8

Nutrition for Healthy Children and Adolescents Ages 2 to 18 Years

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Physical Growth and Development

A child's first year of life is marked by rapid growth, with birth weight tripling and birth length increasing by 50%. After the rapid growth of the first year, physical growth slows down considerably during the preschool and school years, until the pubertal growth spurt of adolescence. Birth weight does not quadruple until two years of age, and birth length does not double until four years of age. A one-year-old child has several teeth, and his/her digestive and metabolic systems are functioning at or near adult capacity. By one year of age, most children are walking or beginning to walk; with improved coordination over the next few years, activity increases dramatically. Although increased activity in turn increases energy needs, a child's rate of growth decreases. Growth patterns vary in individual children, but each year children from two years to puberty gain an average of 4 1/2 to 6 1/2 pounds (2 to 3 kg) in weight and 2 1/2 to 3 1/2 inches (6 to 8 cm) in height. As the growth rate declines during the preschool years, a child's appetite decreases and food intake may become unpredictable and erratic. Parents and other caregivers need to know that these changes are normal so that they can avoid struggles with children over food and eating.

After the first year of life, more significant development occurs in fine and gross motor, cognitive, and social-emotional areas than during the first year of life. During the second year of life, children learn to feed themselves independently. By 15 months of age, children can manage a cup, but with some spilling. At 18 to 24 months of age, children learn to tilt cups by manipulating their fingers. Children are able to transfer food from bowls to their mouths with less spilling by 16 to 17 months of age, when well-defined wrist rotation develops. However, two-year-old children often prefer foods that can be picked up with their fingers without having to chase it across their plates.

The normal events of puberty and the simultaneous growth spurt are the primary influences on nutritional requirements during the second decade of life. During puberty, height and weight increase, many organ systems enlarge, and body composition is altered due to increased lean body mass and changes in the quantity and distribution of fat. The

timing of the growth spurt is influenced by genetic as well as environmental factors. Children who weigh more than average for their height tend to mature early, and vice versa. Although stature tends to increase most rapidly during the spring and summer, weight tends to increase either at a fairly steady rate over the entire year or undergoes a more rapid increase during the autumn. The most rapid linear growth spurt for an average American boy occurs between 12 and 15 years of age. For the average American girl, the growth spurt occurs about two years earlier, between 10 and 13 years of age. The growth spurt during adolescence contributes about 15% to final adult height, and approximately 50% to adult weight. During adolescence, boys tend to gain more weight than girls, and gain it at a faster rate. Furthermore, the skeletal growth of boys continues for a longer time than that of adolescent girls. Adolescent boys deposit more muscle mass, and adolescent girls deposit relatively more total body fat. Menarche, which is closely linked to the growth process, has a lasting impact on nutritional requirements of adolescent girls.

Adolescence is a period of various cognitive challenges. For example, when an adolescent realizes that his or her body is in the process of maturing, he or she may begin to assess changes in his or her own body size and shape, compare them with those of others, and form opinions about any differences. Adolescent girls and boys may be very self-conscious, especially during early and mid-adolescence. According to Piaget's developmental levels, it is usually during adolescence that abstract thinking supersedes concrete thinking. Thus, an adolescent may consider his or her body not just as it is, but also as it *might* be. In addition, an adolescent can contemplate new or different ways of combining or eating food. Furthermore, an adolescent can more easily conceptualize nutrients such as calories and fat, and skillfully manipulate their dietary intake.

Energy and Nutrient Needs

Dietary Reference Intakes and Recommended Dietary Allowances

The Dietary Reference Intakes (DRIs) expand and replace the series of Recommended Dietary Allowances (RDAs) published beginning in 1941 through 1989 by the Food and Nutrition Board.[1] Although previous RDAs focused on preventing classical nutrient deficiencies, the DRIs go beyond this to include current knowledge about the role of nutrients and food components in long-term health. The DRIs are reference values that are quantitative estimates of nutrient intakes to be used for planning and assessing diets for healthy people in America and Canada.[2] The DRIs include RDAs as goals for intake by individuals, but also present the following new types of reference values: Estimated Average Requirement (EAR), Adequate Intake (AI), and Tolerable Upper Intake Level (UL); these are discussed in detail in another section. Briefly, within the DRI framework, the RDA serves as a goal for individuals; it is the average daily dietary intake level that is sufficient to meet the nutrient needs of almost all (97 to 98%) healthy individuals in a lifestage and gender group. The EAR is a nutrient intake value that is estimated to meet the nutrient needs of 50% of the healthy individuals in a lifestage and gender group; it is used to assess adequacy of intakes of population groups, and to develop RDAs. The AI is used instead of an RDA when sufficient scientific evidence is not available to calculate an EAR; the AI is based on observed or experimentally determined approximations of nutrient intake by a lifestage and gender group (or groups) of healthy people. The UL is the highest level of nutrient intake per day that is likely to pose no risks of adverse health effects to almost all individuals in the general population. The risk of

TABLE 8.1

Recommended Levels for Individual Intake[a] for Children and Adolescents

	Children		Boys		Girls	
	1–3 years	**4–8 years**	**9–13 years**	**14–18 years**	**9–13 years**	**14–18 years**
Calcium (mg/d)	500*	800*	1300*	1300*	1300*	1300*
Phosphorus (mg/d)	**460**	**500**	**1250**	**1250**	**1250**	**1250**
Magnesium (mg/d)	**80**	**130**	**240**	**410**	**240**	**360**
Vitamin D (μg/d)[bc]	5*	5*	5*	5*	5*	5*
Fluoride (mg/d)	0.7*	1*	2*	3*	2*	3*
Thiamin (mg/d)	**0.5**	**0.5**	**0.9**	**1.2**	**0.9**	**1.0**
Riboflavin (mg/d)	**0.5**	**0.6**	**0.9**	**1.3**	**0.9**	**1.0**
Niacin (mg/d)[d]	**6**	**8**	**12**	**16**	**12**	**14**
Vitamin B_6 (mg/d)	**0.5**	**0.6**	**1.0**	**1.3**	**1.0**	**1.2**
Folate (μg/d)[e,f]	**150**	**200**	**300**	**400**	**300**	**400**
Vitamin B_{12} (μg/d)	**0.9**	**1.2**	**1.8**	**2.4**	**1.8**	**2.4**
Pantothenic acid (mg/d)	2*	3*	4*	5*	4*	5*
Biotin (μg/d)	8*	12*	20*	25*	20*	25*
Choline (mg/d)[g]	200*	250*	375*	550*	375*	400*
Vitamin C (mg/d)	**15**	**25**	**45**	**75**	**45**	**65**
Vitamin E (mg/d of α-tocopherol)[h]	**6**	**7**	**11**	**15**	**11**	**15**
Selenium (μg/d)	**20**	**30**	**40**	**55**	**40**	**55**
Vitamin A (μg/d)	**300**	**400**	**600**	**900**	**600**	**700**
Vitamin K (μg/d)	30*	55*	60*	75*	60*	75*
Chromium (μg/d)	11*	15*	25*	35*	21*	24*
Copper (μg/d)	**340**	**440**	**700**	**890**	**700**	**890**
Iodine (μg/d)	**90**	**90**	**120**	**150**	**120**	**150**
Iron (mg/d)[i]	**7**	**10**	**8**	**11**	**8**	**15**
Manganese (mg/d)	1.2*	1.5*	1.9*	2.2*	1.6*	1.6*
Molybdenum (μg/d)	**17**	**22**	**34**	**43**	**34**	**43**
Zinc (mg/d)	**3**	**5**	**8**	**8**	**11**	**9**

[a] Recommended Dietary Allowances (RDAs) are presented in bold type and Adequate Intakes (AIs) in ordinary type followed by an asterisk (*). RDAs and AIs may both be used as goals for individual intake. RDAs are set to meet the needs of almost all (97-98%) individuals in a group. The AI for other life-stage and gender groups is believed to cover needs of all individuals in the group, but lack of data or uncertainty in the data prevent being able to specify with confidence the percentage of persons covered by this intake. Adapted from: Food and Nutrition Board, Institute of Medicine, *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride*, National Academy Press, Washington, DC, 1997; Food and Nutrition Board, Institute of Medicine, *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B_6, Folate, Vitamin B_{12}, Pantothenic Acid, Biotin, and Choline*, National Academy Press, Washington, DC, 1998; Food and Nutrition Board, Institute of Medicine, *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids,* National Academy Press, Washington, DC, 2000; Food and Nutrition Board, Institute of Medicine, *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc,* National Academy Press, Washington, DC, 2001.

[b] As cholecalciferol. 1 μg cholecalciferol = 40 IU vitamin D.

[c] In the absence of adequate exposure to sunlight.

[d] As niacin equivalents (NE). 1 mg niacin = 60 mg tryptophan.

[e] As dietary folate equivalent (DFE). 1 DFE = 1 μg food folate = 0.6 μg folic acid (from fortified food or supplement) consumed with food = 0.5 μg synthetic (supplemental) folic acid taken on an empty stomach.

[f] In view of evidence linking folate intake with neural tube defects in the fetus, it is recommended that all women capable of becoming pregnant consume 400 μg synthetic folic acid from fortified foods and/or supplements in addition to intake of food folate from a varied diet.

[g] Although AIs have been set for choline, there are few data to assess whether a dietary supply of choline is needed at all states of the life cycle, and it may be that the choline requirement can by met by endogenous synthesis at some of these stages.

[h] DRIs for vitamin E are based on α-tocopherol only and do not include amounts obtained from the other seven naturally occurring forms historically called vitamin E. RDAs and AIs apply only to intake of 2*R*-stereoisomeric forms of α-tocopherol from food, fortified food, and multivitamins.

[i] For girls under 14 years who have started to menstruate, one might advise an increased intake to approximately 2.5 mg/d to what would be advised for a girl of the same characteristics before menarche.

TABLE 8.2

Tolerable Upper Intake Levels[a,b] (ULs) for Children and Adolescents

	1–3 years	4–8 years	9–13 years	14–18 years
Calcium (g/d)	2.5	2.5	2.5	2.5
Phosphorus (g/d)	3	3	4	4
Magnesium (mg/d)[c]	65	110	350	350
Vitamin D (μg/d)	50	50	50	50
Fluoride (mg/d)	1.3	2.2	10	10
Niacin (mg/d)[d]	10	15	20	30
Vitamin B6 (mg/d)	30	40	60	80
Synthetic folic acid (μg/d)[d]	300	400	600	800
Choline (g/d)	1.0	1.0	2.0	3.0
Vitamin C (mg/d)	400	650	1200	1800
Vitamin E (mg/d α-tocopherol)[e]	200	300	600	800
Selenium (μg/d)	90	150	280	400
Vitamin A (μg/d performed A)	600	900	1700	2800
Copper (μg/d)	1000	3000	5000	8000
Iodine (μg/d)	200	300	600	900
Iron (mg/d)	40	40	40	45
Manganese (mg/d)	2	3	6	9
Molybdenum (μg/d)	300	600	1100	1700
Zinc (mg/d)	7	12	23	34
Boron (mg/d)	3	6	11	17
Nickel (mg/d soluble nickel salts)	0.2	0.3	0.6	1.0
Vanadium (mg/d)[f]				

[a] UL = the maximum level of daily nutrient intake that is likely to pose no risk of adverse effects. Unless otherwise specified, the UL represents total intake from food, water, and supplements. Currently, ULs are not available for other nutrients. In the absence of ULs, extra caution may be warranted in consuming levels above recommended intakes.

[b] Adapted from: Food and Nutrition Board, Institute of Medicine, *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride*, National Academy Press, Washington, DC, 1997; Food and Nutrition Board, Institute of Medicine, *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B_6, Folate, Vitamin B_{12}, Pantothenic Acid, Biotin, and Choline*, National Academy Press, Washington, DC, 1998; Food and Nutrition Board, Institute of Medicine, *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids,* National Academy Press, Washington, DC, 2000; Food and Nutrition Board, Institute of Medicine, *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc,* National Academy Press, Washington, DC, 2001.

[c] The UL for magnesium represents intake from a pharmacological agent only and does not include intake from food and water.

[d] The ULs for niacin and synthetic folic acid apply to forms obtained from supplements, fortified foods, or a combination of the two.

[e] DRIs for vitamin E are based on α-tocopherol only and do not include amounts obtained from the other seven naturally occurring forms historically called vitamin E. The ULs apply to any form of supplementary α-tocopherol.

[f] The UL for adults is 1.8 mg/d of elemental vanadium. It was not possible to establish ULs for children for vanadium, but the source of intake should be from food only.[5]

adverse effects increases as intake increases above the UL.[2] Although the DRIs are based on data, scientific judgment was required in setting all reference values because data were often scanty or drawn from studies with limitations; this is especially true in deriving DRIs for children and adolescents.[2]

In 1997, DRIs were published for calcium, phosphorus, magnesium, vitamin D, and fluoride.[2] In 1998, DRIs were published for thiamin, riboflavin, niacin, vitamin B_6, folate, vitamin B_{12}, pantothenic acid, biotin, and choline.[3] In 2000, DRIs were published for vitamin C, vitamin E, and selenium.[4] No DRIs were proposed for carotenoids, although

TABLE 8.3

1989 Recommended Dietary Allowances (RDAs) for Children and Adolescents for Nutrients without Dietary Reference Intakes[a]

		Weight[b]		Height[b]		Calories	Protein	
Category	Age (years)	(kg)	(lb)	(cm)	(in)	(kcal/day)	(g/day)	(g/kg)
Children	1–3	13	29	90	35	1300	16	1.2
	4–6	20	44	112	44	1800	24	1.1
	7–10	28	62	132	52	2000	28	1.0
Boys	11–14	45	99	157	62	2500	45	1.0
	15–18	66	145	176	69	3000	59	0.9
Girls	11–14	46	101	157	62	2200	46	1.0
	15–18	55	120	163	64	2200	44	0.8

[a] Adapted from Food and Nutrition Board, National Research Council, *Recommended Dietary Allowances*, 10th ed, National Academy Press, Washington, DC, 1989. The RDAs, expressed as average daily intakes over time, are intended to provide for individual variations among most normal persons as they live in the U.S. under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined. The RDAs are designed for the maintenance of good nutrition of practically all healthy people in the U.S.

[b] The median weights and heights of those under 19 years of age were taken from Hamill, P. V. V., Drizd, T. A., Johnson, R. B., et al., *Am J Clin Nutr*, 32, 607, 1979. The use of these figures does not imply that the height-to-weight ratios are ideal.

existing recommendations for increased consumption of carotenoid-rich fruits and vegetables are supported. However, β-carotene supplements are not advisable.[4] In 2001, DRIs were published for vitamin A, vitamin K, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, vadadium, and zinc.[5] No DRIs were set for arsenic or silicon.[5] For boron, nickel, and vanadium, ULs were proposed, but EARs, RDAs, or AIs were not set.[5] The RDAs and AIs for children and adolescents are provided in Table 8.1. The ULs for children and adolescents are provided in Table 8.2. Additional groups of nutrients and food components slated for review over the next several years include energy and macronutrients, electrolytes, and other food components.[2]

Energy

Daily energy needs depend on three major factors: energy expended when at rest, during physical activity, and as a result of thermogenesis. Resting energy expenditure is the largest of the three factors unless the physical activity level is very high; thermogenesis is the smallest. In turn, these factors are affected by individual variables which include age, sex, body size and composition, genetics, energy intake, physiologic state (e.g., growth, pregnancy, lactation), coexisting pathological conditions, and ambient temperature.

Recommended energy allowances for children and adolescents from the 1989 RDAs are stipulated as kilocalories (kcal)/day based on reference weights for children ages 1 to 10 years in three age groups for both genders combined, and for adolescents ages 11 to 18 years in two age groups for boys and girls separately (see Table 8.3). According to Heald and Gong, the best way to calculate individual energy requirements for adolescents may be to use kcal/centimeter (cm) of height; thus, boys 11 to 14 years of age need 15.9 kcal/cm, boys 15 to 18 years of age need 17.0 kcal/cm, girls 11 to 14 years of age need 14.0 kcal/cm, and girls 15 to 18 years of age need 13.5 kcal/cm.[6] In Table 8.4, energy requirements for children and adolescents from Pellett[7] are stipulated in terms of kcal/day (mean

TABLE 8.4

Energy Requirements for Children and Adolescents[a]

Age (years)	Weight[b] (kg)	Height (cm)	Estimated Energy Allowance		
			By Time (kcal/d (range))	By Weight (kcal/kg)	By Height (kcal/cm)
Children					
1–1.9	11	82	1200 (900–1600)	105	14.0
2–3.9	14	96	1400 (1100–1900)	100	14.6
4–5.9	18	109	1700 (1300–2300)	92	15.6
6–7.9	22	121	1800 (1400–2400)	83	14.9
8–9.9	28	132	1900 (1400–2500)	69	14.4
Boys					
10–11.9	36	143	2200 (1700–2900)	61	15.4
12–17.9[c]	57	169	2700 (2000–3600)	47	16.0
Girls					
10–14.9	44	155	2200 (1700–2900)	50	14.2
15–17.9[c]	56	162	2300 (1700–3000)	41	14.2

[a] Adapted from Pellett, P. L., *Am J Clin Nutr*, 51, 711, 1990. Data originate from original median weights and heights (see original document).

[b] Weight is rounded to nearest kilogram for age.

[c] During these years, individual growth rates can vary enormously; thus, allowances should be based on individual weights and the requirements per kg body weight.

and range), kcal/kilogram (kg), and kcal/cm for children ages 1 to 9.9 years in five groups for both genders combined, for adolescent boys ages 10 to 17.9 years in two groups, and for adolescent girls ages 10 to 17.9 years in two groups.

Physical activity patterns are quite variable among children and adolescents, and there is considerable variability in both the timing and magnitude of the growth spurt. Thus, recommended energy allowances for children and adolescents assume a wide range within which energy can be adjusted individually to account for body weight, activity, and rate of growth. An accepted and practical method for assessing the adequacy of a child's or adolescent's energy intake is to monitor growth by tracking height and weight on growth charts developed by the National Center for Health Statistics; these charts are provided in Section 32.

