Chapter 1

1.1 What is Nutrition?

- **Nutrition** – the study of food, including
  - How food nourished our bodies
  - How food influences our health
- Nutrition is a relatively new discipline of science.
- Nutrition research focuses on supporting health and preventing and/or treating chronic diseases.
- Nutrition involves study of the following:
  - Food consumption
  - Food digestion
  - Food absorption
  - Food storage
  - Factors that influence eating patterns
  - Recommended amounts of types of food
  - Food safety
  - The global food supply

1.2 How Does Nutrition Support Health?

- Nutrition supports health and wellness
- **Wellness** – A multidimensional, active process by which people make choices to enhance their lives
  - Includes: physical, emotional, social, occupational, and spiritual health
- Critical components of wellness
  - Nutrition
  - Physical activity

1.3 Wellness

1.3.1 Physical Health

Includes nutrition and physical activity.

1.3.2 Spiritual Health

Includes spiritual values and beliefs.

1.3.3 Emotional Health

Includes positive feelings about one's self and life.

1.3.4 Social Health

Includes family, community, and social environment.

1.3.5 Occupational Health

Includes meaningful work or vocation.

1.4 Nutrition and Chronic Disease Prevention

- Nutrition can prevent disease
  - Nutrient-deficiency diseases:
    - scurvy (Vitamin-C deficiency)
    - pellagra
  - Three chronic diseases strongly associated with poor nutrition:
    - Heart disease
    - Stroke
    - Diabetes
  - Diseases in which nutrition plays a role:
    - Osteoarthritis
    - Osteoporosis
- Obesity is the primary link between poor nutrition and mortality

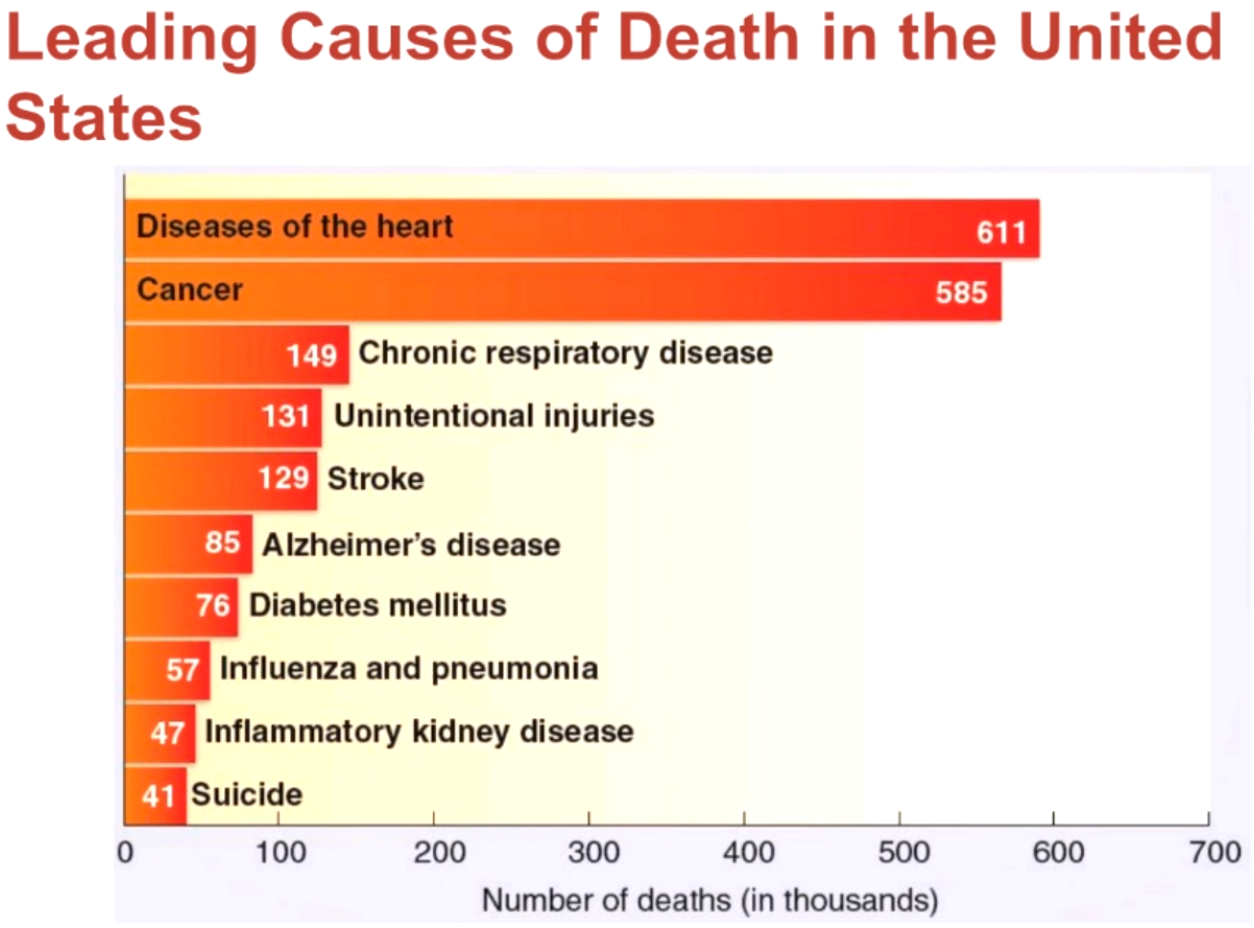
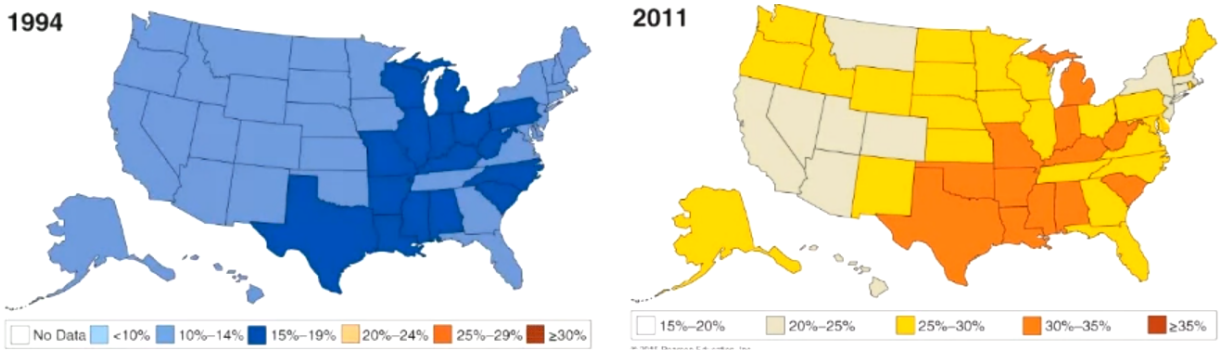


