DEBRUYNE
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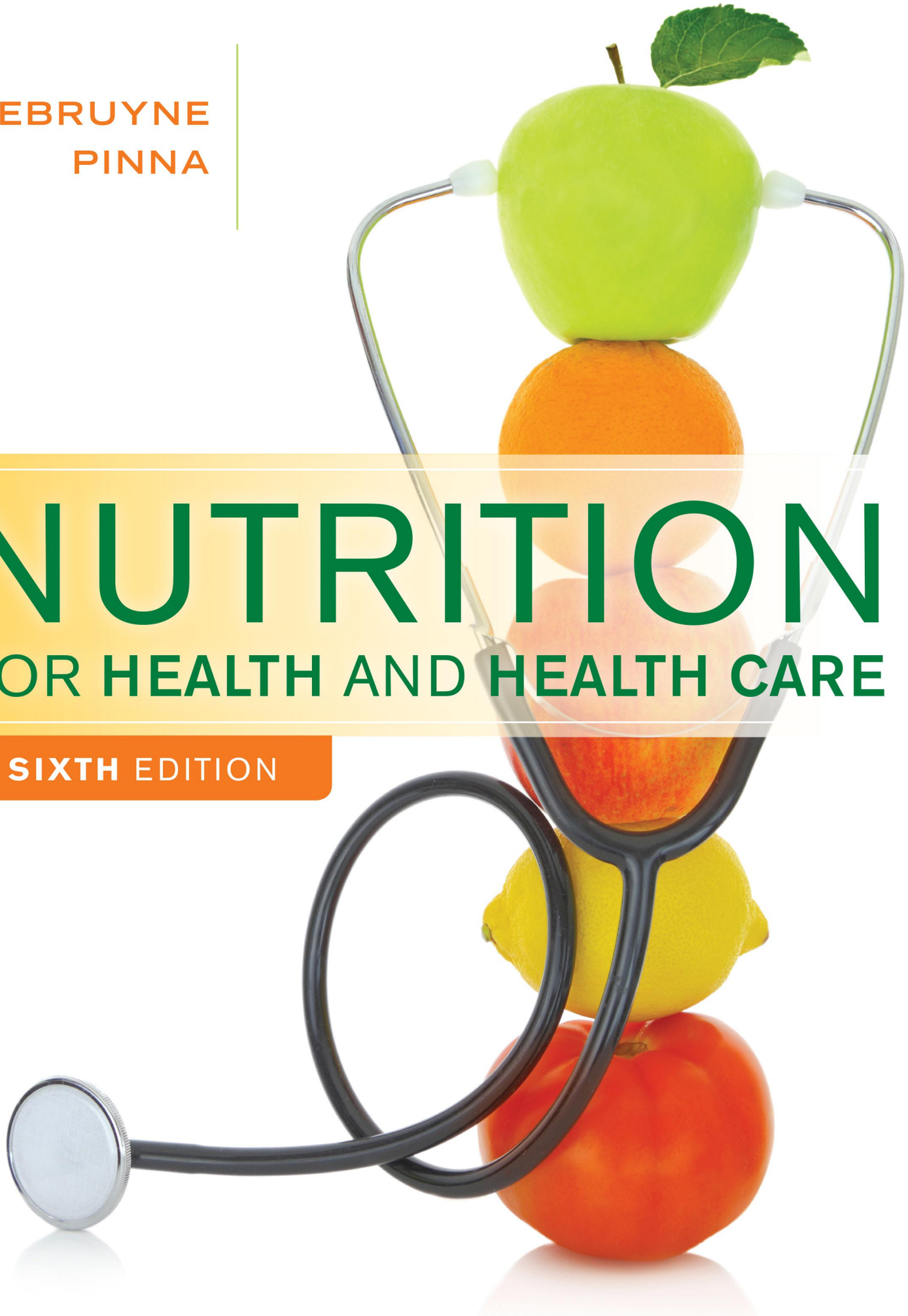

NUTRITION

FOR HEALTH AND HEALTH CARE

SIXTH EDITION

Dietary Reference Intakes (DRI)

The Dietary Reference Intakes (DRI) include two sets of nutrient intake goals for individuals—the Recommended Dietary Allowance (RDA) and Adequate Intake (AI). The RDA reflects the average daily amount of a nutrient considered adequate to meet the needs of most healthy people. If there is insufficient evidence to determine an RDA, an AI is set. In addition, the Estimated Energy Requirement (EER) represents the average dietary energy intake considered adequate to maintain energy balance in healthy people.

The DRI also include the Tolerable Upper Intake Level (UL) that represents the estimated maximum daily amount of a nutrient that appears safe for most healthy people to consume on a regular basis. Turn the page for a listing of the UL for selected vitamins and minerals. Note that the absence of a UL for a nutrient does not indicate that it is safe to consume in high doses, but only that research is too limited to set a UL. Chapter 1 describes these DRI values in detail.

Estimated Energy Requirements (EER), Recommended Dietary Allowances (RDA), and Adequate Intakes (AI) for Water, Energy, and the Energy Nutrients

Age (yr)	Reference BMI (kg/m²)	Reference Height cm (in)	Reference Weight kg (lb)	Water[a] AI (L/day)	Energy EER[b] (kcal/day)	Carbohydrate RDA (g/day)	Total Fiber AI (g/day)	Total Fat AI (g/day)	Linoleic Acid AI (g/day)	Linolenic Acid[c] AI (g/day)	Protein RDA (g/day)[d]	Protein RDA (g/kg/day)
Males												
0–0.5	—	62 (24)	6 (13)	0.7[e]	570	60	—	31	4.4	0.5	9.1	1.52
0.5–1	—	71 (28)	9 (20)	0.8[f]	743	95	—	30	4.6	0.5	11	1.20
1–3[g]	—	86 (34)	12 (27)	1.3	1046	130	19	—	7	0.7	13	1.05
4–8[g]	15.3	115 (45)	20 (44)	1.7	1742	130	25	—	10	0.9	19	0.95
9–13	17.2	144 (57)	36 (79)	2.4	2279	130	31	—	12	1.2	34	0.95
14–18	20.5	174 (68)	61 (134)	3.3	3152	130	38	—	16	1.6	52	0.85
19–30	22.5	177 (70)	70 (154)	3.7	3067[h]	130	38	—	17	1.6	56	0.80
31–50	22.5[i]	177 (70)[i]	70 (154)[i]	3.7	3067[h]	130	38	—	17	1.6	56	0.80
>50	22.5[i]	177 (70)[i]	70 (154)[i]	3.7	3067[h]	130	30	—	14	1.6	56	0.80
Females												
0–0.5	—	62 (24)	6 (13)	0.7[e]	520	60	—	31	4.4	0.5	9.1	1.52
0.5–1	—	71 (28)	9 (20)	0.8[f]	676	95	—	30	4.6	0.5	11	1.20
1–3[g]	—	86 (34)	12 (27)	1.3	992	130	19	—	7	0.7	13	1.05
4–8[g]	15.3	115 (45)	20 (44)	1.7	1642	130	25	—	10	0.9	19	0.95
9–13	17.4	144 (57)	37 (81)	2.1	2071	130	26	—	10	1.0	34	0.95
14–18	20.4	163 (64)	54 (119)	2.3	2368	130	26	—	11	1.1	46	0.85
19–30	21.5	163 (64)	57 (126)	2.7	2403[j]	130	25	—	12	1.1	46	0.80
31–50	21.5[i]	163 (64)[i]	57 (126)[i]	2.7	2403[j]	130	25	—	12	1.1	46	0.80
>50	21.5[i]	163 (64)[i]	57 (126)[i]	2.7	2403[j]	130	21	—	11	1.1	46	0.80
Pregnancy												
1st trimester				3.0	+0	175	28	—	13	1.4	46	0.80
2nd trimester				3.0	+340	175	28	—	13	1.4	71	1.10
3rd trimester				3.0	+452	175	28	—	13	1.4	71	1.10
Lactation												
1st 6 months				3.8	+330	210	29	—	13	1.3	71	1.30
2nd 6 months				3.8	+400	210	29	—	13	1.3	71	1.30

NOTE: For all nutrients, values for infants are AI. Dashes indicate that values have not been determined.

[a]The water AI includes drinking water, water in beverages, and water in foods; in general, drinking water and other beverages contribute about 70 to 80 percent, and foods, the remainder. Conversion factors: 1 L = 33.8 fluid oz; 1 L = 1.06 qt; 1 cup = 8 fluid oz.

[b]The Estimated Energy Requirement (EER) represents the average dietary energy intake that will maintain energy balance in a healthy person of a given gender, age, weight, height, and physical activity level. The values listed are based on an "active" person at the reference height and weight and at the midpoint ages for each group until age 19. Chapter 6 and Appendix D provide equations and tables to determine estimated energy requirements.

[c]The linolenic acid referred to in this table and text is the omega-3 fatty acid known as alpha-linolenic acid.

[d]The values listed are based on reference body weights.

[e]Assumed to be from human milk.

[f]Assumed to be from human milk and complementary foods and beverages. This includes approximately 0.6 L (~2½ cups) as total fluid including formula, juices, and drinking water.

[g]For energy, the age groups for young children are 1–2 years and 3–8 years.

[h]For males, subtract 10 kcalories per day for each year of age above 19.

[i]Because weight need not change as adults age if activity is maintained, reference weights for adults 19 through 30 years are applied to all adult age groups.

[j]For females, subtract 7 kcalories per day for each year of age above 19.

SOURCE: Adapted from the *Dietary Reference Intakes series*, National Academies Press. Copyright 1997, 1998, 2000, 2001, 2002, 2004, 2005, 2011 by the National Academies of Sciences.

Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) for Vitamins

Age (yr)	Thiamin RDA (mg/day)	Riboflavin RDA (mg/day)	Niacin RDA (mg/day)[a]	Biotin AI (µg/day)	Pantothenic acid AI (mg/day)	Vitamin B_6 RDA (mg/day)	Folate RDA (µg/day)[b]	Vitamin B_{12} RDA (µg/day)	Choline AI (mg/day)	Vitamin C RDA (mg/day)	Vitamin A RDA (µg/day)[c]	Vitamin D RDA (µg/day)[d]	Vitamin E RDA (mg/day)[e]	Vitamin K AI (µg/day)
Infants														
0–0.5	0.2	0.3	2	5	1.7	0.1	65	0.4	125	40	400	10	4	2.0
0.5–1	0.3	0.4	4	6	1.8	0.3	80	0.5	150	50	500	10	5	2.5
Children														
1–3	0.5	0.5	6	8	2	0.5	150	0.9	200	15	300	15	6	30
4–8	0.6	0.6	8	12	3	0.6	200	1.2	250	25	400	15	7	55
Males														
9–13	0.9	0.9	12	20	4	1.0	300	1.8	375	45	600	15	11	60
14–18	1.2	1.3	16	25	5	1.3	400	2.4	550	75	900	15	15	75
19–30	1.2	1.3	16	30	5	1.3	400	2.4	550	90	900	15	15	120
31–50	1.2	1.3	16	30	5	1.3	400	2.4	550	90	900	15	15	120
51–70	1.2	1.3	16	30	5	1.7	400	2.4	550	90	900	15	15	120
>70	1.2	1.3	16	30	5	1.7	400	2.4	550	90	900	20	15	120
Females														
9–13	0.9	0.9	12	20	4	1.0	300	1.8	375	45	600	15	11	60
14–18	1.0	1.0	14	25	5	1.2	400	2.4	400	65	700	15	15	75
19–30	1.1	1.1	14	30	5	1.3	400	2.4	425	75	700	15	15	90
31–50	1.1	1.1	14	30	5	1.3	400	2.4	425	75	700	15	15	90
51–70	1.1	1.1	14	30	5	1.5	400	2.4	425	75	700	15	15	90
>70	1.1	1.1	14	30	5	1.5	400	2.4	425	75	700	20	15	90
Pregnancy														
≤18	1.4	1.4	18	30	6	1.9	600	2.6	450	80	750	15	15	75
19–30	1.4	1.4	18	30	6	1.9	600	2.6	450	85	770	15	15	90
31–50	1.4	1.4	18	30	6	1.9	600	2.6	450	85	770	15	15	90
Lactation														
≤18	1.4	1.6	17	35	7	2.0	500	2.8	550	115	1200	15	19	75
19–30	1.4	1.6	17	35	7	2.0	500	2.8	550	120	1300	15	19	90
31–50	1.4	1.6	17	35	7	2.0	500	2.8	550	120	1300	15	19	90

NOTE: For all nutrients, values for infants are AI. The glossary on the inside back cover defines units of nutrient measure.

[a]Niacin recommendations are expressed as niacin equivalents (NE), except for recommendations for infants younger than 6 months, which are expressed as preformed niacin.

[b]Folate recommendations are expressed as dietary folate equivalents (DFE).

[c]Vitamin A recommendations are expressed as retinol activity equivalents (RAE).

[d]Vitamin D recommendations are expressed as cholecalciferol and assume an absence of adequate exposure to sunlight.

[e]Vitamin E recommendations are expressed as α-tocopherol.

Recommended Dietary Allowances (RDA) and Adequate Intakes (AI) for Minerals

Age (yr)	Sodium AI (mg/day)	Chloride AI (mg/day)	Potassium AI (mg/day)	Calcium RDA (mg/day)	Phosphorus RDA (mg/day)	Magnesium RDA (mg/day)	Iron RDA (mg/day)	Zinc RDA (mg/day)	Iodine RDA (µg/day)	Selenium RDA (µg/day)	Copper RDA (µg/day)	Manganese AI (mg/day)	Fluoride AI (mg/day)	Chromium AI (µg/day)	Molybdenum RDA (µg/day)
Infants															
0–0.5	120	180	400	200	100	30	0.27	2	110	15	200	0.003	0.01	0.2	2
0.5–1	370	570	700	260	275	75	11	3	130	20	220	0.6	0.5	5.5	3
Children															
1–3	1000	1500	3000	700	460	80	7	3	90	20	340	1.2	0.7	11	17
4–8	1200	1900	3800	1000	500	130	10	5	90	30	440	1.5	1.0	15	22
Males															
9–13	1500	2300	4500	1300	1250	240	8	8	120	40	700	1.9	2	25	34
14–18	1500	2300	4700	1300	1250	410	11	11	150	55	890	2.2	3	35	43
19–30	1500	2300	4700	1000	700	400	8	11	150	55	900	2.3	4	35	45
31–50	1500	2300	4700	1000	700	420	8	11	150	55	900	2.3	4	35	45
51–70	1300	2000	4700	1000	700	420	8	11	150	55	900	2.3	4	30	45
>70	1200	1800	4700	1200	700	420	8	11	150	55	900	2.3	4	30	45
Females															
9–13	1500	2300	4500	1300	1250	240	8	8	120	40	700	1.6	2	21	34
14–18	1500	2300	4700	1300	1250	360	15	9	150	55	890	1.6	3	24	43
19–30	1500	2300	4700	1000	700	310	18	8	150	55	900	1.8	3	25	45
31–50	1500	2300	4700	1000	700	320	18	8	150	55	900	1.8	3	25	45
51–70	1300	2000	4700	1200	700	320	8	8	150	55	900	1.8	3	20	45
>70	1200	1800	4700	1200	700	320	8	8	150	55	900	1.8	3	20	45
Pregnancy															
≤18	1500	2300	4700	1300	1250	400	27	12	220	60	1000	2.0	3	29	50
19–30	1500	2300	4700	1000	700	350	27	11	220	60	1000	2.0	3	30	50
31–50	1500	2300	4700	1000	700	360	27	11	220	60	1000	2.0	3	30	50
Lactation															
≤18	1500	2300	5100	1300	1250	360	10	13	290	70	1300	2.6	3	44	50
19–30	1500	2300	5100	1000	700	310	9	12	290	70	1300	2.6	3	45	50
31–50	1500	2300	5100	1000	700	320	9	12	290	70	1300	2.6	3	45	50

NOTE: For all nutrients, values for infants are AI. The glossary on the inside back cover defines units of nutrient measure.