Protein

Protein is essential for growth, development, and maintenance of the body; it also provides energy. Protein yields 4 kcal/gram (g). Food sources of protein include meat, fish, poultry, milk, cheese, yogurt, dried beans, peanut butter, nuts, and grain products. Animal proteins are called "high-quality" or "complete" because they contain all the essential amino acids in the proportions needed by humans. Vegetable proteins, with the exception of soybeans, are called "low-quality" or "incomplete" because they have low levels of one or more essential amino acids. A vegetable protein may be paired with another vegetable protein or with a small amount of animal protein to provide adequate amounts of all the essential amino acids. For example, black-eyed peas can be paired with rice, peanut butter with wheat bread, pasta with cheese, or cereal with milk.

Proteins in the body are continuously being degraded and resynthesized. Because the process is not entirely efficient and some amino acids are lost, a continuous supply of amino acids is needed to replace these losses, even after growth has stopped. The primary factor that influences protein needs is energy intake because when energy intake is insufficient, protein is used for energy. Thus, all protein recommendations are based on the assumption that energy needs are adequately met. In addition, protein recommendations are based on high-quality protein intakes; appropriate corrections must be made for diets which customarily provide low-quality proteins.

Table 8.3 provides the 1989 RDAs for high-quality protein in g/day and g/kg of body weight for children and adolescents. As Table 8.3 indicates, requirements slowly decline relative to weight during the preschool and elementary school-age years. During the adolescent years, protein recommendations do not emphasize the growth spurt because it is small relative to body size. A 14-year-old adolescent who weighs 54 kilograms (kg) (118.8 pounds) needs 54 g of protein each day; assuming that energy needs are met, this protein need is met by eating a hamburger (3-ounce meat patty on a bun) and two slices of cheese pizza.

According to Heald and Gong,[6] the most useful method for determining protein needs for adolescents is to use the 1989 RDAs for protein as they relate to height. For adolescent boys ages 11-14 and 15-18 years, the protein daily recommendation based on height is 0.29 and 0.34 g/cm height, respectively. For adolescent girls ages 11-14 and 15-18 years, the protein daily recommendation based on height is 0.29-0.27 g/cm height, respectively.[6]

Carbohydrates

Children and adolescents should get 55-60% of their daily calories from carbohydrates.[8] Complex carbohydrates (starchy foods such as pasta, breads, cereals, rice, and legumes) should provide the majority of kcal from carbohydrates, and simple carbohydrates (naturally occurring sugars in fruits and vegetables) should provide the rest. Carbohydrate yields 4 kcal/g. A 4- to 6-year-old child who needs 1800 kcal/day would need about 990 to 1080 kcal (or 248 to 270 g) from carbohydrates daily. An 11- to 14-year-old adolescent who needs 2500 kcal/day would need about 1375 to 1500 kcal (or 344 to 375 g) from carbohydrates daily.

Fat and Cholesterol

To promote lower cholesterol levels in all healthy U.S. children ages 2-18 years, the American Academy of Pediatrics recommends that children older than two years should gradually adopt a diet that by the age of five years reflects the following five guidelines.[9]

1. Nutritional adequacy should be achieved by eating a wide variety of foods.
2. Caloric intake should be adequate to support growth and development and to reach or maintain desirable body weight.
3. Total fat intake over several days should be no more than 30% of total calories and no less than 20% of total calories.
4. Saturated fat intake should be less than 10% of total calories.
5. Dietary cholesterol intake should be less than 300 milligrams (mg) per day.[9]

These recommendations are consistent with those of the Dietary Guidelines for Americans, which were designed to provide advice for healthy Americans age two years and over

about food choices that promote health and prevent disease.[10] A precise percentage of dietary fat intake that supports normal growth and development while maximally reducing atherosclerosis risk is unknown. Thus, a range of appropriate values averaged over several days for children and adolescents is recommended based on the available scientific information. More information regarding the safety of low-fat diets for children is found in "Low Fat Diets" in this section.

Fat yields 9 kcal/g. Dietary sources of fat include oils, margarine, butter, fried foods, egg yolks, mayonnaise, salad dressings, ice cream, hard cheese, cream cheese, nuts, fatty meats, chips, and doughnuts. Table 8.5 provides the fat, saturated fat, and cholesterol content of various foods.

TABLE 8.5

Total Fat, Saturated Fat, and Cholesterol Content of Various Foods

Food	Amount	Total Fat (g)	Saturated Fat (g)	Cholesterol (mg)	Kcal
Almonds, roasted, salted	1 oz	15.3	1.1	0	172
Bacon	2 slices	6.3	2.2	11	73
Bread, white	1 slice	0.9	0.0	0	64
Butter	1 t	4.1	2.5	11	36
Cheese, American	1 oz	8.9	5.6	27	106
Cheese, cheddar	1 oz	9.4	6.0	30	114
Chicken breast with skin, roasted	1/2 breast	7.6	2.2	83	193
Chicken breast without skin, roasted	1/2 breast	3.1	0.9	73	142
Coconut, dried, sweetened, flaked	1/3 c	8.1	7.2	0	115
Corn oil	1 t	13.6	1.7	0	120
Cottonseed oil	1 t	13.6	3.5	0	120
Egg, whole, boiled	1 large	5.3	1.6	213	77
Egg, white only, boiled	1 large	0.0	0.0	0	17
Egg, yolk only, boiled	1 large	5.1	1.6	213	59
Fish, flounder or sole, cooked	3 oz	1.3	0.3	58	99
Ground beef, regular, broiled	3.5 oz	19.5	7.7	101	292
Ground beef, extra lean, broiled	3.5 oz	15.8	6.2	99	265
Ice cream, vanilla, 10% fat	1/2 c	7.3	4.5	29	132
Ice milk, vanilla	1/2 c	2.8	1.7	9	92
Lard (pork fat)	1 t	12.8	5.0	12	115
Margarine, corn & hydrogenated corn	1 t	3.8	0.7	0	34
Margarine, liquid oil	1 t	3.8	0.7	0	34
Milk, whole	1 cup	8.2	5.1	33	150
Milk, 2%	1 cup	4.7	2.9	18	121
Milk, 1%	1 cup	2.6	1.6	10	102
Milk, skim	1 cup	0.4	0.3	4	86
Olive oil	1 t	13.5	1.8	0	119
Peanut butter	2 t	16.0	3.1	0	188
Peanuts, dry roasted	1 oz	13.9	1.9	0	164
Pecans, raw	1 oz	19.0	2.0	0	190
Pork, lean, roasted	3.5 oz	4.8	1.7	93	166
Safflower oil	1 t	13.6	1.2	0	120
Shrimp, boiled	3 oz	0.9	0.2	166	84
Soybean oil	1 t	13.6	2.0	0	120
Tuna fish, oil pack, drained	3 oz	7.0	1.3	15	169
Tuna fish, water pack, drained	3 oz	0.7	0.2	25	99
Turkey breast with skin, roasted	3.5 oz	3.5	1.0	42	126
Yogurt, frozen, vanilla, soft serve	1/2 c	4.0	2.5	2	114

Adapted from Bowes, A. D. P., *Bowes and Church's Food Values of Portions Commonly Used,* 16 ed, revised by Pennington, J. A. T., J. B. Lippincott Company, Philadelphia, 1994.

TABLE 8.6

Fiber Content of Foods that Most U.S. Children and Adolescents Will Eat

Food source	Serving size	Approximate grams of dietary fiber
Baked Beans	1 c	13
Chili with beans	1 c	7
Refried beans	4 oz	6
Brown rice	1 c	4
Peanuts (dry roasted)	2 oz	4
Strawberries	1 c	4
Whole-wheat bread	2 slices	4
Potato, baked, with skin	1 medium	3.5
Apple	1 medium	3
Banana	1 large	3
Carrot (raw)	1 medium	3
Corn	1/2 c	3
Kiwi	1 large	3
Raisins	1/3 c	3
Whole-grain crackers	1/2 oz	2–3
Cereal	1 c	2–3[a]
Applesauce	1/2 c	2
Broccoli	1/2 c	2
Orange	1 medium	2
Peanut butter	2 Tbsp	2

[a] Dietary fiber content of cereal varies widely. Best fiber choice for children has 3+ g per cup.

[b] Adapted from Williams, C. L., *J Am Diet Assoc*, 95, 1140, 1995.

Fiber

Fiber has important health benefits such as promoting normal laxation which can be a problem for many children. In addition, fiber may help reduce the risk of certain chronic diseases of adulthood such as some cancers, cardiovascular disease, and diabetes. The American Health Foundation recommends that children ages two years and older consume a minimal amount of fiber equal to their age plus 5 g/day, and a maximum amount of age plus 10 g/day, to achieve intakes of a maximum of 35 g/day after the age of 20 years.[11,12] This range is thought to be safe even if intake of some vitamins and minerals is marginal. According to the American Academy of Pediatrics,[13] a reasonable daily fiber intake for children is 0.5 g/kg of body weight to a maximum of 35 g/day. The two recommendations are similar for children up to age 10 years, but the age plus 5 recommendation is lower for older adolescents than the recommendation for 0.5 g/kg of body weight.

Fiber intake should be increased gradually through consumption of a variety of fruits, vegetables, legumes, cereals, and other whole-grain products such as breads and crackers. Fiber supplements for children are not recommended as a means of meeting dietary fiber goals.[11] Increased intakes of dietary fiber should be accompanied by increased intakes of water because dietary fiber increases water retention in the colon, which leads to bulkier and softer stools.[11] For most children and adolescents, dietary fiber goals can be met if the daily diet includes two servings of vegetables, three servings of fruits, two slices of whole wheat bread, and a serving of breakfast cereal containing three or more grams of fiber.[12] Table 8.6 provides a list of foods containing fiber that most U.S. children and adolescents will eat.

High-fiber diets do have the potential for reduced energy density, reduced kcal intake, and poor growth, especially in very young children. Furthermore, high-fiber diets may reduce the bioavailability of minerals such as iron, calcium, and zinc. However, the potential health benefits of a moderate increase in dietary fiber intake in childhood are thought to outweigh the potential risks significantly, especially in highly industrialized countries such as the U.S.[11]

Selected Vitamins and Minerals

Vitamin D

Throughout the world, the major source of vitamin D for humans is the exposure of the skin to sunlight; vitamin D that is synthesized in the skin during the summer and fall months can be stored in the fat for use in the winter, which minimizes requirements for vitamin D. In nature, very few foods contain vitamin D; thus, children and adolescents who live in far northern latitudes (e.g., northern Canada and Alaska) may need vitamin D supplements. Food sources of vitamin D include some fish liver oils, eggs from hens that have been fed vitamin D, the liver and fat from aquatic mammals such as seals and polar bears, and the flesh of fatty fish. Foods fortified with vitamin D include milk products and other foods such as margarine and breakfast cereals; the majority of human intake of vitamin D is from fortified foods. Fortified milk is supposed to contain 10 μg (400 IU) per quart regardless of the fat content of milk; however, several recent surveys have indicated that many milk samples contained less than 8 μg per quart. Although it is well recognized that vitamin D deficiency causes abnormalities in calcium and bone metabolism, it is premature to suggest that cancer risk is increased by vitamin D deficiency. The AIs for vitamin D for children and adolescents (see Table 8.1) were set to cover the needs of almost all children and adolescents regardless of exposure to sunlight. Currently, there is no scientific evidence that demonstrates an increased requirement for vitamin D during puberty even though metabolism of vitamin D increases during puberty to enhance intestinal calcium absorption to provide adequate calcium for the rapidly growing skeleton.[2]

Folate

Folate is important during periods of increased cell replication and growth due to its role in DNA synthesis and the formation of healthy red blood cells; thus, the 1998 RDAs for folate are 1.5 times greater for children age 9 to 13 years than for children age 4 to 8 years (see Table 8.1). There is strong evidence that the risk of having a fetus with a neural tube defect decreases with increased intake of folate during the periconceptional period; thus, it is recommended that all women capable of becoming pregnant take 400 μg of synthetic folic acid daily, from fortified foods and/or supplements, in addition to consuming food folate from a varied diet. Folate fortification became mandatory for enriched grain products in the U.S. effective January 1, 1998. Besides fortified grains and cereals, other food sources of folate include leafy green vegetables, orange juice, liver, cantalope, yeast, and seeds.[3]

Calcium

Over 99% of total body calcium is found in teeth and bones. Approximately 45% of adult skeletal mass is accounted for by skeletal growth during adolescence; thus, achieving and maintaining adequate calcium intake during adolescence is necessary for the development of a maximal peak bone mass which may help reduce the risk of osteoporosis later in adulthood.

TABLE 8.7

Approximate Calcium Content for One Serving of Various Foods

Food	Serving Size	Approximate Calcium Content (mg)
Cheese (Swiss)	1.5 oz	405
Cheese (cheddar or jack)	1.5 oz	310
Milk (whole, 1%, 2%, or buttermilk)	1 c	300
Yogurt	8 oz	300
Cheese (part skim mozzarella)	1.5 oz	280
Tofu, raw, firm	1/2 c	260
Cheese (American)	2 oz	250
Calcium-fortified orange juice	6 oz	200
Canned sardines (with bones)	2 oz	180
Canned salmon (with bones)	3 oz	180
Cooked greens (collards)	1/2 c	180
Pudding	1/2 c	150
Spinach (cooked)	1/2 c	120*
Frozen yogurt (vanilla, soft serve)	1/2 c	100
Ice cream (vanilla, 10% fat)	1/2 c	85
Cooked greens (mustard, kale)	1/2 c	80
Cottage cheese	1/2 c	75
Spinach (raw)	1 c	60*
Orange	1 medium	55
Beans, canned (baked, pinto, or navy)	1/2 c	50
Sweet potatoes (mashed)	1/2 c	40
Broccoli (cooked)	1/2 c	35
Broccoli (raw)	1/2 c	20

* The calcium from spinach is essentially nonbioavailable.

Adapted from Bowes, A. D. P., *Bowes and Church's Food Values of Portions Commonly Used,* 16th ed, revised by Pennington, J. A. T., J. B. Lippincott Company, Philadelphia, 1994.

The calcium AIs for adolescents are higher than for children because from age 9 through 18 years (see Table 8.1), calcium retention increases to a peak and then declines. However, the calcium AIs remain the same for adolescents from age 9 to 18 years because calcium absorption efficiency decreases. Thus, during this developmental period, measures of sexual maturity are better predictors of calcium retention than chronological age.[2]

Major food sources of calcium include milk, yogurt, cheese, and green leafy vegetables. Calcium-fortified orange juice is also an excellent source of calcium, as is tofu. Table 8.7 contains approximate calcium contents for one serving of various common foods. Vitamin D (discussed previously in this section) is needed for the body to absorb calcium.

The calcium content of food is generally of greater importance than bioavailability when evaluating food sources of calcium. The efficiency of calcium absorption is fairly similar from most foods, including milk and milk products and grains, which are major food sources of calcium in North American diets. Calcium may be poorly absorbed from foods such as spinach, beans, sweet potatoes, and rhubarb which are rich in oxalic acid, and from unleavened bread, raw beans, seeds, nuts and grains, and soy isolates which are rich in phytic acid. Calcium absorption is relatively high from soybeans, although they contain large amounts of phytic acid. Compared to calcium absorption from milk, calcium absorption from spinach is about one tenth, and from dried beans is about half.[2]

When developing the AIs for calcium, the Food and Nutrition Board of the Institute of Medicine reviewed concerns regarding factors that affect the calcium requirement.[2] For example, they discussed racial differences in calcium metabolism, that sodium and calcium excretion are linked in the proximal renal tubule and that many commonly consumed processed foods are high in sodium, that protein increases urinary calcium excretion, that

caffeine has a modest negative impact on calcium retention, that calcium bioavailability is reduced in vegetarian diets due to the high oxalate and phytate content, and that exercise and calcium both influence bone mass. However, the Board concluded that available evidence did not warrant different calcium intake requirements for individuals according to their race, sodium consumption, protein intake, caffeine intake, level of physical activity, or for individuals who consume a vegetarian diet.[2]

Children and adolescents (and adults) with lactose intolerance develop symptoms of diarrhea and bloating after ingesting large doses of lactose such as the amount present in a quart of milk (~46 g). People who generally are lactose digesters include Northern Europeans, Finns, Hungarians, probably Mongols, the Fulani and Tussi tribes of Africa, and the Punjabi of India; the remainder of the world's population are lactose nondigesters.[14] However, as digesters intermix reproductively with nondigesters, the rate of lactose malabsorption falls.[14] In general, evidence for lactose malabsorption as a clinical problem is not manifest until after five to seven years of age, although this age can vary.[14] Individuals with lactose intolerance can increase their tolerance to dairy products by drinking smaller doses of milk (such as eight ounces), or by ingesting fermented products such as yogurt, hard cheeses, cottage cheese, and acidophilus milk.[14] In addition, lactose-free dairy products are available. Although lactose intolerance may influence intake, lactose-intolerant individuals absorb calcium normally from milk; thus, there is no evidence to suggest that it influences the calcium requirement.[2]

Iron

According to the American Academy of Pediatrics,[15] iron deficiency is the most common nutritional deficiency in the U.S. Children aged one to two years are the most susceptible to iron deficiency due to increased iron needs related to rapid growth during the first two years of life and a relatively low iron content in most infant diets when iron is not added by supplementation or fortification. Children age 3 to 11 years are at less risk for iron deficiency until the rapid growth of puberty. Preadolescent school-age children who consume a strict vegetarian diet are at greater risk for iron deficiency anemia. Adolescent boys are at risk for iron deficiency anemia during their peak growth period when iron stores may not meet the demand of rapid growth; however, the iron deficiency anemia generally corrects itself after the growth spurt. Adolescent girls are at greater risk for iron deficiency anemia due to blood losses during menstruation. A major consequence of iron deficiency is that significant iron deficiency adversely affects child development and behavior. Furthermore, iron deficiency leads to enhanced lead absorption, and childhood lead poisoning is a well-documented cause of neurologic and developmental deficits. These consequences, along with evidence that dietary intake during infancy is a strong determinant of iron status for older infants and younger children, emphasize the importance of prevention. Significant improvements have been made in the iron nutritional status of infants and young children in the U.S. during the past two decades, perhaps because during this same time frame, several changes were made in infant feeding patterns.[15] These changes included increased dietary iron content or iron bioavailability, increased incidence of breastfeeding, increased use of iron-fortified formula, and reduced use of whole milk and low-iron formula during the first year of life.[15]

Dietary iron is classified as "heme" or "non-heme" iron. Heme iron is found in foods from animals such as meat, fish, and poultry. Non-heme iron is provided by plants; good sources include dark-green leafy vegetables, tofu, lentils, white beans, dried fruits, and iron-fortified breads and cereals. On average, healthy people absorb about 5 to 10% of the iron consumed, and people who are iron deficient absorb about 10 to 20%. Heme iron is more easily absorbed than non-heme iron. About 20% of heme iron consumed is

absorbed regardless of how it is prepared and served; however, the absorption rate of non-heme iron can be increased by eating foods with non-heme iron with either meat, foods rich in vitamin C, or foods that contain some heme iron at the same meal. Non-heme iron absorption can be hindered by as much as 50% when tannins, phytates, and calcium (which are found in foods such as tea, bran, and milk, respectively) are eaten at the same meal.