Figure 1.1: Leading Causes of Death in the United States



(a) Obesity rates per U.S. state in 1994.

(b) Obesity rates per U.S. state in 2011.

Figure 1.2: A 15-year difference between obesity rates in the United States.

1.5 Healthy People 2020

- Nutrition is so important that it has become a national goal

- The *Healthy People* plan, revised every decade, identifies goals and objectives to reach by 2020.

1.5.1 Goals of Healthy People 2020

- Attain high-quality, longer lives free of preventable disease, disability, injury, and premature death
- Achieve health equity, eliminate disparities, and improve the health of all groups
- Create social and physical environments that promote good health for all
- Promote quality of life, healthy development, and healthy behaviors across all life stages

Table 1.1: Weight, Nutrition, and Physical Activity Objecives from *Healthy People 2020*

Topic	Objective Number and Description
Weight status	NWS-8. Increase the proportion of adults who are at a healthy weight from 30.8% to 33.9%. NWS-9. Reduce the proportion of adults who are obese from 34.0% to 30.6%. NWS-10.2. Reduce the proportion of children aged 6 to 11 years who are considered obese from 17.4% to 15.7%.
Food and nutrient composition	NWS-14. Increase the contribution of fruits to the diets of the population aged 2 years and older. NWS-15. Increase the variety and contribution of vegetables to the diets of the population aged 2 years and older.
Physical activity	PA–1. Reduce the proportion of adults who engage in no leisure-time physical activity from 36.2% to 32.6%. PA–2.1. Increase the proportion of adults who engage in aerobic physical activity of at least moderate intensity for at least 150 minutes per week, or 75 minutes per week of vigorous intensity, or an equivalent combination from 43.5% to 47.9%. PA–2.3. Increase the proportion of adults who perform muscle-strengthening activities on 2 or more days of the week from 21.9% to 24.1%.

Data adapted from: *Healthy People 2020 (U.S. Department of Health and Human Services).*

1.6 What Are Nutrients?

- **Nutrients** – chemicals in foods that are critical to human growth and function

- There are six groups of essential nutrients found in foods:
  - Carbohydrates
  - Vitamins
  - Fats and oils
  - Minerals
  - Proteins
  - Water
- **Macronutrients** – nutrients required in relatively large amounts (grams)
  - Provide energy
  - Carbohydrates, fats and oils, proteins
- **Micronutrients** – nutrients required in smaller amounts

1.7 Macronutrients Provide Energy

- We measure energy in kilocalories (kcal)
- **Kilocalorie** – amount of energy required to raise the temperature of 1 kg of water by 1°C
- On food labels, "Calorie" actually refers to kilocalories.

