**MINERALS**

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**INTRODUCTION**

* Minerals are inorganic nutrients. That is, they are materials found in foods that are essential for growth and health and do not contain the element carbon.
* The minerals that are relevant to human nutrition are water, sodium, potassium, chloride, calcium, phosphate, sulphate, magnesium, iron, copper, zinc, manganese, iodine, selenium, and molybdenum.
* Cobalt is a required mineral for human health, but it is supplied by vitamin B 12 .

**CLASSIFICATION**

* **Major minerals**

Required in amounts greater than 100 mg a day

* **Trace minerals**

Needed in amounts smaller than 100 mg a day

**ELECTROLYTES**

IONS

* Electrically charged atoms resulting from chemical reactions
* Positively charged called cations
* Negatively charged called anions
* Must be balanced within body
* These ions are known as electrolytes

**Electrolytes maintain the body’s fluid balance, contribute to electrical balance, assist in transmission of nerve impulses and contraction of muscles, help regulate the body’s acid-base balance.**

**TOXICITY**

* Toxicity occurs when concentrated forms of minerals are taken regularly over time.Excessive amount of one mineral may lead to deficiency of another mineral.
* Hair loss and changes in blood, hormones, bones, muscles, blood vessels, and nearly all tissues may result.
* Concentrated minerals only if prescribed.

**MAJOR MINERALS**

* Calcium
* Phosphorus
* Potassium
* Sodium &
* Chloride
* **CALCIUM (CA)**
* Human body contains more calcium than any other mineral.
  + 99% found in skeleton and teeth
  + 1% found in blood

**CALCIUM: FUNCTIONS**

* In combination with phosphorus, gives strength and hardness to bones and teeth.
* Bones provide storage for calcium.
* Needed for normal nerve and muscle action, blood clotting, heart function, and cell metabolism.

**Calcium Regulation**

* Hormonal system regulates delivery of calcium to cells. Every cell needs calcium and normal blood calcium levels are maintained even if intake is poor.
* Parathyroid glands release a hormone telling the kidneys to retrieve calcium before it is excreted when blood calcium levels drop. This hormone, works with calcitriol causing increased release of calcium from bones by stimulating activity of osteoclasts. Both actions increase blood calcium levels.
* Bones become increasingly fragile as calcium is withdrawn from them. Osteoporosis may result from years of low calcium intake.
* Osteoblasts increase bone mass if blood calcium level is high until one is age 30-35 years old.
* Bone mass will remain stable in women until menopause with adequate consumption of calcium, phosphorus, and vitamin D.

**Calcium: Sources**

* Milk and milk products
* Dark green, leafy vegetables
* When vegetables contain oxalic acid, as spinach and Swiss chard do, the calcium remains unavailable because the oxalic acid binds it and prevents it from being absorbed

**Fiber**

When the intake of fiber exceeds 35g a day, calcium will also bind with phytates (phosphorus compounds found in some high-fiber cereal), which also limits its absorption.

**Enhances absorption of Calcium**

* Vitamin D
* Calcium-to-phosphorus ratio that includes no more phosphorus than calcium
* Presence of lactose

**Retards absorption**

* Lack of weight-bearing exercise

**Calcium: Requirements**

* **0-6 months - 210 mg**
* **6-12 months-270 mg**
* **1-3 year - 500 mg**
* **4-8 year -800 mg**
* **9-18 years -1,300 mg**
* **19-50 years -1,000 mg**
* **51-70+ years -1,200 mg**

**Pregnant women**

* 14-18 years -1,300 mg
* 19-50 years- 1,000 mg
* Lactating women same as no lactating women of same age

**Calcium: Supplements**

* Calcium carbonate, form found in calcium-based antacid tablets, has highest concentration of bioavailable calcium.
* Appear to be absorbed most efficiently when consumed in doses of 500 mg.
* Check for USP-approved products, which are unlikely to contain lead.

