



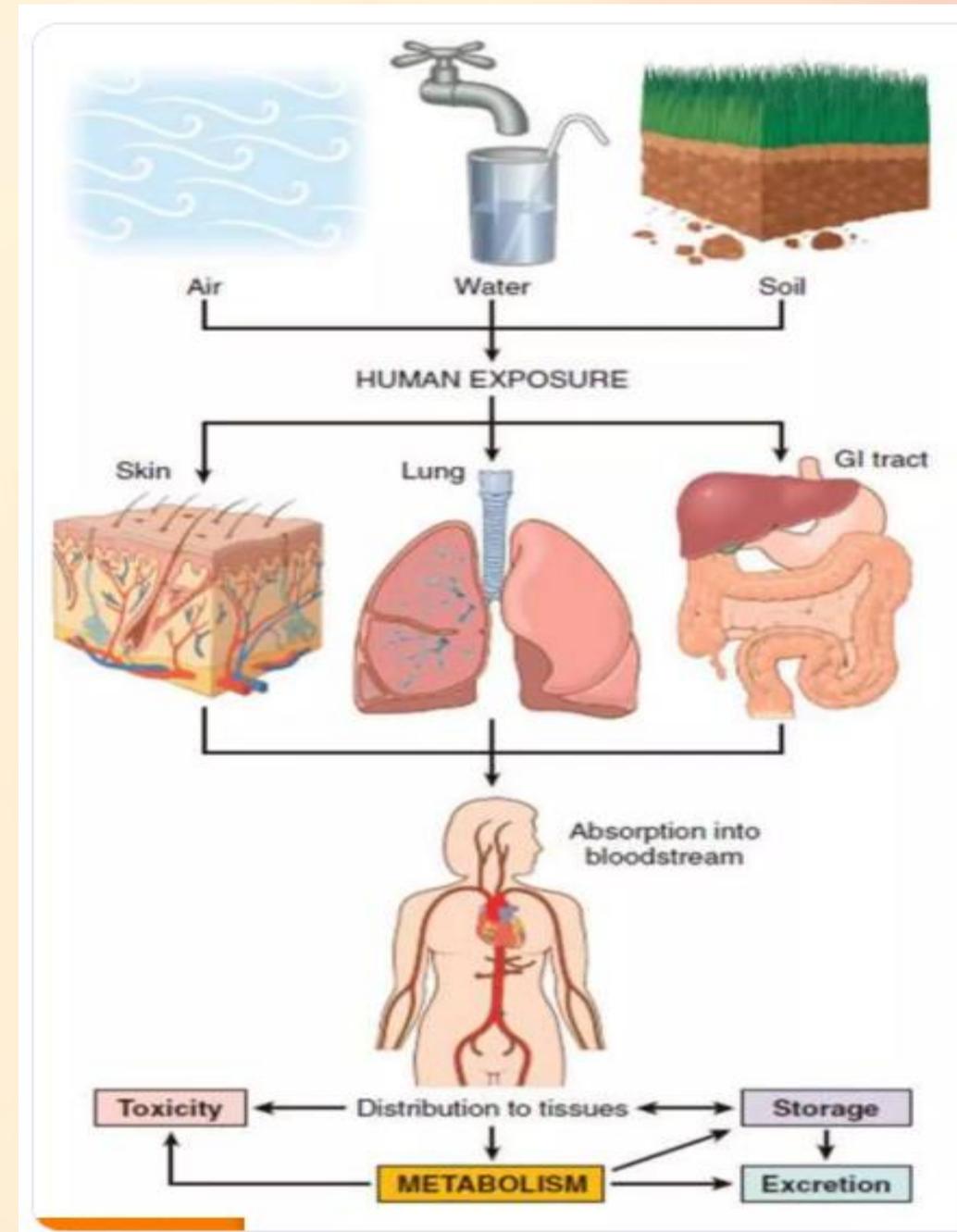
Environmental and Nutritional Disease

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Environmental Diseases

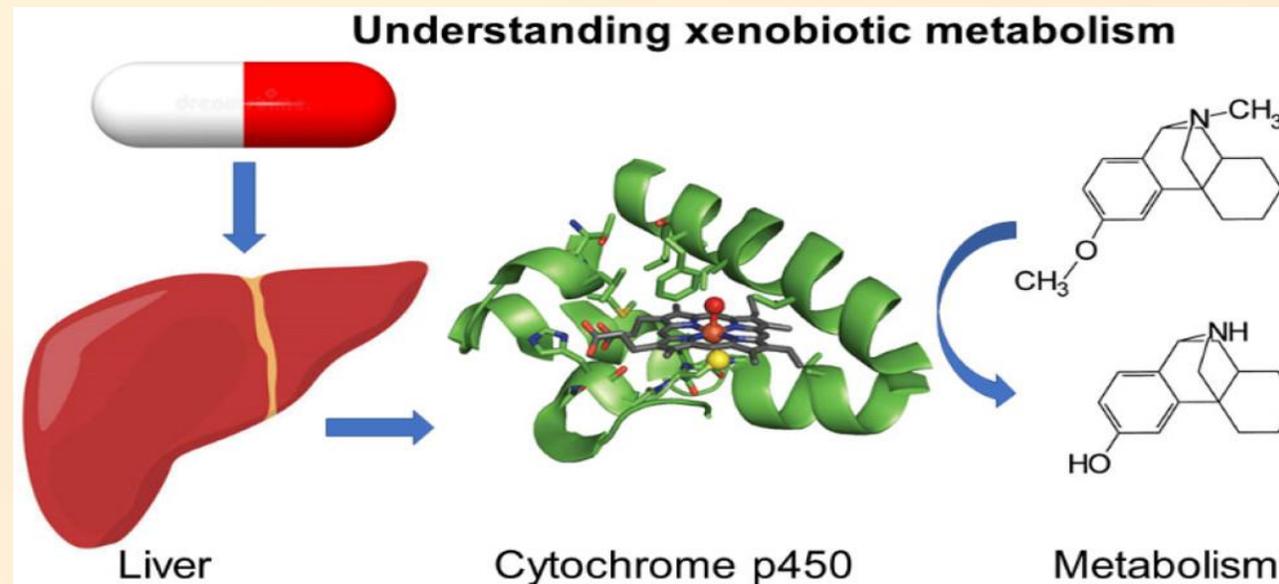
- **Environmental disease** refers to conditions caused by exposure to chemical or physical agents in the ambient, workplace, and personal environment.
- **Toxicology**: the science of poisons
- Toxins can be chemical or physical.
- Physical such as Radiation and Heat
- Chemical such as Drugs and Alcohol.
- “all substances are poisons; the right dosage differentiates a poison from a remedy” So **Toxin is quantitative concept that depends on dosage**
- **Xenobiotics** are exogenous chemicals in the environment in air, water, food, and soil that may be absorbed into the body through inhalation, ingestion, and skin contact

