Nutrition

ACROSS LIFE STAGES

Second Edition

Melissa Bernstein | Kimberley McMahon

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DEDICATION

Nutrition Across Life Stages is dedicated to my grandmother, Cherie Fine, who passed away at the age of 95 as we were nearing the completion of the first edition of this book. She had a special gift of connecting with people of all ages. Everyone who was fortunate to be a part of her life experienced her warmth, generosity, and wisdom. May her memory be a blessing.

—Melissa Bernstein

Nutrition Across Life Stages is dedicated to my three children. May they always see the value in making good choices for their health and well-being, and that they set good examples for others.

—Kimberley McMahon

FOREWORD

In *Nutrition Across Life Stages*, Melissa Bernstein and Kimberly McMahon take us across the life cycle with scientific clarity, covering the intersection between nutrition and health from preconception to adolescence to older adulthood. Over the course of this whirlwind trip, the authors raise insightful questions vital to the study of Life Cycle Nutrition. What are the benefits and disadvantages of iron supplements at different stages of life? Can being overweight affect a child's health? Why is it important for a woman to take folic acid before she becomes pregnant? The authors discuss topics beyond how diet, nutrients, and foods impact health at every stage of life. For example, which substances found in the home or workplace can make it more difficult for a woman to become pregnant, or what social factors are needed to support healthy aging for an older adult? Conditions throughout the life cycle are reviewed in detail with practical case studies and examples.

Bernstein and McMahon are particularly good at citing the latest studies to show the consequences of dietary decisions. Vitamin D deficiency, for example, is a major, unrecognized epidemic in adult women of childbearing age and can result in significant health problems in children born to these women. What about adolescents who are strict vegetarians? Can they meet all their nutritional needs?

A very strong and compelling part of the book is the material related to the older adult and geriatric population. The authors expertly discuss the role of nutrition in the management of acute or chronic conditions specific to mature adults, such as drug–nutrient interactions, depression, anorexia of aging, arthritis, osteoporosis, overweight and obesity, and Alzheimer's disease. Given the increased role Registered Dietitian Nutritionists now play in health care for older adults, the latter part of the book becomes a veritable page turner.

Paul Insel, PhD
Stanford University

PREFACE

Welcome to *Nutrition Across Life Stages*! This text covers topics applicable and relevant for entry-level Nutrition and Dietetics students who are focusing their study on nutritional requirements and challenges during each life stage. As such, *Nutrition Across Life Stages* includes chapters highlighting clinical-, health-, and disease-related topics specific to each age group that provide students with a knowledge and understanding of prevalent nutritional concerns from preconception to advanced age. Throughout, we as authors have striven to incorporate topics of special interest and to break down complex topics into key components to improve student understanding and build their practical knowledge base.

In writing this text, we kept in mind the needs of undergraduate students enrolled in an introductory Life Cycle Nutrition course. As such, our aim has been to map to the way these courses are taught in a Nutrition and Dietetics program; however, we hope nursing and health professionals programs as well as programs that offer nutrition certification will also find this book a good fit.

The Goal of this Text

Good nutrition is a critical component at every stage of life, from preconception to end-of-life care. The maintenance of good health for all ages requires approaches that recognize multiple levels of influence on the individual and the impact of social, cultural, environmental, organizational, and medical factors. At any given age, there are significant challenges to healthy eating, especially for those affected by chronic conditions, physical limitations, and financial constraints; those who are racial and ethnic minorities; and those who reside in potentially challenging environments. More attention, resources, and nutrition expertise are needed to meet the food and nutrition requirements of vulnerable populations so that they can live healthfully with a good quality of life at every stage of life. Healthcare providers have opportunities to develop care plans that can help individuals of all ages promote personal well-being. Providing targeted and personalized nutrition guidance, services, and programs is vital to making a positive impact in the lives of all people.

As authors on two well-established introductory nutrition texts—*Nutrition* and *Discovering Nutrition*—we aim to keep our texts current and engaging for instructors and students alike. Having taught Life Cycle Nutrition ourselves, we saw a need for a fresh approach to this material. Learning about the varying needs and challenges of different age groups begins with a solid foundation in nutrition basics, before then applying that knowledge to different ages, environments, challenges, and medical conditions. By using an approach that begins with normal nutrition and then considers alterations in nutritional needs and challenges resulting from common diseases and conditions that affect individuals at various ages, *Nutrition Across Life Stages* strives to keep students engaged and thinking critically in order to creatively apply their knowledge to problem-solving challenging real-life scenarios. Our aim is to make learning the material approachable, interesting, relevant, and fun without feeling overwhelming. We believe *Nutrition Across Life Stages* accomplishes this by presenting fresh pedagogy and engaging, student-centered learning activities that appeal to various learning styles.

Nutrition Across Life Stages facilitates active and participatory learning by providing many opportunities for classroom discussion and active engagement, presenting students with a multidimensional approach to the material. Discussion prompts and learning activities embedded throughout the text are designed to facilitate personalized teacher interaction with students. In lieu of rote lecturing, these endeavor to create a dynamic learning experience, whether they're used in a traditional classroom, as part of an online curriculum, or some hybrid of the two.

In crafting this text, we wanted to avoid categorizing older adults by chronological age. As a result, this is the first Life Cycle Nutrition text to break out coverage of older adults across three unique chapters. Chapter 14, "Older Adult Nutrition," discusses normal nutrition for otherwise healthy older adults, while Chapter 15, "Geriatric Nutrition," highlights topics relevant to those who are frail, ill, and whose health is failing. Finally, Chapter 16, "Nutrition for Health and Disease in Older Adults and Geriatrics," addresses common health-related situations that require additional nutrition consideration.

Organization of the Text

We wrote *Nutrition Across Life Stages* with the typical Life Cycle Nutrition course in mind—that is, one focused on normal nutrition. *Nutrition Across Life Stages* begins in Chapter 1 with an overview of normal nutrition, national nutrition guidelines, and recommendations. Subsequent chapters then follow a consistent pattern: first, normal nutritional needs at two to three life stages are presented, followed by a chapter discussing the nutritional

implications of health and common conditions and diseases, their consequences, and treatment for those life stages. The text reviews the life cycle progressively by breaking it into the following stages:

- Preconception
- Pregnancy
- Lactation
- Infancy
- Early childhood
- Preadolescence
- Adolescence
- Adulthood
- Older adulthood
- Geriatrics

The last two categories aren't necessarily chronological, but rather more categorically based on health status in old age, an organizing principle unique to this text.

Features and Benefits

Nutrition Across Life Stages incorporates a strong array of pedagogical features, including several that contain a strong visual component. These are deployed consistently across chapters, ensuring a uniform learning experience for the student.

Each chapter begins with a brief Chapter Outline, along with a series of Learning Objectives that establish what the chapter seeks to convey to the reader. Toward the beginning of each chapter, a Case Study is also introduced that is directly relevant to the content being discussed. These case studies are progressive and revisited throughout the chapter; questions tied to each Case Study have been included that can be used for self-study or as part of a classroom assignment.

Within the chapters, several boxed features appear. These include the following:

- *The Big Picture* is an enhanced visual feature that incorporates key photos, diagrams, graphs, and illustrations to help visual learners by highlighting key concepts and breaking down tough concepts to their constituent components.
- *News You Can Use* presents topics of special interest to students, usually tied to current research in nutritional science.
- *Let's Discuss* provides topics that are meant to trigger engaging and insightful conversations in the classroom.

Each chapter concludes with a Learning Portfolio that contains the following:

- Bulleted Chapter Summary
- Key Terms
- Discussion Questions
- Activities
- Study Questions
- Weblinks

The Complete Learning Package

Nutrition Across Life Stages provides instructors with a full suite of resources, including:

- Test Bank, containing more than 200 questions
- Slides in PowerPoint format, featuring more than 800 slides
- Image Bank, collecting photographs and illustrations that appear in the text
- Instructor's Manual, including an array of useful instructor tools:
  - ❍ Learning Objectives
  - ❍ Chapter Outlines
  - ❍ Answers to in-text Case Study questions
  - ❍ Answers to in-text Study Questions
  - ❍ Answers to in-text Discussion Questions

What's New to this Edition

- Nutrition is constantly changing and our understanding of the role of nutrients and dietary patterns in health and diseases is always evolving. We've gone to great lengths to incorporate the most current evidence-based research available, including the newest edition of the *Dietary Guidelines for Americans, 2020–2025*, which for the first time emphasizes healthy dietary patterns at every stage of life
- Updated and expanded discussions on nutrition-related conditions and diseases throughout the life cycle
- Updated and expanded discussions on common nutrition considerations during each stage of life

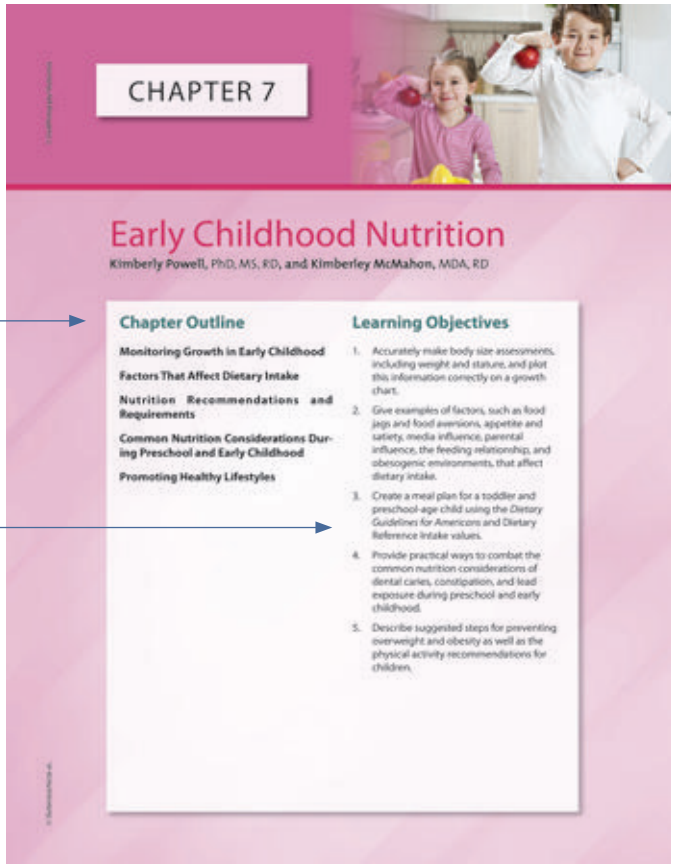
Wishing you good health at every age!
Melissa Bernstein
Kimberley McMahon

THE PEDAGOGY

Nutrition Across Life Stages incorporates an array of pedagogical features in order to facilitate active student engagement and class discussion.

- The **Chapter Outline** at the beginning of each chapter gives students a preview of topics that will be covered.

- **Learning Objectives** focus students on the key concepts of each chapter and the material they will learn.


CHAPTER 7

Early Childhood Nutrition

Kimberly Powell, PhD, MS, RD, and Kimberley McMahon, MDA, RD

Chapter Outline

Monitoring Growth in Early Childhood

Factors That Affect Dietary Intake

Nutrition Recommendations and Requirements

Common Nutrition Considerations During Preschool and Early Childhood

Promoting Healthy Lifestyles

Learning Objectives

1. Accurately make body size assessments, including weight and stature, and plot this information correctly on a growth chart.
2. Give examples of factors, such as food jags and food aversions, appetite and satiety, media influence, parental influence, the feeding relationship, and obesogenic environments, that affect dietary intake.
3. Create a meal plan for a toddler and preschool-age child using the *Dietary Guidelines for Americans* and Dietary Reference Intake values.
4. Provide practical ways to combat the common nutrition considerations of dental caries, constipation, and lead exposure during preschool and early childhood.
5. Describe suggested steps for preventing overweight and obesity as well as the physical activity recommendations for children.

- A **Case Study** is introduced at the beginning of each chapter, illustrating how topics discussed in the text might appear in real life. These case studies are revisited throughout the chapter, building in concert with the foundational material. As the case study progresses, questions are incorporated to encourage active student engagement with the scenarios.

- **Key Terms** are in boldface type the first time they are mentioned, with definitions appearing in the end-of-chapter Learning Portfolio.


Case Study

Carla is a 14-year-old girl who lives with her mother and 17-year-old brother. She has had annual preventive health care from birth and has grown along average height and weight trends. Her medical history includes only seasonal allergies. Carla's parents divorced when she was very young, and she does not see her father. Her mother has a full-time job and is comfortably able to provide food for the family. Carla is a strong student at her public middle school and has enjoyed participating in team sports for the past several years.

Adolescence is a period of great physical, psychological, and emotional development that occurs from 10 to 19 years old.[1] Perhaps the simplest way to define its endpoints is the entrance of a child and emergence of a young adult. Changes over this near decade of life are constant, with internal influences such as hormonal shifts and external factors such as family, school, media, and daily social interactions. Adequate nutrition is necessary for adolescents to achieve their growth potential, and with this period of development comes increased

1960s, this scale is a well-accepted method of evaluation in adolescent health care.[4,5] A child with an SMR of stage 1 has no visual signs of change, which indicates prepuberty, whereas SMR stage 5 is reached once adult characteristics have developed.[4,5]

It has been suggested that leptin is one of the hormones responsible for progression of puberty. Leptin is predominantly made in fat cells and plays a role in immunity, reproduction, our neuroendocrine system, and energy homeostasis.[6] Body fat has been proposed as a large determinant of pubertal events, and serum leptin concentrations are correlated with body fat content. Higher concentrations of serum leptin have been observed in girls who have increased body fat and earlier onset of puberty.[7]

Gonadarche is the first visual sign of puberty and heralds the child's transition from SMR stage 1 to stage 2. Boys generally reach this milestone about 2 years after girls. Gonadarche in girls is marked by breast budding—also called **thelarche**—and usually occurs between 9 and 13 years old.[8] In boys, gonadarche is marked by an increase in testicular size. On average for boys, this occurs at 11.5 to 12 years old,[9] with the vast majority of boys beginning pubertal genital development by age 13.[3]

- Each section begins with a **Preview** statement, giving the reader a sense of what content to expect.

Preview Physical and psychological developments occur side by side during adolescence, though each can progress at different paces. This section discusses these two formative processes.

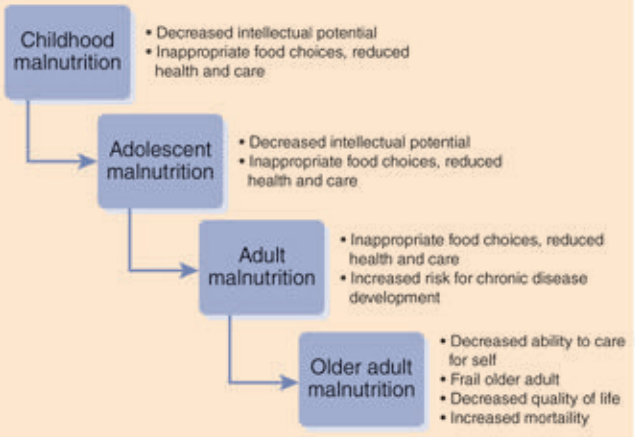
- **Recap** boxes summarize each section and provide open-ended questions, encouraging students to reflect on what they've just read.

Recap The adolescent years are a time of rapid physical change, and adequate nutritional intake is needed to support the changes taking place. Adolescents' diets have been shown to have several shortcomings, and close attention should be paid to ensure they are meeting nutritional needs for continued growth and development.

1. Which micronutrients are most commonly lacking in the adolescent's diet?
2. Which micronutrients are important for bone health and development?
3. You have a 25-kg female client and are asked to calculate her maintenance fluid needs. What equation would you use and how much fluid in milliliters does she need per day?

- **The Big Picture** feature incorporates key photos, diagrams, and illustrations, highlighting key ideas and making difficult concepts easier to understand.

The Big Picture



Adult malnutrition starts in childhood.