1.7.1 Carbohydrates

- Provide 4 kcal per gram.

Functions

Primary energy source of fuel for the body, especially for the brain

Composed of

Chains of carbon, hydrogen, and oxygen

Best Sources

Whole grains, vegetables, fruits

1.7.2 Vitamins

Functions

Important source of energy at rest during low-intensity exercise

Composed of

Carbon, hydrogen, and oxygen

Best Sources

Vegetable oils, butter and dairy products

1.7.3 Fats and oils

- Fats are composed of lipids, molecules that are insoluble in water
- Provide 9 kcal per gram.
- Fats are an important source of fuel for our bodies during times of rest or low-intensity exercise
- Our bodies can store fat which can be used for energy while we are not eating
- Source of fat-soluble vitamins and essential fatty acids

Functions

Support tissue growth, repair and maintenance

Composed of

Amino acids made up of carbon, hydrogen, oxygen and nitrogen

Best Sources

Meats, dairy products, seeds, nuts, legumes

1.7.4 Minerals

Functions

Assist with release of macronutrients; critical to building and maintaining bone, muscle, and blood; support immune function and vision

Composed of

fat-soluble and water-soluble compounds

Best Sources

fruits, vegetables, dairy products, meats

1.7.5 Proteins

- Proteins are chains of amino acids
- Can supply 4 kcal of energy per gram, but are not usually a primary energy source
- Important for:
  - Building cells and tissues

Functions

Assist with fluid regulation and energy production; maintain health of blood and bones; rid body of harmful by-products of metabolism

Composed of

Carbon,

Best Sources

Fruits, vegetables, dairy products, meats

1.7.6 Water

Functions

Ensures proper fluid balance; assists in regulation of nerve impulses, body temperature, and muscle contractions

Composed of

Hydrogen and oxygen

Best Sources

Water, juices, soups, fruits, vegetables

1.8 Micronutrients

- Vitamins and minerals (and phytochemicals/phytonutrients) are known as micronutrients
- **Micronutrients** – Nutrients needed in relatively small amounts to support normal health and body functions
- Neither vitamins not minerals provide kilocalories

1.8.1 Vitamins

- **Vitamins** – organic molecules that assist in regulating body processes
- Vitamins are classified by the way they are absorbed, transported, and stored in the body
  - Fat-soluble vitamins
  - Water-soluble vitamins

Table 1.2: Overview of Vitamins

Type	Names	Distinguishing Features
Fat soluble	A, D, E, K	Soluble in fat Stored in the human body Toxicity can occur from consuming excess amounts, which accumulate in the body
Water soluble	C, B-vitamins (thiamin, riboflavin, niacin, vitamin B_6, vitamin B_{12}, pantothenic acid, biotin, folate)	Soluble in water Note stored to any extent in the human body Excess excreted in urine Toxicity generally only occurs as a result of vitamin supplementation

1.8.2 Minerals

- **Minerals** – inorganic (cannot be broken down) substances required for body processes
  - Minerals include sodium, calcium, iron, potassium, and magnesium
  - Minerals have many different functions, such as fluid regulation and energy production; are essential to bones and blood; and help eliminate harmful by-products of metabolism

Table 1.3: Overview of Minerals

Type	Names	Distinguishing Features
Major Minerals	Calcium, phosphorus, sodium, potassium, chloride, magnesium, sulfur	Needed in amounts greater than 100 mg/day in our diet Amount present in the human body is greater than 5 g (5,000 mg)
Trace minerals	Iron, zinc, copper, manganese, fluoride, chromium, molybdenum, selenium, iodine	Needed in amounts less than 100 mg/day in our diet Amount present in the human body is less than 5 g (5,000 mg)

1.8.3 Water Supports All Body Functions

- Water is an inorganic nutrient that is vital for health and survival
- Water is involved in many bodily processes:
  - fluid balance
  - nutrient transport
  - nerve impulses
  - removal of wastes
  - muscle contractions
  - body temperature

1.9 Determining Nutrient Needs

- Dietary Reference Intakes (DRIs) identify the
  - Amount of a nutrient needed to prevent deficiency disease in healthy people
  - Amount of a nutrient that may reduce the risk of chronic disease
  - Upper level of safety for nutrient intake
- DRIs consist of four values
  - Estimated Average Requirement (EAR)
  - Recommended Dietary Allowance (RDA)
  - Adequate Intake (AI)
  - Tolerable Upper Intake Level (UL)

1.9.1 Estimated Average Requirement (EAR)

- The average daily intake level of a nutrient that will meet the needs of half of the healthy people in a particular life stage and gender group
- Used to determine the Recommended Dietary Allowance (RDA) of a nutrient

