

Quiz #2 – Chapters 4-10

What is fair game for the quiz?

Anything that we covered in class. Maybe a few bonus questions of other things.

CHAPTER

9

Third Canadian Edition

nutrition

a functional approach

Janice Thompson

Melinda Manore

Judy Sheeshka

Nutrients Involved in Bone Health and In Depth

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Bone Health

Bone structure

- Provides strength to support the body
- Allows for flexibility
- Contains about 65% minerals, providing the hardness of bone
- Contains 35% organic structures for strength, durability, and flexibility

Bone Health

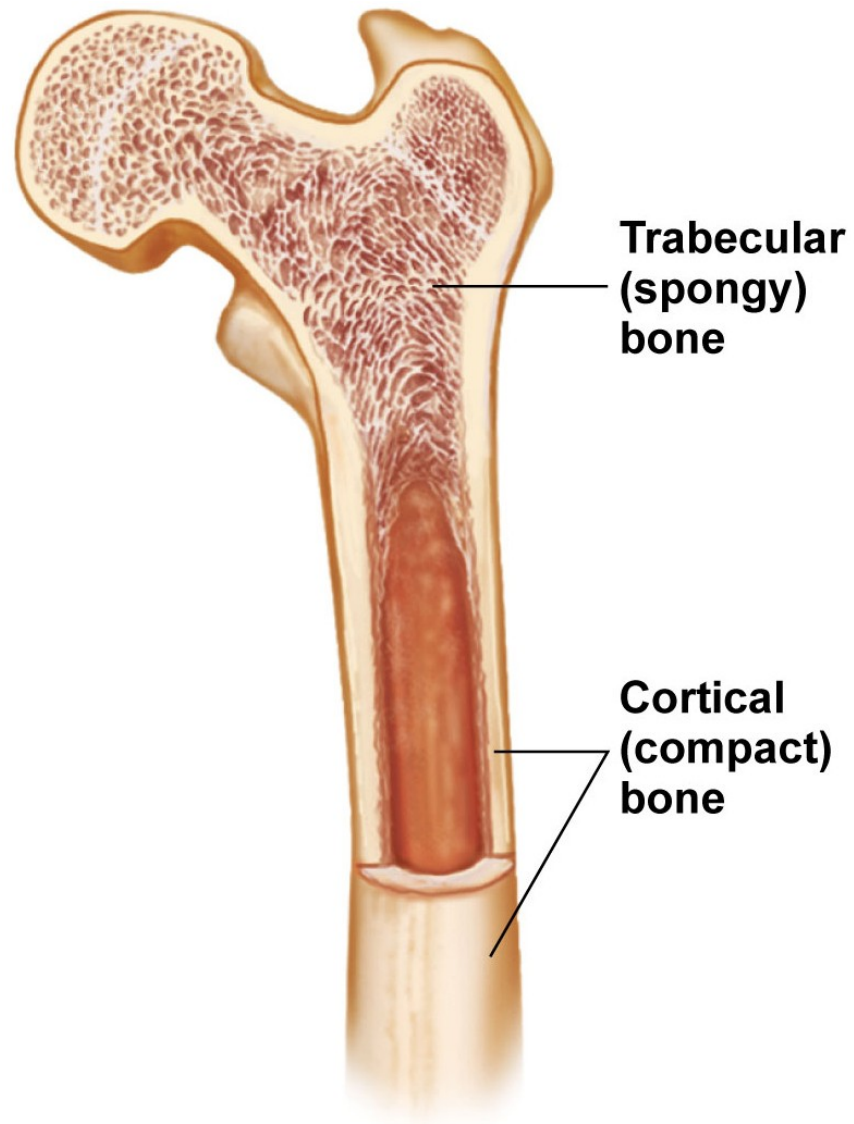