- Chemicals may be excreted in urine or feces; eliminated in expired air; or accumulate in bone, fat, brain, or other tissues.
- Chemicals may act at the site of entry or at other sites following transport through the blood.
- Most solvents, drugs, and xenobiotics are metabolized to form inactive water-soluble products (detoxification) or are activated to form toxic substances.
- **The most important catalyst of chemicals is the cytochrome P-450 enzyme system.**



Cytochrome P-450 enzyme system

- These enzymes are primarily **expressed in hepatocytes**, but can also be found in skin, lungs, gastrointestinal mucosa, and other organs.
- The P-450 system function: **1) detoxify xenobiotics** or, less commonly, **2) convert xenobiotics into active compounds that cause cellular injury**. Both types of reactions may produce, as a by-product, reactive oxygen species (ROS), which can cause cellular damage



Environmental pollution

❖ 1) Air pollution:

- Air is precious to life, but can also carry many potential causes of disease.
- Outdoor air pollution:
 - The most important six air pollutants are: **sulfur dioxide, CO, ozone**, nitrogen dioxide, lead, and particulate matter. Collectively, these agents produce the well-known **smog**, (smoke and fog), that sometimes stifles large cities such as Beijing, Los Angeles, Houston, Cairo, New Delhi, Mexico City.
 - Affect mainly the lung
 - Indoor air pollution:
 - **The most common pollutant is tobacco smoke**



- **Carbon Oxide:**
- **CO** is a systemic asphyxiant that is an important cause of accidental and suicidal death.
- **CO is a nonirritating, colorless, tasteless, odorless gas** that is produced during any process that results in the incomplete oxidation of hydrocarbons.
- **Hemoglobin has 200-fold greater affinity for CO than for oxygen, and the resultant carboxyhemoglobin cannot carry O₂. Systemic hypoxia develops when the hemoglobin is 20% to 30% saturated with CO; unconsciousness and death are likely with 60% to 70% saturation**
- **CO kills in part by inducing central nervous system (CNS) depression, which appears so insidiously that victims are often unaware of their plight.**
- **Acute poisoning is marked by a characteristic generalized cherry-red color of the skin and mucous membranes,**

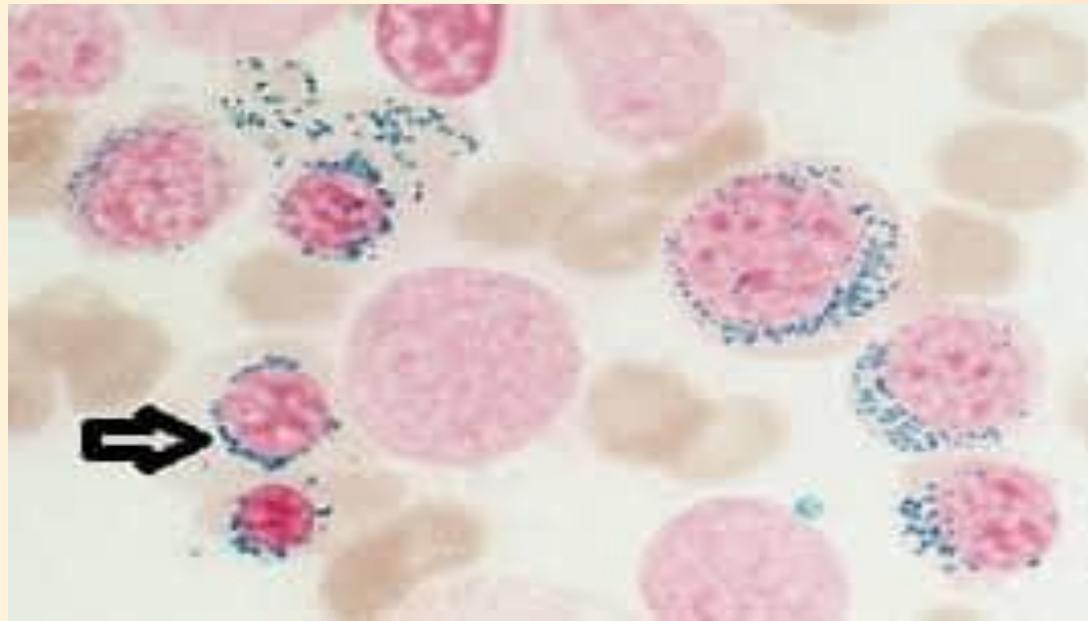


❖ 2) Metals:

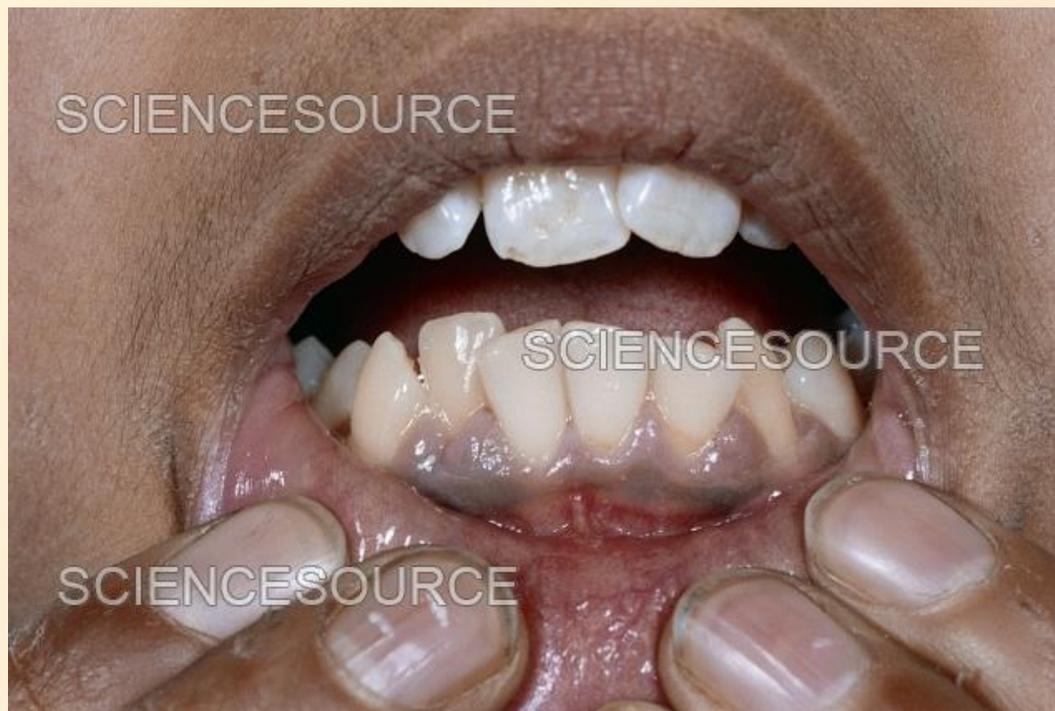
- Lead, mercury, arsenic, and cadmium are the heavy metals most commonly associated with toxic effects in humans.
- **Lead**
- **Children are more affected than adult.**
- The main source of lead: lead-containing paint in older housing and lead-containing drinking water.
- Signs and symptoms:
 - 1) Blood and marrow changes: **Ring Sideroblasts**, red cell precursors with iron-laden mitochondria
 - 2) Brain damage is prone to occur in children.
 - 3) **Burton line on gingiva**
 - 4) **Lead lines: inhibiting bone growth at site of growth plate.**