News You Can Use

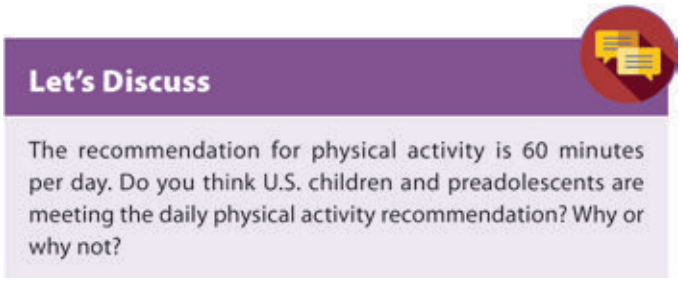
Use of Federal Nutrition Assistance at Farmers' Markets

Farmers' markets around the country accept WIC vouchers as a way to increase fruit and vegetable intake, decrease food insecurity, and improve overall diet of WIC participants. Congress established the WIC Farmers' Market Nutrition Program (FMNP) in 1992 as an intervention strategy to allow WIC participants to use vouchers at local farm stands and farmers' markets. In 2017, 49 states, territories, and Indian Tribal Organizations operated this program, and over 1.7 million WIC participants received WIC FMNP benefits. Participants can receive anywhere from $10 to $30 per year to use for locally grown WIC-approved foods. Nearly 17,000 farmers, 3,300 farmers' markets, and 2,400 roadside stands were authorized to accept WIC FMNP benefits, resulting in over $18.5 million in revenue among local farmers in 2017. Low-income mothers may also be eligible to participate in SNAP, which allows for the purchase of SNAP-approved items at numerous farmers' markets across the country.

Data from U.S. Department of Agriculture Food and Nutrition Service. WIC farmers market nutrition program. Updated July 2018. Accessed February 16, 2021. https://www.fns.usda.gov/fmnp/wic-farmers-market-nutrition-program

- The **News You Can Use** feature presents topics of special interest to students, usually anchored in current nutritional science research.

- The **Let's Discuss** feature provides prompts for class discussion.



Let's Discuss

The recommendation for physical activity is 60 minutes per day. Do you think U.S. children and preadolescents are meeting the daily physical activity recommendation? Why or why not?

- Each chapter concludes with a **Learning Portfolio**, assembling an array of student-centered resources and activities. The Learning Portfolio opens with a **Chapter Summary** to highlight key concepts.

Learning Portfolio

Chapter Summary

Benefits of Breastfeeding

- Breastfeeding rates have increased over the past 30 years although they remain below goals set by health organizations.
- Benefits of breastfeeding stretch well beyond basic nutrition.
- Breastfeeding can protect an infant from certain diseases, both in childhood and as an adult.
- Breastfeeding decreases the risk of infant death and disease and enhances comfort and stability for infants.
- Breastfeeding decreases cancer rates among mothers and reduces the likelihood of metabolic disease for both infants and mothers.
- Individual and societal benefits of breastfeeding are significant and breastfeeding rates are included in Healthy People 2030.

The Physiology of Lactation

- Structures in the breast produce human milk for an infant.
- Hormones enhance development of the mammary gland and prepare the mammary system for milk production.
- Colostrum, the first milk produced after birth, is uniquely nutritive and significantly important.

Human Milk Composition

- Human milk is a dynamic fluid that contains bioactive factors and nutrients needed for infant health and development.
- The composition of breastmilk changes through the course of lactation, providing the nutrients required for infant growth.

Nutrition Recommendations and Requirements During Lactation

- Although somewhat dependent on the mother's diet, the carbohydrate, protein, fat, calcium, and iron contents in breastmilk do not change much. However, a mother whose diet is deficient in thiamin, vitamin A, and vitamin D produces less of these in her milk.
- All infants require vitamin D and K supplementation. DHA and polyunsaturated fatty acids may need to be supplemented in order for breastmilk to achieve optimal levels.
- A satisfactory gain in the infant's weight is the best way to judge the adequacy of the diet of the infant.
- During lactation, mothers' nutrition requirements increase to support the increased maternal metabolism associated with breastmilk production and fetal and infant growth.
- Although the quantity of breastmilk is largely determined by demand from the breastfeeding infant, inadequate protein and calorie intake of the lactating woman may contribute to milk quality; therefore, it is essential for women to maintain an adequate and well-balanced diet throughout the course of lactation.
- Vegetarians and vegans can successfully breastfeed but require careful dietary monitoring of both infant and mother to ensure nutrition adequacy.

Feeding in Early Infancy

- Although breastfeeding is a natural activity, both babies and mothers need to learn how to nurse.
- A well-latched infant creates the right amount of compression and suction to remove milk effectively from the milk ducts.
- Poor latch can result in engorgement, mastitis, decreased milk supply, plugged ducts, and nipple pain.

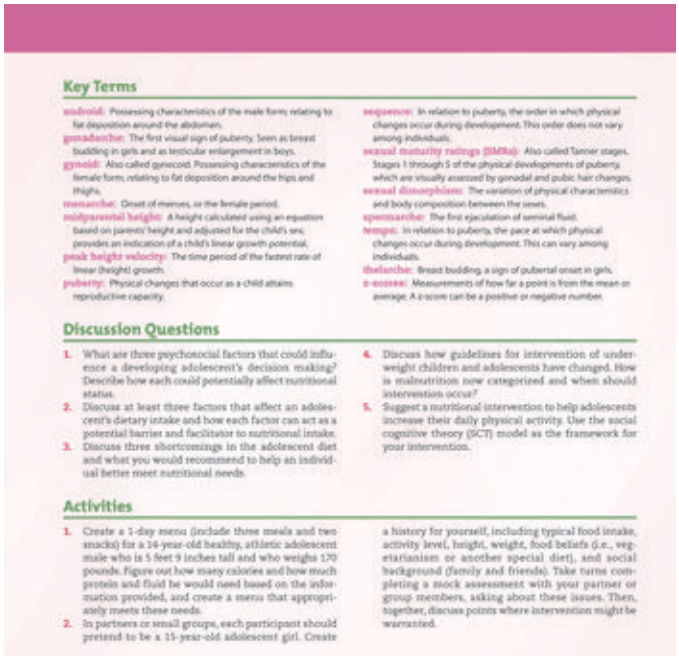
Nutrition and Lactation Outcomes

- Barriers to breastfeeding include lack of knowledge, lack of social support, perceived lack of milk supply, poor infant growth, maternal working environment, and having difficulties or pain with breastfeeding.
- Few contraindications for breastfeeding exist, however, management of conditions that do contraindicate breastfeeding should be considered on an individual basis.
- Neonatal jaundice, poor weight gain, and use of various prescription medications may be managed successfully to permit continued breastfeeding.
- Most medications, including those for mental health conditions, are compatible with breastfeeding, but mothers should consult with their doctor and pediatrician prior to exposing an infant to medications.

Support and Education for Breastfeeding

- The combination of prenatal and postnatal promotion activities provides the most increase in exclusive breastfeeding.

- Each chapter ends with an inventory of **Key Terms** and their definitions; all terms and definitions are also found in the end-of-text Glossary.



Key Terms

android: Possessing characteristics of the male form; relating to fat deposition around the abdomen.
gonadarche: The first visual sign of puberty. Seen as breast budding in girls and as testicular enlargement in boys.
gynoid: Also called gynecoid. Possessing characteristics of the female form; relating to fat deposition around the hips and thighs.
menarche: Onset of menses, or the female period.
midparental height: A height calculated using an equation based on parents' height and adjusted for the child's sex; provides an indication of a child's linear growth potential.
peak height velocity: The time period of the fastest rate of linear (height) growth.
puberty: Physical changes that occur as a child attains reproductive capacity.
sequence: In relation to puberty, the order in which physical changes occur during development. This order does not vary among individuals.
sexual maturity ratings (SMRs): Also called Tanner stages. Stages 1 through 5 of the physical developments of puberty, which are visually assessed by gonadal and pubic hair changes.
sexual dimorphism: The variation of physical characteristics and body composition between the sexes.
spermarche: The first ejaculation of seminal fluid.
tempo: In relation to puberty, the pace at which physical changes occur during development. This can vary among individuals.
thelarche: Breast budding, a sign of pubertal onset in girls.
z-scores: Measurements of how far a point is from the mean or average. A z-score can be a positive or negative number.

- **Discussion Questions** encourage students to probe deeper into the chapter content, making connections and gaining new insights.

Discussion Questions

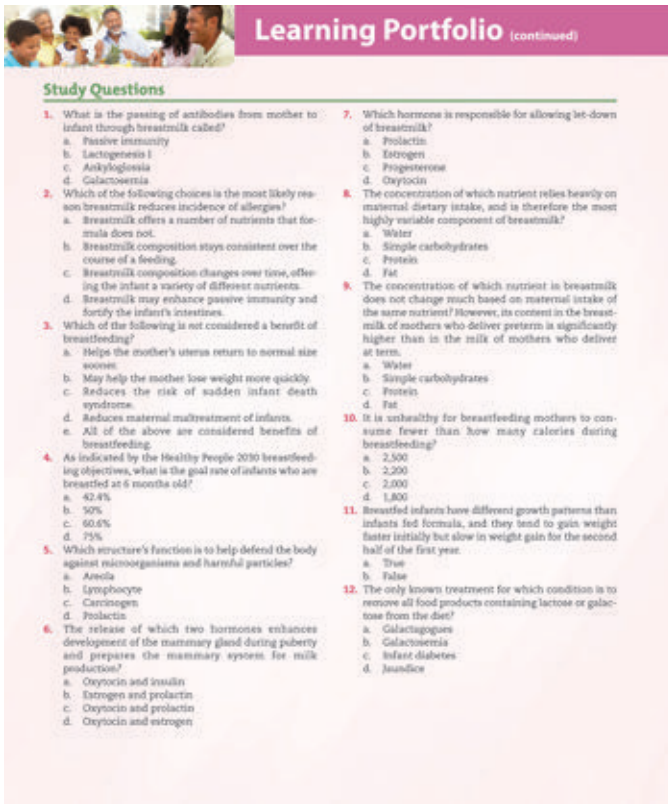
1. What are three psychosocial factors that could influence a developing adolescent's decision making? Describe how each could potentially affect nutritional status.
2. Discuss at least three factors that affect an adolescent's dietary intake and how each factor can act as a potential barrier and facilitator to nutritional intake.
3. Discuss three shortcomings in the adolescent diet and what you would recommend to help an individual better meet nutritional needs.
4. Discuss how guidelines for intervention of underweight children and adolescents have changed. How is malnutrition now categorized and when should intervention occur?
5. Suggest a nutritional intervention to help adolescents increase their daily physical activity. Use the social cognitive theory (SCT) model as the framework for your intervention.

- Suggested **Activities** encourage students to put theory into practice.

Activities

1. Create a 1-day menu (include three meals and two snacks) for a 14-year-old healthy, athletic adolescent male who is 5 feet 9 inches tall and who weighs 170 pounds. Figure out how many calories and how much protein and fluid he would need based on the information provided, and create a menu that appropriately meets these needs.
2. In partners or small groups, each participant should pretend to be a 15-year-old adolescent girl. Create a history for yourself, including typical food intake, activity level, height, weight, food beliefs (i.e., vegetarianism or another special diet), and social background (family and friends). Take turns completing a mock assessment with your partner or group members, asking about these issues. Then, together, discuss points where intervention might be warranted.

- **Study Questions** provide multiple-choice and true/false questions at the end of each chapter, testing students' knowledge of the information covered in the text. These can be utilized for student self-assessment or as homework material.



Learning Portfolio (continued)

Study Questions

1. What is the passing of antibodies from mother to infant through breastmilk called?
   a. Passive immunity
   b. Lactogenesis I
   c. Ankyloglossia
   d. Galactosemia
2. Which of the following choices is the most likely reason breastmilk reduces incidence of allergies?
   a. Breastmilk offers a number of nutrients that formula does not.
   b. Breastmilk composition stays consistent over the course of a feeding.
   c. Breastmilk composition changes over time, offering the infant a variety of different nutrients.
   d. Breastmilk may enhance passive immunity and fortify the infant's intestines.
3. Which of the following is not considered a benefit of breastfeeding?
   a. Helps the mother's uterus return to normal size sooner.
   b. May help the mother lose weight more quickly.
   c. Reduces the risk of sudden infant death syndrome.
   d. Reduces maternal maltreatment of infants.
   e. All of the above are considered benefits of breastfeeding.
4. As indicated by the Healthy People 2030 breastfeeding objectives, what is the goal rate of infants who are breastfed at 6 months old?
   a. 42.4%
   b. 50%
   c. 60.6%
   d. 75%
5. Which structure's function is to help defend the body against microorganisms and harmful particles?
   a. Areola
   b. Lymphocyte
   c. Carcinogen
   d. Prolactin
6. The release of which two hormones enhances development of the mammary gland during puberty and prepares the mammary system for milk production?
   a. Oxytocin and insulin
   b. Estrogen and prolactin
   c. Oxytocin and prolactin
   d. Oxytocin and estrogen
7. Which hormone is responsible for allowing let-down of breastmilk?
   a. Prolactin
   b. Estrogen
   c. Progesterone
   d. Oxytocin
8. The concentration of which nutrient relies heavily on maternal dietary intake, and is therefore the most highly variable component of breastmilk?
   a. Water
   b. Simple carbohydrates
   c. Protein
   d. Fat
9. The concentration of which nutrient in breastmilk does not change much based on maternal intake of the same nutrient? However, its content in the breastmilk of mothers who deliver preterm is significantly higher than in the milk of mothers who deliver at term.
   a. Water
   b. Simple carbohydrates
   c. Protein
   d. Fat
10. It is unhealthy for breastfeeding mothers to consume fewer than how many calories during breastfeeding?
    a. 2,500
    b. 2,200
    c. 2,000
    d. 1,800
11. Breastfed infants have different growth patterns than infants fed formula, and they tend to gain weight faster initially but slow in weight gain for the second half of the first year.
    a. True
    b. False
12. The only known treatment for which condition is to remove all food products containing lactose or galactose from the diet?
    a. Galactogogues
    b. Galactosemia
    c. Infant diabetes
    d. Jaundice

- **Weblinks** direct students to online resources relevant to the chapter content.

Weblinks

- **Ameda Breastfeeding**
  https://www.ameda.com/breastfeeding-guide
  Provider of breast pumps and breastfeeding supplies as well as education on how to breastfeed under normal and special circumstances.
- **Galactosemia Foundation**
  http://www.galactosemia.org/
  Research organization that provides education resources for infants with galactosemia.
- **International Lactation Consultant Association**
  https://www.ilca.org
  Provides links to lactation care providers by geographical area as well as up-to-date statistics, education, and advice on breastfeeding.
- **Human Milk Banking Association of North America**
  https://www.hmbana.org
  Discusses the process of milk banking and provides locations for donation and purchase of breastmilk.
- **LactMed**
  https://www.ncbi.nlm.nih.gov/books/NBK501922/
  Provides information on medication interactions with breastfeeding.
- **La Leche League International**
  https://www.llli.org/
  A member-based organization that provides peer support and free resources for nursing mothers.
- **Medela Breastfeeding University**
  https://www.medela.us/breastfeeding/articles
  Provider of breast pumps and breastfeeding supplies as well as education on how to breastfeed under normal and special circumstances.
- **Stanford Breastfeeding support videos**
  http://med.stanford.edu/newborns/professional-education/breastfeeding.html
  Provides instruction on how to breastfeed under normal and special circumstances.
- **USDA Food and Nutrition Service**
  http://www.fns.usda.gov/
  Main site for food assistance in the United States. Includes links to WIC and other peer support programs for breastfeeding mothers.
- **WHO Baby-Friendly Hospital Initiative**
  https://www.who.int/nutrition/bfhi/en/
  Discusses healthcare factors related to breastfeeding success and provides training and direction in how to improve lactation services in healthcare facilities.
- **WHO Growth Standards for Breastfed Infants**
  http://www.cdc.gov/growthcharts/who_charts.htm
  Growth charts derived for breastfed infants only. These charts reflect the unique growth patterns discussed in the chapter.

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CHAPTER 1

Nutrition Overview

Kimberley McMahon, MDA, RD

Chapter Outline

The Science of Nutrition

Micronutrients

Nutrition Assessment

The *Dietary Guidelines for Americans, 2020–2025*

Physical Activity Guidelines

The Obesity Epidemic May Be Decreasing Life Expectancy

Learning Objectives

1. Describe four basic principles of healthy eating.
2. Describe how Dietary Reference Intakes are used to help determine needs of healthy individuals.
3. Describe each macronutrient, its function in the body, and food sources.
4. List primary functions and common food sources of major and trace minerals.
5. List the various functions of water in the body.
6. List and define what is considered the ABCDs of nutrition assessment.
7. List the four overarching guidelines and the key recommendations outlined in the *Dietary Guidelines for Americans, 2020–2025.*
8. Explain the importance of following the suggestions set forth in the *Physical Activity Guidelines* for Americans.
9. Explain how the current obesity epidemic may be decreasing life expectancy in the United States.