**Calcium: Deficiency**

* Rickets results in poorly formed bone structure and causes bowed legs, “pigeon breast”, enlarged wrists or ankles, and stunted growth.
* “Adult rickets” (osteomalacia) causes bones to become soft.
* Tetany, characterized by involuntary muscle movement, results from insufficient calcium in blood.

**Calcium: Excess**

Excessive intake may:

* Cause constipation
* Cause kidney stones
* Inhibit the absorption of iron and zinc
* **PHOSPHORUS (P)**
* Constituent of all body cells.
* Necessary for the formation of strong, rigid bones and teeth; metabolism of carbohydrates, fats, and proteins; proper acid-base balance; and effective action of several B vitamins.
* Stored in bones, absorption is increased in the presence of vitamin D.

**Phosphorus: Sources**

* Protein-rich foods such as milk, cheese, meats, poultry, and fish.
* Cereals, legumes, nuts, soft drinks

**Phosphorus: Requirements**

**Adequate Intake**

* 0-6 months - 100 mg
* 6-12 months - 275 mg

**Estimated Average Requirements**

* 1-3 year- 380 mg
* 4-8 years- 405 mg
* 9-18 years- 1,055 mg

**Phosphorus: Deficiency**

* Deficiency is rare.
* Excessive use of antacids affect absorption.
* Symptoms of deficiency include bone demineralization (loss of minerals), fatigue, and anorexia.
* **Potassium (K)**
* Found primarily in intracellular fluid.
* Essential for fluid balance and osmosis.
* Maintains fluid level within the cell.
* Necessary for transmitting nerve impulses and muscle contractions.

**Potassium: Sources**

* Fruits–especially melons, oranges, bananas, peaches
* Vegetables–mushrooms, brussel sprouts, potatoes, tomatoes, winter squash, lima beans, carrots.

**Potassium: Deficiency**

* Hypokalemia
* Caused by diarrhea, vomiting, diabetic acidosis, severe malnutrition, or excessive use of laxatives or diuretics
* Symptoms of deficiency include nausea, anorexia, fatigue, muscle weakness, heart abnormalities.

**Potassium: Excess**

* Hyperkalemia
* Caused by dehydration, renal failure, excessive intake
* Cardiac failure can result
* **SODIUM**
* Primary function is the control of fluid balance in the body.
* Maintains acid-base balance.
* Participates in the transmission of nerve impulses essential for normal muscle function.

**Sodium: Sources**

* Table salt contains 40% sodium.
* One teaspoon of table salt contains 2,000 mg of sodium.
* Naturally available in animal foods.

**Sodium: Requirements**

* **0-5 months- 120 mg**
* **6-11 months- 200 mg**
* **1 year - 225 mg**
* **2-5 years - 300 mg**
* **6-9 years - 400 mg**
* **10-18 years - 500 mg**
* **> 18 years - 500 mg**

**Sodium: Deficiency**

* Caused by severe vomiting, diarrhea, and heavy perspiration.
* Can upset the acid-base balance.
* Tetany due to alkalosis may develop.

**Sodium: Excess**

* May cause edema and resulting hypertension.
* Associated with hypertension and congestive heart failure.
* Treatment includes sodium-restricted diets; 3-4g (no-added salt, or NAS) or 1-2g sodium-restricted diet. Diets below 1g rarely prescribed.
* **CHLORIDE**
* Essential for maintenance of fluid, electrolyte, and acid-base balance.
* Found in hydrochloric acid, cerebrospinal fluid, and muscle and nerve tissue.
* Helps blood carry carbon dioxide to the lungs and is necessary during immune

responses when white blood cells attack foreign cells.

* Found almost exclusively in table salt or in foods containing sodium chloride.
* Estimated minimum requirement for normal adults is 750 mg a day.
* Deficiency is rare.
* Can occur with severe vomiting, diarrhea, excessive use of diuretics, and alkalosis.
* **MAGNESIUM**
* Vital to both hard and soft body tissues.
* Essential for metabolism.
* Regulates nerve and muscle function.
* Plays a role in the blood-clotting process.

