Lecture 13: Minerals

Nutrition 150

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What are Minerals

Minerals are elements, can be found on the periodic table

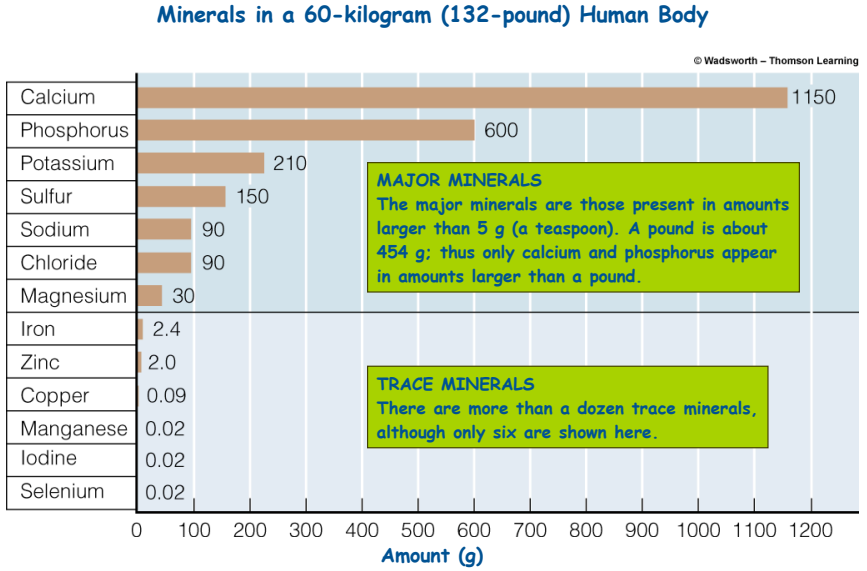
Inorganic (in chemical sense)

Not broken down during digestion nor destroyed by heat or light

Trace versus Major Minerals

- Major minerals: Minerals that are required in our diet at amounts greater than 100mg/day
- Trace minerals: Minerals that are required in our diet at amounts less than 100mg/day

Note: a dollar bill weighs one gram…1g=1000mg



Mineral Absorption

- Some minerals and vitamins block or facilitate the uptake of other minerals and vitamins
- In general, absorption is higher when body stores are low
  - Prevents deficiencies
  - Prevents absorption when levels are high

Primary Roles

- Metabolic health
- Antioxidants
- Blood health
- Bone health
- Electrolyte balance

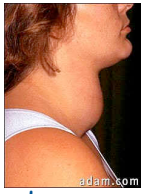
Metabolic Health and Antioxidants

Iodine

- How much: Trace mineral
- From where: Mostly in saltwater foods and enriched salt
- Functions: Metabolism: Synthesis of thyroid hormones
  - Thyroid hormones regulate body temperature, metabolic rate, growth, and reproduction

Iodine

- Too much: Rare (Is due to supplements)
  - Blocks production of thyroid hormones (causes a goiter)
- Too little:
  - Deficiency of thyroid hormone
    - Goiter: Enlargement of the thyroid gland
    - Metabolic problems (weight gain, fatigue, failure to deal well with cold temperatures)
    - Mental retardation (cretinism) in child if mother is deficient when pregnant



Selenium

- How much: Trace mineral
- From where: Plants and meats
  - Plants and meats get selenium from the soil
- Functions: 1) Metabolism: Part of thyroid hormones
  2) Antioxidant: helps Vit E

Selenium

- Too much? (Rare, due to supplements)
  - Brittle and nails
  - Digestive problems
- Too little?
  - Heart disorder
  - Arthritis
  - Impaired immune system

Manganese

- How much: Trace mineral
- From where: Whole-grains, some fruits and vegetables
- Functions:1) Energy metabolism
  2) Antioxidant
  3) Bone health: building cartilage

Chromium

- How much: Trace mineral
- From where: Whole-grains, mushrooms, dark chocolate, nuts, red wine etc.
- Functions: Metabolism of carbohydrate

Blood Health

Iron

- How much: Trace mineral
  - Only about 18% is absorbed from diet
  - Vit. C helps with absorption
- From where:
  - Meat, poultry, fish, shellfish
    - Esp. clams, oysters, beef liver
  - Fortified cereals and breads
  - Some vegetables (which ones?) and legumes

Iron

Functions:

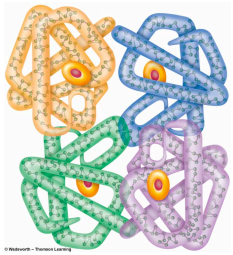
1) Blood health
2) Metabolism: part of enzymes used in energy production
3) Antioxidant

Iron

Binds and carries oxygen in hemoglobin.

