokes, and Green Leafy Vegetables
- Legumes, tofu, and some seafood.
- Sesame seeds, cashews, almonds.
- RDA for adults 19 – 30 years 400 mgs / day for men and 310 mgs / day for women.
- Ages 31-70 -- 420mg / day men 320 mg / day women.



Functions



- Provides structure for healthy bones.
- Produces energy from the food molecules.
- Maintains proper functioning of muscle and nervous system.

Causes

- Kidney disease
- Associated with alcoholism
- Diuretic drugs
- Prolonged diarrhea
- Chronically poor diets



Clinical Signs and Symptoms



- Short term deficiency:
 - Loss of appetite, nausea, and weakness.
- Long-term deficiency:
 - Muscle cramps, irritability, and confusion.
- Extreme:
 - Death due to heart rhythm problems.



Hypermagnesemia



- Causes
 - Uncommon in the absence of Kidney disease
 - Use of magnesium containing antacids or laxatives
- Clinical Signs and Symptoms
 - Nausea
 - General weakness



Sodium



- Sodium (Na) is an essential nutrient.
- Fluid balance. Maintains proper body water distribution and blood pressure.
- Nerve transmission and muscle function.
- Control's the body's acidity.
- Maintains cellular osmotic pressure.
- Helps in maintaining blood volume and blood pressure and fluid balance in the body.



Sodium Food Sources and Recommended Intake



- Limit to 2,300 milligrams / day (DV)
- Table Salt, Cheese, Milk, Soy Sauce, and Unprocessed Meat
- Sauces, pickled foods, salty meats, salted snack foods, canned and instant foods, and seasonings based on salt can all be high sources.
- The GI tract absorbs nearly all dietary sodium.
- The kidneys excrete excess.



Hyponatremia



- **Hyponatremia** – abnormally low sodium concentrations in the blood due to excessive excretion of sodium (by the kidneys), prolonged vomiting, or diarrhea.
- Symptoms of hyponatremia resemble dehydration.
- Severe hyponatremia causes extracellular fluid to move into cells, causing them to swell.
- Cancer, kidney disease, and heart disease can cause hyponatremia.



Hypernatremia



- **Hypernatremia** – abnormally high sodium concentrations in the blood due to increased kidney retention of sodium or rapid ingestion of large amounts of salt.
- Hypernatremia is seen in patients with congestive heart failure and kidney disease.
- Eating too much sodium over a long period of time can contribute to hypertension (high blood pressure) in some people.
- Excess dietary sodium can contribute to osteoporosis by increasing calcium loss in the urine.

- **Hypervolemia** – also known as fluid overload, Condition where too much fluid volume in your body.
- an abnormal increase in the circulating blood volume.
- Hypervolemia leads to edema (swelling) and a rise in blood pressure.



Potassium



Functions:

- Muscle contractions
- Transmission of nerve impulses
- Helps regulate blood pressure
- Controls nerve impulses and muscle contractions.
- Helps in maintaining fluid balance in the body.
- Maintains proper functioning of muscle and nervous system.



Potassium Food Sources



- Spinach, Apples, Oranges, Tomatoes, Papaya, Bananas, Lemons, Celery, Mushrooms, Pecans, Raisins, Pineapple, Rice, Cucumbers, Strawberries, Figs, Brussels Sprouts, and Legumes
- Fresh vegetables and fruits.
 - Especially potatoes, spinach, melons, and bananas.
- Fresh meat, milk, coffee, and tea also contain some potassium.



Hypokalemia



- Hypokalemia – low levels of blood potassium.
- Low intake can disrupt acid-base balance, contribute to bone loss and kidney stones.
- Severe deficiency results from potassium depletion (excessive losses).
 - Prolonged vomiting, chronic diarrhea, laxative abuse, use of diuretics.
- Risk factor for hypertension.

- **Symptoms**
- Muscle weakness
- Loss of appetite
- Confusion
- Severe or rapid potassium depletion can disrupt heart rhythms



Hyperkalemia



- Hyperkalemia – abnormally high blood potassium.
- Malfunctioning kidneys or an excess of intravenous potassium can cause hyperkalemia.
- Hyperkalemia can slow and eventually stop the heart.



Chloride



- Chloride (Cl^-) – anion in table salt.
- Chlorine (Cl_2) – poisonous gas – highly reactive, used to treat water to kill bacteria and other pathogens.
- Chloride is a major extracellular anion.
- Fluid balance.
- Combines with H^+ to form HCl (hydrochloric acid in the stomach).
- White blood cells use chloride to kill invading bacteria.
- Assists in the transmission of nerve impulses.



Chloride Food Source



- Most of our chloride comes from salt.
- Table Salt, Soy Sauce, liver Unprocessed Meat, Milk and Peanuts
- The kidneys secrete excess chloride and some is lost in sweat.
- The only known cause of high blood chloride is severe dehydration.
- Maintains proper blood volume, blood pressure, and pH of our body fluids.