**Magnesium: Sources**

* Found primarily in plant foods.
* Green leafy vegetables, legumes, nuts, whole grains, some fruits (avocados and bananas)
* Milk in sufficient quantities.

**Magnesium: Requirements**

**Adequate Intake**

* **0-6 months-30 mg**
* **6-12 months- 75 mg**

**Boys and girls**

* **1-3 years- 80 mg**
* **4-8 year- 130 mg**
* **9-13 years -240 mg**

**Boys 14-18 years 410 mg**

**Girls 14-18 years 360 mg**

**Men 19-30 years 400 mg**

**Women 19-30 years 310 mg**

**Men 31-70+ years 420 mg**

**Women 31-70+ years 320 mg**

**Pregnant women 14-18 years 400 mg**

**19-30 years 350 mg**

**31-50 years 360 mg**

**Lactating women 14-18 years 360 mg**

**19-30 years 310 mg**

**31-50 years 320 mg**

**Magnesium: Deficiency**

* Deficiency among people on normal diets is unknown.
* Experimentally induced symptoms include nausea, mental, emotional, muscular disorders

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* **SULPHUR (S)**
* Necessary to all body tissue and is found in all body cells.
* Contributes to the characteristic odor of burning hair and tissue.
* Necessary for metabolism.
* Component of some amino acids.
* Found in protein-rich foods.
* Neither the amount of sulfur required by the human body nor its deficiency is known.

**TRACE MINERALS**

**Iron, Iodine, Zinc, Selenium, Copper, Manganese, Fluoride, Chromium, Molybdenum**

* **IRON (Fe)**
* Delivers oxygen to body tissues.
* Component of hemoglobin.
* Component of myoglobin, a protein compound in muscles that provides oxygen to cells.
* Utilized by enzymes that are involved in making amino acids, hormones,and neurotransmitters.

**Iron: Sources**

* Meat, poultry, and fish are the best sources of iron. Animal flesh contains heme iron, which is absorbed more than twice as efficiently as non-heme iron.
* Non heme iron is found in whole grain cereals, enriched grain products, vegetables, fruit, eggs, meat, fish, and poultry.

**Factors that Affect Iron Absorption**

**Increase**

* Acid in the stomach
* Heme iron
* High body demand for red blood cells (blood loss, pregnancy)
* Low body stores of iron
* Meat protein factor (MPF)
* Vitamine

**Decrease**

* Phytic acid (in fiber)
* Oxalic acid
* Polyphenols in tea and coffee
* Full body stores of iron
* Excess of other minerals (Zn, Mn, Ca)
* Some antacids

**Iron: Requirements**

* Men lose approximately 1 mg/day.Women lose approximately 1.5 mg/day.
* RDA ( recommended daily allowance)for men is 10 mg, and for women age eleven through childbearing is 15 mg.
* RDA doubled during pregnancy; difficult to meet by diet alone.
* Iron supplement commonly prescribed during pregnancy.
* Heavy need during infancy and teens

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**Iron: Deficiency**

* Caused by insufficient intake, malabsorption, lack of stomach acid, or excessive blood loss.
* Most common nutrient deficiency worldwide is iron-deficiency anemia.
* Symptoms include fatigue, weakness, irritability, shortness of breath, pale skin, and spoon-shaped fingernails.

**Iron: Excess**

* Hemochromatosis is a condition due to an inborn error of metabolism and causes excessive absorption of iron.
* Untreated, can damage liver, spleen, heart.
* To control buildup of iron, patients with this condition must give blood on a regular basis.

**IODINE (I)**

* Component of thyroid hormones, thyroxine (T4) and triiodothyronine (T3).
* Necessary for the normal functioning of thyroid gland, which determines rate of metabolism.
* Sources include iodized salt, seafood, and some plant foods grown in soil bordering the sea.
* RDA for adults is 150 μg a day.Additional amounts needed during pregnancy and lactation.
* Lack of iodine results in decrease in thyroxine and triiodothyronine.
* Gland grows, forming a lump on the neck called a goiter.
* Myxedema is a condition of hypothyroidism in adults.
* Cretinism is low thyroid in a child; retards physical and mental development.

