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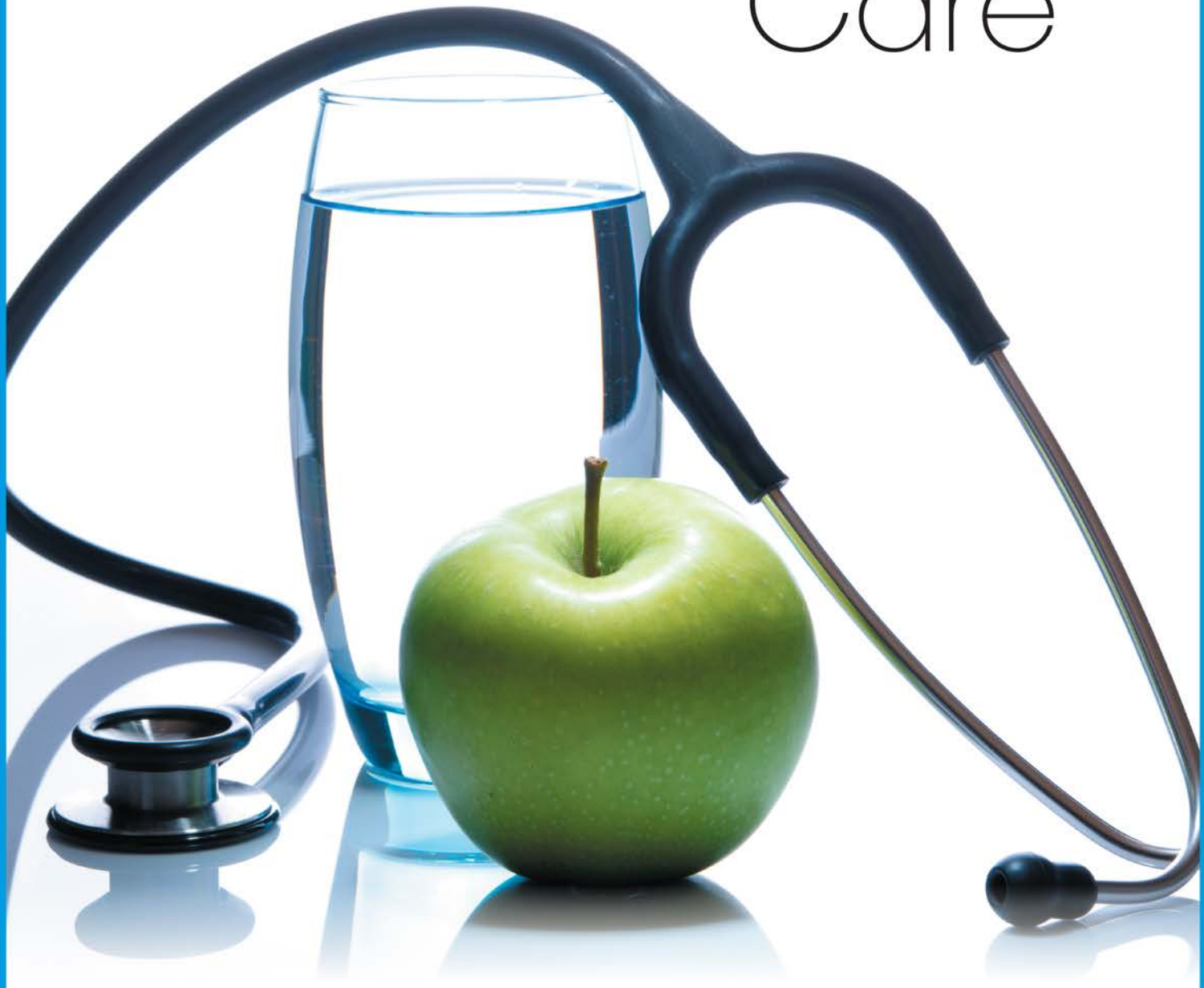
# Nutrition for Health & Health Care



Linda DeBruyne • Kathryn Pinna

# Nutrition for Health and Health Care

Eighth Edition

Linda Kelly DeBruyne
Kathryn Pinna

CENGAGE

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***Nutrition for Health and Health Care,***
**Eighth Edition**
**Linda Kelly DeBruyne, Kathryn Pinna**

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To my grandchildren, Ryder, Cruz, and Skyler, with love from the luckiest Nani in the world.

**Linda Kelly DeBruyne**

In memory of my parents, John and Tina Pinna, who inspired my love of books and learning from my earliest years.

**Kathryn Pinna**

# About the Authors

**Linda Kelly DeBruyne, M.S., R.D.,** received her B.S. and M.S. degrees in nutrition and food science at Florida State University. She is a founding member of Nutrition and Health Associates, an information resource center in Tallahassee, Florida, where her specialty areas are life cycle nutrition and fitness. She worked with a group of pediatricians for 30 years, teaching infant nutrition classes to new parents. Her other publications include the textbooks *Nutrition and Diet Therapy* and *Health: Making Life Choices.* She is a registered dietitian and maintains a professional membership in the Academy of Nutrition and Dietetics.

**Kathryn Pinna, Ph.D.,** received her M.S. and Ph.D. degrees in nutrition from the University of California at Berkeley. She taught nutrition, food science, and human biology courses in the San Francisco Bay Area for more than 25 years and also worked as an outpatient dietitian, Internet consultant, and freelance writer. Her other publications include the textbooks *Understanding Normal and Clinical Nutrition* and *Nutrition and Diet Therapy*. She is a member of the American Society for Nutrition and the Academy of Nutrition and Dietetics.

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# Preface

We are pleased to present this eighth edition of *Nutrition for Health and Health Care*, which provides a solid foundation in nutrition science and the role of nutrition in clinical care. Health professionals and patients alike rank nutrition among their most serious concerns, as good nutrition status plays critical roles in both disease prevention and the appropriate treatment of illness. Moreover, medical personnel are frequently called upon to answer questions about foods and diets or provide nutrition care. Although much of the material has been written for nursing students and is relevant to nursing care, this textbook can be useful for students of other health-related professions, including nursing assistants, physician assistants, dietitians, dietary technicians, and health educators.