Hemoglobin: Oxygen-carrying protein found in our red blood cells

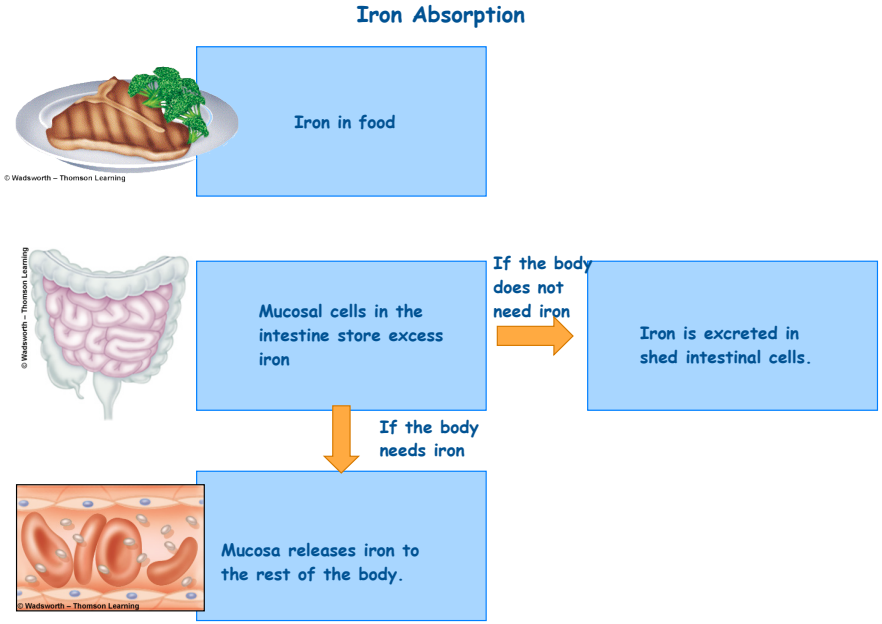
- similar molecule carries oxygen in muscles



Iron

Why does recommended intake change with sex, age, and pregnancy?

- Men, age 19+: 8 mg/day
- Women, age 19-50: 18 mg/day
  age 51+: 8 mg/day
  pregnant: 27 mg/day



Iron Overdose

- Rare, from supplements and usually in children
  - Digestive problems, dizziness, confusion, rapid heart beat
  - Damage to heart, central nervous system, liver and kidneys

Iron Deficiency=Anemia

- Iron deficiency is the most common nutrient deficiency in the world!
- Iron-deficiency Anemia
  - Production of health red blood cells ceases and hemoglobin levels are too low
  - Lost work productivity, fatigue, pale skin, depressed immune function, impaired functioning of brain and nervous system, increased risk of death
  - Most at risk: People living developing countries, pregnant women, young children

Zinc

- How much: Trace mineral
- From where: Red meats, some seafood, whole grains, enriched foods
- Too much: Digestive distress, headaches, depressed immune function
  - Happens only from taking supplements or fortified foods

Zinc: Functions

- Blood Health
  - Assists in production of hemoglobin
- Antioxidant
- Protein production
- Immune system
  - Development and functioning

Zinc-Deficiency Symptoms—The Stunted Growth of Dwarfism

The boy on the left is 17 years old but is only 4 feet tall.

The man on the right is an adult of average height.

Copper

- How much: Trace mineral
- From where: Widespread, but high in organ meats, seafood, nuts and seeds

Copper - Functions

- Blood health
  - Necessary for proper transportation of iron
- Metabolism
  - Involved in reactions that lead to energy production
- Antioxidant
- Bone health
  - Production of collagen