Tolerable Upper Intake Levels (UL) for Vitamins

Age (yr)	Niacin (mg/day)[a]	Vitamin B_6 (mg/day)	Folate (µg/day)[a]	Choline (mg/day)	Vitamin C (mg/day)	Vitamin A (µg/day)[b]	Vitamin D (µg/day)	Vitamin E (mg/day)[c]
Infants								
0–0.5	—	—	—	—	—	600	25	—
0.5–1	—	—	—	—	—	600	38	—
Children								
1–3	10	30	300	1000	400	600	63	200
4–8	15	40	400	1000	650	900	75	300
9–13	20	60	600	2000	1200	1700	100	600
Adolescents								
14–18	30	80	800	3000	1800	2800	100	800
Adults								
19–70	35	100	1000	3500	2000	3000	100	1000
>70	35	100	1000	3500	2000	3000	100	1000
Pregnancy								
≤18	30	80	800	3000	1800	2800	100	800
19–50	35	100	1000	3500	2000	3000	100	1000
Lactation								
≤18	30	80	800	3000	1800	2800	100	800
19–50	35	100	1000	3500	2000	3000	100	1000

[a]The UL for niacin and folate apply to synthetic forms obtained from supplements, fortified foods, or a combination of the two.

[b]The UL for vitamin A applies to the preformed vitamin only.

[c]The UL for vitamin E applies to any form of supplemental α-tocopherol, fortified foods, or a combination of the two.

From Whitney/Rolfes, *Understanding Nutrition*, 13E. © 2013 Cengage Learning.

Tolerable Upper Intake Levels (UL) for Minerals

Age (yr)	Sodium (mg/day)	Chloride (mg/day)	Calcium (mg/day)	Phosphorus (mg/day)	Magnesium (mg/day)[d]	Iron (mg/day)	Zinc (mg/day)	Iodine (µg/day)	Selenium (µg/day)	Copper (µg/day)	Manganese (mg/day)	Fluoride (mg/day)	Molybdenum (µg/day)	Boron (mg/day)	Nickel (mg/day)	Vanadium (mg/day)
Infants																
0–0.5	—	—	1000	—	—	40	4	—	45	—	—	0.7	—	—	—	—
0.5–1	—	—	1500	—	—	40	5	—	60	—	—	0.9	—	—	—	—
Children																
1–3	1500	2300	2500	3000	65	40	7	200	90	1000	2	1.3	300	3	0.2	—
4–8	1900	2900	2500	3000	110	40	12	300	150	3000	3	2.2	600	6	0.3	—
9–13	2200	3400	3000	4000	350	40	23	600	280	5000	6	10	1100	11	0.6	—
Adolescents																
14–18	2300	3600	3000	4000	350	45	34	900	400	8000	9	10	1700	17	1.0	—
Adults																
19–50	2300	3600	2500	4000	350	45	40	1100	400	10,000	11	10	2000	20	1.0	1.8
51–70	2300	3600	2000	4000	350	45	40	1100	400	10,000	11	10	2000	20	1.0	1.8
>70	2300	3600	2000	3000	350	45	40	1100	400	10,000	11	10	2000	20	1.0	1.8
Pregnancy																
≤18	2300	3600	3000	3500	350	45	34	900	400	8000	9	10	1700	17	1.0	—
19–50	2300	3600	2500	3500	350	45	40	1100	400	10,000	11	10	2000	20	1.0	—
Lactation																
≤18	2300	3600	3000	4000	350	45	34	900	400	8000	9	10	1700	17	1.0	—
19–50	2300	3600	2500	4000	350	45	40	1100	400	10,000	11	10	2000	20	1.0	—

[d]The UL for magnesium applies to synthetic forms obtained from supplements or drugs only.

NOTE: An upper Limit was not established for vitamins and minerals not listed and for those age groups listed with a dash (—) because of a lack of data, not because these nutrients are safe to consume at any level of intake. All nutrients can have adverse effects when intakes are excessive.

SOURCE: Adapted with permission from the *Dietary Reference Intakes for Calcium and Vitamin D*, © 2011 by the National Academies of Sciences, Courtesy of the National Academies Press, Washington, D.C.

NUTRITION FOR HEALTH AND HEALTH CARE

sixth edition

Linda Kelly DeBruyne
Kathryn Pinna

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To my newest grandson, Cruz Kai DeBruyne. You are welcomed with so much love and aloha.

LINDA KELLY DEBRUYNE

To my mom, Tina C. Pinna, who started me on the path to good nutritional practices in my earliest years.

KATHRYN PINNA

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LINDA KELLY DEBRUYNE, M.S., R.D., received her B.S. and her M.S. degrees in nutrition and food science from 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. Her other publications include the textbooks *Nutrition and Diet Therapy* and *Health: Making Life Choices* and a multimedia CD-ROM called *Nutrition Interactive*. As a consultant for a group of Tallahassee pediatricians, she has taught infant nutrition classes to parents. She is a registered dietitian and maintains a professional membership in the Academy of Nutrition and Dietetics.

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Brief Contents

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Case Studies

How To Features

Preface

We are pleased to present this sixth 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.

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 nutrition 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. Each chapter concludes with a Nutrition on the Net feature, which lists websites relevant to the topics covered in the chapter.

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, metabolic syndrome, and childhood obesity and chronic disease.

APPENDIXES

The appendixes support the book with a wealth of information on the nutrient contents of thousands of foods, Canadian nutrient recommendations and food choices, U.S. nutrient intake recommendations, food lists for diabetes, physical activity and energy requirements, nutrition assessments, enteral formulas, aids to calculations, and answers to Self Check questions.

NEW TO THIS EDITION

Each chapter of this book has been updated to reflect advances in research and clinical practice since the fifth edition. In addition, we have made the following changes:

Chapter 1

- Defined empty kcalories, reorganized the fitness section, introduced the Dietary Guidelines for Americans 2015
- Added a new table of nutrients of concern
- Created a new figure showing recommended and actual intakes of food groups

Chapter 2

- Added definition of enzymes and more information about digestive enzymes in the glossary of digestive glands and their secretions
- Improved the discussion of LDL and HDL
- In the Nutrition in Practice section, enhanced the instructions for proper hand washing based on new CDC guidelines

Chapter 3

- Enhanced the discussion of cholesterol-lowering effects of fiber
- Added more information to Figure 3-5 (Characteristics, Sources, and Health Effects of Fibers)
- Enhanced Figure 3-6 (Fiber in Selected Foods) by adding tips to increase fiber intakes
- Added a discussion of added sugars and diabetes

Chapter 4

- Moved the table of major sources of various lipids from the Nutrition in Practice to the chapter
- Added a new table of omega-3 fatty acids in fish and seafood
- Included a new table of fat options among milk and milk products
- Updated information on dietary cholesterol restrictions based on American Heart Association and new Dietary Guidelines information
- Emphasized the importance of overall dietary patterns when reducing the intake of saturated and *trans* fat

Chapter 5

- Reorganized the malnutrition discussion
- Added definitions of wasting, stunting, and marasmic kwashiorkor
- Included a new How to Calculate Protein Intakes box
- In the Nutrition in Practice section, enhanced the glossary of vegetarian diets and added a new figure showing vegetarian sources and equivalents for protein foods and milk and milk products

Chapter 6

- Included the latest information from the 2013 American Heart Association/American College of Cardiology and The Obesity Society Guidelines for the management of overweight and obesity in adults
- In the Nutrition in Practice section, defined and discussed RED-S (relative energy deficiency in sport) from the International Olympic Committee to replace female athlete triad

Chapter 7

- Added information about microbiota and obesity and defined microbiota
- In the Nutrition in Practice section, enhanced the discussion of high-protein diets for weight loss and maintenance

Chapter 8

- Added a list of vitamins of concern from the 2015 Dietary Guidelines Advisory Committee
- Enhanced the discussion of vitamin D and obesity and other disease relationships

Chapter 9

- Added a list of minerals of concern from the 2015 Dietary Guidelines Advisory Committee

Chapter 10

- Moved the section on infancy to Chapter 11 to focus only on nutrition for the mother during pregnancy and lactation
- Included the latest FDA and EPA guidelines on fish consumption during pregnancy
- Added a brief discussion about choline and pregnancy

Chapter 11

- Added a discussion of the importance of zinc in complementary foods for breastfed infants
- Created a new table listing protective factors in breast milk and how they function
- Restructured and simplified table of nutrient supplements for infants
- Added a new table: USDA Nutrition Standards for Foods Sold in Schools.

Chapter 12

- Enhanced the discussion of protein needs for older adults
- In the Nutrition in Practice section, included new definitions for food security and food insecurity
- Revised the food security questionnaire

Chapter 13

- Updated nursing diagnoses
- Added a paragraph about C-reactive protein in the section on biochemical analyses
- Revised the discussion on fluid retention

Chapter 14

- Expanded the section on estimating energy intakes in hospital patients
- Shortened the section on foodservice
- Modified the paragraph on isoniazid and vitamin B_6 in the "Diet–Drug Interactions" section
- Modified the table showing examples of grapefruit juice–drug interactions
- In the Nutrition in Practice section, modified the table listing examples of herb–drug interactions

Chapter 15

- Updated the feeding tube photo
- Introduced the term cyclic feedings in the section on formula delivery methods
- Shortened the section on discontinuing parenteral nutrition
- In the Nutrition in Practice on inborn errors, added a photo showing phenylalanine-free formula and updated the medical foods and treatments used in phenylketonuria

Chapter 16

- Revised the section on estimating energy needs during acute stress
- Changed the table on using disease-specific stress factors for estimating energy needs to a "How To" box
- Emphasized the Penn State equation in the table on predictive equations used in ventilator-dependent patients
- Modified the discussion on the use of glutamine and arginine during critical illness
- Modified some sections on nutrition therapy for respiratory failure

Chapter 17

- Modified some of the material in the sections on dumping syndrome and bariatric surgery
- Added sleeve gastrectomy to the figure on surgical procedures for severe obesity
- In the Nutrition in Practice on oral health, revised the table on nutrient deficiencies and development of dental caries and modified several sections related to oral diseases and chronic illness.

Chapter 18

- Revised some of the material in the sections on intestinal gas, acute and chronic pancreatitis, cystic fibrosis, celiac disease, irritable bowel syndrome, and diverticular disease of the colon
- Introduced the concept of *FODMAPs* and added definitions of *bloating* and *bacterial translocation*
- Eliminated the photo of gluten-free foods and added photos showing the effect of celiac disease on intestinal tissue

Chapter 19

- Revised the paragraph on nutrition treatment for hepatitis
- Modified some of the sections about cirrhosis complications
- Revised the sections on the medical treatment and nutrition therapy for cirrhosis, introduced the term *transjugular intrahepatic portosystemic shunt* in the discussion about ascites treatment, and eliminated the description of the peritoneovenous shunt

Chapter 20

- Updated statistics throughout the chapter
- Added a note about the types of insulin used in the Diabetes Control and Complications Trial
- Added a margin table comparing HbA_{1c} and plasma glucose levels
- Revised various sections on nutrition therapy
- Added inhaled insulin and sodium-glucose cotransporter 2 (SGLT2) inhibitors to the tables listing the different types of insulin and antidiabetic drugs
- Modified the sections on insulin in type 2 diabetes, use of antidiabetic drugs, and maintaining glycemic control during exercise
- Updated several sections in the Nutrition in Practice on metabolic syndrome
- Added a figure showing how metabolic syndrome varies among ethnic groups and removed the figure showing how it varies with age

Chapter 21

- Revised various paragraphs in the sections on atherosclerosis, CHD risk assessment, CHD lifestyle management, hypertension, and heart failure
- Eliminated the box on assessing risk of heart disease
- Updated CHD recommendations to reflect the 2013 guidelines from the American Heart Association and American College of Cardiology
- Updated the section on hypertension treatment to reflect 2013 guidelines from the Eighth Joint National Committee (JNC 8).

Chapter 22

- Modified sections related to nephrotic syndrome
- Revised the table on causes of acute kidney injury
- Updated the section on nutrition therapy for acute kidney injury
- Updated the section on the evaluation of chronic kidney disease to reflect new clinical practice guidelines
- Clarified and updated some sections related to the nutrition therapy for chronic kidney disease to reflect current recommendations
- Modified the section on prevention of calcium oxalate stones
- Revised the table on food sources of oxalates

Chapter 23

- Rearranged and revised the sections related to the consequences of cancer
- Introduced the term *oral mucositis*, modified the section on hematopoietic stem cell transplantation, and introduced the term *graft-versus-host disease*
- Revised the paragraph about protein and energy intakes for cancer patients
- Revised the section about food safety concerns for immunosuppressed cancer patients
- Rearranged and revised some sections related to the consequences of HIV infection
- Revised some sections related to the nutrition therapy for HIV infection

STUDENT AND INSTRUCTOR RESOURCES

MindTap: A new approach to highly personalized online learning. Beyond an eBook, homework solution, digital supplement, or premium website, MindTap is a digital learning platform that works alongside your campus LMS to deliver course curriculum across the range of electronic devices in your life. MindTap is built on an "app" model allowing enhanced digital collaboration and delivery of engaging content across a spectrum of Cengage and non-Cengage resources. Includes the **Diet & Wellness Plus** App that 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.

Instructor Companion Site: Everything you need for your course in one place! This collection of book-specific lecture and class tools is available online via www.cengage.com/login. Access and download PowerPoint presentations, images, instructor's manual, videos, and more.

