



Nutrition & Diet Therapy Third Stage First Semester 2023-2024

Lecture Four : Vitamins, Minerals & Water



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Vitamins: Basic Concepts

In 1753, British physician James Lind published an article describing an experiment he had performed on 12 sailors suffering from scurvy. Lind divided the sick sailors into 6 pairs, and each pair received a different treatment. The six treatments were cider, vinegar, sulfuric acid, seawater, nutmeg, oranges and lemons. Lind observed that the pair of sailors given the citrus fruit were the only ones to recover from scurvy. Lind found the cure for scurvy is eating oranges and lemons.

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/TOXICITY
Fat-soluble vitamins			
Vitamin A (retinol)	Animal	Maintenance of vision in dim light	Deficiency
	Liver		Night blindness
	Whole milk	Maintenance of mucous membranes and healthy skin	Xerophthalmia
	Butter		Respiratory infections
	Cream	Growth and development of bones	Bone growth ceases
	Cod liver oil		Toxicity
	Plants	Reproduction	Birth defects
	Dark green leafy vegetables	Healthy immune system	Bone pain
	Deep yellow or orange fruit	Antioxidant	Anorexidant
	Fortified margarine		Enlargement of liver
Vitamin D (calciferol)	Animal	Regulation of absorption of calcium and phosphorus	Deficiency
	Eggs		Rickets
	Liver	Building and maintenance of normal bones and teeth	Osteomalacia
	Fortified milk		Osteoporosis
	Fortified margarine	Prevention of tetany	Poorly developed teeth and bones
	Oily fish		Muscle spasms
	Plants		Toxicity
	None		Kidney stones
	Other sources		Calcification of soft tissues
	Sunlight		

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/TOXICITY
Vitamin E (tocopherol)	Animal	Antioxidant	Deficiency
	None	Considered essential for protection of cell structure, especially of red blood cells	Destruction of red blood cells
	Plants		Toxicity
	Green and leafy vegetables		
	Margarine		
	Salad dressing		
	Wheat germ		
Vegetable oils			
Nuts			
Vitamin K	Animal	Blood clotting	Deficiency
	Liver		Prolonged blood clotting or hemorrhaging
	Milk		Toxicity
	Plants		Hemolytic anemia
	Green leafy vegetables		Interferes with anticlotting medications
Cabbage, broccoli			
Brussels sprouts			

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/TOXICITY
Water-soluble vitamins			
Thiamine (vitamin B₁)	Animal Lean pork Beef Liver Eggs Fish Plants Whole and enriched grains Legumes Brewer's yeast	Metabolism of carbohydrates and some amino acids Maintains normal appetite and functioning of nervous system	Deficiency Gastrointestinal tract, nervous system, and cardiovascular system problems Beriberi Toxicity None
Riboflavin (vitamin B₂)	Animal Liver, kidney, heart Milk Cheese Plants Green, leafy vegetables Cereals Enriched bread	Aids release of energy from food Health of the mouth tissue Healthy eyes	Deficiency Cheilosis Eye sensitivity Dermatitis Glossitis Photophobia Toxicity None
Niacin (nicotinic acid)	Animal Milk Eggs Fish Poultry Plants Enriched breads and cereals	Energy metabolism Healthy skin and nervous and digestive systems	Deficiency Pellagra—dermatitis, dementia, diarrhea Toxicity Vasodilation of blood vessels

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/TOXICITY
Pyridoxine (vitamin B₆)	Animal Pork Fish Poultry Liver, kidney Milk Eggs Plants Whole-grain cereals Legumes	Conversion of tryptophan to niacin Release of glucose from glycogen Protein metabolism and synthesis of nonessential amino acids	Deficiency Cheilosis Glossitis Dermatitis Confusion Depression Irritability Toxicity Depression Nerve damage
Vitamin B₁₂ (cobalamin)	Animal Seafood Poultry Liver, kidney Muscle meats Eggs Milk Cheese Plants None	Synthesis of red blood cells Maintenance of myelin sheaths Treatment of pernicious anemia Folate metabolism	Deficiency Degeneration of myelin sheaths Pernicious anemia Sore mouth and tongue Anorexia Neurological disorders Toxicity None
Folate (folic acid)	Animal Liver Plants Leafy green vegetables Spinach Legumes Seeds Broccoli Cereal and flour fortified with folate Fruit	Synthesis of RBCs Synthesis of DNA	Deficiency Anemia Glossitis Neural tube defects such as anencephaly and spina bifida Toxicity Could mask a B ₁₂ deficiency