The RDAs for iron for children and adolescents are included in Table 8.1. Because the amount of iron available in the American diet is estimated to be about 5 to 7 mg/1000 kcal, it may be difficult for adolescent girls to obtain 15 mg of iron from dietary sources alone if their caloric intake is between 2000 and 2400 kcal/day. Groups of adolescents at special risk of iron deficiency include 1) older adolescent girls due to their increased iron need and their low dietary intake, 2) pregnant adolescents, and 3) girl athletes such as runners who may lose iron through occult gastrointestinal bleeding.

The Committee on the Prevention, Detection, and Management of Iron Deficiency Anemia Among U.S. Children and Women of Childbearing Age was established under the Food and Nutrition Board of the Institute of Medicine; its recommended guidelines were published in 1993.[16] The committee concluded that iron enrichment and fortification of the U.S. food supply should remain at current levels rather than increasing or decreasing the levels. Furthermore, it was recommended that dietary sources of iron be consumed instead of supplemental sources when possible. Iron supplements should be kept out of reach of children because iron is a very common cause of poisoning in children.[16]

Zinc

Zinc is needed for protein synthesis, wound healing, and sexual maturation; thus, zinc is especially important during adolescence due to the rapid rate of growth and sexual maturation.[6] (See Table 8.1 for the RDAs for zinc for children and adolescents.) Adolescents undergoing rapid growth are at risk for inadequate zinc levels, and should be encouraged to include zinc-rich foods in their daily diet. Foods high in zinc include red meats, certain seafood, and whole grains; many breakfast cereals are fortified with zinc. The bioavailability of zinc in foods varies widely. Zinc from whole grain products is less available than zinc from meat, liver, eggs, and seafood (especially oysters). Furthermore, consumption of phytate-rich foods limits absorption and maintenance of zinc balance.[5]

Food Guide Pyramid for Young Children

Figure 8.1 illustrates the Food Guide Pyramid for Young Children released by the United States Department of Agriculture (USDA) in March, 1999.[17] The pyramid targets children two to six years of age; it is an adaptation of the original Food Guide Pyramid[18] released in 1992. The purpose of the new pyramid is to simplify educational messages and focus on young children's food preferences and nutritional needs. The new pyramid was developed by adapting existing food guidance recommendations to meet the specific needs of young children after actual food patterns of young children were analyzed by USDA's Center for Nutrition Policy and Promotion. Table 8.8 provides an overview of changes made in the new pyramid. The new pyramid continues to emphasize eating a variety of foods. However, it de-emphasizes fat restriction, recognizing that some fats are necessary for early growth and development.

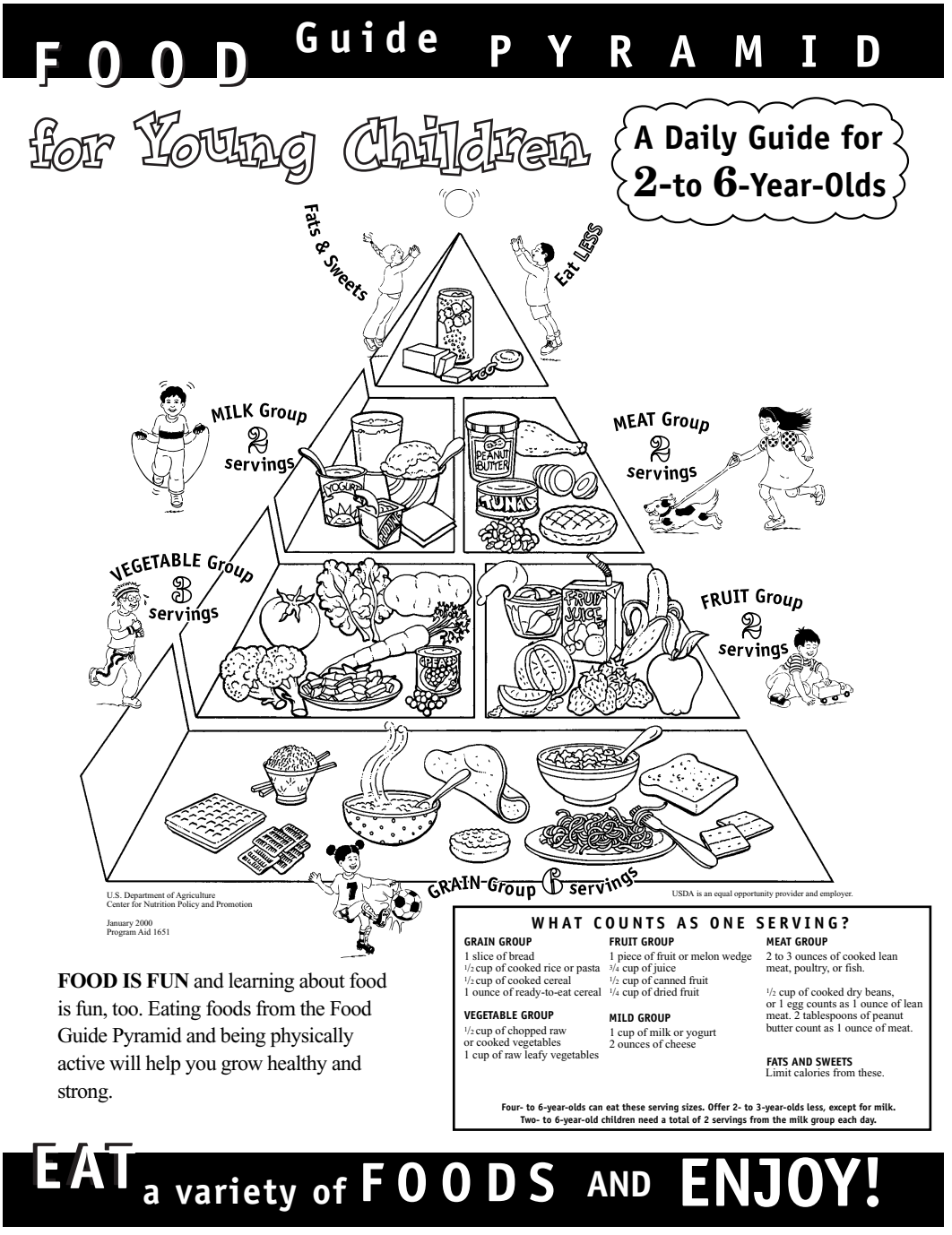

FIGURE 8.1
Food guide pyramid for young children.

TABLE 8.8

Changes Made in the New Food Guide Pyramid for Young Children

- The food groups have shorter names.
- A single number of servings is given for each food group rather than a range of servings.
- Foods are drawn in a realistic style.
- Foods are illustrated in single serving portions when possible.
- Foods included are those commonly eaten by young children such as fruit juice, green beans, breads, cereals, and pasta. (Although the baked potato is not the most commonly served form of potato, it is illustrated to encourage children to consume a lower fat version of potato. Also, dark-green leafy vegetables and whole-grain products are illustrated to encourage children to eat them more often.)
- Abstract symbols for fat and added sugars in the original pyramid have been eliminated.
- The tip of the pyramid has drawings of food items rather than symbols.
- The pyramid is surrounded with illustrations of children engaged in active pursuits, to show the importance of physical activity.

From *Tips for Using the Food Guide Pyramid for Young Children 2 to 6 Years Old*, USDA, Center for Nutrition Policy and Promotion, Washington, DC, 1999, Program Aid 1647.

A booklet entitled *Tips for Using the Food Guide Pyramid for Young Children 2 to 6 Years Old* was developed to go along with the new pyramid.[19] It includes tips to encourage healthful eating, basic information about the new pyramid, "child-size" serving sizes, lists of foods by group to encourage children to eat a variety of foods, suggested kitchen activities for parents to do with children, snack and meal planning ideas, a chart to track foods eaten over several days, and "hands-on" food activities for home or child care centers.

Both the original and the new pyramid show how adults, adolescents, and children can make food choices for a healthful diet as described in the *Dietary Guidelines for Americans*.[10] The five food groups in the pyramid include grains, vegetables, fruits, milk, and meat. Each group provides some, but not all, of nutrients and energy that children need. No one food group is more important than another. The grain group forms the base of the pyramid because the largest number of servings needed each day comes from this group. Grain products provide vitamins, minerals, complex carbohydrates, and dietary fiber. Foods from the fruit and vegetable groups provide vitamins, minerals, and dietary fiber. Foods from the milk group provide calcium. Foods from the meat group (meat, poultry, fish, eggs, dry beans/peas, and peanut butter) provide protein, iron, and zinc. The small tip of the pyramid shows fats and sweets (e.g., salad dressing, cream, butter, margarine, soft drinks, and candy); these foods contain kcal but few vitamins and minerals.

Table 8.9 contains young children's serving sizes by food group, along with the number of servings needed from each food group each day. Two- to three-year-olds need the same variety of foods as four- to six-year-olds but fewer kcal, so offer them smaller amounts (about 2/3 serving). The one exception is that two- to six-year-olds need a total of two servings from the milk group each day. Offer children a variety of foods from the five food groups, and let children decide how much to eat. Table 8.10 contains a sample meal and snack plan according to food group for one day for four- to six-year-old children.

What are Children and Adolescents Eating?

1989–1991 Continuing Survey of Food Intakes by Individuals (CSFII)

The 1989–1991 CSFII sample consisted of individuals residing in households in the 48 contiguous United States; it included two separate samples, basic and low income. All

TABLE 8.9

Young Children's Serving Sizes by Food Group

Grain Group (6 servings each day)
Offer whole or mixed grain products for at least 3 of the 6 grain group servings each day.

Whole grain:
1/2 cup cooked brown rice
2-3 graham cracker squares
5-6 whole grain crackers
1/2 cup cooked oatmeal
1/2 cup cooked bulgur
3 cups popped popcorn*
3 rice or popcorn cakes*
1 ounce ready-to-eat whole grain cereal
1 slice pumpernickel, rye, or whole wheat bread
2 taco shells*
1 7-inch corn tortilla

Enriched:
1/2 cup cooked rice, pasta, or grits
1/2 English muffin or bagel
1 slice white, wheat, French or Italian bread
1/2 hamburger or hot dog bun
1 small roll
6 crackers (saltine size)
1 4-inch pita bread or 1 4-inch pancake
1/2 cup cooked farina or other cereal
9 3-ring pretzels*
1 7-inch flour tortilla
1 ounce ready-to-eat, unfrosted cereal

Grain products with more fat and sugars:
1 small biscuit, muffin, or piece of cornbread
1/2 medium doughnut
9 animal crackers

Vegetable Group (3 servings each day)

1/2 cup of chopped raw or cooked vegetable
1 cup raw leafy greens
1/2 cup tomato or spaghetti sauce
3/4 cup vegetable juice
1 cup vegetable soup
1 medium (ear of corn, potato)
2 cooked broccoli spears
7-8 raw carrot or celery sticks (3" long)*
10 french fries
5 cherry tomatoes*

Fruit Group (2 servings each day)

1 medium orange, apple, banana, or peach
1/2 grapefruit
1/2 cup cut-up fresh, canned, or cooked fruit
3/4 cup fruit juice
1/4 cup dried fruit*
12 grapes or 11 cherries*
7 medium strawberries
1/2 cup blueberries or raspberries
1 large kiwi
1 small pear

Milk Group (2 servings each day)

For this amount of food …	*Count this many milk group servings*
1 cup milk or 1 cup soy milk (calcium fortified)	1
1/2 cup milk	1/2
1 cup yogurt (8 ounces)	1
1.5 ounces natural cheese	1
2 ounces processed cheese	1
1 string cheese (1 ounce)	2/3
1/2 cup cottage cheese	1/4
1/2 cup ice cream	1/3
1/2 cup frozen yogurt or 1/2 cup pudding	1/2

TABLE 8.9 *(Continued)*

Young Children's Serving Sizes by Food Group

Meat Group (2 servings each day)
Two to three ounces of cooked lean meat, poultry, or fish equal one serving of meat. Amounts from the meat group should total 5 ounces a day for 4- to 6-year-olds and about 3 1/2 ounces a day for 2- to 3-year-olds.

For this amount of food …	*Count this many ounces*
2 ounces cooked lean meat, poultry, or fish	2 ounces
1 egg (yolk and white)	1 ounce
2 tablespoons peanut butter*	1 ounce
1 1/2 frankfurters (2 ounces)*	1 ounce
2 slices bologna or lunchmeat (2 ounces)	1 ounce
1/4 cup drained canned salmon or tuna	1 ounce
1/2 cup cooked kidney, pinto, or white beans	1 ounce
1/2 cup tofu	1 ounce
1 soy burger patty	1 ounce

* May cause choking in 2- and 3-year-old children.

Adapted from *Tips for Using the Food Guide Pyramid for Young Children 2 to 6 Years Old*, USDA, Center for Nutrition Policy and Promotion, Washington, DC, 1999, Program Aid 1647.

household members were asked to provide intake information. Each individual provided three consecutive days of dietary data which consisted of one 24-hour recall and a two-day food record. A knowledgeable adult (usually the primary meal planner/preparer) reported the food intakes of household members younger than 12 years.[20]

Data from the 1989–1991 CSFII have been analyzed numerous ways to provide insight into what children and adolescents are eating. For example, data were analyzed to determine dietary sources of nutrients among 4008 U.S. children age 2 to 18 years.[21] Results indicated that fortified foods (e.g., ready-to-eat cereals) were influential contributors of many vitamins and minerals. Furthermore, low nutrient-dense foods were major contributors of energy, fats, and carbohydrate, which compromises intakes of more nutrient-dense foods, and may impede compliance with current dietary guidance.

Data from CSFII 1989–1991 were also analyzed to determine fruit and vegetable consumption among 3148 U.S. children age 2 to 18 years.[22] Results indicated that only one in five children met the recommendation of consuming five or more servings of fruits and vegetables per day. Intakes of all fruits and of dark green and/or deep yellow vegetables were very low compared with recommendations. Furthermore, almost one-fourth of all vegetables consumed by children and adolescents were french fries.

Finally, data from the CSFII 1989–1991 were analyzed to determine what percentage of children ages 4-6 (n = 603) and 7-10 (n = 782) met the American Health Foundation's age plus 5 recommendation for fiber,[11,12] and what the leading contributors to total dietary fiber intake were.[23] Results indicated that only 45% of 4- to 6-year-olds and 32% of 7- to 10-year-olds met the age plus 5 rule. Children who met the rule did so by consuming significantly more high- and low-fiber breads and cereals, fruits, vegetables, legumes, nuts, and seeds. Furthermore, children who met the rule had significantly higher energy-adjusted intakes of vitamins A and E, folate, magnesium, and iron compared to children with low fiber intakes who had significantly higher energy-adjusted intakes of fat and cholesterol. Surprisingly, low-fiber breads and cereals provided 21 and 19% of total dietary fiber for 4- to 6-year-olds and 7- to 10-year-olds, respectively, whereas high-fiber breads and cereals provided only 6% of total dietary fiber for both age groups. Conclusions from these results include that substituting high-fiber breads and cereals for low-fiber ones would increase children's fiber intakes and should be relatively easy to accomplish.[23]

TABLE 8.10

Sample Meal and Snack Plan according to Food Group for One Day for Four- to Six-Year-Old Children (Offer two- to three-year-old children the same variety but smaller portions.)

	Grain	Vegetable	Fruit	Milk	Meat
Breakfast					
Orange juice, 3/4 cup			1		
Whole-grain toast, 1 slice	1				
Cheerios, 1 oz	1				
Milk, 1/2 cup				1/2	
Mid-Morning Snack					
Graham crackers, 2 squares	1				
Cold water, 1/2 cup					
Lunch					
Tuna Casserole with:					
Tuna fish, 2 oz (1/2 cup)					2 oz
Macaroni, 1/2 cup	1				
Green peas, 1/2 cup		1			
Processed cheese, 1 oz				1/2	
Banana, 1 medium			1		
Milk, 1/2 cup				1/2	
Mid-Afternoon Snack					
Animal crackers, 9	1				
Peanut butter, 2 Tbsp					1 oz
Cold water, 1/2 cup					
Dinner					
Chicken, 2 oz					2 oz
Baked potato, 1 medium		1			
Broccoli, 1/2 cup		1			
Milk, 1/2 cup				1/2	
Evening Snack					
Whole grain crackers (5)	1				
Cold water, 1/2 cup					
Total Food Group Servings	6	3	2	2	5 oz

Adapted from *Tips for Using the Food Guide Pyramid for Young Children 2 to 6 Years Old*, USDA, Center for Nutrition Policy and Promotion, Washington, DC, 1999, Program Aid 1647.