Test Bank with Cognero: Cengage Learning Testing Powered by Cognero is a flexible, online system that allows you to author, edit, and manage test bank content from multiple Cengage Learning solutions; create multiple test versions in an instant; and deliver tests from your LMS, your classroom, or wherever you want.

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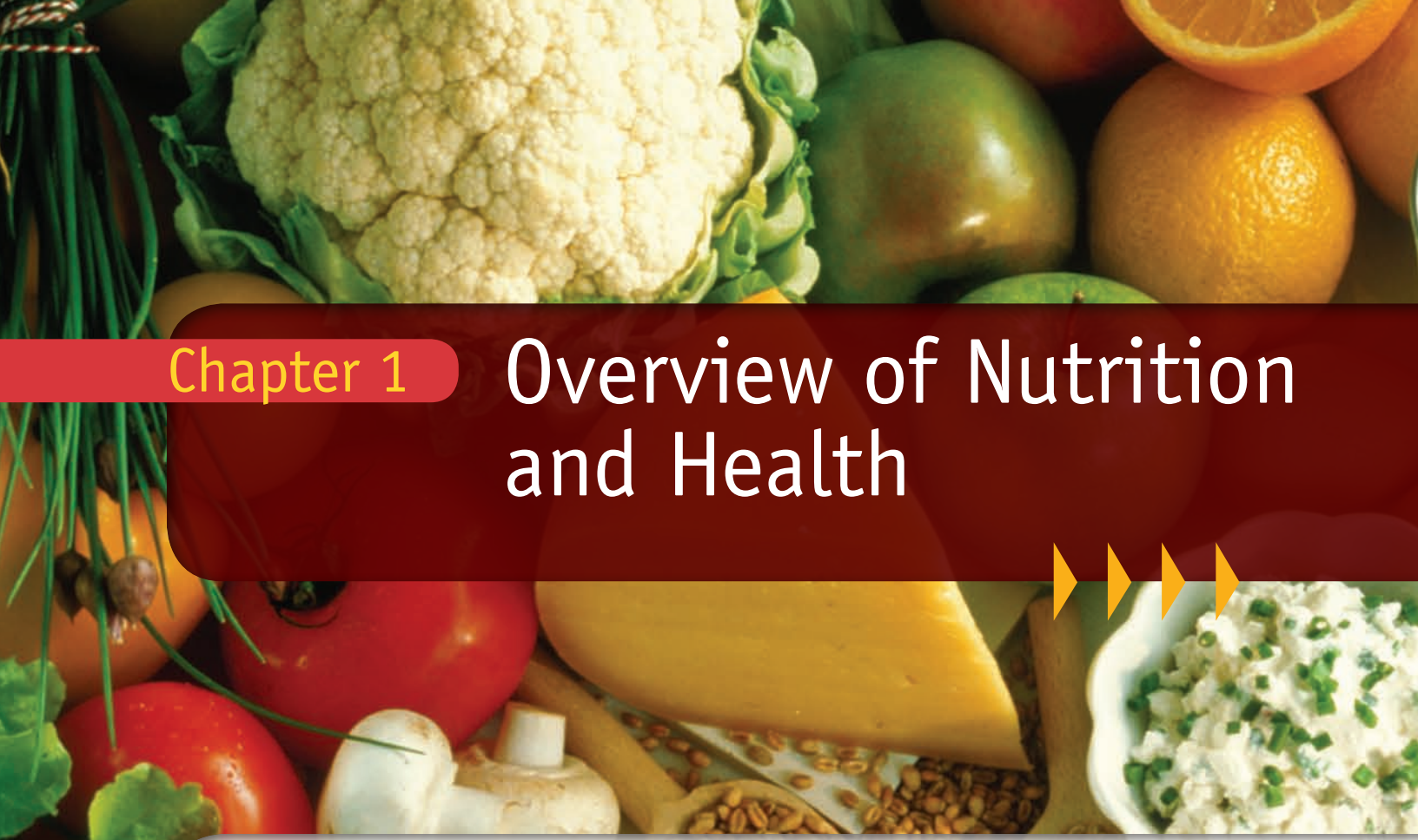


Chapter 1 Overview of Nutrition and Health

Chapter Sections and Learning Objectives (LOs)

1.1 Food Choices
LO1.1 Describe the factors that influence personal food choices.

1.2 The Nutrients
LO1.2 Identify which of the major classes of nutrients are organic and which yield energy.

1.3 Nutrient Recommendations
LO1.3 Describe the four categories of the Dietary Reference Intakes (DRI), the Estimated Energy Requirement (EER), and the Acceptable Macronutrient Distribution Ranges (AMDR).

1.4 National Nutrition Surveys
LO1.4 Describe the ways in which the kinds of information collected by researchers from nutrition surveys are used.

1.5 Dietary Guidelines and Food Guides
LO1.5 Explain how each of the dietary ideals can be used to plan a healthy diet, and how the Dietary Guidelines and USDA Food Patterns help make diet planning easier.

1.6 Food Labels
LO1.6 Compare the information on food labels to make selections that meet specific dietary and health goals.

1.7 Nutrition in Practice: Finding the Truth about Nutrition
LO1.7 Discuss how misinformation and reliable nutrition information can be identified.

Rosenfeld/Flirt/Corbis

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.

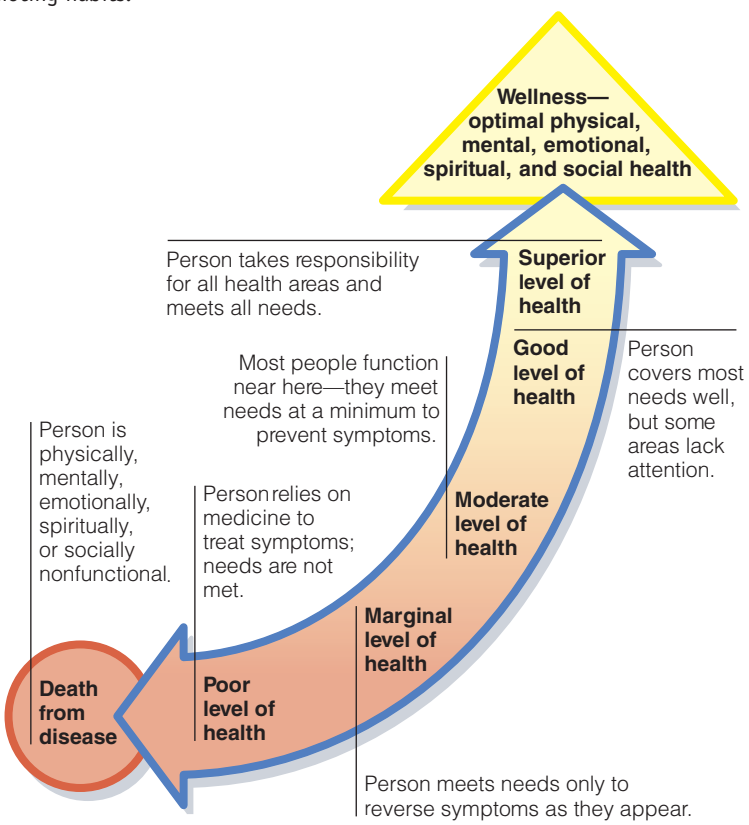
The choices people make each day affect not only their physical health but also their **wellness**—all the characteristics that make a person strong, confident, and able to function well with family, friends, and others. People who consistently make poor lifestyle choices on a daily basis increase their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

As nurses 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.

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 can slip by failing to maintain health-promoting habits.



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 the person who strives toward realizing his or her full potential physically, mentally, emotionally, spiritually, and socially.

*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.

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, most 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 are honored. Developing **cultural competence** is an important aspect of honoring individual preferences, especially for health care professionals who help clients to achieve a nutritious diet.[1]

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

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.[2] Research suggests that genetics influence people's taste preferences, a finding that may eventually have implications for clinical nutrition.[3] For example, sensitivity to bitter taste is an inheritable 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, contain **bioactive food components**—**phytochemicals** and nutrients—that may reduce the risk of cancer. Thus, the role that genetics may play in food selection is gaining importance in cancer research.[4] 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.

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. 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 presents selected **ethnic diets** and food choices.

Values

Food choices may reflect people's environmental ethics, 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 fruit 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

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.

bioactive food components: 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.

TABLE 1-1 Selected Ethnic Cuisines and Food Choices

	Grains	Vegetables	Fruits	Protein Foods	Milk
Asian  Becky Luigart-Stayner/ Encyclopedia/Corbis	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, persimmon, plums	Pork; duck and other poultry; fish, octopus, sea urchin, squid, and other seafood; soybeans, tofu; eggs; cashews, peanuts	Soy milk
Mediterranean  Photodisc, Inc./ Getty Images	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  Mitch Hrdlicka/ Photodisc/Getty Images	Hominy, masa (corn flour dough), tortillas (corn or flour), rice	Bell peppers, cactus, cassava, chayote, chili pepper, corn, jicama, onions, summer squash, tomatoes, winter squash, yams	Avocado, bananas, guava, lemons, limes, mango, oranges, papaya, plantain	Beans, refried beans, beef, goat, pork, chorizo, chicken, fish, eggs	Cheese, flan (baked caramel custard), milk in beverages


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Ethnic meals and family gatherings nourish the spirit as well as the body.

prior to Easter. In Islamic dietary laws, permitted or lawful foods are called *halal*. Other faiths prohibit some dietary practices and promote others. Diet planners can foster sound nutrition practices 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.[5] 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.[6] 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 depressed person 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.

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.

Rising food costs have shifted some consumers' priorities and changed their shopping habits. They are less likely to buy higher-priced convenience foods and more likely to buy less-expensive store brand items and prepare home-cooked meals. Those who frequently prepare their own meals eat fast food less often and are more likely to meet dietary guidelines for fat, calcium, fruits, vegetables, and whole grains. It is not surprising that, 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 kcalories, sodium, saturated fat, and *trans* fat—which can contribute to a variety of health problems.[7]

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 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 needed to treat cancer can interfere with a person's appetite or limit food choices by causing vomiting. Allergy 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 will improve their health.[8] Food manufacturers and restaurant chefs have responded to scientific findings linking health with nutrition by offering an abundant selection of health-promoting foods and beverages. Foods that provide health benefits beyond their nutrient contributions are called **functional foods**.[9] Whole foods—as natural and familiar as oatmeal or tomatoes—are the simplest functional foods. In other cases, foods have been modified through fortification, enrichment, or enhancement. Examples of these functional foods include orange juice fortified with calcium to build strong bones, bread enriched with folate to promote normal fetal development, and margarine enhanced with a plant sterol to lower blood cholesterol. Nutrition in Practice 8 offers more discussion of functional foods.

functional foods: whole, fortified, enriched, or enhanced foods that have a potentially beneficial effect on health when consumed as part of a varied diet on a regular basis at effective levels.

Consumers typically welcome new foods into their diets, provided that these foods are reasonably priced, clearly labeled, easy to find in the grocery store, and convenient to

prepare. These foods must also taste good—as good as the traditional choices. Of course, a person need not eat any "special" foods to enjoy a healthy diet; many "regular" foods provide numerous health benefits as well. In fact, foods such as whole grains; vegetables and legumes; fruits; lean meats, seafood, poultry, eggs, nuts, and seeds; and low-fat milk products are among the healthiest choices a person can make.

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.

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.

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.

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

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.

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

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**.

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.

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.

[†]Note that 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.

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; they are a measure of the energy foods provide. The energy a food provides depends on how much carbohydrate, fat, and protein the food contains.

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. Simply 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 describes how to calculate the energy a food provides).

Energy Nutrients in Foods

Most foods contain mixtures of all three energy-yielding nutrients, although foods are sometimes classified by their predominant nutrient. To speak of meat as "a protein" or of bread as "a carbohydrate," however, is inaccurate. Each is rich in a particular nutrient, but a protein-rich food such as beef contains a lot of fat along with the protein, and a carbohydrate-rich food such as cornbread also contains fat (corn oil) and protein. Only a few foods are exceptions to this rule, the common ones being sugar (which is pure carbohydrate) and oil (which is pure fat).

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.

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*.

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

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.

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

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.

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 particular life stage and gender 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.

Nutrient Recommendations

Nutrient recommendations are used as standards to evaluate healthy people's energy and nutrient intakes. 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 to consume.

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 inside front covers of this book present the DRI values. (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: a set called the **Recommended Dietary Allowances (RDA)** and a set called **Adequate Intakes (AI)**.

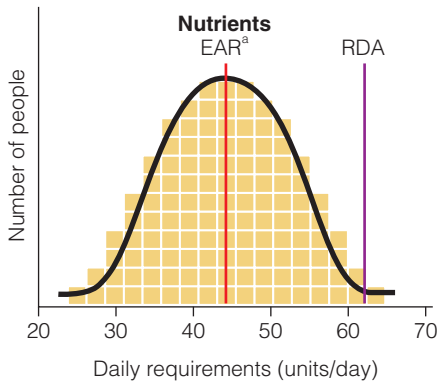
Based on solid experimental evidence and other reliable observations, the RDA are the foundation of the DRI. The AI values are based on less extensive scientific findings and rely more heavily on scientific judgment. The committee establishes an AI value whenever scientific evidence is insufficient to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

In the last several decades, abundant new research has linked nutrients in the diet with the promotion of health and the prevention of chronic diseases. An advantage of the DRI is that, where appropriate, they take into account disease prevention as well as an adequate nutrient intake. For example, the RDA for calcium is based on intakes thought to reduce the likelihood of osteoporosis-related fractures later in life.

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.

FIGURE 1-2 Nutrient Intake Recommendations

The nutrient intake recommendations are set high enough to cover nearly everyone's requirements (the boxes represent people).



[a]Estimated Average Requirement

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

Facilitating Nutrition Research and Policy: EAR

In addition to the RDA and AI, the DRI committee has established another set of values: **Estimated Average Requirements (EAR)**. These values establish average requirements for given life stage and gender 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.

Estimated Average Requirements (EAR): the average daily nutrient intake levels estimated to meet the requirements of half of the healthy individuals in a given age and gender group; used in nutrition research and policymaking and as the basis on which RDA values 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, 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 on the inside front cover.

Tolerable Upper Intake Levels (UL): a set of values reflecting the highest average daily nutrient intake levels that are likely to pose no risk of toxicity to almost all healthy individuals in a particular life stage and gender group. As intake increases above the UL, the potential risk of adverse health effects increases.

Using Nutrient Recommendations

Each of the four DRI categories serves a unique purpose. For example, the EAR are most appropriately used to develop and evaluate nutrition programs for *groups* such as schoolchildren or military personnel. The RDA (or AI, if an RDA is not available) can be used to set goals for *individuals*. The UL help to keep nutrient intakes below the amounts that increase the risk of toxicity. With these understandings, professionals can use the DRI for a variety of purposes.