Lead lines



Sideroblasts



Burton Line:
Thin, gray-blue
line visible along
the margin of
the gums, at the
base of the teeth.

Occupational health risks

- ❖ Occupational health risks arise from work-related accidents and illnesses
 - Work-related accidents are the main occupational health concern in developing countries
 - Work-related diseases are more common in industrialized countries
- ❖ The most important agents are:
 - 1) **Vinyl chloride: can cause angiosarcoma of the liver**
 - 2) Mineral dusts (coal dust, silica, asbestos): causes chronic, nonneoplastic lung diseases called pneumoconiosis
 - 3) **Benzene: causes Leukemia.**

Effect of Tobacco

- Smoking is the most readily preventable cause of death in humans.
- The main culprits are:
 - 1) cigarette smoking
 - 2) Smokeless tobacco (e.g., snuff, chewing tobacco): an important cause of oral cancer.
 - 3) Passive tobacco inhalation from the environment (second hand smoke): cause lung cancer in nonsmokers



- Cigarette contains 2,000–4,000 substances, including over 60 carcinogens.
- The most important carcinogens are: Tar, Nicotine, Polycyclic aromatic hydrocarbons.

❖ Health impact:

1) Causes 90% of lung cancer

- Lung cancer risk correlates with pack years or cigarettes smoked daily.
- Irritates the tracheobronchial mucosa directly, Causes inflammation and increased mucus (bronchitis)

2) Atherosclerosis

3) Maternal smoking increases the risk of spontaneous abortions and preterm births and results in intrauterine growth retardation

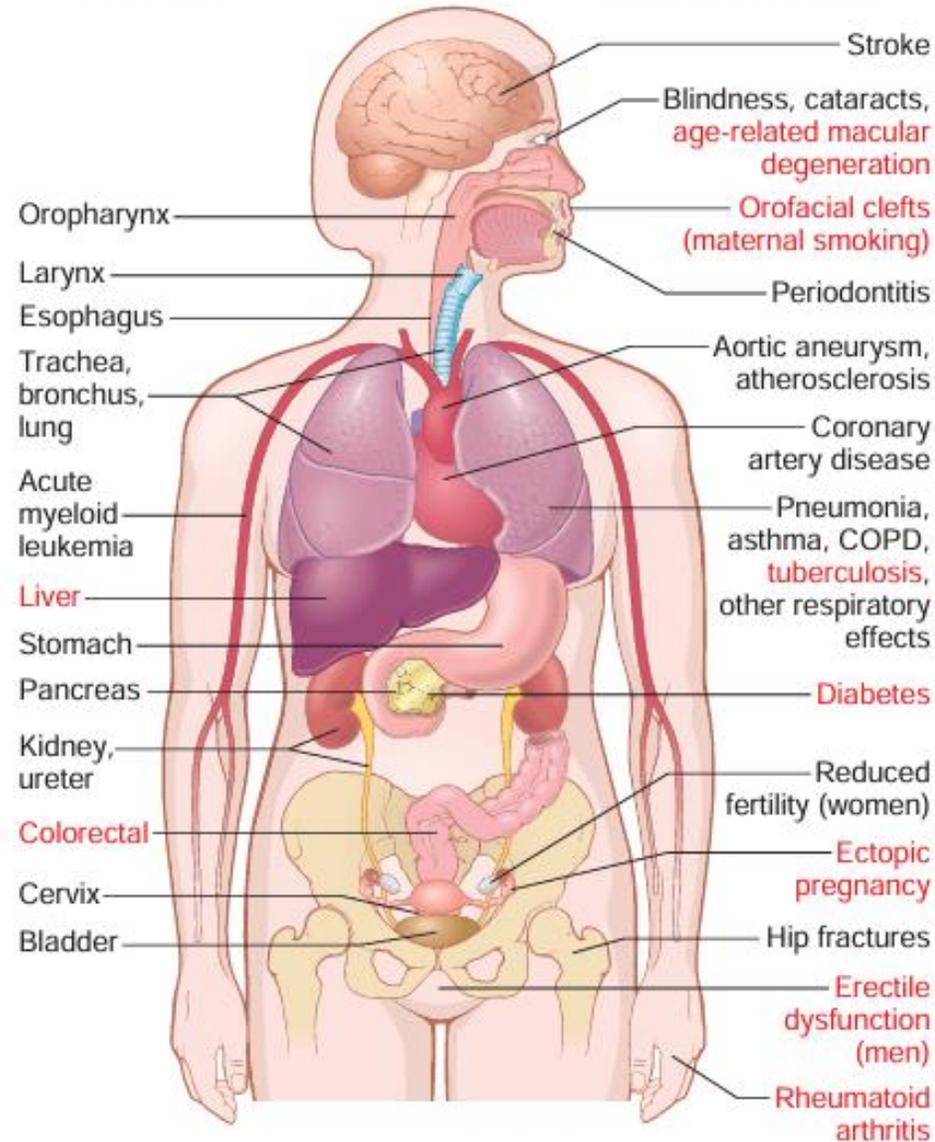
4) Children living in a household with an adult who smokes have an increased frequency of respiratory illnesses such as asthma

5) Cancer in other organs: such as Liver, Colon, Esophagus. And others.