1.9.2 Recommended Dietary Allowance (RDA)

- The average daily intake level required to meet the needs of 97–98% of health people in a particular life stage and gender group

1.9.3 Adequate Intake (AI)

- Recommended average daily intake level for a nutrient that is assumed to be adequate
- Based on observations and estimates from experiments
- Used when the RDA is not yet established: vitamin D, vitamin K, fluoride, and chromium

1.9.4 Tolerable Upper Intake Level (UL)

- Highest average daily intake level that is not likely to have adverse effects on the health of most people
- Consumption of a nutrient at levels above the UL is not considered safe

1.10 DRIs and Energy

- Two DRIs apply to energy specifically
  - Estimated Energy Requirement (EER)
  - Acceptable Macronutrient Distribution Range

1.10.1 Estimated Energy Requirement (EER)

- Average dietary energy intake to maintain energy balance
- Based on age, gender, weight, height, and level of physical activity

1.10.2 Acceptable Macronutrient Distribution Range (AMDR)

- The range of energy intake from carbohydrate, fat and protein associated with reduced risk of chronic disease
- The range of macronutrient intake that provides adequate levels of essential nutrients

1.11 Interpreting Nutrition Research

- Research involves applying the scientific method
  - Observation and description of a phenomenon
  - Creation of a hypothesis
  - Design of a repeatable experiment
  - Collection, analysis, and interpretation of data
    - Formation of a conclusion, or proposal of an alternative hypothesis
  - Development of a theory based on repeated experiments

1.12 Types of Research Studies

- Animal versus human studies
  - Drawbacks: ethical concerns, and results may not apply to humans
- Epidemiological studies
- Observational studies
  - Can only indicate relationships between factors
- Case control studies
- Clinical trials

1.12.1 Clinical Trials

- In clinical trials, an intervention's effect on a certain disease or health condition is tested using two groups: the experimental group and the control group
- Randomized trials
- Single- and double-blind experiments
  - Placebo: an imitation treatment that has no effect, given to the control group in placebo-controlled double-blind randomized clinical trials

1.13 Evaluating Nutrition-Related Claims

- Ask these questions to determine scientific validity:
  - Who is reporting the information?
    - What are their credentials?

  - Who conducted the research and who paid for it?
    * Is there a conflict of interest?
- Is the report based on reputable research studies?
  - Was there a control and an experimental group?
  - Was the sample size large enough to rule out chance variation?
  - Was a placebo effectively administered?
  - Was it a double-blind study?
- Is the report based on testimonials?
- Are the claims too good to be true?

1.14 Determining a Website's Reliability

Look at:

- The website sponsors' credentials
- Whether the date of the website is recent
- The Internet address: ".gov", ".edu" and ".org" are generally considered reliable

1.15 Whom Can You Trust?

- Trustworthy experts are educated and credentialed
  - Registered dietitian (RD)
  - Licensed dietitian
  - Nutritionist with credentials and experience
  - Professional with advanced degree(s) in nutrition (MS, MA, or PhD in nutrition)
  - Physician with appropriate expertise in nutrition
- Government agencies are usually trustworthy
  - The Centers for Disease Control and Prevention (CDC) supports two large national surveys
    * National Health and Nutrition Examination Survey (NHANES)
    * Behavioral Risk Factor Surveillance System Survey (BRFSS)
- National Institutes of Health (NIH) focuses on specific areas of research, including cancer; heart, lung, and blood diseases; diabetes; and alternative medicine

- Professional organizations publish cutting-edge nutrition research and information
- These include
  - Academy of Nutrition and Dietetics (AND)
  - American Society for Nutrition (ASN)
  - American College of Sports Medicine (ACSM)
  - The Obesity Society (TOS)

1.16 In Depth: New Frontiers

- **Nutrigenomics** – studies the interactions among genes, the environment, and nutrition
  - Key theory: foods and environmental factors can "switch" some genes on while turning off others
  - Could help in reducing risk of diet-related disease, treating existing conditions through diet, and making personalized nutrition possible
- The human genome is the set of genes making up the DNA in the nucleus of a human cell
- The human microbiome is the set of genes belonging to microorganisms that inhabit the human body
  - Our health is affected by the way they interact with our human cells and genes that are required for digestion
  - GI flora: helpful bacteria in our gastrointestinal (GI) tract
- Functional foods have biologically active ingredients that provide health benefits beyond basic nutrition
  - **Probiotics** – contain live microorganisms that improve the intestinal microbial balance
  - **Prebiotics** – nondigestible food ingredients that stimulate the growth and/or activity of probiotic bacteria
  - **Phytochemicals** – naturally occuring plant compounds believed to have health-promoting effects in humans