



Body fluids

By Dr. Fadhil faiz
PhD. Sc. Ch

Body Fluids

- **Total amount of fluid in the human body is approximately 70% of body weight**
- **Body fluid has been divided into two compartments –**
 - ❖ **Intracellular fluid (ICF)**
 - **Inside the cells**
 - **55% of total body water**
 - ❖ **Extracellular fluid**
 - **Outside the cells**
 - **45% of total body water**

Body Fluid Compartments

Extracellular fluid includes

Interstitial fluid

- Present between the cells
- Approximately 80% of ECF

Plasma

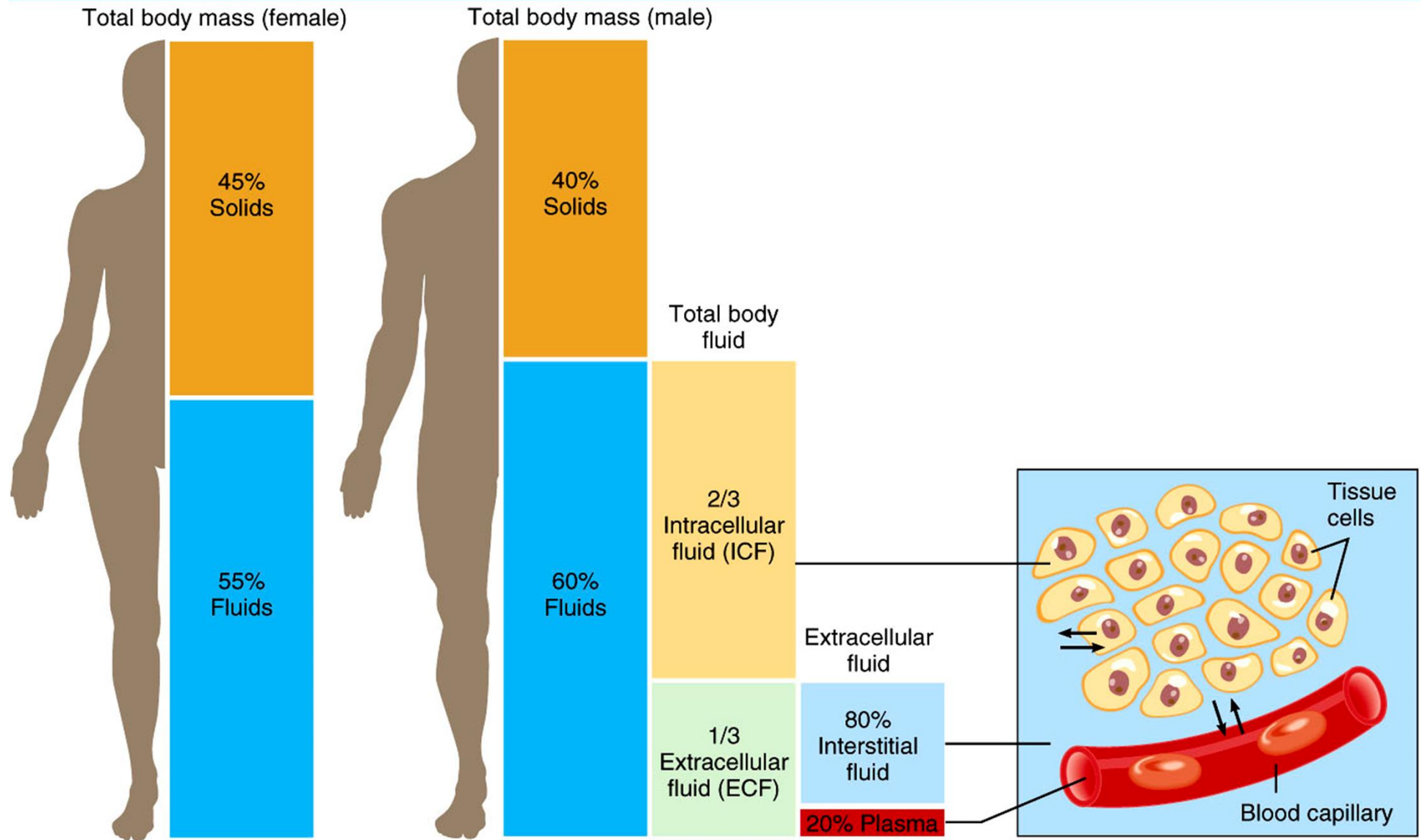
- Present in blood
- Approximately 20% of ECF

Also includes

- Lymph
- synovial fluid
- aqueous humor
- cerebrospinal fluid

- vitreous body,
- endolymph,
- perilymph,
- pleural, pericardial and peritoneal fluids

Body Fluid Compartments



(a) Distribution of body solids and fluids in an average lean, adult female and male

(b) Exchange of water among body fluid compartments

Barriers separate ICF, interstitial fluid and plasma

⦿ Plasma membrane

- Separates ICF from surrounding interstitial fluid

⦿ Blood vessel wall

- Separate interstitial fluid from plasma

Composition of body fluids

● Organic substances

- Glucose
- Amino acids
- Fatty acids
- Hormones
- Enzymes

● Inorganic substances

- Sodium
- Potassium
- Calcium
- Magnesium
- Chloride
- Phosphate
- Sulphate

Difference

⦿ ECF

- ⦿ Most abundant cation - Na^+ ,
 - > muscle contraction
 - > Impulse transmission
 - > fluid and electrolyte balance
- ⦿ Most abundant anion - Cl^-
 - > Regulates osmotic pressure
 - > Forms HCl in gastric acid