In addition to understanding the unique purposes of the DRI, it is important to keep their uses in perspective. Consider the following:

- The values are recommendations for safe intakes, not minimum requirements; except for energy, they include a generous margin of safety. Figure 1-3 presents an accurate view of how a person's nutrient needs fall within a range, with marginal and danger zones both below and above the range.
- The values reflect daily intakes to be achieved on average, over time. They assume that intakes will vary from day to day, and they are set high enough to ensure that body nutrient stores will meet nutrient needs during periods of inadequate intakes lasting a day or two for some nutrients and up to a month or two for others.
- The values are chosen in reference to specific indicators of nutrient adequacy, such as blood nutrient concentrations, normal growth, and reduction of certain chronic diseases or other disorders when appropriate, rather than prevention of deficiency symptoms alone.
- The recommendations are designed to meet the needs of most healthy people. Medical problems alter nutrient needs, as later chapters describe.
- The recommendations are specific for people of both genders as well as various ages and stages of life: infants, children, adolescents, men, women, pregnant women, and lactating women.

Estimated Energy Requirement (EER): the dietary energy intake level that is predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, and physical activity level consistent with good health.

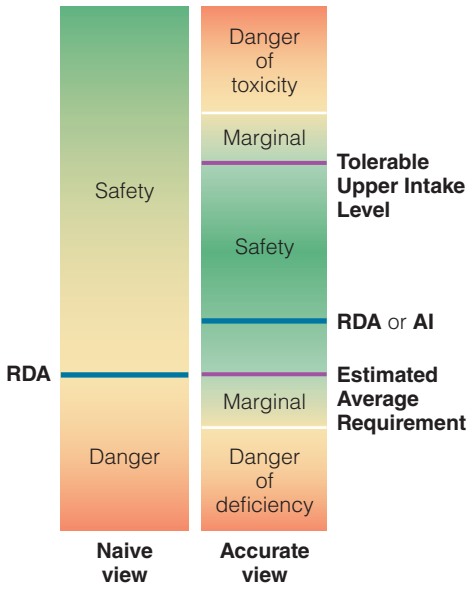
Setting Energy Recommendations

In contrast to the vitamin and mineral recommendations, the recommendation for energy, called the **Estimated Energy Requirement (EER)**, is not generous because excess energy cannot be excreted and is eventually stored as body fat. Rather, the key to the energy recommendation is balance. For a person who has a body weight, body composition, and physical activity level consistent with good health, energy intake from food should match energy expenditure, so the person achieves energy balance. Enough energy is needed to sustain a healthy, active life, but too much energy leads to obesity. The EER is therefore set at a level of energy intake predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, height, and physical activity level.* Another difference

*The EER for children, pregnant women, and lactating women includes energy needs associated with the deposition of tissue or the secretion of milk at rates consistent with good health.

FIGURE 1-3 Naive versus Accurate View of Nutrient Intakes

The RDA or AI for a given nutrient represents a point that lies within a range of appropriate and reasonable intakes between toxicity and deficiency. Both of these recommendations are high enough to provide reserves in times of short-term dietary inadequacies, but not so high as to approach toxicity. Nutrient intakes above or below this range may be equally harmful.



between the requirements for other nutrients and those for energy is that each person has an obvious indicator of whether energy intake is inadequate, adequate, or excessive: body weight. Because *any* amount of energy in excess of need leads to weight gain, the DRI committee did not set a Tolerable Upper Intake Level.

Acceptable Macronutrient Distribution Ranges

As noted earlier, the DRI committee considers prevention of chronic disease as well as nutrient adequacy when establishing recommendations. To that end, the committee established healthy ranges of intakes for the energy-yielding nutrients—carbohydrate, fat, and protein—known as **Acceptable Macronutrient Distribution Ranges (AMDR)**. Each of these three energy-yielding nutrients contributes to a person's total energy (kcalorie) intake, and those contributions vary in relation to each other. The DRI committee has determined that a diet that provides the energy-yielding nutrients in the following proportions provides adequate energy and nutrients and reduces the risk of chronic disease:

- 45 to 65 percent of kcalories from carbohydrate
- 20 to 35 percent of kcalories from fat
- 10 to 35 percent of kcalories from protein

Review Notes

- The Dietary Reference Intakes (DRI) are a set of nutrient intake values that can be used to plan and evaluate dietary intakes for healthy people.
- The Estimated Average Requirement (EAR) defines the amount of a nutrient that supports a specific function in the body for half of the population.
- The Recommended Dietary Allowance (RDA) is based on the EAR and establishes a goal for dietary intake that will meet the needs of almost all healthy people.
- An Adequate Intake (AI) serves a similar purpose as the RDA when an RDA cannot be determined.
- The Tolerable Upper Intake Level (UL) establishes the highest average daily nutrient intake level that appears safe for almost all healthy people.
- The Estimated Energy Requirement (EER) defines the energy intake level needed to maintain energy balance in a healthy adult of a defined age, gender, weight, height, and physical activity level.
- The Acceptable Macronutrient Distribution Ranges (AMDR) define the proportions contributed by carbohydrate, fat, and protein to a healthy diet.

National Nutrition Surveys

How do nutrition experts know whether people are meeting nutrient recommendations? The Dietary Reference Intakes and other major reports that examine the relationships between diet and health depend on information collected from nutrition surveys. Researchers use nutrition surveys to learn which foods people are eating and which supplements they are taking, to assess people's nutritional health, and to determine people's knowledge, attitudes, and behaviors about nutrition and how these relate to health. The resulting wealth of information can be used for a variety of purposes. For example, Congress uses this information to establish public policy on nutrition education, assess food assistance programs, and regulate the food supply. The food industry uses the information to guide decisions in public relations and product development. Scientists use the information to establish research priorities. One of the first nutrition surveys, taken before World War II, suggested that up to a third of the U.S. population might be eating poorly. Programs to correct **malnutrition** have been evolving ever since.

Acceptable Macronutrient Distribution Ranges (AMDR): ranges of intakes for the energy-yielding nutrients that provide adequate energy and nutrients and reduce the risk of chronic disease.

malnutrition: any condition caused by deficient or excess energy or nutrient intake or by an imbalance of nutrients.

Coordinating Nutrition Survey Data

The National Nutrition Monitoring program coordinates the many nutrition-related activities of various federal agencies. All major reports that examine the contribution of diet and nutrition status to the health of the people of the United States depend on information collected and coordinated by this national program. A national food and nutrient intake survey, called *What We Eat in America*, collects data on the kinds and amounts of foods people eat. Researchers then calculate the energy and nutrients in the foods and compare the amounts consumed with standards such as the DRI. *What We Eat in America* is conducted as part of a larger research effort, the National Health and Nutrition Examination Surveys (NHANES), which examine the people themselves using nutrition assessment methods. The data provide valuable information on several nutrition-related conditions such as growth retardation, heart disease, and nutrient deficiencies. These data also provide the basis for developing and monitoring national health goals.

National Health Goals

Healthy People is a program that identifies the nation's health priorities and guides policies that promote health and prevent disease. At the start of each decade, the program sets goals for improving the nation's health during the following 10 years. Nutrition is one of 38 topic areas of Healthy People 2020, each with numerous objectives (www.healthypeople.gov). Table 1-2 lists the nutrition and weight status objectives for 2020.

TABLE 1-2 Healthy People 2020 Nutrition and Weight Status Objectives

- Increase the proportion of adults who are at a healthy weight
- Reduce the proportion of adults who are obese
- Reduce iron deficiency among young children and females of childbearing age
- Reduce iron deficiency among pregnant females
- Reduce the proportion of children and adolescents who are overweight or obese
- Increase the contribution of fruits to the diets of the population aged 2 years and older
- Increase the variety and contribution of vegetables to the diets of the population aged 2 years and older
- Increase the contribution of whole grains to the diets of the population aged 2 years and older
- Reduce consumption of saturated fat in the population aged 2 years and older
- Reduce consumption of sodium in the population aged 2 years and older
- Increase consumption of calcium in the population aged 2 years and older
- Increase the proportion of worksites that offer nutrition or weight management classes or counseling
- Increase the proportion of physician office visits that include counseling or education related to nutrition or weight
- Eliminate very low food security among children in U.S. households
- Prevent inappropriate weight gain in youth and adults
- Increase the proportion of primary care physicians who regularly measure the body mass index of their patients
- Reduce consumption of kcalories from solid fats and added sugars in the population age 2 years and older
- Increase the number of states that have state-level policies that incentivize food retail outlets to provide foods that are encouraged by the Dietary Guidelines
- Increase the number of states with nutrition standards for foods and beverages provided to preschool-age children in childcare
- Increase the percentage of schools that offer nutritious foods and beverages outside of school meals

Source: www.healthypeople.gov.

Healthy People: a national public health initiative under the jurisdiction of the U.S. Department of Health and Human Services (DHHS) that identifies the most significant preventable threats to health and focuses efforts toward eliminating them.

Review Notes

- Nutrition surveys measure people's food consumption and evaluate the nutrition status of populations.
- Information gathered from nutrition surveys serves as the basis for many major diet and nutrition reports, including Healthy People.

TABLE 1-3 Leading Causes of Death in the United States

The diseases in bold italics are nutrition related.

1. ***Heart disease***
2. ***Cancers***
3. Chronic lung diseases
4. ***Strokes***
5. Accidents
6. Alzheimer's disease
7. ***Diabetes mellitus***
8. Pneumonia and influenza
9. Kidney disease
10. Suicide

Source: J. Xu and coauthors, Mortality in the United States, 2012, *NCHS Data Brief* 168, October 2014.

Dietary Guidelines and Food Guides

Today, government authorities are as concerned about **overnutrition** as they once were about **undernutrition**. Research confirms that dietary excesses, especially of energy, sodium, certain fats, and alcohol, contribute to many **chronic diseases**, including heart disease, cancer, stroke, diabetes, and liver disease.[10] Only two common lifestyle habits have more influence on health than a person's choice of diet: smoking and other tobacco use, and excessive drinking of alcohol. Table 1-3 lists the leading causes of death in the United States; notice that three of the top four are nutrition related (and related to tobacco use). Note, however, that although diet is a powerful influence on these diseases, they cannot be prevented by a healthy diet alone; genetics, physical activity, age, gender, and other factors also play a role. Within the range set by genetic inheritance, however, disease development is strongly influenced by the foods a person chooses to eat.

Sound nutrition does not depend on the selection of any one food. Instead, it depends on the overall **eating pattern**—the combination of many different foods and beverages at numerous meals over days, months, and years.[11] So how can health care professionals help people select foods to create an eating pattern that supplies all the needed nutrients in amounts consistent with good health? The principle is simple enough: encourage clients to eat a variety of foods that supply all the nutrients the body needs. In practice, how do people do this? It helps to keep in mind that a nutritious diet achieves six basic ideals.

overnutrition: overconsumption of food energy or nutrients sufficient to cause disease or increased susceptibility to disease; a form of malnutrition.

undernutrition: underconsumption of food energy or nutrients severe enough to cause disease or increased susceptibility to disease; a form of malnutrition.

chronic diseases: diseases characterized by slow progression, long duration, and degeneration of body organs due in part to such personal lifestyle elements as poor food choices, smoking, alcohol use, and lack of physical activity.

eating pattern: customary intake of foods and beverages over time.

adequacy: the characteristic of a diet that provides all the essential nutrients, fiber, and energy necessary to maintain health and body weight.

balance: the dietary characteristic of providing foods in proportion to one another and in proportion to the body's needs.

kcalorie (energy) control: management of food energy intake.

Dietary Ideals

A nutritious diet has the following six characteristics:

- Adequacy
- Balance
- kCalorie (energy) control
- Nutrient density
- Moderation
- Variety

The first, **adequacy**, was already addressed in the earlier discussion on the DRI. An adequate diet has enough energy and enough of every nutrient (as well as fiber) to meet the needs of healthy people. Second is **balance**: the food choices do not overemphasize one nutrient or food type at the expense of another. Balance in the diet helps to ensure adequacy.

The essential minerals calcium and iron illustrate the importance of dietary balance. Meat is rich in iron but poor in calcium. Conversely, milk is rich in calcium but poor in iron. Use some meat for iron; use some milk for calcium; and save some space for other foods, too, because a diet consisting of milk and meat alone would not be adequate. For other nutrients, people need to consume other protein foods, whole grains, vegetables, and fruit.

The third characteristic is **kcalorie (energy) control**: the foods provide the amount of energy needed to maintain a healthy body weight—not more, not less. The key to

kcalorie control is to select foods that deliver the most nutrients for the least food energy. This fourth characteristic is known as **nutrient density**. Nutrient density promotes adequacy and kcalorie control. Consider foods containing calcium, for example. You can get about 300 milligrams of calcium from either 1½ ounces of cheddar cheese or 1 cup of fat-free milk, but the cheese delivers about twice as much food energy (kcalories) as the milk. The fat-free milk, then, is twice as calcium dense as the cheddar cheese; it offers the same amount of calcium for half the kcalories. Both foods are excellent choices for adequacy's sake alone, but to achieve adequacy while controlling kcalories, the fat-free milk is the better choice. (Alternatively, a person could select a low-fat cheddar cheese providing kcalories comparable to fat-free milk.)

Just as a financially responsible person pays for rent, food, clothes, and tuition on a limited budget, healthy people obtain iron, calcium, and all the other essential nutrients on a limited energy (kcalorie) allowance. Success depends on getting many nutrients for each kcalorie "dollar." For example, a can of cola and a handful of grapes may both provide about the same number of kcalories, but grapes deliver many more nutrients. A person who makes nutrient-dense choices, such as fruit instead of cola, can meet daily nutrient needs on a lower energy budget. Such choices support good health.

Foods that are notably low in nutrient density—such as cakes, pies, candy, and colas—deliver **empty kcalories**. The kcalories these foods provide are called "empty" because they deliver a lot of energy (from added sugars, solid fats, or both) but little or no protein, vitamins, or minerals.

The concept of nutrient density is relatively simple when examining the contributions of one nutrient to a food or diet. With respect to calcium, milk ranks high and meats rank low. With respect to iron, meats rank high and milk ranks low. But which food is more nutritious? Answering that question is a more complex task because we need to consider several nutrients—those that may harm health and those that may be beneficial.[12] Ranking foods based on their overall nutrient composition is known as **nutrient profiling**. Researchers have yet to agree on an ideal way to rate foods based on the nutrient profile, but when they do, nutrient profiling will be quite useful in helping consumers identify nutritious foods and plan healthy diets.[13]

The fifth characteristic of a nutritious diet is **moderation**. Moderation contributes to adequacy, balance, and kcalorie control. Foods rich in fat and sugar often provide enjoyment and energy but relatively few nutrients. In addition, they promote weight gain when eaten in excess. A person who practices moderation eats such foods only on occasion and regularly selects foods low in **solid fats** and **added sugars**, a practice that automatically improves nutrient density. Returning to the example of cheddar cheese and fat-free milk, the milk not only offers more calcium for less energy, but it contains far less fat than the cheese.

