Table 1-6 (continued)

	Age (years)	Weight (kg)	Weight (lb)	Height (cm)	Height (in)	Minerals: Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	Iron (mg)	Zinc (mg)	Iodine (μg)
Infants	0.0–0.5	6	13	60	24	360	240	50	10	3	40
	0.5–1.0	9	20	71	28	540	360	70	15	5	50
Children	1–3	13	29	90	35	800	800	150	15	10	70
	4–6	20	44	112	44	800	800	200	10	10	90
	7–10	28	62	132	52	800	800	250	10	10	120
Males	11–14	45	99	157	62	1200	1200	350	18	15	150
	15–18	66	145	176	69	1200	1200	400	18	15	150
	19–22	70	154	177	70	800	800	350	10	15	150
	23–50	70	154	178	70	800	800	350	10	15	150
	51+	70	154	178	70	800	800	350	10	15	150
Females	11–14	46	101	157	62	1200	1200	300	18	15	150
	15–18	55	120	163	64	1200	1200	300	18	15	150
	19–22	55	120	163	64	800	800	300	18	15	150
	23–50	55	120	163	64	800	800	300	18	15	150
	51+	55	120	163	64	800	800	300	10	15	150
Pregnant						+400	+400	+150	h	+5	+25
Lactating						+400	+400	+150	h	+10	+50

[h]The increased requirement during pregnancy cannot be met by the iron content of habitual American diets nor by the existing iron stores of many women; therefore, the use of 30–60 mg of supplemental iron is recommended. Iron needs during lactation are not substantially different from those of nonpregnant women, but continued supplementation of the mother for 2–3 months after parturition is advisable to replenish stores depleted by pregnancy.

Source: National Research Council 1980.

Table 1-7
Estimated Safe and Adequate Daily Intakes of Selected Vitamins and Minerals[a]

	Age (years)	Vitamins: Vitamin K (μg)	Biotin (μg)	Pantothenic Acid (mg)
Infants	0–0.5	12	35	2
	0.5–1	10–20	50	3
Children and Adolescents	1–3	15–30	65	3
	4–6	20–40	85	3–4
	7–10	30–60	120	4–5
	11+	50–100	100–200	4–7
Adults		70–140	100–200	4–7

	Age (years)	Trace Elements[b]: Copper (mg)	Manganese (mg)	Fluoride (mg)	Chromium (mg)	Selenium (mg)	Molybdenum (mg)
Infants	0–0.5	0.5–0.7	0.5–0.7	0.1–0.5	0.01–0.04	0.01–0.04	0.03–0.06
	0.5–1	0.7–1.0	0.7–1.0	0.2–1.0	0.02–0.06	0.02–0.06	0.04–0.08
Children and Adolescents	1–3	1.0–1.5	1.0–1.5	0.5–1.5	0.02–0.08	0.02–0.08	0.05–0.1
	4–6	1.5–2.0	1.5–2.0	1.0–2.5	0.03–0.12	0.03–0.12	0.06–0.15
	7–10	2.0–2.5	2.0–3.0	1.5–2.5	0.05–0.2	0.05–0.2	0.10–0.3
	11+	2.0–3.0	2.5–5.0	1.5–2.5	0.05–0.2	0.05–0.2	0.15–0.5
Adults		2.0–3.0	2.5–5.0	1.5–4.0	0.05–0.2	0.05–0.2	0.15–0.5

	Age (years)	Electrolytes: Sodium (mg)	Potassium (mg)	Chloride (mg)
Infants	0–0.5	115–350	350–925	275–700
	0.5–1	250–750	425–1275	400–1200
Children and Adolescents	1–3	325–975	550–1650	500–1500
	4–6	450–1350	775–2325	700–2100
	7–10	600–1800	1000–3000	925–2775
	11+	900–2700	1525–4575	1400–4200
Adults		1100–3300	1875–5625	1700–5100

[a]Because there is less information on which to base allowances, these figures are not given in the main table of RDA and are provided here in the form of ranges of recommended intakes.
[b]Because the toxic levels for many trace elements may be only several times usual intakes, the upper levels for the trace elements given in this table should not be habitually exceeded.

Source: National Research Council 1980.

The fact that most RDA's are intentionally established to exceed the nutrient requirements of most people means that a dietary intake below the RDA is not necessarily inadequate for an individual whose requirement for a nutrient is average or even above average (NRC 1980). It also means that the small percent of persons who have unusually high nutrient requirements may not meet nutritional needs even when they consume nutrients at RDA levels. The RDA's are estimates of the nutrient requirements for populations rather than for individuals. In addition, RDA's may need to be modified for people who are ill or injured.

Translating the RDA's into a single, universally applicable, ideal pattern of food choices that best supports health and longevity is, for many reasons, difficult. As noted above, individual nutrient requirements depend upon complex interactions between genetic and environmental factors and the stage of physiologic development. The nutritional needs of infants, young adults, and older persons vary, and dietary habits and preferences differ markedly from culture to culture and from individual to individual.