6) Smoking increases the risk of type 2 diabetes, rheumatoid arthritis, age-related macular degeneration, ectopic pregnancy,

CANCERS

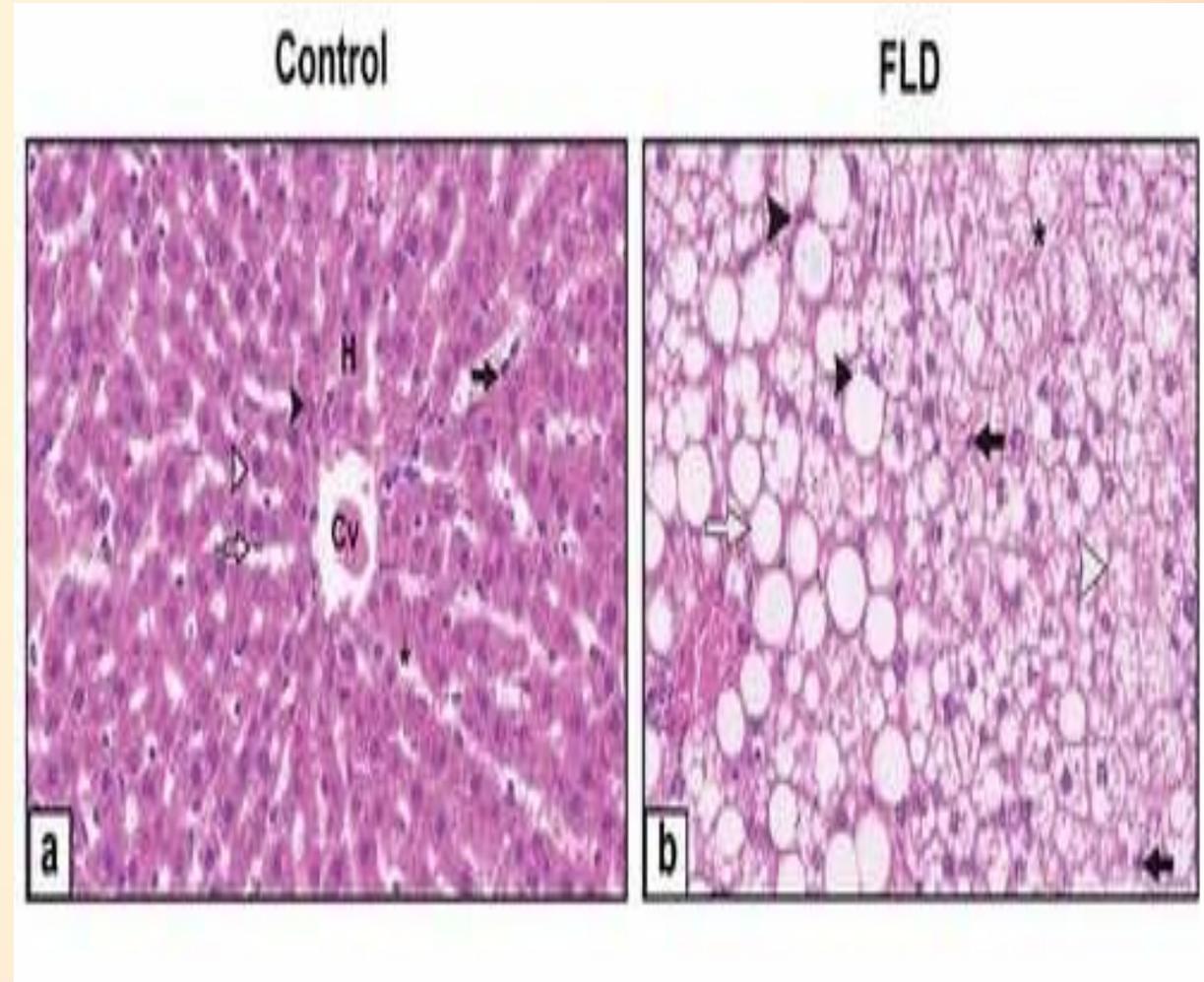
CHRONIC DISEASES



Decreased immune function,
overall diminished health

Effect of Alcohol

- Excessive alcohol intake causes serious physical and psychological harm
- ❖ Health impact:
- ❖ **Acute alcoholism:**
- Mostly are **reversible** changes if alcohol use stops
- Central nervous system (CNS): disordered cortical, motor, and intellectual behavior
- Liver: **Fatty liver (hepatic steatosis)**
- Stomach: Acute gastritis and ulceration
- May cause depression of respiratory centers, potentially leading to respiratory arrest

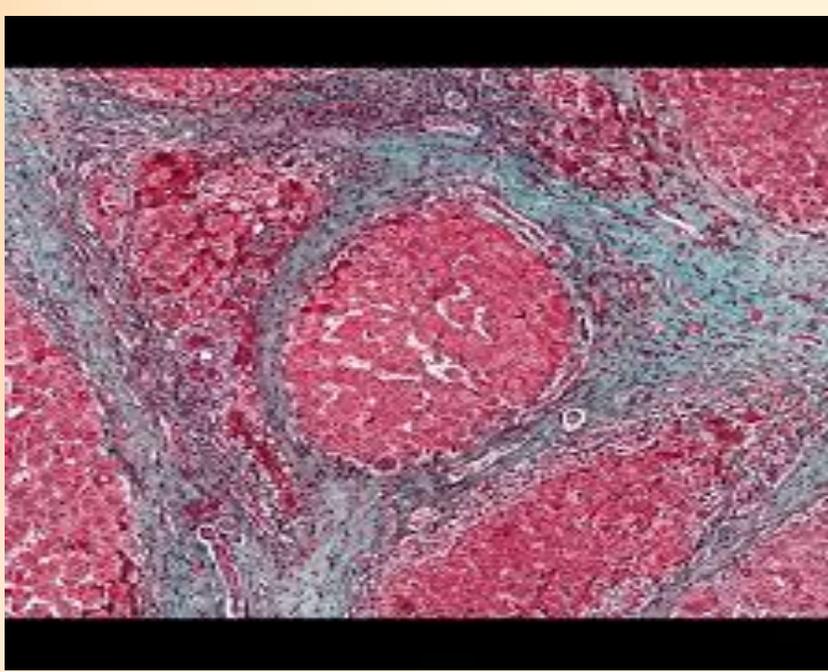


- **Chronic alcoholism:**

- Chronic alcoholism shortens lifespan.