Finally, the sixth characteristic of a nutritious diet is **variety**: the foods chosen differ from one day to the next. A diet may have all the virtues just described and still lack variety if a person eats the same foods day after day. People should select foods from each of the food groups daily and vary their choices within each food group from day to day, for a couple of reasons. First, different foods within the same group contain different arrays of nutrients. Among the fruits, for example, strawberries are especially rich in vitamin C while apricots are rich in vitamin A. Variety improves nutrient adequacy. Second, no food is guaranteed to be entirely free of substances that, in excess, could be harmful. The strawberries might contain trace amounts of one contaminant, the apricots another. By alternating fruit choices, a person will ingest very little of either contaminant.

nutrient density: a measure of the nutrients a food provides relative to the energy it provides. The more nutrients and the fewer kcalories, the higher the nutrient density.

empty kcalories: kcalories provided by added sugars and solid fats with few or no other nutrients.

nutrient profiling: ranking foods based on their nutrient composition.

moderation: the provision of enough, but not too much, of a substance.

solid fats: fats that are not usually liquid at room temperature; commonly found in most foods derived from animals and vegetable oils that have been hydrogenated. Solid fats typically contain more saturated and *trans* fats than most oils (Chapter 4 provides more details).

added sugars: sugars, syrups, and other kcaloric sweeteners that are added to foods during processing or preparation or at the table. Added sugars do not include the naturally occurring sugars found in fruits and milk products.

variety: consumption of a wide selection of foods within and among the major food groups (the opposite of monotony).

Dietary Guidelines for Americans

Many countries set dietary guidelines to answer the question, "What should I eat to stay healthy?" In the United States, for example, the U.S. Department of Agriculture published its *Dietary Guidelines for Americans 2015-2020* as part of an overall nutrition guidance system. While the DRI set nutrient intake goals, the Dietary Guidelines for Americans offer food-based strategies for achieving them. If everyone followed their advice, people's energy intakes would match their requirements and most of their nutrient needs would be met.[††] Table 1-4 presents the *Dietary Guidelines for Americans 2015-2020* and key recommendations.

TABLE 1-4 Dietary Guidelines for Americans 2015-2020: Guidelines and Key Recommendations

The Dietary Guidelines and key recommendations for healthy eating patterns should be applied in their entirety; they are interconnected and each dietary component can affect the others.

Dietary Guidelines	Key Recommendations

1. Follow a healthy eating pattern across the lifespan. All food and beverage choices matter. Choose a healthy eating pattern at an appropriate kcalorie level to help achieve and maintain a healthy body weight, support nutrient adequacy, and reduce the risk of chronic disease.	**Consume a healthy eating pattern that accounts for all foods and beverages within an appropriate kcalorie level.**
	A healthy eating pattern includes:
	• A variety of vegetables from all of the subgroups—dark green, red and orange, legumes (beans and peas), starchy, and other.
	• Fruits, especially whole fruits.
	• Grains, at least half of which are whole grains.
	• Fat-free or low-fat dairy, including milk, yogurt, cheese, and /or fortified soy beverages.
	• A variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas), and nuts, seeds, and soy products.
	• Oils.
	A healthy eating pattern limits:
	• Saturated fats and *trans* fats, added sugars, and sodium.
	  • Consume less than 10 percent of kcalories per day from added sugars.
	  • Consume less than 10 percent of kcalories per day from saturated fats.
	  • Consume less than 2,300 milligrams per day of sodium.
	• If alcohol is consumed, it should be consumed in moderation—up to one drink per day for women and up to two drinks per day for men—and only by adults of legal drinking age.
	Meet the *Physical Activity Guidelines for Americans*.

2. Focus on variety, nutrient density, and amount. To meet nutrient needs within kcalorie limits, choose a variety of nutrient-dense foods across and within all food groups in recommended amounts.	
3. Limit kcalories from added sugars and saturated fats and reduce sodium intake. Consume an eating pattern low in added sugars, saturated fats, and sodium. Cut back on foods and beverages higher in these components to amounts that fit within healthy eating patterns.	
4. Shift to healthier food and beverage choices. Choose nutrient-dense foods and beverages across and within all food groups in place of less healthy choices. Consider cultural and personal preferences to make these shifts easier to accomplish and maintain.	
5. Support healthy eating patterns for all. Everyone has a role in helping to create and support healthy eating patterns in multiple settings nationwide, from home to school to work to communities.	

Note: These guidelines are intended for adults and healthy children age 2 and older.

Source: U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015-2020 Dietary Guidelines for Americans, 8th edition (2015), available at http://health.gov/dietaryguidelines/2015/guidelines/.

The Guidelines Promote Health

People who follow the Dietary Guidelines—that is, those who do not overconsume kcalories, who take in enough of a variety of nutrient-dense foods and beverages, and who make physical activity a habit—often enjoy the best possible health. Only a few people in this country meet this description, however. Instead, about half of American adults suffer from one or more *preventable* chronic diseases related to poor diets and sedentary lifestyles.

How Does the U.S. Diet Compare to the Guidelines?

The Dietary Guidelines committee reviewed nationwide data reflecting nutrient intakes, along with biochemical assessment results for nutrient status. The results are clear: important needed nutrients are undersupplied by the current U.S. diet, while other, less healthful nutrients are oversupplied (see Table 1-5). Figure 1-4 shows that, typically, people take in far too few nutritious foods from most food groups as compared with the ideals of the Dietary Guidelines for Americans (discussed in a later section).

Note that the Dietary Guidelines do not require that you give up your favorite foods or eat strange, unappealing foods. They advocate achieving a healthy dietary pattern through wise food and beverage choices and not by way of nutrient or other dietary supplements except when medically necessary. With a little planning and a few adjustments, almost anyone's diet can contribute to health instead of disease. The Dietary Guidelines also challenge the nation and local communities to change their policies in ways that make health and disease prevention high priorities. Part of the plan must be to increase individuals' physical activity to help achieve and sustain a healthy body weight, and the next section offers some guidelines.

[††]USDA Food Patterns may not provide recommended intakes of vitamin D and potassium.

TABLE 1-5 Nutrients of Concern in the United States

The Dietary Guidelines committee compared average U.S. nutrient intakes with DRI recommendations and identified two categories of nutrients that pose a public health risk due to their under- or overconsumption, indicating a need for change in U.S. eating habits. Added sugars, not listed, are also overconsumed, but no DRI standard exists for added sugars.

Shortfall nutrients: Undersupplied by diets of many people ages 2 years and older:

- Vitamin A
- Vitamin D
- Vitamin E
- Folate
- Vitamin C
- Calcium
- Magnesium
- Potassium
- Iron (for some girls and women; see Chapter 9)
- Fiber

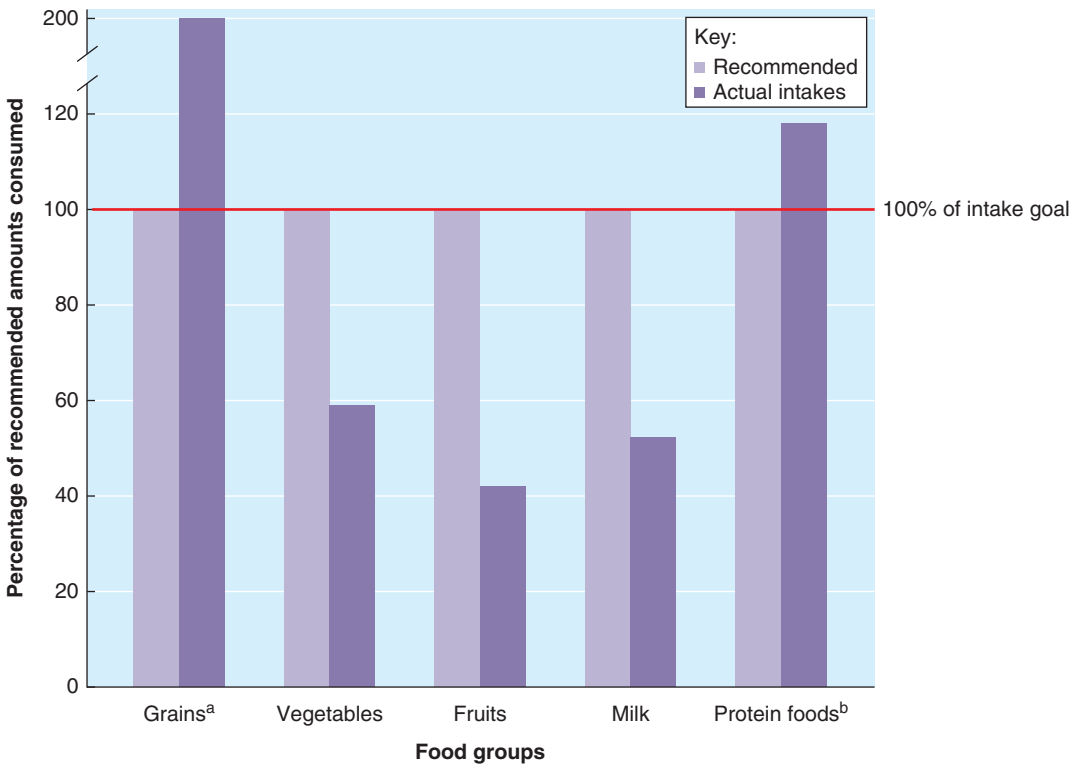
Overconsumed nutrients: Chronically oversupplied by the diets of many people ages 2 years and older:

- Sodium
- Saturated fat

Source: U.S. Department of Agriculture and U.S. Department of Health and Human Services, *Scientific Report of the 2015 Dietary Guidelines Advisory Committee* (2015): D-1:7–8, www.health.gov.

FIGURE 1-4 Recommended and Actual Intakes Compared

This graph shows the improvements needed in the average U.S. diet—more whole grains, far fewer refined grains, more vegetables and fruit, and more milk—to meet intake goals.



[a]At least half of the grain selections should be whole grains.
[b]Intake of the seafood subgroup is only 44 percent of recommended levels.

Review Notes

- A well-planned diet delivers adequate nutrients, a balanced array of nutrients, and an appropriate amount of energy.
- A well-planned diet is based on nutrient-dense foods, moderate in substances that can be detrimental to health, and varied in its selections.
- The Dietary Guidelines for Americans apply these principles, offering practical advice on how to eat for good health.

Fitness Guidelines

The Dietary Guidelines for Americans emphasize the benefits of increasing physical activity and reducing sedentary activities to achieve or sustain a healthy body weight and reduce the risk of chronic disease. Extensive evidence confirms that regular physical activity promotes health and reduces the risk of developing a number of diseases.[14] Yet, despite an increasing awareness of the health benefits physical activity confers, only about 20 percent of adults in the United States meet physical activity guidelines.[15] Like smoking and obesity, physical inactivity is linked to the degenerative diseases that are the primary killers of adults in developed countries: heart disease, cancer, stroke, diabetes, and hypertension.[16] Therefore, one of the most important challenges health care professionals face is to motivate more people to become physically active. To motivate others, health care professionals must first become more physically active themselves, thereby enhancing their own health. Second, they can include regular physical activity as a component of therapy for their clients. As a person becomes physically fit, the health of the entire body improves. In general, physically fit people enjoy:

- *More restful sleep*. Rest and sleep occur naturally after periods of physical activity. During rest, the body repairs injuries, disposes of wastes generated during activity, and builds new physical structures.
- *Improved nutritional health*. Physical activity expends energy and thus allows people to eat more food. If they choose wisely, active people will consume more nutrients and be less likely to develop nutrient deficiencies.
- *Improved body composition*. A balanced program of physical activity limits body fat and increases or maintains lean tissue. Thus, physically active people may have relatively less body fat than sedentary people at the same body weight.[17]
- *Improved bone density*. Weight-bearing physical activity builds bone strength and protects against osteoporosis.[18]
- *Enhanced resistance to colds and other infectious diseases*. Fitness enhances immunity.[‡‡]
- *Lower risks of some types of cancers*. Lifelong physical activity may help to protect against colon cancer, breast cancer, and some other cancers.[19]
- *Stronger circulation and lung function*. Physical activity that challenges the heart and lungs strengthens both the circulatory and respiratory systems.
- *Lower risks of cardiovascular disease*. Physical activity lowers blood pressure, slows resting pulse rate, lowers total blood cholesterol, and raises HDL cholesterol, thus reducing the risks of heart attacks and strokes.[20] Some research suggests that physical activity may reduce the risk of cardiovascular disease in another way as well—by reducing intra-abdominal fat stores.[21]
- *Lower risks of type 2 diabetes*. Physical activity normalizes glucose tolerance.[22] Regular physical activity reduces the risk of developing type 2 diabetes and benefits those who already have the condition.

VLevi/Shutterstock.com

Physical activity helps you look good, feel good, and have fun, and it brings many long-term health benefits as well.

[‡‡]Moderate physical activity can stimulate immune function. Intense, vigorous, prolonged activity such as marathon running, however, may compromise immune function.

- *Reduced risk of gallbladder disease (women).* Regular physical activity reduces the risk of gallbladder disease—perhaps by facilitating weight control and lowering blood lipid levels.[23]
- *Lower incidence and severity of anxiety and depression.* Physical activity may improve mood and enhance the quality of life by reducing depression and anxiety.[24]
- *Stronger self-image.* The sense of achievement that comes from meeting physical challenges promotes self-confidence.
- *Long life and high quality of life in the later years.* Active people live longer, healthier lives than sedentary people do.[25] Even as little as 15 minutes a day of moderate-intensity activity can add years to a person's life. In addition to extending longevity, physical activity supports independence and mobility in later life by reducing the risk of falls and minimizing the risk of injury should a fall occur.[26]

What does a person have to do to reap the health rewards of physical activity? To gain substantial *health* benefits, most guidelines recommend a minimum amount of time performing **aerobic physical activity**.[27] The minimum amount of time depends on whether the activity is **moderate-intensity physical activity** or **vigorous-intensity physical activity**. Whether moderate- or vigorous-intensity, a minimum length of 10 minutes for short bouts of aerobic physical activity is recommended.[28] Of course, more time and greater intensity bring even greater health benefits: maintaining a healthy body weight and further reducing the risk of chronic diseases.

In addition to providing health benefits, physical activity helps to develop and maintain **fitness**. Table 1-6 (p. 20) presents the American College of Sports Medicine (ACSM) guidelines for physical activity.[29] Fitness and health both depend on maintaining an active lifestyle every day.

Review Notes

- Regular physical activity promotes health and reduces risk of chronic disease.
- The ACSM has issued recommendations for physical activity to develop and maintain physical fitness.