Figure 9.1

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Bone Health

Bones develop through 3 processes

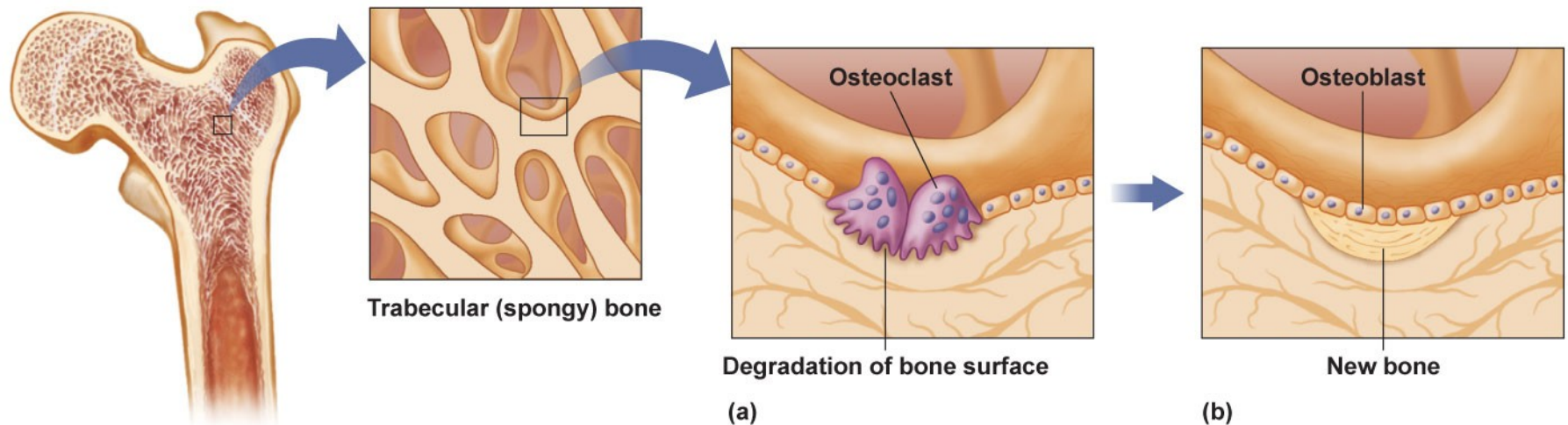
- **Bone growth**—increase in bone size; completed by age 14 in girls and age 17 in boys
- **Bone modelling**—shaping of bone; completed by early adulthood
- **Bone remodelling**—reshaping of bone; occurs throughout life

Bone Health

Bone remodelling involves

- **Resorption:** surface of bones is broken down
 - **Osteoclasts:** cells that erode the surface of bones
- **Formation of new bone** by cells called **osteoblasts**
 - Osteoblasts produce the collagen-containing component of bone