Hypochloremia



- Vomiting removes hydrochloric acid from the stomach.
- Frequent vomiting (bulimia nervosa) can cause a chloride deficiency.
- Frequent vomiting with inadequate fluid and mineral consumption can lead to dehydration and metabolic alkalosis (high blood pH).



Sulfur



- Third most important mineral in the body.
- Sulfur is abundantly found in muscles, skin, bones and hair, as well as many other systems in the body.
- It helps maintain the skin elasticity, and sulfur bonds help muscles, skin and bones maintain their shape.
- Sulfur is present in certain organic compounds (vitamins biotin and thiamine and amino acids methionine and cysteine)
- **Nuts, seeds, grains, and legumes**
- **Chickpeas, couscous, eggs, lentils, oats, turkey and walnuts**
- **Cruciferous Vegetables**
- **Whole grains and Green Leafy Vegetables**



Dietary Sources Of Sulfur



- **Dietary sources of Sulfated Proteins:**

- Cheese, Eggs, Nuts, Turnips, Onions, Fish, Wheat Germ, Cucumbers, Corn, Cauliflower, and Broccoli
- Egg
- Fish
- Meat
- Liver
- Legumes
- Cereals



- A deficiency of sulfur in the body can cause following health disorders:
- Acne, arthritis, brittle nails and hair, convulsions, depression, Eczema, Itchy skin or scalp, Migraine headaches, memory loss, gastrointestinal issues, rashes and even slow wound healing.



Dietary Absorption



- The sulfated Amino acids are **absorbed from intestine**
- Through active transport mechanism.

Body Distribution Of Sulfur

- The total content of Sulfur in an adult body is **150-200 gm.**
- Very small amount of inorganic Sulphate occurs in tissues and body fluids.
- **Sulfur levels in blood=0.1-1 mg%**

Excretion Of Sulfur

- The Sulfur from different **sulfated compounds is oxidized in Liver and excreted through Urine.**
- **Urine excretes both inorganic and organic forms of Sulfur.**
- In the form of **Thiocynates** and **Sulfur containing amino acid.**



Functions



- **Sulfur in the body** is present in **organic form** as various biomolecules carrying following functions:
- Involved in protein synthesis.
- Protects your cells from damage.
- Helps in promoting the loosening and shedding of Skin.

MAJOR MINERALS

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Calcium (Ca ²⁺)	Milk, cheese, sardines, salmon, some dark green leafy vegetables	Development of bones and teeth Transmission of nerve impulses Blood clotting Normal heart action Normal muscle activity	Osteoporosis Osteomalacia Rickets Tetany Retarded growth Poor tooth and bone formation

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Phosphorus (P)	Milk, cheese, lean meat, poultry, fish, whole-grain cereals, legumes, nuts	<p>Development of bones and teeth</p> <p>Maintains normal pH of the blood</p> <p>Constituent of all body cells</p> <p>CHO, CHON and fat metabolism</p>	<p>Poor tooth and bone formation</p> <p>Weakness</p> <p>Anorexia</p> <p>General malaise</p>

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Potassium (K ⁺)	Oranges, bananas, dried fruits, vegetables, legumes, milk, cereals, meat	<p>Contraction of muscles</p> <p>Maintenance of fluid balance</p> <p>Transmission of nerve impulses</p> <p>Regular heart rhythm</p> <p>Cell metabolism</p>	<p>Deficiency:</p> <p>hypokalemia</p> <p>muscle weakness</p> <p>confusion</p> <p>abnormal heartbeat</p> <p>Toxicity:</p> <p>hyperkalemia</p> <p>potentially life-threatening irregular heartbeats</p>

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Sodium (Na ⁺)	Table salt, beef, eggs, poultry, milk, cheese, Soy sauce, moderate amounts in breads and vegetables, large amounts in processed foods	Maintenance of fluid balance Transmission of nerve impulses Acid-base balance Muscle contraction	Deficiency: nausea exhaustion muscle cramps Toxicity: hypertension edema

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Chloride (Cl ⁻)	Table salt, eggs, seafood, milk	Gastric acidity Regulates acid-base balance in the body Maintains fluid and electrolyte balance Formation of hydrochloric acid	Imbalance in gastric acidity Imbalance in blood pH Nausea Exhaustion

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/ TOXICITY
Magnesium (Mg^{2+})	Green, leafy vegetables Whole grains, avocados, nuts, milk, legumes, bananas, nuts, seafood, chocolate, cocoa	Nerve transmission Synthesis of ATP Activation of metabolic enzymes Muscle activity Constituent of bones, muscles, and RBCs	Normally unknown Mental, emotional and muscle disorders



THANK YOU