

# Water and Mineral Metabolism

**Q.1. What is the percentage of water in human body?**

Ans. About 65–70%

**Q.2. What is the percentage of minerals in human body?**

Ans. About 8.5%

**Q.3. Name the important minerals found in the human body.**

Ans. Sodium, potassium, calcium, magnesium, phosphorus, chlorine, sulphur, iron and copper, etc.

**Q.4. Name the macroelements found in the body.**

Ans. Ca, Mg, Na, K, P, S, Cl and Fe

**Q.5. What are the biological functions of water?**

Ans.

- Solvent action
- Ionization
- Homeostasis
- Fluid exchange
- Lubricating action
- Latent heat of evaporation

**Q.6. What is the daily water (fluid) intake by drinks per day?**

Ans. 2.5 – 3.5 L

**Q.7. What is the amount of metabolic water, i.e. produced by oxidation of food per day?**

Ans. Nearly 400 ml

**Q.8. What is the water loss by lungs per day?**

Ans. Nearly 400 ml

**Q.9. What is the water loss through skin per day?**

Ans. 700 ml

**Q.10. What is the water loss through urine per day?**

Ans. Nearly 1250 ml

**Q.11. What is the water loss through feces per day?**

Ans. Nearly 100 ml

**Q.12. What is the daily requirement of sodium chloride in adults?**

Ans. Less than 2.3 g (equal to about 1 teaspoon of table salt).

**Q.13. What is the daily requirement of potassium in adults and pregnant women?**

Ans. About 4.7 g

**Q.14. Why do we require sodium?**

Ans. It helps in the following ways:

- Maintenance of fluid balance
- Neuromuscular excitability
- Active transport
- Enzyme action
- Conduction and transmission of nerve impulses, etc.

**Q.15. Why do we require potassium?**

Ans. It helps in the following ways:

- Neuromuscular excitability
- Enzyme action
- Activity of cardiac muscles
- Conduction and transmission of nerve impulses, etc.

**Q.16. Why do we require chloride?**

Ans. It helps in the following ways:

- Maintenance of fluid balance
- Acid–base balance
- Active transport
- Enzyme action, etc.

**Q.17. What are the sources of iron?**

Ans. Liver, and other organ meats, shellfish, red meat, dates, lentils, lettuce, spinach, radish tops, fig, egg-yolk, nuts, soya beans, etc.

**Q.18. What happens after excessive loss of NaCl through sweat?**

Ans. It causes:

- Salt cramps
- Hyponatraemia with nausea
- Muscle cramps, etc.

**Q.19. What happens after drinking salt-free fluids?**

- Ans. It may cause:
- Hyponatremia with nausea
  - Muscle cramps
  - Diarrhoea, etc.

**Q.20. Intense vomiting leads to:**

- Ans.
- Chloride depletion
  - Fall in plasma chloride, sodium and potassium levels
  - Dehydration
  - Some of the lost Cl may be replaced by  $\text{HCO}_3^-$ , thus increasing the plasma bicarbonate level which may result into metabolic alkalosis

**Q.21. Why do we require magnesium?**

- Ans. We require it because:
- It is a constituent of bones and teeth
  - It also plays a role in neuromuscular excitability
  - It also plays a role in various enzymatic reactions as a cofactor or activator

**Q.22. Why do we require phosphorus?**

- Ans. We require it because:
- It is a constituent of bones and teeth
  - It plays vital role in energy transfer
  - It plays vital role in acid–base regulation
  - It has got role in phosphorylation
  - It helps in the formation of animal products, etc.
  - It is also a constituent of nucleic acids

**Q.23. Why do we require calcium?**

- Ans. We require it because:
- It is a very important constituent of bones and teeth
  - Its requirement gets enhanced in the infants and children as elongation of bones and the development of teeth occur in them at a faster rate
  - It is also required for blood coagulation.
  - It acts as an enzyme activator for various biological reactions
  - It plays a role in muscle contraction, conduction of nerve impulses, neuromuscular transmission and cardiac contraction
  - It is an important constituent of milk and also helps in the secretion of milk

**Q.24. What is the daily requirement of copper in adults?**

Ans. 900 µg

**Q.25. What is the main storehouse of copper in the body?**

Ans. Liver

**Q.26. What does iodine deficiency cause?**

Ans. • Thyroid enlargement (**iodine-deficiency goiter**), the obvious sign of which is swelling in the neck  
• Hypothyroidism

**Q.27. What does inborn error or hereditary defect in copper metabolism cause?**

Ans. **Wilson's disease (hepatolenticular degeneration)**

**Q.28. What are the functions of copper?**

Ans. • Copper is an **essential nutrient** for the body  
• Copper along with iron, enables the body to form RBCs  
• It helps maintain healthy bones, blood vessels, nerves and immune functions  
• It contributes to iron absorption  
• Sufficient copper in the diet may help prevent cardiovascular diseases and osteoporosis, etc.  
• A component of **number of proteins** (hepatocuprein, etc.) and a **number of enzymes** (lysyl hydroxylase, etc.).