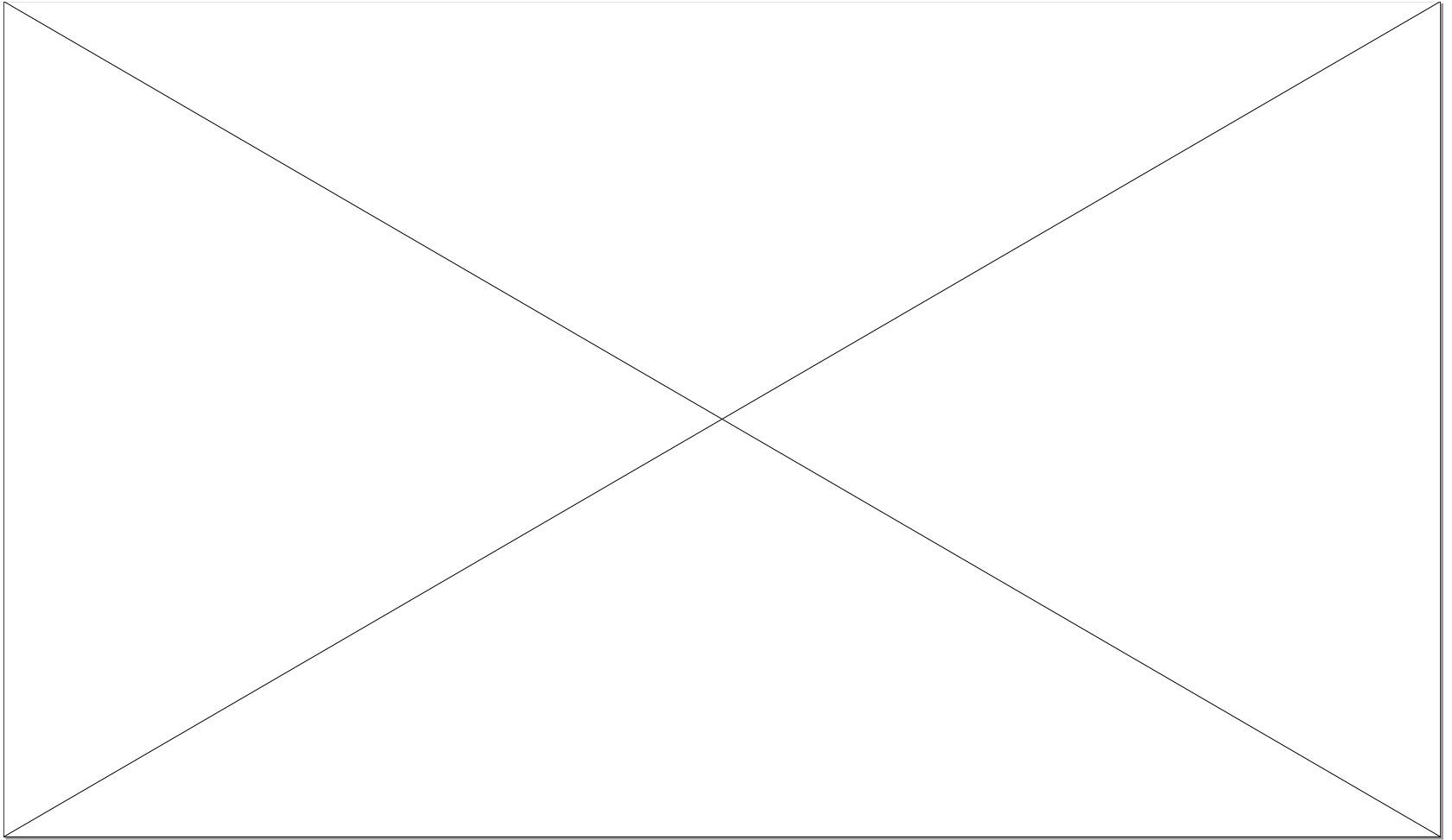
Bone Health



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Figure 9.3

Bone Health



Assessing Bone Health

Bone Density

- Measurement of the “compactness” of our bones
- Peak bone density
- Certain factors associated with lower peak bone density:
 - Late pubertal age in boys and late onset of menstruation in girls
 - Inadequate calcium intake
 - Low body weight
 - Physical inactivity during adolescence

Assessing Bone Health

Dual-energy x-ray absorptiometry (DXA or DEXA)

- Considered to be the most accurate tool to measure bone density
- Uses very low level x-ray energy
- Provides a full body scan or can be used to scan peripheral regions (wrist, heel)
- Is a noninvasive procedure
- A T-score is obtained, which compares bone density to that of a 30-year-old
- Recommended for postmenopausal women

Nutrients in Bone Health: Calcium

Calcium: the most abundant major mineral in the body

- 99% of body calcium is found in bone, with remainder in blood and soft tissues

Functions of calcium

- Forms and maintains bones and teeth
- Transmission of nerve impulses
- Assists in muscle contraction
- Assists with acid–base balance

Nutrients in Bone Health: Calcium

Blood calcium level is tightly controlled

Low calcium level

- Parathyroid hormone (PTH) is released
- PTH stimulates activation of vitamin D
- PTH and vitamin D cause
 - Kidneys to retain more calcium
 - Osteoclasts to break down bone and release calcium
 - Stimulation of calcium absorption from intestines

Nutrients in Bone Health: Calcium

High calcium level

- Thyroid gland releases **calcitonin**
- Calcitonin functions to
 - Inhibit action of Vitamin D
 - Prevent calcium reabsorption from kidneys
 - Limit calcium absorption from intestines
 - Inhibit osteoclasts from breaking down bone

Nutrients in Bone Health: Calcium

Recommended intake:

- There are no RDA values for calcium
- AI values vary with age:
 - 1000 mg/day (19 – 50 years)
 - 1300 mg/day (9 – 18 years)
 - 1200 mg/day (50 + years)
- Many people of all ages fail to consume enough calcium to maintain bone health

Nutrients in Bone Health: Calcium

Bioavailability: degree to which a nutrient is absorbed and used

Calcium bioavailability depends on need and age

- Infants and children can absorb over 60%
- Pregnant and lactating women can absorb 50%
- Healthy adults typically absorb 30%
- Older adults absorb less (as low as 25%)
- Appears that maximum absorbed at one time is limited to 500 mg
- Numerous factors in food influence absorption

