
Nutrition for Health and Health Care
fifth edition
DeBruyne | Pinna

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 (IU/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	400 (10 µg)	4	2.0
0.5–1	0.3	0.4	4	6	1.8	0.3	80	0.5	150	50	500	400 (10 µg)	5	2.5
Children														
1–3	0.5	0.5	6	8	2	0.5	150	0.9	200	15	300	600 (15 µg)	6	30
4–8	0.6	0.6	8	12	3	0.6	200	1.2	250	25	400	600 (15 µg)	7	55
Males														
9–13	0.9	0.9	12	20	4	1.0	300	1.8	375	45	600	600 (15 µg)	11	60
14–18	1.2	1.3	16	25	5	1.3	400	2.4	550	75	900	600 (15 µg)	15	75
19–30	1.2	1.3	16	30	5	1.3	400	2.4	550	90	900	600 (15 µg)	15	120
31–50	1.2	1.3	16	30	5	1.3	400	2.4	550	90	900	600 (15 µg)	15	120
51–70	1.2	1.3	16	30	5	1.7	400	2.4	550	90	900	600 (15 µg)	15	120
>70	1.2	1.3	16	30	5	1.7	400	2.4	550	90	900	800 (20 µg)	15	120
Females														
9–13	0.9	0.9	12	20	4	1.0	300	1.8	375	45	600	600 (15 µg)	11	60
14–18	1.0	1.0	14	25	5	1.2	400	2.4	400	65	700	600 (15 µg)	15	75
19–30	1.1	1.1	14	30	5	1.3	400	2.4	425	75	700	600 (15 µg)	15	90
31–50	1.1	1.1	14	30	5	1.3	400	2.4	425	75	700	600 (15 µg)	15	90
51–70	1.1	1.1	14	30	5	1.5	400	2.4	425	75	700	600 (15 µg)	15	90
>70	1.1	1.1	14	30	5	1.5	400	2.4	425	75	700	800 (20 µg)	15	90
Pregnancy														
≤18	1.4	1.4	18	30	6	1.9	600	2.6	450	80	750	600 (15 µg)	15	75
19–30	1.4	1.4	18	30	6	1.9	600	2.6	450	85	770	600 (15 µg)	15	90
31–50	1.4	1.4	18	30	6	1.9	600	2.6	450	85	770	600 (15 µg)	15	90
Lactation														
≤18	1.4	1.6	17	35	7	2.0	500	2.8	550	115	1200	600 (15 µg)	19	75
19–30	1.4	1.6	17	35	7	2.0	500	2.8	550	120	1300	600 (15 µg)	19	90
31–50	1.4	1.6	17	35	7	2.0	500	2.8	550	120	1300	600 (15 µg)	19	90

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

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

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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 (IU/day)[b]	Vitamin D (IU/day)	Vitamin E (mg/day)[c]
Infants								
0–0.5	—	—	—	—	—	600	1000 (25 µg)	—
0.5–1	—	—	—	—	—	600	1500 (38 µg)	—
Children								
1–3	10	30	300	1000	400	600	2500 (63 µg)	200
4–8	15	40	400	1000	650	900	3000 (75 µg)	300
9–13	20	60	600	2000	1200	1700	4000 (100 µg)	600
Adolescents								
14–18	30	80	800	3000	1800	2800	4000 (100 µg)	800
Adults								
19–70	35	100	1000	3500	2000	3000	4000 (100 µg)	1000
>70	35	100	1000	3500	2000	3000	4000 (100 µg)	1000
Pregnancy								
≤18	30	80	800	3000	1800	2800	4000 (100 µg)	800
19–50	35	100	1000	3500	2000	3000	4000 (100 µg)	1000
Lactation								
≤18	30	80	800	3000	1800	2800	4000 (100 µg)	800
19–50	35	100	1000	3500	2000	3000	4000 (100 µg)	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.