A definition of the food choices that best fulfill nutrient requirements has been a goal of the many Federal agencies and private health organizations that have developed sets of dietary recommendations during the past decade (Dwyer 1983; McNutt 1980). Some of these recommendations are noted in Table 1-5; the evidence on which they are based is presented throughout this Report. Most current recommendations emphasize that it is the overall dietary pattern that determines whether or not nutrient intakes are likely to fall within desirable ranges. Public health concerns about specific nutrients, therefore, usually are directed to the kinds and amounts of foods consumed and to the genetic, behavioral, and environmental factors that affect food choices.

The diet must contain adequate energy, all essential nutrients, and certain other dietary factors to sustain normal growth, development, and health. The nutrients and dietary factors discussed in this Report include carbohydrates, fats, and proteins—the macronutrients—which are sources of energy as well as of essential fatty acids and amino acids that either cannot be synthesized or are synthesized in amounts inadequate to meet body needs; micronutrients—vitamins and mineral elements—which are necessary in small amounts; and substances such as fiber, which does not fall into either category but is nonetheless beneficial for good health. This section defines these nutrients as background for this Report. Basic information on essential nutrients has been reviewed extensively (see, for example, Nutrition Reviews 1984; Passmore and Eastwood 1986; Schneider, Anderson, and Coursin 1983; Shils and Young 1988).

Energy

The diet must supply sufficient energy to support growth and development, maintain basic physiologic functions, meet the demands of muscle activity, and repair damage caused by illness or injury. In the United States, energy intake and expenditure are measured in kilocalories, abbreviated as kcal, and referred to as Calories or, commonly, calories. In international usage, the term is kilojoules, abbreviated kJ (1 kcal = 4.184 kJ). In this Report, the terms energy and calories are used interchangeably to refer to the general concept of energy; specific measures of energy intake or expenditure or the energy value of food are given in kilocalories.

The body obtains chemical energy from food from the oxidation (chemical burning) of protein, fat, carbohydrate, and, when it is consumed, alcohol. The oxidation within the body of 1 g each of these substances in pure form yields about 4, 9, 4, and 7 kcal, respectively. Thus, fat contains more than twice the caloric value of either protein or carbohydrate. The health significance of the relatively high energy value of alcohol is discussed in the chapter devoted to this topic.

Body weight depends on complex physiologic controls of the balance between energy intake and energy expenditure. Both intake and expenditure are equally important in regulation of body weight. Weight increases when more energy is consumed than expended. Over time, such an imbalance can lead to obesity. The physiologic controls of that balance and the ways in which diet and exercise affect body weight are reviewed in the chapter on obesity.

Carbohydrates

Carbohydrates are sources of energy for vital metabolic processes and also are constituents of cellular substances such as nucleic acids, glycoproteins, and enzyme cofactors and structural components of cell walls and cell membranes. Carbohydrates are classified as monosaccharides, disaccharides, and polysaccharides. Monosaccharide and disaccharide sugars are referred to as simple carbohydrates and the polysaccharides (starches and fibers) as complex carbohydrates.

Monosaccharides. Monosaccharides are simple sugars that do not need to be further digested to be absorbed. The most important dietary monosaccharides are glucose, fructose, and galactose. Glucose and fructose are found in fruits, vegetables, and honey. They are also products of the digestion of sucrose (table sugar) and, in the case of glucose, other disaccharides. The glucose obtained from corn starch can be converted by enzymatic processes to fructose to produce high fructose corn sweeteners. As discussed below, galactose is a subunit of the disaccharide lactose.

Disaccharides. Sugars formed from two monosaccharides are called disaccharides. Sucrose, common table sugar, is composed of glucose and fructose. It is found in many fruits and vegetables but occurs in especially high concentrations in sugar beets and sugar cane. Maltose is a disaccharide of two glucose molecules and is found in beer, glucose syrups, and cereals. Lactose, the sugar of milk, is composed of one molecule of glucose and one of galactose.

Polysaccharides. Starch, glycogen, and most types of fiber are large, high-molecular weight polysaccharides. Starch and glycogen are composed of glucose molecules. Fiber includes a variety of carbohydrates and other components. These molecules differ from each other in the ways their monosaccharide units are linked to each other and, therefore, in their ability to be digested to sugars that can be absorbed into the body. The chemical linkages in starch and glycogen can be split by human intestinal enzymes, but those of polysaccharides found in fiber are, by definition, indigestible although some fiber components can be broken down by enzymes released by bacteria in the digestive tract to short-chain fatty acids that can be reabsorbed and furnish small amounts of energy.

Fiber. Dietary fiber is a term used to describe a heterogeneous group of plant food components that are resistant to human digestive enzymes (LSRO 1987). Not all are fibrous in the usual sense of the word, and some are even soluble. Dietary fiber includes some of the structural components of plant cell walls (e.g., cellulose and noncellulosic polysaccharides such as hemicellulose) and certain nonstructural components of cells such as pectins, gums, brans, mucilages, algal polysaccharides, and modified cellulose.