Nutrients in Bone Health: Calcium

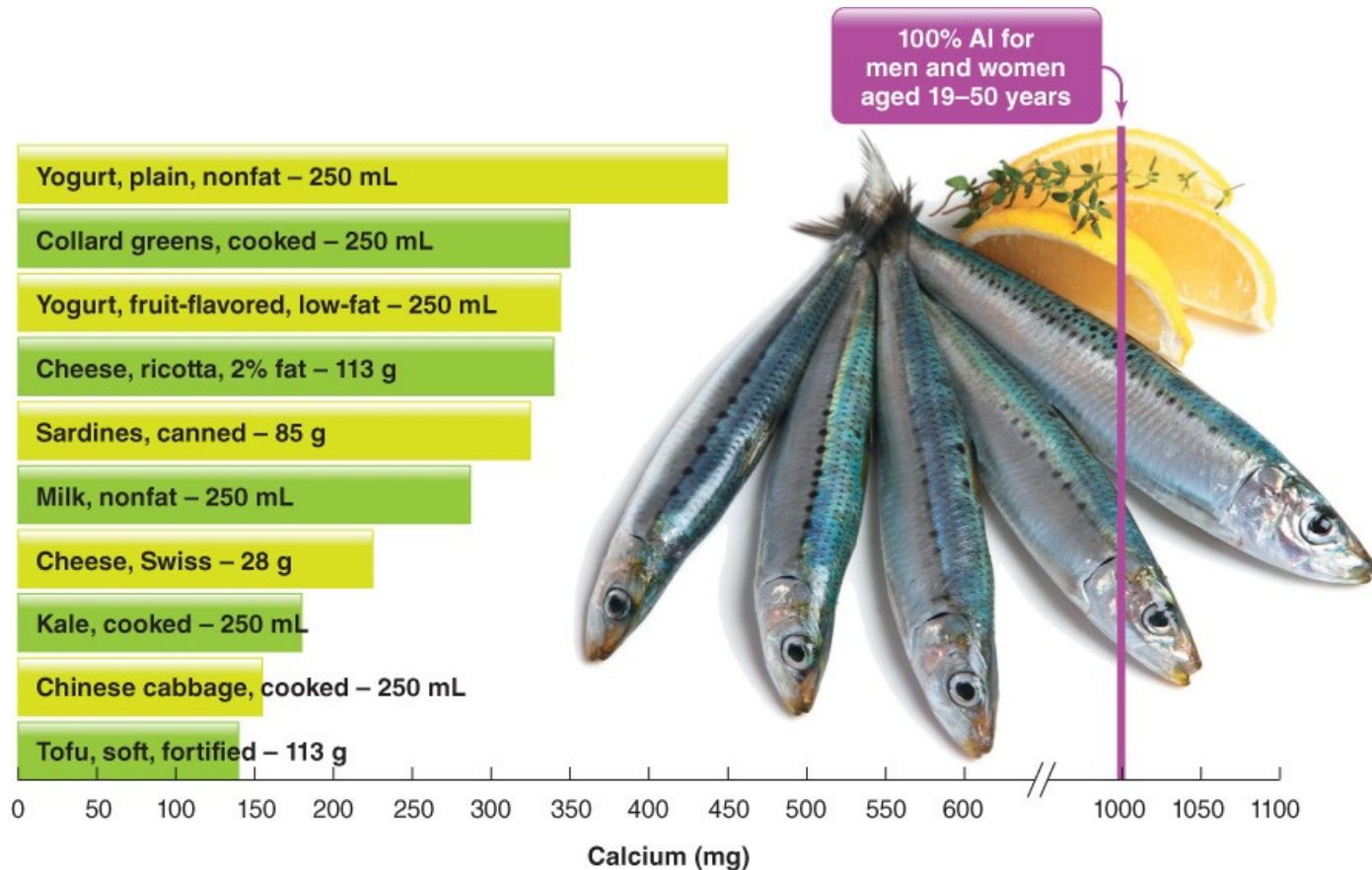
Best food sources of calcium

Skim milk, low-fat cheese, non-fat yogurt, green leafy vegetables

Eat foods such as ice cream, regular cheese, and whole milk in **moderation**

Many packaged foods are now fortified with calcium (e.g., orange juice)

Nutrients in Bone Health: Calcium



➤ **Figure 9.6** Common food sources of calcium. The AI for adult men and women aged 19 to 50 years is 1000 mg of calcium per day. For men and women older than 50 years of age, the AI increases to 1200 mg of calcium per day.

Data from U.S. Department of Agriculture, Agricultural Research Service. 2009. USDA Nutrient Database for Standard Reference, Release 22. Nutrient Data Laboratory Home Page. www.ars.usda.gov/ba/bhnrc/ndl.

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Figure 9.6

Nutrients in Bone Health: Calcium

What if you consume too much calcium?

- Excess calcium is excreted from the body
- Calcium supplements can lead to mineral imbalances
- **Hypercalcemia** (high blood calcium) can be caused by cancer and overproduction of PTH

What if you don't consume enough calcium?