Case Study

Consider your own lifestyle and nutrition choices. Do you make healthy food and activity choices most of the time? What components of your lifestyle could use some adjustments? What components of your lifestyle are you proud of because you know these are steps to being healthy? Throughout this chapter, you will have the opportunity to evaluate components of your lifestyle, which will help you to establish nutrition and activity goals.

The human body has varying nutrition requirements as it moves through different stages of life, and, regardless of which life stage an individual is in, the same fundamental concepts build the foundation for adequate nutrition. As we study nutrition needs and recommendations throughout life, keep in mind these basic principles, which are important for healthy eating regardless of age:

- An individual's poor nutrition status can result from either inadequate or excessive levels of nutrition intake, contributing to the possibility of poor nutrition influencing the development of certain chronic diseases.

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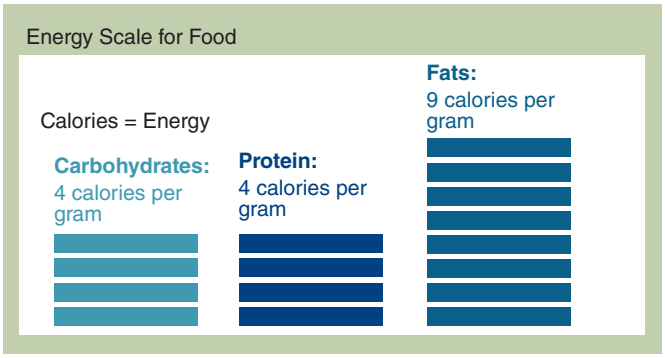
- Energy produced by the body, which is needed for a variety of functions, is provided by food and drink in the form of carbohydrates, protein, and fats (macronutrients), with each macronutrient providing a specific amount of energy measured in calories.



- Energy needs vary from person to person and depend on such factors as basal metabolic rate (BMR) and level of activity.

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- There are many components of healthy eating, with adequacy, balance, variety, and moderation in food choices being key characteristics.

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- A high-quality dietary pattern can promote health, achieve nutrient adequacy and energy balance, and reduce the risk of diet-related chronic diseases.

From the time of conception to the time of death, the body relies on nutrients provided by foods we eat and drink in order to maintain life. Food provides information to the body, signaling basic biological functions and normalizing physiological processes.[1] During early life, growth, development, and maintenance of the body depend on a correct supply of all the necessary nutrients. Later in life, when growth and development are complete, the body depends on its food supply more for maintenance and repair. Although nutrient needs vary over the lifespan, early food preferences influence later food choices. Food habits established during childhood and those that carry into adolescence and adulthood affect overall health and well-being. The absence or existence of chronic disease develops over time; therefore, what we eat today affects not only how we feel today but also our overall health.

Case Study

Think about how you eat. Do you usually select the same foods each day, or do you include a variety of foods and drinks? Challenge yourself to try one new protein and one new fruit or vegetable this week. Consider adding more variety to your overall diet.

The Science of Nutrition

Preview Human physical survival depends on an intake of nutrients provided by both food and water. These nutrients are varied and plentiful, offering both advantages and disadvantages to individual health and well-being. Optimal nutrition is obtained by giving ourselves the best possible intake of nutrients to aid the body in being as healthy and free of illness as possible. Human growth and health rely not only on nutrients and other dietary factors (such as phytochemicals, carotenoids, fiber, and lignans) but also the calories that food and drink provide.

Think about the foods that you eat. Each food consists of a number of different nutrients, and generally foods are eaten in combination with other foods. Therefore, you do not consume nutrients or foods in isolation, but rather in various combinations over time. The elements and nutrients one obtains from eating food make up a person's dietary intake and ultimately their **dietary patterns**. Additionally, there is growing evidence that components of a dietary pattern may have an interactive, synergistic, and potentially cumulative relationship that can predict overall health status and disease risk more fully than can individual foods or nutrients.[2] From newborn to older adult, each stage of life offers opportunities for dietary intake that are unique from every other stage, thus satisfying nutrient needs as they change over time. In addition, early food preferences influence later food choices and subsequently overall health. For example, the health consequences of a fetus, both positive and negative, start with the dietary intake of the expecting mother, followed by feeding behavior in infancy and early childhood. Nutrition exposures early in life have emerged as an etiological risk factor associated with later-life chronic disease risk.[2] Diet quality tends to be higher for young children, declines in adolescence, and again improves somewhat for older adults.[2]

Essential and Nonessential Nutrients

Nutrients are categorized as either **essential** or **nonessential** according to whether the body must obtain them through diet or can synthesize them. Essential nutrients are required for normal physiological function and cannot be synthesized by the body; therefore, they must be obtained from the diet. Essential nutrients include water, minerals, certain vitamins, amino acids, fats, and carbohydrates. (See TABLE 1.1.) The body requires nonessential nutrients to support body processes; however, the body can manufacture these nutrients (although some nutrients such as vitamin D can also come from food sources) and therefore they do not have to be obtained from food sources. Some nonessential amino acids can become essential under certain conditions (such as during periods of high stress, or certain disease states). These amino acids can be referred to as conditionally essential. Nonessential and conditionally essential amino acids are

Table 1.1

Essential Nutrients and Their Functions

Essential Nutrient	Function
Carbohydrates	Provide energy and are the main source of fuel needed for physical activity, brain function, and operation of the organs.
Protein • Essential amino acids include histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine.	The major structural component of cells and responsible for the building and repair of body tissues. Proteins are broken down into amino acids. Nine of the 20 amino acids are essential.

Essential Nutrient	Function
Fat	An energy source; increases the absorption of fat-soluble vitamins; helps to maintain core body temperature.
Vitamins and Minerals	
• Vitamin A	• Helps to maintain healthy skin, teeth, skeletal and soft tissue, mucous membranes, and skin; promotes vision.
• B vitamins	• Energy production, immune function, and iron absorption.
• Vitamin C	• Strengthens blood vessels and gives skin its elasticity; antioxidant function and iron absorption.
• Vitamin D	• Bone health.
• Vitamin E	• Blood circulation and protection from free radicals.
• Vitamin K	• Blood coagulation.
• Folic acid	• Cell renewal and preventing birth defects during pregnancy.
• Calcium	• Promotes healthy teeth and bones.
• Iron	• Maintains healthy blood.
• Zinc	• Immunity, growth, and fertility.
• Chromium	• Helps glucose enter cells.
• Chloride	• Needed for proper fluid balance, and a component of stomach acid.
• Copper	• Part of many enzymes; needed for iron metabolism.
• Iodine	• Found in thyroid hormone, which helps regulate growth, development, and metabolism.
• Magnesium	• Found in bones; needed for making protein, muscle contraction, nerve transmission, immune system health.
• Manganese	• Part of many enzymes.
• Molybdenum	• Part of many enzymes.
• Phosphorus	• Important for healthy bones and teeth; found in every cell; part of the system that maintains acid–base balance.
• Potassium	• Needed for proper fluid balance, nerve transmission, and muscle contraction.
• Selenium	• Antioxidant.
• Sodium	• Needed for proper fluid balance, nerve transmission, and muscle contraction.
Water	Used to regulate body temperature and maintain other body functions.

News You Can Use

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Sodium is necessary for proper fluid balance, nerve transmission, and muscle contraction. Because excess dietary sodium intake has been linked to elevations in blood pressure, it is recommended that Americans limit their intake of sodium to no more than 2,300 mg per day. Salt sensitivity of blood pressure varies widely, but certain subgroups of the population tend to be more salt-sensitive.[3] The current American lifestyle makes it difficult not to consume too much sodium. The average intake for American males is 4,172 mg per day, and females is 3,062 mg per day. It is not just adults who are eating too much sodium; children and teens also consume more than is recommended. Limit sodium intake by eating less fast food, do not add salt while cooking or to food after it has been prepared, and be aware of the amount of sodium in canned foods, restaurant foods, and drinks.

Data from Farquhar WB, Edwards DG, Jurkovitz CT, Weintraub WS. Dietary sodium and health: more than just blood pressure. *J Am Coll Cardiol*. 2015;65(10):1042–1050. doi: 10.1016/j.jacc.2014.12.039

listed in TABLE 1.2. Additionally, **phytochemicals**, which are substances found in plants, are not considered essential, yet they play important roles in maintaining health and well-being.

Dietary Reference Intakes

Estimated needs of all nutrients are not the same for every individual. **Dietary Reference Intakes (DRIs)** are developed and published by the Institute of Medicine and represent the most current scientific knowledge on nutrient needs of healthy individuals. These suggested nutrient intake values are intended to serve as a guide for good nutrition and are specific based on age, gender, and life stage. DRIs cover more than 40 nutrient substances and include the following specific recommendations: **Recommended Dietary Allowance (RDA)**, **Adequate Intake (AI)**, **Estimated Average Requirement (EAR)**, and **Tolerable Upper Intake Level (UL)**.[4] (See FIGURE 1.1.)

Table 1.2

Nonessential and Conditionally Essential Amino Acids

- Alanine
- Arginine*
- Asparagine
- Aspartic acid
- Cysteine*
- Tyrosine*
- Glutamic acid
- Glutamine*
- Glycine
- Proline*
- Serine

*Conditionally essential amino acids

- *Recommended Dietary Allowance (RDA):* Average daily intake level that is sufficient to meet the nutrient requirements of nearly all (97–98%) healthy individuals in a group.
- *Adequate Intake (AI):* A value based on observed or experimentally determined approximations of nutrient intake by a group of healthy people and used when an RDA cannot be determined.
- *Estimated Average Requirements (EARs):* Nutrient intake values that are estimated to meet the requirements of half of the healthy individuals in a group.
- *Tolerable Upper Intake Level (UL):* The highest level of daily nutrient intake that is likely to pose no risk of adverse side effects to almost all individuals in the general population. As intake increases above the UL, the risk of adverse effects increases.

All values given for the DRIs represent the quantity of the nutrient or food component supplied from a diet similar to those consumed in Canada and the United States, and the values apply to a healthy population. Reference intakes are expressed for different life stage groups, and reference weights and heights are used.

Macronutrients Provide Calories (Energy)

A **calorie**, defined as the energy needed to raise the temperature of 1 g of water by 1°C, is the unit used to measure the potential energy in food as it is transferred from its source to the body. The macronutrients carbohydrate, protein, and fat all contribute to the calorie content of food.

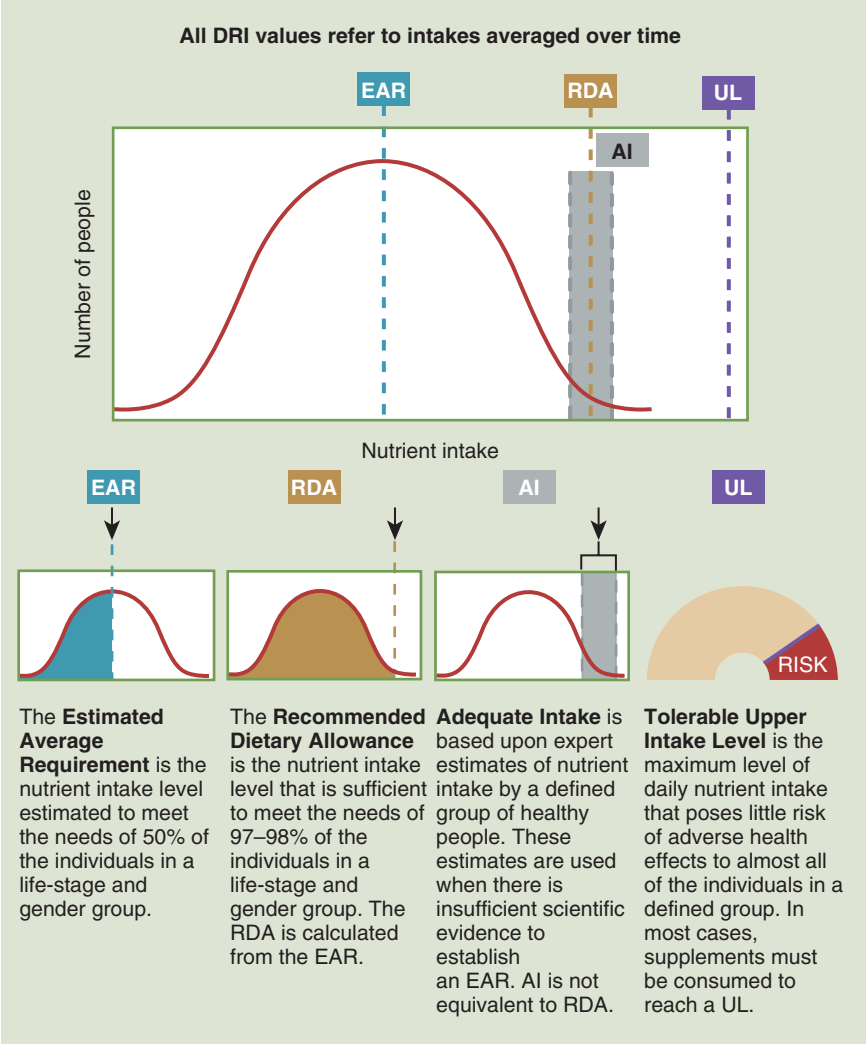
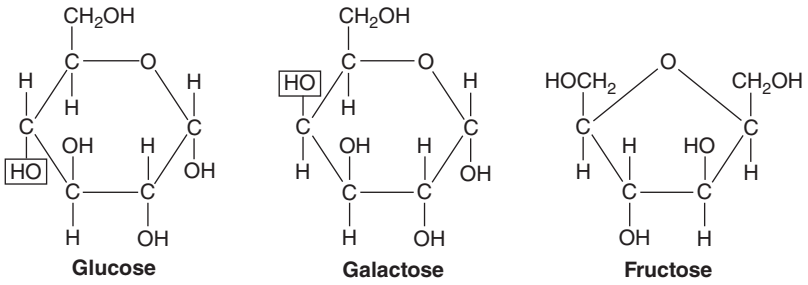


Figure 1.1
Dietary Reference Intakes and average requirements.



The structures of glucose and galactose differ only by the location of the OH on carbon number 4.

Figure 1.2
Chemical structure of the carbohydrates glucose, fructose, and galactose.

Carbohydrates

Carbohydrates are organic compounds that occur in food. These compounds contain carbon, oxygen, and hydrogen and can be broken down to release energy in the body. (See FIGURE 1.2.)

Carbohydrates are the body's preferred source of energy, providing energy to the brain, muscles, and nervous system. In addition, carbohydrates facilitate the metabolism of fat and, when in sufficient supply, ensure that the protein in muscles is not broken down as an energy source. Carbohydrates consumed from food and drinks are broken down into small sugar molecules in the mouth and the small intestine, which then move through the digestive tract and are converted into glucose by the liver to make a usable form of energy for the brain and muscles. Excess carbohydrates are stored by the body in the form of glycogen. The liver and the muscles are storage sites for glycogen. (See FIGURE 1.3.)

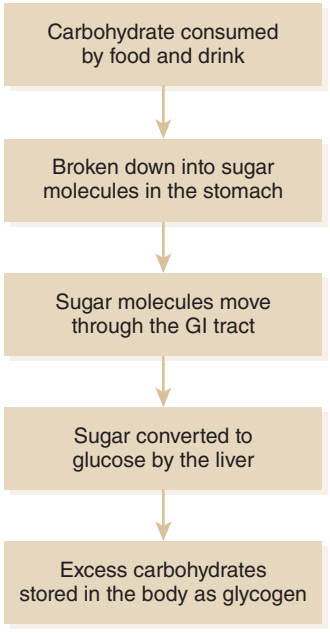


Figure 1.3
Process by which carbohydrates are converted to glucose for energy or to glycogen for storage.