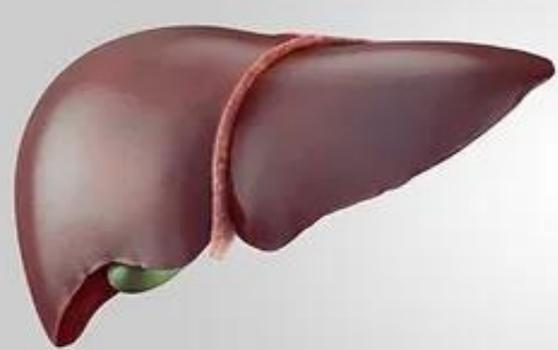
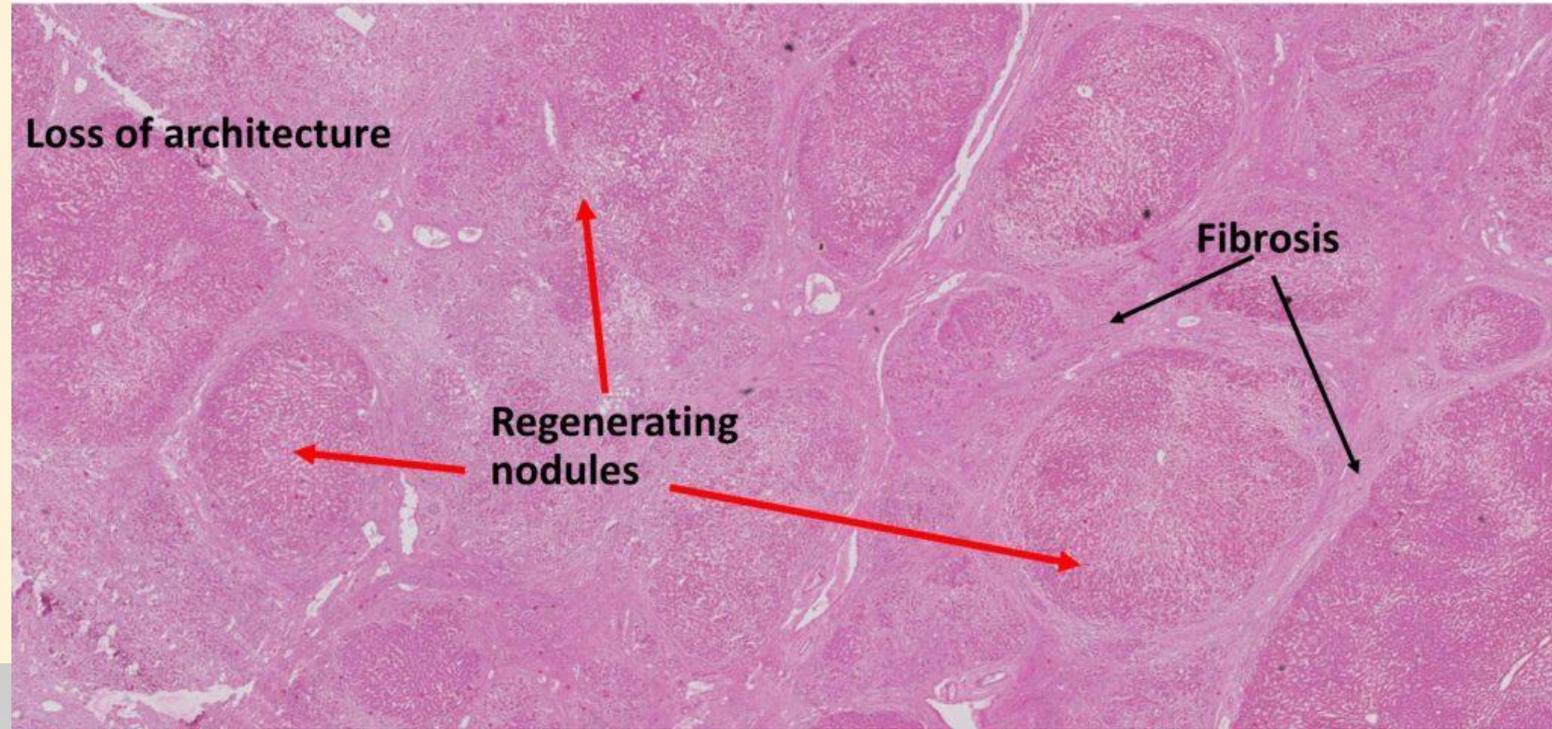
- Major organ damage:

- **Cirrhosis of the liver: increases the risk for development of hepatocellular carcinoma.**
- **Thiamine (vitamin B1) deficiency** leading to peripheral neuropathies and Wernicke-Korsakoff Syndrome (amnesia, confabulation, hallucination, and difficulty walking)
- **Alcoholic cardiomyopathy** (heart muscle disease)
- Acute and chronic pancreatitis
- **Fetal alcohol syndrome**
- Increased risk of cancers: oral cavity, esophagus, liver