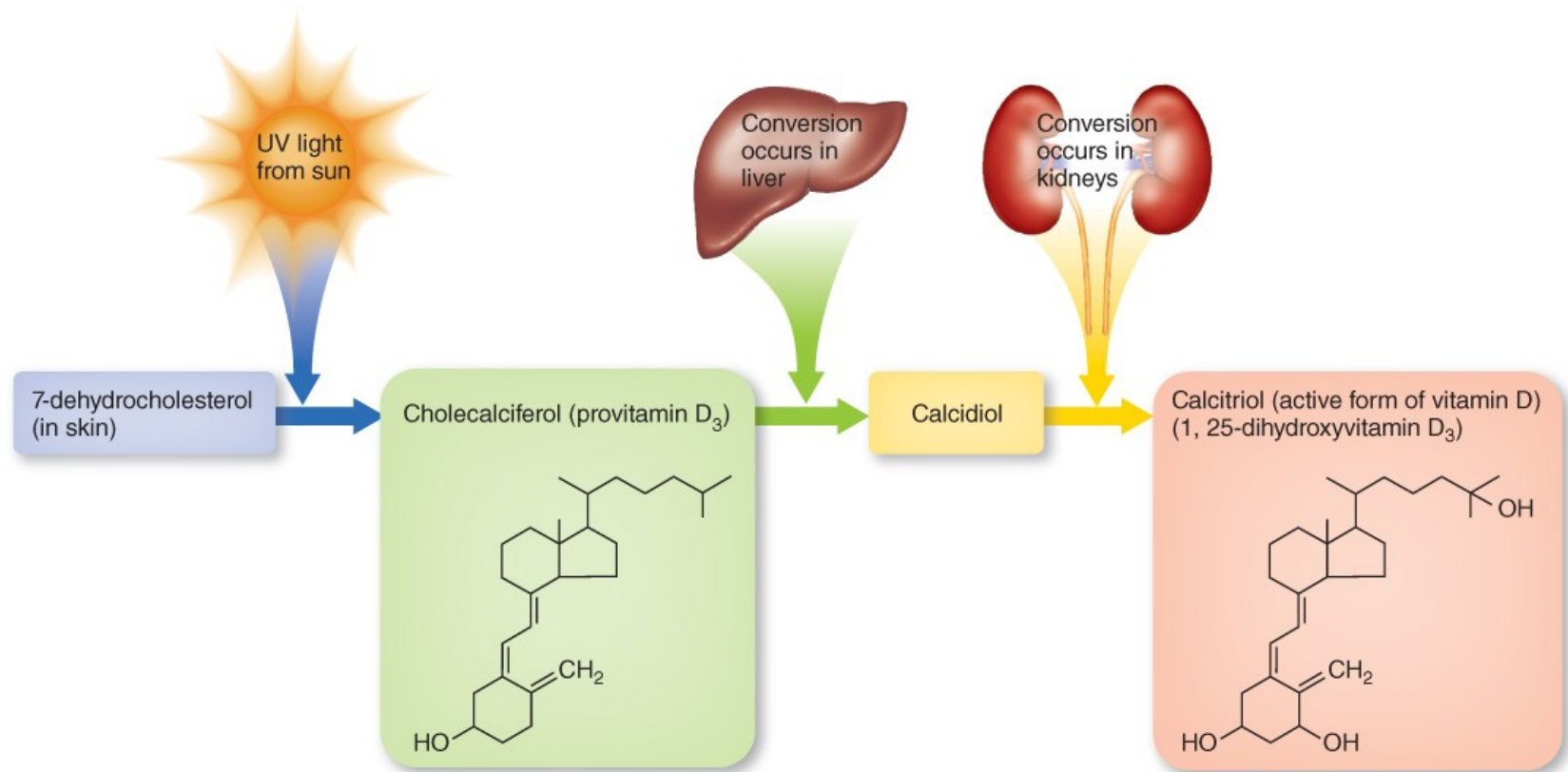
- **Hypocalcemia** (low blood calcium) can be caused by kidney disease or overproduction of parathyroid hormone (PTH)

Nutrients in Bone Health: Vitamin D

Vitamin D

- Fat-soluble vitamin
- Excess is stored in liver and fat tissue
- Can be synthesized by the body by exposure to UV light from the sun
- Is a hormone because it is synthesized in one location and acts in another location

Nutrients in Bone Health: Vitamin D



▶ **Figure 9.8** The process of converting sunlight into vitamin D in our skin. When the ultraviolet rays of the sun hit our skin, they react with 7-dehydrocholesterol. This compound is converted to cholecalciferol, an inactive form of vitamin D also called provitamin D₃. Cholecalciferol is then converted to calcidiol in the liver. Calcidiol travels to the kidneys, where it is converted into calcitriol, which is considered the primary active form of vitamin D in our body.

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Figure 9.8

Nutrients in Bone Health: Vitamin D

Functions of vitamin D

- Regulates blood calcium levels
- Required for calcium and phosphorous absorption
- Stimulates osteoclasts
- Necessary for calcification of bone

Nutrients in Bone Health: Vitamin D

Recommended intake

- New RDA: 15 µg/day (both genders up to age 50 yrs); women and men over 70 yrs: 20 µg/day
- AI values assume that a person's sun exposure is inadequate
- Northern latitudes receive inadequate sunlight in the winter to make vitamin D

Nutrients in Bone Health: Vitamin D

- Canadians **cannot** rely on sun exposure for vitamin D synthesis from October to April: thus, adequate dietary intake and supplementation is essential during this time
- Other factors affecting synthesis: time of day; skin colour; traditional clothing (in some cultures); age; obesity status; aging; sunscreens

Nutrients in Bone Health: Vitamin D

Sources of vitamin D

- Most foods naturally contain very little vitamin D
- Most vitamin D is obtained from fortified foods such as milk
- Vegetarians not consuming dairy foods receive vitamin D from the sun, fortified soy products, or supplements

Nutrients in Bone Health: Vitamin D

What if you consume too much vitamin D?

- Occurs from vitamin supplements, *not* from excessive exposure to sunlight
- Results in **hypercalcemia**—high blood calcium

What if you don't consume enough vitamin D?