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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

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Kathryn Pinna

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To my grandson, Ryder Koa DeBruyne. You are my blue sky and my sunny day. Aloha little man.

LINDA KELLY DEBRUYNE

To my mother, Tina C. Pinna, for her unwavering love and support, and to David L. Stone, for keeping the music in my life.

KATHRYN PINNA

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LINDA KELLY DEBRUYNE, M.S., R.D., received her B.S. in 1980 and her M.S. in 1982 in nutrition and food science at Florida State University. She is a founding member of Nutrition and Health Associates, an information resource center in Tallahassee, Florida, where her specialty areas are life cycle nutrition and fitness. Her other publications include the textbooks *Nutrition and Diet Therapy* and *Health: Making Life Choices* and a multi-media CD-ROM called *Nutrition Interactive*. As a consultant for a group of Tallahassee pediatricians, she teaches 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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Preface

Whether for the prevention of disease or

appropriate treatment of illness, health professionals and patients rank nutrition among their most serious concerns. Moreover, medical personnel are often called upon to answer questions about foods and diets or provide nutrition care. This fifth edition of *Nutrition for Health and Health Care* provides a solid foundation in nutrition science and the role of nutrition in clinical 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.

SPECIAL FEATURES

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 and notes in the margins clarify nutrition information, remind readers of previously defined terms, and provide cross-references. 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, the 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, the exchange system, physical activity and energy requirements, nutrition assessments, enteral formulas, aids to calculations, and answers to Self Check questions.

NEW TO THIS EDITION

Due to the rapid pace of nutrition research, staying current is a primary concern. Each chapter of this book has been substantially updated to reflect advances in research and clinical practice since the fourth edition. In addition, we have made the following changes:

Chapter 1

- Included *Healthy People 2020* nutrition and weight status objectives
- Introduced Dietary Guidelines for Americans, 2010
- Introduced a new MyPlate figure and discussion
- Added definitions of solid fats, added sugars, and nutrient profiling
- Added a new figure on label health claims

Chapter 2

- Enhanced and clarified the GI tract figure, adding labels to describe the function of each part of the system and moving descriptions of carbohydrate, fat, and protein digestion and absorption to each respective chapter
- Mentioned the Food Safety Modernization Act in the Nutrition in Practice
- Reorganized and shortened the foodborne illness table to include the pathogens that cause most foodborne illnesses

Chapter 3

- Added a new figure showing glycogen and starch molecules and their branching
- Reorganized and enhanced the discussion of blood glucose regulation
- Added a brief discussion of and a table on carbohydrate digestion
- Added a discussion of sugar and heart disease
- Emphasized the term *nonnutritive sweeteners* rather than *artificial sweeteners* as per Academy of Nutrition and Dietetics position paper
- Added a new figure of sources of added sugars from the 2010 *Dietary Guidelines*
- Added a new "How to" box on reducing intake of added sugars

Chapter 4

- Added a brief discussion and definition of conjugated linoleic acid
- Added a brief discussion of and table on lipid digestion and absorption
- Greater emphasis on and explanation of solid fats
- Added a new figure of sources of solid fats in U.S. diets
- Added a table of solid fats on food labels
- Added a new figure about replacing saturated fat with unsaturated fat in the Nutrition in Practice

Chapter 5

- Added a brief section and table on protein digestion and absorption
- Enhanced the discussion of proteins as antibodies
- Reorganized the section on protein deficiency
- Introduced and defined the new WHO term *severe acute malnutrition* and defined *chronic malnutrition*
- Added a table comparing severe acute malnutrition and chronic malnutrition
- Enhanced the glossary of terms describing vegetarian diets
- Added the USDA Food Patterns' recommended weekly amounts of protein foods for vegetarians and vegans