## Organization of This Text

Each chapter of this textbook includes essential nutrition concepts along with practical information for addressing nutrition concerns and solving nutrition problems. The introductory chapters (Chapters 1 and 2) provide an overview of the nutrients and nutrition recommendations and describe the process of digestion and absorption. Chapters 3 through 5 introduce the attributes and functions of carbohydrates, lipids, and protein and explain how appropriate intakes of these nutrients support health. Chapters 6 and 7 introduce the concepts of energy balance and weight management and describe the health effects of overweight, underweight, and eating disorders. Chapters 8 and 9 introduce the vitamins and minerals, describing their roles in the body, appropriate intakes, and food sources. Chapters 10 through 12 explain how nutrient needs change throughout the life cycle. Chapters 13 and 14 explore how health professionals can use information from nutrition assessments to identify and address a patient's dietary needs. The remaining chapters (Chapters 15–23) examine nutrition therapy and its role in the prevention and treatment of common medical conditions.

## Features of This Text

Students of nutrition often begin a nutrition course with some practical knowledge of nutrition; after all, they may purchase food, read food labels, and be familiar with common nutrition problems such as obesity or lactose intolerance. After just a few weeks of class, however, the student realizes that nutrition is a biological and chemical science with a fair amount of new terminology and new concepts to learn. This book contains abundant pedagogy to help students master the subject matter. Within each chapter, definitions of important terms appear in the margins. How To skill boxes help readers work through calculations or give practical suggestions for applying nutrition advice. The Nursing Diagnosis feature enables nursing students to correlate nutrition care with nursing care. Review Notes summarize the information following each major heading; these summaries can be used to preview or review key chapter concepts. The Self Check at the end of each chapter provides questions to help review chapter information.

In the life cycle and clinical chapters, Case Studies guide readers in applying nutrition therapy to patient care. Diet-Drug Interaction boxes in the clinical chapters identify important nutrient-drug and food-drug interactions. Clinical Applications throughout the text encourage readers to practice mathematical calculations, synthesize information from previous chapters, or understand how dietary adjustments affect patients. Nutrition Assessment Checklists remind readers of assessment parameters relevant to specific stages of the life cycle or medical problems.

The Nutrition in Practice sections that follow the chapters explore issues of current interest, advanced topics, or specialty areas such as dental health or dialysis. Examples of topics covered include foodborne illness, the glycemic index, vegetarian diets, alcohol in health and disease, nutritional genomics, the metabolic syndrome, and childhood obesity and chronic disease. The appendixes support the book with a wealth of information on the World Health Organization (WHO) nutrient intake recommendations, food lists for diabetes and weight management, dysphagia diets, physical activity and energy requirements, nutrition assessments, enteral formulas, and aids to calculations.

## Ancillary Materials

Students and instructors alike will appreciate the innovative teaching and learning materials that accompany this text.

### MindTap

MindTap for DeBruyne, *Nutrition for Health and Health Care*, 8e, today's most innovative online learning platform, powers your students from memorization to mastery. MindTap gives you complete control of your course to provide engaging content, challenge every individual and build students' confidence.

### Instructor Companion Site

Everything you need for your course in one place! This collection of product-specific lecture and class tools is available online via www.cengage.com/login. Access and download PowerPoint presentations, images, instructors' manual, and more.

### Test Bank with Cognero

Cengage Testing, powered by Cognero®, is a flexible, online system that allows you to import, edit, and manipulate content from the text's test bank or elsewhere, including your own favorite test questions; create multiple test versions in an instant; and deliver tests from your LMS, your classroom, or wherever you want.

### Diet & Wellness Plus

Diet & Wellness Plus helps you understand how nutrition relates to your personal health goals. Track your diet and activity, generate reports, and analyze the nutritional value of the food you eat. Diet & Wellness Plus includes over 75,000 foods as well as custom food and recipe features. Diet & Wellness Plus is also available as an app that can be accessed from the app dock in MindTap.

## New to This Edition

Each chapter of this book is based on current nutrition knowledge and the latest clinical practice guidelines, and features new learning objectives for each major section. Some major content changes in this edition include the following:

### Chapter 1

- Introduced and defined macronutrients and micronutrients.
- Introduced and defined Chronic Disease Risk Reduction Intakes.
- Added a new table and figure featuring the *Dietary Guidelines for Americans, 2020–2025*.
- Included a new food label figure.

### Chapter 2

- Redid the figure on the emulsification of fat by bile.
- Included a new table of refrigerator and freezer home storage times in the Nutrition in Practice.

### Chapter 3

- Added a new heading and section describing the importance of glucose in the body, including as an energy source, and what happens when carbohydrate intake is inadequate.
- Included a new table of the importance of glucose in the body.
- Rewrote the section on the health effects of sugar.

### Chapter 4

- Reorganized the chapter to match the organization of the chapters on carbohydrate and protein.
- Added new information on *trans* fats.
- Added new information on eggs and on dietary cholesterol and blood cholesterol.

### Chapter 5

- Added information on, and a definition of, whey protein.
- Added definitions of omnivorous diet and plant-based diets in the Nutrition in Practice.
- Included a new table of strategies for a more plant-based diet in the Nutrition in Practice.
- Included a sample menu for a vegetarian meal plan in the Nutrition in Practice.

## Chapter 6

- Expanded the discussion of intermittent fasting.
- Added more information about subcutaneous fat.

## Chapter 7

- Added information about ultra-processed foods and weight loss.
- Shortened the discussion of weight-loss drugs and removed the table listing weight-loss drugs.

## Chapter 8

- Added a brief discussion of vitamin C and cancer treatment.