**Q.29. What is Wilson's disease?**

Ans. • An **inherited disorder** that causes **too much copper to accumulate** in the organs  
• In this disease, plasma ceruloplasmin level gets lowered  
• **Copper gets deposited in damaging amounts in tissues like liver, pancreas, kidney, cornea and the lenticular nucleus of the brain which may cause abnormal muscular movements (like Parkinson's disease), diabetes mellitus, renal tubular damage, a visible brown ring (Kayser-Fleischer ring) at the margin of cornea, hepatic cirrhosis and jaundice and the patient may ultimately die of hepatic failure.**

**Q.30. Is there any treatment of Wilson's disease?**

Ans. No cure, except lifelong treatment by taking copper-chelating agents which excrete copper from organs.

**Q.31. Name the sources of iodine.**

Ans. Iodized table salt, flesh and oil of marine fishes like cod, onion and iodates added to bread, etc.

**Q.32. What is the daily requirement of iodine for adults?**

Ans. 140  $\mu\text{g}$

**Q.33. Why do we require iodine?**

Ans. It is required for the synthesis of thyroid hormones, i.e.  $T_3$  and  $T_4$

**Q.34. What is the name of the protein in which thyroxine remains confined?**

Ans. Thyroglobulin

**Q.35. What should be the ideal calcium phosphorus ratio?**

Ans. 1 : 1 for ideal absorption

**Q.36. Name the goitrogenic foods?**

Ans.

- Cauliflower
- Broccoli (a variety of cauliflower with greenish flower head)
- Cabbage, etc.

**Q.37. What happens in hypothyroidism?**

Ans. **Major symptoms include:**

- Fatigue
- Cold sensitivity
- Constipation
- Dry skin
- Delayed puberty
- Slow growth
- Hair loss
- Unexplained weight gain

**Q.38. What is myxedema?**

Ans. If the thyroid gland is removed or it becomes subnormal in activity in the adults then **myxedema** develops in which:

- Skin becomes thick and dry
- Hairs become coarser and fallout
- Non-pitting edema
- There is disinclination towards work, either physically or mentally
- There is a tendency to put on weight
- Metabolic rate is reduced, nitrogen metabolism gets lowered and the body's temperature is subnormal
- Ossification of the bones gets delayed

**Q.39. What is hyperthyroidism?**

- Ans.
- It is state in which thyroid gland is too active as a result of which a condition known as **exophthalmic goiter** occurs
  - Unexpected weight loss
  - **Rapid or irregular heart beat**
  - Sweating and irritability
  - Excess sweating
  - Excessive hunger
  - The patient is nervous and irritable
  - His IQ is above than normal
  - Insomnia
  - Irregular or short or light menstruation
  - Abnormal protrusion of eyes or puffy eyes

**Q.40. Name the sources of fluorine.**

- Ans.
- Drinking water
  - Tea
  - Flesh of marine fishes also contains small amounts

**Q.41. What is the daily requirement of fluoride/fluorine for different categories?**

- Ans.
- Infants (< 4 years) : 1.2–1.6 mg
  - Children (4–11 years) : 2.0–2.2 mg
  - Children (11–14 years) : 2.4 mg
  - Adults : 2.9 mg

**Q.42. What are the main functions of fluorine?**

- Ans.
- It plays a vital role in the development of tooth and dental health
  - It is also concerned with the development of bones

**Q.43. What does deficiency of fluorine or fluoride cause?**

- Ans.
- Increased dental caries
  - Possibly osteoporosis

**Q.44. Whether high concentration of fluorides are toxic to human beings? Which disease is caused due to high intake of it?**

- Ans.
- Yes, **dental fluorosis (mottled enamel)** is caused in the children
  - **Hypercalcification of the bone of spine, pelvis and limbs.** Its severity is fatal and may cause **neurological disturbances** as a result of which such individuals may become crippled

**Q.45. What are the general functions of minerals?**

- Ans.
- As structural components of body tissues
  - In the maintenance of acid–base balance
  - In the regulation of body fluids
  - In the transport of gases
  - In the contraction of muscles

**Q.46. What are the causes of hyponatremia (< 136 mEq/L)?**

- Ans. Common causes are:
- Usage of diuretics
  - Diarrhea
  - Vomiting
  - Heart failure
  - Liver diseases
  - Renal diseases
  - Inappropriate secretion of antidiuretic hormone (ADH)
  - Severe burns
  - Intestinal obstruction