Bone Health

Calcium

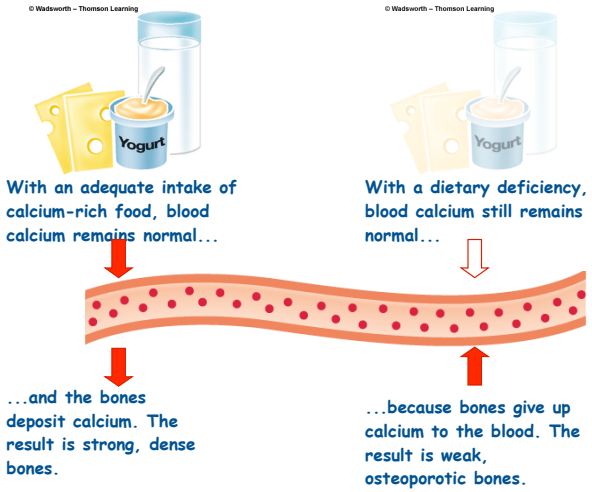
- How much: Major mineral
  - Important in bones and blood
- From where: Dairy, green leafy vegetables, fortified foods
- Functions: 1) Bone and tooth health
  2) Electrolyte balance
  3) Needed for proper nerve and muscle function

Calcium

Too little:

1) Calcium leaches from bones to maintain calcium levels in blood
2) Bones weaken increasing risk of breaks and causing osteoporosis in the long term
3) RARE: Convulsions, muscle twitching and spasms (incl. heart), due to low calcium levels in blood

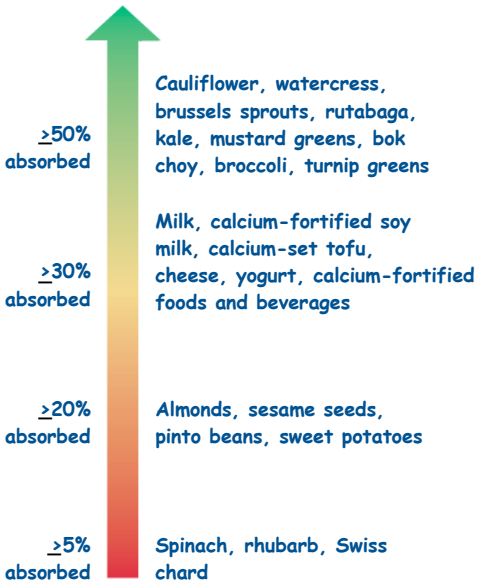
Maintaining Blood Calcium from the Diet and from the Bones



Bones are being built up and/or broken down at all ages.

Calcium Absorption

- Only about 30% of calcium in diet is absorbed by body
- Some nuts, grains, vegetables, and seeds block absorption
- Vitamin D needed for absorption
- Ability to absorb calcium decreases with age



Bioavailability of Calcium from Selected Foods

Calcium and Other Minerals

High levels of dietary calcium interferes with absorption of:

- Iron
- Zinc
- Magnesium

Phosphorus

- How much: Major mineral
- From where: Widespread in foods, esp. in milk, meats, eggs, sodas
- Functions:
  1) Bone health: One of bone minerals
  2) Electrolyte Balance
  3) In ATP, cell membranes, DNA

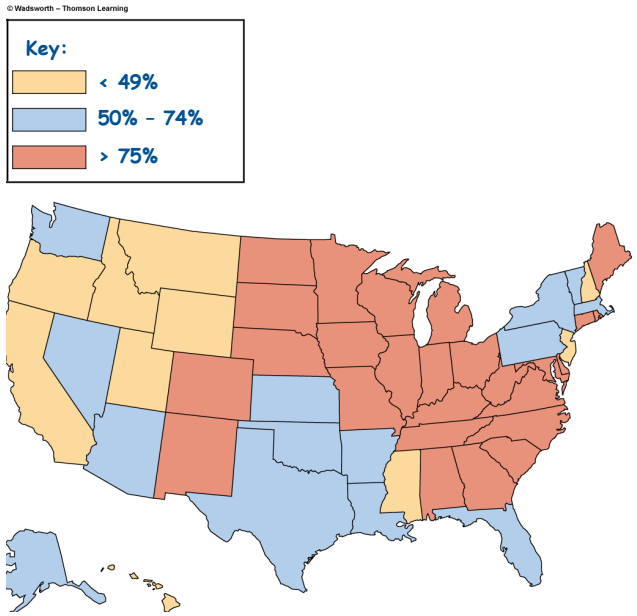
Magnesium

- How much: Major mineral
- From where: Widespread in foods, esp. in green leafy vegetables, whole grains, seeds, nut, seafood
- Functions:
  1) Bone health: One of bone and tooth minerals
  2) Facilitates enzyme reactions
     - ATP production, protein synthesis