## Chapter 9

- Defined the term *osmosis*.
- Included new information about sodium and the Chronic Disease Risk Reduction Intake recommendation for sodium.

## Chapter 10

- Added risk factors for neural tube defects.
- Enhanced the discussion of preeclampsia.
- Introduced and defined the term *certified lactation consultant*.

## Chapter 11

- Added a new table of key dietary recommendations for infants and toddlers from the *Dietary Guidelines for Americans, 2020–2025*.
- Rewrote parts of the Introducing First Foods section.
- Introduced and defined the term *baby-led weaning*.
- Added a new table of recommendations for preventing obesity in children.

## Chapter 12

- Added sodium and potassium to the table of nutrient concerns of aging.
- Introduced and defined food insufficiency in the Nutrition in Practice.

## Chapter 13

- Updated statistics as necessary.
- Added definitions for *muscle wasting*, *morbidity*, and *mortality*.
- Updated the laboratory test values (Table 13-9) according to current references.
- Modified the table on the clinical signs of nutrient deficiencies (Table 13-10).
- Introduced the term *nutrition-focused physical examination*.
- Modified the discussion of hydration status.
- In the Nutrition in Practice on nutritional genomics, replaced the glossary term *polymorphism* with the term *variant*, in keeping with the current research literature.

## Chapter 14

- Reorganized the sections related to approaches to nutrition care.
- Modified some material related to diet-drug interactions.
- Updated several paragraphs in the Nutrition in Practice on complementary and alternative medicine.

## Chapter 15

- In the section on enteral nutrition, modified several paragraphs related to enteral formulas, the administration of tube feedings, and gastric residual volume.
- In the section on parenteral nutrition, replaced the term *total parenteral nutrition (TPN)* with *central parenteral nutrition (CPN)* and modified the discussion about adding medications to parenteral solutions.
- In the Nutrition in Practice about inborn errors, modified the information related to glycogen storage disease in Table NP15-1 and added a new type of enzyme therapy to the section on treatments for phenylketonuria.

## Chapter 16

- Modified several paragraphs related to nutritional requirements during acute stress.
- In the section on chronic obstructive pulmonary disease (COPD), revised material on the nutrition therapy for COPD and exercise recommendations for people with COPD.

## Chapter 17

- Updated statistics throughout the chapter.
- Introduced the International Dysphagia Diet Standardisation Initiative (IDDSI), an alternative framework for dysphagia diets. Added a new appendix (Appendix G) that provides additional information on the IDDSI diets.
- Modified material in the sections on dysphagia, dyspepsia, gastritis, and peptic ulcer disease.

## Chapter 18

- Updated statistics throughout the chapter.
- Added a sample menu listing a day's fiber-containing foods in the section on constipation, and modified the discussion of the treatment of constipation.
- Clarified material in the sections on diarrhea, bacterial overgrowth, pancreatitis, cystic fibrosis, irritable bowel syndrome, and diverticular disease of the colon; revised some information about the nutrition therapy for chronic pancreatitis.
- Added a definition for *toxic megacolon* in the section on ulcerative colitis.

## Chapter 19

- Updated table data and statistics throughout the chapter.
- Modified information on the nutrition-related treatments for fatty liver and liver cirrhosis.
- Revised the discussion of hepatic encephalopathy. Modified the definition of *branched-chain amino acids* and eliminated the definition of *aromatic amino acids*.
- In the Nutrition in Practice on alcohol, updated the recommendations for alcohol consumption and clarified the descriptions of binge drinking and alcohol use disorder.

## Chapter 20

- Updated statistics throughout the chapter.
- Updated material on the diagnosis of diabetes and prevention of type 2 diabetes; updated dietary recommendations to reflect current clinical practice guidelines.
- In the section on meal-planning strategies, added a paragraph about the diabetes plate method.
- Expanded the section on the nutrition treatment for gestational diabetes.
- In the Nutrition in Practice on metabolic syndrome, eliminated the figure on ethnic differences in metabolic syndrome in the United States, added a statement about the global prevalence of metabolic syndrome, and modified the discussion of dietary strategies for this condition.

## Chapter 21

- Updated statistics throughout the chapter.
- Modified some paragraphs in the section on causes of atherosclerosis; eliminated the definition for *shear stress.*
- Revised material in the section on lifestyle management for cardiovascular disease, including the box on implementing a heart-healthy diet.
- Modified some material on nutrition-related treatments for heart failure.

## Chapter 22

- Updated statistics throughout the chapter.
- Revised the tables on the evaluation of chronic kidney disease, the dietary guidelines for chronic kidney disease, and the one-day menu for chronic kidney disease.
- In the section on the treatment of chronic kidney disease, revised the paragraphs about energy intakes, protein, potassium, and vitamins and minerals.
- In the section on kidney stones, modified the paragraphs on the prevention and treatment of calcium oxalate stones and uric acid stones.

## Chapter 23

- Updated statistics throughout the chapter.
- Updated the tables on the environmental factors that increase cancer risk, nutrition-related factors that influence cancer risk, and guidelines for reducing cancer risk.
- Revised the section on immunotherapy for cancer and added a definition for *cancer immunotherapy.*

# Acknowledgments

Among the most difficult words to write are those that express the depth of our gratitude to the many dedicated people whose efforts have made this book possible. A special note of appreciation to Sharon Rolfes for her numerous contributions to the chapters and Nutrition in Practice sections as well as to the Dietary Reference Intakes in the appendices. Many thanks to Fran Webb for sharing her knowledge, ideas, and resources about the latest nutrition developments. Thanks also to David L. Stone for his assistance with multiple sections in the clinical chapters. We are indebted to our production team, especially Rachel Kerns for seeing this project through. To the many others involved in designing, indexing, typesetting, dummying, and marketing, we offer our thanks. We are especially grateful to our associates, family, and friends for their continued encouragement and support.