Chapter 6

- Updated the discussion of energy balance to explain the shortcomings of the traditional 3500 kcal per pound rule
- Added risks of underweight to coincide with risks of overweight
- Enhanced and updated the table comparing popular diets
- Added a new table called "Tips for Identifying Fad Diets and Weight-Loss Scams"
- Added a brief discussion of protein and kcalorie restriction

Chapter 7

- Introduced and defined screen time, food deserts, satiation, and satiety
- Added a new section on neighborhood obstacles to physical activity and healthy food choices
- Streamlined obesity drug discussion and simplified and updated the list of FDA-approved obesity drugs
- Separated and enhanced tables of weight-loss and weight-gain strategies
- Addressed new thinking and research about the degree of energy restriction required to achieve weight loss over time

Chapter 8

- Revised and updated information on vitamin D as per the 2011 DRI
- Added a new table comparing fat-soluble and water-soluble vitamins
- Figures of good sources of vitamins (A, folate, and C) updated for current USDA nutrient data
- Added a new table in the Nutrition in Practice called "Tips for Consuming Phytochemicals"

Chapter 9

- Simplified the table of major and trace minerals
- Added a new margin list of top 10 sodium food sources
- Added a section on potassium and hypertension and noted this mineral's status as a *Dietary Guidelines* "nutrient of concern"
- Addressed the U.S. Preventive Task Force findings on use of calcium supplements for fracture protection
- Added information on magnesium and disease
- Added information on iron excess and oxidative stress
- Added information on hepcidin, the iron-regulating hormone

Chapter 10

- Enhanced the discussion of essential fatty acids in breast milk
- Added information on breastfeeding and reduced risk of SIDS
- Added a new table of the benefits of breastfeeding
- Personalized the table of strategies for successful breastfeeding

Chapter 11

- Added a new table providing tips for picky eaters
- Enhanced the table of food skills for preschoolers, adding developmental milestones
- Added a new figure to highlight MyPlate resources for children
- Described the new National School Lunch/Breakfast requirements
- Added a new table of physical activities for children and adolescents
- Updated and simplified the "How to" on protecting against lead toxicity

Chapter 12

- Added a new table comparing signs of Alzheimer's and typical age-related changes
- Added the definition of health care communities from the Academy of Nutrition and Dietetics
- Added a brief discussion of the obesity/food insecurity paradox
- Enhanced the "How to" on meal planning to stretch food dollars and reduce waste

Chapter 13

- Reorganized the table on the criteria for identifying malnutrition risk
- Included a discussion of the multiple-pass method for conducting a 24-hour dietary recall interview

Chapter 14

- Introduced the use of indirect calorimetry for determining RMR
- Updated names for diets in the "Modified Diets" section to more closely match current dietetics terminology
- Moved the discussion about improving food intake from the "Modified Diets" section to the "Foodservice" section
- In the "Foodservice" section, introduced the room service model adopted at many hospitals and shortened the discussion about marking selective menus
- In the "Diet-Drug Interactions" section, modified some paragraphs and added some common names for drugs in addition to their generic names; moved discussions on isoniazid and corticosteroids to sections that better reflect their effects on nutrition status
- In the Nutrition in Practice, modified the table listing examples of herb-drug interactions

Chapter 15

- Introduced a new section about oral supplements at the beginning of the chapter
- Reorganized the enteral nutrition section to address tube feeding candidates and tube feeding routes before describing enteral formulas
- Simplified the presentation of tube feeding initiation and advancement
- In the Nutrition in Practice on inborn errors, revised the introductory paragraph about PKU, removed the figure related to PKU, and added a table listing examples of inborn errors that are related to defects in nutrient metabolism

Chapter 16

- Added a photo showing pressure sores
- Simplified the discussion about the inflammatory process
- Updated the discussion about the clinical effects of altering omega-6 and omega-3 fatty acid intakes based on recent analyses
- Added the concept of hypocaloric feedings for obese critical care patients to the section on energy needs in acute illness
- Updated the Diet-Drug Interactions box with current drug treatments for COPD