Specific types of dietary fiber are often classified as soluble or insoluble on the basis of their response to extraction methods. In general, the soluble fibers include gums, mucilages, and some pectins and hemicelluloses, while insoluble fibers include cellulose, lignin, and other pectins and hemicelluloses. Although all fruits, vegetables, and grains contain these fiber components, some are especially good sources of one or another type. Oat bran and beans, for example, contain relatively large proportions of soluble fibers whereas wheat bran is a good source of insoluble fiber. In general, diets that contain large amounts of fiber add bulk and may confer greater feelings of satiety.

The effects of the various fiber types on intestinal function differ, however. Insoluble fibers that adsorb water increase stool weights. Some soluble fibers have been found in short-term studies to reduce blood cholesterol, enhance glucose tolerance, and increase insulin sensitivity (LSRO 1987). These issues are reviewed in appropriate chapters of this Report.

Lipids

Dietary fats or lipids include a variety of substances soluble in organic solvents, such as chloroform or benzene, but insoluble in water. Food lipids include triglycerides (composed of fatty acids and glycerol), phospholipids, and cholesterol. Any excess of energy in the body, whether derived from carbohydrate, fat, protein, or alcohol, can be converted to fatty acids and stored in adipose tissue triglyceride, but dietary fat is essential because it supplies linoleic acid (an essential fatty acid) and it is a vehicle for absorption of fat-soluble substances such as the vitamins A, D, E, and K (NRC 1980).

Lipids are concentrated sources of energy as well as structural components of cell membranes and are molecular precursors for the synthesis of hormones and other substances. In adults, these functions usually can be met by a daily intake of 15 to 25 g of fat (NRC 1980), a level well below that typical of current American diets. In addition, fats impart characteristic mouth-feel and flavors to foods and increase the feeling of satiety after meals by delaying the passage of food from the stomach to the small intestine. The reservoirs of fat stored in the body protect the body's organs, provide insulation from heat loss, and maintain energy production during long periods of reduced food consumption, such as in starvation, dieting, or serious illness or injury.

Fatty Acids. Fatty acids are molecules containing carbon, hydrogen, and oxygen with chain lengths ranging from 4 to about 25 carbon atoms. A small amount of food fat occurs as phospholipid. Most fat in food, however, occurs as triglycerides, three fatty acid chains attached to a glycerol molecule. Triglycerides are called fats or oils depending on whether they are solid or liquid at room temperature. Both provide concentrated sources of metabolizable energy, about 9 kcal/g, more than twice the level of either proteins or carbohydrates. Recent studies suggest that the caloric value of fat may appear even higher in growing rats, reflecting greater efficiency of utilization under certain circumstances (Donato and Hegsted 1985; Donato 1987).

The fatty acids commonly found in food are usually composed of an even number of carbon atoms, usually 12 to 22, and contain from 0 to 6 double bonds—sites where additional hydrogen atoms can be attached. The number of double bonds determines the degree of saturation of fats. Fatty acids with no double bonds are saturated, those with one double bond are monounsaturated, and those with two or more double bonds are polyunsaturated.

Although all dietary fats consist of a mixture of saturated, monounsaturated, and polyunsaturated fatty acids, fatty acids in foods of animal origin are more often saturated, while those in plants are more likely to be monounsaturated and polyunsaturated. There are some important exceptions to this generalization. Coconut oil and palm kernel oil contain a high proportion of saturated fatty acids even though they are derived from plants, and as discussed below, certain fish are good sources of polyunsaturated fatty acids.

The location of double bonds along the carbon chain is also of physiologic importance. The site of the double bonds is used to categorize unsaturated fatty acids into three groups—the omega-3, omega-6, and omega-9 fatty acids. In the metabolism of fatty acids, the end of the carbon chain containing the methyl group (whose carbon atom is known as the omega carbon) tends to remain unchanged, whereas enzymes can add or subtract carbon atoms or double bonds starting from the end of the molecule that contains the carboxyl group. For convenience, the chemical features of fatty acids are usually described in terms of the structure at the methyl end of the chain. Oleic acid has nine carbon atoms between its methyl omega carbon atom and its closest double bond, so it belongs to the omega-9 family of fatty acids. Linoleic acid and the compounds to which it is connected in the body have six carbons between their omega carbons and closest double bonds, and they are omega-6 fatty acids. Linolenic acid and its derivatives have three carbons between the omega carbon and the closest double bond and are omega-3 fatty acids.

Monounsaturated omega-9 fatty acids such as oleic and palmitoleic acids are not essential in the human diet because they can be synthesized biochemically within the body. Linoleic acid, an omega-6 fatty acid, cannot be synthesized by the human body and must be consumed in the diet. It is a component of cell membranes and is required for the synthesis of arachidonic acid, the major precursor of prostaglandins, prostacyclins, thromboxanes, and leukotrienes that influence many physiologic processes, including blood vessel dilation, platelet aggregation, smooth muscle contraction, inflammation, and reproduction. Linoleic acid is widely distributed in the fatty portion of both plant and animal foods. Vegetable seed oils are especially rich sources. Symptoms of its deficiency have been reported among infants restricted to skim milk and among children and adults fed intravenous solutions lacking fat (Rivers and Frankel 1981). Linoleic acid deficiency can be prevented by consuming about 3 to 5 g of linoleic acid a day, an amount considerably less than that consumed by the average adult in the United States. Thus, essential fatty acid deficiencies are reported rarely in the United States (NRC 1980).

