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Micronutrients

- + Nutrients needed by the body in small amounts are called **micronutrients**
- + Types of micronutrients
 - **Vitamins**
 - **Minerals**
 - **Trace elements**
- + Do not provide energy
- + Required for maintaining normal body functions and health, and prevent diseases

Vitamins:

- ↗ Organic compounds present in small quantities in different types of food
- ↗ Help in various biochemical processes in cell
- ↗ Important for growth and good health
- ↗ Essential
- ↗ Noncaloric
- ↗ Required in very small amounts

Minerals:

- ↗ Needed for normal growth and maintenance of the body :
- ↗ **Macrominerals** : Minerals needed in amounts more than 100 mg/day are called major elements or macrominerals .
Calcium, Sodium
- ↗ **Microminerals** : Minerals needed in amounts less than 100 mg/day are called microminerals or minor elements or trace elements.
Iron, Iodine

Fat-Soluble Vitamins

- Usually absorbed slowly
- **Stored** in the body
- Excess may accumulate and cause toxicity
- Reported cases of toxicity with vitamin **A** and **D**
- Do not need to consume each day due to storage in the body

Name of vitamins	Functions	Disorders of Vitamin Deficiency	Others
Vitamin D <i>(Calciferol)</i>	<ul style="list-style-type: none"> ❖ Maintains calcium homeostasis, healthy bones and teeth ❖ Promotes absorption of calcium and phosphorus from the intestine ❖ Increases bone mineralization ❖ Increases reabsorption of calcium and phosphorus by renal tubules in the kidneys 	<p>Rickets:</p> <ul style="list-style-type: none"> ➤ Common in children ➤ Insufficient mineralization of bone ➤ Bones become soft – bone deformities <p>Osteomalacia:</p> <ul style="list-style-type: none"> ➤ Bones are softened due to demineralization and increased osteoporosis ➤ Pain in bones is common ➤ More bone fractures 	<p>- Synthesized either from 7-dehydrocholesterol or ergosterol by the action of ultraviolet light</p> <p>- Considered a hormone, can be synthesized by the body</p>
Vitamin E <i>(Tocopherol)</i>	<ul style="list-style-type: none"> ❖ Antioxidant function: Prevents oxidation of cell components such as: <ul style="list-style-type: none"> • Poly unsaturated fatty acids by molecular oxygen and free radicals ❖ May have a role in fertility ❖ May have anti-aging effect 	<ul style="list-style-type: none"> ➤ Deficiency observed mostly in premature infants ➤ Defective lipid absorption / transport in adults causing anemia due to decreased production of hemoglobin and short life span of RBCs ➤ May limit LDL oxidation ➤ Does not prevent or reduce heart disease 	<p>α - tocopherol is the most active form in the body</p>

Water -Soluble Vitamins

- ◆ Present in **small** quantities in different types of food
- ◆ Help in various biochemical processes in cell
- ◆ Important for growth and good health
- ◆ Function as coenzymes

Name of vitamins	Functions	Disorders of Vitamin Deficiency
Vitamin B₃ <i>(Niacin)</i> <ul style="list-style-type: none"> • Nicotinic acid • Nicotinamide (NAD and NADP) 	<ul style="list-style-type: none"> ❖ NAD and NADP act as coenzymes for various dehydrogenases <ul style="list-style-type: none"> • Lactate dehydrogenase • Pyruvate dehydrogenase • Glyceraldehyde dehydrogenase • Malate dehydrogenase ❖ Nicotinic acid lowers plasma cholesterol by reducing fat mobilization from adipose tissue 	<ul style="list-style-type: none"> ➤ Pellegra – a disease that affects <ul style="list-style-type: none"> ○ Skin, GI tract, CNS causing : <ul style="list-style-type: none"> ▪ Diarrhea, depression, dementia ➤ Treatment of hyperlipidemia
Vitamin B₆	<ul style="list-style-type: none"> ❖ Three forms: Pyridoxine, Pyridoxal Pyridoxamine ❖ Active form: pyridoxal phosphate ❖ As coenzyme for : <ul style="list-style-type: none"> • Transamination • Deamination • Decarboxylation • Condensation reactions 	<ul style="list-style-type: none"> ➤ Deficiency leads to decreased neurotransmitter synthesis such as: <ul style="list-style-type: none"> ○ Serotonin, epinephrine, noradrenaline, GABA ➤ Demyelination of nerves and peripheral neuritis