The USDA Food Patterns

To help people achieve the goals set forth by the Dietary Guidelines for Americans, the USDA provides a **food group plan**—the **USDA Food Patterns**—that builds a diet from categories of foods that are similar in vitamin and mineral content. Thus, each group provides a set of nutrients that differs somewhat from the nutrients supplied by the other groups. Selecting foods from each of the groups eases the task of creating an adequate and balanced diet. The DASH Eating Plan, presented in Chapter 21, is another dietary pattern that meets the goals of the Dietary Guidelines for Americans.

Figure 1-5 presents the major food groups and their subgroups. The plan assigns foods to five major food groups—fruits, vegetables, grains, protein foods, and milk and milk products. The USDA specifies portions (ounce or cup equivalents) of various foods within each group that are nutritional equivalents and thus can be treated interchangeably in diet planning. Figure 1-5 lists the key nutrients of each group, information worth noting and remembering, and also sorts foods within each group by nutrient density.

Recommended Amounts

All food groups offer valuable nutrients, and people should make selections from each group daily. Table 1-7 (p. 21) specifies the amounts of food needed from each group daily to create a healthful diet for several energy (kcalorie) levels. A person needing 2000 kcalories a day, for example, would select 2 cups of fruit; 2½ cups of vegetables;

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A portion of grains is 1 ounce, yet most bagels today weigh 4 ounces or more—meaning that a single bagel can easily supply four or more portions of grains, not one, as many people assume.

aerobic physical activity: activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Aerobic activity, also called *endurance activity*, improves cardiorespiratory fitness. Brisk walking, running, swimming, and bicycling are examples.

moderate-intensity physical activity: physical activity that requires some increase in breathing and/or heart rate and expends 3.5 to 7 kcalories per minute. Walking at a speed of 3 to 4.5 miles per hour (about 15 to 20 minutes to walk one mile) is an example.

vigorous-intensity physical activity: physical activity that requires a large increase in breathing and/or heart rate and expends more than 7 kcalories per minute. Walking at a very brisk pace (>4.5 miles per hour) or running at a pace of at least 5 miles per hour are examples.

fitness: the characteristics that enable the body to perform physical activity; more broadly, the ability to meet routine physical demands with enough reserve energy to rise to a physical challenge; the body's ability to withstand stress of all kinds.

food group plan: a diet-planning tool that sorts foods into groups based on nutrient content and then specifies that people should eat certain amounts of food from each group.

USDA Food Patterns: the USDA's food group plan for ensuring dietary adequacy that assigns foods to five major food groups.

FIGURE 1-5 USDA Food Groups and Subgroups

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1 c fruit =
1 c fresh, frozen, or canned fruit
½ c dried fruit
1 c 100% fruit juice

Fruits contribute folate, vitamin A, vitamin C, potassium, and fiber.

Consume a variety of fruits, and choose whole or cut-up fruits more often than fruit juice.

Apples, apricots, avocados, bananas, blueberries, cantaloupe, cherries, grapefruit, grapes, guava, honeydew, kiwi, mango, nectarines, oranges, papaya, peaches, pears, pineapples, plums, raspberries, strawberries, tangerines, watermelon; dried fruit (dates, figs, prunes, raisins); 100% fruit juices

Limit these fruits that contain solid fats and/or added sugars:
Canned or frozen fruit in syrup; juices, punches, ades, and fruit drinks with added sugars; fried plantains

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1 c vegetables =
1 c cut-up raw or cooked vegetables
1 c cooked legumes
1 c vegetable juice
2 c raw, leafy greens

Vegetables contribute folate, vitamin A, vitamin C, vitamin K, vitamin E, magnesium, potassium, and fiber.

Consume a variety of vegetables each day, and choose from all five subgroups several times a week.

Dark-green vegetables: Broccoli and leafy greens such as arugula, beet greens, bok choy, collard greens, kale, mustard greens, romaine lettuce, spinach, turnip greens, watercress

Red and orange vegetables: Carrots, carrot juice, pumpkin, red bell peppers, sweet potatoes, tomatoes, tomato juice, vegetable juice, winter squash (acorn, butternut)

Legumes: Black beans, black-eyed peas, garbanzo beans (chickpeas), kidney beans, lentils, navy beans, pinto beans, soybeans and soy products such as tofu, split peas, white beans

Starchy vegetables: Cassava, corn, green peas, hominy, lima beans, potatoes

Other vegetables: Artichokes, asparagus, bamboo shoots, bean sprouts, beets, brussels sprouts, cabbages, cactus, cauliflower, celery, cucumbers, eggplant, green beans, green bell peppers, iceberg lettuce, mushrooms, okra, onions, seaweed, snow peas, zucchini

Limit these vegetables that contain solid fats and/or added sugars:
Baked beans, candied sweet potatoes, coleslaw, french fries, potato salad, refried beans, scalloped potatoes, tempura vegetables

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1 oz grains =
1 slice bread
½ c cooked rice, pasta, or cereal
1 oz dry pasta or rice
1 c ready-to-eat cereal
3 c popped popcorn

Grains contribute folate, niacin, riboflavin, thiamin, iron, magnesium, selenium, and fiber.

Make most (at least half) of the grain selections whole grains.

Whole grains: Amaranth, barley, brown rice, buckwheat, bulgur, cornmeal, millet, oats, quinoa, rye, wheat, wild rice and whole-grain products such as breads, cereals, crackers, and pastas; popcorn

Enriched refined products: Bagels, breads, cereals, pastas (couscous, macaroni, spaghetti), pretzels, white rice, rolls, tortillas

Limit these grains that contain solid fats and/or added sugars:
Biscuits, cakes, cookies, cornbread, crackers, croissants, doughnuts, fried rice, granola, muffins, pastries, pies, presweetened cereals, taco shells

continued

FIGURE 1-5 USDA Food Groups and Subgroups *(continued)*

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1 oz protein foods =
1 oz cooked lean meat, poultry, or seafood
1 egg
¼ c cooked legumes or tofu
1 tbs peanut butter
½ oz nuts or seeds

Protein foods contribute protein, essential fatty acids, niacin, thiamin, vitamin B_6, vitamin B_{12}, iron, magnesium, potassium, and zinc.

Choose a variety of protein foods from the three subgroups, including seafood in place of meat or poultry twice a week.

Seafood: Fish (catfish, cod, flounder, haddock, halibut, herring, mackerel, pollock, salmon, sardines, sea bass, snapper, trout, tuna), shellfish (clams, crab, lobster, mussels, oysters, scallops, shrimp)

Meats, poultry, eggs: Lean or low-fat meats (fat-trimmed beef, game, ham, lamb, pork, veal), poultry (no skin), eggs

Nuts, seeds, soy products: Unsalted nuts (almonds, cashews, filberts, pecans, pistachios, walnuts), seeds (flaxseeds, pumpkin seeds, sesame seeds, sunflower seeds), legumes, soy products (textured vegetable protein, tofu, tempeh), peanut butter, peanuts

Limit these protein foods that contain solid fats and/or added sugars:
Bacon; baked beans; fried meat, seafood, poultry, eggs, or tofu; refried beans; ground beef; hot dogs; luncheon meats; marbled steaks; poultry with skin; sausages; spare ribs

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1 c milk or milk product =
1 c milk, yogurt, or fortified soy milk
1½ oz natural cheese
2 oz processed cheese

Milk and milk products contribute protein, riboflavin, vitamin B_{12}, calcium, potassium, and, when fortified, vitamin A and vitamin D.

Make fat-free or low-fat choices. Choose other calcium-rich foods if you don't consume milk.

Fat-free or 1% low-fat milk and fat-free or 1% low-fat milk products such as buttermilk, cheeses, cottage cheese, yogurt; fat-free fortified soy milk

Limit these milk products that contain solid fats and/or added sugars:
2% reduced-fat milk and whole milk; 2% reduced-fat and whole-milk products such as cheeses, cottage cheese, and yogurt; flavored milk with added sugars such as chocolate milk, custard, frozen yogurt, ice cream, milk shakes, pudding, sherbet; fortified soy milk

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1 tsp oil =
1 tsp vegetable oil
1 tsp soft margarine
1 tbs low-fat mayonnaise
2 tbs light salad dressing

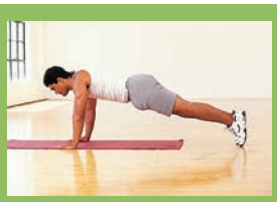
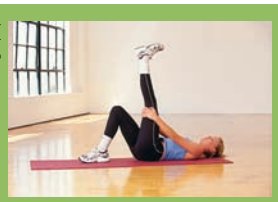
Oils are not a food group, but are featured here because they contribute vitamin E and essential fatty acids.

Use oils instead of solid fats, when possible.

Liquid vegetable oils such as canola, corn, flaxseed, nut, olive, peanut, safflower, sesame, soybean, sunflower oils; mayonnaise, oil-based salad dressing, soft *trans*-free margarine; unsaturated oils that occur naturally in foods such as avocados, fatty fish, nuts, olives, seeds (flaxseeds, sesame seeds), shellfish

Limit these solid fats:
Butter, animal fats, stick margarine, shortening

TABLE 1-6 American College of Sports Medicine's Guidelines for Physical Activity

	 Steve Cole/Photodisc/Getty Images **Cardiorespiratory**	 © David Hanover Photography **Strength**	 © David Hanover Photography **Flexibility**
Type of activity	Aerobic activity that uses large-muscle groups and can be maintained continuously	Resistance activity that is performed at a controlled speed and through a full range of motion	Stretching activity that uses the major muscle groups
Frequency	5 to 7 days per week	2 or more nonconsecutive days per week	2 to 7 days per week
Intensity	Moderate (equivalent to walking at a pace of 3 to 4 miles per hour)[a]	Enough to enhance muscle strength and improve body composition	Enough to feel tightness or slight discomfort
Duration	At least 30 minutes per day	8 to 12 repetitions of 8 to 10 different exercises (minimum)	2 to 4 repetitions of 15 to 30 seconds per muscle group
Examples	Running, cycling, swimming, inline skating, rowing, power walking, cross-country skiing, kickboxing, jumping rope; sports activities such as basketball, soccer, racquetball, tennis, volleyball	Pull-ups, push-ups, weight-lifting, pilates	Yoga

[a]For those who prefer vigorous-intensity aerobic activity such as walking at a very brisk pace (>4.5 mph) or running (5 mph), a minimum of 20 minutes per day, 3 days per week is recommended

Source: American College of Sports Medicine position stand, Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromuscular fitness in apparently healthy adults: Guidance for prescribing exercise, *Medicine and Science in Sports and Exercise* 43 (2011): 1334–1359; W. L. Haskell and coauthors, Physical activity and public health: Updated recommendation for adults from the American College of Sports Medicine and the American Heart Association, *Medicine and Science in Sports and Exercise* 39 (2007): 1423–1434.

6 ounces of grain foods; 5½ ounces of protein foods; and 3 cups of milk or milk products.[§§] Additionally, a small amount of unsaturated oil, such as vegetable oil or the oils of nuts, olives, or fatty fish, is required to supply needed nutrients. Estimated daily kcalorie needs for sedentary and active men and women are shown in Table 1-8. Chapter 6 explains how to determine energy needs.

All vegetables provide an array of vitamins, fiber, and the mineral potassium, but some vegetables are especially good sources of certain nutrients and beneficial phytochemicals. For this reason, the vegetable group is sorted into five subgroups. The dark green vegetables deliver the B vitamin folate; the red and orange vegetables provide vitamin A; legumes supply iron and protein; the starchy vegetables contribute carbohydrate energy; and the other vegetables fill in the gaps and add more of these same nutrients.

In a 2000-kcalorie diet, then, the recommended 2½ cups of daily vegetables should be varied among the subgroups over a week's time. In other words, eating 2½ cups of potatoes or even nutrient-rich spinach every day for seven days does *not* meet the recommended vegetable intakes. Potatoes and spinach make excellent choices when consumed in balance with vegetables from the other subgroups. One way to help ensure selections for all of the subgroups is to eat vegetables of various colors—for example, green broccoli, orange sweet potatoes, black beans, yellow corn, and white cauliflower. Intakes of vegetables are appropriately averaged over a week's time—it isn't necessary to include every subgroup every day.

[§§]Milk and milk products also can be referred to as dairy products.

TABLE 1-7 USDA Healthy U.S.-Style Food Pattern: Recommended Daily Amounts from Each Food Group[a]

Food Group	1600 kcal	1800 kcal	2000 kcal	2200 kcal	2400 kcal	2600 kcal	2800 kcal	3000 kcal
Fruits	1½ c	1½ c	2 c	2 c	2 c	2 c	2½ c	2½ c
Vegetables	2 c	2½ c	2½ c	3 c	3 c	3½ c	3½ c	4 c
Grains	5 oz	6 oz	6 oz	7 oz	8 oz	9 oz	10 oz	10 oz
Protein foods	5 oz	5 oz	5½ oz	6 oz	6½ oz	6½ oz	7 oz	7 oz
Milk	3 c	3 c	3 c	3 c	3 c	3 c	3 c	3 c
Oils	5 tsp	5 tsp	6 tsp	6 tsp	7 tsp	8 tsp	8 tsp	10 tsp
Solid fats	8 g (1½ tsp)	11 g (2½ tsp)	18 g (4 tsp)	18 g (4 tsp)	23 g (5 tsp)	25 g (5½ tsp)	26 g (5½ tsp)	31 g (6½ tsp)
Added sugars	14 g (3½ tsp)	19 g (5 tsp)	30 g (7½ tsp)	32 g (8 tsp)	39 g (10 tsp)	43 g (11 tsp)	45 g (11½ tsp)	53 g (13½ tsp)

Source: U.S. Department of Agriculture and U.S. Department of Health and Human Services, *Scientific Report of the 2015 Dietary Guidelines Advisory Committee* (2015): Table D1.10, 100–101.

[a]Other healthy USDA Food Patterns include the Vegetarian Pattern and the Mediterranean-Style Pattern.

TABLE 1-8 Estimated Daily kCalorie Needs for Adults

	Sedentary[a]	Active[b]
Women		
19–25 yr	2000	2400
26–30 yr	1800	2400
31–50 yr	1800	2200
51–60 yr	1600	2200
61+ yr	1600	2000
Men		
19–20 yr	2600	3000
21–35 yr	2400	3000
36–40 yr	2400	2800
41–55 yr	2200	2800
56–60 yr	2200	2600
61–75 yr	2000	2600
76+ yr	2000	2400

[a]*Sedentary* describes a lifestyle that includes only the activities typical of day-to-day life.
[b]*Active* describes a lifestyle that includes physical activity equivalent to walking more than 3 miles per day at a rate of 3 to 4 miles per hour, in addition to the activities typical of day-to-day life. In addition to gender, age, and activity level, energy needs vary with height and weight (see Chapter 6).