The structure of a carbohydrate determines whether it is a simple or complex carbohydrate. **Simple carbohydrates** are monosaccharides (one simple sugar molecule) and disaccharides (two simple sugar molecules linked together). The most common monosaccharides are glucose, fructose, and galactose. The most common disaccharides are sucrose, maltose, and lactose. The monosaccharides that make up these disaccharides are as follows:

- Glucose + Fructose = Sucrose (table sugar) →

- Glucose + Glucose = Maltose (malt sugar) →

- Glucose + Galactose = Lactose (milk sugar) →

Because of their structure, simple carbohydrates are rapidly digested and are therefore the quickest source of energy. Examples of foods that contain simple carbohydrates are table sugar, corn syrup, and honey.

Complex carbohydrates are called polysaccharides and are multiple sugar molecules linked together. Complex carbohydrates include starches, glycogen, and most types of fiber. Complex carbohydrates are commonly found in whole plant foods, which are also good sources of vitamins and minerals as well as fiber, which slows the body's absorption of glucose and limits dramatic blood glucose changes. Examples of complex carbohydrates are whole grains and foods, such as pasta and bread; starchy vegetables, such as potatoes, sweet potatoes, and corn; and beans, lentils, and peas.

Overall, carbohydrates are present in a variety of foods such as fruits, vegetables, grains, legumes (beans, peas, lentils), milk and milk products, and foods containing added sugar in the form of starch, sugar, or fiber. With the exception of fiber, each gram of carbohydrate provides 4 calories. Although in general fiber is *not* broken down in the digestive tract, some types of fiber can be broken down in the gut and do release energy; however, energy production is minimal and we do not view energy production as a main function of fiber.

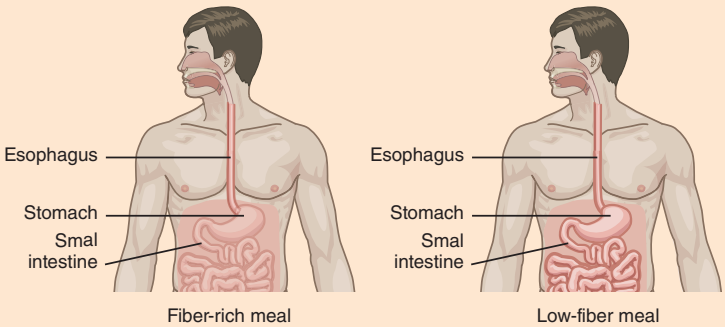
Dietary Fiber

Dietary fiber comes from the edible parts of plants and cannot be digested or absorbed in the small intestine. Fiber passes into the large intestine intact, contributing a number of health benefits such as normalizing bowel movements, lowering cholesterol levels, helping control blood sugar levels, and aiding in achieving healthy weight.

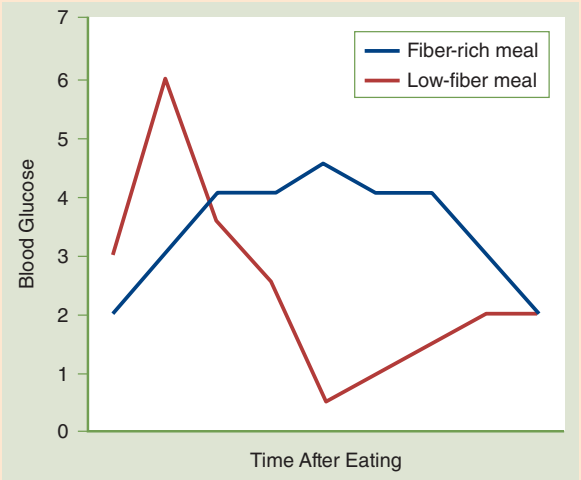
To understand some of the benefits of fiber, we must first define the different categories of fiber: **soluble fiber** and **insoluble fiber**. Soluble fiber attracts water and turns to a gel during digestion. This characteristic helps a person feel full longer, and possibly slows the digestion and absorption of carbohydrates, which prevents spikes in blood glucose following a meal. Food sources of soluble fiber include oat bran, barley, nuts, seeds, beans, peas, and some fruits and vegetables. Soluble fiber is associated with lowering the risk of heart disease.

The Big Picture

A fiber-rich meal adds bulk and volume to stomach contents, slowing the digestion of food and the absorption of nutrients, delaying the rise in blood glucose that occurs after a meal. In a low-fiber meal, nutrients are concentrated, causing digestion and absorption to occur more rapidly and thus creating a sharper rise in blood glucose.



Fiber-rich meal Low-fiber meal



Insoluble fiber adds bulk to stool and helps food pass through the stomach and intestines, serving to prevent constipation by increasing stool weight and decreasing gut transit time, which in turn can reduce the risk of diseases and disorders such as diverticular disease and hemorrhoids. Insoluble fiber is found in foods such as wheat bran, vegetables, and whole grains. Fiber is also associated with possible prevention of coronary heart disease by improving the blood lipid profile.[5]

The Institute of Medicine sets the DRI for carbohydrates as 45 to 65% of daily calories. The RDA for fiber is 38 g per day for adult men and 25 g per day for adult women up to 50 years old. The RDA for fiber in men older than 50 years is 30 g per day, and for women older than 50 years, the RDA for fiber is 21 g per day.

Protein

A **protein** is any group of organic molecules that contain carbon, hydrogen, oxygen, and nitrogen and one or more chains of amino acids. Protein is in every cell in the body and functions to build, repair, and maintain bones, muscles, and skin. For example, proteins make up collagen for supportive tissue, hemoglobin for transport, antibodies for immune defense, and enzymes for metabolism.

Proteins are made of individual amino acids linked together by peptide bonds. Amino acids consist of a central carbon atom connected to an amino group, a carboxyl group, a hydrogen atom, and a variable component called a side chain. Proteins are built from a set of 20 amino acids, each of which has a unique side chain. (See FIGURE 1.4.)

Protein is stored primarily in muscle and collagen, and the amino acids, which make up protein's structure function as hormones, enzymes, and transporters of other nutrients. Proteins provide 4 calories per gram, and food sources of protein include meat, fish, eggs, milk, and legumes. It is important to eat protein every day because your body does not store protein the same way that it stores carbohydrates. The protein we eat is broken into individual amino acids used to build body proteins, is reconfigured into glucose to be used as energy, or is reconfigured into fat and is stored. The DRI for protein is 0.8 g per kilogram of body weight, or 0.36 g per pound of body weight. A typical American diet provides enough protein to meet estimated needs for each day.

Fat

Fat is a macronutrient used by the body in a variety of ways. Dietary fat builds nervous tissue and hormones; is essential for brain development; helps the body absorb the fat-soluble vitamins A, D, E, and K; insulates and protects systems and organs in the body; provides fuel for the body; and contributes to the feeling of satiety after eating. As a food component, fat gives food flavor and texture, making many foods palatable and desirable. Fat also is a source of two essential (cannot be manufactured by the body) fatty acids: linoleic acid and alpha-linolenic acid.

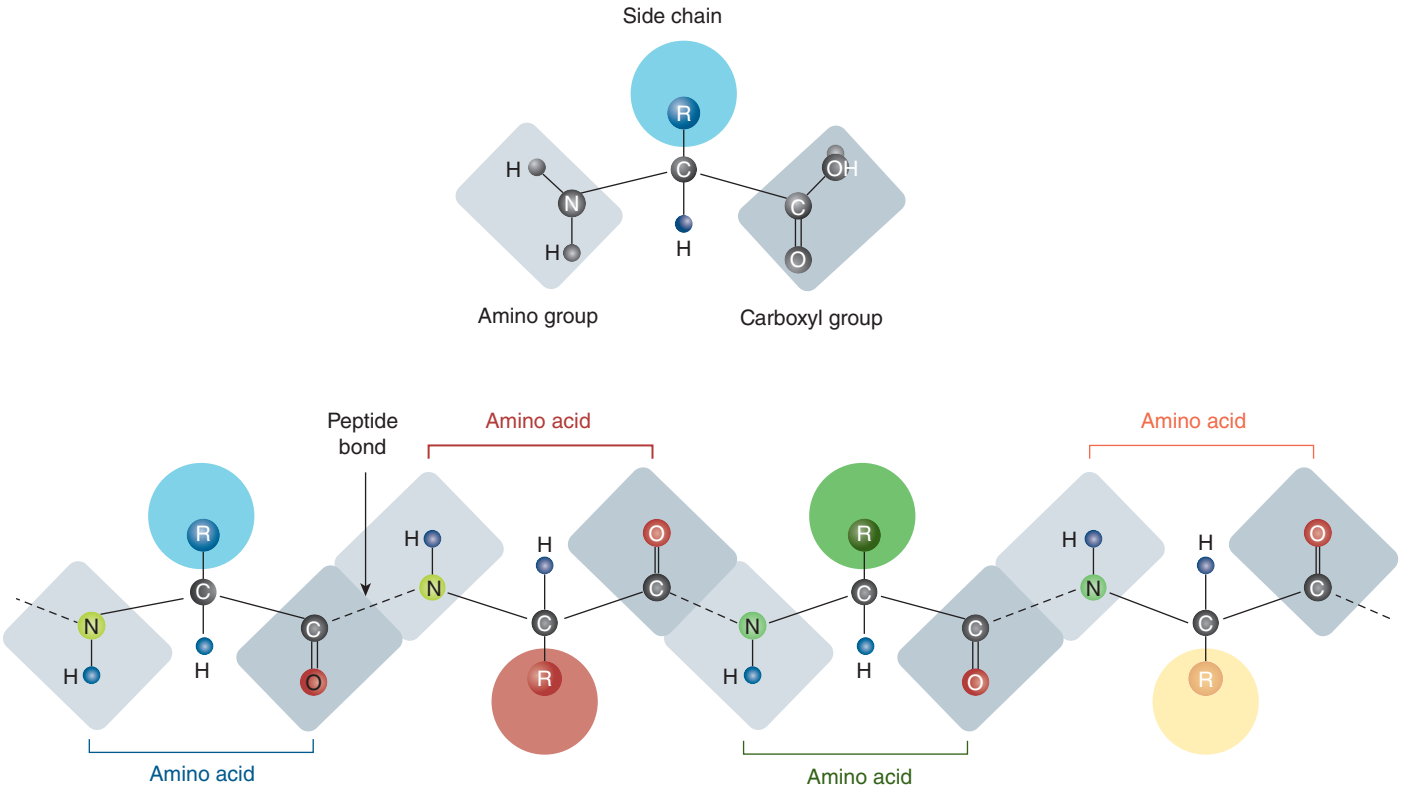


Figure 1.4
Protein configuration.

The body needs these fatty acids for brain development, inflammation control, and blood clotting.

Linoleic Acid

Linoleic acid is an essential, polyunsaturated, omega-6 fatty acid that is necessary for healthy brain function, skin and hair growth, bone density, energy production, and reproductive health. Your body can convert linoleic acid into two forms: arachidonic acid and gamma linolenic acid, or GLA. Arachidonic acid is an omega-6 fatty acid that supports brain and muscle function and promotes and resolves inflammation.[6] GLA has been found to be an anti-inflammatory agent as well and may benefit conditions such as diabetic neuropathy, rheumatoid arthritis, allergies, and menopausal disorders.[7] Food sources of linoleic acid include safflower and sunflower seeds, soybean oil, corn oil, pine nuts, and pecans.

Alpha-Linolenic Acid

Alpha-linolenic acid is an essential, polyunsaturated, omega-3 fatty acid essential to the body for formation of prostaglandins. Alpha-linolenic acid is a precursor to the omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), both of which are found in fish oil and are known to be important during fetal development.[8] EPA and DHA have also been shown to reduce inflammation and may help prevent chronic diseases such as heart disease and arthritis.[9] The body can convert small amounts of EPA and DHA from alpha-linolenic acid. Food sources of alpha-linolenic acid include flaxseed oil, canola oil, soy oil, walnut oil, and the eggs from chickens fed arachidonic acid. Food sources of EPA and DHA include fish and specialty egg and dairy products. The body stores small amounts of DHA and EPA.

Classification of Fats

Whether a fatty acid has single or double bonds between the carbon atoms determines its classification as either **saturated** or **unsaturated**. If the carbon atoms in the fatty acid are linked by single bonds, the fat is classified as saturated. Unsaturated fatty acids have one or more double bonds between the carbon atoms. (See FIGURE 1.5.) Unsaturated fatty acids are further classified by the number of double bonds that exist between the carbon atoms. Fatty acids with one double bond are referred to as monounsaturated fats, whereas fatty acids with more than one double bond between carbon atoms are considered polyunsaturated.

Most foods contain both saturated and unsaturated fats; however, we generally identify them according to the type of the largest amount of fat in them. Animal products tend to contain more saturated fats than unsaturated fats, and plant foods tend to include more unsaturated fats than saturated fats. Saturated fats are associated with raising low-density lipoprotein (LDL) cholesterol, putting a person at risk for heart attack, stroke, and other major health problems. Food sources of saturated fats include those made from animal products such as butter, cheese, whole milk, ice cream, cream, fatty meats, and some vegetable oils (those that are solid at room temperature). Unsaturated fats can help lower LDL cholesterol. Food sources of unsaturated fats include olive, canola, safflower, sunflower, corn, and soy oils.

Trans fat is a type of unsaturated fat that is created by adding hydrogen to the double bonds between carbon atoms. This process, which converts liquid oils into solids, is referred to as hydrogenation, and it creates products such as margarine and frying oils. Trans fats are used in commercial products because they tend to keep some food fresh for a longer period of time. When consumed, trans fat's greatest danger is its capacity to distort cell membranes, and the primary health risk identified with trans fats consumption is an elevated risk of coronary heart disease.[10] In addition, trans fats have adverse effects on the brain and nervous system, which can diminish mental performance and increase depression symptoms.[10] There is growing evidence for a possible role of trans fat in the development of Alzheimer's disease and cognitive decline with age.[10] In addition, consumption of trans fats is associated with increasing LDL cholesterol and lowering high-density lipoprotein (HDL) cholesterol levels. For decades, European countries have questioned the use of trans fatty acids in edible oils, and they went

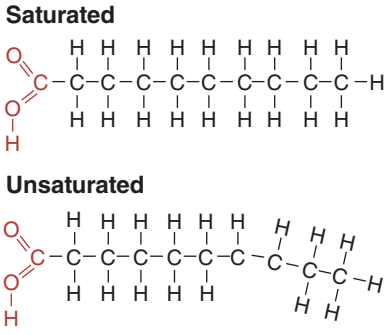


Figure 1.5
Saturated and unsaturated fatty acids.

Sources of saturated fats.

Sources of unsaturated fats.

Foods high in trans fats.

ahead of the rest of the world to put regulations in place that limit the amount of trans fats in edible and formulated foods.[11]

Omega-6 and Omega-3 Fatty Acids

Omega-3 fatty acids and **omega-6 fatty acids** are two polyunsaturated fatty acids, both required for the body to function. Each of these fatty acid types has been shown to play a critical role in brain function and normal growth and development. These two fatty acids may have opposite effects when it comes to the inflammatory response and cardiovascular health.

Omega-3 fatty acids (also called n-3 fatty acids) have been shown to decrease the production of inflammatory mediators, having a positive effect on obesity and type 2 diabetes mellitus.[12] Omega-3 fatty acids are thought to provide a wide range of health benefits, including lowering the risk of coronary heart disease and improving cholesterol profiles. In addition, omega-3 fatty acids have been associated with improvements in cancer risk, depression treatment and prevention, and attention-deficit hyperactivity disorder (ADHD) treatment, with some of these mentioned health benefits resulting in part from positive changes in gut bacteria brought about by the intake of omega-3 fatty acids.[13]

Omega-6 fatty acids (also called n-6 fatty acids) are believed to play an important role in cell growth, production of hormone-like messengers, and transmission of nerve impulses. Other benefits of omega-6 fatty acid intake include stimulation of skin and hair growth, maintenance of bone health, regulation of metabolism, and maintenance of the reproductive system.

At the onset of the Industrial Revolution (about 250 years ago), there was a marked shift in the ratio of n-6 to n-3 fatty acids in the typical diet. Consumption of the former increased at the expense of the latter. This change resulted from both the development of the modern vegetable oil industry and the increased use of cereal grains to feed domestic livestock. Prior to these shifts, the ratio of n-6 to n-3 fatty acids was 1:1, whereas studies now indicate a ratio of 20:1 or higher among U.S. diets.[14] A balance of omega-6 to omega-3 fatty acids in the diet has been shown to be of benefit in the prevention and management of obesity, and most experts agree that the omega-6:omega-3 ratio should range from 1:1 to 5:1.[14]

Cholesterol

Cholesterol is a waxy, fat-like substance found in every cell of the body. Your body needs cholesterol to produce the hormones estrogen and testosterone. Cholesterol is also a precursor of vitamin D. Our bodies produce cholesterol and we obtain cholesterol through various foods that we eat. Sources of cholesterol include eggs, fish, butter, bacon, red meat, cheese, and milk and other dairy products.