The role of omega-3 fatty acids, particularly eicosapentaenoic acid and docosahexaenoic acid, in human nutrition and health is under active investigation. Omega-3 fatty acids are present in the human brain, retinal lipids, and phosphoglycerides of synaptic membranes. Of current interest are the potential health effects of these highly polyunsaturated fatty acids derived from linolenic acid (omega-3).

Recent epidemiologic, clinical, and experimental data suggest that omega-3 fatty acids may have important physiologic effects that cannot be met by omega-6 or omega-9 fatty acids. Some of these effects are reviewed in the chapter on coronary heart disease.

Cholesterol. Cholesterol is a fatty substance required for synthesis of sex hormones, bile acids, and vitamin D, and it is an important constituent of all cell membranes. It is both synthesized in the body (endogenous) and obtained from the diet (exogenous) and is not, therefore, an essential nutrient. In normal individuals, endogenous synthesis of cholesterol is reduced when blood cholesterol levels are high. When the physiologic mechanisms that regulate this feedback mechanism are insufficient, blood cholesterol levels can rise and increase the risk for coronary heart disease (see that chapter). Dietary cholesterol is found only in foods derived from animals (meat, poultry, fish, eggs, and dairy products); it is not present in plants.

Protein

Body proteins serve many functions; they include structural components of cells and tissues, enzyme catalysts of biochemical reactions, peptides and hormone messengers, and components of the immune system. The amino acids in proteins can also serve as sources of energy, and most can be used to synthesize glucose when dietary carbohydrate is inadequate. Some amino acids are needed for the synthesis of special compounds;

tryptophan, for example, is required for synthesis of serotonin (a neurotransmitter) and niacin (a vitamin).

Proteins are formed from various combinations of amino acids that are linked together in chains ranging from several to hundreds in length. Each plant and animal species has its own characteristic proteins that are distinguished by the sequence of amino acids. Plants can synthesize all of their amino acids from the elements carbon, oxygen, hydrogen, nitrogen, and sulfur, but humans lack the ability to synthesize at least eight amino acids and must obtain them from the diet. The rest are called nonessential amino acids because, although needed for protein synthesis, they are not required in the diet. Essential amino acids include isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. The amino acid cystine can replace part of the requirement for methionine, and tyrosine can replace part of the requirement for phenylalanine. Histidine is an essential amino acid for infants, but its essentiality for adults has not been conclusively demonstrated (NRC 1980).

The proteins in different foods vary in their biologic value due to their content and balance of amino acids. When the concentration of one essential amino acid is low relative to the others, that amino acid is considered limiting and the protein is said to be incomplete. The presence of limiting amino acids in incomplete proteins can be compensated for at least partially by dietary intake of complementary proteins, those with different limiting amino acids. When consumed together or within a short time (the exact length of time has not been defined), such proteins can meet requirements for essential amino acids. This explains, in part, why strict vegetarians can maintain good health without eating foods derived from animals. The addition of even a small amount of protein from animal foods can improve amino acid intake. The RDA's for protein intake of men, women, and children of different ages are given in Table 1-6.

Vitamins

Vitamins are organic (carbon-containing) compounds that are essential in very small amounts for health, growth, and reproduction. They must be obtained from the diet either because they cannot be synthesized at all by the body or because the amounts made are insufficient to meet requirements. Vitamins are classified according to their solubility in fat or water, and this property affects their occurrence in foods as well as their absorption, transport, storage, and metabolism.

Fat-Soluble Vitamins. The fat-soluble vitamins are vitamins A, D, E, and K. These vitamins are generally found in high concentrations in the fatty portions of food and are absorbed, transported, metabolized, and stored along with fat. Their absorption requires bile and dietary fat. They are transported in the body by the same mechanisms by which fat is transported, are bound to lipoproteins or specific transport proteins, and are stored in liver and fat tissue. Fat-soluble vitamins are excreted into the intestine in bile and are either reabsorbed or are eliminated in feces. They are not excreted to any appreciable extent in urine. Because excretion of fat-soluble vitamins is minimal, excess intake is more likely to cause toxicity symptoms. For the same reason, deficiencies are reported rarely among healthy adults, although they are observed among children who are growing rapidly and who lack adequate fat stores and among children or adults who have disease conditions that interfere with fat metabolism, such as malabsorption, biliary obstruction, or renal or liver disease. The RDA's for vitamins A, D, and E are given in Table 1-6; the estimated safe and adequate intake of vitamin K is shown in Table 1-7.