TABLE 1-9 Recommended Weekly Amounts from the Vegetable and Protein Foods Subgroups

Vegetables Subgroups	1600 kcal	1800 kcal	2000 kcal	2200 kcal	2400 kcal	2600 kcal	2800 kcal	3000 kcal
Dark green	1½ c	1½ c	1½ c	2 c	2 c	2½ c	2½ c	2½ c
Red and orange	4 c	5½ c	5½ c	6 c	6 c	7 c	7 c	7½ c
Legumes	1 c	1½ c	1½ c	2 c	2 c	2½ c	2½ c	3 c
Starchy	4 c	5 c	5 c	6 c	6 c	7 c	7 c	8 c
Other	3½ c	4 c	4 c	5 c	5 c	5½ c	5½ c	7
Protein Foods Subgroups								
Seafood	8 oz	8 oz	8 oz	9 oz	10 oz	10 oz	10 oz	10 oz
Meats, poultry, eggs	23 oz	23 oz	26 oz	28 oz	31 oz	31 oz	33 oz	33 oz
Nuts, seeds, soy products	4 oz	4 oz	5 oz	5 oz	5 oz	5 oz	6 oz	6 oz

Note: Table 1-7 specifies the recommended amounts of total vegetables and protein foods per day. This table shows those amounts dispersed among five vegetable and three protein foods subgroups per *week*.

Source: U.S. Department of Agriculture and U.S. Department of Health and Human Services, *Scientific Report of the 2015 Dietary Guidelines Advisory Committee* (2015): D1.10, 100–101.

For similar reasons, the protein foods group is sorted into three subgroups. Perhaps most notably, each of these subgroups contributes a different assortment of fats. Table 1-9 presents the recommended *weekly* amounts for each of the subgroups for vegetables and protein foods.

Notable Nutrients

As Figure 1-5 notes, each food group contributes key nutrients. This feature provides flexibility in diet planning because a person can select any food from a food group (or its subgroup) and receive similar nutrients. For example, a person can choose milk, cheese, or yogurt and receive the same key nutrients. Importantly, foods provide not only these key nutrients, but small amounts of other nutrients and phytochemicals as well.

Legumes contribute the same key nutrients—notably protein, iron, and zinc—as meats, poultry, and seafood. They are also excellent sources of fiber, folate, and potassium, which are commonly found in vegetables. To encourage frequent consumption of these nutrient-rich foods, legumes are included as a subgroup of both the vegetable group and the protein foods group, and thus can be counted as either.[30] In general, people who regularly eat meat, poultry, and seafood count legumes as a vegetable, and vegetarians and others who seldom eat meat, poultry, or seafood count legumes in the protein foods group.

The USDA Food Patterns encourage greater consumption from certain food groups to provide the nutrients most often lacking in the diets of Americans—dietary fiber, vitamin A, vitamin C, vitamin D, vitamin E, folate, calcium, and magnesium. In general, most people need to eat:

- *More* vegetables, fruits, whole grains, seafood, and fat-free or low-fat milk and milk products.
- *Less* sodium, saturated fat, and *trans* fat, and *fewer* refined grains and foods and beverages with solid fats and added sugars.

legumes (lay-GYOOMS, LEG-yooms): plants of the bean and pea family with seeds that are rich in protein compared with other plant-derived foods.

Nutrient-Dense Choices

A healthy eating pattern emphasizes nutrient-dense options within each food group. By consistently selecting nutrient-dense foods, a person can obtain all the nutrients needed and still keep kcalories under control. In contrast, eating foods that are low in nutrient density makes it difficult to get enough nutrients

without exceeding energy needs and gaining weight. For this reason, consumers should select low-fat foods from each group and foods without added fats or sugars—for example, fat-free milk instead of whole milk, baked chicken without the skin instead of hot dogs, green beans instead of french fries, orange juice instead of fruit punch, and whole-wheat bread instead of biscuits. Notice that Figure 1-5 indicates which foods *within each group* contain solid fats and/or added sugars and therefore should be limited. Oil is a notable exception: even though oil is pure fat and therefore rich in kcalories, a small amount of oil from sources such as nuts, fish, or vegetable oils is necessary every day to provide nutrients lacking from other foods. Consequently, these high-fat foods are listed among the nutrient-dense foods (see Nutrition in Practice 4 to learn why).

Solid Fats, Added Sugars, and Alcohol Reduce Nutrient Density As noted earlier, solid fats and added sugars add empty kcalories to foods, reducing their nutrient density. Solid fats include:

- Naturally occurring fats such as milk fat and meat fats.
- Added fats, such as butter, cream cheese, hard margarine, lard, sour cream, and shortening.

Added sugars include:

- All kcaloric sweeteners, such as brown sugar, honey, molasses, sugar, and syrups; and foods made from them, such as candy, jelly, and soft drinks.

The USDA suggests that intakes of solid fats and added sugars not exceed a daily suggested total, listed in Table 1-7.

Alcoholic beverages are a top contributor of kcalories to the diets of many U.S. adults, but they provide few nutrients. People who drink alcohol should monitor and moderate their intakes, not to exceed one drink per day for women and two for men. People in many circumstances should never drink alcohol (see Nutrition in Practice 19).

Cup and Ounce Equivalents Recommended daily amounts for fruits, vegetables, and milk are measured in cups, and those for grains and protein foods in ounces. Figure 1-5 provides the equivalent measures for foods that are not readily measured in cups and ounces. For example, 1 ounce of grains is considered equivalent to 1 slice of bread or ½ cup of cooked rice.

Consumers using the USDA Food Patterns can learn how to estimate the cups or ounces in their usual **portion sizes** by determining the answers to questions such as these: What fraction of a cup is a small handful of raisins? Is a "helping" of mashed potatoes more or less than a half cup? How many ounces of cereal do you typically pour into your bowl? How many ounces does the steak at your favorite restaurant weigh? How many cups of milk does your glass hold? For quick and easy estimates, visualize each portion as being about the size of a common object:

- ¼ c dried fruit or nuts = a golf ball
- 1 c fruit or vegetables = a baseball
- 3 oz meat = a deck of cards
- 2 tbs peanut butter = a ping pong ball

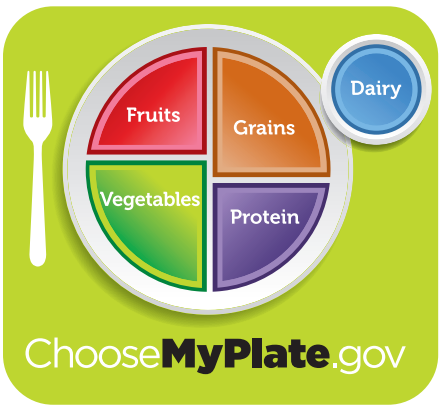
Mixtures of Foods Some foods—such as casseroles, soups, and sandwiches—fall into two or more food groups. With a little practice, users can learn to divide these foods into food groups. From the USDA Food Patterns' point of view, a taco represents four different food groups: the taco shell from the grains group; the onions, lettuce, and tomatoes from the vegetable group; the ground beef from the protein foods group; and the cheese from the milk group.

Vegetarian Food Guide Vegetarian diets are plant-based eating patterns that rely mainly on grains, vegetables, legumes, fruits, seeds, and nuts. Some vegetarian diets include eggs, milk products, or both. People who do not eat meats or milk products can still use the USDA Food Patterns to create an adequate diet.[31] Nutrition in Practice 5 defines vegetarian terms and provides details on planning healthy vegetarian diets.

portion sizes: the quantity of food served or eaten at one meal or snack; *not* a standard amount.

FIGURE 1-6 MyPlate

Note that vegetables and fruits occupy half the plate and that the grains portion is slightly larger than the portion of protein foods.



Source: USDA, www.choosemyplate.gov.

Ethnic Food Choices People can use the USDA Food Patterns and still enjoy a diverse array of culinary styles by sorting ethnic foods into their appropriate food groups. For example, a person eating Mexican foods would find tortillas in the grains group, jicama in the vegetable group, and guava in the fruit group. Table 1-1 (p. 4) features ethnic food choices.

MyPlate

The USDA created an educational tool called MyPlate to illustrate the five food groups and remind consumers to make healthy food choices. The MyPlate icon, shown in Figure 1-6, divides a plate into four sections, each representing a food group—fruits, vegetables, grains, and protein foods. The sections vary in size, indicating the relative proportion each food group contributes to a healthy diet. A circle next to the plate represents the milk group (dairy).

The MyPlate icon does not stand alone as an educational tool. A wealth of information can be found at the MyPlate website (*ChooseMyPlate.gov*). The USDA's MyPlate online suite of information makes applying the USDA Food Patterns easier. Consumers can create a personal profile to estimate kcalorie needs and determine the kinds and amounts of foods they need to eat each day based on their height, weight, age, gender, and activity level. Information is also available for children, pregnant and lactating women, and vegetarians. In addition to creating a personal plan, consumers can find daily tips to help them improve their diet and increase physical activity. A key message of the website is to enjoy food, but eat less by avoiding oversized portions.

Review Notes

- Food group plans such as the USDA Food Patterns help consumers select the types and amounts of foods to provide adequacy, balance, and variety in the diet.
- Each food group contributes key nutrients, a feature that provides flexibility in diet planning.
- MyPlate is an educational tool used to illustrate the five food groups.

Food Labels

Today, consumers know more about the links between diet and disease than they did in the past, and they are demanding still more information on disease prevention. Many people rely on food labels to help them select foods with less saturated fat, *trans* fat, and sodium and more vitamins, minerals, and dietary fiber. Food labels appear on virtually all packaged foods, and posters or brochures provide similar nutrition information for fresh fruits, vegetables, and other foods. A few foods need not carry nutrition labels: those contributing few nutrients, such as plain coffee, tea, and spices.

The Ingredient List

All packaged foods must list *all* ingredients on the label in descending order of predominance by weight. Knowing that the first ingredient predominates by weight, consumers can glean much information. Compare these products, for example:

- A beverage powder that contains "sugar, citric acid, natural flavors . . ." versus a juice that contains "water, tomato concentrate, concentrated juices of carrots, celery . . . ."
- A cereal that contains "puffed milled corn, sugar, corn syrup, molasses, salt . . ." versus one that contains "100 percent rolled oats. . . ."

In each comparison, consumers can tell that the second product is the more nutrient dense.

Nutrition Facts Panel

The Food and Drug Administration (FDA) requires food labels to include key nutrition facts. The "Nutrition Facts" panel provides such information as serving sizes, Daily Values, and nutrient quantities. Because knowledge about nutrition science has advanced greatly since food labels were first introduced, the FDA has recently proposed updates to the Nutrition Facts panel to make it easier for consumers to make informed decisions about the foods they eat.[32] The updated panel will also feature a refreshed design that displays kcalories and serving size information more prominently to emphasize parts of the label that are most important in addressing public health concerns such as obesity, diabetes, and heart disease. Manufacturers may take up to 2 years to change their labels, so Figure 1-7 illustrates and compares both the original "Nutrition Facts" panel and the proposed panel.

Serving Sizes

Food labels must identify the serving size (food quantity) for which nutrition information is presented. The FDA has established specific serving sizes for various foods and requires that all labels for a given product use the same serving size. By law, serving sizes must be based on the amounts of food or beverage people actually consume, not what they "should" consume. In general, people are eating and drinking more today than 20 years ago when the label was first designed, so the FDA has proposed updating the reference values for serving sizes that manufacturers use, to better reflect what people really eat and drink. For example, the serving size for all ice creams may be changed from ½ cup to 1 cup. The use of specific serving sizes for various foods facilitates comparison shopping. Consumers can see at a glance which brand has more or fewer kcalories or grams of fat, for example. However, these serving sizes do not provide a standard for desirable consumption. Standard serving sizes are expressed in both common household measures, such as cups, and metric measures, such as milliliters, to accommodate users of both types of measures (see Table 1-10).

FIGURE 1-7 Original and Proposed Nutrition Facts Panel

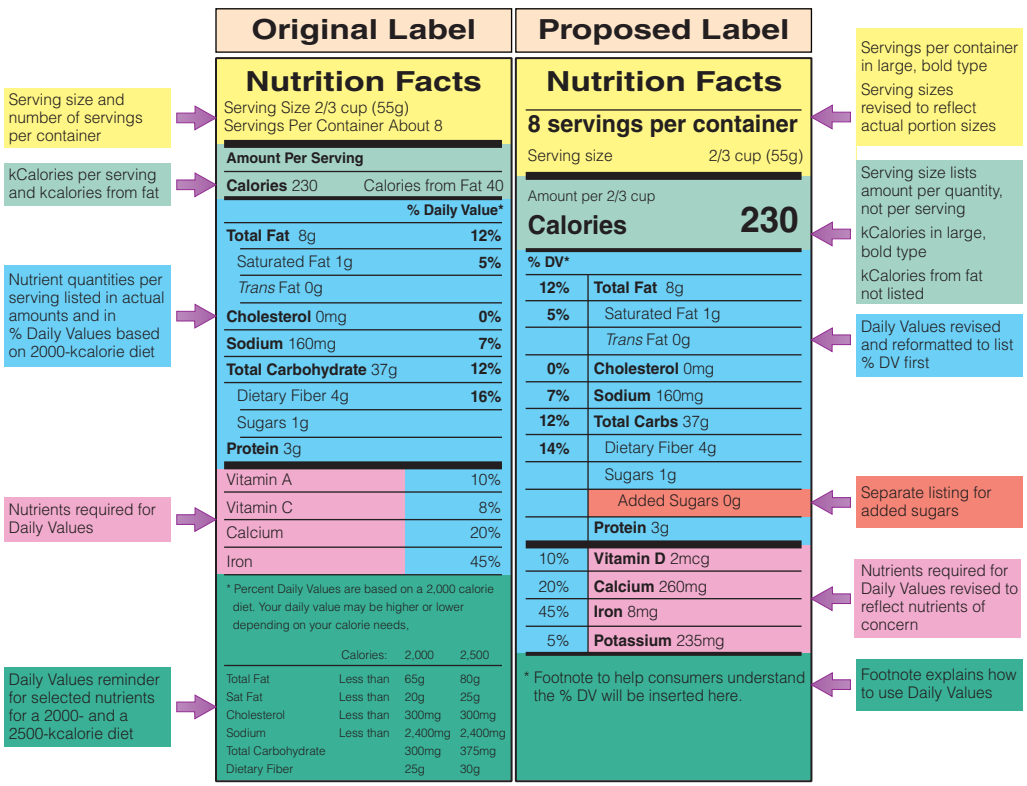


TABLE 1-10 Household and Metric Measures

- 1 teaspoon (tsp) = 5 milliliters (mL)
- 1 tablespoon (tbs) = 15 mL
- 1 cup (c) = 240 mL
- 1 fluid ounce (fl oz) = 30 mL
- 1 ounce (oz) = 28 grams (g)

Note: The Aids to Calculation section at the back of the book provides additional weights and measures.