1994–1996 Continuing Survey of Food Intakes by Individuals (CSFII)

The 1994–1996 CSFII sample consisted of individuals residing in households in the 50 United States, and included an oversampling of the low-income population. Only selected household members were asked to provide intake information. Each individual provided two nonconsecutive days of dietary data obtained by the 24-hour recall method

through in-person interviews.[20] Proxy interviews were conducted routinely for subjects under 6 years of age, and children 6 to 11 years of age were asked to describe their own food intake assisted by an adult household member (referred to as the assistant). The preferred proxy or assistant was the person responsible for preparing the subject's meals.[24]

To determine how the dietary intake of children and adolescents compared with nutrition recommendations, the Healthy Eating Index (HEI) was used to examine the diets of 5354 American children ages 2 to 18 from USDA's 1994–1996 CSFII.[25] The HEI is computed on a regular basis by USDA as a summary measure of people's diet quality. It consists of 10 components, each representing different aspects of a healthful diet. Components 1 to 5 measure the degree to which a person's diet conforms to USDA's Food Guide Pyramid serving recommendations for the five major food groups: grains, vegetables, fruits, milk, and meat/meat alternatives. Components 6 and 7 measure total fat and saturated fat consumption, respectively, as percentages of total kcal intake. Components 8 and 9 measure total cholesterol and sodium intake, respectively. Component 10 measures the degree of variety in a person's diet. Each component has a maximum score of ten and a minimum score of zero. High component scores indicate intakes close to recommended ranges or amounts; low component scores indicate less compliance with recommended ranges or amounts. The maximum combined score for the 10 components is 100. An HEI score above 80 implies a good diet, a score between 51 and 80 implies a diet that needs improvement, and a score less than 51 implies a poor diet.[25]

Results indicate that most children have a diet that is poor or needs improvement. As children get older, their overall HEI score declines; thus, the percentage of children with a diet that needs improvement or is poor increases, and the percentage of children with a good diet declines. For children ages 2 to 3, 35% have a good diet, and 5% have a poor diet. For boys 15 to 18 years old, only 6% have a good diet, and 21% have a poor diet. The decline in diet quality begins between the 2-3 and 4-6 age groups, with the percentage of children having a good diet falling from 35 to 16%, and the percentage having a diet that needs improvement rising from 60 to 75%. The decline continues between the 7-10 and 11-14 age groups, with the percentage of children having a good diet falling from 14 to 7%. As indicated by the HEI component scores in Table 8.11, the decline in the quality of children's diets as they get older is linked to declines in their fruit and milk consumption. Fifty-three percent of children ages 2 to 3 meet the recommendation for fruit compared to only 11 to 12% of children ages 15 to 18. Although 44% of children ages 2 to 3 meet the recommendation for milk, only 12 and 28% of girls and boys, respectively, ages 15 to 18, do so. Except for cholesterol and variety to a smaller extent, most children do not meet most recommendations.[25]

Further analyses of data from the 1994–1996 CSFII indicated that the quality of a child's diet is related to the income of his or her family.[26] As indicated in Table 8.12, poor children are less likely than nonpoor children to have a diet rated as good. For children ages 2-5, 19% of those in a poor household had a good diet compared to 28% of those in a nonpoor household.

Data from the 1994–1996 CSFII were also analyzed to determine whether carbonated soft drink consumption was associated with consumption of milk, fruit juice, and the nutrients concentrated in these beverages among children and adolescents age 2-18 years (n = 1810).[27] Results indicated that adolescents (13-18 years) were more likely to consume soft drinks than preschool-age children (2-5 years) and school-age children (6-12 years). Among preschool-age children, school-age children, and adolescents, 49.5, 35.9, and 17.5%, respectively, did *not* consume any soft drinks during the two days of dietary recall; furthermore, the majority of children in each age category were nonconsumers of diet soft

TABLE 8.11

Healthy Eating Index (HEI): Overall and Component Mean Scores for Children, 1994–1996[a,b]

Age (years)	Children 2–3	Children 4–6	Children 7–10	Girls 11–14	Boys 11–14	Girls 15–18	Boys 15–18
Overall HEI Score	73.8	67.8	66.6	63.5	62.2	60.9	60.7
1. Grains	8.3	7.2	7.6	6.7	7.2	6.3	7.5
	(54)	(27)	(31)	(16)	(29)	(17)	(34)
2. Vegetables	5.9	4.9	5.1	5.5	5.4	5.8	6.3
	(31)	(16)	(20)	(24)	(23)	(26)	(35)
3. Fruits	7.0	5.3	4.3	3.9	3.5	3.1	2.8
	(53)	(29)	(18)	(14)	(9)	(12)	(11)
4. Milk	7.2	7.4	7.6	5.2	6.2	4.2	6.1
	(44)	(44)	(49)	(15)	(27)	(12)	(28)
5. Meat	6.3	5.3	5.5	5.7	6.5	5.8	6.9
	(28)	(14)	(17)	(15)	(28)	(21)	(36)
6. Total fat	7.4	7.3	7.2	7.2	6.8	7.1	6.8
	(40)	(38)	(35)	(37)	(33)	(38)	(34)
7. Saturated fat	5.4	5.6	5.7	5.8	5.7	6.6	6.0
	(27)	(28)	(28)	(31)	(32)	(42)	(35)
8. Cholesterol	9.0	8.9	8.7	8.5	7.6	8.4	6.7
	(83)	(83)	(80)	(78)	(69)	(77)	(58)
9. Sodium	8.8	8.1	6.8	7.1	5.2	6.9	3.7
	(64)	(53)	(34)	(39)	(21)	(37)	(15)
10. Variety	8.4	7.9	8.1	7.8	8.1	6.7	7.8
	(64)	(53)	(54)	(51)	(58)	(37)	(51)

[a] Parentheses contain % of children meeting dietary recommendations for each component.

[b] From *Report Card on the Diet Quality of Children*. Nutrition Insights, Insight 9, October, 1998, issued by the Center for Nutrition Policy and Promotion, USDA, http://www.usda.gov/cnpp (accessed July 21, 1999).

TABLE 8.12

Percentage of Children Ages 2 to 18 by Age, Poverty Status, and Diet Quality as Measured by the Healthy Eating Index, Three-Year Average 1994–1996

Characteristic	Good Diet[a]	Needs Improvement[a]	Poor Diet[a]
Ages 2-5			
At or below poverty	19	70	11
Above poverty	28	65	7
Ages 6-12			
At or below poverty	10	78	12
Above poverty	12	78	10
Ages 13-18			
At or below poverty	3[b]	72	25
Above poverty	7	74	19

[a] A Healthy Eating Index (HEI) score above 80 implies a good diet, a score between 51 and 80 implies a diet that needs improvement, and a score less than 51 implies a poor diet.

[b] Sample size relatively small to make reliable comparisons.

Adapted from Federal Interagency Forum on Child and Family Statistics, *America's Children: Key National Indicators of Well-Being, 1999.* Federal Interagency Forum On Child and Family Statistics, Washington, DC, US Government Printing Office. The report is also available on the World Wide Web: http://childstats.gov.

drinks (94.9, 89.0, and 85.9%, respectively). White preschool-age children and adolescents were more likely to consume soft drinks than black preschool-age children and adolescents. Among adolescents, boys were more likely than girls to consume soft drinks. Among preschool-age children and adolescents, those who resided in central city metropolitan statistical areas (within a metropolitan area containing the largest population) were more likely to consume soft drinks than those residing in noncentral city metropolitan statistical areas (within a metropolitan area not containing the largest population). No significant differences in soft drink consumption were found by poverty status or region of the country. In general, soft drink consumption was inversely associated with consumption of milk, fruit juice, and the nutrients concentrated in these beverages. For all age groups, energy intake was higher among those in the highest soft drink consumption category compared with nonconsumers. These results indicate that nutrition education messages for children and/or their parents should encourage limited consumption of soft drinks.[27]

1994–1996 and 1998 Continuing Survey of Food Intakes by Individuals (CSFII)

The Supplemental Children's Survey to the 1994–1996 CSFII (CSFII 1998) was conducted to add intake data from 5559 children age birth through 9 years to the intake data collected from 4253 children of the same age who participated in the CSFII 1994–1996. The CSFII 1998 was designed to be combined with the CSFII 1994–1996; thus, approaches to sample selection, data collection, data file preparation, and weighting were consistent.[28]

Analyses of data from the 1994–1996 and 1998 CSFII provide some of the most recent insight into the dietary intake of children and adolescents nationwide. Tables 8.13 through 8.17 include national probability estimates based on all four years of the CSFII (1994–1996 and 1998) for children ages 9 years and under, and on CSFII 1994–1996 only for individuals age 10 years and over.[28] As indicated in Table 8.13, mean intakes as percentages of the 1989 RDAs meet or exceed the RDAs for most nutrients for both girls and boys of all ages. The most notable exception is for calcium for girls ages 12 to 19 years, for which mean intake as a percentage of the RDA for this group is only 64%, down from 102% for girls ages 6 to 11 years. As indicated in Table 8.14, the percentages of children with diets meeting 100% of the 1989 RDAs is around or below 50% for energy, vitamin E, and zinc for both boys and girls, and for vitamin A and calcium for girls. For all nutrients for all ages of children, the percentages of children with diets meeting 100% of the 1989 RDAs is higher for males than females. Furthermore, in general, the percentages of children with diets meeting 100% of the 1989 RDAs decreases as children get older, especially between the 6-11 and 12-19 year age groups, and more so for girls than boys. As indicated in Table 8.15, the mean percentages of kcal from protein, total fat, saturated fat, and carbohydrate in the diets of children and adolescents closely follows nutrition recommendations. However, as indicated in Table 8.16, although the diets of many children do meet recommendations for cholesterol, most children do not meet recommendations for total fat or saturated fat. Breakfast consumption declines as children get older; ~97% of children ages 2 to 5 years eat breakfast, compared to ~93% of children ages 6 to 11 years and ~76% of children ages 12 to 19 years (data not shown). Although ~80% of children of all ages from 2 to 18 years consume vegetables, the percentages of children consuming fruits and fruit juices declines as children get older, from ~73% for children ages 2 to 5 years to ~59% for children ages 6 to 11 years, to ~45% for children ages 12 to 19 years (data not shown).[28]

TABLE 8.13

Nutrient Intakes: Mean Intakes as Percentages of the 1989 Recommended Dietary Allowances Intakes by Individuals 1994–1996, 1998

Sex and Age (Years)	Sample Size	Food Energy	Protein	Vitamin A (μg RE)	Vitamin E	Vitamin C	Thiamin	Riboflavin	Niacin
	Number			Percentages of 1989 RDA					
Boys & Girls									
1–2	2118	102	307	185	79	257	161	213	142
3–5	4574	103	281	179	88	240	170	193	155
Boys									
6–9	787	103	258	147	98	227	175	190	164
6–11	1031	101	244	139	96	226	172	186	161
12–19	737	99	184	108	93	213	150	155	148
Girls									
6–9	704	91	227	127	89	214	150	162	139
6–11	969	91	214	121	91	208	149	160	138
12–19	732	87	145	100	88	171	131	135	126

Adapted from USDA, Agricultural Research Service, *Food and Nutrient Intakes by Children 1994–96, 1998*, 1999, bhnrc/foodsurvey/home.htm (accessed December 22, 1999).

(RDAs), by Sex and Age, Children 19 Years of Age and Under, One Day, Continuing Survey of Food

Sex and Age (Years)	Vitamin B_6	Folate	Vitamin B_{12}	Calcium	Phosphorus	Magnesium	Iron	Zinc	Selenium
	Number			Percentages of 1989 RDA					
Boys & Girls									
1–2	130	396	457	107	121	234	108	74	299
3–5	144	424	421	108	136	204	132	92	375
Boys									
6–9	136	319	337	122	159	156	158	109	334
6–11	133	298	326	116	152	146	161	107	318
12–19	117	180	292	95	136	92	169	96	263
Girls									
6–9	115	237	307	106	138	140	136	94	297
6–11	114	248	283	102	134	129	130	93	276
12–19	104	138	190	64	92	77	91	82	178

Online, ARS Food Surveys Research Group, available on the "Products" page at http://www.barc.usda.gov/

TABLE 8.14

Nutrient Intakes: Percentage of Children with Diets Meeting 100% of the 1989 Recommended Dietary Individuals 1994–1996, 1998

Sex and Age (Years)	Sample Size	Food Energy	Protein	Vitamin A (μg RE)	Vitamin E	Vitamin C	Thiamin	Riboflavin	Niacin
	Number			Percentage of Children					
Boys & Girls									
1–2	2023	45.1	98.9	78.5	19.0	81.4	85.7	95.1	71.8
3–5	4386	44.6	99.1	75.5	25.2	79.6	89.6	93.1	82.7
Boys									
6–9	758	46.3	98.7	66.3	35.5	77.4	93.4	93.5	87.2
10–11	991	42.9	97.8	63.2	33.4	78.3	90.2	92.2	86.0
12–19	696	39.4	90.4	35.9	35.4	67.5	76.0	76.8	75.8
Girls									
6–9	665	26.3	98.9	53.5	28.0	77.8	83.4	85.7	77.0
10–11	922	27.9	95.3	50.4	27.7	75.1	80.5	83.8	74.7
12–19	702	25.2	76.2	30.6	24.0	57.7	68.0	64.4	61.9

Adapted from USDA, Agricultural Research Service, *Food and Nutrient Intakes by Children 1994-96, 1998*, 1999, bhnrc/foodsurvey/home.htm (accessed December 22, 1999).

Allowances (RDAs), by Sex and Age, Two-Day Average, Continuing Survey of Food Intake by

Sex and Age (Years)	Vitamin B_6	Folate	Vitamin B_{12}	Calcium	Phosphorus	Magnesium	Iron	Zinc	Selenium
	Number			Percentage of Children					
Boys & Girls									
1–2	65.5	99.0	99.0	49.9	65.6	97.4	44.5	15.2	97.9
3–5	75.7	99.1	98.0	48.4	75.3	95.2	65.7	30.4	99.7
Boys									
6–9	68.9	96.6	97.9	63.0	89.9	85.6	82.9	49.6	99.4
10–11	67.9	95.5	97.8	57.2	83.3	77.2	81.6	47.0	99.1
12–19	53.8	73.2	92.5	36.2	72.9	33.4	83.2	34.6	97.4
Girls									
6–9	56.1	95.6	96.9	47.3	78.9	80.2	69.5	32.7	99.3
10–11	55.1	90.6	93.9	43.2	73.1	68.3	61.5	31.9	98.3
12–19	42.4	58.3	73.9	13.4	33.6	17.8	27.5	23.9	86.4

Online, ARS Food Surveys Research Group, available on the "Products" page at http://www.barc.usda.gov/

TABLE 8.15

Nutrient Intakes: Mean Percentage of Calories from Protein, Total Fat, Saturated Fat, and Carbohydrate, by Sex and Age, One-Day, Continuing Survey of Food Intakes by Individuals 1994–1996, 1998

Sex and Age (Years)	Sample Size Number	Protein	Total Fat	Saturated Fat	Carbohydrate
		Percentage of kcal			
Boys & Girls					
1–2	2118	14.8	32.4	13.3	54.3
3–5	4574	14.2	32.2	12.1	55.2
Boys					
6–9	787	14.0	32.5	12.0	54.9
6–11	1031	14.0	32.6	12.0	54.8
12–19	737	14.4	33.1	11.7	53.2
Girls					
6–9	704	13.9	32.4	11.9	55.2
6–11	969	13.9	32.6	11.9	54.9
12–19	732	14.0	32.2	11.3	55.0

Adapted from USDA, Agricultural Research Service, *Food and Nutrient Intakes by Children 1994-96, 1998*, 1999, Online, ARS Food Surveys Research Group, available on the "Products" page at http://www.barc.usda.gov/bhnrc/foodsurvey/home.htm (accessed December 22, 1999).

TABLE 8.16

Nutrient Intakes: Percentage of Children with Diets Meeting Recommendations for Total Fat, Saturated Fatty Acids, and Cholesterol, by Sex and Age, Two-Day Average, Continuing Survey of Food Intakes by Individuals 1994–1996, 1998

Sex and Age (Years)	Sample Size	Total Fat Intake at or below 30% of kcal	Saturated Fatty Acid Intake below 10% of kcal	Cholesterol Intake at or below 300 Milligrams
		Percentage of Children		
Boys & Girls				
1–2	2023	34.2	18.2	85.5
3–5	4386	33.0	22.6	84.6
Boys				
6–9	758	30.5	22.5	80.4
10–11	991	31.3	24.9	79.1
12–19	696	30.4	27.6	55.9
Girls				
6–9	665	32.6	23.4	86.2
10–11	922	33.5	24.5	85.5
12–19	702	35.4	33.5	80.9

Adapted from USDA, Agricultural Research Service, *Food and Nutrient Intakes by Children 1994-96, 1998*, 1999, Online, ARS Food Surveys Research Group, available on the "Products" page at http://www.barc.usda.gov/bhnrc/foodsurvey/home.htm (accessed December 22, 1999).

Vitamin-Mineral Supplements

According to the Food and Nutrition Board, the "RDAs can typically be met or closely approximated by diets that are based on the consumption of a variety of foods from diverse food groups that contain adequate energy."[1,29] According to the American Dietetic Association,[30] children can best achieve healthful eating habits by consuming a varied diet in moderation[10] that includes foods from each of the major food groups, as illustrated by the Food Guide Pyramid.[18] Routine supplementation is not necessary for healthy growing children who consume a varied diet, according to the American Academy of Pediatrics.[31] If parents wish to give supplements to their children, a standard pediatric vitamin-mineral product with nutrients in amounts no larger than the RDA may be given. Megadose levels should be discouraged due to potential toxic effects. Parents should be cautioned to keep vitamin-mineral supplements out of the reach of children because the taste, shape, and color of most pediatric preparations make them quite appealing to children.

Although the American Academy of Pediatrics advocates that routine vitamin-mineral supplementation is not necessary for healthy growing children who eat a varied diet, it does identify five groups of children at nutritional risk who may benefit from supplementation.[31] These groups are identified in Table 8.17. Dietary intake over several days should be assessed by a Registered Dietitian to determine if an individual child from one of these groups needs to take a supplement.