Vitamin A is present in the diet both as the vitamin and its precursor. Retinol, or preformed vitamin A, is found in foods derived from animals (milk, butter, egg yolks, liver) and, when bound to a fatty acid, is used to fortify many foods. Retinol occurs in foods primarily in the ester form. Certain carotenoids (pigments found in many dark green, yellow, and orange vegetables, fruits, and egg yolks) can be converted by the body into retinol. The conversion of beta-carotene into retinol occurs mainly in the intestinal mucosa. Retinol circulates in the plasma bound to a specific transport protein called retinol-binding protein. Excess amounts are stored in the liver. Excessive intake of retinol has caused toxic symptoms (headache, skin and bone disorders, and renal failure) among people consuming abnormally large amounts of vitamin supplements, or—less commonly—liver from animals with high vitamin A levels (Selhorst et al. 1984; Mahoney et al. 1980). High intakes of retinol supplements have also been associated with birth defects (Rosa 1986); synthetic retinoid analogs, used to treat a variety of skin disorders (Bollag 1983), can cause fetal malformations. They are hazardous to pregnant women or women planning to become pregnant (Lammer et al. 1985) and should be used only under medical supervision. Excess amounts of beta-carotene are stored in body fat deposits. Excessive intake of foods rich in beta-carotene, such as carrots, is not known to cause toxic effects. It raises levels of carotene in the blood and can cause the skin to take on an orange color that disappears when the carotene consumption declines. Vitamin A is essential for visual processes, for the normal differentiation of epithelial tissue, for the regulation of cell membrane structure and function, and for the maintenance of immunocompetence. Vitamin A deficiency, through adverse effects on eye epithelial tissues, is a major cause of blindness among children in many developing countries, and it is also responsible for substantial additional illness. Recent studies of children consuming inadequate levels of retinol or carotenes suggest that retinol supplementation may improve their survival (Sommer et al. 1986; Tarwotjo et al. 1987).

Vitamin D_3 (cholecalciferol or calciol) is synthesized from a precursor (7-dehydrocholesterol) in skin that becomes activated by exposure to ultraviolet light from the sun. It is essential in the diet only when exposure to sun is inadequate. The vitamin is converted by the liver to 25-dihydroxyvitamin D (calcidiol) and then further converted by the kidney to 1,25-dihydroxyvitamin D (calcitriol), the metabolically active form. Excess vitamin D can be toxic, especially to children and adults who have kidney disease or certain metabolic disorders. The metabolism and functions of vitamin D are reviewed in detail in the skeletal diseases chapter.

Vitamin E functions as an antioxidant. Its principal dietary sources are vegetable seed oils. Its deficiency has been associated with a hemolytic anemia in premature infants and with neurologic symptoms in adults. Vitamin K functions as an activator of blood clotting proteins, proteins in bone and kidney, and the formation of other proteins that contain gamma-carboxyglutamic acid (GLA). It is synthesized by intestinal bacteria. Thus, deficiencies generally occur only in infants whose intestinal flora has not yet been established, in children and adults receiving antibiotic or anti-coagulant therapy (see chapter on drug-nutrient interactions), and in individuals with disease conditions that interfere with intestinal absorption. Vitamins E and K are less toxic than vitamins A or D.

Water-Soluble Vitamins. The water-soluble vitamins include vitamin C (ascorbic acid) and those of the B-complex group: biotin, folate, niacin, pantothenic acid, riboflavin, thiamin, vitamin B_6, and vitamin B_{12}. The RDA's for vitamin C, thiamin, riboflavin, niacin, vitamin B_6, folacin, and vitamin B_{12} are presented in Table 1-6; the safe and adequate ranges of intake of biotin and pantothenic acid are given in Table 1-7. These vitamins are generally found in whole grain cereals, legumes, leafy vegetables, and meat and dairy foods. The two exceptions are vitamin C, which can be obtained in adequate amounts only from fruits and vegetables, and vitamin B_{12}, which is made by bacteria and found only in foods of animal origin. Water-soluble vitamins are absorbed from the intestine, and most are stored in a form that is bound to enzymes or transport proteins and excreted in urine. Thus, they should be supplied in adequate amounts in the daily diet even though tissue depletion may take as long as weeks or months.

Water-soluble vitamins are essential components of enzymes and enzyme systems that catalyze a wide variety of biochemical reactions in cellular energy production and biosynthesis. Thus, deficiencies of these vitamins particularly affect tissues that grow or metabolize rapidly, such as skin, blood, and the cells of the digestive tract and nervous system. Common deficiency symptoms are skin disorders, anemia, malabsorption and diarrhea, neurologic disorders, and defects in tissues of the mouth. Specific vitamin deficiencies infrequently occur in the United States. When deficiencies occur, they usually are found along with other deficiencies and are due to diseases or to consumption of highly restricted diets or excessive amounts of alcohol or drugs that interfere with vitamin metabolism. The risk for deficiencies is greater in growing infants (see maternal and child nutrition chapter) and, perhaps, in older persons (see chapter on aging). Substantial intake of these vitamins causes toxicity infrequently, although severe toxic reactions have been reported from very excessive intakes of niacin and vitamin B_6.