In addition to updating serving sizes for certain products, the FDA may require some food and beverage containers previously labeled as more than one serving to be labeled as a single serving because people typically eat or drink the contents in one sitting. Examples are a 20-ounce soda and a 15-ounce can of soup. Certain larger packages may have a two-column label because some people may consume them in one sitting while others consume them in two or three sittings. For example, a 24-ounce bottle of soda or a 19-ounce can of soup might be one serving for one person but not for another.

When examining the nutrition information on a food label, consumers need to compare the serving size on the label with how much they actually eat and adjust their calculations accordingly. For example, if the serving size is four cookies and you only eat two, then you need to cut the nutrient and kcalorie values in half; similarly, if you eat eight cookies, then you need to double the values. The number of servings per container is listed just above the serving size on the updated label.

The Daily Values

To help consumers evaluate the information found on labels, the FDA created a set of nutrient standards called the **Daily Values** specifically for use on food labels. The Daily Values do two things: they set adequacy standards for nutrients that are desirable in the diet such as protein, vitamins, minerals, and fiber, and they set moderation standards for other nutrients that must be limited, such as fat, saturated fat, and sodium.

The "% Daily Value" column on a label provides a ballpark estimate of how individual foods contribute to the total diet. It compares key nutrients in a serving of food with the daily goals of a person consuming 2000 kcalories. Although the Daily Values are based on a 2000-kcalorie diet, people's actual energy intakes vary widely; some people need fewer kcalories, and some people need many more. This makes the Daily Values most useful for comparing one food with another and less useful as nutrient intake targets for individuals. By examining a food's general nutrient profile, however, a person can determine whether the food contributes "a little" or "a lot" of a nutrient, whether it contributes "more" or "less" than another food, and how well it fits into the consumer's overall diet.

The proposed label will include updated Daily Values for calcium, potassium, sodium, dietary fiber, and vitamin D. The Daily Values footnote will better explain the standards to consumers.

Nutrient Quantities

In addition to the serving size and the servings per container, the FDA requires that the Nutrition Facts panel on a label present nutrient information in two ways—in quantities (such as grams) and as percentages of the Daily Values. The updated Nutrition Facts panel must provide the nutrient amount, percent Daily Value, or both for the following:

- Total food energy (kcalories)
- Total fat (grams and percent Daily Value)—note that the proposed revision does not include kcalories from fat
- Saturated fat (grams and percent Daily Value)
- *Trans* fat (grams)
- Cholesterol (milligrams and percent Daily Value)
- Sodium (milligrams and percent Daily Value)
- Total carbohydrates, including starch, sugar, and fiber (grams and percent Daily Value)
- Dietary fiber (grams and percent Daily Value)
- Sugars, which includes both those naturally present in and those added to the foods (grams)
- Added sugars (grams)—note that the original label does not include a line for added sugars
- Protein (grams)
- The following vitamins and minerals (percent Daily Value): vitamin D, potassium, iron, and calcium

Daily Values: reference values developed by the FDA specifically for use on food labels.

Food energy from fat will no longer be required to appear on the label because research shows that the type of fat is more important than the amount. Note that vitamin D and potassium will be required because these are nutrients of concern for consumers, whereas vitamins A and C, once mandatory, will no longer be required but can be included on a voluntary basis.

The FDA developed the Daily Values for use on food labels because comparing nutrient amounts against a standard helps make them meaningful to consumers. A person might wonder, for example, whether 1 milligram of iron is a little or a lot. As Table 1-11 shows, the Daily Value for iron is 18 milligrams, so 1 milligram of iron is enough to take notice of: it is more than 5 percent.

TABLE 1-11 Daily Values for Food Labels

Food labels must present the "% Daily Value" for these nutrients.	
Food Component	**Daily Value**
Fat (total)	65 g
Saturated fat	20 g
Cholesterol	300 mg
Carbohydrate (total)	300 g
Fiber	28 g
Vitamin D	20 µg
Sodium	2300 mg
Potassium	4700 mg
Calcium	1300 mg
Iron	18 mg

Note: Daily Values were established for adults and children over 4 years old. The values for energy-yielding nutrients are based on 2000 kcalories a day.

Front-of-Package Labels

Some consumers find the many numbers on Nutrition Facts panels overwhelming. They want an easier and quicker way to interpret information and select products. Food manufacturers responded by creating front-of-package labels that incorporate text, color, and icons to present key nutrient facts.[33] Without any regulations or oversight, however, different companies used a variety of different symbols to describe how healthful their products were. To calm the chaos and maintain the voluntary status of front-of-package labels, major food industry associations created a standardized presentation of nutrient information called Facts Up Front (see Figure 1-8). Whether consumers find this approach to be the most helpful remains to be seen. The FDA is currently evaluating the program and reviewing recommendations from the Institute of Medicine to determine the best way to present front-of-package information.[34]

Claims on Labels

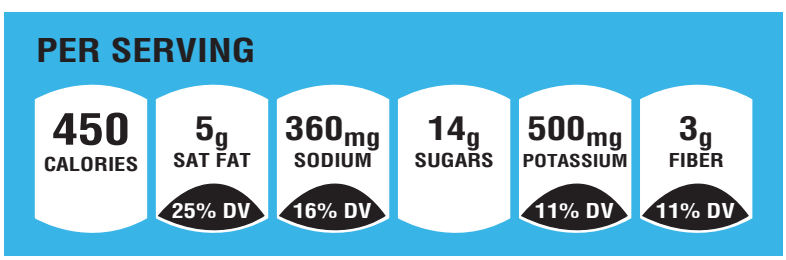
In addition to the Nutrition Facts panel, consumers may find various claims on labels. These claims include nutrient claims, health claims, and structure-function claims.

Nutrient Claims

Have you noticed phrases such as "good source of fiber" on a box of cereal or "rich in calcium" on a package of cheese? These and other **nutrient claims** may be used on labels only if the claims meet FDA definitions, which include the conditions under which each term can be used. For example, in addition to having less than 2 milligrams of cholesterol, a "cholesterol-free" product may not contain more than 2 grams of saturated fat and *trans* fat combined per serving. Table 1-12 defines nutrient terms on food labels, including criteria for foods described as "low," "reduced," and "free."

FIGURE 1-8 Facts Up Front

This example of front-of-package labeling (created by the Grocery Manufacturers Association and the Food Marketing Institute) presents key nutrient facts.



nutrient claims: statements that characterize the quantity of a nutrient in a food.

TABLE 1-12 Terms Used on Food Labels

General Terms
free: "nutritionally trivial" and unlikely to have a physiological consequence; synonyms include *without, no,* and *zero*. A food that does not contain a nutrient naturally may make such a claim but only as it applies to all similar foods (for example, "applesauce, a fat-free food").
good source of: the product provides between 10 and 19 percent of the Daily Value for a given nutrient per serving.
healthy: a food that is low in fat, saturated fat, cholesterol, and sodium and that contains at least 10 percent of the Daily Values for vitamin A, vitamin C, iron, calcium, protein, or fiber.
high: 20 percent or more of the Daily Value for a given nutrient per serving; synonyms include *rich in* or *excellent source*.
less: at least 25 percent less of a given nutrient or kcalories than the comparison food (see individual nutrients); synonyms include *fewer* and *reduced*.
light or lite: one-third fewer kcalories than the comparison food; 50 percent or less of the fat or sodium than the comparison food; any use of the term other than as defined must specify what it is referring to (for example, "light in color" or "light in texture").
low: an amount that would allow frequent consumption of a food without exceeding the Daily Value for the nutrient. A food that is naturally low in a nutrient may make such a claim but only as it applies to all similar foods (for example, "fresh cauliflower, a low-sodium food"); synonyms include *little, few,* and *low source of*.
more: at least 10 percent more of the Daily Value for a given nutrient than the comparison food; synonyms include *added* and *extra*.
organic (on food labels): at least 95 percent of the product's ingredients have been grown and processed according to USDA regulations defining the use of fertilizers, herbicides, insecticides, fungicides, preservatives, and other chemical ingredients.
Energy
kcalorie-free: fewer than 5 kcalories per serving.
low kcalorie: 40 kcalories or less per serving.
reduced kcalorie: at least 25 percent fewer kcalories per serving than the comparison food.
Fat and Cholesterol[a]
percent fat free: may be used only if the product meets the definition of *low fat* or *fat free* and must reflect the amount of fat in 100 grams (for example, a food that contains 2.5 grams of fat per 50 grams can claim to be "95 percent fat free").
fat free: less than 0.5 gram of fat per serving (and no added fat or oil); synonyms include *zero-fat, no-fat,* and *nonfat*.
low fat: 3 grams or less fat per serving.
less fat: at least 25 percent less fat than the comparison food.
saturated fat free: less than 0.5 gram of saturated fat and 0.5 gram of *trans* fat per serving.
low saturated fat: 1 gram or less saturated fat and less than 0.5 gram of *trans* fat per serving.
less saturated fat: at least 25 percent less saturated fat and *trans* fat combined than the comparison food.
***trans* fat free**: less than 0.5 gram of trans fat and less than 0.5 gram of saturated fat per serving.
cholesterol-free: less than 2 milligrams cholesterol per serving and 2 grams or less saturated fat and *trans* fat combined per serving.
low cholesterol: 20 milligrams or less cholesterol per serving and 2 grams or less saturated fat and *trans* fat combined per serving.
less cholesterol: at least 25 percent less cholesterol than the comparison food (reflecting a reduction of at least 20 milligrams per serving), and 2 grams or less saturated fat and *trans* fat combined per serving.
extra lean: less than 5 grams of fat, 2 grams of saturated fat and *trans* fat combined, and 95 milligrams of cholesterol per serving and per 100 grams of meat, poultry, and seafood.
lean: less than 10 grams of fat, 4.5 grams of saturated fat and *trans* fat combined, and 95 milligrams of cholesterol per serving and per 100 grams of meat, poultry, and seafood. For mixed dishes such as burritos and sandwiches, less than 8 grams of fat, 3.5 grams of saturated fat, and 80 milligrams of cholesterol per reference amount customarily consumed.

continued

continued

Carbohydrates: Fiber and Sugar
high fiber: 5 grams or more fiber per serving. A high-fiber claim made on a food that contains more than 3 grams fat per serving and per 100 grams of food must also declare total fat.
sugar-free: less than 0.5 gram of sugar per serving.
Sodium
sodium-free and salt-free: less than 5 milligrams of sodium per serving.
low sodium: 140 milligrams or less per serving.
very low sodium: 35 milligrams or less per serving.

[a]Foods containing more than 13 grams total fat per serving or per 50 grams of food must indicate those contents immediately after a cholesterol claim. As you can see, all cholesterol claims are prohibited when the food contains more than 2 grams saturated fat and *trans* fat combined per serving.

Some descriptions *imply* that a food contains, or does not contain, a nutrient. Implied claims are prohibited unless they meet specified criteria. For example, a claim that a product "contains no oil" implies that the food contains no fat. If the product is truly fat free, then it may make the no-oil claim, but if it contains another source of fat, such as butter, it may not.

Health Claims

Health claims describe the relationship of a food or food component to a disease or health-related condition. In some cases, the FDA authorizes health claims based on an extensive review of the scientific literature. For example, the health claim that "diets low in sodium may reduce the risk of high blood pressure" is based on enough scientific evidence to establish a clear link between diet and health. Such reliable health claims have a high degree of scientific validity (see Table 1-13).

In cases where there is emerging—but not established—evidence for a relationship between a food or food component and disease, the FDA allows the use of *qualified* health claims that must use specific language indicating that the evidence supporting the claim is limited. A qualified health claim might state that "Very limited and preliminary research suggests that eating one-half to one cup of tomatoes and/or tomato sauce a week may reduce the risk of prostate cancer. The FDA concludes that there is little scientific evidence supporting the claim." Unfortunately, many consumers are not knowledgeable enough to distinguish between scientifically reliable claims and those that are best ignored.

health claims: statements that characterize the relationship between a nutrient or other substance in food and a disease or health-related condition.

TABLE 1-13 Reliable Health Claims on Food Labels

- Calcium and reduced risk of osteoporosis
- Sodium and reduced risk of hypertension
- Dietary saturated fat and cholesterol and reduced risk of coronary heart disease
- Dietary fat and reduced risk of cancer
- Fiber-containing grain products, fruits, and vegetables and reduced risk of cancer
- Fruits, vegetables, and grain products that contain fiber, particularly soluble fiber, and reduced risk of coronary heart disease
- Fruits and vegetables and reduced risk of cancer
- Folate and reduced risk of neural tube defects
- Sugar alcohols and reduced risk of tooth decay
- Soluble fiber from whole oats and from psyllium seed husk and reduced risk of heart disease
- Soy protein and reduced risk of heart disease
- Whole grains and reduced risk of heart disease and certain cancers
- Plant sterol and plant stanol esters and reduced risk of heart disease
- Potassium and reduced risk of hypertension and stroke

Structure–Function Claims

Structure–function claims describe the effect that a substance has on the structure or function of the body but do not make reference to a disease—for example, "calcium builds strong bones." Unlike health claims, which require food manufacturers to collect scientific evidence and petition the FDA, structure–function claims can be made without any FDA approval. Product labels can claim to "slow aging," "improve memory," and "support immunity and digestive health" without any proof. The only criterion for a structure–function claim is that it must not mention a disease or symptom. Unfortunately, structure–function claims can be deceptively similar to health claims. Consider these statements:

structure-function claims: statements that describe how a product may affect a structure or function of the body; for example, "calcium builds strong bones." Structure-function claims do not require FDA authorization.

- "May reduce the risk of heart disease."
- "Promotes a healthy heart."

Although most consumers do not distinguish between these two types of claims, the first is a health claim that requires FDA approval, whereas the second is an unproven, but legal, structure-function claim. Figure 1-9 compares the three types of label claims.

FIGURE 1-9 Label Claims

Sam Kolich/Bill Smith Group/Cengage Learning

Nutrient claims characterize the level of a nutrient in the food—for example, "fat free" or "less sodium."

Health claims characterize the relationship of a food or food component to a disease or health-related condition—for example, "soluble fiber from oatmeal daily in a diet low in saturated fat and cholesterol may reduce the risk of heart disease" or "a diet low in total fat may reduce the risk of some cancers."

Structure/function claims describe the effect that a substance has on the structure or function of the body and do not make reference to a disease—for example, "supports immunity and digestive health" or "calcium builds strong bones."

Review Notes

- Food labels list the ingredients, the serving size, the number of kcalories provided, and the key nutrient quantities in a food—information consumers need to select foods that will help them meet their nutrition and health goals.
- Daily Values are a set of nutrient standards created by the FDA for use on food labels.
- Reliable health claims are backed by the highest standards of scientific evidence.