Chapter 17

- Modified the table of suggestions for managing dry mouth
- Modified the discussion of the causes and signs of dysphagia, expanded the discussion about food thickeners, and updated the "How to" about improving the acceptance of mechanically altered foods
- Rewrote the paragraph about causes of vomiting
- Added a table listing suggestions for preventing oral diseases to the Nutrition in Practice about oral health

Chapter 18

- Revised or reorganized the tables describing laxatives and bulk-forming agents and foods that cause intestinal gas
- Revised the sections on acute and chronic pancreatitis, cystic fibrosis, inflammatory bowel diseases, short bowel syndrome, and diverticular disease of the colon

Chapter 19

- Modified the introduction of fatty liver
- Modified the descriptions of the different types of hepatitis viruses
- Modified some sections on cirrhosis complications and the table on the stages of hepatic encephalopathy
- Revised the sections on the medical treatment and nutrition therapy for cirrhosis

- In the Nutrition in Practice about alcohol, expanded the discussion about the benefits of alcohol for chronic illness risk reduction

Chapter 20

- Revised the discussion about complications of diabetes and included a new figure that outlines the acute effects of insulin insufficiency
- Added a definition for continuous glucose monitoring to the section on evaluating diabetes treatment
- Reorganized the discussion about body weight concerns: the topic of weight gain in type 1 diabetes was moved to the insulin therapy section, and weight loss for type 2 diabetes was moved to the nutrition therapy section
- In the nutrition therapy section, added a paragraph about macronutrient distribution, shortened the discussion about fat intake, and modified the paragraph related to micronutrient supplementation
- Revised the section about physical activity and diabetes management, the discussion about pregnancy in type 1 or type 2 diabetes, and several sections in the Nutrition in Practice on metabolic syndrome

Chapter 21

- Reorganized and revised several sections on the causes of atherosclerosis; modified some sections on the risk factors and treatment of hypertension
- Expanded and modified the discussion of CHD risk assessment
- Modified several sections related to therapeutic lifestyle changes, adding a new discussion about cholesterol and egg intakes

Chapter 22

- Modified the sections related to the nephrotic syndrome, uremia, and the uremic syndrome
- Clarified/updated some sections related to the nutrition therapy for chronic kidney disease to reflect the current recommendations
- Added a new table listing foods high in phosphorus and a table describing an appropriate menu for a person with chronic kidney disease; eliminated the table on the dietary guidelines following a kidney transplant and a table listing foods high in purines
- Added a new section about the medical treatment of kidney stones

Chapter 23

- Replaced the paragraph about high-fat diets and cancer risk with a discussion about alcohol consumption and cancer risk
- Modified the section about hematopoietic stem cell transplantation, added a section about biological therapies for cancer, and modified the section about medications used for treating anorexia and wasting
- Expanded the "How to" about increasing energy and protein in meals
- Replaced the section about nutrition therapy for bone marrow transplant patients with a section about the low-microbial diet for individuals with suppressed immunity
- Modified the introductory paragraphs in the HIV/AIDS section
- Expanded the table listing antiretroviral drugs to include recently approved medications for HIV infection
- Reorganized and revised the section on nutrition therapy for HIV infection, and included a discussion about weight management and overweight/obesity

INSTRUCTOR TOOLS

A number of helpful ancillary materials are available for instructors, including a Power Lecture DVD-ROM that includes figures and photos from the text as well as PowerPoint lecture presentations, a test bank in Word and ExamView formats, and an instructor's manual. A printed version of the instructor's manual and test bank is also available.

STUDENT ANCILLARIES

A printed study guide for students provides numerous review exercises including multiple-choice, true/false, fill-in, matching, and discussion questions; math exercises; and case study problems to help students master chapter concepts. The book's CourseMate website, accessible via CengageBrain.com, provides additional study tools. The new MindTap Reader, a fully interactive online e-reader, seamlessly integrates content, rich media assets, and robust note-taking.