- Occurs with diseases that reduce intestinal absorption of fat and limited exposure to sunlight
- **Rickets**—occurs in children; inadequate mineralization of bones
- **Osteomalacia**—loss of bone mass in adults

Nutrients in Bone Health: Vitamin K

Vitamin K

- Fat-soluble vitamin
- Stored in the liver
- **Phylloquinone**: plant form of vitamin K
- **Menaquinone**: form of vitamin K produced by bacteria in the large intestine

Functions of vitamin K

- Blood coagulation (prothrombin synthesis)
- Bone metabolism (osteocalcin synthesis)

Nutrients in Bone Health: Vitamin K

We also absorb vitamin K produced by bacteria in our large intestine

Recommended intake

- There is no RDA for vitamin K
- AI values are 120 µg/day for men and 90 µg/day for women

Sources of vitamin K

- Green leafy vegetables, vegetable oils

Nutrients in Bone Health: Vitamin K

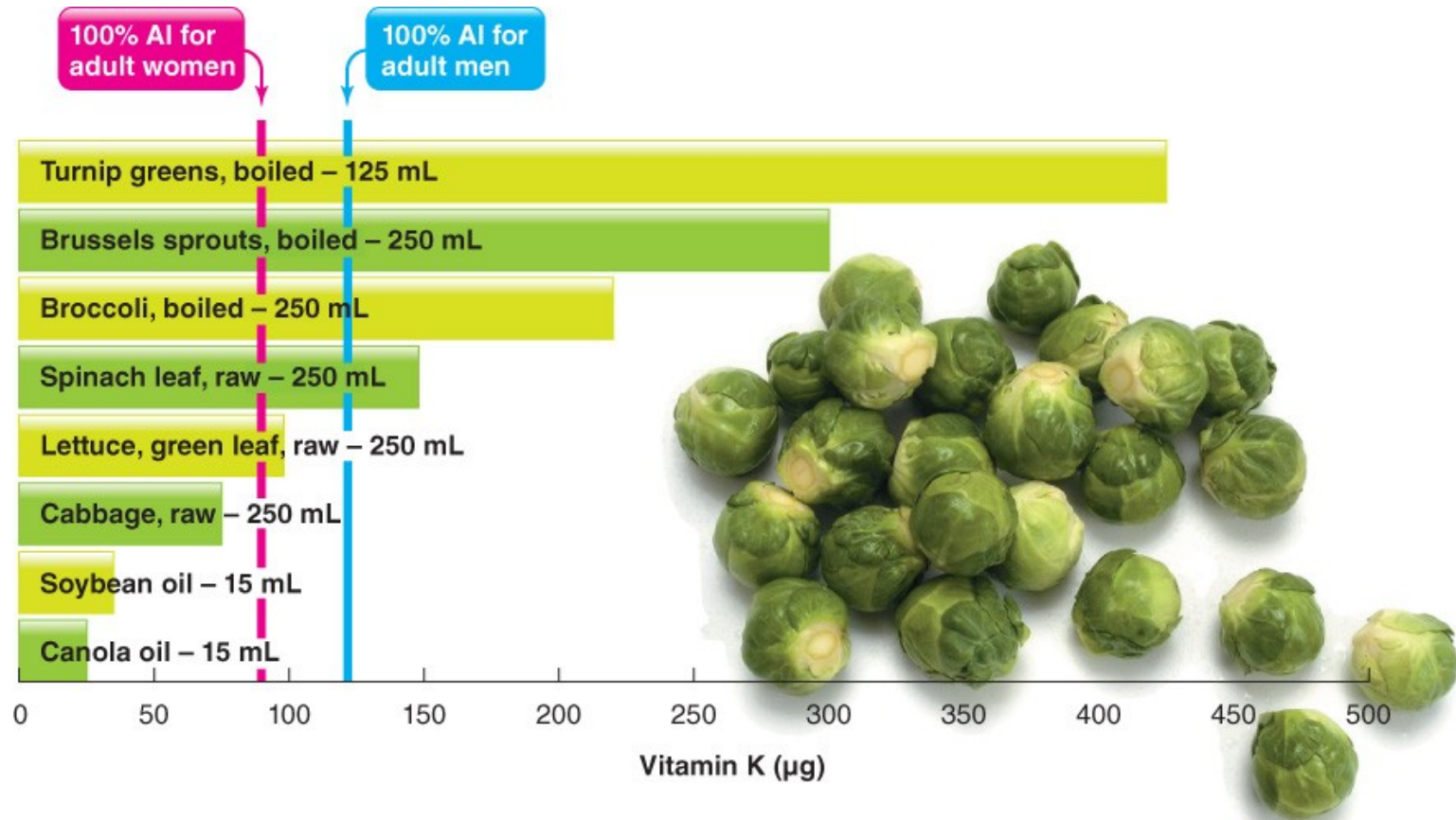


Figure 9.10 Common food sources of vitamin K. The AIs for adult men and women are 120 µg per day and 90 µg per day, respectively.

Data from U.S. Department of Agriculture, Agricultural Research Service. 2009. USDA Nutrient Database for Standard Reference, Release 22. Nutrient Data Laboratory Home Page. www.ars.usda.gov/ba/bhnrc/ndl.