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/TOXICITY
Biotin	Animal Milk Liver and kidney Egg yolks Plants Legumes Brewer's yeast Soy flour Cereals Fruit	Coenzyme in carbohydrate and amino acid metabolism Niacin synthesis from tryptophan	Deficiency Dermatitis Nausea Anorexia Depression Hair loss Toxicity None
Pantothenic acid	Animal Eggs Liver Salmon Poultry Plants Mushrooms Cauliflower Peanuts Brewer's yeast	Metabolism of carbohydrates, lipids, and proteins Synthesis of fatty acids, cholesterol, steroid hormones	Deficiency Rare: burning feet syndrome; vomiting; fatigue Toxicity None
Vitamin C (ascorbic acid)	Animal None Plants All citrus fruits Broccoli Melons Strawberries Tomatoes Brussels sprouts Potatoes Cabbage Green peppers	Prevention of scurvy Formation of collagen Healing of wounds Release of stress hormones Absorption of iron Antioxidant Resistance to infection	Deficiency Scurvy Muscle cramps Ulcerated gums Tendency to bruise easily Toxicity Raised uric acid level Hemolytic anemia Kidney stones Rebound scurvy

Figure 8.1 Functions of vitamins and related compounds. Groups of vitamins and related compounds (e.g., choline and certain carotenoids) work together to maintain good health.



Water

► Compared to the other nutrients, water is so unusual, it is in a class by itself. Water is a simple compound; a molecule of water is comprised of two hydrogen atoms and one oxygen atom (H₂O). Water does not need to be digested, and it is easily absorbed by the intestinal tract.

Functions of Water in the Body

- 1- Is a solvent
- 2- Is a major component of blood, saliva, sweat, tears, mucus, and joint fluid
- 3- Removes wastes
- 4- Helps transport substances
- 5- Lubricates tissues
- 6- Regulates body temperature
- 7- Helps digest foods
- 8- Participates in many chemical reactions
- 9- Helps maintain proper blood pH

Can Too Much Water Be Toxic?

► We need about 30 ml of water for each kilogram of body weight. Water intoxication, however, can occur when an excessive amount of water is consumed in a short time period or the kidneys have difficulty filtering water from blood. The excess water dilutes the sodium concentration of blood, disrupting water balance. As a result of the imbalance, too much water moves into cells, including brain cells. Signs and symptoms of water intoxication may include dizziness, headache, and confusion, inability to coordinate muscular movements, bizarre behavior, and seizures. If the condition is not detected early and treated effectively, coma and death can result. Healthy people rarely drink enough water to become intoxicated. However, water intoxication can develop in people with disorders that interfere with the kidney's ability to excrete water normally.

Minerals: Basic Concepts

A mineral is an inorganic element that is necessary for the body to build tissues, regulate body fluids, or assist in various body functions. Minerals are found in all body tissues and cannot provide energy. Any abnormal concentration of minerals in the blood can help diagnose different disorders. Minerals are found in water and in natural (unprocessed) foods, together with proteins, carbohydrates, fats, and vitamins.

Classification of Minerals

Minerals are divided into two groups:

- 1- **Major minerals**, so named because each is required in amounts greater than 100 mg a day.
- 2- **Trace minerals**, which are needed in amounts smaller than 100 mg a day.

Electrolytes: As mineral salts dissolve in water, they break into separate electrically charged atoms called ions. Ions, if positively charged, are called **cations**. When negatively charged, they are **anions**.

Table 8-1 Major Minerals

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/TOXICITY
Calcium (Ca ⁺⁺)	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	Deficiency Osteoporosis Osteomalacia Rickets Tetany Retarded growth Poor tooth and bone formation
Phosphorus (P)	Milk, cheese Lean meat Poultry Fish Whole-grain cereals Legumes Nuts	Development of bones and teeth Maintenance of normal acid-base balance of the blood Constituent of all body cells Necessary for effectiveness of some vitamins Metabolism of carbohydrates, fats, and proteins	Deficiency Poor tooth and bone formation Weakness Anorexia General malaise
Potassium (K ⁺)	Oranges, bananas Dried fruits Vegetables Legumes Milk Cereals Meat	Contraction of muscles Maintenance of fluid balance Transmission of nerve impulses Osmosis Regular heart rhythm Cell metabolism	Deficiency Hypokalemia Muscle weakness Confusion Abnormal heartbeat Toxicity Hyperkalemia Potentially life-threatening irregular heartbeats