Masson Trichrome stain

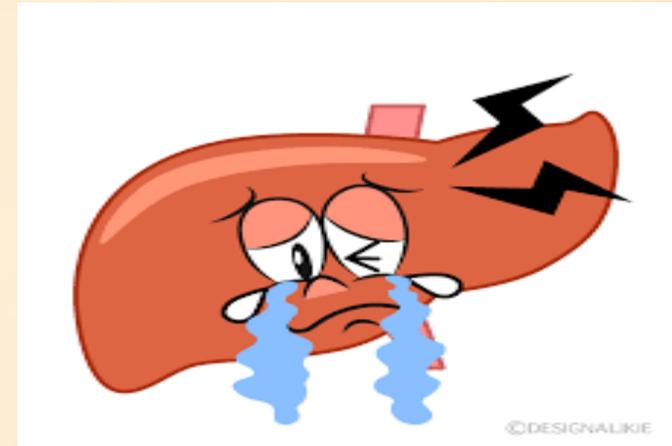
MICROSCOPY of CIRRHOSIS

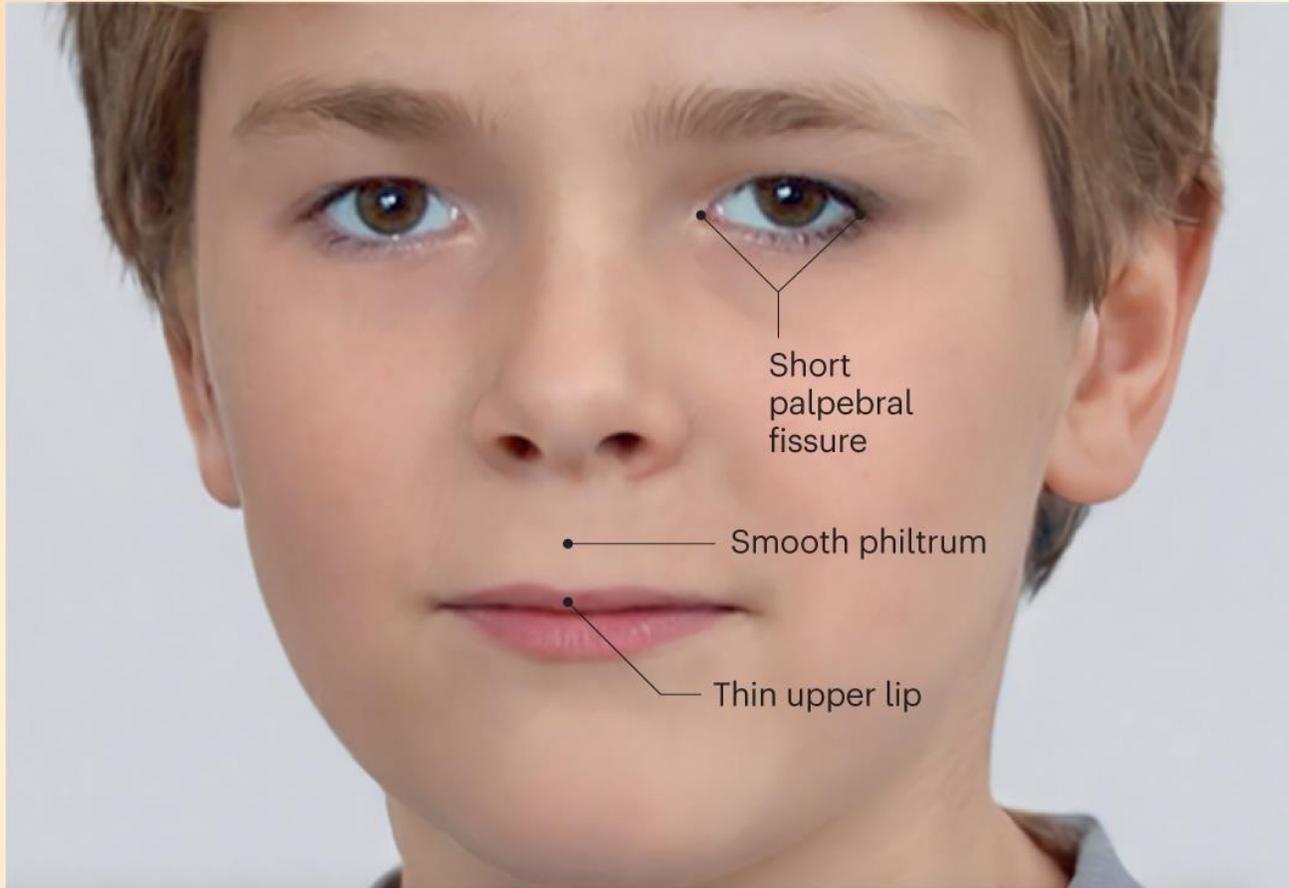


healthy liver



cirrhosis





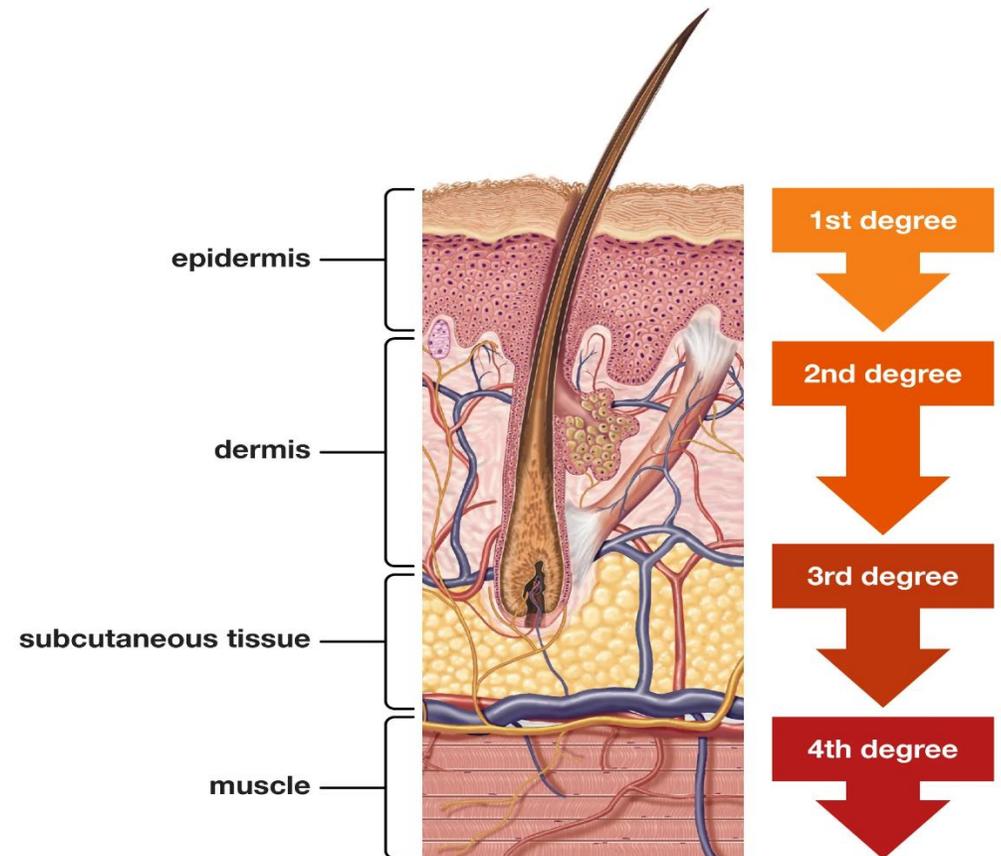
- Fetal alcohol syndrome:
- Learning disabilities
- Memory problems
- Poor impulse control.

