CENGAGE

NUTRITION & DIET THERAPY

DeBruyne Pinna

10TH 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	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: BMI is calculated as the weight in kilograms divided by the square of the height in meters. For all nutrients, values for infants are AI. The glossary on the insert defines units of nutrient measure. 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 8 and Appendix F 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. 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.

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

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.

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

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.

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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 & DIET THERAPY

tenth edition

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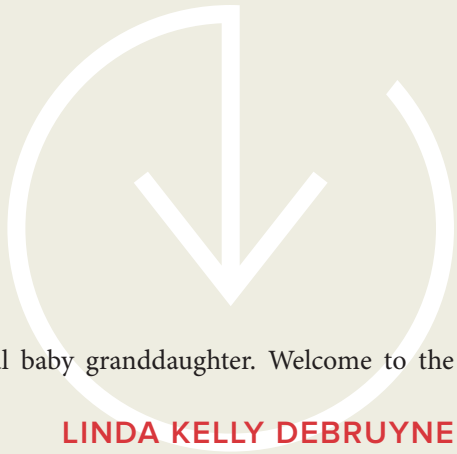

To Skyler Lani DeBruyne, my beautiful baby granddaughter. Welcome to the world little lady.

LINDA KELLY DEBRUYNE

To David Stone, who shares my passion for nutrition, science, old-time fiddle music, and swallowtail butterflies.

KATHRYN PINNA

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Brief Contents

Contents

Case Studies

How To Features

Preface

Numerous discoveries in nutrition science over the past few years have continued to benefit the field of health care. In revising this tenth edition of *Nutrition and Diet Therapy*, we have been pleased at the number of new findings we have been able to incorporate into these pages. As always, major goals of this textbook are to present both core nutrition information and guidelines about the prevention of, and care during, illness. Another mission is to help nutrition students evaluate information and products available from the media, colleagues, and the marketplace.

As in the previous edition of this book, Chapters 1 through 10 introduce basic concepts in nutrition and explain how sound nutrition supports health. Chapters 11 to 13 apply nutrition principles to individuals during different stages of life, from pregnancy and birth through old age. The second half of the book addresses the concerns of individuals who are at risk of illness or have medical conditions that require nutrition therapy. A hallmark of the text is the "Nutrition in Practice" section located at the end of every chapter: these sections provide coverage of current research topics, advanced subjects, or specialty areas.

CHANGES FOR THIS EDITION

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

Chapter 1

Added a new section on marketing and food choices, added a discussion of processed and ultra-processed foods versus whole foods and included definitions for each term, expanded the discussion of Healthy People goals and progress made so far, enhanced the Nutrient Intake Recommendation figure and the Accurate/Inaccurate View of Nutrient Intakes figure, added information about the job duties of dietitians in the Nutrition in Practice.

Chapter 2

Moved Digestion/Absorption chapter from Chapter 5 to Chapter 2 and dispersed details about carbohydrate, fat, and protein digestion to each individual chapter, simplified the main Gastrointestinal Tract figure, added a new section on GI tract health, regulation, and microbiota, added a new handwashing figure to the Nutrition in Practice, and enhanced the table showing refrigerator home storage times for fresh and processed foods.

Chapter 3

Added information about added sugars in ultra-processed foods, added a discussion of sugar and diabetes, included tips to increase fiber intake in the table of fiber in foods, and included additional individual characteristics that influence a person's blood glucose response to food in the Nutrition in Practice.

Chapter 4

Moved the table of major sources of fatty acids from the Nutrition in Practice to the chapter, and added a discussion and table of the Mediterranean diet to the Nutrition in Practice.

Chapter 5

Added the definition of processed meat, added a table of the USDA Healthy Vegetarian Eating Pattern to the Nutrition in Practice and added a new figure of the vegetarian MyPlate.

Chapter 6

Added a brief discussion of intermittent fasting, added and defined a new term, adiposity-based chronic disease, and included information about metabolically healthy obesity.

Chapter 7

Added a brief discussion about ghrelin, sleep, and obesity, included a discussion of obestiy and the gut microbiota, simplified the discussion of over-the-counter weight loss drugs and herbs, enhanced the discussion of energy density and weight loss and reworded the section on behavior modification and deleted the food diary figure to emphasize mobile applications to track food and activity.

Chapter 8

Replaced drawings with photos in the figures showing good sources of certain vitamins, simplified the figure of the blood-clotting process, reorganized the niacin section,

deleted How to Estimate Dietary Folate Equivalents, added a section about choline, shortened and simplified some sections in the Nutrition in Practice, and added definitions of edamame, miso, and soy milk.

Chapter 9
Deleted the figure called what processing does to sodium and potassium contents of foods, replaced drawings with photos in figures showing good sources of certain minerals, and included a new figure of a supplement label in the Nutrition in Practice.

Chapter 10
Defined and discussed myokines, reorganized the section on glucose use during physical activity, created a table of carbohydrate recommendations for athletes, updated protein recommendations for athletes and created a table of food sources, and added a discussion of dietary nitrate as an ergogenic aid; removed chromium picolinate and ribose.

Chapter 11
Rewrote parts of the beginning of the chapter, deleted the infant mortality figure, included a section on choline during pregnancy, added a new table of advice for preganant and lactationg women eating fish, and added a new table listing signs and symptoms of preeclampsia.

