

Water And Electrolytes

Distribution of Water

- Water is the most abundant component of the human body, making up about **50–70%** of total body weight, depending on age, sex, and body composition.

Total Body Water (TBW)

Divided into two main compartments:

Characteristic	Intracellular Fluid	Extracellular Fluid
 % of TBW	~66%	~33%
 Location	Inside cells	Outside cells
 Major Electrolytes	K^+ , Mg^{2+} , PO_4^{3-}	Na^+ , Cl^- , HCO_3^-
 Subcompartments	N/A	Interstitial fluid, plasma, transcellular

A. Intracellular Fluid (ICF)

- Accounts for about two-thirds (~66%) of TBW.
- Found inside cells.
- Major electrolytes: Potassium (K^+), Magnesium (Mg^{2+}), and Phosphate (PO_4^{3-}).

B. Extracellular Fluid (ECF)

- Make up about one-third (~33%) of TBW.
- Further divided into:
 - Interstitial fluid (about 75% of ECF): Fluid between cells.
 - Plasma (about 25% of ECF): Fluid part of the blood.
 - Transcellular fluids (minor): Includes cerebrospinal fluid, synovial fluid, digestive juices, etc.
- Major electrolytes: Sodium (Na^+), Chloride (Cl^-), and Bicarbonate (HCO_3^-).

Electrolyte Distribution & Functions of Water in the Body

Electrolyte Distribution

- Electrolytes are ions that help regulate fluid balance, nerve function, and muscle function.

The key point is their asymmetric distribution between ICF and ECF.

Electrolyte	Intracellular Fluid	Extracellular Fluid
Sodium (Na^+)	Low	High
Potassium (K^+)	High	Low
Chloride (Cl^-)	Low	High
Calcium (Ca^{2+})	Very low (mostly in bone or ECF)	Low
Magnesium (Mg^{2+})	High	Low
Phosphate (PO_4^{3-})	High	Low
Bicarbonate (HCO_3^-)	Low	Moderate

- These gradients are essential for membrane potential, muscle contractions, and nerve impulses.

Functions of Water in the Body

Water is not just a filler – it plays numerous **vital roles** in body physiology:

1. Solvent

- Water is the universal solvent, enabling dissolution of nutrients, gases (like O_2 and CO_2), and waste products for transport and reactions.

2. Transport Medium

- Facilitates movement of nutrients, hormones, and waste via blood and lymphatic systems.

3. Thermoregulation

- Maintains body temperature through sweating and heat dissipation due to water's high heat capacity.

4. Chemical Reactions

- Acts as a reactant or product in biochemical reactions, e.g., hydrolysis in digestion.

5. Lubrication and Cushioning

- Water lubricates joints (synovial fluid), moistens tissues (eyes, mouth), and cushions organs (cerebrospinal fluid for the brain and spinal cord).

6. Maintaining Cell Shape and Volume

- Helps maintain osmotic balance; improper water levels can cause cells to shrink or swell.

7. Excretion of Wastes

- Water is critical for the removal of waste through urine, sweat, and feces.

Water Turnover and Balance

Water Turnover

- Water turnover refers to the continuous process of water intake and loss in the body.
- Maintaining proper water turnover is essential to keep the body's internal environment stable (homeostasis).

Water Intake

- Water enters the body from:
 - Drinking fluids (~1,200–1,500 mL/day)
 - Food (e.g., fruits, vegetables) (~700–1,000 mL/day)
 - Metabolic water (produced during cellular metabolism) (~200–300 mL/day)
- **Total intake:** ~2,000–2,800 mL/day depending on environment, activity, and diet.

Water Loss

- Water is lost through:
 - **Urine** (~1,200–1,500 mL/day)
 - **Skin (sweat)** (~500–600 mL/day)
 - **Lungs (respiration)** (~400–500 mL/day)
 - **Feces** (~100–200 mL/day)
- **Total loss:** Must roughly equal intake for balance.

Water Balance

- Maintained by:
 - **Thirst mechanism** (regulated by hypothalamus)
 - **Antidiuretic hormone (ADH):** Controls water reabsorption in kidneys.
 - **Aldosterone:** Promotes sodium (and water) retention.
 - **Kidneys:** Main organs regulating water output based on body's needs.

- **Imbalance** leads to:
 - Dehydration (excess water loss)
 - Overhydration or water intoxication (excess water intake)

Electrolyte Composition of Body Fluids & Dietary Intake

Electrolytes – Key Roles:

- Electrolytes are ions that dissociate in water and are essential for:
 - Nerve conduction
 - Muscle contraction
 - Acid-base balance
 - Maintenance of osmotic pressure and fluid distribution

Electrolyte Composition

Electrolyte	Intracellular Fluid (ICF)	Extracellular Fluid (ECF)
Sodium (Na^+)	~10–15 mEq/L	~135–145 mEq/L
Potassium (K^+)	~140 mEq/L	~3.5–5 mEq/L
Calcium (Ca^{2+})	Very low in cytosol	~1.1–1.3 mM (free in plasma)
Chloride (Cl^-)	Low	~98–106 mEq/L
Bicarbonate (HCO_3^-)	Low	~22–26 mEq/L
Magnesium (Mg^{2+})	~20–30 mEq/L	~1.7–2.2 mEq/L
Phosphates	High	Low

- Electrolyte gradients are essential for:
 - **Nerve conduction**
 - **Muscle contraction**
 - **Acid-base balance**
 - **Enzymatic activity**

Dietary Intake of Electrolytes

Electrolyte	Recommended Daily Intake	Dietary Sources
Sodium (Na^+)	1500–2300 mg/day	Salt, processed foods

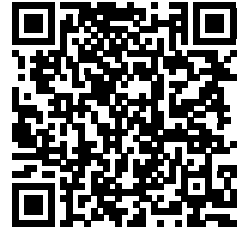


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