Injury by physical agents

❖ Thermal injury:

- Thermal injury results from excessive heat and excessive cold
- **1) Thermal burns:**
- Caused by fire or scalding
- Burns covering more than 20% of body surface increase risk for: shock, sepsis and respiratory insufficiency.
- Inhalation of heated air and toxic gases causes airway and lung injury

Depth of burn as classified by degree



2) Hyperthermia:

- Prolonged exposure to high ambient temperatures
- ❖ **Heat exhaustion**: Most common hyperthermic syndrome; results from cardiovascular failure to compensate for dehydration-induced hypovolemia; leads to collapse.
- **Recovery from heat exhaustion**: Brief collapse followed by spontaneous recovery if rehydration occurs
- ❖ **Heat stroke** linked to high temperatures, humidity, and physical exertion
- Failure of thermoregulation causes sweating to stop and core temperature to exceed 40°C
- Elevated core temperature leads to multiorgan dysfunction, which can be rapidly fatal
- Generalized vasodilation causes blood pooling in the periphery and reduces effective circulating volume
- Systemic effects include hyperkalemia, tachycardia, and arrhythmias

- **3) Hypothermia:**

- Hypothermia results from prolonged exposure to cold temperatures
- **At about 32.2°C, unconsciousness occurs**
- **Lower core temperatures cause bradycardia and atrial fibrillation**
- **Slow chilling** causes vasoconstriction and increased vascular permeability, leading to edema and hypoxia, known as “trench foot”
- **Sudden, persistent chilling** causes vasoconstriction and increased blood viscosity, potentially resulting in ischemic injury and nerve degeneration

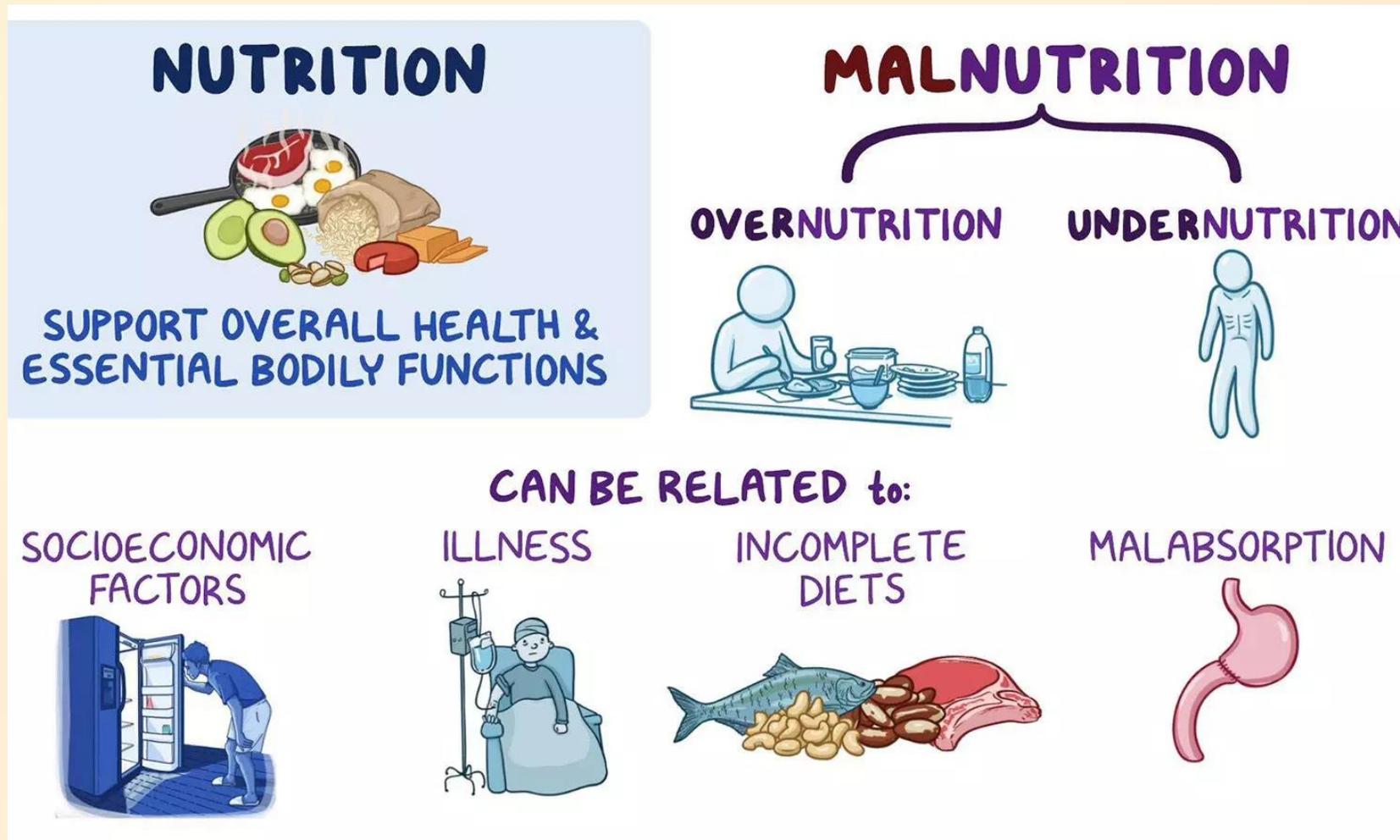
(**Frostbite**)



Nutritional diseases

Malnutrition

- Malnutrition results from insufficient protein and calorie intake or poor protein digestion/absorption.



- **Dietary Insufficiency**

- Appropriate diet should provide:

1) Sufficient energy:
carbohydrates, fats, and
proteins

2) amino acids and fatty acids
to be used as building blocks
for synthesis of proteins and
lipids;

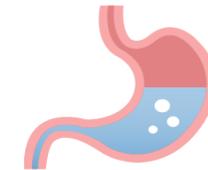
3) vitamins and minerals, which
function as coenzymes or
hormones in vital metabolic
pathways

- **primary malnutrition**, one or all of these components are missing from the diet.
- **Secondary malnutrition** results from malabsorption, impaired utilization or storage, excess loss, or increased need for nutrients.

Reasons for Nutrient Deficiencies



Picky Eating



Poor Digestion



Malabsorption



Poor
Methylation



Long-Term
Dieting



Certain
Medications

• Severe Acute Malnutrition

- ❖ **Marasmus** develops when the diet is severely lacking in calories.
- Weight falls to 60% of normal for sex, height, and age. A marasmic child suffers growth retardation and loss of muscle mass and subcutaneous fat.
- **Kwashiorkor**. marked protein deprivation is associated with severe loss of the visceral protein compartment, and the resultant hypoalbuminemia gives rise to generalized or dependent edema.
- The weight of children with severe kwashiorkor typically is 60% to 80% of normal.



Figure 9.21 Childhood malnutrition. (A) Marasmus. Note the loss of muscle mass and subcutaneous fat; the head appears to be too large for the emaciated body. (B) Kwashiorkor. The infant shows generalized edema, seen as ascites and puffiness of the face, hands, and legs. (A, From Clinic Barak, Reisebericht, Kenya.)