Cholesterol travels through the bloodstream packaged in carriers called lipoproteins. There are two kinds of lipoproteins: low-density lipoproteins (LDLs) and high-density lipoproteins (HDLs). LDLs are often referred to as "bad" cholesterol because high LDL levels lead to a buildup of cholesterol in arteries. HDLs are often referred to as "good" cholesterol because these lipoproteins carry cholesterol from other parts of the body to the liver, where it can then be removed.

Having high levels of blood cholesterol is associated with a greater chance of developing coronary heart disease, which results from plaque buildup inside the coronary arteries. Over time, plaque hardens and narrows the coronary arteries, limiting the flow of blood to the heart, which can lead to a heart attack. (See FIGURE 1.6.) Although genetics play a role in blood cholesterol levels, for healthy cardiac function, it is advised you limit your dietary cholesterol intake.

Dietary fat, regardless of its type, provides 9 calories per gram. The DRI for fat is 20–35% of overall calorie intake for adults and 25–40% of overall calorie intake for children. Most experts agree that the omega-6:omega-3

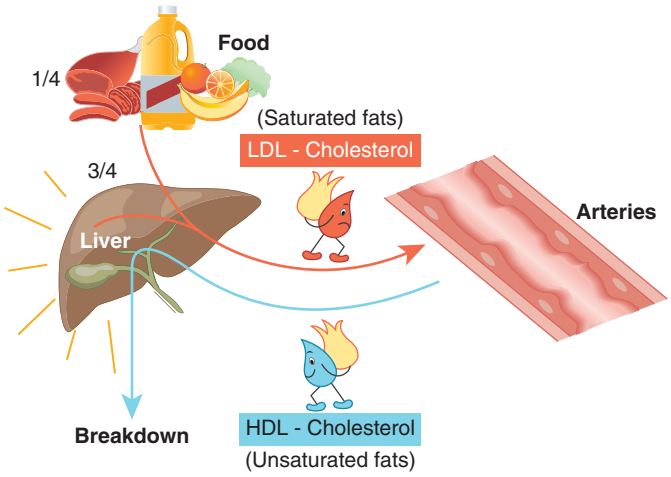


Figure 1.6
The role of LDL and HDL cholesterol in moving fat between the liver and the arteries.

ratio should range from 1:1 to 5:1. The current daily value for cholesterol is 300 mg/day.

Your Guide to Lowering Your Cholesterol with TLC from the United States Department of Health and Human Services suggests the following nutrition recommendations for lowering serum cholesterol levels:[15]

1. Decrease consumption of saturated fat, trans fat, and cholesterol.
2. Add plant stanols and sterols and increase soluble fiber in your diet.
3. Try to get at least 30 minutes of moderate-intensity exercise most days of the week.
4. If you are overweight, lose the extra weight to help reduce the risks associated with high cholesterol.

Recap Knowing the basic principles of healthy eating can help guide you to healthy nutrition choices. Our diets are made up of a combination of essential and nonessential nutrients, each with a recommended intake level for optimal nutrition. The macronutrients carbohydrate, protein, and fat provide our bodies with calories and essential nutrients. Carbohydrates are the body's preferred source of energy, providing energy to the brain, muscles, and nervous system. Protein exists in every cell of the body and functions to build, repair, and maintain bones, muscles, and skin. Fat provides calories, helps our bodies absorb fat-soluble vitamins, and keeps our skin and hair healthy.

1. List the nutrients that contribute to the calorie content of food.
2. Identify the benefits of eating a high-fiber diet.
3. Describe two differences between saturated and unsaturated fatty acids.
4. Describe the role of LDL and HDL cholesterol in heart disease.

Micronutrients

Preview We obtain micronutrients from foods we eat and drink. Micronutrients are required in small amounts for normal growth and development; they do not provide energy, but they are required to enable chemical reactions in the body.

Micronutrients are chemical elements or substances required in small amounts for normal growth and development of all living organisms. These include vitamins and minerals. Compared with macronutrients, the body needs only small amounts of micronutrients; however, both types of nutrients are required. Unlike the macronutrients carbohydrate, protein, and fat, micronutrients do not function to provide energy, but they are required to enable the many chemical reactions that occur throughout the body, including the process of producing energy.

Vitamins

Vitamins are a group of organic substances that are essential for proper functioning of the body. Vitamins are found in food but can also be obtained through supplements. There are 13 nutrients classified as vitamins. These are further categorized based on their solubility: 4 are fat soluble and 9 are water soluble. (See TABLE 1.3.) All of these nutrients are essential to maintain healthy homeostasis and metabolic function.

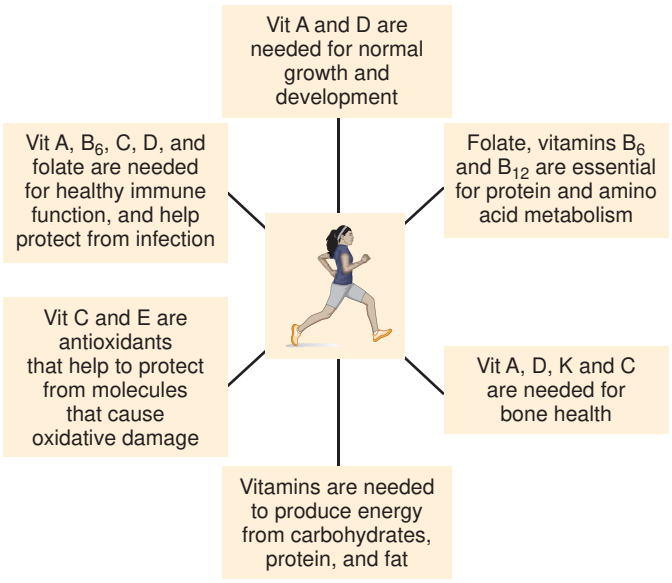
The fat-soluble vitamins are vitamins A, D, E, and K. Because these are soluble in fat, they are absorbed in fat globules (called chylomicrons) that travel through the lymphatic system of the small intestines and into the general blood circulation of the body. Fat-soluble vitamins can be stored in body fat tissue and in the liver, with stores lasting for months to years.

The water-soluble vitamins are the B-complex vitamins and vitamin C. With few exceptions, they are not

Table 1.3

Vitamins Based on Solubility

Water-Soluble Vitamins	Fat-Soluble Vitamins
B-complex vitamins • Thiamin (B_1) • Riboflavin (B_2) • Niacin (B_3) • Pyridoxine (B_6) • Folate • Cobalamin (B_{12}) • Biotin • Pantothenic acid • Choline (a compound similar to the B-complex vitamins) Vitamin C	Vitamin A (retinol, beta-carotene) Vitamin D (1,25 dihydroxy-cholecalciferol) Vitamin E (alpha-tocopherol) Vitamin K



Benefits of vitamins.

stored in the body and, if intake is inadequate over time, the availability of these nutrients can run out within a few weeks to a few months. Water-soluble vitamins are eliminated in the urine and tend to be excreted from the body more quickly than fat-soluble vitamins.

Initially thought to be just one vitamin, the eight vitamins that make up the B complex have different characteristics. The B-complex vitamins are thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folate, and cobalamin. These vitamins are necessary for the body to produce energy because they convert potential energy from the nutrients that we eat into adenosine triphosphate (ATP), which is the energy carrier in the cells of all known organisms. Our bodies produce energy through the production of ATP.

Water-soluble vitamins are generally not stored in the body, and the body adjusts absorption based on needs. However, caution still needs to be exercised due to the possibility of toxicity. Consuming too little or too much of some vitamins can cause a nutritional disorder.

The Big Picture

The following is a summarization of how vitamin D contributes to daily function:

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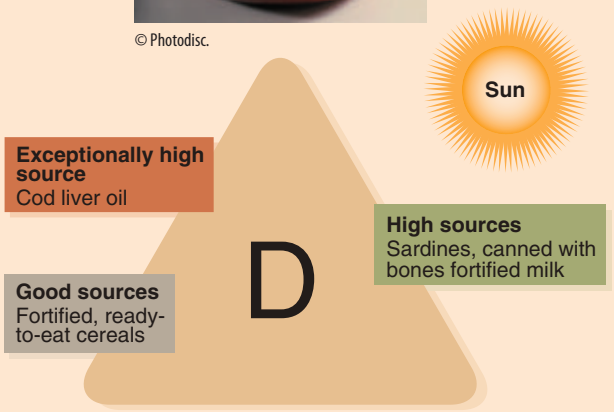


Data from Parva NR, Tadepalli S, Singh P, et al. Prevalence of vitamin D deficiency and associated risk factors in the US population (2011–2012). *Cureus*. 2018;10(6):e2741. doi: 10.7759/cureus.2741

News You Can Use

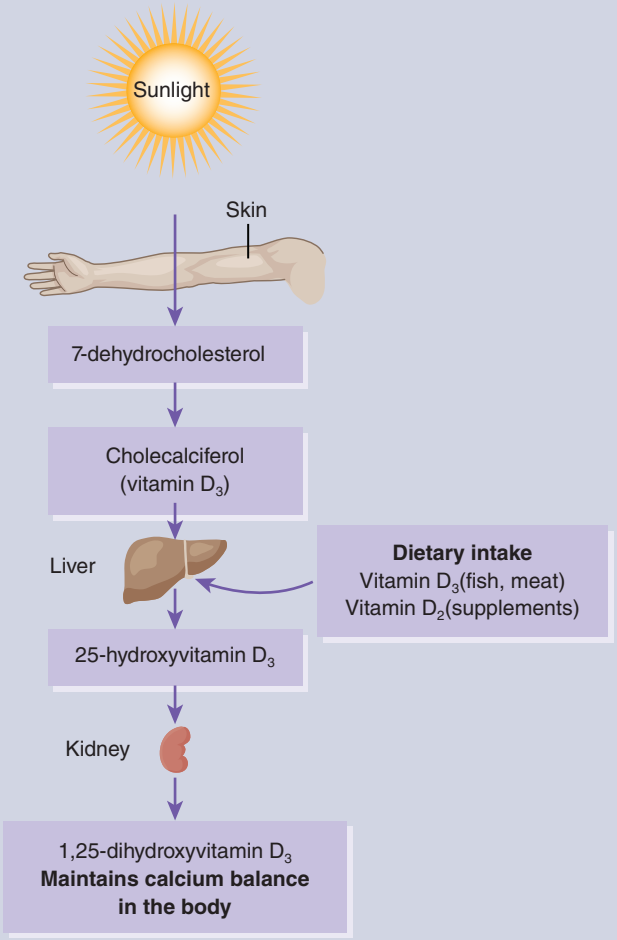
We have understood the dangers of direct sun exposure for decades. The American Academy of Dermatology recommends we never expose bare skin to the sun without sunscreen, and the United States Food and Drug Administration calls ultraviolet radiation a carcinogen. This message has been so effective that it has created paranoia about sunlight, especially among parents who religiously apply sun protection to their children.

Although it is certainly a good idea to avoid the things that research tells us will increase our risk of skin cancer, the sun is also a very reliable way to get enough calcitriol, which is the active form of vitamin D. When the sun's UV rays come into contact with the skin, vitamin D precursor molecules are converted into vitamin D_3, which then follows a metabolic pathway through the liver and kidneys, where it is converted into the molecule calcitriol—the active form of vitamin D. Vitamin D has roles in many tissues and cells, and is essential for bone health. Without the active form of vitamin D, the body is not able to absorb the calcium it ingests, increasing the risk of osteoporosis and fractures. Vitamin D also helps maintain normal blood levels of phosphorus, which is another bone-building mineral. Individuals who limit their dietary intake of vitamin D (found in foods such as cow's milk, eggs, tuna fish, salmon, fortified cereal, and pork), who are diligent about using sunscreen, and who live in the northern part of the United States are all at risk for vitamin D deficiency. More specifically, except during the summer months, the skin makes little if any vitamin D with help from the sun's UV rays at latitudes above 37 degrees north (see map below). These individuals should use caution in regard to sun exposure in consideration of their vitamin D status.

How much sun exposure is enough? If you're fair-skinned, experts say going outside for 10 minutes in the midday sun while

wearing shorts, a tank top, and no sunscreen will give you enough radiation to produce about 10,000 international units (IU) of vitamin D. The RDA for vitamin D is 400 IU for children younger than 12 months, 600 IU for those between 1 and 70 years old, and 800 IU for those older than 70 years.

The message that direct sun exposure can increase the risk of cancer is relevant; however, like many topics in nutrition, a little goes a long way. Be cautious about your time in the sun, but also be realistic. After all, deficiencies of vitamin D can be detrimental, and the "sunshine vitamin" may protect against a host of diseases, including osteoporosis, heart disease, and some forms of cancer. In addition, some exposure to sunlight has benefits such as protecting against depression, insomnia, and an overactive immune system.



Data from Parva NR, Tadepalli S, Singh P, et al. Prevalence of vitamin D deficiency and associated risk factors in the US population (2011–2012). *Cureus*. 2018;10(6):e2741. doi: 10.7759/cureus.2741

Minerals

Minerals are inorganic substances that are essential nutrients needed by the body in small amounts. Although they do not provide calories, minerals play key roles in multiple body functions. Our bodies do not produce minerals, so we must obtain them through food. Minerals are found in soil, and we can incorporate them in the diet by eating plants, the meat of animals that graze on plants, fish, and drinking water.

Minerals are classified as either major or trace minerals. This designation does not represent the body's need for them but rather their presence in the body. The major minerals include calcium, chloride, magnesium, phosphorus, potassium, sodium, and sulfur. Main functions of the major minerals include maintaining water balance in the body; maintaining bone health; and helping to stabilize protein structure, including for hair, skin, and nails. (See TABLE 1.4.)

The trace minerals include chromium, copper, fluoride, iodine, iron, manganese, molybdenum, selenium, and zinc. With the exception of chromium, which helps the body maintain normal blood sugar levels, trace minerals are incorporated into enzymes or hormones required for metabolism and therefore serve a variety of functions within the body. (See TABLE 1.5.)

Although not as prevalent in the United States, deficiencies in trace minerals are a major global health problem that can impair growth and mental development and

Food sources of various nutrients.

Table 1.4

Major Minerals: Functions and Common Food Sources

Nutrient	Primary Function in the Body	Common Food Sources
Calcium	Provides rigidity to bone; 99% of calcium in the body is found in bones and teeth.	Milk, yogurt, fortified orange juice, canned salmon, fortified cereals
Chloride	Travels primarily with sodium and water and helps generate the osmotic pressure of body fluids. Is an essential part of the stomach acid (HCl) that aids in digestion.	A component of table salt or sea salt as sodium chloride, many vegetables, and salt substitutes
Magnesium	Promotes resistance to tooth decay by holding calcium in tooth enamel; stored in bone; component in forming blood clots; necessary for enzyme reactions.	Dark green leafy vegetables, peanut butter, beans and peas, bananas, almonds
Phosphorus	Component of hydroxyapatite crystals in bone.	Yogurt, almonds, milk, cheese, salmon, meat, eggs
Potassium	Maintains alkaline blood pH, which prevents withdrawal of bone minerals.	Spinach, squash, bananas, orange juice, milk, meat, legumes, whole grains
Sodium	Regulates body fluid balance, maintains acid–base balance, aids muscle contractions and nerve impulse transmission.	Table salt
Sulfur	A component of four different amino acids, performs functions in enzyme reactions and protein synthesis.	Meat, fish, poultry, eggs, milk, legumes

Table 1.5

Minor Minerals: Functions and Common Food Sources

Nutrient	Primary Function in the Body	Common Food Sources
Chromium	Important in the metabolism of fats and carbohydrates; stimulates fatty acid and cholesterol synthesis; important in the breakdown of insulin.	Beef, liver, eggs, chicken, oysters, wheat germ, green peppers, apples, bananas, spinach
Copper	Contributes to collagen synthesis.	Liver, cocoa, beans, nuts, whole grains, dried fruit
Fluoride	Strengthens bones and teeth; stimulates osteoblasts.	Seafood, tea, fluoridated water
Iodine	A component of hormones produced by the thyroid gland that are responsible for a number of functions in the body, including growth, metabolism, reproduction, nerve and muscle function, regulation of body temperature, and blood cell production.	Iodized table salt, seafood, dairy products, plants grown in iodine-rich soil
Iron	Cofactor in vitamin D activation; contributes to collagen synthesis; an essential component of hemoglobin and myoglobin; supports metabolism.	Red meat, poultry (dark meat), seafood, eggs, tofu, broccoli, peas, bran, enriched bread, dried fruit, leafy-green vegetables, and iron fortified foods
Manganese	Cofactor for bone-remodeling enzymes.	Nuts, oats, beans, tea
Molybdenum	A cofactor for four enzymes and necessary for the metabolism of sulfur-containing amino acids.	Legumes, grain products, and nuts
Selenium	A component of the amino acid found in at least 25 different proteins.	Organ meats and seafood
Zinc	Needed for catalytic, structural, and regulatory functions in the body.	Oysters, beef, crab, pork

can lead to illness or even death. People who consume a balanced diet containing a variety of foods are unlikely to develop either a mineral toxicity or deficiency; however, people who follow strict diets that eliminate certain food groups or overemphasize others can be at risk for nutrition disorders.