TABLE 8.17

Five Groups of Children at Nutritional Risk Who May Benefit from Vitamin-Mineral Supplementation

- Children from deprived families or who suffer parental neglect or abuse
- Children with anorexia or an inadequate appetite or who consume a fad diet
- Children with chronic disease (e.g., cystic fibrosis, inflammatory bowel disease, hepatic disease)
- Children who participate in a dietary program for managing obesity
- Children who consume a vegetarian diet without adequate dairy products

From Committee on Nutrition, American Academy of Pediatrics, Feeding from Age One Year to Adolescence, *Pediatric Nutrition Handbook*, 4th ed., Kleinman, R. E., Ed., American Academy of Pediatrics, Elk Grove Village, IL, 1998, pg 125, with permission.

Development of Preschool Children's Food Preferences and Consumption Patterns

Widespread evidence indicates that the nutrition guidelines are not being followed by most children. For example, most children consume far too few fruits and vegetables,[22,32-34] and the majority of children still exceed daily recommendations for total fat, saturated fat, and cholesterol.[35] Furthermore, the incidence of childhood obesity has increased dramatically during the last three decades.[36,37] To help understand why children eat less of what is recommended by nutrition guidelines and more of what is not recommended, and why the incidence of childhood obesity is increasing, Birch and Fisher[38] recommend that consideration be given to factors that impact children's food preferences and con-

sumption patterns. Extensive evidence suggests that children's food preferences are shaped by early experience with food and eating, and that family environment and practices used by parents and other adults (e.g., school staff) may permanently affect dietary practices of children.[39] Birch and colleagues[40] have repeatedly found that exposure to food, as well as the social environment in which it is eaten, are crucial in the development of preschool children's food preferences and consumption patterns. Research indicates that children's food preferences are major determinants of consumption;[41-45] therefore, not eating certain items (such as vegetables) is related to low preferences. Furthermore, research indicates that preschool children's preferences for dietary fat are related to their levels of body fat.[45]

Learning to Eat

During the first years of life, an enormous amount of learning about food and eating occurs as infants transition from consuming only milk to consuming a variety of foods,[38] and from eating when depleted or hungry to eating due to a variety of social, cultural, environmental, and/or physiological cues.[46] According to Birch and Fisher,[38] this transition from univore to omnivore is shaped by the infant's innate preference for sweet and salty tastes and the rejection of sour and bitter tastes,[47] and by the predisposition of infants and children to be neophobic or to reject new foods.[48] A child's experience with food and flavors is shaped beginning with the parents' decision to breastfeed or formula-feed.[38] Limited research indicates that breastfed infants eat more of new foods than formula-fed infants, which suggests that the varied flavors in breastmilk facilitate the breastfed infant's acceptance of new foods during the weaning period.[49]

Exposure to Food and Preschool Children's Food Preferences and Consumption

Table 8.18 includes three studies by Birch and colleagues[50-52] which indicate that preschool children's neophobia or rejection of new foods can be overcome by exposure. Results from

TABLE 8.18

Research Concerning Exposure to Food and Preschool Children's Food Preferences and Consumption

Reference	Authors and Year	Subjects	Study Design	Results
50	Birch and Marlin, 1982	14 two-year-olds	Each child received 2-20 exposures to 5 novel fruits or cheeses over 25-26 days	Later, children ate more of items with higher exposures when given pairs of items and asked to taste both and pick one to eat more of
51	Birch et al., 1987	43 children in 3 age groups: 26, 38, or 64 months old	Each child received 5, 10, or 15 exposures to 7 new fruits; asked to taste some and look at others	For all age groups, preferences increased significantly only when foods were tasted
52	Sullivan and Birch, 1990	39 children, 4-5 years old	Each child tasted 1 of 3 versions of tofu (sweetened, salty, or plain) 15 times over several weeks	Preferences increased with exposure regardless of added sugar, salt, or plain; 10 exposures needed

these studies indicate that preschool children's food preferences are learned through repeated exposure to foods.

Social Environment of Eating and Preschool Children's Food Preferences and Consumption

Although exposure and availability are necessary for children to learn to accept new foods, the social environment of eating is also important. Children learn about what to eat and why to eat, and receive reinforcements and incentives for eating from their families and the larger environment.[53] Most of this learning occurs during routine mealtime experiences, in the absence of formal teaching.[40] For example, adults who want children to eat healthful foods (e.g., vegetables) may bribe children with rewards for eating healthful foods. However, research indicates that such practices actually lead children to dislike the healthful foods, which is not what adults intend. The five studies[54-58] included in Table 8.19 indicate the importance of the social environment of eating and food contingencies (i.e., "if you eat __, then you can __") on preschool children's food preferences and consumption. Results from another study of influential factors of caregiver behavior at lunch in early child-care programs indicated that although caregivers believed they positively influenced children's eating behaviors, observed behaviors of caregivers at mealtimes were inconsistent with expert recommendations.[59]

Adult Influences on Preschool Children's Ability to Self-Regulate Caloric Intake

Infants are born with the ability to self-regulate their kcal intake by adjusting their formula intake when the kcal level of the formula changes[60] and when solid foods are added.[61] Preschool children are able to adjust the kcal eaten in a snack or meal, based on the kcal eaten in a preload snack.[62,63] Furthermore, preschool children are able to adjust the kcal eaten at various meals and snacks during the day so that the number of kcal consumed in a 24-hour period is relatively constant.[64] Although children have the ability to self-regulate their kcal intake, the two studies[65,66] included in Table 8.20 indicate that this ability may be negatively impacted by child-feeding practices that encourage or restrict children's eating. Using observations of family meal times, Klesges and colleagues[67] found that parental prompts, especially encouragements to eat, were highly correlated to preschool children's relative weight, and increased the probability that a child would eat. Furthermore, a child's refusal to eat usually led to a parental prompt to eat more food, whereas a child's food request was not likely to elicit either a parental prompt to eat or subsequent eating by the child.

According to Birch,[46] child feeding practices that encourage children to eat in response to external cues instead of internal cues regarding hunger and satiety "may form the basis for the development of individual differences in styles of intake control that exist among adults. Some of the problems of energy balance seen in adulthood may result from styles of intake control in which hunger and satiety cues are not particularly central." According to the American Dietetic Association,[30] "perhaps some of the best advice regarding child feeding practices continues to be the division of parental and child responsibility advocated by Satter." Satter advocates that parents (or adults) are responsible for presenting a variety of nutritious and safe foods to children at regular meal- and snack-times, as well as the physical and emotional setting of eating; children are responsible for deciding how much, if any, they will eat.[68,69]

TABLE 8.19

Research Concerning Social Environment of Eating and Preschool Children's Food Preferences and Consumption

Reference	Authors and Year	Subjects	Study Design	Results
54	Birch et al., 1980	64 children, 3-4 years old; 16 per context	Children given sweet or nonsweet foods (with initially neutral preferences) over several weeks in 1 of 4 contexts: 1) as reward for behavior, 2) paired with adult greeting, 3) as nonsocial behavior (put in child's locker), or 4) at snack time	Preferences increased when foods presented as rewards, or paired with adult greeting; effects lasted longer than 6 weeks after contexts ended; suggest positive social contexts can be used to increase preferences for foods not liked but more nutritious
55	Birch et al., 1982	12 children, 3-5 years old	Children told if they drank juice, then they could play	Instrumental ("if") use of juice reduced preferences for it
56	Birch et al., 1984	31 children, 3-5 years old	Children told if they drank milk drink, then they received verbal praise or a movie	Instrumental ("if") use of milk beverage reduced preferences for it
57	Newman and Taylor, 1992	86 children, 4-7 years old	Children told that if they ate one snack, then they could eat another snack (with both of neutral preference initially)	"If" snacks became less preferred and "then" snacks became more preferred
58	Hendy, 1999	64 preschool children	To encourage acceptance of 4 new fruits and vegetables during 3 preschool lunches, teachers used 1 of 5 actions: 1) choice-offering ("Do you want any of this?"), 2) reward (special dessert), 3) insisting children try one bite, 4) modeling by teacher, or 5) simple exposure	Choice-offering and reward were more effective than other actions; Hendy concluded that dessert rewards are not needed because the less expensive and more nutritious action of choice-offering works as well

Feeding Toddlers and Preschool Children

Young children cannot innately choose a well-balanced diet. They depend on adults to offer them a variety of nutritious and developmentally appropriate foods. A child's intake at individual meals may vary considerably, but the total daily caloric intake remains fairly constant.[64] Many parents become anxious about the adequacy of their young child's diet or frustrated with their child's unpredictable eating behavior which may include refusals

TABLE 8.20

Research Concerning Adult Influences on Preschool Children's Ability to Self-Regulate Caloric Intake

Reference	Authors and Year	Subjects	Study Design	Results
65	Birch et al., 1987	22 children, 4 years old	Flavored pudding preload of different kcal followed by ad lib snacks; children encouraged to focus on either internal cues (hunger, satiety) or external cues (time of day, amount left, rewards)	Only children encouraged to focus on internal cues showed sensitivity to kcal density of preload by decreasing kcal eaten in snack after preload that was high in kcal (and vice versa)
66	Johnson and Birch, 1994	77 children, 3-5 years old	Preload snacks of different kcal followed by ad lib foods; children's body fat measured; mothers completed questionnaire regarding their degree of control of what and how much their children ate	Children with greater body fat stores were less able to regulate kcal consumption in response to alterations in preload snacks; more controlling mothers had children who showed less ability to self-regulate ($r = 0.67$).

to eat certain foods, and food jags. Parents may resort to feeding tactics such as bribery, clean your plate rules, struggles, or short-order cooking to encourage their child to eat. A more healthful approach is Satter's division of feeding responsibility (see "Adult Influences on Preschool Children's Ability to Self-Regulate Caloric Intake" in this section). Table 8.21 contains suggestions for concerns parents commonly encounter when feeding young children. Table 8.22 contains healthful eating tips to use with young children.

Snacks

Most young children fare best when fed four to six times a day, due to their smaller stomach capacities and fluctuating appetites. Snacks should be considered minimeals by contributing to the total day's nutrient intake. Snacks generally accepted by many children include fresh fruit, cheese, whole-grain crackers, breads (e.g., bagels, tortilla), milk, raw vegetables, 100% fruit juices, sandwiches, peanut butter on crackers or bread, and yogurt.

Choking

Young children should always be watched while eating meals and snacks because they are at risk for choking on food. Children remain at risk for choking on food until around age four years when they can chew and swallow better. Foods most likely to cause problems include ones that are hard, round, and do not readily dissolve in saliva. Table 8.23 contains a list of foods that may cause choking, along with some tips to decrease young children's risk of choking. Any food can cause choking if the child is not supervised while eating, if the child runs while eating, or if too much food is stuffed in the mouth.

TABLE 8.21

Suggestions for Concerns Parents Commonly Encounter when Feeding Children

If a child refuses to try new foods

- Remember, this is normal! Continue to offer each new food twice per week for a total of 10-12 times.
- Serve a new food with familiar ones.
- Ask the child if s/he would like to try some of the new food, but avoid forcing or bribing the child to eat the new food. Be an effective role model and eat some of the new food yourself.
- Involve the child in shopping for and preparing the new food.

If a child refuses to eat what is served

- Remember, children may have strong likes and dislikes, but this does *not* mean they need to be served different foods than the rest of the family.
- Allow the child to choose from the foods available at a meal what s/he will eat, but avoid forcing or bribing him/her to eat.
- Include at least one food at each meal that you know your child will eat, but do not cater to a child's likes or dislikes. Avoid becoming a short-order cook. The less attention paid to this behavior, the better.

If a child is stuck on a food jag or wants to eat the same food over and over

- Children may want to eat only one or two foods day after day, meal after meal; common food jags occur with peanut butter and jelly sandwiches, pizza, macaroni and cheese, and dry cereal with milk.
- Relax, and realize this is normal and temporary. Refuse to call attention to the behavior.
- Continue to offer regular meal, but do not force or bribe the child to eat it.
- Serve the food jag item as you normally would (maybe once or twice a week).

If a child refuses to eat meat

- Tough meat is often difficult for children to chew. Offer bite-size pieces of tender, moist meat, poultry, or fish.
- Use meat in casseroles, meatloaf, soup, spaghetti sauce, pizza, or burritos.
- Try other high-protein foods such as eggs, beans, and peanut butter.

If a child refuses to drink milk

- Offer cheese, cottage cheese, yogurt, or pudding either alone or in combination dishes (such as macaroni and cheese, pizza, cheese sauce, banana pudding).
- Use milk when cooking hot cereals, scrambled eggs, macaroni and cheese, soup, and other recipes.
- Use calcium-fortified juices.

If a child refuses to eat vegetables and fruits

- Offer more fruits if a child refuses vegetables, and vice versa.
- Avoid over-cooking vegetables; serve vegetables steamed or raw (if appropriate). Include dips or sauces (e.g., applesauce with broccoli or carrots).
- Include vegetables in soups and casseroles.
- Continue to offer a variety of fruits and vegetables.

If a child eats too many sweets

- Avoid using sweets as a bribe or reward.
- Limit the purchase and preparation of sweet foods in the home.
- Incorporate sweets into meals instead of snacks for better dental health.
- Try using fruit as dessert.

Adapted from Lucas, B., Normal Nutrition from Infancy through Adolescence, *Handbook of Pediatric Nutrition*, Queen, P. M., Lang, C. E., Eds., Aspen, Gaithersburg, MD, 1993, pg 145.

TABLE 8.22

Healthful Eating Tips to Use with Young Children

Be Patient

Because young children are often afraid to try new foods...
- Offer a new food more than once; food may be accepted when it becomes familiar to the child.
- Offer new foods in small "try me" portions (one to two tablespoons) and let the child ask for more.
- Show the child how the rest of the family enjoys the new food.

Be a Planner

Most children need three regular meals plus one or two snacks each day.
- For breakfast and lunch, offer foods from three or more of the five pyramid food groups.
- For the main meal, offer foods from four or more of the five pyramid food groups.
- For snacks, offer foods from two or more of the five pyramid food groups. Make sure that snacks are not served too close to mealtime.

Be a Healthful Role Model

Remember, what you *do* can mean more than what you *say*.
Children learn about how and what to eat from routine eating experiences.
- Eat meals with children whenever possible.
- Try new foods and new preparation methods.
- Walk, run, and play with children instead of just watching them.

Be Adventurous

- Take children grocery shopping and let them choose a new vegetable or fruit from two or three choices.
- Have a weekly "family try-a-new-food" night.
- At home, allow children to help you wash and prepare food.

Be Creative

- Encourage children to invent a new snack or sandwich from three or four healthful ingredients you provide.
- Try a new bread or whole grain cracker.
- Talk about food groups in the new snack or sandwich, how they taste — smooth, crunchy, sweet, juicy, chewy, and how colorful the items are.

Adapted from *Tips for Using Food Guide Pyramid for Young Children*, USDA, Center for Nutrition Policy and Promotion, Washington, DC, 1999, Program Aid 1647.

Excessive Fruit Juice Consumption

Fruit juice, especially apple, is a common beverage for young children. Although fruit juice is a healthful, low-fat, nutritious beverage, there are some health concerns regarding excessive fruit juice consumption by young children. For example, drinking fruit juice helps fulfill nutrition recommendations to eat more fruits and vegetables. However, as children increase their intake of fruit juices, they may decrease their intake of milk,[70] which can decrease their intake of calcium unless the juice is calcium-fortified. This is a concern because results from the CSFII 1994–1996, 1998 indicated that only ~50% of children ages one to five years met the 1989 RDAs for calcium.[28] Carbohydrate malabsorption is common following the ingestion of several fruit juices in young children with chronic nonspecific diarrhea as well as in healthy young children.[71] In 1991, a policy statement by the Committee on Nutrition of the American Academy of Pediatrics recommended that parents be cautioned about young children's potential gastrointestinal problems associated with the ingestion of excessive amounts of juices containing sorbitol (e.g., apple, pear, and prune), which is a naturally occurring but nonabsorbable sugar alcohol.[72] Excess fruit juice

TABLE 8.23

Choking in Young Children

Foods that May Cause Choking in Young Children

- frankfurters (hot dogs)
- chunks of meat
- nuts and seeds
- peanut butter (spoonful)
- raisins
- whole grapes
- cherries with pits
- large pieces of fruit
- raw carrots or celery
- popcorn
- chips
- pretzels
- marshmallows
- round or hard candy

Tips to Decrease Young Children's Risk of Choking

- Cut frankfurters lengthwise into thin strips.
- Cook carrots or celery until slightly soft and then cut into sticks.
- Cut grapes or cherries into small pieces.
- Spread a thin layer of peanut butter on a cracker instead of allowing young children to eat peanut butter from a spoon.
- Insist that young children sit down while eating so they can concentrate on chewing and swallowing.
- Always watch young children while they eat meals and snacks.
- Discourage allowing a young child to eat in the car if the only adult present is driving because it may be difficult for the adult to quickly aide a choking child.

Adapted from *Tips for Using the Food Guide Pyramid for Young Children 2 to 6 Years Old*, USDA, Center for Nutrition Policy and Promotion, Washington, DC, 1999, Program Aid 1647.

consumption may present a contributing factor in nonorganic failure to thrive.[73] Drinking 12 or more fluid ounces of fruit juice per day is associated with short stature and with obesity in young children;[74] thus, it is recommended that parents and caretakers limit young children's consumption of fruit juice to less than 12 ounces per day.[70,74]

Low-Fat Diets

Emphasis regarding low-fat, low-cholesterol diets has increased during the past decade, as has the debate over whether low-fat diets are appropriate for children.[75-80] Parental concern about later atherosclerosis or obesity has led to failure to thrive in some infants age 7 to 22 months who were fed very low-fat, calorie-restricted diets.[81] The American Academy of Pediatrics Committee on Nutrition supports recommendations that children older than two years follow a diet with a maximum of 30% of calories from fat and no more than 300 mg of cholesterol per day.[9] (Ages two to five years represent a transition between the higher fat intake during infancy and the population-based recommended fat intake). Nonfat and low-fat milks are not recommended for use during the first two years of life.