Chapter 12
Improved and simplified the table of supplement recommendations for infants, added a new section called How to Feed Infants that includes and defines responsive feeding, added information about hunger and satiety signals to the table of infant development and recommended foods, included updated American Academy of Pediatrics juice recommendations for infants and children, and rewrote and shortened the section on nutrition at school.

Chapter 13
Deleted the table of ineffective dietary strategies for arthritis and shortened the discussion of food insufficiency and obesity in the Nutrition in Practice.

Chapter 14
Updated laboratory values in the table on routine laboratory tests, added a short table showing examples of nursing diagnoses that have nutritional implications, and rearranged several paragraphs in the section on Dietary Modifications.

Chapter 15
Updated tables related to herbal products, and updated statistics and terminology in the Nutrition in Practice on CAM.

Chapter 16
Refined the terms related to nutrition support (introduced the terms *specialized nutrition support* and *oral nutrition support*), modified the table comparing tube feeding routes, reorganized the sections about administration of tube feedings, modified sections on formula safety and initiating and advancing tube feedings, and modified dietary recommendations for phenylketonuria in the Nutrition in Practice about inborn errors.

Chapter 17
Added a discussion about gastroparesis; modified some material in sections on gastroesophageal reflux disease, gastritis, and bariatric surgery; and added glossary definitions for *acid regurgitation, heartburn, bloating*, and *pernicious anemia*.

Chapter 18
Revised the discussion about intestinal gas, added a definition for *FODMAPs*, modified the table of foods that increase intestinal gas, revised some material in the section on constipation, added calcium channel activators to the table of laxatives and bulk-forming agents, and revised the paragraphs on nutrition therapies for irritable bowel syndrome and diverticular disease. In the Nutrition in Practice on probiotics, modified the table of intestinal bacteria, the section about dietary sources of probiotics, and the paragraph about safety concerns associated with the use of probiotics.

Chapter 19
Modified the section on evaluating malabsorption, added definitions for *oxalates* and *bacterial translocation*, revised some information about nutrition therapies for acute and chronic pancreatitis and cystic fibrosis, and added some gluten sources to the table describing the gluten-free diet.

Chapter 20
Shortened the paragraph on the nutrition treatment for hepatitis, modified the table of laboratory values for the evaluation of liver disease, modified the table listing the clinical features of hepatic encephalopathy, and revised the section on the nutrition therapy for cirrhosis, including the table summarizing nutrition recommendations.

Chapter 21
Updated statistics throughout the chapter; modified the section on type 1 diabetes; distinguished between peripheral and autonomic neuropathy in the section on diabetic neuropathy; revised various sections on nutrition therapy to reflect updated clinical guidelines; modified the table on insulin preparations, including the addition of inhaled insulin; added sodium-glucose cotransporter 2 (SGLT2) inhibitors to the table listing the different types of antidiabetic drugs, modified the section on physical activity in diabetes management, added a box showing the glycemic goals for pregnant women with diabetes; in the Nutrition in Practice, added a figure showing how metabolic syndrome varies among ethnic groups and removed the figure

showing how it varies with age, and updated several sections in the Nutrition in Practice on metabolic syndrome, including a modified discussion about obesity's influence on hypertension.

Chapter 22

Updated statistics throughout the chapter; revised various paragraphs in the sections on CVD lifestyle management, hypertension, and heart failure; updated the box showing how blood pressure measurements are classified; updated the table of recommended lifestyle modifications for blood pressure reduction; added a box describing the effects of drugs used in hypertension treatment; and in the Nutrition in Practice on feeding disabilities, modified several paragraphs and changed the photo showing an example of adaptive feeding equipment.

Chapter 23

Updated statistics throughout the chapter, modified the table on causes of acute kidney injury, revised the section on malnutrition in chronic kidney disease and introduced the term *protein-energy wasting*, revised the table on dietary guidelines for chronic kidney disease, introduced *hypocitraturia* as a risk factor for calcium kidney stones, revised and reformatted the table of foods high in oxalates, and in the Nutrition in Practice on dialysis, revised the description of the different types of hemodialysis.

Chapter 24

Revised the section on micronutrient needs in acute stress, shortened the section on causes of chronic obstructive pulmonary disease, revised some sections on nutrition therapy for respiratory failure, modified the section on nutrition support in respiratory failure, and added information about the types of oxygen equipment available for patients on oxygen therapy.

Chapter 25

Updated statistics throughout the chapter, updated the tables on factors that influence cancer risk, revised the section on cancer immunotherapy, revised the section about food safety concerns for immunosuppressed cancer patients, included information about prophylactic medications used in persons at risk of HIV exposure, updated the definition of AIDS-wasting syndrome to reflect current guidelines, and in the Nutrition in Practice on ethical issues, revised some glossary definitions and modified the discussion about the effectiveness of advance directives in medical care.

FEATURES OF THIS TEXT

Throughout the book, the readable text and pedagogic features should help to facilitate students' understanding and retention of the material. For example, **definitions of key terms** appear in the margins. **"How To" skill boxes** help readers work through calculations or give practical suggestions for applying nutrition information. **Learning objectives** at the beginning of each chapter and **"Review Notes"** at the end of each major chapter section help students assimilate the material and assess reading comprehension.