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# Overview of Nutrition and Health

## Learning Objectives (LOs)

**LO 1.1** Describe the factors that influence personal food choices.

**LO 1.2** Identify which of the major classes of nutrients are organic and which yield energy.

**LO 1.3** Describe the five categories of the Dietary Reference Intakes (DRI); the Estimated Energy Requirement (EER); and the Acceptable Macronutrient Distribution Ranges (AMDR).

**LO 1.4** Describe the ways in which the kinds of information collected by researchers from nutrition surveys are used.

**LO 1.5** Explain how each of the dietary ideals can be used to plan a healthy diet, and how the Dietary Guidelines and USDA Dietary Patterns help make diet planning easier.

**LO 1.6** Compare the information on food labels to make selections that meet specific dietary and health goals.

**LO 1.7** Discuss how misinformation and reliable nutrition information can be identified.

**Every day, several times a day, you make choices that will either** improve your **health** or harm it. Each choice may influence your health only a little, but when these choices are repeated over years and decades, their effects become significant.

The choices people make each day affect not only their physical health but also their **wellness**—all the characteristics that make a person strong, confident, and able to function well with family, friends, and others. People who consistently make poor lifestyle choices on a daily basis increase their risks of developing diseases. These daily choices may be influenced by environmental and social factors, which in turn may contribute to people's health outcomes. Figure 1-1 shows how a person's health can fall anywhere along a continuum, from maximum wellness on one end to total failure to function (death) on the other end.

As nurses, registered dietitian nutritionists, or other health care professionals, when you take responsibility for your own health by making daily choices and practicing behaviors that enhance your well-being, you prepare yourself physically, mentally, and emotionally to meet the demands of your profession. As health care professionals, however, you have a responsibility to your clients as well as to yourselves.* You have unique opportunities to make your clients aware of the benefits of positive health choices and behaviors, to show them how to change their behaviors and make daily choices to enhance their own health, and to serve as role models for those behaviors.

This text focuses on how nutrition choices affect health and disease. The early chapters introduce the basics of nutrition to promote good health and reduce disease risks. The later chapters emphasize medical nutrition therapy and its role in supporting health and in treating diseases and symptoms.

## 1.1 Food Choices

Sound **nutrition** throughout life does not ensure good health and long life, but it can certainly help to tip the balance in their favor. Nevertheless, many people choose foods for reasons other than their nourishing value. Even people who claim to choose foods primarily for the sake of health or nutrition will admit that other factors also influence their food choices. Because food choices become an integral part of their lifestyles, people sometimes find it difficult to change their eating habits. Health care professionals who help clients make diet changes must understand the dynamics of food choices because people will alter their eating habits only if their preferences and other influencing factors such as ethnic heritage and food availability are honored. Developing **cultural competence** is one aspect of honoring individual preferences, especially for health care professionals who help clients achieve a nutritious diet.

**Preference** Why do people like certain foods? One reason, of course, is their preference for certain tastes. Some tastes are widely liked, such as the sweetness of sugar and the savoriness of salt. Research suggests that genetics influence people's taste preferences, a finding that may eventually have implications for clinical nutrition.[1] For example, sensitivity to bitter taste is a heritable trait. People born with great sensitivity to bitter tastes tend to avoid foods with bitter flavors such as broccoli, cabbage, brussels sprouts, spinach, and grapefruit juice. These foods, as well as many other fruits and vegetables,

**health:** a range of states with physical, mental, emotional, spiritual, and social components. At a minimum, health means freedom from physical disease, mental disturbances, emotional distress, spiritual discontent, social maladjustment, and other negative states. At a maximum, health means *wellness*.

**wellness:** maximum well-being; the top range of health states; the goal of people who strive toward realizing their full potential physically, mentally, emotionally, spiritually, and socially.

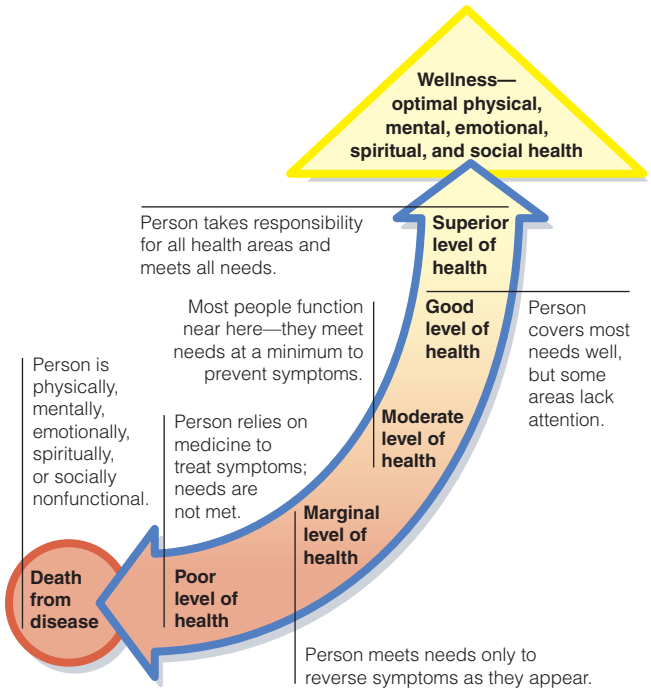
**nutrition:** the science of foods and the nutrients and other substances they contain, and of their ingestion, digestion, absorption, transport, metabolism, interaction, storage, and excretion. A broader definition includes the study of the environment and of human behavior as it relates to these processes.

**cultural competence:** an awareness and acceptance of one's own and others' cultures, combined with the skills needed to interact effectively with people of diverse cultures.

*Health care professionals generally use either *client* or *patient* when referring to an individual under their care. The first 12 chapters of this text emphasize the nutrition concerns of people in good health; therefore, the term *client* is used in these chapters.

**Figure 1-1** The Health Line

No matter how well you maintain your health today, you may still be able to improve tomorrow. Likewise, a person who is well today may slip if they are unable to maintain health-promoting habits.