Vitamin deficiencies

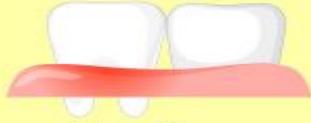
- Thirteen vitamins are necessary for health; **vitamins A, D, E, and K are fat-soluble, and all others are water-soluble.**

Vitamin	Functions	Deficiency Syndromes
Fat-Soluble		
Vitamin A	A component of visual pigment Maintenance of specialized epithelia Maintenance of resistance to infection	Night blindness, xerophthalmia, blindness Squamous metaplasia Vulnerability to infection, particularly measles
Vitamin D	Facilitates intestinal absorption of calcium and phosphorus and mineralization of bone	Rickets in children Osteomalacia in adults
Vitamin E	Major antioxidant; scavenges free radicals	Spinocerebellar degeneration, hemolytic anemia
Vitamin K	Cofactor in hepatic carboxylation of procoagulants—factors II (prothrombin), VII, IX, and X and protein C and protein S	Bleeding diathesis (Chapter 14)
Water-Soluble		
Vitamin B ₁ (thiamine)	As pyrophosphate, is coenzyme in decarboxylation reactions	Dry and wet beriberi, Wernicke syndrome, Korsakoff syndrome (Chapter 28)
Vitamin B ₂ (riboflavin)	Converted to coenzymes flavin mononucleotide and flavin adenine dinucleotide, cofactors for many enzymes in intermediary metabolism	Ariboflavinosis, cheilosis, stomatitis, glossitis, dermatitis, corneal vascularization
Niacin	Incorporated into nicotinamide adenine dinucleotide (NAD) and NAD phosphate, involved in a variety of redox reactions	Pellagra—"three Ds": dementia, dermatitis, diarrhea
Vitamin B ₆ (pyridoxine)	Derivatives serve as coenzymes in many intermediary reactions	Cheilosis, glossitis, dermatitis, peripheral neuropathy (Chapter 28) Maintenance of myelination of spinal cord tracts
Vitamin B ₁₂	Required for normal folate metabolism and DNA synthesis	Megaloblastic pernicious anemia and degeneration of posterolateral spinal cord tracts (Chapter 14)
Vitamin C	Serves in many oxidation-reduction (redox) reactions and hydroxylation of collagen	Scurvy
Folate	Essential for transfer and use of one-carbon units in DNA synthesis	Megaloblastic anemia, neural tube defects (Chapter 14)
Pantothenic acid	Incorporated in coenzyme A	No nonexperimental syndrome recognized
Biotin	Cofactor in carboxylation reactions	No clearly defined clinical syndrome

Signs of scurvy



Fatigue



Bleeding or swollen gums



Reddish spots on the skin or petechiae



Swollen muscles or joints



Open wounds that take time to heal

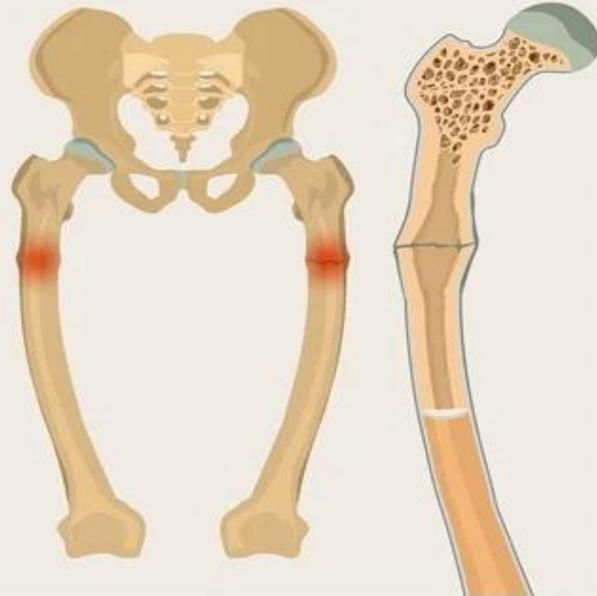


Falling of teeth

NORMAL BONES

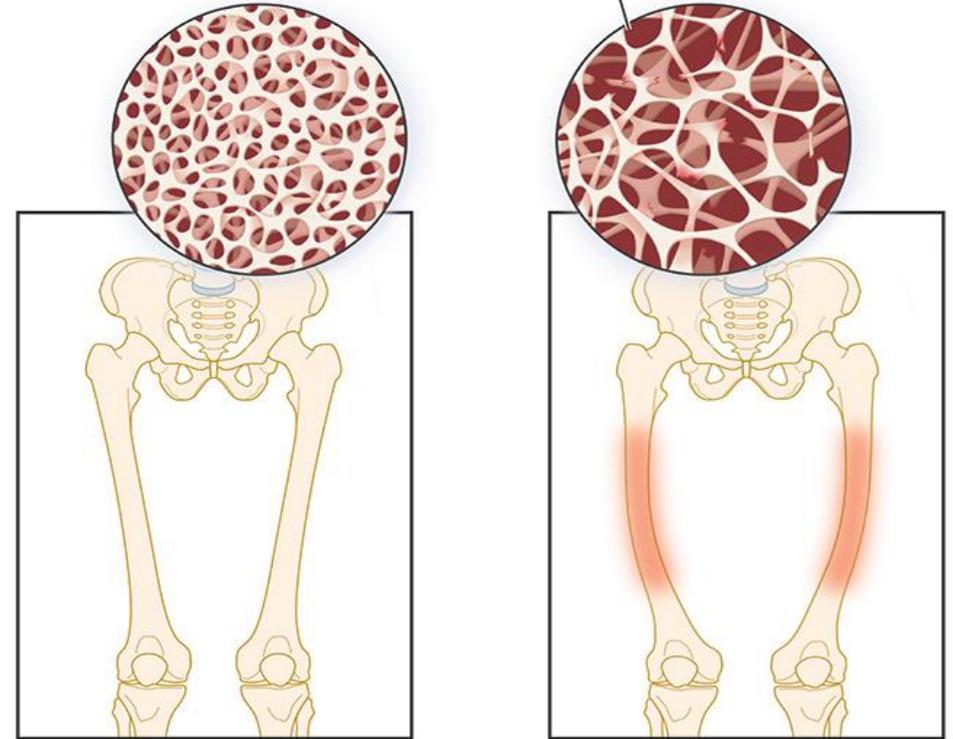


RICKETS



Osteomalalacia

Weakened bone density



Healthy bones

Osteomalalacia

Obesity

- **Definition:** Excess adipose tissue accumulation that negatively affects health
- **Health risks:** Increased likelihood of type 2 diabetes, dyslipidemias, cardiovascular disease, hypertension, and cancer
- **BMI categories:**
 - Normal: 18.5 to 25 kg/m²
 - Overweight: 25 to 30 kg/m²
 - Obese: Over 30 kg/m²
-



Thank you