Study tools include the **"Self Check"** at the end of each chapter, which helps readers test their understanding of the chapter material. **"Your Diet"** exercises ask students to apply nutrition information from each chapter to their own diets. **Case studies** in the later chapters challenge readers to apply chapter information to clinical situations. **"Clinical Applications"** provide practice with mathematical calculations and help students understand the impact of nutrition-related issues on health care professionals and their clients.

"Nutrition Assessment Checklists" summarize assessment parameters relevant to different stages of the life cycle or groups of disorders. **"Diet-Drug Interaction"** boxes point out interactions relevant to the medications described in each chapter. The **appendixes** include a wealth of information on enteral formulas, WHO Nutrition Recommendations, food lists for diabetes, physical activity and energy requirements, additional information about nutrition assessment, and aids to calculations.

We hope that as you discover the many fascinating aspects of nutrition, you will enthusiastically apply the concepts in both your professional and your personal life. To access additional course materials including MindTap, please visit **www.cengage.com.** At the Cengage.com home page, search for the ISBN of your title (from the back cover of your book) using the search box at the top of the page. This will take you to the product page where these resources can be found.

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- A test bank is available through **Cengage Learning Testing Powered by Cognero,** a flexible online system that allows instructors to author, edit, and manage test bank content from multiple Cengage Learning solutions; create multiple test versions in an instant; and deliver tests from an LMS, a classroom, or wherever the instructor wants.
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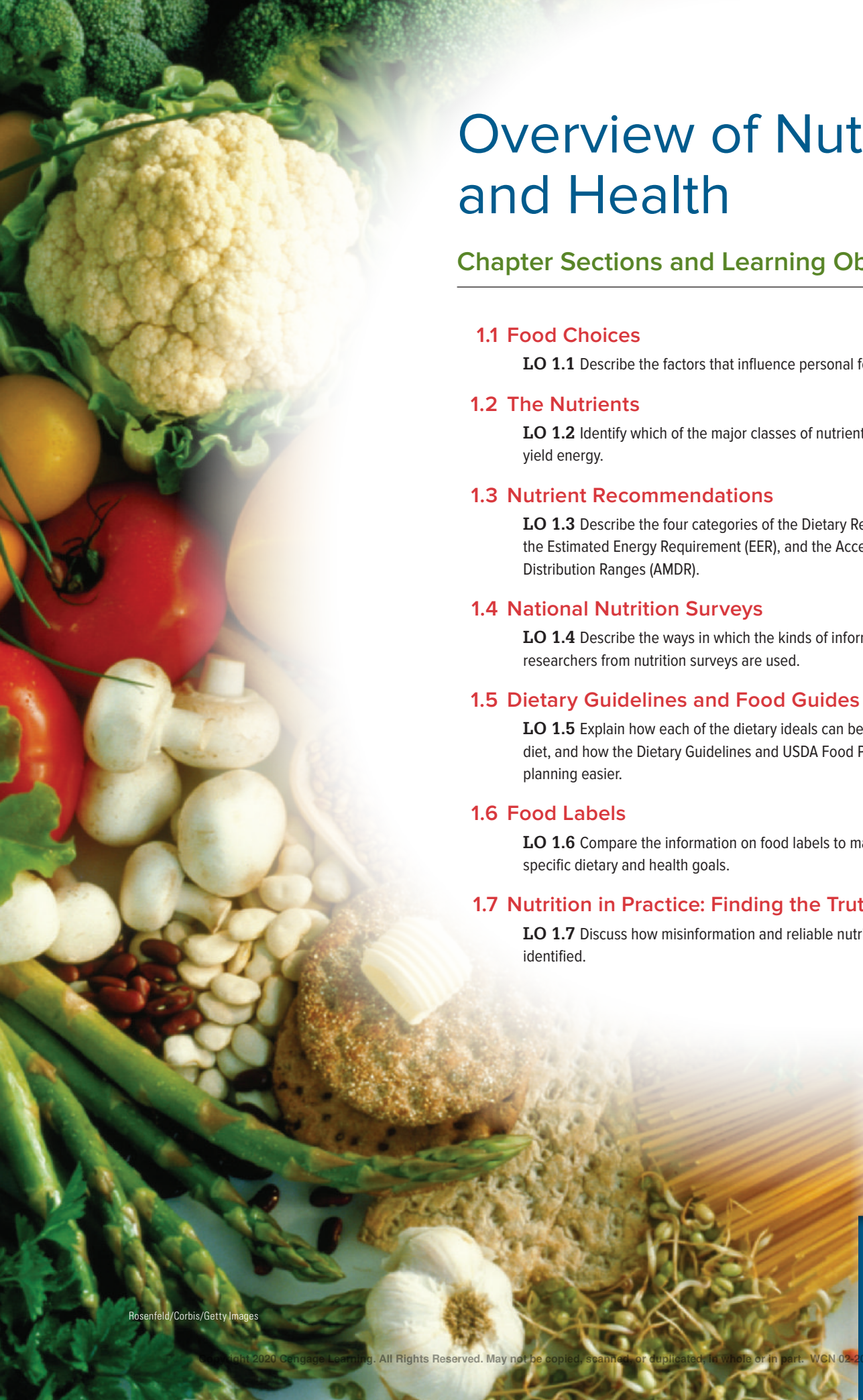

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Overview of Nutrition and Health

Chapter Sections and Learning Objectives (LOs)

1.1 Food Choices

LO 1.1 Describe the factors that influence personal food choices.