**ZINC (Zn)**

* Cofactor for more than 300 enzymes.
* Essential for growth, wound healing, taste acuity, glucose tolerance, and mobilization of vitamin A within the body.
* Sources include meat, fish, eggs, dairy products, wheat germ, and legumes.
* RDA for normal adult males is 11 mg.RDA for normal adult females is 8 mg.
* Increased requirements during pregnancy and lactation.
* Symptoms of deficiency include decreased appetite, taste acuity, delayed growth, dwarfism, hypogonadism, poor wound healing, anemia, acnelike rash, impaired immune response.
* **SELENIUM (Se)**
* Constituent of most body tissues.
* Concentrated in liver, kidneys, and heart.
* Component of an enzyme that acts as an antioxidant, thereby protecting cells against oxidation and sparing vitamin E.
* Sources include seafood, kidney,liver, muscle meats.
* RDA for adult male is 70 μg. RDA for adult female is 55 μg.
* Selenium supplements appear to be effective in treating Keshan disease
* High doses are toxic causing vomiting, loss of hair and nails, and skin lesions.
* **COPPER (Cu)**
* Found in all tissues; heaviest concentration in the liver, kidneys, muscles, and brain.
* Helps in formation of hemoglobin; aids in transport of iron to bone marrow for the formation of red blood cells; and participates in energy production.
* Sources include organ meats, shellfish, legumes, nuts, cocoa, whole grain cereals, and human milk.
* No RDA; NRC’s estimated safe intake for adults is 1.5-3 mg/day.
* Deficiency is rare.
* People with malabsorption conditions and gross protein deficiency such as premature infants; clients on long-term parenteral nutrition programs lacking copper; and people taking excess zinc supplements are candidates for deficiency.
* Anemia, bone demineralization, and impaired growth may result.
* Excess is highly toxic.
* Single dose of 10-15 mg can cause vomiting.
* Wilson’s disease is an inherited condition causing damage to liver cells and neurons. Detected early, copper-binding agents may be used to bind copper in bloodstream and increase excretion.

**MANGANESE (Mn)**

* Constituent of several enzymes involved in metabolism.
* Important in bone formation.
* Sources include whole grains, tea, vegetables, and fruits.
* Adequate intake is 2.3 mg for men and 1.8 mg for women.
* No deficiency/toxicity from ingestion known.
* Inhalation linked to neurological problems.

**FLUORIDE (F)**

* Increases resistance to dental caries, and may strengthen teeth and bones.
* Sources include fluoridated water, fish and tea. Commercially prepared foods with fluoridated water.
* Deficiency can result in increased tooth decay.
* Excess can cause discoloration or mottling of children’s teeth.

**Fluoride: Requirements**

* 0-6 months - .01 mg
* 6-12 months - 0.5 mg
* 1-3 years - 0.7 mg
* 4-8 years - 1.0 mg
* 9-13 years - 2.0 mg
* Boys 14-18 years - 3.1 mg

Girls 14-18 years - 3.0 mg

Males 19+ years - 4.0 mg

Females 19+ years - 3.0 mg

* **CHROIUM (Cr)**
* Associated with glucose and lipid metabolism.
* Levels decrease with age except in lungs, where chromium accumulates.
* Sources include meat, mushrooms, nuts, yeast, organ meats, and wheat germ.
* Safe and adequate daily intake for men is 35 μg and women 25 μg
* Deficiency related to disturbances in glucose metabolism.

**MOLYBEDNUM (Mo)**

* Constituent of enzymes, and thought to play a role in metabolism.
* Sources include milk, liver, legumes, and cereals.
* Safe and adequate daily intake for adults is 45 μg.
* No deficiencies noted.
* Excess inhibits copper absorption.

Signature

**THANK YOU**