**bioactive food compounds:** compounds in foods (either nutrients or phytochemicals) that alter physiological processes in the body.

**phytochemicals** (FIGH-toe-CHEM-ih-cals)**:** compounds in plants that confer color, taste, and other characteristics. Some phytochemicals are bioactive food components in functional foods. Nutrition in Practice 8 provides details.

**foodways:** the eating habits and culinary practices of a people, region, or historical period.

**ethnic diets:** foodways and cuisines typical of national origins, races, cultural heritages, or geographic locations.

contain **bioactive food compounds**—**phytochemicals** and nutrients—that may reduce the risk of cancer and other chronic diseases. Thus, the role that genetics may play in food selection is gaining importance in cancer research. Nutrition in Practice 8 addresses phytochemicals and their role in disease prevention.

**Habit** Sometimes habit dictates people's food choices. People eat a sandwich for lunch or drink orange juice at breakfast simply because they have always done so. Eating a familiar food and not having to make any decisions can be comforting.

**Positive and Negative Associations** People also like foods with happy associations—foods eaten in the midst of warm family gatherings on traditional holidays or given to them as children by someone who loved them. By the same token, people can attach intense and unalterable dislikes to foods that they ate when they were sick or that were forced on them when they weren't hungry.

**Ethnic Heritage and Regional Cuisines** Every country, and every region of a country, has its own typical foods and ways of combining them into meals (see Photo 1-1). The **foodways** of North America reflect the many different cultural and ethnic backgrounds of its inhabitants. Many foods with foreign origins are familiar items on North American menus: tacos, egg rolls, lasagna, sushi, and gyros, to name a few. Still others, such as spaghetti and croissants, are almost staples in the "American diet." North American regional cuisines such as Cajun and TexMex blend the traditions of several cultures. Table 1-1 (p. 4) presents selected **ethnic diets** and food choices.

**Photo 1-1**

pepsee3D/Shutterstock.com

An enjoyable way to learn about a culture is to taste the ethnic foods.

**Table 1-1** Selected Ethnic Cuisines and Food Choices

| | Grains | Vegetables | Fruits | Protein Foods | Milk |
|---|---|---|---|---|---|
| Asian  Plateresca/Shutterstock.com | Millet, rice, rice or wheat noodles | Baby corn, bamboo shoots, bok choy, leafy greens (such as amaranth), cabbages, mung bean sprouts, scallions, seaweed, snow peas, straw mushrooms, water chestnuts, wild yam | Kumquats, loquats, lychee, mandarin oranges, melons, pears, persimmons, plums | Pork; duck and other poultry; fish, octopus, sea urchin, squid, and other seafood; soybeans, tofu; eggs; cashews, peanuts | Soy milk |
| Mediterranean  from my point of view /Shutterstock.com | Bulgur, couscous, focaccia, Italian bread, pastas, pita pocket bread, polenta, rice | Artichokes, cucumbers, eggplant, fennel, grape leaves, leafy greens, leeks, onions, peppers, tomatoes | Berries, dates, figs, grapes, lemons, melons, olives, oranges, pomegranates, raisins | Fish and other seafood, gyros, lamb, pork, sausage, chicken, fava beans, lentils, almonds, walnuts | Feta, goat, mozzarella, parmesan, provolone, and ricotta cheeses; yogurt and yogurt beverages |
| Mexican  Natasha Breen /Shutterstock.com | Hominy, masa (corn flour dough), tortillas (corn or flour), rice | Bell peppers, cactus, cassava, chayote, chili peppers, corn, jicama, onions, summer squash, tomatoes, winter squash, yams | Avocados, bananas, guava, lemons, limes, mangoes, oranges, papayas, plantains | Beans, refried beans, beef, goat, pork, chorizo, chicken, fish, eggs | Cheese, flan (baked caramel custard), milk in beverages |

**Values** Food choices may reflect people's environmental concerns, religious beliefs, and political views. By choosing to eat some foods or to avoid others, people make statements that reflect their values. For example, people may select only foods that come in containers that can be reused or recycled. A concerned consumer may boycott fruits or vegetables picked by migrant workers who have been exploited. People may buy vegetables from local farmers to save the fuel and environmental costs of foods shipped from far away. Labels on some foods carry statements or symbols—known as *ecolabels*—that imply that the foods have been produced in ways that are considered environmentally favorable.

Religion also influences many people's food choices. Jewish law sets forth an extensive set of dietary rules. Many Christians forgo meat on Fridays during Lent, the period prior to Easter. In Islamic dietary laws, permitted or lawful foods are called *halal*. Other faiths prohibit some dietary practices and promote others. Professionals who help others plan healthy dietary patterns can do so only if they respect and honor each person's values.

**Social Interaction** Social interaction is another powerful influence on people's food choices. Meals are often social events, and the sharing of food is part of hospitality. Social customs invite people to accept food or drink offered by a host or shared by a group—regardless of hunger signals. Social interactions may also influence people to reject or refuse food or drink. Food brings people together for many different reasons: to celebrate a holiday or special event, to renew an old friendship, to make new friends, to conduct business, and many more. Sometimes food is used to influence or impress someone. For example, a business executive invites a prospective new client out to dinner in hopes of edging out the competition. In each case, for whatever the purpose, food plays an integral part of the social interaction.

**Emotional State** Emotions guide food choices and eating behaviors.[2] Some people cannot eat when they are emotionally upset. Others may eat in response to a variety of emotional stimuli—for example, to relieve boredom or depression or to calm anxiety. A person who is depressed may choose to eat rather than to call a friend. A person who has returned home from an exciting evening out may unwind with a late-night snack. Eating in response to emotions can easily lead to overeating and obesity but may be appropriate at times. For example, sharing food at times of bereavement serves both the giver's need to provide comfort and the receiver's need to be cared for and to interact with others as well as to take nourishment.