The Special Turku coronary Risk factor Intervention Project for Babies (STRIP Baby Trial) evaluated the effects of a low-saturated fat diet on growth during the first three years of life in 1062 healthy infants who were randomized at age seven months into an intervention group (n = 540) or control group (n = 522).[82] The intervention consisted of individualized dietary counseling provided to parents at one- to six-month intervals to reduce risk factors to atherosclerosis. Results indicated that mean fat intake of children in both groups was lower than expected, especially during the first two years of life. The true mean of the height of intervention boys was at most 0.34 cm more or 0.57 cm less, and the weight was at most 0.19 kg more or 0.22 kg less than that of control boys. The respective values for girls were at most 0.77 cm more or 0.16 cm less and at most 0.42 kg more or 0.04 kg less.

Furthermore, there were similar numbers of slim children in both groups. The authors concluded that a supervised, low-saturated fat, low-cholesterol diet had no influence on growth of children in the study between 7 and 36 months of age.[82] Follow-up analyses were conducted on intervention and control children who were followed for more than two years (n = 848) to study the fat and energy intakes of children with different growth patterns. Results indicated that relative fat intakes (as percent of energy intake) were similar in children showing highly different height gain patterns. Furthermore, children with consistently low fat intake grew equally to the children with higher fat intake. The authors concluded that moderate supervised restriction of fat intake to values between 25 and 30% of kcal is compatible with normal growth in children ages 7 to 36 months.[83]

The safety and efficacy of lower fat diets in pubertal children have been indicated by results from the Dietary Intervention Study in Children (DISC). The three-year, six-center randomized controlled trial involved 663 children; at baseline, boys (n = 362) and girls (n = 301) had a mean age of 9.7 and 9.0 years, respectively.[84] An intervention group (n = 334) followed a diet with 28% of kcal from total fat, ~10% of kcal from saturated fat, and 95 mg/day of cholesterol. A comparable usual care group (n=329) consumed ~33% of kcal from total fat, ~12% of kcal from saturated fat, and 113 mg/day of cholesterol. The intervention group had significant but modestly lower levels of LDL-cholesterol and maintained a psychologic well-being; however, there were no differences in height, weight, or serum ferritin levels in the two groups. The authors concluded that a properly designed dietary intervention is effective in achieving modest lowering of LDL cholesterol levels over three years while maintaining adequate growth, iron stores, nutritional adequacy, and psychological well-being during the critical growth period of adolescence. Furthermore, "an important public health inference from the DISC results is that current dietary recommendations for healthy children, which are less restricted in total fat than the DISC diet, can be advocated safely, particularly when children are under health care that follows their growth and development."[84] Follow-up analyses were conducted to assess the relationship between energy intake from fat and anthropometric, biochemical, and dietary measures of nutritional adequacy and safety.[85] Results indicated that lower fat intakes during puberty were nutritionally adequate for growth and maintenance of normal levels of nutritional biochemical measures; furthermore, they were associated with beneficial effects on blood folate and hemoglobin. Lower fat diets were related to lower self-reported intakes of several nutrients (i.e., calcium, zinc, magnesium, phosphorus, vitamin B_{12}, thiamin, niacin, and riboflavin); however, no adverse effects were observed on blood biochemical measures of nutritional status. The authors concluded that "current public health recommendations for moderately lower fat intakes in children during puberty may be followed safely."[85]

Further evidence regarding the safety and efficacy of lower fat diets in upper elementary school children (third through fifth grades) has been provided by the Child and Adolescent Trial for Cardiovascular Health (CATCH), which is described more fully later in this section. Results from CATCH failed to indicate any evidence of deleterious effects of the three-year intervention on growth or development of children who were third-graders at the beginning of the intervention.[86]

Group Feeding

Many young children spend some or most days away from home in child care centers, preschools, Head Start programs, or home child care centers, where they may eat up to two meals and two snacks daily. Federal and state regulations or guidelines exist for food service in child care centers, Head Start programs, and preschool programs in public

schools. Some centers participate in USDA-sponsored child nutrition programs. When choosing a child care center or preschool, parents should be encouraged to consider the feeding program, including food variety, quality, safety, cultural aspects, and developmental appropriateness. Peer pressure regarding food and eating among preschoolers is evident in a study by Birch which indicated that the food selections and eating behaviors of preschool children influenced the food preferences and eating behaviors of other preschool children.[87]

Portion Sizes

Portion sizes for young children are small, especially when compared with adult portions. A rule-of-thumb method is to initially offer one tablespoon of each food for every year of age for preschool children; more food may be provided according to appetite.

Limited research indicates the effects of portion size on children's food intake.[88] Sixteen younger (three years) and 16 older (five years) preschool children participated in three lunches during their usual lunchtime at day-care. Each lunch consisted of macaroni and cheese served in either small, medium, or large portion sizes, along with set portion sizes of carrot sticks, applesauce, and milk. Results indicated that older preschoolers consumed more macaroni and cheese when served the large portion compared to the small portion ($p<0.002$). However, portion sizes did not significantly affect food intake among younger preschoolers. These results indicate the important role of portion size in shaping children's dietary intake, and imply that portion size can either promote or prevent the development of overweight among older preschool children. Furthermore, these results indicate the importance of encouraging preschool children to focus on their own internal cues of hunger and satiety instead of "eating everything to clean the plate."[88]

Feeding School-Age Children

During the school-age years (ages 6-12), steady growth is paralleled by increased food intake. Although children tend to eat fewer times a day, after-school snacks are common. Studies indicate that eating breakfast is related positively to children's cognitive function and school performance, especially for undernourished children (for a review, see Reference 89). Specifically, schoolchildren who had fasted both overnight and in the morning, particularly children who were nutritionally at risk, demonstrated slower stimulus discrimination, increased errors, and slower memory recall.[90] According to Grantham-McGregor, "studies to date have provided insufficient evidence to determine whether children's long-term scholastic achievement is improved by eating breakfast daily."[91]

Although eating breakfast is important, research indicates that between 6 and 16% of elementary school children skip breakfast.[92-94] Furthermore, between 1965 and 1991, breakfast consumption declined significantly for each age group of children (1-4 years, 5-7 years, 8-10 years) and adolescents (11-14 years and 15-18 years), especially for older adolescents age 15-18 years; breakfast was consumed by 89.7% of boys and 84.4% of girls in 1965, and by 74.9 and 64.7%, respectively, in 1991.[95] Children who skip breakfast tend to have a lower kcal intake and consume fewer nutrients than children who eat breakfast.[92,93] During the upper elementary years, children may skip breakfast due to time constraints, because school starts early, due to the responsibility of getting themselves ready in the morning, or simply because they do not feel like eating. When breakfast nutrient consumption

patterns of third graders were examined using baseline data from CATCH, 94% of the 1872 children from 96 public schools in four states reported eating breakfast on the day of the survey.[92] Of the 94% who ate breakfast, 80% ate at home, 13% ate at school, 3% ate at both home and school, and 4% ate breakfast elsewhere.

National School Lunch and Breakfast Programs

One in ten children gets two of their three major meals in school, and more than half get one of their three major meals in school.[96] The National School Lunch Program (NSLP) is a federally assisted meal program available in almost 99% of all public schools and to about 92% of all students in the country.[97] On a typical day, about 58% of the students to whom it is available participate. Regulations stipulate that a NSLP lunch provide one-third of the RDAs for kcal, protein, iron, calcium, and vitamins A and C. Schools may choose one of four systems for planning their menus; two options are based on a computerized nutritional analysis of the week's menu, and the other two options are based on minimum component quantities of meat or meat alternate, vegetables and fruits, grains and breads, and milk.[97]

The School Breakfast Program (SBP) is available to approximately half of the nation's students in more than 70,000 schools.[98] On a typical day, about 7.2 million children participate. Regulations stipulate that a SBP breakfast provide one-fourth of the RDAs for kcal, protein, iron, calcium, and vitamins A and C.[98]

Any child at a participating school may purchase a NSLP lunch or SBP breakfast. Children from families with incomes at or below 130% of the poverty level are eligible for free breakfasts and lunches. Those between 130 and 185% of the poverty level are eligible for reduced-price breakfasts and lunches. The federal government reimburses the schools for each breakfast and lunch that meets SBP and NSLP requirements, respectively.[97,98]

Impact of School Meals on Children's Dietary Intake

The School Nutrition Dietary Assessment Study (SNDAS) collected information on school meals from a nationally representative sample of schools (n=545) and 24-hour recalls from approximately 3350 students from these schools in spring, 1992.[99] Results from the SNDAS regarding dietary intakes of NSLP participants and nonparticipants[100] indicated that 1) NSLP participants had higher lunch intakes of vitamin A, calcium, and zinc, and lower intakes of vitamin C than nonparticipants who ate lunch; 2) NSLP participants' lunches provided a higher percentage of kcal from fat and saturated fat, and a lower percentage of carbohydrate than nonparticipants' lunches; 3) NSLP participants were more than twice as likely as nonparticipants to consume milk and milk products at lunch; and 4) NSLP participants also consumed more meat, poultry, fish, and meat mixtures than nonparticipants.

Results from the SNDAS regarding dietary intakes of SBP participants and nonparticipants[100] indicated that 1) SBP participants had higher average breakfast intakes of kcal, protein, and calcium, and derived a greater proportion of kcal from fat and saturated fat than nonparticipants; 2) SBP participants were three times more likely than nonparticipants to consume meat, poultry, fish, or meat mixtures at breakfast; and 3) SBP participants were also more likely than nonparticipants to consume milk or milk products at breakfast. The most surprising finding from the SNDAS was that the presence of the SBP in schools did not affect the likelihood that a student ate breakfast before starting school. Research is needed to determine the best ways to encourage elementary school students to consume healthful breakfasts. Universal school breakfast, which allows all students to eat school

breakfast for free, has been advocated by some as a means to increase the percentage of children who eat breakfast. However, results from the SNDAS indicated that approximately 42% of children who were eligible for free or reduced price school breakfast did not eat it.[94] Perhaps scheduling the SBP for classes to eat as a part of regular school hours (similar to the NSLP) is needed to increase the percentage of children who eat breakfast.

Results from a study by Baranowski et al.[101] indicate the important contribution that school lunch makes in increasing children's consumption of fruits and vegetables. Differences in children's consumption of fruits and vegetables by meal and day of the week were assessed using seven-day food records completed by 2984 third-graders from 48 elementary schools in the Atlanta, Georgia area. Results indicated that fruits and vegetables were most frequently consumed at weekday lunch, and second most frequently at dinner. Participation in school lunch accounted for a substantial proportion of fruits and vegetables consumed at lunch. Few fruits and vegetables were consumed at breakfast or snack.[101]

Impact of Elementary Schools on Older Children's Food Preferences and Consumption Patterns

The impact of exposure and social environment on preschool children's food preferences and consumption is discussed earlier in this section. Limited research indicates that exposure to food also plays a role in older children's food preferences and consumption. Results from a study by Hearn et al.[102] indicated that availability and accessibility to fruits and vegetables (as assessed by telephone interviews with parents) was positively related to upper elementary school children's preferences and consumption. Furthermore, children ate more fruits and vegetables for lunch at schools that offered more fruits and vegetables for lunch.

Research with upper elementary school children indicates that they prefer vegetables less than fruits.[43,103,104] Results from focus groups with ~600 fourth- and fifth-grade students from Georgia, Alabama, and Minnesota indicate that children predominantly believe that vegetables taste "nasty"[104] and "if it's good for you, then it must taste bad"[103,104] which is related to statements made by adults such as "I don't care if they don't taste good; eat your vegetables because they're good for you."[104] Research concerning the influence of a variety of psychological and social factors on children's fruit and vegetable consumption indicates that preferences are the strongest predictors.[44,105] This implies that interventions that alter children's preferences for fruits and vegetables will be more effective in increasing their consumption than other strategies pursued to date. However, intensive school-based interventions designed to specifically increase children's preferences for fruits and vegetables have had limited success.[32,106,107] Furthermore, although some elementary school programs have helped children to improve their dietary intake,[108] intensive interventions specifically designed to increase children's fruit and vegetable consumption have had only limited success.[32,106,107,109-111] Finally, schools may represent a potentially useful setting for preventing childhood obesity, but comprehensive elementary school programs in the U.S. such as CATCH and Know Your Body have not had major effects on children's body weight.[108,112,113] Perhaps the limited success of elementary school-based interventions to date to increase children's preferences for and consumption of fruits and vegetables, and to help prevent childhood obesity is because the interventions have not attempted to educate school staff and parents about how their behaviors impact children's food preferences and consumption patterns.

Children have acquired knowledge about eating and have developed food preferences by the time they enter school; however, their food preferences and consumption patterns

are continually modified because they eat daily.[114] More than 95% of children in the U.S. are enrolled in school, where they may eat one or two meals per school day.[115] Thus, elementary schools play a critical role in shaping children's food acceptance patterns and can therefore help to improve their diet.[116] No other public institution has as much continuous and intensive contact with children during their first two decades of life than public schools.[113] Elementary school staff have a greater potential influence on a child's health than any other group outside of the home.[117] School-based programs offer a systematic and efficient means to improve the health of youth in America by promoting positive lifestyles.[118] Health promotion programs in elementary schools have the potential to help prevent chronic diseases in U.S. adults.[117] Although school-based health programs may promote healthful lifestyles, classroom lessons are not sufficient to produce lasting changes in students' eating behaviors.[53] In fact, curriculum-based nutrition education in schools has had minimal effects on student's eating behavior.[119] Children's food preferences and consumption are influenced by the elementary school environment through familiarity and reinforcement.[120] Students of public elementary schools generally attend for 7 hours a day, 180 days a year. Although students have options for obtaining food in schools, the most prominent federally supported programs are the SBP and the NSLP.

Elementary school breakfast and lunch menus typically follow a cycle that repeats several times during the school year; thus, children are provided with repeated exposures to healthful foods (e.g., fruits and vegetables).[121] However, elementary schools also provide children with repeated exposures to other foods (e.g., candy and pizza) which are used by school staff as rewards.[53,122-124] Unfortunately, the social context in which vegetables are often offered at school (e.g., "If you eat your peas, then you can eat your cookie") probably negatively affects preferences for them, thereby potentially decreasing their consumption.[121] However, the social context in which candy and pizza are offered probably positively affects preferences for those foods, thereby potentially increasing their consumption.[121] These repeated exposures to vegetables and foods such as candy and pizza in negative and positive social contexts, respectively, provide the associative learning that help children develop food consumption patterns that are inconsistent with nutrition guidelines[40] which recommend increased intake of vegetables but moderation in sugar and fat intake.[10,29,125,126] In addition, school staff often encourage children to finish all of their food, regardless of whether or not the children are still hungry,[122] which encourages children to disregard their own feelings of hunger and satiety.

Concern regarding the impact of school staff on children's food preferences and consumption patterns has been voiced by several government and professional groups. According to the Centers for Disease Control and Prevention,[116] students need exposure to healthful foods as well as the support of people around them, and teachers need to be discouraged from using food for disciplining or rewarding students. According to the American Dietetic Association, "… the nutrition goals of the National School Lunch Program and School Breakfast Program should be supported and extended through school district policies that create an overall school environment with learning experiences that enable students to develop lifelong, healthful eating habits."[127] Furthermore, the American Dietetic Association recommends that school meals be served in an environment that encourages their acceptance,[128] or a setting and atmosphere that encourages their consumption,[127] which may be interpreted to mean an environment that avoids the use of food contingencies. A joint statement by the American Dietetic Association, Society for Nutrition Education, and the American School Food Service Association indicates that schools are to be healthful environments where the cafeteria and food-related policy allow students the opportunity to make healthful food choices and provide them with models of healthful food practices.[129]

Considerable research has been conducted concerning the impact of exposure and the social context of eating on preschool children's food preferences, consumption, self-regulation of intake, and adiposity. However, research of this type is needed with older children. According to Hill and Trowbridge,[39] insights gained from research concerning children's food preferences and consumption patterns "can assist in developing interventions to improve child-feeding practices, which may lead to development of healthier eating patterns." Parents and school staff need to expose children to healthful foods, provide opportunities for children to learn to like rather than dislike healthful foods, encourage children to respect their own feelings of hunger and satiety, and reduce the extent to which learning and experience potentiate children's liking for high-sugar and/or high-fat foods.[130] Interventions to increase children's consumption of foods consistent with nutrition guidelines and to prevent childhood obesity must educate adults about their role in the development of children's food preferences and consumption patterns, specifically exposure to food, the social context of eating (e.g., food rewards and contingencies), and adult influences on children's ability to self-regulate caloric intake. Table 8.24 provides five practical applications for adults to use when feeding children.

TABLE 8.24

Five Practical Applications for Adults to Use when Feeding Children

- Offer a variety of healthful foods in a positive environment at regular meal and snack times.
- Instead of requiring children to finish all of their food, encourage them to respect their own feelings of hunger and satiety. Use choice-offering statements such as "If you're still hungry, there's more ___" or "If you're full, then you don't have to eat any more."
- To help children learn to eat a variety of foods, continue to offer new foods even if a new food is initially rejected. Ten to 12 exposures at two per week may be needed before a child learns to accept a new food.
- To encourage children to eat or to try new foods, use choice-offering statements such as "Would you like to try/taste your ___?" Avoid rewarding or bribing children for eating. Also, avoid using food contingencies (e.g., "If you eat your ___, then you can ___.")
- Instead of using food as a reward, use non-food items such as stickers or a token economy (e.g., wherein tokens are exchanged for tangible non-food rewards such as shoe laces, wrist bands, play time).

Childhood Obesity

Overwhelming evidence indicates that the incidence of obesity among children and adolescents has increased dramatically during the last three decades.[36,37] According to Dietz, "obesity is now the most prevalent nutritional disease of children and adolescents in the United States."[131] Critical periods during the childhood years for the development of obesity include the period of adiposity rebound that occurs between five and seven years of age, and adolescence.[131] The causes of childhood obesity are multifactorial, including both genetics and environment. Inactivity appears to play a major role in the increasing rate of childhood obesity, as does television viewing. Results from the Third National Health and Nutrition Examination Survey indicated that children ages 8 to 16 years who watched four or more hours of television each day had greater body fat and greater body mass index than children who watched television less than two hours each day.[132] With the advances in technology, especially regarding computers, more children are spending more hours in sedentary states. Preventing childhood obesity is more desirable than trying to treat obesity during adolescence and adulthood. One critical component of obesity prevention is increased physical activity; another is educating adults regarding the development of children's food preferences and food consumption patterns. The topic of childhood obesity is covered thoroughly in Section 70.