We hope that as you discover the many fascinating aspects of nutrition science and nutrition therapy, you will enthusiastically apply the concepts in both your personal and professional life.

Linda Kelly DeBruyne
Kathryn Pinna

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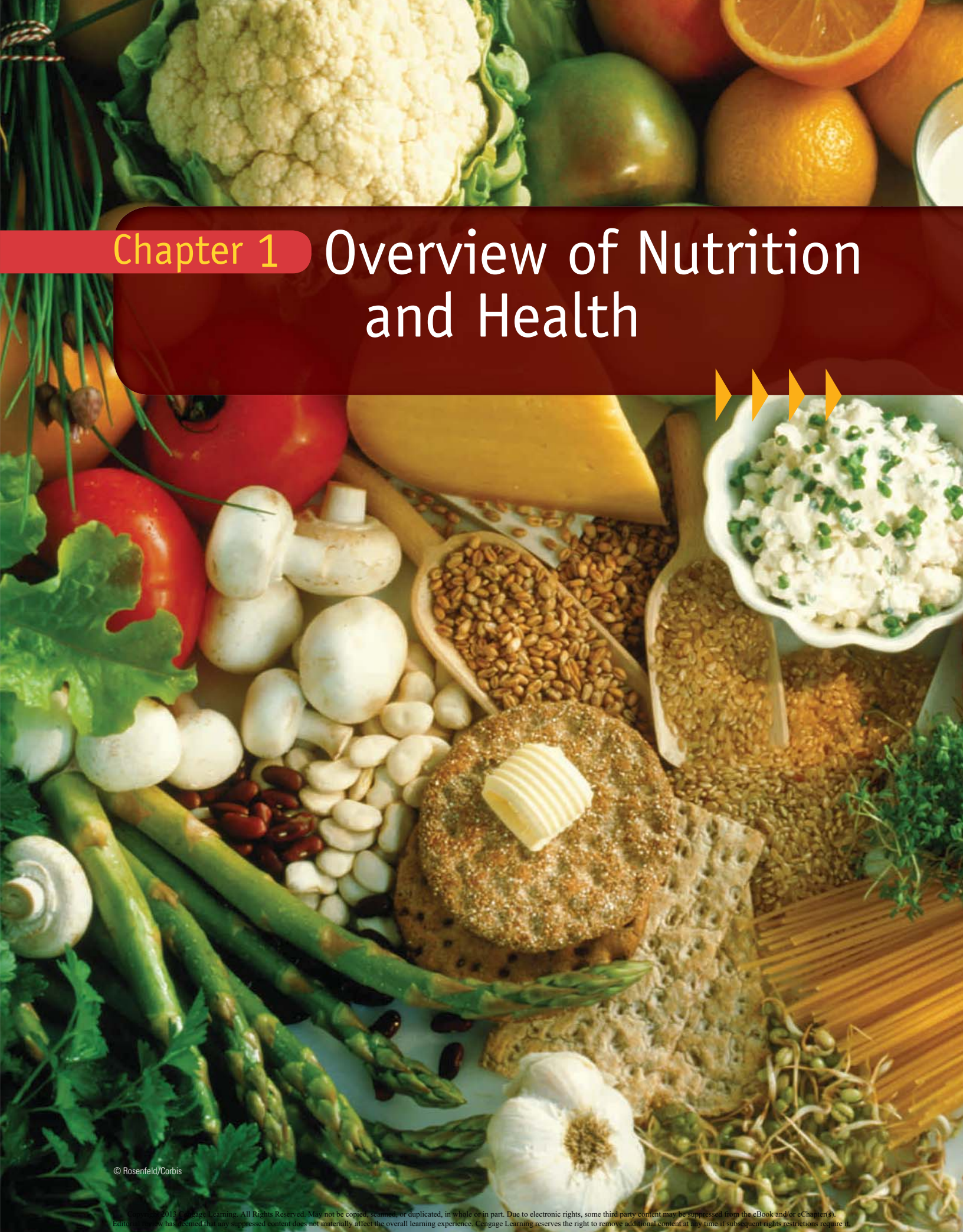


Chapter 1 Overview of Nutrition and Health

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.