Minerals

Minerals perform a number of roles in the body. They function as inorganic components of enzyme systems that catalyze the metabolism of protein, carbohydrate, and lipids. Some act to regulate fluid and electrolyte balance, to provide rigidity to the skeleton, and to regulate the function of muscles and nerves. Minerals also work together with vitamins, hormones, peptides, and other substances to regulate the body's metabolism.

Essential minerals are often classified as macrominerals, required in amounts from several hundred milligrams to 1 or more grams a day (calcium, phosphorus, magnesium, sodium, potassium, and chloride), or as trace elements—iron, zinc, iodine, copper, manganese, fluoride, chromium, selenium, molybdenum, and cobalt (as a component of vitamin B_{12})—which are required in small amounts (Underwood 1977). Other minerals such as nickel, vanadium, silicon, or boron have been shown to be essential under rigorous conditions for experimental animals but do not have well-established functions in humans. Still others, such as lead or mercury, are potentially toxic. RDA's for six minerals are given in Table 1-6. Ranges of dietary intake considered safe and adequate are given for nine others in Table 1-7.

Minerals are distributed in a variety of foods, but they usually are present in limited amounts. Thus, diets must contain enough of a variety of foods to meet daily requirements. People consuming diets low in energy for prolonged intervals are at risk of developing mineral deficiencies. Deficiencies can also result from therapy with medications that interfere with mineral absorption and metabolism; alcoholism, renal disease, or gastrointestinal diseases (see relevant chapters); and causes of mineral loss such as bleeding or diarrhea. Toxic symptoms can result from consumption of excessive amounts of almost any mineral or as a result of defective regulation of absorption or inadequate excretion.

Dietary Patterns

There are two types of data for monitoring dietary patterns: food availability and dietary intake. Food availability data are derived from annual estimates of per capita availability of selected commodities in the food supply. These data are useful in examining changes over time in the availability of agricultural commodities. Estimates of dietary intake come from periodic national food consumption surveys of individuals.

Time Trends in the Availability of Foods

Food availability data are produced by the USDA and are derived from annual production and marketing estimates of food products that are then usually adjusted for imports, exports, and stock changes. Such data have been collected since 1909 and have been published as a historical series from 1909 to the mid-1960's (USDA 1968). Data for the most recent 20 years are published annually (Bunch 1987). Per capita estimates of food availability are derived by dividing the total amount of food available by the total U.S. population. These data represent economic rather than physiologic consumption because they estimate the amount of food available at wholesale and retail levels rather than actual intake by individuals. Certain limitations restrict use of such data as proxies for consumption—for example, the difficulty in correcting for wastes and losses that occur before consumption by individuals, for inedible food components and food for human consumption fed to pets, or for variabilities in intakes of population subgroups.

Nonetheless, food availability data provide useful information when used within their appropriate limits of interpretation. Time trend changes in availability of foods are best estimated from these data because the data have been available on an annual basis for many years. At the current time, these data are also the best source of information for tracking changes in the use of commodities or products that can be substituted for one another (e.g., partial substitution of high-fructose corn syrup for refined sugar).

A summary of the recent trends is noted below, taken mainly from the data of the last two decades as presented in Table 1-8 (Bunch 1987), but in part from the early data series as well (USDA 1968).

Overall, total per capita availability of *meat, poultry, and fish* increased by about 10 percent since 1965–67, primarily due to increases in poultry and fish and shellfish. Availability of red meat increased substantially after World War II (USDA 1968) but, after peaking in about 1970, has since declined to approximately 1965–67 levels.

Egg availability reached its peak about 1950. During the past 20 years, it has declined by about 18 percent; this is approximately equivalent to a decrease of one egg per week per person (from about six to five eggs per week).

The availability of fluid whole *milk* declined by 48 percent from 1965–67, while available levels of low-fat milk and milk products (including yogurt) more than doubled from 1965–67 to 1983–85. Cheese availability also more than doubled during this period.

Availability of *fats and oils* increased by approximately 23 percent since 1965–67, primarily due to a 77 percent increase in salad and cooking oil and a 36 percent increase in shortening. Butter availability was about 18 lb per capita per year in 1909 (USDA 1968) and has declined to about 5 lb, including about a 20 percent decline since 1965–67 (Bunch 1987). Availability of total animal fat also declined by 1983–85, to levels approximately 80 percent of those in 1965–67, but with a slight recent increase. Over the two decades, vegetable sources increased from 67 percent to 79 percent of all fats and oils—in marked contrast to the first half of the century when animal sources provided most of the fats and oils (USDA 1968).

As noted earlier, these data represent availability of commodities and thus do not necessarily reflect changes in actual intakes of fats and oils by the U.S. population. For example, there is no correction for losses of fats and oils used for deep fat frying, which are discarded after use rather than consumed. Second, the bulk data represent only fats and oils that are added to foods or used in table spreads; they do not include "hidden" fats in foods such as marbled fat in meats or the fats in nuts.

Vegetable and fruit availability increased from 1965–67 by 19 percent and 7 percent, respectively, primarily due to increases in availability of fresh produce. There was, however, no consistent change in availability of legumes (beans, peas, and nuts) or starchy vegetables (potatoes and sweet potatoes).