Table 8-1 Major Minerals

Sodium (Na ⁺)	Table salt Beef, eggs Poultry Milk, cheese	Maintenance of fluid balance Transmission of nerve impulses Osmosis Acid-base balance Regulation of muscle and nerve irritability	Deficiency Nausea Exhaustion Muscle cramps Toxicity Increase in blood pressure Edema
Chloride (Cl ⁻)	Table salt Eggs Seafood Milk	Gastric acidity Regulation of osmotic pressure Osmosis Fluid balance Acid-base balance Formation of hydrochloric acid	Deficiency Imbalance in gastric acidity Imbalance in blood pH Nausea Exhaustion
Magnesium (Mg ⁺⁺)	Green, leafy vegetables Whole grains Avocados Nuts Milk Legumes Bananas	Synthesis of ATP Transmission of nerve impulses Activation of metabolic enzymes Constituent of bones, muscles, and red blood cells Necessary for healthy muscles and nerves	Deficiency Normally unknown Mental, emotional, and muscle disorders
Sulfur (S)	Eggs Poultry Fish	Maintenance of protein structure For building hair, nails, and all body tissues Constituent of all body cells	Unknown

Table 8-2 Trace Minerals

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/TOXICITY
Iron (Fe ⁺)	Muscle meats Poultry Shellfish Liver Legumes Dried fruits Whole-grain or enriched breads and cereals Dark green and leafy vegetables Molasses	Transports oxygen and carbon dioxide Component of hemoglobin and myoglobin Component of cellular enzymes essential for energy production	Deficiency Iron deficiency anemia characterized by weak- ness, dizziness, loss of weight, and pallor Toxicity Hemochromatosis (genetic) Can be fatal to children May contribute to heart disease Injure liver
Iodine (I ⁻)	Iodized salt Seafood	Regulation of basal metabolic rate	Deficiency Goiter Cretinism Myxedema
Zinc (Zn ⁺)	Seafood, especially oysters Liver Eggs Milk Wheat bran Legumes	Formation of collagen Component of insulin Component of many vital enzymes Wound healing Taste acuity Essential for growth Immune reactions	Deficiency Dwarfism, hypogo- nadism, anemia Loss of appetite Skin changes Impaired wound healing Decreased taste acuity
Selenium (Se ⁻)	Seafood Kidney Liver Muscle meats Grains	Constituent of most body tissue Needed for fat metabolism Antioxidant functions	Deficiency Unclear, but related to Keshan disease Muscle weakness Toxicity Vomiting Loss of hair and nails Skin lesions

NAME	FOOD SOURCES	FUNCTIONS	DEFICIENCY/TOXICITY
Manganese (Mn ⁺)	Whole grains Nuts Fruits Tea	Component of enzymes Bone formation Metabolic processes	Deficiency Unknown Toxicity Possible brain disease
Fluoride (F ⁻)	Fluoridated water Seafood	Increases resistance to tooth decay Component of bones and teeth	Deficiency Tooth decay Possibly osteoporosis Toxicity Discoloration of teeth (mottling)
Chromium (Cr)	Meat Vegetable oil Whole-grain cereal and nuts Yeast	Associated with glucose and lipid metabolism	Deficiency Possibly disturbances of glucose metabolism
Molybdenum (Mo)	Dark green, leafy vegetables Liver Cereal Legumes	Enzyme functioning Metabolism	Deficiency Unknown Toxicity Inhibition of copper absorption
Copper (Cu ⁺)	Liver Shellfish, oysters Legumes Nuts Whole grains	Essential for formation of hemoglobin and red blood cells Component of enzymes Wound healing Needed metabolically for the release of energy	Deficiency Anemia Bone disease Disturbed growth and metabolism Toxicity Vomiting; diarrhea Wilson's disease (genetic)



Case in point: KASIA: INCREASING VITAMIN AND MINERAL

- Kasia is a 13-year-old girl of Polish descent who has nine siblings and lives in the mountains of Kentucky with her family. She attended school for a short time but had to drop out because she was needed at home after her mother died. Her father works very hard in a local mine but does not make enough money to feed and clothe his family. Kasia worries all the time about her younger siblings and knows that they are not healthy. Kasia cannot remember when she had a glass of milk or enough to eat; she feels hungry all the time. She has not started her menses yet, and she is concerned about her recent loss of hair. Kasia was preparing breakfast, using a dulled knife to cut some bacon, when the knife slipped and she cut her thumb. She tried to stem the bleeding but could not get it to stop for hours. Kasia was frightened about the bleeding. Knowing that she needed to get help from someone, Kasia walked to the local school, 8 miles away, and asked to see the school nurse. Kasia spoke with the nurse and then agreed to see a dietitian.

Case in point: KASIA: INCREASING VITAMIN AND MINERAL

► ASSESSMENT

1. What data do you have about Kasia?
2. What might be lacking in Kasia's diet?
3. As the dietitian, what would you find helpful in Kasia's history?
4. What food category is a priority for Kasia? What other food categories would be helpful to her health?
5. Complete the following sentence: Kasia's delayed menses and growth and development problems are related to _____ .

► DIAGNOSIS

6. Write a nursing diagnosis for Kasia.