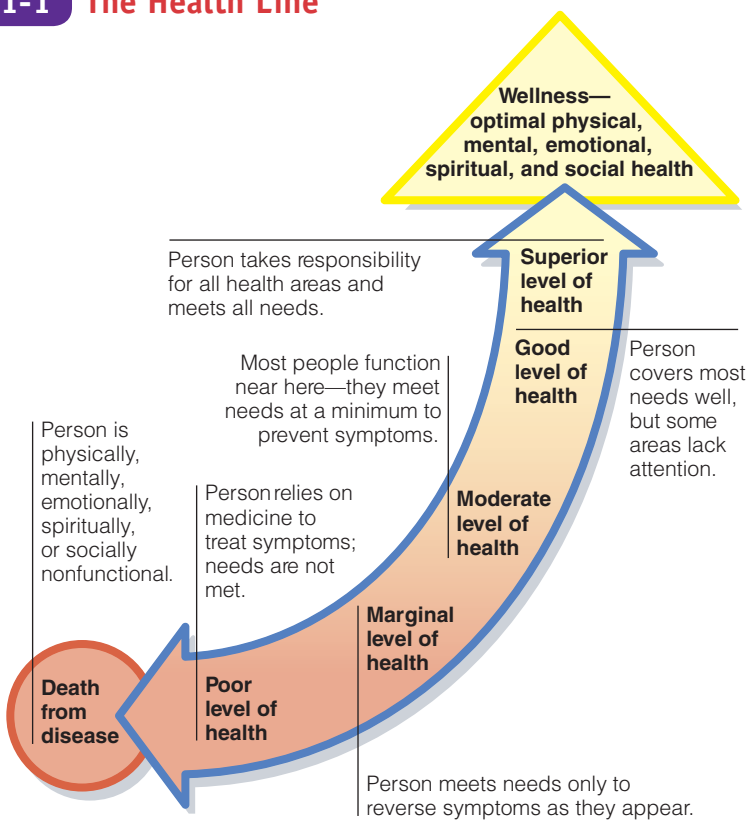
This text focuses on how nutrition choices affect health and disease. The early chapters introduce the basics of nutrition to support good health. The later chapters emphasize medical nutrition therapy and its role in supporting health and treating diseases and symptoms.

■ Nurses 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.

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.

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.

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 people's lifestyles, they 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 zest of salt. Research suggests that genetics influence people's taste preferences, a finding that may eventually have implications for clinical nutrition.[2] 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.

■ 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.

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 like Cajun and TexMex blend the traditions of several cultures. Table 1-1 (p. 4) 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 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.

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/Corbis	Millet, rice, rice or wheat noodles	Amaranth, baby corn, bamboo shoots, bok choy, cabbages, mung bean sprouts, scallions, seaweed, snow peas, straw mushrooms, water chestnuts, wild yam	Kumquats, loquats, lychee, mandarin oranges, melons, pears, persimmon, plums	Pork, poultry, fish and other seafood, squid, soybeans, tofu, duck eggs, cashews, peanuts	Soy milk
Mediterranean  Photodisc, Inc./Getty Images	Bulgur, couscous, focaccia, Italian bread, pastas, pita pocket bread, polenta, rice	Cucumbers, eggplant, grape leaves, onions, peppers, tomatoes	Dates, figs, grapes, lemons, melons, olives, raisins	Beef, gyros, lamb, pork, sausage, chicken, fish and other seafood, fava beans, lentils, almonds, walnuts	Feta, goat, mozzarella, parmesan, provolone, and ricotta cheeses; yogurt
Mexican  Mitch Hrdlicka/Photodisc/Getty Images	Taco shells, tortillas (corn or flour), rice	Cactus, cassava, chayote, chilies, corn, jicama, onions, tomatoes, tomato salsa, yams	Avocado, bananas, guava, lemons, limes, mango, oranges, papaya, plantain	Beef, chorizo, chicken, fish, refried beans, eggs	Cheese, flan (caramel custard)