Fluoride

- How much: Trace mineral
- From where: Fortified water or dental products
- Functions:
  1) Bone health: Development and health of bones and teeth
  2) Protects teeth from dental caries

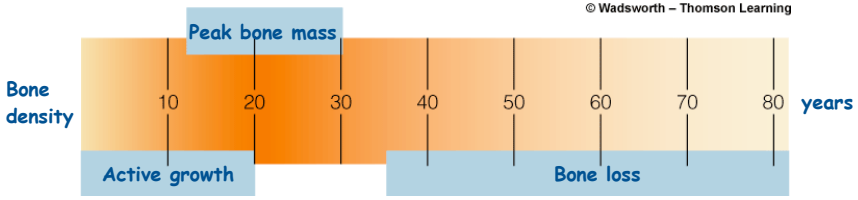
U.S. Population with Access to Fluoridated Water through Public Water Systems



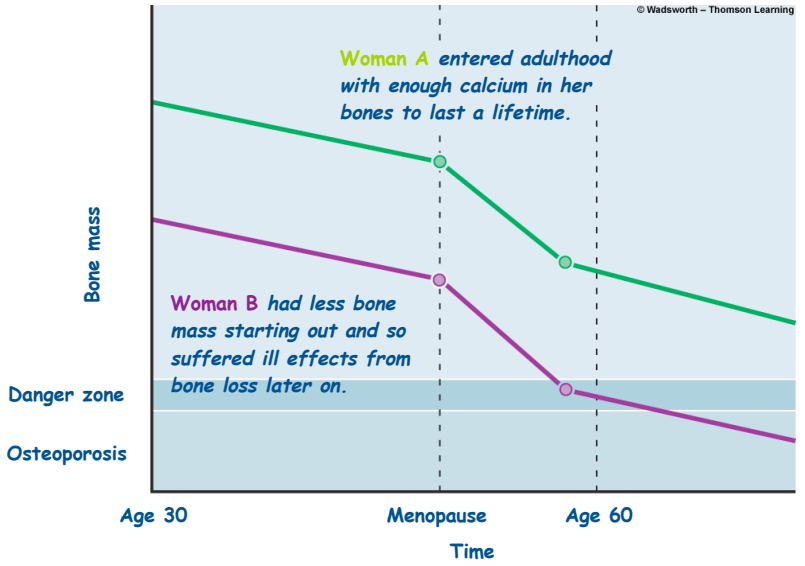
Fluoride

- Too much?
  - Staining and pitting of teeth potentially bones
- Too little?
  - Dental caries and tooth decay
  - Lower bone density

Phases of Bone Development throughout Life

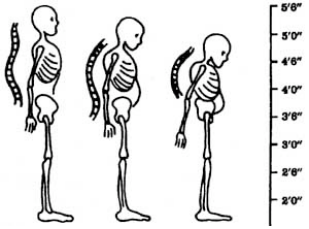


Bone Losses over Time Compared



Poor Bone Health

- Due to low calcium, magnesium, fluoride, and vitamin D
- Bones are more likely to break
- Leads to osteoporosis



Healthy and Osteoporotic Trabecular Bones

Electron micrograph of healthy bone.

Electron micrograph of bone affected by osteoporosis.

TABLE H12-2 Risk Factors and Protective Factors for Osteoporosis

Risk Factors	Protective Factors
• Older age	• Younger age
• Low BMI	• High BMI
• Caucasian, Asian, or Hispanic heritage	• African American heritage
• Cigarette smoking	• No smoking
• Alcohol consumption in excess	• Alcohol consumption in moderation
• Sedentary lifestyle	• Regular weight-bearing exercise
• Use of glucocorticoids or anticonvulsants	• Use of diuretics
• Female gender	• Male gender
• Maternal history of osteoporosis fracture or personal history of fracture	• Bone density assessment and treatment (if necessary)
• Estrogen deficiency in women (amenorrhea or menopause, especially early or surgically induced); testosterone deficiency in men	• Use of estrogen therapy
• Lifetime diet inadequate in calcium and vitamin D	• Lifetime diet rich in calcium and vitamin D

Mineral Deficiencies

- Improper diet
- Kidney disease can cause deficiencies in calcium, magnesium