Table 1-8
Annual Per Capita Availability of Selected Commodities in the U.S. Food Supply, 1965–1985[a]
(pounds)

	Meat, Poultry, and Fish[b]					Dairy Products[d]			
Year	Meat	Poultry	Fish and Shellfish	**Total**	**Eggs[c]**	Fluid Whole Milk	Low-fat Milk[e] and Milk Products (fluid)	Cheese[f]	**Totals[g]**
1965–67	123.6	30.6	10.8	165.0	40.0	240.3	41.7	9.8	343.9
1968–70	130.8	33.0	11.3	175.1	39.5	219.5	54.6	11.0	334.6
1971–73	129.5	35.1	12.3	176.9	38.2	199.2	69.3	12.9	327.7
1974–76	128.7	35.5	12.4	176.6	35.1	176.0	82.9	14.9	317.1
1977–79	126.2	40.1	13.0	179.3	34.6	155.9	95.3	16.8	310.2
1980–82	120.9	44.2	12.7	177.8	33.9	138.1	101.7	18.7	299.7
1983–85	120.9	47.6	13.8	182.3	32.8	125.3	111.4	21.5	301.7

[a]Totals may include more categories than the selected commodities.
[b]Meat (beef, veal, pork, lamb), poultry, and fish, edible weight. Fish excludes game fish (Bunch 1987, Table 9, p. 15).
[c]Eggs, retail weight. Weight of a dozen eggs is assumed to be 1.57 lb (Bunch 1987, Table 8, p. 14).
[d] Dairy products are for civilian population, except fluid milk and cream data, which use U.S. resident population (Bunch 1987, Table 10, p. 16).
[e]Low-fat and other milk products include low-fat, skim, buttermilk, flavored drinks, and yogurt.
[f]Cheese is whole and part-whole milk cheese, excluding pot, baker's, and cottage cheese.
[g]Total dairy products calculated as total retail product weight minus butter (Bunch 1987, Table 10, p. 16). Includes frozen dairy products, cottage cheese, and other products not indicated in table. The amount of calcium contributed by this food group has actually increased slightly during the 20-year period shown, as a result of increases in products such as dry milk powder.

Table 1-8 (continued)

	Fats and Oils[h]								Fruits[i]		
	Animal			Vegetable							
Year	Butter	Lard	Total Animal	Margarine	Shortening	Salad and Cooking Oil	Total Vegetable	**Total**	Fresh	Processed	**Total**
1965–67	5.9	5.7	16.9	10.3	15.4	12.6	35.2	52.1	79.0	35.3	114.3
1968–70	5.5	5.0	16.0	10.7	16.9	14.4	38.8	54.9	77.1	37.6	114.7
1971–73	4.9	3.7	14.1	11.0	17.2	16.7	41.9	56.0	75.5	39.4	114.9
1974–76	4.5	2.9	11.6	11.4	17.2	18.5	44.8	56.4	79.9	40.6	120.5
1977–79	4.4	2.3	11.6	11.3	17.9	20.0	46.3	57.9	80.4	39.8	120.2
1980–82	4.4	2.5	12.8	11.2	18.4	21.6	48.1	60.9	84.8	37.1	121.9
1983–85	4.9	2.0	13.5	10.5	20.9	22.3	50.6	64.1	87.9	34.8	122.7

[h] Food fats and oils calculated on a total population basis except butter, which is based on civilian population (Bunch 1987; animal and vegetable fats are from Table 2, p. 7; butter, lard, margarine, shortening, and salad and cooking oil are from Table 12, p. 18). The animal and vegetable categories are not strictly distinct because some margarines and shortenings include animal fats.

[i] Selected fruits, retail weights. Include fruits for which data are available for the entire series: oranges, tangerines, tangelos, lemons and limes, grapefruit, apples, avocados, bananas, cherries, grapes, nectarines, peaches, pears, pineapples, plums and prunes, strawberries, minor fruits, and a variety of canned, frozen, and chilled fruit and juices (Bunch 1987, Table 2, p. 7).

Table 1-8 (continued)

Year	Vegetables[j] Fresh	Processed	Total	Beans, Peas, and Nuts	Potatoes[k] and Sweet Potatoes	Flour and Cereal Products	Sugar and Sweeteners[l] Refined Cane and Beet	Corn Sweeteners	Total Caloric Sweeteners	Coffee, Tea and Cocoa
1965–67	62.6	41.4	104.0	14.8	84.5	143.8	97.6	15.5	114.8	15.1
1968–70	65.2	45.4	110.6	14.8	85.1	141.9	100.6	18.2	120.4	14.5
1971–73	66.1	45.9	112.0	14.2	80.6	138.5	101.7	21.8	125.0	14.2
1974–76	68.9	46.1	115.0	15.1	81.5	143.6	92.7	27.3	121.4	13.1
1977–79	71.7	46.1	117.7	14.3	81.5	145.8	91.7	33.8	126.8	11.1
1980–82	74.3	44.2	118.6	14.0	76.3	150.2	78.9	44.4	124.6	11.3
1983–85	79.7	44.7	123.3	14.6	79.5	150.5	67.4	58.3	127.1	11.6

[j] Selected vegetables: fresh vegetables for which data are available for entire series include broccoli, carrots, cauliflower, celery, corn, lettuce, onions and shallots, and tomatoes; 1985 data for processed vegetables are unavailable (Bunch 1987, Table 2, p. 7).