Water

Water makes up more than two-thirds of the weight of the human body, and without it human survival is not possible. All cells, organs, and tissues in the body need water to help regulate temperature and to maintain other body functions. Our bodies are constantly losing water through the processes of respiration, perspiration, and digestion; therefore, keeping the body hydrated through adequate fluid intake is important.

Water serves vital functions in the body, including the following (FIGURE 1.7):

1. Water distributes essential nutrients to cells throughout the body and helps deliver oxygen throughout the body.
2. Water helps to remove waste products, including toxins, through urine and feces.
3. Water is a component of nutrient breakdown and nutrient metabolism, including formation of saliva. For example, water allows the chemical

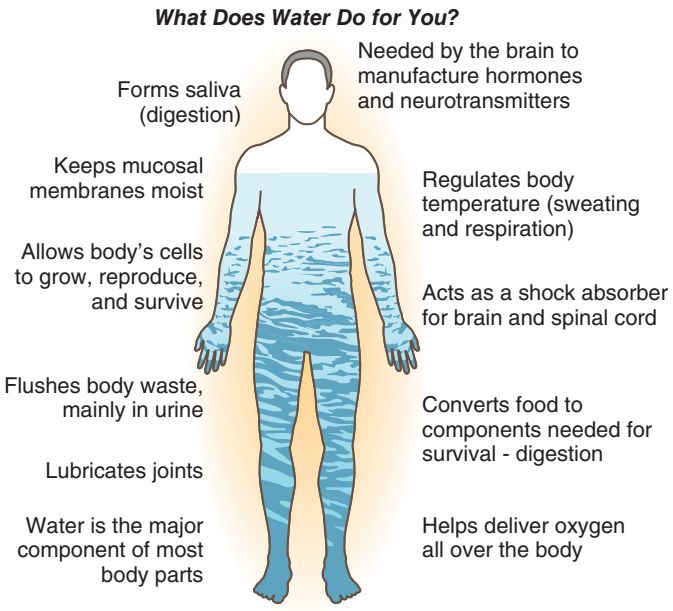


Figure 1.7
Various functions of water.

U.S. Department of the Interior. The water in you: water and the human body. https://www.usgs.gov/special-topic/water-science-school/science/water-you-water-and-human-body?qt-science_center_objects=0#qt-science_center_objects

reactions that result in protein and carbohydrates being absorbable and usable by the body to occur.

4. Water helps to regulate body temperature through the process of perspiration. When water evaporates from the skin surface, body temperature is lowered.
5. Water lubricates joints and acts as a shock absorber for the eyes, brain, spinal cord, and for fetuses in utero in the form of amniotic fluid.
6. Water keeps mucosal membranes moist.

Water is the major component of most body parts.

Intake of water comes from foods we eat and fluids we drink. In addition, the body produces water during the process of metabolism. If water intake is inadequate, body fluids can become imbalanced, causing dehydration. The DRI for water is between 91 and 125 fluid ounces (2.7 to 3.5 L) of water per day for adults. However, individual needs depend on weight, age, and activity level. TABLE 1.6 gives examples of how to calculate fluid needs.

Table 1.6

Various Methods for Calculating Fluid Needs

Method	Calculation
1	Weight (kg) × 30 mL = milliliters of fluid required daily
2	1 mL/kcal of intake = milliliters of fluid required daily
3	(kg body weight – 20) × 15 + 1,500 = milliliters of fluid required daily

Case Study

Using each of the three methods in Table 1.6, calculate the amount of fluid that your body needs. Compare these numbers to the standard recommendation of 2.7 to 3.5 L per day. Fill a container with water to the amount of fluid you should drink each day. Challenge yourself to drink that amount throughout the day. Reflect on this task—was it easy to drink the suggested amount of water? Difficult? Did you feel thirsty at times during the day? Did your energy level or hunger level seem different throughout the day? Based on your experience and observations, determine whether you should make changes to your usual fluid intake.

Recap Adequate vitamin, mineral, and water intake is essential for life. Our body can produce some of the vitamins it needs, while others must come from the diet. Minerals are elements that originate in the earth and cannot be made by human bodies. Plants obtain minerals from the soil, providing us with dietary sources of minerals when we consume the plants directly or indirectly through animal sources that have fed on mineral-rich food sources. Minerals may also be present in the water we drink. Water makes up more than two-thirds of the weight of the human body, and without it, human survival is not possible.

1. Describe the difference between how fat-soluble and water-soluble vitamins are stored in the body.
2. List three vital functions of water in the body.
3. Identify the daily requirements for water intake.

Nutrition Assessment

Preview Nutrition assessment is a comprehensive evaluation in which a clinician observes, interprets, analyzes, and infers data in an effort to appraise an individual's nutrition history and current nutrition status.

There are multiple indicators of nutrition health and, therefore, measures of nutrition status should include a number of factors. Typically, these factors are anthropometric measures, biochemical tests, clinical observations, and dietary intake—generally referred to as the *ABCDs of nutrition assessment*. (See TABLE 1.7.)

Anthropometric Measures

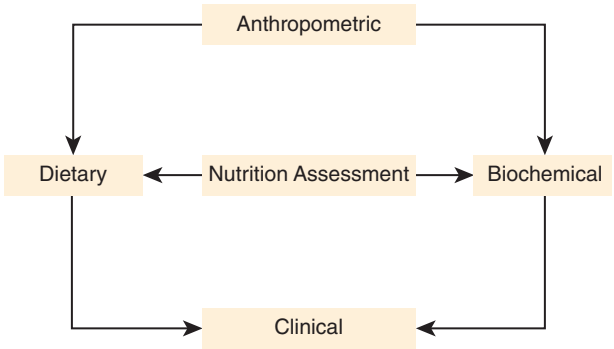
Anthropometric measures are physical measurements of the body. For nutrition assessment purposes, anthropometric measurements generally include height, weight, head circumference, body mass index, waist circumference, and body fat percentage. These measurements can

Table 1.7

The ABCDs of Nutrition Assessment

Assessment Method	What It Measures
Anthropometric measures	Measure growth and show changes in weight, height, and body fat percentage over time.
Biochemical tests	Measure blood, urine, and feces for nutrients or metabolites that indicate infection or disease.
Clinical observations	Assess changes in the color and health of skin and hair.
Dietary intake	Tracks an individual's food intake over time.

be compared with standard values or they can be used to assess weight changes in an individual over time. To be effective, anthropometric measurement procedures should follow measurement standards with regard to technique and equipment.



Height, Weight, and Head Circumference

Techniques for measuring height and weight should follow age standards because infants and children are measured differently than adults. Weight in a nutrition assessment represents various factors because it can be used to assess growth, predict energy expenditure and protein needs, and determine body mass index.

For infants and children, another anthropometric measurement, head circumference, is used in the nutrition assessment. Head circumference is a useful measure of normal growth and development, especially from birth to 3 years old, when growth is rapid.

Body Mass Index

Body mass index (BMI) is a number calculated from a person's weight and height, with the result providing a reliable indicator of body fatness. Additionally, this number provides a good gauge of risk for various diseases associated with increased body fat. The higher the BMI, the higher the individual's risk for certain diseases such as heart disease, high blood pressure, type 2 diabetes, gallstones, breathing problems, and certain forms of cancer.[16]

Table 1.8

BMI Classifications

Class	BMI
Underweight	Below 18.5
Normal weight	18.5–24.9
Overweight	25.0–29.9
Obese	30.0 and above

BMI can be used for both males and females; however, this measurement has two known limitations: (1) it may overestimate body fat in athletes and others who have a muscular build; and (2) it may underestimate body fat in older persons and others who have lost muscle.[17] Calculating BMI allows comparison of an individual to population standards. The formula for calculating BMI is: BMI = (Weight in kilograms) / (Height in meters)^2. See TABLE 1.8 for BMI weight classifications.

Waist Circumference

Waist circumference measurements tend to be a good indicator of abdominal fat and therefore a predictor of chronic disease in adults. A high waist circumference is associated with an increased risk for type 2 diabetes, dyslipidemia, hypertension, and cardiovascular disease in patients with a BMI in the range between 25 and 34.9.[18] (See TABLE 1.9.) To correctly measure waist circumference, place a flexible tape measure around the waist just above the hipbone of an individual who is standing.

Percent Body Fat Measurements

Body fat percentages represent fat including essential body fat and storage body fat. Essential body fat is necessary to maintain life and reproductive functions. Storage body fat consists of fat accumulation in adipose tissue, part of which protects the internal organs. TABLE 1.10 shows how average percentages of body fat differ according to specified groups.

A number of different methods are used to measure body fat percentage. It is essential for the clinician

Table 1.9

Waist Circumference and Associated Health Risk

Health Risk	Women	Men
Low risk	Below 31.5 inches	Below 37 inches
Moderate risk	31.5 to 35 inches	37 to 40 inches
High risk	35 inches or more	40.2 inches or more

Data from National Institutes of Health, National Heart, Lung, and Blood Institute. Assessing your weight and health risk. http://www.nhlbi.nih.gov/health/educational/lose_wt/risk.htm. Accessed August 13, 2016.

Table 1.10

Average Percentage of Body Fat According to Group

Category	Females	Males
Essential fat	10–13%	2–5%
Competitive athlete	14–20%	6–13%
Individual who exercises regularly, but not competitively	21–24%	14–17%
Average	25–31%	18–24%
Obese	32%+	25%+

and the individual to employ accurate and consistent techniques to take measurements. Hydrostatic weighing, which requires the individual to be submerged entirely in water, is generally considered the gold standard because of its accuracy in measuring body fat percentage. Other methods tend to be less invasive but have slightly higher variances. A dual-energy X-ray absorptiometry (DEXA) scan is primarily used for measuring bone density by taking a full-body X-ray, and it can provide body fat percentage measurements as well. The BOD POD is a costly machine that works by measuring the volume of air that is displaced inside the pod, which then equates to a body fat measurement. The BOD POD is considered accurate; however, only special facilities have the equipment.

Hand-held devices and body fat scales use bioelectrical impedance to gauge the amount of lean mass, water, and fat in the body by sending an electric current from the metal plates under the feet or the palms of the hands of the individual through the body. Although these methods are generally inexpensive and easy to use, without proper hydration and consistent measurements over time, they tend to be less reliable than others. Calipers are another tool that a skilled user can employ to assess body fat percentage. Calipers measure the thickness of skinfolds at certain points on the body. The numbers are tallied and used in a formula to estimate body fat percentage. Although calipers are generally considered an accurate method of measurement, results can vary widely depending on who is administering the test and whether the calipers themselves are reliable.

The InBody is a machine that combines the ease of use of a bioelectrical impedance analysis (BIA) device with the accuracy of hydrostatic weighing. The InBody requires the individual stand on a metal platform and hold two handles for about a minute. The InBody machine analyzes data and produces a report with information such as body weight, total body water, dry lean mass, lean body mass, body fat mass, body mass index, body fat percentage, and basal metabolic rate. The InBody is a device not typically used outside of the medical industry or by fitness and nutrition providers because of the high cost of the various machines.

Biochemical Data

Biochemical data use laboratory measurements obtained through blood, urine, or stool samples as indicators of nutritional status. Although not all nutrients can or should be assessed by laboratory methods, the following are examples of some of the more likely serum laboratory values used to help assess nutrition status:

- Albumin and prealbumin: Transport proteins used to assess protein status.
- C-reactive protein: Decreased value correlates with end of acute phase and beginning of anabolic phase response when nutrition repletion is possible.
- Insulin-like growth factor 1: Responds to growth hormone stimulation with decreased concentrations seen in protein-energy malnutrition.
- Creatinine height index: Estimates lean body mass.
- Iron, folate, ferritin, hemoglobin, hematocrit, mean corpuscular hemoglobin: Blood-forming nutrients.
- Total lymphocyte count: Affected by conditions such as cancer, inflammation, infection, stress, sepsis, and certain drugs and chemotherapeutic agents.
- Thiamine, riboflavin, niacin, and vitamin C: The water-soluble vitamins.
- Vitamins A, D, E, and K: The fat-soluble vitamins.
- Calcium, iron, iodine, and other trace elements: Minerals.
- Cholesterol, triglycerides, LDL, HDL: Blood lipid levels.
- Glucose (fasting) or glycated hemoglobin ($HbA1_c$): Current blood glucose level and average blood glucose level over the past 3 months.
- Blood urea nitrogen: Increased values indicate renal failure.

Clinical Assessment

Clinical assessment includes a medical history; current use of medications or vitamins, minerals, or herbal supplements; and a physical examination to identify signs of nutrition status. Clinical observations that can help to determine nutrition status include hair, nails, skin, eyes, lips, mouth, muscle tone, and hydration status. Clinical assessment should also include evaluation of personal, social, environmental, and lifestyle factors that could affect access to healthy food and nutritional well-being.

Dietary Data

Dietary data is the component of nutrition assessment that looks at food intake over time. There are many ways to document dietary intake; however, obtaining accurate data tends to be challenging because collecting good dietary data relies on the expertise of the clinician in conducting the data collection interview as well as the accuracy and honesty of the information provided by the individual.

Examples of methods used to assess dietary intake include the 24-hour recall, for which the clinician asks the individual what he or she has eaten over the past 24 hours, the 3-day food diary, for which the individual keeps track of everything ingested over 3 days, and food frequency questionnaires, for which the individual indicates how often they eat particular foods on a list over a specific period of time (such as a week or month).

Accurate information regarding portion sizes and how food is prepared are important components of dietary intake records. Estimating portion sizes may be difficult, and the use of food models or photographs of food, or various plate and bowl sizes, can make this process more accurate. Information regarding food allergies or intolerances, food avoidance, and caffeine and alcohol use should also be collected.

Estimated Calorie Needs

An additional component of nutrition assessment is to determine calorie needs. Various methods exist for estimating calorie needs, from simple equations using an individual's height and weight, to more complicated equations, to machines or scales similar to those used to determine body fat percentage. **Indirect calorimetry** and **direct calorimetry** are two accurate methods for determining estimated energy needs. Indirect calorimetry measures carbon dioxide produced and oxygen consumed. This noninvasive and generally accurate method can determine energy requirements. (See FIGURE 1.8.) Direct calorimetry measures the amount of heat produced by a subject who is enclosed in a small chamber. (See FIGURE 1.9.)

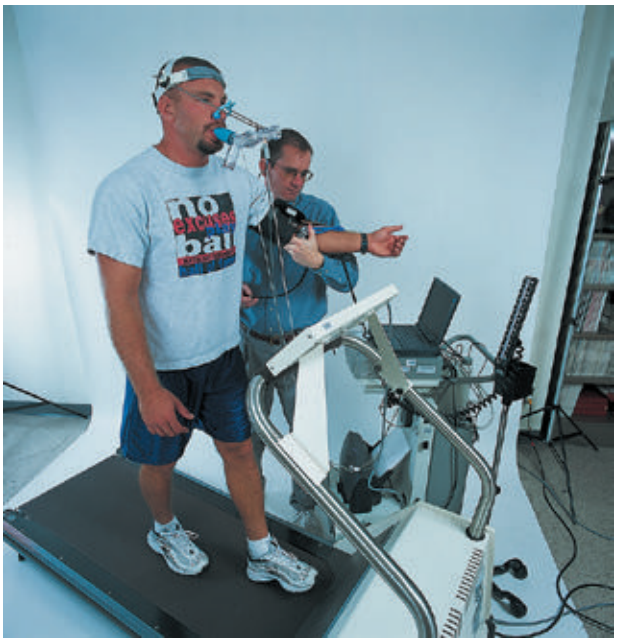


Figure 1.8
Indirect calorimetry.