Monkey Business Images/Shutterstock.com

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

Social Interaction Social interaction is another powerful influence on people's food choices. Meals are social events, and the sharing of food is part of hospitality. It is often considered rude to refuse food or drink being shared by a group or offered by a host. 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 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, cook meals ahead at storefront meal preparation sites, or have food delivered.[3] 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 prepare home-cooked meals.[4] 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. Not surprisingly, when eating out, consumers choose low-cost fast-food outlets over more expensive fine-dining restaurants.[5]

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 7.

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.[6] 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**.[7] Whole foods—as natural and familiar as oatmeal or tomatoes—are the simplest functional foods. In other cases, foods have been modified through fortifications, 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 or modified foods that contain bioactive food components believed to provide health benefits, such as reduced disease risks, beyond the benefits that their nutrients contribute. All whole foods are functional in some ways because they provide at least some needed substances, but certain foods stand out as rich sources of bioactive food components.

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; meats, seafood, poultry, eggs, nuts, and seeds; and 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.

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

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**.

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.

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 spend daily. Carbohydrates and fats meet most of the body's energy needs; proteins make a significant contribution only when other fuels are unavailable.

organic: carbon containing. 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.

Vitamins, Minerals, and Water

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

inorganic: not containing carbon or pertaining to living things.

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

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

calories: units in which energy is measured. 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*.

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.

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. (■) If you know how many grams of each nutrient 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 (the accompanying "How to" 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, whether from carbohydrate, fat, or protein, 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.

■ Chapter 7 comes back to energy density with regard to weight management.

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.

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

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.

■ Appendix B presents nutrient recommendations developed by the World Health Organization.

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.

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.

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.*[8] The inside front covers of this book present the DRI values.

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.[9] 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.

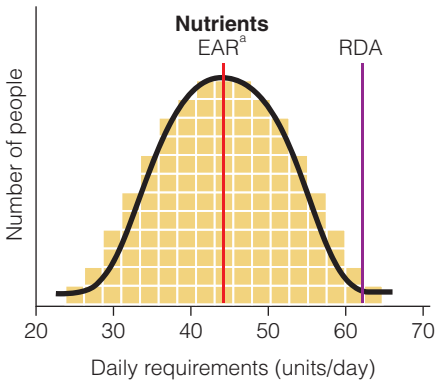
Facilitating Nutrition Research and Policy: EAR

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.

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

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.

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.

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.

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.

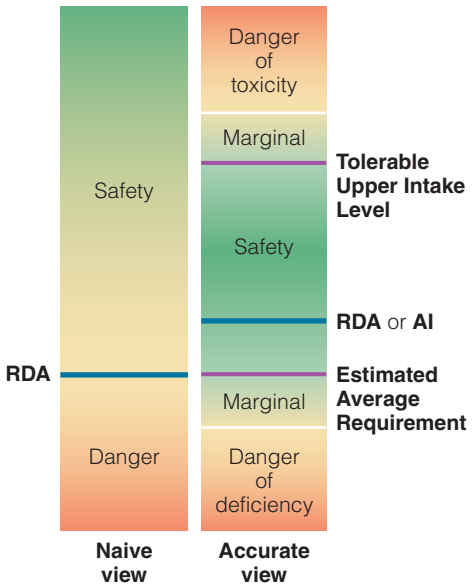
In addition to understanding the unique purposes of the DRI, it is important to keep their uses in perspective. Consider the following:

- 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.

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 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.

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.

*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.