<p>Folate: natural form Folic acid: synthetic form</p>	<ul style="list-style-type: none"> ❖ Plays a key role in one-carbon metabolism ❖ Essential for the biosynthesis of several compounds ❖ Transfers one-carbon unit to intermediates, amino acids, purine and thymine synthesis ❖ Helps prevent cancer and heart disease ❖ Folic acid supplementation in early pregnancy reduces the risk of neural tube defects in fetus 	<ul style="list-style-type: none"> ➤ Megaloblastic anemia <ul style="list-style-type: none"> ○ A type of anemia with red blood cells that are larger than normal, usually resulting from a deficiency of folic acid or vitamin B₁₂ ➤ Pregnancy and lactation <ul style="list-style-type: none"> ○ Low levels of serum folate due to increased demand in pregnancy and lactation ➤ Poor absorption by intestine, alcoholism or by drugs such as methotrexate
<p>Vitamin C (Ascorbic Acid)</p>	<ul style="list-style-type: none"> ❖ Powerful antioxidant: May prevent some cancers ❖ Helps in dentine and intercellular matrix formation ❖ Promotes collagen formation ❖ Increases iron absorption ❖ Helps in the maturation of RBCs ❖ Promotes wound healing ❖ Helps in reconvertng methemoglobin to hemoglobin ❖ Involved in the synthesis of bile acids from cholesterol ❖ Stimulates phagocytic action of leukocytes ❖ Reduces risk of cataract formation 	<ul style="list-style-type: none"> ➤ Scurvy <ul style="list-style-type: none"> ○ Due to severe vitamin C deficiency ○ Abnormal collagen production ○ Gums become painful, swollen and spongy ○ The pulp is separated and the teeth are lost <div data-bbox="1373 691 1724 984" data-label="Image"> </div> <p>scorbutic gums in vitamin C deficiency. Gums are swollen, ulcerated, and bleeding due to vitamin C-induced defects in oral epithelial basement membranes and periodontal collagen fiber synthesis.</p>

Minerals

	Calcium	Sodium	Iron	Iodine
Functions	<ul style="list-style-type: none"> • Important for bone growth and teeth formation • Neurotransmission of nerve impulse • Muscle function • Blood coagulation • Activates enzymes such as protein kinases 	<ul style="list-style-type: none"> • A major cation of extracellular fluid • Sodium pump is present in all cells to keep the sodium extracellular • Important in the regulation of acid-base balance (as sodium bicarbonate) 	<ul style="list-style-type: none"> • Essential in oxygen transport and metabolism. Part of hemoglobin and myoglobin • Part of cytochromes in electron transport chain – important for oxidative phosphorylation • Body contains iron in two major pools: <ul style="list-style-type: none"> ○ Functional iron in hemoglobin, myoglobin and enzymes ○ Storage iron in ferritin, hemosiderin and transferrin • Adult women have much lower iron storage than men 	<ul style="list-style-type: none"> • Dietary iodine is absorbed, transported and stored in thyroid gland for: <ul style="list-style-type: none"> ○ Tri-iodo-thyronine (T3) and thyroxine (T4) synthesis • Iodine absorption is mainly through small intestine • Substances in food that prevent utilization of iodine are called goitrogens
Disorders & Deficiency	<ul style="list-style-type: none"> • Rickets • Osteomalacia • Osteoporosis 	<ul style="list-style-type: none"> • Edema (in case of Na retention). Sodium and water content in the body is increased • Effect of diuretic drugs. Sodium excretion is increased • Hypertension and heart disease. Sodium-restricted diet is advised in cardiac failure and hypertension • Hyponatremia . Observed in Cushing’s disease • Prolonged cortisone therapy • In pregnancy, steroid hormones cause sodium retention in the body • In dehydration, the blood volume is decreased with increase in sodium concentration. 	<ul style="list-style-type: none"> • Iron deficiency anemia is the most common type • Growing children, pregnant, lactating and menstruating women need more iron • Hemosiderosis (iron overload disorder) • Due to iron excess (toxicity) • Hemosiderin (Iron stored in complex with ferritin protein in liver and spleen) • Occurs in persons receiving repeated blood transfusions 	<ul style="list-style-type: none"> • Cretinism: deficiency of thyroids hormones in children causing: Stunted physical and mental growth • Goiter: enlargement of thyroid gland due to iodine deficiency affecting thyroid hormone synthesis