Influences from Peers and Media

Children's food preferences and consumption patterns can be altered either positively or negatively by peers and the media. For example, results from the Third National Health and Nutrition Examination Survey indicated that approximately 26% of U.S. children ages 8 to 16 years watched four or more hours of television each day, and that as hours of television viewing increased, so did body fat and body mass index.[132] Unfortunately, research indicates that food advertisements aired during children's Saturday morning television programming are generally contrary to nutrition recommendations.[133]

Sugar and Aspartame

Although there are widespread beliefs that both sugar (i.e., sucrose) and aspartame produce hyperactivity and other behavioral problems in children, both dietary challenge and dietary replacement studies have demonstrated that sugar has little if any adverse effects on behavior.[134] For example, Wolraich et al.[135] conducted a double-blind controlled trial with 25 normal preschool children and 23 school-age children who were described by their parents as sensitive to sugar. The different diets that children and their families followed for each of three consecutive three-week periods were either high in sucrose, aspartame, or saccharin (placebo). Children's behavior and cognitive performance were evaluated weekly. Results strongly indicated that even when intake exceeded typical dietary levels, neither sucrose nor aspartame had discernible cognitive or behavioral effects in normal preschool children or in school-age children who were believed to be sensitive to sugar. Furthermore, the few differences associated with the ingestion of sucrose were more consistent with a slight calming effect than with hyperactivity.[135] Results from a 1995 meta-analytic synthesis of 16 reports containing 23 controlled double-blind challenge studies found that sugar did not affect the behavior or cognitive performance of children; however, a small effect of sugar or effects on subsets of children could not be ruled out.[136]

According to Kanarek,[134] the strong belief of parents, educators, and medical professionals that sugar has adverse effects on children's behavior may be attributed to several factors. First, adults may misconceive the relationship between sugar and behavior. Children in general have difficulty altering their behavior in response to changing environmental conditions, such as shifting from the unstructured nature of a party or snack time at school to the more rigorous demands of classwork. If the party or snack included foods with a high sugar content, adults may relate the child's sugar intake with behavioral problems as the child tries to adapt from an unstructured activity to one with structure. Second, sugar-containing foods such as candy are often forbidden or given to children in very limited amounts; the prohibited nature of these foods may contribute to the belief which associates them with increased activity. Finally, expectations of both adults and children could promote the idea that sugar leads to hyperactivity. Children hear adults comment that "too much sugar makes children hyper" and children believe them and act accordingly to fulfill the prophecy.[134]

Although experimental evidence fails to indicate that sugar affects children's behavior and cognition, children should not have unlimited access to sugar, because undernutrition may occur if foods with essential nutrients are replaced by kcal from sugar; furthermore, sugar (and starch) can promote tooth decay. On the Food Guide Pyramid,[18] sweets are located at the tip along with fats and oils, indicating that these foods should be used sparingly. According to the Dietary Guidelines for Americans,[10] the diet should be moderate in sugars, especially if kcal needs are low. The position of the American Dietetic

Association regarding the use of nutritive and nonnutritive sweeteners[137] is that "consumers can safely enjoy a range of nutritive and nonnutritive sweeteners when consumed in moderation and within the context of a diet consistent with the Dietary Guidelines for Americans."

Feeding Adolescents

Characteristics of Food Habits of Adolescents

Adolescents often experience newly found independence, busy schedules, searches for self-identification, dissatisfaction with body image, difficulty accepting existing values, and a desire for peer acceptance. Each of these events may help explain changes in food habits of adolescents. Common characteristics of food habits of adolescents include an increased tendency to skip meals (especially breakfast and lunch), eating more meals outside the home, increased snacking (especially on candy), consumption of fast foods, and dieting.[138]

Insight regarding adolescents' perceptions about factors influencing their food choices and eating behaviors was provided from focus groups with 141 seventh- or tenth-graders (40% white, 25% Asian-American, 21% African-American, 7% multiracial, 6% Hispanic, 1% Native American) from two urban schools in St. Paul, Minnesota.[139] Factors identified by the adolescents as being most influential on their food choices included hunger and food cravings, appeal of food (primarily taste), time considerations of themselves and their parents, and convenience of food. Factors identified by the adolescents to be of secondary importance included food availability, parental influences on eating behavior (including the family's culture or religion), perceived benefits of food (e.g., for health, energy, body shape), and situational factors (e.g., place, time). Additional factors discussed included mood, body image concerns, habit, cost, media influences, and vegetarian lifestyle choices. A sense of urgency about personal health in relation to other concerns, and taste preferences for other foods were major barriers to eating more fruits, vegetables, and dairy products and eating fewer high-fat foods. Suggestions provided by the adolescents to help adolescents eat a more healthful diet included making healthful food taste and look better, making healthful food more available and convenient, limiting the availability of unhealthful options, teaching them good eating habits at an early age, and changing social norms to make it "cool" to eat healthfully. These results suggest that if interventions to improve adolescent nutrition are to be effective, they need to have adolescent input and address a broad range of factors, especially environmental factors (e.g., increased availability and promotion of appealing, convenient foods in homes, schools, and restaurants).[139]

The Minnesota Adolescent Health Survey (MAHS) was completed by more than 30,000 adolescents from 1986 through 1987. The MAHS was a comprehensive assessment of adolescent health status, health behaviors, and psychosocial factors; although it included relatively few nutrition-related items, a wealth of knowledge about adolescent nutrition was gained. Neumark-Sztainer et al. summarized the knowledge learned from a decade of subsequent analyses of data collected in the MAHS, as well as implications for working with youth.[140] Major concerns identified included overweight status, unhealthful weight-control practices, and high prevalence rates of inadequate intakes of fruits, vegetables, and dairy products. Risk factors for inadequate food intake patterns or unhealthful weight-control practices included low socioeconomic status, minority status, chronic illness, poor school achievement, low family connectedness, weight dissatisfaction, overweight, homo-

sexual orientation among boys, and use of health-compromising behaviors. The results suggest a need for innovative outreach strategies that include educational and environmental approaches to improve adolescent eating behaviors. A critical issue that needs to be addressed is the validity of adolescents' self-reported behaviors.[140]

Youth Risk Behavior Surveillance — United States, 1997

The Youth Risk Behavior Surveillance System (YRBSS) monitors six categories of priority health-risk behaviors among high school youth in grades 9 through 12.[141] In 1997, as part of the YRBSS, the Centers for Disease Control and Prevention conducted a national school-based Youth Risk Behavior Survey (YRBS) that resulted in 16,262 questionnaires completed by students in 151 schools. Table 8.25 provides an overview of results from the YRBS for dietary behaviors including fruit and vegetable consumption, fat consumption, perceived overweight, attempted weight loss, laxative use or vomiting, diet pill use, dieting, and exercising to either lose weight or keep from gaining it.[141]

TABLE 8.25

Results Regarding Dietary Behaviors from the Youth Risk Behavior Survey, United States, 1997

Dietary Behavior	Percentage of Students*
Ate five or more servings of fruits and vegetables (defined as fruit, fruit juice, green salad, or cooked vegetables) during day prior to survey:	
Overall	29
Boys	32[a]
Girls	26[a]
Ate two or fewer servings of foods typically high in fat content (defined as hamburgers, hot dogs, or sausage; french fries or potato chips; and cookies, doughnuts, pie, or cake) during day prior to survey:	
Overall	62
Girls	71[a]
Boys	56[a]
Hispanics	64[b]
Whites	63[b]
Blacks	55[b]
White girls	73[c]
Black girls	63[c]
Hispanic boys	60[d]
Black boys	47[d]
Girls in grade 12	77[e]
Girls in grade 9	65[e]
Boys in grade 12	59[f]
Boys in grade 10	52[f]
Boys in grade 11	61[g]
Boys in grade 9	50[g]
Boys in grade 10	52[g]
Considered themselves overweight:	
Overall	27
Girls	34[a]
Boys	22[a]
Hispanics	30[b]
Blacks	24[b]
Hispanic boys	27[c]
White boys	22[c]
Black boys	15[c]
Tried to lose weight during the 30 days preceding the survey:	
Overall	40
Girls	60[a]
Boys	23[a]

TABLE 8.25 *(Continued)*

Results Regarding Dietary Behaviors from the Youth Risk Behavior Survey, United States, 1997

Dietary Behavior	Percentage of Students*
Hispanics	46[b]
Blacks	36[b]
White girls	62[c]
Hispanic girls	61[c]
Black girls	51[c]
Hispanic boys	33[d]
White boys	22[d]
Black boys	20[d]
Used laxatives or vomited during the 30 days preceding the survey to lose weight or keep from gaining it:	
Overall	5
Girls	8[a]
Boys	2[a]
Hispanics	7[b]
Whites	4[b]
Hispanic girls	10[c]
Black girls	6[c]
Black boys	4[d]
White boys	2[d]
Used diet pills during the 30 days preceding the survey to lose weight or keep from gaining it:	
Overall	5
Girls	8[a]
Boys	2[a]
Dieted to either lose weight or keep from gaining it during the 30 days preceding the survey:	
Overall	30
Girls	46[a]
Boys	18[a]
Hispanics	33[b]
Whites	30[b]
Blacks	25[b]
White girls	48[c]
Hispanic girls	46[c]
Black girls	34[c]
Hispanic boys	23[d]
White boys	17[d]
Black boys	16[d]
Exercised to either lose weight or keep from gaining it during the 30 days preceding the survey:	
Overall	52
Girls	65[a]
Boys	40[a]
Hispanics	56[b]
Whites	52[b]
Blacks	44[b]
White girls	70[c]
Hispanic girls	65[c]
Black girls	49[c]
Hispanic boys	48[d]
White boys	39[d]
Black boys	38[d]

* Percentages with the same letter within a dietary behavior are significantly different.

Adapted from Kann, L., Kinchen, S. A., Williams, B. I., et al, *Youth Risk Behavior Surveillance - United States, 1997*, In CDC Surveillance Summaries, MMWR 47 (No. SS-3), 1998; available at http://www.cdc.gov/.

Health Behaviour in School-Aged Children: A WHO Cross-National Study International Report, 1997–1998

The Health Behaviour in School-Aged Children Study is a unique cross-national research study conducted in collaboration with the World Health Organization (WHO) Regional Office for Europe.[142] The first survey was carried out in 1983–1984; since 1985, surveys have been conducted at four-year intervals in a growing number of countries. The study looks at 11-, 13-, and 15-year old children's attitudes and experiences concerning a wide range of health related behaviors and lifestyle issues. The 1997–1998 survey included more than 123,227 children from 26 European countries and regions, Canada, and the U.S. The 1997–1998 sample of children from the U.S. included 5168 children; of these, there were 2395 boys and 2774 girls, 1558 11-year-olds, 1803 13-year-olds, and 1808 15-year-olds. Results indicated that for the most part, U.S. children were less likely to have a good diet than were children in other countries. Specifically, U.S. children were less likely to eat fruit and vegetables each day than were children in the majority of other countries. Children in the U.S. were more likely to eat potato chips and french fries every day, as well as sweets or chocolate, than were children in most other countries. Children in the U.S. ranked among the top three or four countries for consuming soft drinks every day. For all countries, boys were more likely to drink more milk and eat more junk foods and fried foods, and girls were more likely to eat fruit and vegetables each day. However, fruit and vegetable consumption decreased with age. Concerns about body size and dieting behavior increased with age for girls in all countries, but decreased for boys. Children in the U.S. were more likely than children in any other country to report that they were dieting or should be on a diet (47, 53, and 62% of 11-, 13-, and 15-year-old U.S. girls, respectively, and 34, 33, and 29% of 11-, 13-, and 15-year-old U.S. boys, respectively). For all countries, children with mothers or fathers with high socioeconomic status had the highest levels of daily consumption of healthy food items, and those with mothers or fathers whose status was low had the highest daily consumption of less nutritious food items. These results emphasize important relationships between age, gender, country, and socioeconomic status on food intake and dieting habits.[142]

Feeding Adolescents at School

Some research regarding feeding adolescents at school has been conducted. For example, one study surveyed 2566 adolescents in grades 6, 7, and 8 (which covers ages 10 to 15 years) to assess their perceptions of school food service and nutrition programs.[143] Results indicated that the top predictors of satisfaction were school menus which include food that students like, quality of the food choices, and prices that are acceptable for what students get. Girls were more satisfied with school-prepared foods than boys, perhaps because girls mature faster than boys during these years, which may be reflected as willingness to try new foods at an earlier age. Sixth-grade students were more satisfied than either seventh- or eighth-grade students. This may be because as adolescents move into the early teenage years, they become more independent from their parents and begin making their own decisions instead of eating school meals because their parents want or expect them to do so.[143]

Another study examined the effects of pricing strategies on sales of fruits and vegetables with adolescents in two high schools (1431 students at one urban school and 1935 students at the other suburban school).[144] Fruit, carrot, and salad purchases were monitored in each school cafeteria during an initial baseline period. Next, prices for these items were reduced by 50%, and sales were monitored. Finally, prices were returned to baseline, and

sales were monitored for an additional three weeks. Results indicated that even though promotion was minimal, lower pricing significantly increased sales for fruit and carrots but not salads among high school students. However, the magnitude of the intervention effects differed by school, which suggests that contextual factors (e.g., packaging, display) may modify pricing effects. These results imply that adolescents can be encouraged to select fruits and vegetables when the prices of these items are lowered, and that this may occur without measurable changes in the overall a la carte sales revenue or the number of meal pattern customers, which are both important considerations for school food service revenues.[144]

Caffeine

Caffeine is a stimulant for the central nervous system; it tends to decrease drowsiness and reduce the sense of fatigue, but too much can cause palpitations, stomach upset, insomnia, and anxiety. Its effects vary among individuals, depending on the amount ingested, body size of the individual, and personal tolerance. Some people are able to build up a tolerance to caffeine through regular use; others are more sensitive to it. If someone who has regularly consumed caffeine suddenly stops using it, mild withdrawal symptoms (e.g., headaches, craving for caffeine) may occur. Substantial amounts of caffeine are found in several soft drinks, coffee, tea, and some pain relievers; smaller amounts are found in chocolate and foods with cocoa. Consumption of caffeine increases during adolescence with greater intakes of soft drinks, tea, and coffee. This can be a concern because caffeine has a modest negative impact on calcium retention, yet consumption of milk and other foods high in calcium decreases as children get older.[25,28] Furthermore, the stimulating effect of caffeine may set the stage for needing stimulation; although caffeine is classified as a drug, society is very accepting of this stimulant and has not considered it a nuisance.[145]

Vegetarian Diets

During the adolescent years, when there is increased independence and decision making and greater influence by peers and role models, vegetarian diets may be relatively common. There is considerable variation in the eating patterns of vegetarians. For the lacto-ovo-vegetarian, the eating pattern is based on grains, vegetables, fruits, legumes, seeds, nuts, dairy products, and eggs; meat, fish, and poultry are excluded. For the vegan, or total vegetarian, the eating pattern is similar to the lacto-ovo-vegetarian pattern except for the additional exclusion of eggs, dairy, and other animal products. However, considerable variation may exist in the extent to which animal products are avoided within both of these patterns.[146]

According to the American Dietetic Association, "well-planned vegan and lacto-ovo-vegetarian diets are appropriate for all stages of the life cycle, including pregnancy and lactation."[146] Appropriately planned vegan and lacto-ovo-vegetarian diets satisfy nutrient needs of infants, children, and adolescents and promote normal growth.[147] Dietary deficiencies are more common in populations with very restrictive diets. All vegan children need a reliable source of vitamin B_{12}; in addition, vitamin D supplements or fortified foods should be used if sun exposure is limited. Emphasis should be placed on foods rich in calcium, iron, and zinc. Vegetarian children can be helped to meet energy needs through frequent meals and snacks, as well as the use of some refined foods and foods higher in fat.[146] Section 40 contains additional information regarding vegetarian diets.

Eating Disorders

Anorexia nervosa and bulimia may affect about one million adolescents. Eating disorders are thought to occur for a variety of reasons which include poor self-concept, pressure to be thin, body shape and size, depression, and biological errors in organ function or structure. Up to 10% of these adolescents may die prematurely as a result of eating disorders.[145] Most eating disorder patients develop the problem during adolescence; however, it may be difficult to distinguish an adolescent with "normal" eating habits from one with an eating disorder, due to some of the psychologic changes which occur during adolescence.[6] More information regarding eating disorders may be found in Section 68.

Teen Pregnancy

Nutrient needs rise considerably during pregnancy; for adolescents who are pregnant, nutritional considerations are paramount, especially if they are still growing. For adolescent girls, linear growth typically is not completed until approximately four years after the onset of menarche. Some indication of physiologic maturity and growth potential may be obtained from gynecologic age, which is the difference between chronologic age and age at menarche. A young adolescent girl (i.e., gynecologic age of two years or less) who becomes pregnant may still be growing; thus, her nutrient requirements must meet her own needs for growth and development, as well as the extra demands of fetal growth.[6] Eating habits of adolescents (e.g., skipped meals, increased snacking, consumption of fast foods, and dieting) create a health risk for pregnant adolescents because during pregnancy, nutritional needs for the fetus are met before needs of the mother.[145] Adolescents who are pregnant should be cautioned against skipping meals, especially breakfast, because skipping meals may increase the risk of ketosis.[138] More information regarding teen pregnancy may be found in Section 5.

Health Promotion and Disease Prevention

Healthy People 2010 Nutrition Objectives for Children and Adolescents

Table 8.26 includes Healthy People 2010 nutrition objectives, as well as dental objectives related to nutrition, for children and adolescents.[126] The nutrition objectives address reducing weight, reducing growth retardation, improving eating behavior (e.g., increasing consumption of fruit, vegetables, grain products, and calcium products; decreasing consumption of fat, saturated fat, and sodium), reducing iron deficiency, and improving meals and snacks at school. The dental objectives related to nutrition address dental caries, untreated dental decay, and school-based health centers with oral health components.