1.2 The Nutrients

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

1.3 Nutrient Recommendations

LO 1.3 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

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

1.5 Dietary Guidelines and Food Guides

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

1.6 Food Labels

LO 1.6 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

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

chapter 1

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

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

1.1 Food Choices

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.

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.

Sound **nutrition** throughout life does not ensure good health and long life, but it can certainly help to tip the balance in their favor. Nevertheless, many people choose foods for reasons other than their nourishing value. Even people who claim to choose foods primarily for the sake of health or nutrition will admit that other factors also influence their food choices. Because food choices become an integral part of their lifestyles, people sometimes find it difficult to change their eating habits. Health care professionals who help clients make diet changes must understand the dynamics of food choices because people will alter their eating habits only if their preferences 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]

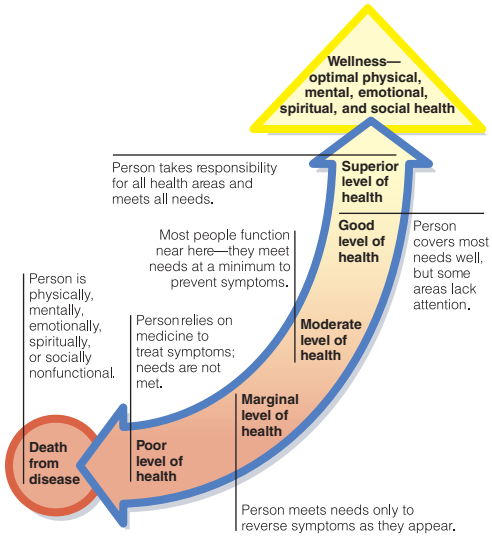
Preference Why do people like certain foods? One reason, of course, is their preference for certain tastes. Some tastes are widely liked, such as the sweetness of sugar and the savoriness of salt.[2] Research suggests that genetics influence people's taste preferences, a finding that may eventually have 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 fruit 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.

*Health care professionals generally use either *client* or *patient* when referring to an individual under their care. The first 13 chapters of this text emphasize the nutrition concerns of people in good health; therefore, the term *client* is used in these chapters.

FIGURE 1-1 The Health Line

No matter how well you maintain your health today, you may still be able to improve tomorrow. Likewise, a person who is well today can slip by failing to maintain health-promoting habits.



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.

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

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

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.

Photo 1-1

Monkey Business Images/Shutterstock.com

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

TABLE 1-1 Selected Ethnic Cuisines and Food Choices

	GRAINS	VEGETABLES	FRUIT	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

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.

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

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

Given the abundance of convenient food options, fewer adults are learning the cooking skills needed to prepare meals at home, which has its downside. People who are competent in their cooking skills and frequently eat their meals at home tend to make healthier food choices.[7] Not surprisingly, when eating out, consumers choose low-cost fast-food outlets over more expensive fine-dining restaurants. Foods eaten away from home, especially fast-food meals, tend to be high in nutrients that Americans overconsume (saturated fat and sodium) and low in nutrients that Americans underconsume (calcium, fiber, and iron)—all of which can contribute to a variety of health problems.[8]

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.

Photo 1-2

PHOVOIR/Alamy Stock Photo

Nutrition is only one of the many factors that influence people's 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 are nutritious and healthy (see Photo 1-2). Making healthy food choices 100 years ago was rather easy when the list of options was relatively short and markets sold mostly fresh, **whole foods**. Examples of whole foods include vegetables and legumes; fruit; seafood, meats, poultry, eggs, nuts, and seeds; milk; and whole grains. Today, tens of thousands of food items fill the shelves of super-grocery stores and most of those items are **processed foods**. Whether a processed food is a healthy choice depends, in part, on how extensively the food was processed. When changes are minimal, processing can provide an abundant, safe, convenient, affordable, and nutritious product.[9]

Examples of minimally processed foods include frozen vegetables, fruit juices, smoked salmon, cheeses, and breads. The nutritional value diminishes, however, when changes are extensive, creating **ultra-processed foods**. Ultra-processed foods no longer resemble whole foods; they are made from substances that are typically used in food preparation, but not consumed as foods themselves (such as oils, fats, flours, refined

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

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

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

starches, and sugars). These substances undergo further processing by adding little, if any, processed foods, salt and other preservatives, and additives such as flavors and colors. Examples of ultra-processed foods include soft drinks, corn chips, fruit gummies, chicken nuggets, canned cheese spreads, and toaster pastries. Notably, these foods cannot be made in a home kitchen using common grocery ingredients. Dominating the global market, ultra-processed foods tend to be attractive, tasty, and cheap—as well as high in fat and sugar.[10] Consumers wanting to make healthy food choices will select fewer ultra-processed foods and more whole foods and minimally processed foods.[11]

Review Notes

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

1.2 The Nutrients

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

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

Six Classes of Nutrients

Water, carbohydrates, fats, proteins, vitamins, and minerals are the six classes of nutrients commonly found in spinach and other foods. Some of the other materials in foods, such as the pigments and other phytochemicals, are not nutrients but may still be important to health. The body can make some nutrients for itself, at least in limited quantities, but it cannot make them all, and it makes some in insufficient quantities to meet its needs. Therefore, the body must obtain many nutrients from foods. The nutrients that foods must supply are called **essential nutrients**.