⦿ ICF

- ⦿ Most abundant cation - K^+
 - > Resting membrane potential
 - > Action potentials
 - > Maintains intracellular volume
 - > Regulation of pH
- ⦿ Anion are proteins and phosphates (HPO_4^{2-})

- **Na^+ / K^+ pumps play major role in keeping K^+ high inside cells and Na^+ high outside cell**

Sodium Na^+

- > Most abundant ion in ECF
- > 90% of extracellular cations
- > Plays pivotal role in fluid and electrolyte balance as it accounts for half of the osmolarity of ECF

Chloride Cl^-

- > Most prevalent anion in ECF
- > Moves easily between ECF and ICF because most plasma membranes contain Cl^- leakage channels and transporters
- > Can help balance levels of anions in different fluids

Bicarbonate HCO_3^-

- > Second most prevalent extracellular anion
- > Concentration increases in blood passing through systemic capillaries picking up carbon dioxide
- > Chloride shift helps maintain correct balance of anions in ECF and ICF

Potassium K^+

- > Most abundant cation in ICF
- > Establish resting membrane potential in neurons and muscle fibers
- > Maintains normal ICF fluid volume
- > Helps regulate pH of body fluids when exchanged for H^+

Magnesium

- > Mg^{2+} in ICF (45%) or ECF (1%)
- > Second most common intracellular cation
- > Cofactor for certain enzymes and sodium-potassium pump
- > Essential for synaptic transmission, normal neuromuscular activity and myocardial function

Specialized Fluids of the Body

- ⦿ Lymph
- ⦿ Milk
- ⦿ Cerebrospinal fluid
- ⦿ Amniotic fluid
- ⦿ Aqueous humor
- ⦿ Sweat
- ⦿ Tears

Functions of Lymph

- ⦿ Return protein from tissue spaces into blood
- ⦿ Redistribution of fluid
- ⦿ Removal of bacteria, toxins and other foreign bodies from tissues
- ⦿ Maintain structural and functional integrity of tissue
- ⦿ Route for intestinal fat absorption
- ⦿ Transport lymphocytes

Milk

- ◉ Secreted by mammary glands
- ◉ Complete natural food
- ◉ 83-87% water and 13-17% solids
- ◉ Solids
 - > Carbohydrates
 - Lactose
 - > Lipids
 - Triacylglycerols
 - Palmitic acid, myristic acid, stearic acid, lauric acid, butyric acid, oleic acid
 - > Proteins
 - Casein (80%), Lactalbumin
 - Enzymes (proteases, xanthine oxidase, lysozyme), immunoglobulins
 - > Minerals
 - Ca, Mg, P, Na, K, Cl
 - > Vitamins
 - Fat and water soluble vitamins except Vit - C

Functions of Milk

- ◉ Milk sugar provides galactose, a structural unit for growing infant.
- ◉ In intestine, it gets metabolized to lactic acid which eliminates harmful bacteria.
- ◉ Source of protein, mineral and vitamins

Cerebrospinal fluid (CSF)

Clear, colorless liquid formed within the cavities of brain and around spinal cord
500ml CSF is formed everyday

At any given time, there is 120-150ml CSF in the system

CSF is completely replaced about three times a day.

Functions of CSF

- ⦿ Hydraulic shock absorber
- ⦿ Regulation of intracranial pressure
- ⦿ Influences the hunger sensation and eating behaviours

Amniotic Fluid

- ⦿ Liquid produced by membranes and fetus
- ⦿ Volume of fluid increases with gestational age
- ⦿ Clear with some desquamated fetal cell and a little lipid.

Functions of AF

- ⦿ Physical protection to the fetus
- ⦿ Medium for exchange of various chemical

Aqueous Humor

- ◉ Fluid that fills the interior chamber of eye
- ◉ Secreted by ciliary body, enters anterior chamber
- ◉ Blockade in the flow of aqueous humor causes glaucoma due to increased intraocular pressure.
- ◉ Posterior chamber of eye is filled with vitreous humor which contains a gel (vitreous body of hyaluronic acid secreted by retina)

Sweat

- ⦿ Secretion of sweat gland
- ⦿ Regulates body temperature by cooling and evaporation
- ⦿ Sweat glands controlled by ANS, Adrenal cortical steroid - which affect the quantity of electrolyte present

Sweat

- Insensible perspiration amounts to 800-1200ml/day
- Volume of sweat produced/day during muscular exercise at elevated temperature may range from 10-14l, which may lead to water and electrolyte imbalance
- Water content of sweat varies from 99.2-99.7%
- pH – 4.7 to 7.5
- Total non protein nitrogen (urea) varies from 0.07-1% per hour during copius sweating

Sweat

- Electrolyte in sweat varies

- > Na⁺ 12.6-127 meq/l
- > K⁺ 5-32 meq/l
- > Cl⁻ 8.5-85 meq/l

Tears

- ⦿ Produced by lachrymal glands
- ⦿ Isotonic but becomes hypertonic due to evaporation as fluid passes over the cornea
- ⦿ When the tear flow is copious, fluid is isotonic
- ⦿ Under stimulus with a slow rate of tear flow, the fluid is about 25m osm hypertonic

Tears

- ⦿ pH – 7 to 7.6 due to loss of CO₂
- ⦿ Protein content is 0.6 to 0.18g/dl with an albumin/globulin ratio of 1:5 or 2:1
- ⦿ Small amount of mucin is also present
- ⦿ Lysozyme – lyses the cells of a number of micro-organisms by breaking down the polysaccharides of their outer layer

Functions of Tears

- ① Lysozyme protects eye from infectious agents
- ① Lubricate the surface of the cornea
- ① Fill the irregularities of the corneal surface to improve optical properties
- ① Protects eyes from injury