**Marketing** Another major influence on food choices is marketing. The food industry competes for our food dollars, persuading consumers to eat more—more food, more often. These marketing efforts pay off well, generating more than $900 billion in sales each year. In addition to building brand loyalty, food companies attract busy consumers with their promises of convenience.

**Availability, Convenience, and Economy** The influence of these factors on people's food selections is clear. You cannot eat foods if they are not available, if you cannot get to the grocery store, if you do not have the time or skill to prepare them, or if you cannot afford them. Consumers who value convenience frequently eat out, bring home ready-to-eat meals, or have food delivered. Whether decisions based on convenience meet a person's nutrition needs depends on the choices made. Eating a banana or a candy bar may be equally convenient, but the fruit provides more vitamins and minerals and less sugar and fat than the candy bar.

Given the abundance of convenient food options, fewer adults are learning the cooking skills needed to prepare meals at home, which has its downside. People who are competent in their cooking skills and frequently eat their meals at home tend to make healthier food choices.[3] Not surprisingly, when eating out, consumers choose low-cost fast-food outlets over more expensive fine-dining restaurants. Foods eaten away from home, especially fast-food meals, tend to be high in nutrients that Americans overconsume (saturated fat and sodium) and low in nutrients that Americans underconsume (calcium, fiber, and iron)—all of which can contribute to a variety of health problems.

Some people have jobs that keep them away from home for days at a time, require them to conduct business in restaurants or at conventions, or involve hectic schedules that allow little or no time for meals at home. For these people, the kinds of restaurants available to them and the cost of eating out so often may limit food choices.

**Age** Age influences people's food choices. Infants, for example, depend on others to choose foods for them. Older children also rely on others but become more active in selecting foods that taste sweet and are familiar to them and rejecting those foods whose taste or texture they dislike. In contrast, the links between taste preferences and food choices in adults are less direct than in children. Adults often choose foods based on health concerns such as body weight. Indeed, adults may avoid sweet or familiar foods because of such concerns.

**Body Weight and Image** Sometimes people select certain foods and supplements that they believe will improve their physical appearance and avoid those they believe might be detrimental. Such decisions can be beneficial when based on sound nutrition and fitness knowledge but may undermine good health when based on fads or carried to extremes. Eating disorders are the topic of Nutrition in Practice 6.

**Medical Conditions** Sometimes medical conditions and their treatments (including medications) limit the foods a person can select. For example, a person with heart disease might need to adopt a diet low in certain types of fats. The chemotherapy used to treat cancer can interfere with a person's appetite or limit food choices by causing vomiting.

Photo 1-2

wavebreakmedia/Shutterstock.com

Nutrition is only one of the many factors that influence people's food choices.

Allergies to certain foods can also limit choices. The second half of this text discusses how diet can be modified to accommodate different medical conditions.

**Health and Nutrition** Finally, of course, many consumers make food choices they believe are nutritious and healthy (see Photo 1-2). Making healthy food choices 100 years ago was rather easy when the list of options was relatively short and markets sold mostly fresh, **whole foods**. Examples of whole foods include vegetables and legumes; fruit; seafood, meats, poultry, eggs, nuts, and seeds; milk; and whole grains. Today, tens of thousands of food items fill the shelves of super-grocery stores and most of those items are **processed foods**. Whether a processed food is a healthy choice depends, in part, on how extensively the food was processed. When changes are minimal, processing can provide an abundant, safe, convenient, affordable, and nutritious product.

Examples of minimally processed foods include frozen vegetables, fruit juices, smoked salmon, cheeses, and breads. The nutritional value diminishes, however, when changes are extensive, creating **ultra-processed foods**. Ultra-processed foods no longer resemble whole foods; they are made from substances that are typically used in food preparation but not consumed as foods themselves (such as oils, fats, flours, refined starches, and sugars). These substances undergo further processing by adding a little, if any, minimally processed foods, salt and other preservatives, and additives such as flavors and colors. Examples of ultra-processed foods include soft drinks, corn chips, fruit gummies, chicken nuggets, canned cheese spreads, and toaster pastries. Notably, these foods cannot be made in a home kitchen using common grocery ingredients. Dominating the global market, ultra-processed foods tend to be attractive, tasty, designed for a long shelf-life, heavily advertised, and cheap—as well as high in fat and sugar.[4] People who are willing and able to make healthy food choices will select fewer ultra-processed foods and more whole foods and minimally processed foods.[5]

**whole foods:** fresh foods such as vegetables, grains, legumes, meats, and milk that are unprocessed or minimally processed.

**processed foods:** foods that have been intentionally changed by the addition of substances, or a method of cooking, preserving, milling, or such.

**ultra-processed foods:** foods that have been made from substances that are typically used in food preparation but are not consumed as foods by themselves (such as oils, fats, flours, refined starches, and sugars), and that undergo further processing by adding a little, if any, minimally processed foods, salt and other preservatives, and additives such as flavors and colors.

**nutrients:** substances obtained from food and used in the body to provide energy and structural materials and to serve as regulating agents to promote growth, maintenance, and repair. Nutrients may also reduce the risks of some diseases.

## Review Notes

- A person selects foods for many different reasons.
- Food choices influence health—both positively and negatively. Individual food selections neither make nor break a diet's healthfulness, but the balance of foods selected over time can make an important difference to health.
- In the interest of health, people are wise to think "nutrition" when making their food choices.

## 1.2 The Nutrients

You are a collection of molecules that move. All these moving parts are arranged in patterns of extraordinary complexity and order—cells, tissues, and organs. Although the arrangement remains constant, the parts are continually changing, using **nutrients** and energy derived from nutrients.

Almost any food you eat is composed of dozens or even hundreds of different kinds of materials. Spinach, for example, is composed mostly of water (95 percent), and most of its solid materials are the compounds carbohydrates, fats (properly called lipids), and proteins. If you could remove these materials, you would find a tiny quantity of minerals, vitamins, and other compounds.