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Nutrients in Bone Health: Vitamin K

What if you consume too much vitamin K?

- No side effects from large quantities

What if you don't consume enough vitamin K?

- Reduced blood clotting, excessive bleeding
- Occurs with diseases that limit absorption of fat in the small intestine

Nutrients in Bone Health: Phosphorus

Phosphorus (as phosphate) is the primary intracellular negatively charged electrolyte

Functions of phosphorus

- Critical to mineral composition of bone
- Required for proper fluid balance
- Component of ATP, DNA, and membranes

Nutrients in Bone Health: Phosphorus

Recommended intake

- RDA for phosphorus is 700 mg/day

Sources of phosphorus

- High in protein-containing foods such as milk, meats, and eggs
- In processed foods as a food additive
- In soft drinks as phosphoric acid

Nutrients in Bone Health: Phosphorus

What if you consume too much phosphorus?

- Excessive vitamin D supplements or consumption of too many phosphorus-containing antacids can cause elevated phosphorus levels, muscle spasms, and convulsions

What if you don't consume enough phosphorus?

- Deficiencies are rare in healthy adults

Nutrients in Bone Health: Magnesium

The bones contain 50–60% of the body's magnesium

Functions of magnesium

- A mineral found in bone structure
- **Cofactor** for over 300 enzyme systems
- Required for the production of ATP, DNA, and proteins

Nutrients in Bone Health: Magnesium

Recommended intake

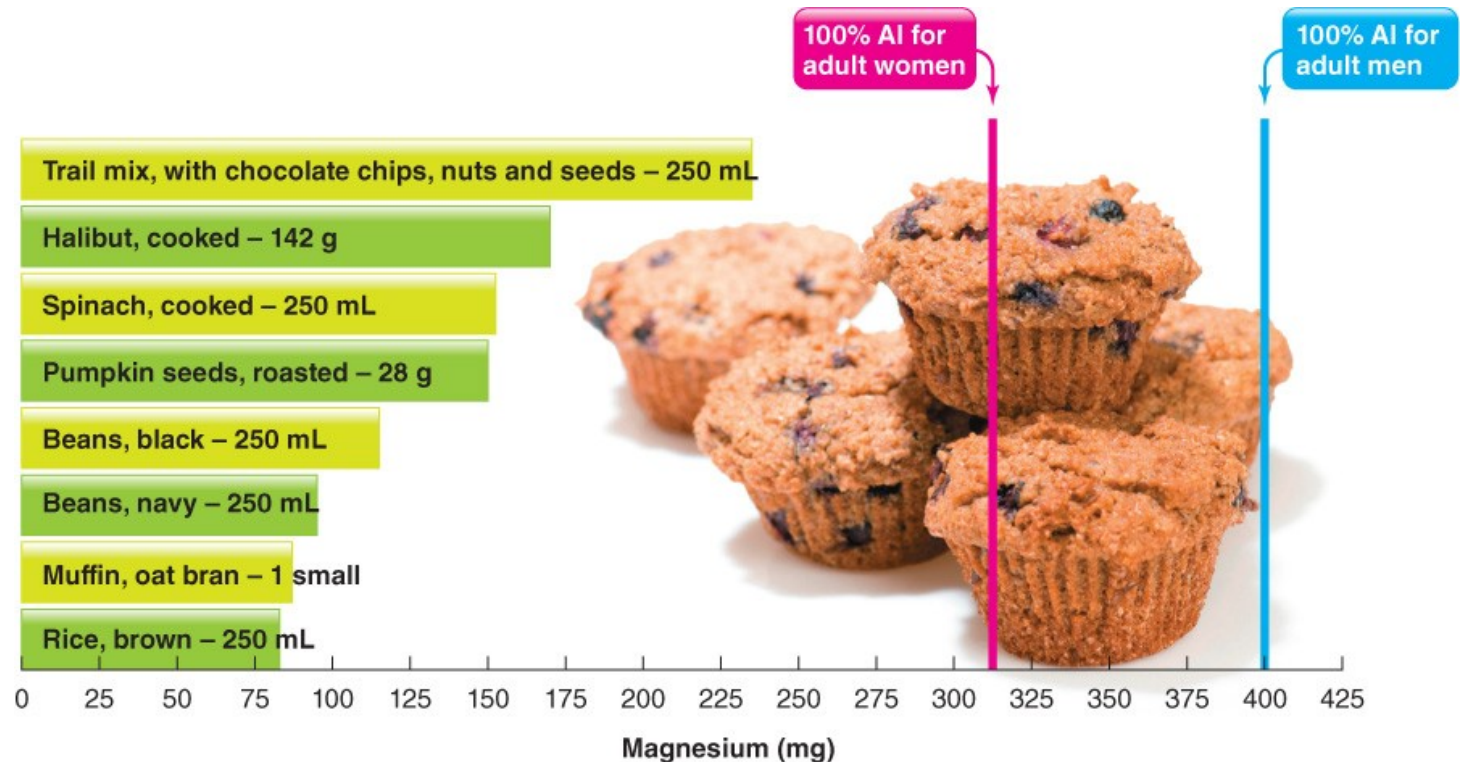
RDA varies based on age and gender

- 310 mg/day for women age 19–30
- 400 mg/day for men age 19–30
- 320 mg for women over 30
- 420 mg for men over 30