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.

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

*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.

contrast, minerals and water are **inorganic** nutrients. Minerals yield no energy in the human body, but, like vitamins, they help to regulate the release of energy, among their many other roles. As for water, it is the medium in which all of the body's processes take place.

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

kCalories: A Measure of Energy

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

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).

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.

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:

$$16 \text{ g carbohydrate} \times 4 \text{ kcal/g} = 64 \text{ kcal}$$

$$7 \text{ g protein} \times 4 \text{ kcal/g} = 28 \text{ kcal}$$

$$9 \text{ g fat} \times 9 \text{ kcal/g} = 81 \text{ kcal}$$

$$\text{Total} = 173 \text{ kcal}$$

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:

$$81 \text{ fat kcal} \div 173 \text{ total kcal} = 0.468 \text{ (rounded to 0.47)}$$

Then multiply by 100 to get the percentage:

$$0.47 \times 100 = 47\%$$

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.

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 20 discusses alcohol's effects on nutrition.

Review Notes

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

1.3 Nutrient Recommendations

Nutrient recommendations are 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.)

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.

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

*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.

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.

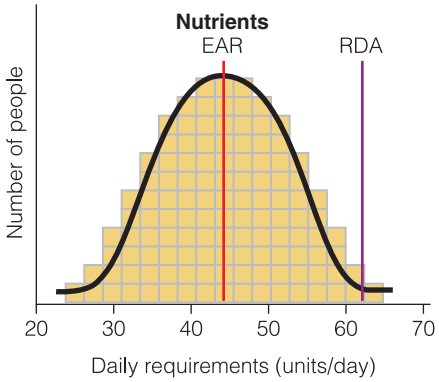
To ensure that the vitamin and mineral recommendations meet the needs of as many people as possible, the recommendations are set near the top end of the range of the population's estimated average requirements (see Figure 1-2). Small amounts above the daily **requirement** do no harm, whereas amounts 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 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.

FIGURE 1-2 **Nutrient Intake Recommendations**

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



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 (p. 10) presents an accurate view of how a person's nutrient needs fall within a range, with 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)**,

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.

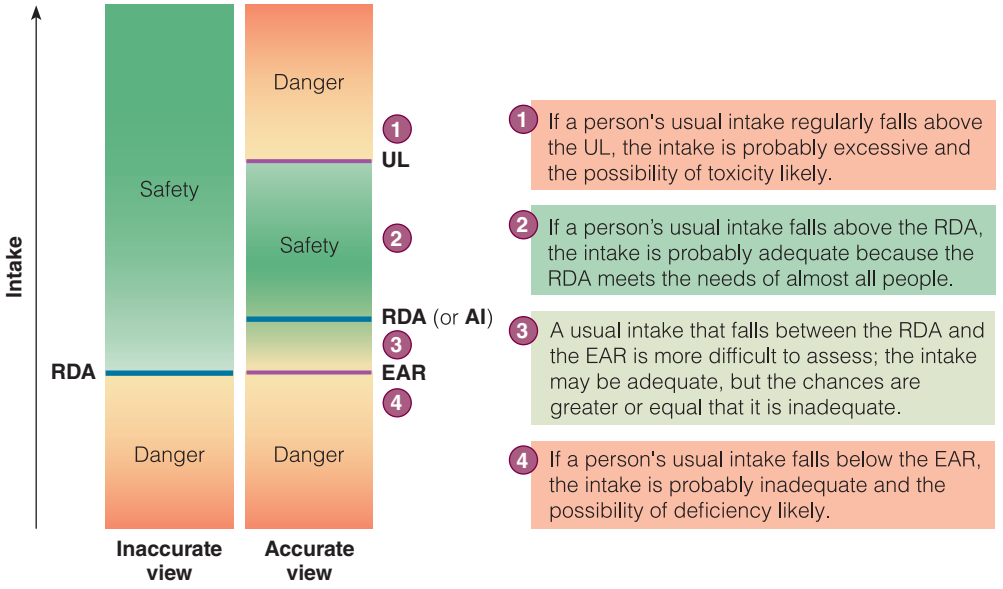
Estimated Average Requirements (EAR): the average daily nutrient intake levels estimated to meet the requirements of half of the healthy individuals in a given age and gender group; used in nutrition research and policymaking and as the basis on which RDA values are set.

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.

FIGURE 1-3 Inaccurate 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.



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.

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

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.

*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.

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.

1.4 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. 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.

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.

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. 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 42 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.

Progress in meeting the 2020 goals is mixed. The objective to meet physical activity and muscle-strengthening guidelines has been achieved, but the objective to eat more fruit and vegetables showed no improvement.[12] Trends in overweight and obesity actually worsened slightly. Clearly, to achieve the Healthy People goals, "what we eat in America" must change.

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

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.

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 fruit 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.

National Trends What do we eat in America and how has it changed over the last 45 years? The short answer to both questions is "a lot." We eat more meals away from home, particularly at fast-food restaurants. We eat larger portions. We drink more sweetened beverages and eat more energy-dense, nutrient-poor foods such as candy and chips. We snack frequently. As a result of these dietary habits, our energy intake has risen and, consequently, so has the incidence of overweight and obesity. Overweight and obesity, in turn, profoundly influence our health—as Chapter 6 explains.