**Q.47. What are the side effects of hyponatremia?**

- Ans.
- Whole body dizziness
  - Headache
  - Confusion
  - Fatigue

**Q.48. Name the diseases in which potassium level is remarkably low (hypokalemia).**

- Ans.
- **Cushing's syndrome** (due to high cortisol level for a long time).
  - Gitelman syndrome (kidney disorder that causes an imbalance of charged ions ( $\text{Ca}^{++}$ ,  $\text{K}^+$ ,  $\text{Mg}^{++}$  in the body).
  - Liddle syndrome (genetic disorder inherited in an autosomal dominant manner, characterized by high blood pressure with low plasma renin activity).
  - Fanconi syndrome (a disorder of kidney tubes)

**Q.49. What are the causes of hypokalemia (< 3.5 mEq/L)?**

- Ans.
- Inadequate dietary intake of potassium
  - Vomiting
  - Diarrhea
  - Medication side effects
  - Caffeine
  - Dehydration
  - Malnutrition

**Q.50. Is hypokalemia < 2.5 Eq/L life-threatening?**

Ans. Yes

**Q.51. What are the side effect of hypokalemia?**

- Ans.
- Muscle twitches
  - Muscle cramps or weakness
  - Muscles that will not move (paralysis)
  - Abnormal heart rhythms
  - Kidney problems

**Q.52. Name the diseases in which serum sodium level is high (hypernatremia).**

Ans. Cushing's syndrome

**Q.53. What are the causes of hypernatremia?**

- Ans.
- Dehydration
  - Diarrhea
  - Excessive sweating
  - Not drinking enough water
  - Kidney dysfunction
  - Diuretics
  - If hypernatremia worsens, then  
Muscle twitches  
Seizures (epilepsy)  
Confusion

**Q.54. What are the side effects of hypernatremia?**

- Ans.
- Thirst
  - Restlessness
  - Fatigue
  - Dry mouth
  - Fast heart rate
  - Insufficient urinary output

**Q.55. Name the diseases in which serum potassium level is high (hyperkalemia).**

- Ans.
- Chronic kidney diseases
  - Uncontrolled diabetes

**Q.56. What are the causes of hyperkalemia?**

- Ans.
- Severe bleeding
  - Consumption of too much potassium



- Potassium shift due to blood loss or dehydration
- Not being able to excrete potassium through kidneys properly due to kidney diseases

**Q.57. What are the side effects of hyperkalemia?**

- Ans.
- Heart palpitations
  - Shortness of breath
  - Chest pain
  - Nausea
  - Vomiting

Sudden or severe hyperkalemia is life-threatening

**Q.58. What is the daily requirement of calcium for adults, pregnant or lactating women, infants/children?**

- Ans. 1 g, 1.2 g and 0.4–1.2 g respectively

**Q.59. Name the calcium rich-foods**

- Dairy products like milk, cheese, khoa, curd, hard water, lime used with betel leaves
- Dark green leafy vegetables like radish-tops, etc. carrot, soya bean, dry beans, etc.
- Egg-yolk

**Q.60. Name the conditions in which serum calcium level is increased.**

- Ans.
- Hyperparathyroidism
  - Hypervitaminosis-D

**Q.61. Name the conditions in which serum calcium level gets decreased.**

- Ans.
- Hypothyroidism
  - Increased loss of calcium due to kidney diseases
  - Decreased absorption from the intestines
  - Decreased dietary intake

**Q.62. Name the factors which affect the absorption of calcium.**

- Ans.
- Vitamin D promotes the absorption of calcium.
  - High protein diet also promotes the absorption of calcium
  - Absorption of calcium requires acidic pH
  - Oxalates, phosphates and phytates inhibit the absorption of calcium

**Q.63. What is the daily requirement of iron for adult man, adult woman, pregnant and lactating woman?**

- Ans.
- Men (18 yrs and above): 8.7 mg
  - Women (19–50 years): 14.8 mg
  - Pregnancy: At least 27 mg
  - Lactation: At least 9 mg

**Q.64. Why do we require iron (functions of iron)?**

- Ans. Our body requires iron for:
- Growth and development
  - Body uses iron to make hemoglobin (a protein in RBCs that carries oxygen from the lungs to all the parts of the body)
  - Body uses iron to make myoglobin (a proteins that provides oxygen to muscles)
  - Body also uses iron to make some hormones, like thyroid hormones including the conversion of inactive thyroid hormone  $T_4$  to active form, i.e.  $T_3$