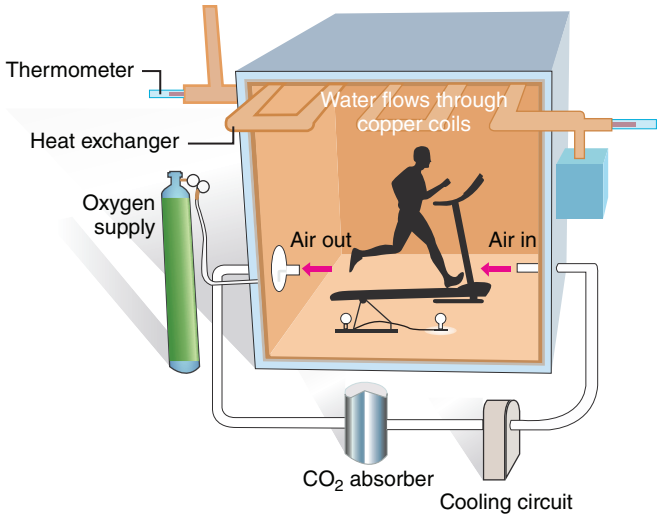


Figure 1.9
Direct calorimetry.

For the purposes of nutrition assessment, and when equipment is not available, mathematical calculations can help estimate daily calorie needs. Various websites provide simple and quick calculations for determining estimated energy expenditure. The following are two familiar calculation methods that can be used.

Method 1

Step 1:

Define the following information:

a. Age
b. Usual physical activity during the day as indicated in TABLE 1.11
c. Weight in kilograms, which equals your weight in pounds divided by 2.2
d. Height in meters, which equals your height in inches divided by 39.4

Table 1.11

Physical Activity Factors for Men and Women

Physical Activity Level	Physical Activity Factor for Men	Physical Activity Factor for Women
Sedentary—little or no daily activity	1.0	1.0
Low activity—sedentary for most of the day and light activity, such as walking, for no more than 2 hours daily	1.11	1.12
Moderate activity—equivalent to walking about 1.5 to 3 miles per day at 3 to 4 miles per hour, on most days of the week in addition to light physical activity associated with typical day-to-day life	1.25	1.27
Vigorous activity—activity that requires a lot of effort and causes rapid breathing and a substantial increase in heart rate on most days of the week	1.48	1.45

Step 2:

Using your answers from above (a, b, c, and d), complete the following calculations (EER stands for estimated energy requirement):

For males, 19+ years old

EER = 662 – (9.53 × ___) + ___ × [(15.91 × ___) + (539.6 ×___)]

(a) (b) (c) (d)

For females, 19+ years old

EER = 354 – (6.91 × ___) + ___ × [(9.36 × ___) + (726 × ___)]

(a) (b) (c) (d)

Method 2

The *Harris–Benedict equation* is a popular method for calculating estimated calorie needs. This equation uses known variables such as height, weight, age, and activity level. Basal metabolic rate (BMR) is a component of the Harris–Benedict equation. BMR is the amount of energy (calories) that the body needs during a 24-hour period to perform daily, life-sustaining functions.

To calculate estimated daily calorie needs using the Harris–Benedict equation, first calculate BMR using either of the following equations:

- For females: BMR = (10 × Weight in kilograms) + (6.25 × Height in centimeters) – (5 × Age in years) – 161
- For males: BMR = (10 × Weight in kilograms) + (6.25 × Height in centimeters) – (5 × Age in years) + 5

Next, multiply BMR by one of the following activity levels:

- Little to no exercise: 1.2
- Light exercise (1–3 days per week): 1.375
- Moderate exercise (3–5 days per week): 1.55
- Heavy exercise (6–7 days per week): 1.725
- Very heavy exercise (twice per day, extra heavy workouts): 1.9

Therefore, Estimated energy requirement = BMR × Activity factor. Because BMR equations do not take body composition into account, the resulting calculation may not be accurate for individuals who have a low body fat percentage or who are obese.

Case Study

Using one of the two methods for determining energy needs, calculate your estimated energy requirement. How many calories should you be consuming each day? Do you think you are consuming less or more than the suggested amount? Keep in mind that the calculation methods for determining estimated energy requirement produce estimates, not the specific results of more sophisticated methods such as indirect and direct calorimetry.

Methods of Evaluating Dietary Intake

Although there are many tools available for tracking food intake and physical activity, it is important to find one that best suits your individual needs. Once the nutrient content of the diet has been collected, and estimated energy requirements are established, evaluation of the information should follow. Various methods for evaluating nutrition intake and making body weight recommendations are available. Through their website, the United States Department of Agriculture (USDA) offers individual dietary assessment tools such as the Healthy Eating Index, Fat Intake Screener, and Fruit, Vegetable and Fiber Screener.[19] In addition, this site also offers a tool called Healthy Body Calculator which calculates body frame size, BMI, waist-to-hip ratio, and nutrition intake recommendations. The National Institutes of Health offers a program titled Body Weight Planner which provides guidelines for estimated calorie needs to meet personal body weight goals.[19] Various companies also offer interactive tools to assist in physical activity and nutrition intake assessment, such as My Fitness Pal by Under Armour.[20] If used accurately, programs such as these provide good estimates of average energy intake and can help individuals determine where nutrition intake can be improved.

Outcomes of Nutrition Assessment

After information for a nutrition assessment is gathered and evaluated, all components should be considered collectively to create an accurate overall assessment. When considered together, anthropometric measures, biochemical tests, clinical exams, and dietary evaluations can give a complete picture of an individual's nutritional health. A complete nutrition assessment can lead to recommendations for diet changes as necessary.

Recap A nutrition assessment is an in-depth evaluation of both objective and subjective data as they relate to an individual's food and nutrient intake, lifestyle, and medical history. Once all of the information that makes up a nutrition assessment is obtained and evaluated, appropriate recommendations for dietary improvements can be made. Overall, the nutrition assessment is intended to help people either maintain or attain a healthier nutrition status.

1. Identify the percent body fat considered average for adult females and adult males.
2. Identify each component of a nutrition assessment.
3. Describe two different methods of determining an individual's estimated energy requirements.

The *Dietary Guidelines for Americans, 2020–2025*

Preview The *Dietary Guidelines for Americans* are a set of dietary recommendations released jointly by the United States Department of Health and Human Services (HHS) and the United States Department of Agriculture (USDA). The most current guidelines, the *Dietary Guidelines for Americans 2020–2025*, translate the current science on diet and health into guidelines intended to help people choose foods and beverages that make up a healthy and enjoyable dietary pattern in an effort to achieve good health, reduce risk of diet-related chronic diseases, and meet nutrition needs throughout the lifespan.[21]

Reproduced from U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2020–2025*. 9th ed. Published December 2020. https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf

Dietary Guidelines Focus on Life Stages

The aim of the *Dietary Guidelines for Americans* is to promote health and prevent disease at every stage of life. The *Dietary Guidelines for Americans* are updated every 5 years to reflect the most current body of scientific evidence. Recommendations have remained relatively consistent over time, but each edition builds upon previous editions and evolves with expanded scientific knowledge. The 2020–2025 edition of the *Dietary Guidelines* are the first to include recommendations by life stage from birth through older adulthood. The current *Dietary Guidelines* reflect three fundamental premises: (1) Recognize that diet-related chronic diseases such as cardiovascular disease (CVD), type 2 diabetes, obesity, and some types of cancer are very prevalent among Americans and pose a major public health problem. Therefore, just about everyone, no matter their age or health status, can benefit from shifting their food and beverage choices to better support healthy patterns; (2) Understand that nutrients and foods are not consumed in isolation, but rather in various combinations over time; and (3) Healthy dietary patterns are encouraged at every life stage from infancy through older adulthood.[21] The scientific connection between food and health continues to demonstrate that particular lifestyle components, including having a healthy dietary pattern, help people achieve and maintain good health throughout all stages of life. The *Dietary Guidelines, 2020–2025* focus on the importance of a healthy dietary pattern over time. Because early food choices affect later dietary patterns and health, the *Dietary Guidelines* remind individuals that it is never too late to start and maintain a healthy dietary pattern, which can yield health benefits in the short term and cumulatively over time. This approach recognizes that each life stage is distinct—nutrient needs vary over the lifespan and each life stage has unique implications.[21]

Dietary Pattern

The *Dietary Guidelines for Americans, 2020–2025* recognizes that people consume nutrients and foods in various combinations over time and that these foods and beverages act synergistically to affect health.[21] This concept is referred to as a person's dietary pattern, and it represents the totality of what individuals habitually eat and drink over time. Just as healthy eating and exercise produce an effect on health that is greater than either can yield alone, each part of a person's dietary pattern acts synergistically to affect health and serve as a possible predictor of individual overall health status and disease risk. Science is now showing us that not only do individual dietary patterns support health at any given point in time, they also support health in the next life stage and possibly for future generations. When healthy dietary patterns can be established early in life and sustained, the positive impact on health can be significant.

How does science describe healthy dietary patterns? Healthy dietary patterns consist of eating nutrient-dense forms of foods and beverages from all food groups in recommended serving sizes and within calorie limits. The concept of a healthy dietary pattern provides a framework for the *Dietary Guidelines* to help people personalize their food and beverage choices at each stage of life in such a way as to accommodate their nutritional needs, personal food preferences, cultural traditions and customs, and budgetary considerations.[21] For most individuals, no matter their age or health status, achieving a healthy dietary pattern will require changes in food and beverage choices.

"Make Every Bite Count with the Dietary Guidelines."

- *Dietary Guidelines for Americans, 2020–2025* has a call to action which encourages people to focus on choosing healthy foods and beverages rich in nutrients while staying within individual calorie needs. The most recent edition of the *Dietary Guidelines* shifts the mentality from "taking away bad foods" to "including more nutrient-dense foods" and suggests that 85% of the calories you eat each day come from nutrient-rich foods, leaving 15% of calories for added sugars, saturated fat, and alcohol.[21]

Overarching Guidelines

The *Dietary Guidelines for Americans, 2020–2025* (See FIGURE 1.10) provide four overarching Guidelines supported by Key Recommendations which offer further guidance on healthy eating across the lifespan:

1. Follow a healthy dietary pattern at every life stage.
2. Customize and enjoy nutrient-dense food and beverage choices to reflect personal preferences, cultural traditions, and budgetary considerations.
3. Focus on meeting food group needs with nutrient-dense foods and beverages, and stay within calorie limits.
4. Limit foods and beverages higher in added sugars, saturated fat, and sodium, and limit alcoholic beverages.

Key Recommendations

- Added sugars, saturated fat, sodium, and alcoholic beverages top the list of nutrients or foods that most Americans consume in excess, and although the current *Dietary Guidelines* are not prescriptive in suggesting exactly what to eat and what to avoid, they do provide recommendations on specific limits for each of these nutrients.
- Limit added sugars to less than 10% of calories per day for anyone aged 2 years and older. Infants and toddlers should avoid added sugars completely.

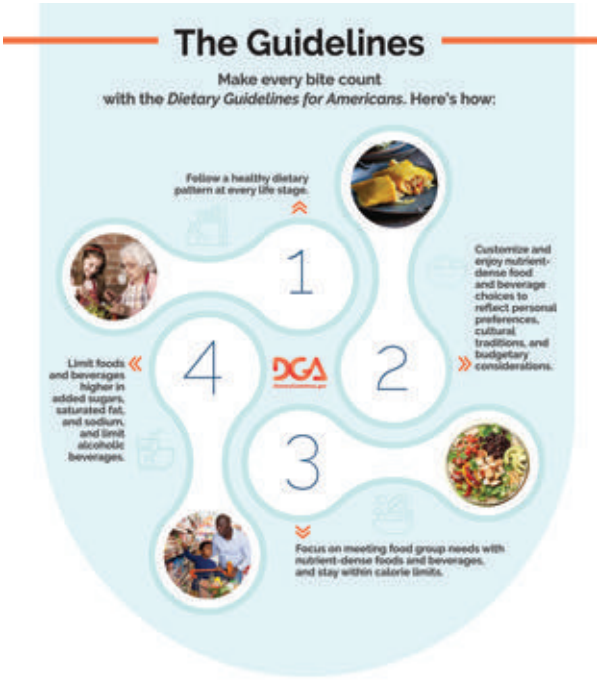


Figure 1.10
***The Dietary Guidelines for Americans, 2020–2025*. Overarching Guidelines and Key Recommendations.**

Reproduced from U.S. Department of Agriculture and U.S. Department of Health and Human Services. *Dietary Guidelines for Americans, 2020–2025*. 9th ed. Published December 2020. https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf

- Limit saturated fat to less than 10% of calories per day starting at 2 years old.
- Limit sodium to less than 2,300 mg per day starting at 2 years old.
- If you consume alcohol, limit intake to 2 drinks per day or less for men and 1 drink per day or less for women.[21]
- The *Dietary Guidelines* provide dietary pattern recommendations for each life stage by suggested calorie levels. They also offer examples of non-nutrient dense foods and nutrient-dense forms of foods.[21] (See TABLE 1.12.)

Table 1.12

***Dietary Guidelines For Americans, 2020–2025* Nutrition Concerns and Recommendations**

Age Group	*Nutrition Circumstances and Concerns*	*Key Recommendations*
Infants and Toddlers	• Key time for establishing healthy dietary patterns that may influence the trajectory of eating behaviors and health throughout the lifespan • Growth and brain development require critical nutrients in adequate amounts	• Exclusively feed infants human milk until 1 year old, or longer if desired • When human milk is not available, feed iron-fortified infant formula during the first year • Supplement with vitamin D beginning soon after birth • At about 6 months, introduce infants to nutrient-dense foods, including potentially allergenic foods • Encourage infants and toddlers to consume a variety of foods from all food groups, including foods rich in iron and zinc, particularly for infants fed human milk • Avoid foods and beverages with added sugars

Age Group	*Nutrition Circumstances and Concerns*	*Key Recommendations*
		• Limit foods and beverages higher in sodium • As infants wean from human milk or infant formula, transition to a healthy dietary pattern
Children and Adolescents (2 to 18 years old)	• Dietary patterns are transitioning and forming during a more independent life stage • Diverse calorie and nutrient needs are based on age and patterns of growth, development, and physical activity	• Calorie suggestions from 2 to 5 years old: Females require about 1,000 to 1,400 calories per day; Males require about 1,000 to 1,600 calories per day • Calorie suggestions from 5 to 8 years old: Females require about 1,200 to 1,800 calories per day; Males require about 1,200 to 2,000 calories per day • Physical activity guidelines for children: At least 3 hours per day of physical activity for preschool-aged children; School-aged children and adolescents need at least 60 minutes of moderate-to-vigorous activity each day, including both aerobic and muscle-strengthening activity • Focus on adequate intake of calcium, vitamin D, potassium, and dietary fiber • Decrease consumption of sugar-sweetened beverages • Increase consumption of nutrient-dense foods
Adults (19 to 59 years old)	• Real or perceived barriers to healthy eating exist during this life stage (balancing work or school responsibilities with personal, family, or other commitments) • Time and financial resource constraints may make it challenging to adopt and maintain a healthy dietary pattern • Because adults live, work, play, and gather in a variety of locations, support for healthy food and beverage choices are needed to improve dietary patterns	• Follow a healthy dietary pattern • Engage in regular physical activity • Manage body weight • Increase intake of dietary fiber, calcium, and vitamin D • Decrease intake of added sugars, saturated fat, and sodium • Limit alcoholic beverages to 1 drink or less in a day for women and 2 drinks or less in a day for men
Women who are Pregnant or Lactating	• Need for adequate nutrient intake to support good health and development of the baby • Need for adequate nutrient intake to maintain good health of the mother • Healthy dietary patterns before and during pregnancy may improve pregnancy outcomes • Following a healthy dietary pattern before and during pregnancy and lactation has the potential to affect health outcomes for both the mother and child in subsequent life stages	• Achieve and maintain a healthy weight before pregnancy, gain weight within gestational weight gain guidelines, and return to a healthy weight during the postpartum period • Meet nutrition needs for folate/folic acid, iron, iodine, and vitamin D during pregnancy • Avoid drinking alcohol • If caffeine is consumed during pregnancy or while lactating, limit to low–moderate amounts
Older Adults	• Greater risk of chronic disease and cancer as well as health conditions related to changes in bone and muscle mass (osteoporosis and sarcopenia) • Achieving a healthy weight	• Calorie needs are generally lower with similar or increased nutrient needs • Calorie suggestions: Females require about 1,600 to 2,200 calories per day; Males require about 2,000 to 2,600 calories per day • Adequacy in nutrients of concern, including protein and vitamin B_{12} • Meet recommendations for protein by choosing from a wide variety of protein sources • Drink enough water to prevent dehydration and aid in the digestion of food and absorption of nutrients • To help increase food enjoyment and promote adequate intake, share meals with friends and family • For those who have difficulty chewing or swallowing, identify food textures that are acceptable, appealing, and enjoyable • Practice safe food handling

Data from U.S. Department of Health and Human Services and U.S. Department of Agriculture. *2015–2020 Dietary Guidelines for Americans*. 8th ed. U.S. Department of Health and Human Services and U.S. Department of Agriculture; 2015. http://health.gov/dietaryguidelines/2015/guidelines

Adequacy, Balance, Moderation, and Variety

As basic principles for healthy eating, the concepts of adequacy, balance, moderation, and variety within an individual's eating pattern are important. Each of these principles introduces an important component to overall health.