### Six Classes of Nutrients

Water, carbohydrates, fats, proteins, vitamins, and minerals are the six classes of nutrients commonly found in spinach and other foods. Some of the other materials in foods, such as the pigments and other phytochemicals, are not nutrients but may still be important

to health. The body can make some nutrients for itself, at least in limited quantities, but it cannot make them all, and it makes some in insufficient quantities to meet its needs. Therefore, the body must obtain many nutrients from foods. The nutrients that foods must supply are called **essential nutrients**. When used to refer to nutrients, the word *essential* means more than just "necessary"; it means "needed from outside the body"—normally, from foods.

**essential nutrients:** nutrients a person must obtain from food because the body cannot make them for itself in sufficient quantities to meet physiological needs.

**Carbohydrates, Fats, and Proteins** Four of the six classes of nutrients (carbohydrates, fats, proteins, and vitamins) contain carbon, which is found in all living things. They are therefore **organic** (meaning, literally, "alive").* During metabolism, three of these four (carbohydrates, fats, and proteins) provide energy the body can use.** These **energy-yielding nutrients** continually replenish the energy you expend daily.

Carbohydrate, fat, and protein are sometimes called **macronutrients** because the body requires them in relatively large amounts (many grams daily). In contrast, vitamins and minerals are **micronutrients**, required only in small amounts (milligrams or micrograms daily).

**organic:** in chemistry, substances or molecules containing carbon–carbon bonds or carbon–hydrogen bonds. The four organic nutrients are carbohydrate, fat, protein, and vitamins.

**energy-yielding nutrients:** the nutrients that break down to yield energy the body can use. The three energy-yielding nutrients are carbohydrate, protein, and fat.

**macronutrients:** another name for the energy-yielding nutrients: carbohydrate, fat, and protein.

**micronutrients:** nutrients required in very small amounts: vitamins and minerals.

**Vitamins, Minerals, and Water** Vitamins are organic but do not provide energy to the body. They facilitate the release of energy from the three energy-yielding nutrients. In contrast, minerals and water are **inorganic** nutrients. Minerals yield no energy in the human body, but, like vitamins, they help to regulate the release of energy, among their many other roles. As for water, it is the medium in which all of the body's processes take place.

**inorganic:** not containing carbon or pertaining to living organisms. The two classes of nutrients that are inorganic are minerals and water.

## kCalories: A Measure of Energy

The amount of energy that carbohydrates, fats, and proteins release can be measured in **calories**—tiny units of energy so small that a single apple provides tens of thousands of them. To ease calculations, energy is expressed in 1000-calorie metric units known as **kilocalories** (shortened to **kcalories**, but commonly called "calories"). When you read in popular books or magazines that an apple provides "100 calories," understand that it means 100 kcalories. This book uses the term *kcalorie* and its abbreviation *kcal* throughout, as do other scientific books and journals.*** kCalories are not constituents of foods, but rather a measure of the energy foods provide. The energy a food provides depends on how much carbohydrate, fat, and protein the food contains.

**calories:** a measure of *heat* energy. Food energy is measured in **kilocalories** (1000 calories equal 1 kilocalorie), abbreviated **kcalories** or kcal. One kcalorie is the amount of heat necessary to raise the temperature of 1 kilogram (kg) of water 1°C. The scientific use of the term *kcalorie* is the same as the popular use of the term *calorie*.

Carbohydrate yields 4 kcalories of energy from each gram, and so does protein. Fat yields 9 kcalories per gram. Thus, fat has a greater **energy density** than either carbohydrate or protein. Chapter 7 revisits energy density with regard to weight management. If you know how many grams of carbohydrate, protein, and fat a food contains, you can derive the number of kcalories potentially available from the food. Multiply the carbohydrate grams times 4, the protein grams times 4, and the fat grams times 9, and add the results together (Box 1-1 on p. 8 describes how to calculate the energy a food provides).

**energy density:** a measure of the energy a food provides relative to the amount of food (kcalories per gram).

**Energy Nutrients in Foods** Most foods contain a mixture of the energy-yielding nutrients, vitamins, minerals, water, and other substances. For example, meat contains water, fat, vitamins, and minerals as well as protein. Bread contains water, a trace of fat, a little protein, and some vitamins and minerals in addition to its carbohydrate. Only a few foods are exceptions to this rule, with the common ones being sugar (which is pure carbohydrate) and oil (which is pure fat).

*This definition of *organic* excludes coal, diamonds, and a few carbon-containing compounds that contain only a single carbon and no hydrogen, such as carbon dioxide ($CO_2$).

**Metabolism* is the set of processes by which nutrients are rearranged into body structures or broken down to yield energy.

***Food energy can also be measured in kilojoules (kJ). The kilojoule is the international unit of energy. One kcalorie equals 4.2 kJ.

**Box 1-1**

## How to Calculate the Energy a Food Provides

To calculate the energy available from a food, multiply the number of grams of carbohydrate, protein, and fat by 4, 4, and 9, respectively. Then add the results together. For example, one slice of bread with 1 tablespoon of peanut butter on it contains 16 grams of carbohydrate, 7 grams of protein, and 9 grams of fat:

16 g carbohydrate × 4 kcal/g = 64 kcal

7 g protein × 4 kcal/g = 28 kcal

9 g fat × 9 kcal/g = 81 kcal

Total = 173 kcal

From this information, you can calculate the percentage of kcalories each of the energy nutrients contributes to the total.

To determine the percentage of kcalories from fat, for example, divide the 81 fat kcalories by the total 173 kcalories:

81 fat kcal ÷ 173 total kcal = 0.468 (rounded to 0.47)

Then multiply by 100 to get the percentage:

0.47 × 100 = 47%

Dietary recommendations that urge people to limit fat intake to 20 to 35 percent of kcalories refer to the day's total energy intake, not to individual foods. Still, if the proportion of fat in each food choice throughout a day exceeds 35 percent of kcalories, then the day's total surely will, too. Knowing that this snack provides 47 percent of its kcalories from fat alerts a person to the need to make lower-fat selections at other times that day.