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.

1.5 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.[13] Only one other lifestyle habit has more influence on health than a person's choice of diet: smoking and other tobacco use. 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.[14] 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.

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. Accidents
5. ***Strokes***
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, 2015, *NCHS Data Brief* 267, December 2016.

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. The fourth characteristic of a nutritious diet, **nutrient density**, promotes adequacy and kcalorie control. To eat well without overeating, select nutrient-dense foods—that is, foods that deliver the most nutrients for the least food energy.[15] 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.

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.

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.

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 potato chips, 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.[16] 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.[17]

The fifth characteristic of a nutritious diet is **moderation**. Moderation contributes to adequacy, balance, and kcalorie control. Foods rich in **solid fats** and **added sugars** often provide some enjoyment and lots of 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, **variety**, improves nutrient adequacy. 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 fruit, for example, strawberries are especially rich in vitamin C while apricots are rich in vitamin A. 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.

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 fruit 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.

*USDA Food Patterns may not provide recommended intakes of vitamin D and potassium.

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

THE GUIDELINES

The following guidelines "encourage healthy eating patterns, recognize that individuals will need to make shifts in their food and beverage choices to achieve a healthy pattern, and acknowledge that all segments of our society have a role to play in supporting healthy choices."

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.
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.** Adopt 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.

KEY RECOMMENDATIONS

The following key recommendations provide more detailed tips on how individuals can establish healthy eating patterns to meet the guidelines.

Adopt 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.
- Fruit, especially whole fruit.
- 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 to less than 10 percent of kcalories per day.
- Added sugars to less than 10 percent of kcalories per day.
- Sodium to less than 2300 milligrams per day.
- 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* (www.health.gov/paguidelines).

Note: These guidelines and key recommendations are designed for individuals 2 years of age or older and should be applied in their entirety; they are interconnected, and each dietary component can affect the others.

Source: U.S. Department of Health and Human Services and U.S. Department of Agriculture, *2015–2020 Dietary Guidelines for Americans,* 8th ed. (2015), www.health.gov/dietaryguidelines/2015/guidelines.

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.

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

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.

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.

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 22, is another dietary pattern that meets the goals of the Dietary Guidelines for Americans.

Figure 1-4 (p. 18–19) presents the major food groups and their subgroups. The plan assigns foods to five major food groups—fruit, 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 1-4 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 1-5 presents the recommended daily amounts from each food group for one of the USDA Food Patterns—the Healthy U.S.-Style Eating Pattern. (Nutrition in Practice 4 introduces the Healthy Mediterranean-Style Eating Pattern, and Nutrition in Practice 5 includes the Healthy Vegetarian Eating Pattern.) As Table 1-5 shows, an adult needing 2000 kcalories a day, for example, would select 2 cups of fruit; 2½ cups of vegetables; 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

TABLE 1-5 USDA Food Patterns: Healthy U.S.-Style Eating Pattern

FOOD GROUP	1600 kcal	1800 kcal	2000 kcal	2200 kcal	2400 kcal	2600 kcal	2800 kcal	3000 kcal
Fruit	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
Limit on kcalories available for other uses*	130 kcal	170 kcal	270 kcal	280 kcal	350 kcal	380 kcal	400 kcal	470 kcal

*The limit on kcalories for other uses describes how many kcalories are available for foods that are not in nutrient-dense forms.

Source: U.S. Department of Health and Human Services and U.S. Department of Agriculture, *2015–2020 Dietary Guidelines for Americans,* 8th ed. (2015): www.health.gov/dietaryguidelines/2015/guidelines/.

*Milk and milk products also can be referred to as dairy products.

sedentary and active men and women are shown in Table 1-6. 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.

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 1-7 (p. 20) presents the recommended *weekly* amounts for each of the subgroups for vegetables and protein foods.

TABLE 1-6 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).

Notable Nutrients As Figure 1-4 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.[18] 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, choline, vitamin A, vitamin C, Vitamin D, Vitamin E, calcium, magnesium, and potassium. In general, most people need to eat:

- *More* vegetables, fruit, 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.

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

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.

FIGURE 1-4 USDA Food Patterns: Food Groups and Subgroups

Polara Studios, Inc.

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

Fruit contributes folate, vitamin A, vitamin C, potassium, and fiber.

Consume a variety of fruit, and choose whole or cut-up fruit 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 percent fruit juices

Limit these fruit 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

Polara Studios, Inc.

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

Polara Studios, Inc.

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 1-4 USDA Food Patterns: Food Groups and Subgroups *(continued)*

Polara Studios, Inc.

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

Polara Studios, Inc.

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 percent low-fat milk and fat-free or 1 percent 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 percent reduced-fat milk and whole milk; 2 percent 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

Matt Farruggio Photography

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 1-7 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	1 ½ c	1 ½ c	1 ½ c	2 c	2 c	2 ½ c	2 ½ c	2 ½ c
Red and orange	4 c	5 ½ c	5 ½ c	6 c	6 c	7 c	7 c	7 ½ c
Legumes	1 c	1 ½ c	1 ½ c	2 c	2 c	2 ½ c	2 ½ c	3 c
Starchy	4 c	5 c	5 c	6 c	6 c	7 c	7 c	8 c
Other	3 ½ c	4 c	4 c	5 c	5 c	5 ½ c	5 ½ 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 1-5 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 Health and Human Services and U.S. Department of Agriculture, *2015–2020 Dietary Guidelines for Americans,* 8th ed. (2015): www.health.gov/dietaryguidelines/2015/guidelines.