"5 A Day for Better Health" Program

The national "5 A Day for Better Health" Program was instituted in 1991 to encourage Americans to eat five or more servings of fruits and vegetables every day. The program is a public-private partnership between the National Cancer Institute (NCI) and the Produce for Better Health Foundation (a nonprofit foundation representing the fruit and vegetable industry); it includes retail, media, community, and research components.[148] At

TABLE 8.26

Healthy People 2010 Nutrition Objectives for Children and Adolescents

19-3. Reduce the proportion of children and adolescents who are overweight or obese (defined as at or above the gender- and age-specific 95th percentile of BMI).

Objective	Reduction in Overweight or Obese Children and Adolescents*	2010 Target	1988–1994 Baseline
19-3a.	Children and adolescents aged 6 to 11 years	5%	11%
19-3b.	Children and adolescents aged 12 to 19 years	5%	10%
19-3c.	Children and adolescents aged 6 to 19 years	5%	11%

* Defined as at or above the gender- and age-specific 95th percentile of BMI based on the revised CDC growth charts for the U.S.

19-4. Reduce growth retardation (defined as height-for-age below the fifth percentile in the age-gender appropriate population using the 1977 NCHS/CDC growth charts) among low-income children under age 5 years.
Target: 5% Baseline: 8%

19-5. Increase the proportion of persons age 2 years and older who consume at least two daily servings of fruit.
Target: 75% Baseline: 28%

19-6. Increase the proportion of persons age 2 years and older who consume at least three daily servings of vegetables, with at least one-third being dark green or orange vegetables.
Target: 50% Baseline: 3%

19-7. Increase the proportion of persons age 2 years and older who consume at least six daily servings of grain products, with at least three being whole grains.
Target: 50% Baseline: 7%

19-8. Increase the proportion of persons age 2 years and older who consume less than 10 percent of calories from saturated fat.
Target: 75% Baseline: 36%

19-9. Increase the proportion of persons age 2 years and older who consume no more than 30 percent of calories from total fat.
Target: 75% Baseline: 33%

19-10. Increase the proportion of persons age 2 years and older who consume 2400 mg or less of sodium daily (from foods, dietary supplements, tap water, and salt use at the table).
Target: 65% Baseline: 21%

19-11. Increase the proportion of persons aged two years and older who meet dietary recommendations for calcium (based on consideration of calcium from foods, dietary supplements, and antacids).
Target: 75% Baseline: 46%

19-12. Reduce iron deficiency among young children and females of childbearing age.

Objective	Reduction in Iron Deficiency*	2010 Target	1988-1994 Baseline
19-12a.	Children age 1 to 2 years	9%	5%
19-12b.	Children age 3 to 4 years	1%	4%
19-12c.	Nonpregnant females age 12 to 49 years	7%	11%

* Iron deficiency is defined as having abnormal results for two or more of the following tests: serum ferritin concentration, erythrocyte protoporphyrin, or transferrin saturation.

19-15. (Developmental) Increase the proportion of children and adolescents aged 6 to 19 years whose intake of meals and snacks at school contributes to good overall dietary quality.

21-1. Reduce the proportion of children and adolescents who have dental caries experience in their primary or permanent teeth.

Objective	Reduction of Dental Caries in Primary and/or Permanent Teeth	2010 Target	1988–1994 Baseline
21-1a.	Young children	11%	18%
21-1b.	Children	42%	52%
21-1c.	Adolescents	51%	61%

TABLE 8.26 *(Continued)*

Healthy People 2010 Nutrition Objectives for Children and Adolescents

21-2. Reduce the proportion of children, adolescents, and adults with untreated dental decay.

Objective	Reduction of Untreated Dental Decay	2010 Target	1988-1994 Baseline
21-2a.	Young children	9%	16%
21-2b.	Children	21%	29%
21-2c.	Adolescents	15%	20%

21-13. (Developmental) Increase the proportion of school-based health centers with an oral health component.

Adapted from US Department of Health and Human Services, *Healthy People 2010*, 2nd ed., US Government Printing Office, Superintendent of Documents, Washington, DC, November, 2000. Available online at http://www.health.gov/healthypeople (accessed July 30, 2001).

the beginning of the program in 1991, a baseline survey with adults indicated that only 23% reported consuming five or more daily servings of fruits and vegetables.[149] The NCI funded nine studies in the spring of 1993 to develop, implement, and evaluate interventions in specific community channels to increase the consumption of fruits and vegetables in specific target populations; four of the nine projects used school-based programs to target children or adolescents.[150] Of these four projects, one targeted fourth-grade students and their parents,[110] two targeted fourth- and fifth-grade students,[106,109] and one targeted high school students.[111] Although all four interventions increased daily consumption of fruits and vegetables, the increases were small for three interventions and ranged from 0.2 servings for "Gimme 5 Fruit, Juice, and Vegetables for Fun and Health" in Georgia,[106] 0.4 servings for "Gimme 5: A Fresh Nutrition Concept for Students" in New Orleans,[111] and 0.6 servings for "5 A Day Power Plus" in Minnesota.[109] Increases were larger, at 1.4 servings for "High Five" in Alabama, possibly because classroom lessons were delivered by trained curriculum coordinators instead of classroom teachers.[110] Perhaps the limited success of school-based interventions to date is because they have not attempted to educate school staff about how their behaviors impact children's food acceptance patterns as discussed earlier.

Child Nutrition and Health Campaign

Launched in October, 1995, the Child Nutrition and Health Campaign is sponsored by the American Dietetic Association/Foundation, Kellogg Company, and National Dairy Council.[151] The campaign focuses on five major objectives:

1. Convene a nationally recognized panel of experts on child nutrition to address the nutritional needs of children, provide leadership to the campaign, and guide the development of messages for the campaign.
2. Educate parents, children, and health care professionals about the links among healthful childhood nutrition, classroom performance, and health during the adult years.
3. Publicize the important roles of high-carbohydrate, low-fat breakfast foods and healthful snacks for children's nutrition.
4. Fund research on the behavioral aspects of achieving healthful nutrition in children and on the development of lifelong healthful eating habits.
5. Launch a multi-year, multifaceted campaign to improve children's nutrition and health and to build strategic coalitions to spread the messages of the campaign.[151]

Five papers which review the scientific literature regarding links between nutrition and cognition have been published.[12,35,89,152,153] An intensive media program was developed to bring three key messages to various audiences through publications, public service announcements, news releases, consumer education activities, professional kits, and a video. The three key messages are: 1) give children a healthy start to their day, 2) get children (and adults) moving for the fun of it, and 3) grownups: be a role model.[151]

USDA School Meals Initiative for Healthy Children and Team Nutrition

The USDA School Meals Initiative (SMI) for Healthy Children underscores the national health responsibility to provide children with school meals consistent with the Dietary Guidelines for Americans and current scientific nutrition recommendations; the vision of the SMI is to "improve the health and education of children through better nutrition."[154] Team Nutrition was established by USDA as a nationwide integrated initiative to help implement the SMI; the goal of Team Nutrition is to "improve the health and education of children by creating innovative public and private partnerships that promote food choices for a healthful diet through the media, schools, families, and the community." Team Nutrition exists to empower schools in all 50 states to serve meals that meet the Dietary Guidelines for Americans, and to teach and motivate children in grades pre-kindergarten through 12 to make healthy eating choices. The four Dietary Guidelines for Americans that Team Nutrition focuses on are 1) eat a variety of foods, 2) eat more fruits, vegetables and grains, 3) eat lower fat foods more often, and 4) be physically active. Helping every child in the nation to have the opportunity to learn how to eat for good health is made possible by extensive, strategic public-private partnerships and approximately 300 Team Nutrition Supporters who represent all of the industries that touch children's lives, including nutrition and health, education, food and agriculture, consumer, media and technology, and government.[154] Table 8.27 lists common values shared by supporters of Team Nutrition.

TABLE 8.27

Common Values Shared by Supporters of Team Nutrition

- Children should be empowered to make food choices that reflect the Dietary Guidelines for Americans.
- Good nutrition and physical activity are essential to children's health and educational success.
- School meals that meet the Dietary Guidelines for Americans should appeal to children and taste good.
- Programs must build upon the best science, education, communication and technical resources available.
- Public/private partnerships are essential to reaching children to promote food choices for a healthful diet.
- Messages to children should be age appropriate and delivered in a language they speak, through media they use, in ways that are entertaining and actively involve them in learning.
- The focus should be on positive messages regarding food choices children can make.
- It is critical to stimulate and support action and education at the national, state, and local levels to successfully change children's eating behaviors.

From http://www.fns.usda.gov/tn/Missions/index.htm (accessed January 29, 2000).

The Child and Adolescent Trial for Cardiovascular Health (CATCH)

CATCH was a four-center, randomized field trial that evaluated the effectiveness of a school-based cardiovascular health promotion program.[155] A total of 5106 ethnically diverse students (who were third-graders at baseline and fifth-graders at the end of the intervention) participated in 56 intervention and 40 control public schools in California, Louisiana, Minnesota, and Texas. Of the 56 intervention schools, 28 schools participated

in a third-grade through fifth-grade intervention which included school food service modifications, enhanced physical education, and classroom health curricula; the other 28 schools received these components plus family education. Results at the end of the three-year intervention indicated that the percentage of energy from fat in intervention school lunches fell significantly more (from 38.7 to 31.9%) than in control school lunches (from 38.9 to 36.2%) ($p<0.001$). The intensity of physical activity in physical education classes increased significantly in intervention schools compared with control schools ($p<0.02$). The percentage of energy from fat from 24-hour recalls among intervention school students was significantly reduced (from 32.7 to 30.3%) compared with that among control school students (from 32.6 to 32.2%, $p<0.001$). Intervention students reported significantly more daily vigorous activity than controls (58.6 vs. 46.5 minutes, $p<0.003$). However, no significant differences were detected in blood pressure, body size, and cholesterol measures for students at the intervention schools compared to those at the control schools.[86]

A three-year followup was conducted with 3714 students (73%) of the initial CATCH cohort of 5106 students.[156] End-point comparisons were made between students from intervention and control schools to determine whether changes at the end of intervention in grade five were maintained through grade eight. Results for eighth-graders indicated that self-reported daily energy intake from fat remained lower for intervention than control students (30.6 vs. 31.6%, $p = 0.01$). Intervention students maintained significantly higher daily vigorous physical activity than controls ($p = .001$), although differences narrowed over time. Significant differences in favor of intervention students persisted at grade eight for dietary knowledge and dietary intentions, but not for social support for physical activity. No significant differences were noted for BMI, blood pressure, or serum lipid and cholesterol levels. In summary, followup of the CATCH cohort suggests that behavior changes from the intervention were sufficient to produce effects detectable three years later. However, differences between the intervention and control groups were narrowing in magnitude over time. Additional research is needed to determine how best to maintain the intervention effects long-term.[156]

Food Safety

The Fight Bac!™ campaign is a partnership of industry, government, and consumer groups dedicated to reducing the incidence of foodborne illness.[157] The multifaceted campaign includes television and radio public service announcements in several languages, media mailings, newspaper articles, publications, World Wide Web (www.fightbac.org), community action kits, supermarket action kits, exhibit and convention kits, and educator kits for grades kindergarten through three and four through six. Launched in October, 1997, the eye-catching Fight Bac!™ cartoon character teams up with the following four critical messages to teach consumers about safe food handling: clean, separate, cook, and chill.[157] Table 8.28 provides more details regarding these four messages.

Children, adolescents, and adults of all ages need to understand the important role they play in decreasing the incidence of foodborne illnesses through proper hand washing as well as safe food preparation and storage. According to the Hospitality Institute of Technology and Management,[158] hands should be washed with soap, a fingernail brush with soft bristles, and a large volume of flowing warm water to ensure adequate removal of pathogenic microorganisms (e.g., those from fecal sources) from fingertips and under fingernails. Fingernails should be neatly trimmed to less than 1/16 inch to make them easier to clean. When working with food, hand washing without the fingernail brush is sufficient because the pathogen count is much lower. Table 8.29 describes the double and single methods of hand washing. Although young children may be encouraged to wash

TABLE 8.28

Details Regarding the Four Critical Messages of the Fight Bac!™ Campaign

Clean: Wash Hands and Surfaces Often

- Wash hands with hot soapy water before handling food.
- Wash hands with hot soapy water after using the bathroom, changing diapers, and touching animals.
- Wash dishes, utensils, cutting boards, and counter tops with hot soapy water after preparing each food item and before preparing the next food item.
- Use paper towels to dry hands and clean kitchen surfaces.

Separate: Don't Cross-Contaminate

- Keep raw meat, poultry, and seafood separate from other foods in grocery carts and refrigerators.
- Use a different cutting board for preparing raw meats.
- Wash hands, cutting boards, dishes, and utensils with hot soapy water after they come in contact with raw meat, poultry, or seafood.
- Do not place cooked food on a plate or serving dish that previously held raw meat, poultry, or seafood.

Cook: Cook to Proper Temperatures

- To make sure that meat, poultry, casseroles, etc. are cooked all the way through, use a clean thermometer.
- Cook roasts and steaks to at least 145°F; cook whole poultry to 180°F.
- Cook ground beef to at least 160°F. Do not eat ground beef that is still pink inside.
- Cook eggs until the white and yolk are firm.
- Do not eat foods that contain raw eggs or only partially cooked eggs.
- Cook fish until it is opaque and flakes easily with a fork.
- When microwaving foods, make sure there are not cold spots by stirring and rotating food for even heating.
- Reheat sauces, soups, and gravies to a boil. Heat other leftovers thoroughly to at least 165°F.

Chill: Refrigerate Promptly

- Refrigerate or freeze prepared foods and leftovers within two hours or sooner.
- Defrost food in the refrigerator, under cold running water, or in the microwave, but never at room temperature.
- Marinate foods in the refrigerator.
- Divide large amounts of leftovers into small, shallow containers for quick cooling in the refrigerator.
- Avoid packing the refrigerator because cool air must circulate to keep food safe.

Adapted from *Fight Bac!™ Four Simple Steps to Food Safety*, Partnership for Food Safety Education, www.fightbac.org (accessed January 11, 2000).

their hands long enough for them to sing their "A, B, Cs" slowly, the amount of lathering and the volume of water used to wash off the lathering appear to be more important than the length of time spent washing.[158]

Dental Health

Nutrition is an integral component of oral health.[159] Nutrition and diet may affect the development and progression of diseases of the oral cavity. Likewise, oral infectious diseases and acute, chronic, and terminal systemic diseases with oral manifestations, affect diet and nutritional status. The primary factors to be considered in determining the cariogenic, cariostatic, and anticariogenic properties of the diet include the form of the food (liquid, solid and sticky, long lasting), frequency of consumption of sugar and other fermentable carbohydrates, nutrient composition, sequence of food intake, and combinations of foods.[159]

Because children of all ages eat frequently, snacks should emphasize foods that are low in sucrose, are not sticky, and that stimulate saliva flow which helps limit acid production in the mouth.[160] Protein foods such as nuts and cheese may provide nutritional and dental

TABLE 8.29

Two Methods of Hand Washing

Double Wash Procedure (to be used to remove fecal pathogens and other pathogenic microorganisms from skin surfaces when entering the kitchen, after using the toilet, after cleaning up vomitus or fecal material, or after touching sores or bandages):

First wash using the fingernail brush (~7 seconds required to complete):

- Turn on water so it runs at 2 gallons per minute with a temperature of 110 to 115°F. Place hands, lower arms, and fingernail brush under flowing water and thoroughly wet them.
- Apply 1/2 to 1 teaspoon of hand soap or detergent to fingernail brush.
- Brush and lather hand surfaces with tips of bristles on fingernail brush under flowing water, especially fingertips and around and under fingernails. Build a good lather.
- Continue to use fingernail brush under water until there is no more soapy lather on hands, lower arms, or nail brush. Hazardous microorganisms in the lather are only removed to a safe level when all the soap is rinsed off the hands, arms, and fingertips.
- Place nail brush on holder with bristles up so bristles can dry.

Second wash without the fingernail brush (~13 seconds required to complete):

- Apply 1/2 to 1 teaspoon of hand soap or detergent to hands.
- While adding warm water as necessary, rub hands together to produce a good lather; lathering must extend from fingertips to shirt sleeves.
- After lathering, rinse all of lather from fingertips, hands, and arms in flowing water. The volume of water used for rinsing hands, not the time of the wash, is the critical factor.
- Thoroughly dry hands and arms using disposable paper towels. Discard paper towels in waste container without touching container.

Single Wash Procedure (to be used to remove normal low levels of pathogens before and after eating and drinking; after handling garbage; after handling dirty dishes or utensils; between handling raw and cooked foods; after blowing or wiping nose; after touching skin, hair, or soiled clothes; and as often as necessary to keep hands clean after they become soiled):

- Wet hands and lower arms with warm water.
- Follow directions above for "Second wash without the fingernail brush."

Adapted from Snyder, O. P., Hospitality Institute of Technology and Management, 1998, http://www.hi-tm.com/Documents/Safehands.html (accessed January 11, 2000).

benefits because some protein foods are thought to have a protective effect against caries. When desserts are consumed, it is best if they are eaten with meals. Chewing sugarless gum after snacks containing fermentable carbohydrate may benefit school-age children and adolescents. The efforts of dietary control are complemented by good oral hygiene. A fluoride supplement is recommended into the teen years if the water supply is not fluoridated.[160]

Maxillary anterior caries (baby bottle tooth decay or BBTD) is the major nutrition-related dental disease found in infants and preschool children; it appears to be related to feeding behaviors after longer bottle or breastfeeding.[159] The primary cause of BBTD is prolonged exposure of the teeth to a sweetened liquid such as formula, milk, juice, soda pop, or other sweetened drinks.[160] This often occurs when a child is routinely given a bottle at bedtime or naptime, because the liquid pools around the teeth during sleep, saliva flow decreases, and the child may continue to suck liquid over an extended period of time. Toddlers are also at high risk if they hold their own bottle and have access to it anytime throughout the day. The primary strategy to prevent BBTD is education. Parents and child care providers should be encouraged to avoid putting an infant or young child to sleep with a bottle, and to use a cup to offer juices and liquids other than breast milk or formula.[160] Section 54 provides additional information regarding the prevention of dental caries in children and adolescents.

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