

Water

BCH 282

- Water makes up about 60% of the body weight, 40% inside the cells, 15% outside the cells (extracellular fluid) and the remainder is in the blood vessel.
- The total amount of fluid in the body is kept constant by delicate balancing mechanisms.

Roles of water in the body fluids are:

1. Carries nutrients and waste products throughout the body.
2. Participate in chemical reaction.
3. Serve as a solvent of minerals, vitamins, amino acids, glucose.... etc.
4. Aid in maintaining the body's blood pressure, temperature.
5. Acts as lubricant and cushion around joints.

Water balance:

- To support water balance and other functions. The body regulates its water balance.
- Water balance can cause dehydration and water intoxication, but the body quickly restores the balance to normal if it can. By water intake and water excretion regulation.

Water intake regulation:

- Human can survive for weeks without food, but can live only few days without water.
- The mechanism to regulate water intake is the thirst.
- When the blood becomes too concentrated (having lost water, but not salt and other dissolved substance), the mouth become dry and the hypothalamus initiates drinking behaviour.
- Dehydration can threaten elderly people who do not develop the habit of drinking water regularly.

Water excretion regulation:

- Water excretion involves the brain and the kidneys.
- Hypothalamus stimulate the pituitary gland to release antidiuretic hormone "ADH" whenever the salt concentration is too high, or the blood volume and blood pressure is too low.
- ADH stimulate the kidneys to reabsorb water rather than excrete it.

Water recommendation and source:

Water needs vary depending on:

1. The foods person eat e.g. salty diet need more water drinking.
2. The environment temperature and humidity.
3. Person's activity level.
4. Others.

Recommendations for adults are expressed in proportion to the amount of energy expended under normal environmental condition.

For the person who expends about 2000Kcal/day loses ~ 2-3 L (8-12 cups).

- Both alcohol and caffeine act as diuretics, causing the body to lose fluids.
- Foods provide water too e.g. most fruits, vegetables contain upto 95% H₂O, meat and cheese contain 50% H₂O.
- Milk and juice can also contribute to the day's recommended intake.

Normally the body must be in a state of water balance i.e. the daily water loss must be replaced by an equal volume of daily water intake.

A) Water losses:

1. Skin
2. Respiration
3. Urine 1200 ml/day
4. Stools 200 ml/day

With total losses of about 2600 ml water daily.

B) Water gains:

1. Metabolic water 300 ml/day
2. Foods
3. Water and juices 1200 ml/day

With total body gains of about 2600 ml water daily.

Metabolic Water:

This is the water that is formed inside the body due to the oxidation processes of carbohydrates, fats and amino acids (about 300 ml/day).

Fatty acids provide more metabolic water upon oxidation than other metabolic fuels, which is advantageous to people in dry environment.

Fluid and electrolyte balance:

- When salts dissolve in water, they dissociate into charged particles known as ions, which can conduct electricity. For this reason, a salt that dissociates in water is known as an electrolyte. The body fluids, which contain water and dissociated salts, are electrolyte solutions.
- In an electrolyte solution; the number of +ve charge ions always equals the number of -ve charge ions.
- The main +ve charge ions (cation) in the body are Na^+ , K^+ and the main -ve ions (anion) are Cl^- and P^{3-} .

There are two major fluid compartments in the body:

- ❖ 2/3 of body water is in intracellular fluid.
- ❖ 1/3 of it is in extracellular fluid e.g. blood plasma and interstitial fluid (The fluid between cells).
- ❖ Na^+ is the main cation in extracellular fluid, whereas K^+ is the major cation in intracellular fluid.
- ❖ To maintain the balance of Na^+ and K^+ , all cell membranes incorporate Na^+/K^+ pumps that actively pump Na^+ out of the cell and allow K^+ back in (enter the cell).

When salts, such as NaCl dissolve in water, they come apart and form free electrically charged ions.

Dissolving salt in water. When dissolving salt, the oxygen atoms of the water molecules are attracted to the negatively charged chloride ions. Water's hydrogen atoms are attracted to the positively charged sodium ions.

Intracellular fluid

Intracellular fluid

Extracellular fluid
interstitial fluid
plasma

Intracellular and extracellular fluid. Extracellular fluids and their solutes (except for proteins) move across capillary membranes easily. Plasma (the fluid portion of the blood) has a higher concentration of proteins than interstitial fluid. Excluding protein, their compositions are roughly the same.