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 nutrient-dense foods from each group and foods without solid fats or added 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 1-4 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.

Table 1-5 includes a limit on kcalories available for other uses. If all food choices are nutrient-dense, a small number of kcalories remain within the overall kcalorie limit of the eating pattern. These kcalories can be used for solid fats, added sugars, or to

eat additional amounts of nutrient-dense foods. Alternatively, a person wanting to lose weight might choose to *not* use these kcalories.

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 20).

Photo 1-3

Matt Farruggio Photography

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.

Cup and Ounce Equivalents Recommended daily amounts for fruit, vegetables, and milk are measured in cups, and those for grains and protein foods in ounces (see Photo 1-3). Figure 1-4 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

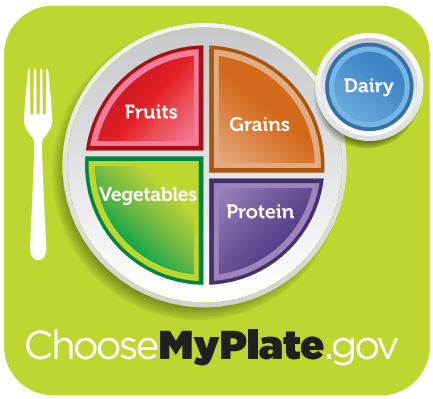
Mixtures of Foods Some foods—such as casseroles, soups, and sandwiches—fall into two or more food groups. With a little practice, users can learn to divide these foods into food groups. From the USDA Food Patterns' point of view, a taco represents four different food groups: the taco shell from the grains 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, fruit, seeds, and nuts. Some vegetarian diets include eggs, milk products, or both. People who do not eat meats or milk products can use the USDA Healthy Vegetarian Eating Pattern to create an adequate diet.[19] Nutrition in Practice 5 defines vegetarian terms and provides details on planning healthy vegetarian diets.

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.

FIGURE 1-5 MyPlate

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



Source: USDA, www.choosemyplate.gov.

MyPlate

The USDA created an educational tool called MyplPlate to illustrate the five food groups and remind consumers to make healthy food choices. The MyPlate icon, shown in Figure 1-5, divides a plate into four sections, each representing a food

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

group—fruit, 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 (www.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

- 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. Regular physical activity promotes health and reduces risk of chronic disease.
- 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.

1.6 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 fruit, vegetables, and other foods. A few foods need not carry nutrition labels: those contributing few nutrients, such as plain coffee, tea, and spices; those produced by small businesses; and those prepared and sold in the same establishment. Markets selling nonpackaged items may voluntarily present nutrient information, either in brochures or on signs posted at the point of purchase.

Restaurants with 20 or more locations must provide menu listings of an item's kcalories, grams of saturated fat, and milligrams of sodium. In addition, kcalorie information must be provided for prepared foods and beverages sold in supermarkets, convenience stores, movie theaters, and vending machines. Other restaurants need not supply nutrition information for menu items unless claims such as "low-fat" or "heart healthy" have been made. When ordering from menus, keep in mind that restaurants tend to serve large portions—two to three times standard serving sizes. In general, most consumers support restaurant menu labeling and use the kcalorie information when making selections.[20]

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. Updated revisions to the nutrition facts panel reflect current nutrition science, actual serving sizes, and an improved design (see Figure 1-6).[21]