**Energy Storage in the Body** The body first uses the energy-yielding nutrients to build new compounds and fuel metabolic and physical activities. Excesses are then rearranged into storage compounds, primarily body fat, and put away for later use. Thus, if you take in more energy than you expend, the result is an increase in energy stores and weight gain. Similarly, if you take in less energy than you expend, the result is a decrease in energy stores and weight loss.

**Alcohol, Not a Nutrient** One other substance contributes energy: alcohol. The body derives energy from alcohol at the rate of 7 kcalories per gram. Alcohol is not a nutrient, however, because it cannot support the body's growth, maintenance, or repair. Nutrition in Practice 19 discusses alcohol's effects on nutrition.

### Review Notes

- Foods provide nutrients—substances that support the growth, maintenance, and repair of the body's tissues.
- The six classes of nutrients are water, carbohydrates, fats, proteins, vitamins, and minerals.
- Vitamins, minerals, and water do not yield energy; instead, they facilitate a variety of activities in the body.
- Foods rich in the energy-yielding nutrients (carbohydrates, fats, and proteins) provide the major materials for building the body's tissues and yield energy the body can use or store.
- Energy is measured in kcalories.

## 1.3 Nutrient Recommendations

Nutrient recommendations are sets of standards against which healthy people's nutrient and energy intakes can be measured. Nutrition experts use the recommendations to assess nutrient intakes and to guide people on amounts to consume. Individuals can use them to decide how much of a nutrient they need and how much is too much.

## Dietary Reference Intakes

Defining the amounts of energy, nutrients, and other dietary components that best support health is a huge task. Nutrition experts have produced a set of standards that define the amounts of energy, nutrients, other dietary components, and physical activity that best support health. These recommendations are called **Dietary Reference Intakes (DRI)** and reflect the collaborative efforts of scientists in both the United States and Canada.* The DRI values are presented in Appendix H. (A set of nutrient recommendations developed by the World Health Organization for international use is presented in Appendix B.)

**Setting Nutrient Recommendations: RDA and AI** One advantage of the DRI is that they apply to the diets of individuals. The DRI committee offers two sets of values to be used as nutrient intake goals by individuals: the **Recommended Dietary Allowances (RDA)** and the **Adequate Intakes (AI)**.

Based on solid experimental evidence and other reliable observations, the RDA are the foundation of the DRI. The AI values are based on less extensive scientific findings and rely more heavily on scientific judgment. The committee establishes an AI value whenever scientific evidence is insufficient to generate an RDA. To see which nutrients have an AI and which have an RDA, turn to Appendix H.

To ensure that the vitamin and mineral recommendations meet the needs of as many people as possible, the recommendations are set near the top end of the range of the population's estimated average requirements (see Figure 1-2). Small amounts above the daily **requirement** do no harm, whereas amounts below the requirement may lead to health problems. When people's intakes are consistently **deficient**, their nutrient stores decline, and over time this decline leads to deficiency symptoms and poor health.

**Facilitating Nutrition Research and Policy: EAR** In addition to the RDA and AI, the DRI committee has established another set of values: the **Estimated Average Requirements (EAR)**. These values establish average requirements for sex and age groups that researchers and nutrition policymakers use in their work. Nutrition scientists may use the EAR as standards in research. Public health officials may use them to assess nutrient intakes of populations and make recommendations. The EAR values form the scientific basis on which the RDA are set.

**Establishing Safety Guidelines: UL** The DRI committee also establishes upper limits of intake for nutrients posing a hazard when consumed in excess. These values, known as the **Tolerable Upper Intake Levels (UL)**, are indispensable to consumers who take supplements. Consumers need to know how much of a nutrient is too much. The UL are also of value to public health officials who set allowances for nutrients that are added to foods and water. The UL values are listed in Appendix H.

**Chronic Disease Risk Reduction Intakes (CDRR)** The DRI categories discussed up to this point focus on deficient or excessive intakes of nutrients likely to cause harmful symptoms in all people—symptoms generally reversible by adjusting the diet. A new category of DRI broadens this scope to determine intake levels that might reduce the risks of chronic diseases. The **Chronic Disease Risk Reduction Intakes (CDRR)** reflect the levels of nutrient intake that researchers associate with a low risk of developing

*The DRI reports are produced by the Food and Nutrition Board, which is part of the National Academies of Sciences, Engineering, and Medicine, with active involvement of scientists from Canada.

**Dietary Reference Intakes (DRI):** a set of values for the dietary nutrient intakes of healthy people in the United States and Canada. These values are used for planning and assessing diets.

**Recommended Dietary Allowances (RDA):** a set of values reflecting the average daily amounts of nutrients considered adequate to meet the known nutrient needs of practically all healthy people in a sex and age group; a goal for dietary intake by individuals.

**Adequate Intakes (AI):** a set of values that are used as guides for nutrient intakes when scientific evidence is insufficient to determine an RDA.

**requirement:** the lowest continuing intake of a nutrient that will maintain a specified criterion of adequacy.

**deficient:** in regard to nutrient intake, describes the amount below which almost all healthy people can be expected, over time, to experience deficiency symptoms.

**Estimated Average Requirements (EAR):** the average daily nutrient intake levels estimated to meet the requirements of half of the healthy individuals in a specific sex and age group; used in nutrition research and policymaking and as the basis on which RDA values are set.

**Figure 1-2 Nutrient Intake Recommendations**

The nutrient intake recommendations are set high enough to cover nearly everyone's requirements (the boxes represent people). The Estimated Average Requirement (EAR) meets the needs of about half of the population (shown here by the red line). The Recommended Dietary Allowance (RDA) is set well about the EAR, meeting the needs of about 98 percent of the population (shown here by the purple line).