**Q.65. What is the transported form of iron?**

- Ans. Transferrin

**Q.66. What is the state of iron in transferrin?**

- Ans. Ferric form

**Q.67. Name few iron containing compounds.**

- Ans.
- Hemoglobin
  - Ferritin
  - Transferrin
  - Myoglobin
  - Enzymes like catalase, cytochromes b,  $c_1$ , c and a, catalase and peroxidase

**Q.68. By which ‘chemical compound’ iron stores of liver and spleen are known as?**

- Ans. Ferritin

**Q.69. What is siderosis?**

- Ans.
- Siderosis is the deposition of **excess iron in body tissues**.
  - When used without qualification, it usually refers to an environmental disease of the lungs, also known more specifically as pulmonary siderosis or Welder’s disease, which is a form of pneumoconiosis.

**Q.70. The deposition of which substance causes hemosiderosis?**

- Ans. Haemosiderin

**Q.71. What is hemosiderin?**

- Ans. It is a form of ferritin complexed with other proteins and iron

**Q.72. Which chelating agent has got the capability to induce the excretion of iron to some extent through the kidneys?**

Ans. Desferrioxamine

**Q.73. Which vitamin is responsible to increase the absorption of iron strongly?**

Ans. Vitamin C (ascorbic acid)

**Q.74. What are the symptoms of siderosis?**

Ans.

- Hearing loss
- Movement abnormalities (ataxia)
- Motor difficulties due to suspected spinal cord injury (myelopathy)
- Hepatic cirrhosis
- Bronzing of the skin

**Q.75. Name the antioxidant minerals**

Ans. Copper, zinc and selenium

**Q.76. Name the most powerful antioxidant out of all antioxidant vitamins and antioxidant minerals.**

Ans. Vitamin C [See explanation for this in vitamin C (vitamin chapter)]

**Q.77. What is the biochemical action of manganese?**

Ans.

- **Manganese shows a free radical scavenging activity.**
- The chain breaking antioxidant capacity of manganese seems to be related to the rapid quenching of peroxy radicals
- Helps the body form connective tissue, bones, blood clotting factors and sex hormones
- In blood sugar regulation

**Q.78. What is the biochemical action of zinc?**

Ans.

- **Zinc is a cofactor for over 100 enzymes and is important in nucleic acids metabolism and protein synthesis**
- Zinc has been shown to have an **antioxidant role** in defined chemical systems
- In body's defensive (immune) system
- In cell division, cell growth
- In wound healing
- Breakdown of carbohydrates
- Required for the senses of smell and taste

**Q.79. What is the biochemical action of selenium?**

- Ans.
- **Selenium** is an essential trace element and is an integral part of the enzyme system **glutathione peroxidase, which protects intracellular structures against oxidative damage.**
  - Selenium is being increasingly recognized as a **versatile anticarcinogenic agent.**
  - Selenium is an essential component of **selenoproteins** playing an important role in many biological functions, such as antioxidant defense
  - In the synthesis of thyroid hormones
  - In DNA synthesis, fertility and reproduction

**Q.80 Which mineral is required for the decomposition of hydrogen peroxide?**

Ans. Selenium

**Q.81 Which mineral is required for the formation of prothrombin?**

Ans. Calcium

**Q.82 What is osteoporosis?**

Ans. It literally means abnormally **porous bones** which are compressible like a sponge. This disorder of the skeleton weakens this bones to the tune of **frequent fractures (breaks) in the bones.**

**Q.83 In which two forms, phosphorus remains present in the body?**

- Ans.
- Inorganic form
  - Organic form

**Q.84 What are the sources of calcium and phosphorus?**

- Ans.
- Milk and dairy products are rich sources
  - Egg yolk, dry fruits, legumes, cabbage and cauliflower are also good sources

**Q.85 What are the biochemical functions of calcium?**

- Ans.
- Calcification of the growing bones and teeth and afterwards maintenance of mature bones
  - It acts as an activator for several enzymes like adenyl cyclase, ATPase and protein kinase, etc.
  - It is required for clotting of blood
  - It is also required for contraction of muscles

- It is also required to regulate the permeability of the capillary walls and excitability of the nerve fibers
- It is required for the secretion of various hormones
- **It also acts as a second messenger**

**Q.86 What are the biochemical functions of phosphorus?**

- Ans.
- Phosphorus along with calcium is very essential for mineralization of bones
  - It plays an important role in the **regulation of acid– base balance**
  - **As a component of several coenzymes**, it also participates in various enzyme-catalysed reactions
  - $\text{P}_i$  as well as organic esters of phosphoric acid, such as ADP, glucose-6- $\text{PO}_4$ , etc. are necessary for the metabolism of carbohydrates, and thus, in the production of energy