FIGURE 1-6 Original and Proposed Nutrition Facts Panel

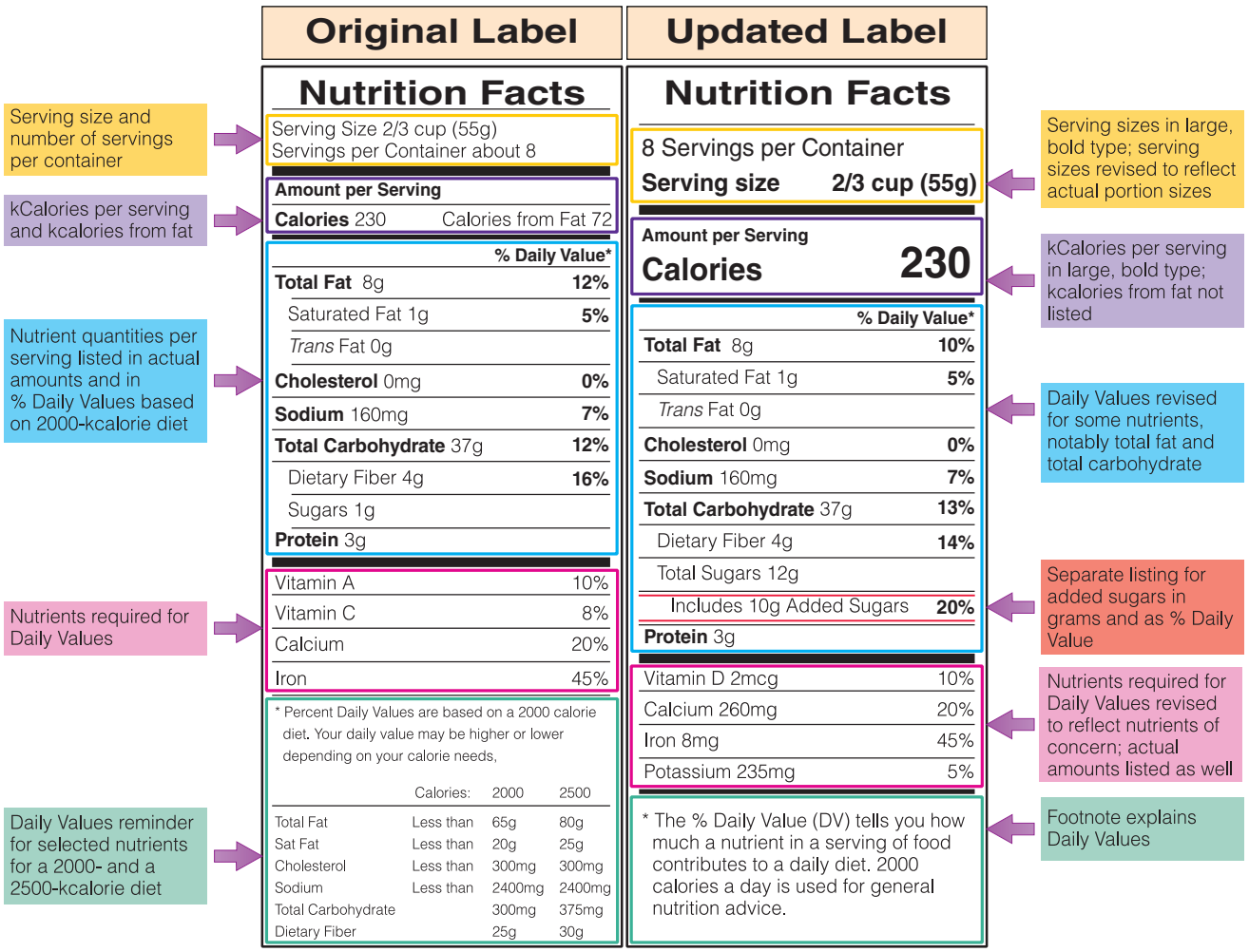


TABLE 1-8 Household and Metric Measures

- 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.

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 is updating the reference values for serving sizes that manufacturers use, to better reflect what people really eat and drink. For example, the proposed standard serving size for all ice creams is $^{2}/_{3}$ 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 1-8).

In addition to updating serving sizes for certain products, the FDA is requiring 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 pint of ice cream 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.

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 updated label does not include kcalories from fat

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

- Saturated fat (grams and percent Daily Value)
- *Trans* fat (grams)
- Cholesterol (milligrams and percent Daily Value)
- Sodium (milligrams and percent Daily Value)
- Total carbohydrate, which includes starch, sugar, and fiber (grams and percent Daily Value)
- Dietary fiber (grams and percent Daily Value)
- Total sugars, which includes both those naturally present in and those added to the food (grams)
- Added sugars, which includes only those added to the food (grams and percent Daily Value)—note that the original label does not include a separate line for added sugars.
- Protein (grams)
- The updated labels will no longer include information for vitamins A and C, but must present nutrient content information in actual amounts and as a percent Daily Value for the following nutrients: vitamin D, calcium, iron, and potassium.

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 1-9 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 1-9 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
Sodium	2300 mg
Carbohydrate (total)	275 g
Sugars	50 g
Fiber	28 g
Vitamin D	20 µg
Potassium	4700 mg
Calcium	1300 mg
Iron	18 mg

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

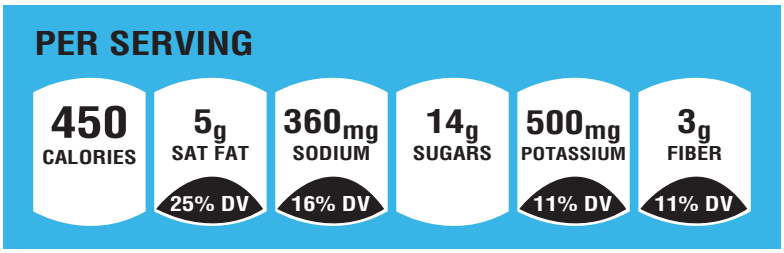
Front-of-Package Labels Some consumers find the many numbers on Nutrition Facts panels overwhelming. They want an easier and quicker way to interpret information and select products. Some food manufacturers responded by creating front-of-package labels that incorporate text, color, and icons to present key nutrient facts.[22] 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 1-7). In general, consumers find front-of-package labeling to be a quick and easy way to select products.[23]

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.

FIGURE 1-7 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.

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

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.

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 1-10 defines nutrient terms on food labels, including criteria for foods described as "low," "reduced," and "free."

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.

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."

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

TABLE 1-10 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").
gluten-free: a food that contains less than 20 parts per million of gluten from any source: synonyms include *no gluten, free of gluten,* or *without gluten.*
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*.

(*Continued*)

TABLE 1-10 Terms Used on Food Labels *(continued)*

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.
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.

FIGURE 1-8 Label Claims

Sam Kolich Photograpy

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."

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:

- "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 1-8 compares the three types of label claims.

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.