Adequacy

Adequacy as it relates to healthy eating means that the foods you choose to eat provide all of the essential nutrients, fiber, and energy in amounts sufficient to support growth and maintain health.[22] Adequacy goes beyond calorie intake. In fact, many Americans eat adequate

calories each day but are still considered undernourished. This is because the foods that they choose to eat are high in calories and low in nutrients. Take, for example, a meal of a hamburger, french fries, and soda. This meal can provide adequate calories for a single meal; however, because it is high in fat and low in vitamins and minerals, it is therefore low in nutrient density and does not meet the criteria for adequacy. Choosing meals and snacks that are high in vitamins and minerals but low to moderate in calorie content offers important benefits such as normal growth and development for children, health promotion for people of all ages, and reduction of risk for a number of chronic diseases that are major public health problems.[22]

Balance and Moderation

Eating healthfully requires having *balance*, or *moderation*, in all food groups, energy sources, and other nutrients such as vitamins and minerals. One challenge when it comes to balance is to consume enough but not too much from all the different food groups. This principle is also where the concept that "all food can fit into a healthy diet" comes into play. Choosing low-nutrient foods occasionally does not classify an individual's diet as unbalanced or unhealthy; rather, eating a balance of high- and low-nutrient-density foods helps to create an overall healthy eating pattern. Like balance, moderation means not taking anything to extremes. Food graphics convey the message of balance and moderation by suggesting amounts of different food groups.

Variety

Variety refers to including many of different foods in the diet. This means eating foods from different food groups and different foods within each of those food groups. For example, if apples are the only fruit a person eats, although this individual is including fruit, the diet lacks variety. Variety is important for a number of reasons. Eating different vegetables, for example, provides a mix of different vitamins, minerals, and other nutrients such as phytochemicals. Having variety in the diet helps ensure that individuals are getting all of the nutrients they need. Studies show that people who eat a varied diet are more likely to meet their overall nutrient needs compared with those who eat a less-varied diet.[23]

Recap *Dietary Guidelines for Americans, 2020–2025* reflects the current body of nutrition science and provides recommendations to help Americans make healthy food and beverage choices. These guidelines serve as the foundation for vital nutrition policies and programs across the United States. They emphasize that healthy dietary patterns at every life stage are important and, regardless of age, individuals should "make every bite count."

1. List the key recommendations in the *Dietary Guidelines for Americans, 2020–2025*.
2. Describe the concept of a dietary pattern and why it is important to the overall health of individuals.
3. Define and describe what adequacy refers to in regard to healthy eating.
4. Explain the difference between having variety in your diet and eating in moderation.

Physical Activity Guidelines

Preview The *Physical Activity Guidelines for Americans* are based on the latest science and provide guidance on how children and adults can improve their health through physical activity. Being physically active is important for individuals of all ages.

Recognizing that regular physical activity is one of the most important things a person can do to improve their health, the HHS, along with the USDA, provides the *Physical Activity Guidelines for Americans*.[23] These guidelines complement the *Dietary Guidelines for Americans* and provide science-based guidance to help Americans ages 6 and older improve their health through physical activity. Since the publication of the first *Physical Activity Guidelines*, more evidence for the benefits of physical activity has surfaced, and such suggestions have become a part of the second edition.[23] New research shows that physical activity is associated with even more positive immediate and long-term health outcomes than previously thought, and those outcomes exist for individuals of all ages, fitness levels, and abilities. In addition, evidence shows that regular physical activity can prevent and/or favorably influence management of seven out of the 10 of the most common chronic conditions. What is more, new research indicates that bouts of moderate-to-vigorous physical activity in any duration of time can contribute to health benefits.[24] Some of the most recent research findings regarding the benefits of physical activity include:

1. Improved bone health and weight status for children 3 to 5 years old
2. Improved cognitive function for youth 6 to 13 years old
3. Reduced risk of bladder, breast, colon, endometrium, esophagus, kidney, stomach, lung and other types of cancer as previously identified

4. Improved cognitive function, reduced anxiety and depression risk, and improved sleep and quality of life
5. For pregnant women, reduced risk of excessive weight gain, gestational diabetes, and postpartum depression
6. For older adults, reduced risk of fall-related injuries
7. For people with various chronic medical conditions, reduced risk of all-cause disease-specific mortality, improved physical function, and improved quality of life.[25]

In recognition of the impact of physical activity on overall health, Key Guidelines have been established for various age groups. Specific physical and activity guidelines will be addressed in corresponding chapters throughout this textbook. Guidelines exist for the following:

- Preschool-Aged Children (3 to 5 years old)
- Children and Adolescents (6 to 17 years old)
- Adults
- Older Adults
- Women During Pregnancy and the Postpartum Period
- Adults with Chronic Health Conditions and Adults with Disabilities
- Safe Physical Activity

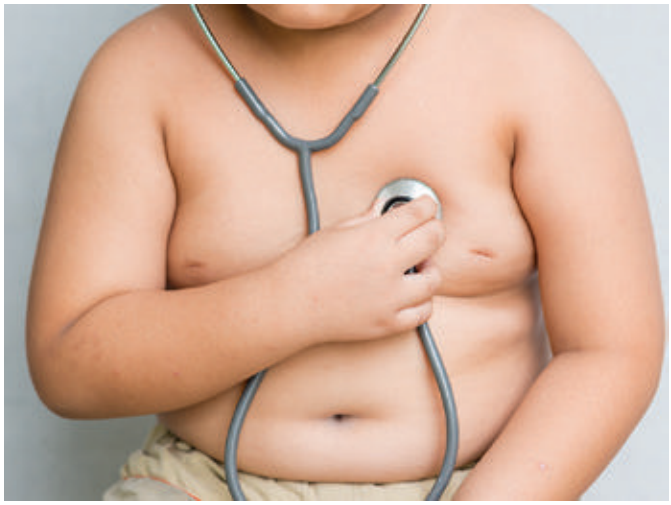
Recap For a healthy lifestyle, it is important to understand the benefits of physical activity and how to make activity a part of your regular routine.

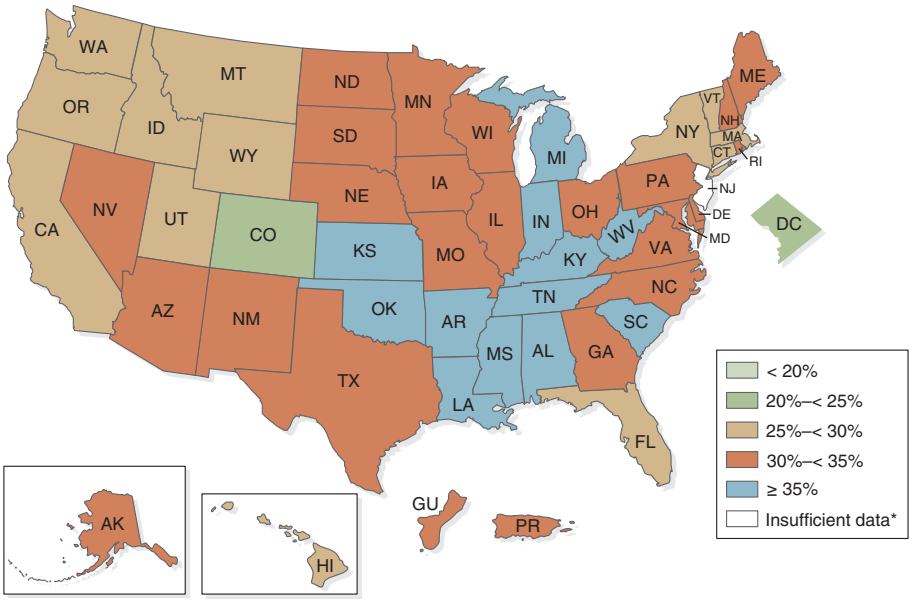
1. What is the daily suggested activity level for children and adolescents?
2. What are the daily suggested activity guidelines for adults to achieve substantial health benefits?

The Obesity Epidemic May Be Decreasing Life Expectancy

Preview Rapid changes in the modern lifestyle have introduced many factors that may decrease the life expectancy of the latest generation.

From the end of the Civil War to the late twentieth century, life span increased rapidly in the United States, a tremendous public health triumph brought about by a more dependable food supply, improved sanitation, and advances in medical care.[25] During the late 1970s, what we now refer to as the obesity epidemic started, and with it a change in U.S. death rates. Rapid changes in today's lifestyle have introduced many factors that have a negative impact on life expectancy. According to the Centers for Disease Control and Prevention (CDC), 18.5% of American children and adolescents aged 2 to 19 years old are classified as obese.[26] Childhood obesity can lead to the development of significant health problems at earlier ages—health problems that can contribute to death well before the current U.S. life expectancy of 78 years is reached. The CDC reports the prevalence of obesity at 39.8%, affecting about 93.3 million U.S. adults.[27] (See FIGURE 1.11.) This trend seems likely to accelerate as the current generation of children reaches adulthood because the prevalence of childhood obesity is higher than it has been in the past. One analysis predicts that by the year 2030, 48.9% of adults in the United States will be obese and 24.2% will be severely obese.[27] In addition, severe obesity and its associated health problems and extra healthcare costs will disproportionately affect women, low-income adults, non-Hispanic black adults and states bordering the lower half of the Mississippi River.[27]





*Sample size < 50, the relative standard error (dividing the standard error by the prevalence) ≥ 30%, or no data in a specific year.

Figure 1.11
Prevalence of Self-Reported Obesity Among U.S. Adults by State and Territory.

Centers for Disease Control and Prevention. Adult obesity prevalence maps: prevalence of self-reported obesity among U.S. adults by state and territory, BRFSS, 2019. https://www.cdc.gov/obesity/data/prevalence-maps.html#states

The formula for achieving and maintaining a healthy weight throughout the life span is multifactorial and even a bit complicated, with suggested factors ranging from genetics, to energy balance, to environmental factors. Recent studies suggest that body weight might have less to do with the body's ability to burn excess calories consumed by increasing activity level and more to do with the type of foods that make up an individual's diet on a regular basis.

As suggested by such sources as the *Dietary Guidelines for Americans*, the public health approach to obesity remains focused on advising people to choose appropriate calorie levels and engage in enough physical activity to achieve or maintain a healthy body weight. At the same time, current trends in the American diet suggest that added sugars and other highly processed carbohydrates comprise the most harmful components of individual diets. Because of this, it may be that national policies must shift away from low-quality commodities such as corn and wheat and instead encourage production of high-quality proteins, fruits and vegetables, legumes, nuts, and other whole foods by offering incentives.[26] Additional action plans from health advocacy groups include taxing sugary beverages, limiting advertising of unhealthy foods targeted to children, and encouraging Congress to increase spending on obesity-related research. Learning and maintaining healthy eating habits early in life can go a long way in preventing deaths resulting from causes brought about by obesity. Furthermore, Americans have an overall shorter life expectancy compared with residents of almost all other high-income countries.[28] Adopting a healthy lifestyle including optimal amounts of physical activity, avoiding smoking, limiting alcohol intake, and maintaining a healthy diet and BMI could substantially reduce the risk of premature death and prolong life expectancy in U.S. adults.[28]

Recap As obesity among the U.S. population continues to increase across age categories, the advice to choose appropriate calorie levels and engage in enough physical activity to achieve or maintain a healthy body weight are paramount.

1. Identify the most harmful components of an individual's diet with regard to contributions to obesity.
2. The formula for achieving and maintaining a healthy weight is multifactorial. Identify some factors that may be contributing to unhealthy weight in both children and adults.

Let's Discuss

Consider that the current obesity epidemic may be decreasing life expectancy. Discuss possible changes and phenomena in the modern lifestyle and factors that negatively affect life expectancy. Describe different ways in which social media, cell phones, and video games contribute to childhood obesity.

Learning Portfolio

Chapter Summary

Introduction

- As we study nutrition needs and recommendations throughout life, we must keep in mind these basic principles that are important for healthy eating regardless of age:
  - Poor nutrition status can result from either inadequate or excessive nutrition intake and can contribute to the development of certain chronic diseases.
  - Energy produced by the body, which is needed for a variety of functions, is provided by food and drink in the form of carbohydrates, proteins, and fats (macronutrients). Each macronutrient provides a specific amount of energy measured in calories.
  - Energy needs vary from person to person and depend on such factors as basal metabolic rate (BMR) and activity level.
  - There are many components of healthy eating, with adequacy, balance, moderation, and variety in food choices being key characteristics.

The Science of Nutrition

- Basic principles of healthy eating can help guide healthy nutrition choices.
- Our diets are made up of a combination of essential and nonessential nutrients, each with suggested recommended intake levels for optimal nutrition.
- The macronutrients carbohydrate, protein, and fat provide our bodies with calories and essential nutrients. Carbohydrates are the body's preferred source of energy, providing energy to the brain, muscles, and nervous system. Protein exists in every cell of the body and functions to build, repair, and maintain bones, muscles, and skin. Fat not only provides calories but also helps our bodies absorb fat-soluble vitamins and keeps our skin and hair healthy.

Micronutrients

- Adequate vitamin, mineral, and water intake is essential for life.
- Our body can produce some of the vitamins that it needs; others must come from the diet.
- Minerals are elements that originate in the earth and cannot be made by human bodies. Plants obtain minerals from the soil, providing humans dietary sources of a number of minerals either directly through the consumption of plants or indirectly through the consumption of animal sources that feed on mineral-rich food sources. Minerals may also be present in the water we drink.

Nutrition Assessment

- A nutrition assessment is an in-depth evaluation of both objective and subjective data as they relate to an individual's food and nutrient intake, lifestyle, and medical history. Once all of the information that makes up a nutrition assessment is obtained and evaluated, appropriate recommendations for dietary improvements can be made. Overall, the nutrition assessment is intended to help people either maintain a healthy or attain a healthier nutrition status.

The *Dietary Guidelines for Americans 2020–2025*

- *Dietary Guidelines for Americans, 2020–2025* reflects the current body of nutrition science. The guidelines provide recommendations that help Americans make healthy food and beverage choices and serve as the foundation for vital nutrition policies and programs across the United States.
- The nutrition principles of adequacy, balance, moderation, and variety can help individuals maintain or improve their overall health at all stages of life.

Physical Activity Guidelines

- Regular physical activity is one of the most important things a person can do to improve their health.
- New research shows that physical activity is associated with even more positive immediate and long-term health outcomes than previously thought.
- Evidence shows that regular physical activity can prevent and/or favorably influence management of seven out of the 10 most common chronic conditions. What is more, new research indicates that bouts of moderate-to-vigorous physical activity in any duration of time can contribute to health benefits.

The Obesity Epidemic May Be Decreasing Life Expectancy

- As obesity among the U.S. population continues to increase across age categories, the advice to choose appropriate calorie levels and engage in enough physical activity to achieve or maintain a healthy body weight is paramount.