Sources of magnesium

- Green leafy vegetables, whole grains, seeds, nuts, seafood, beans, some dairy products

Nutrients in Bone Health: Magnesium



➤ **Figure 9.11** Common food sources of magnesium. For adult men 19 to 30 years of age, the RDA for magnesium is 400 mg per day; the RDA increases to 420 mg per day for men 31 years of age and older. For adult women 19 to 30 years of age, the RDA for magnesium is 310 mg per day; this value increases to 320 mg per day for women 31 years of age and older.

Data from U.S. Department of Agriculture, Agricultural Research Service. 2009. USDA Nutrient Database for Standard Reference, Release 22. Nutrient Data Laboratory Home Page. www.ars.usda.gov/ba/bhnrc/ndl.

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Figure 9.11

Nutrients in Bone Health: Magnesium

What if you consume too much magnesium?

- No toxicity from magnesium in food
- Magnesium supplements can cause diarrhea, nausea, cramps, dehydration, and cardiac arrest

What if you don't consume enough magnesium?

- **Hypomagnesemia** can result in low blood calcium and osteoporosis
- Other symptoms include muscle cramps, spasms, nausea, weakness, and confusion

Nutrients in Bone Health: Fluoride

Fluoride is a trace mineral

- 99% of the body's fluoride is stored in teeth and bones

Functions of fluoride

- Development and maintenance of teeth and bones
- Combines with calcium and phosphorus to make tooth enamel stronger, which protects teeth from dental caries (cavities)

Nutrients in Bone Health: Fluoride

Recommended intake

- No RDA for fluoride
- AI varies by gender and increases with age, ranging from 1–4 mg/day

Sources of fluoride

- Fluoridated dental products
- Fluoridated water

Nutrients in Bone Health: Fluoride

What if you consume too much fluoride?

- **Fluorosis** (excess fluoride) creates porous tooth enamel; teeth become stained and pitted

What if you don't consume enough fluoride?

- Dental caries (cavities)

In Depth: Osteoporosis

Osteoporosis is a disease characterized by

- Low bone mass
- Deterioration of bone tissue
- Fragile bones, leading to bone fractures
- Compaction of bone; decreased height
- Shortening and hunching of the spine, dowager's hump

In Depth: Osteoporosis



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Figure 1 In Depth

In Depth: Osteoporosis: Prevalence in Canada

- In 2009, 19.2% of Canadian women and 3.4% of men aged 50+ reported a diagnosis of osteoporosis
- In 2011, 31.3% of women and 6.4% of men aged 71+ were diagnosed with osteoporosis
- Canada spends an estimated \$1.3 billion annually to treat osteoporosis

In Depth: Osteoporosis

Factors influencing the risk of osteoporosis include

- Age
- Gender
- Genetics
- Consumption of tobacco, alcohol, and caffeine
- Nutrition
- Physical activity
- History of amenorrhea (loss of menstrual function)

In Depth: Osteoporosis

Age is a factor for osteoporosis because

- Bone mass decreases with age
- Age-related hormonal changes influence bone density (reduced estrogen and testosterone production)
- Older adults are less able to absorb vitamin D

In Depth: Osteoporosis

Gender is a risk factor for osteoporosis because

- 19% of Canadian women aged 50+ years have osteoporosis
- Women have lower bone density than men
- Estrogen loss in postmenopausal women causes increased bone loss
- Women live longer than men

In Depth: Osteoporosis

Tobacco, alcohol, and caffeine are risk factors for osteoporosis because

- cigarette smoking decreases bone density due to effects on the hormones that influence bone formation and resorption
- chronic alcohol abuse is detrimental to bone health and is associated with high fracture rates
- high caffeine intake increases calcium in the urine

In Depth: Osteoporosis

Nutrition is a risk factor for osteoporosis because

- diets high in fruits and vegetables are associated with improved bone health
- the impact of protein on bone health is controversial
- calcium and vitamin D are important, especially during childhood and adolescence
- high sodium intake is known to increase the kidney's excretion of calcium in the urine

In Depth: Osteoporosis

Physical activity influences the risk for osteoporosis because

- Regular exercise causes stress to bones, leading to increased bone mass
- Weight-bearing activities (walking, jogging) are especially helpful in increasing bone mass

Treatment for Osteoporosis

There is no cure for osteoporosis

The progression of osteoporosis may be slowed by

- Adequate calcium and vitamin D intake
- Regular exercise
- Antiresorptive medications (biophosphonates)
- Hormone replacement therapy