[k] Potatoes and sweet potatoes: data not comparable to pre-1960 figures. Data revised to reflect conversion from processed weight to fresh-weight equivalent to dehydrated potatoes, frozen potatoes, chips, and shoestrings (Bunch 1987, Table 2, p. 8).

[l] Sugars and sweeteners, dry weight basis (Bunch 1987, Table 27, p. 33).

Availability of *flour and cereal products* showed both decreasing and increasing fluctuations during the 20-year period; 1983–85 levels were approximately 5 percent higher than 1965–67 levels. Availability of grains was at its lowest point this century in 1971–73, but has since increased by about 9 percent.

Availability of *sugars and sweeteners* increased by about 11 percent since 1965–67. It should be noted that the availability data for sugars and sweeteners are for bulk commodity forms only; they do not include estimates of sugars that are consumed as a natural constituent of food products, for example, lactose in milk or sugars naturally present in fruits.

Availability of *coffee, tea, and cocoa* decreased approximately 25 percent since 1965–67.

Current Dietary Intakes

Food consumption surveys can be used to estimate food and nutrient intakes of populations and population subgroups. The most recent nationally representative survey is the first Continuing Survey of Food Intakes by Individuals (CSFII), conducted by the USDA in 1985. Data are limited to three subgroups: children 1 through 5 years and adult men and women 19 through 50 years of age. Results are presented based on 1 day of intake (Table 1-9). When applicable, estimated mean intakes are compared with recommendations in the latest report on RDA's (NRC 1980). In interpreting results, it should be noted that the RDA's (except for energy) have a margin of safety above average requirements. Thus, diets that do not meet the RDA's do not by themselves provide conclusive evidence of nutritional deficiencies. Corroborating health data are needed.

Food Energy. Men and children had estimated mean intakes of more than 90 percent of the Recommended Energy Intakes (REI); for women, the estimated mean intake was 82 percent of the REI.

Total Fat, Fatty Acids, and Cholesterol. Fat contributed 34 percent of total energy intake for children and 36 to 37 percent for men and women. The relative fatty acid contributions were approximately 40 percent saturated, 40 percent monounsaturated, and 20 percent polyunsaturated. Cholesterol intakes ranged from a mean of 254 mg/day for children to 304 and 435 mg for women and men, respectively.

Protein. For men, women, and children, estimated mean intakes were 140 percent or more of the RDA. Protein contributed approximately 16 percent of total energy intakes.

Table 1-9
Mean Daily Intake[a] of Food Energy, Nutrients, and Food Components for Men, Women, and Young Children From the Continuing Survey of Food Intakes by Individuals (CSFII), 1985[b]

	Men	Women	Children
Total Food Energy (% REI)[c]	(94)	(82)	(100)
Fat [% total energy]			
Total fat	[36]	[37]	[34]
Saturated fatty acids	[13]	[13]	[14]
Monounsaturated fatty acids	[14]	[14]	[12]
Polyunsaturated fatty acids	[7]	[7]	[6]
Cholesterol mg	435	304	254
Protein			
[% total energy]	[16]	[16]	[16]
(% RDA)[d]	(175)	(144)	(222)
Carbohydrates [% total energy]	[45]	[46]	[52]
Dietary Fiber g	18	12	10
Vitamins (% RDA)			
Vitamin A	(122)	(127)	(215)
Vitamin E	(98)	(97)	(108)
Vitamin C	(182)	(133)	(186)
Thiamin	(124)	(110)	(153)
Riboflavin	(129)	(115)	(197)
Niacin	(146)	(130)	(151)
Vitamin B_6	(85)	(61)	(127)
Vitamin B_{12}	(245)	(156)	(192)
Folacin	(76)	(51)	(157)
Minerals (% RDA)			
Calcium	(115)	(78)	(105)
Phosphorus	(192)	(126)	(132)
Iron	(159)	(61)	(88)
Zinc	(94)	(60)	(84)
Magnesium	(94)	(72)	(121)
Minerals (ESADDI)[e]			
Sodium	(exceeds)	(within)	(exceeds)
Potassium	(within)	(within)	(1–3 years exceeds) (4–5 years within)
Copper	(below)	(below)	(below)

[a]Estimated mean daily intake is expressed in several ways: amount of intake, percent of total energy intake, percent of Recommended Dietary Allowance, or comparison with Estimated Safe and Adequate Daily Dietary Intake.
[b]Data based on 1-day dietary recalls obtained by personal interview for 658 men 19 to 50 years of age, for 1,459 women 19 to 50 years of age, and for 489 of their children 1 to 5 years of age in 1985 (unweighted numbers). Nutrient intakes do not include vitamin and mineral supplements or sodium from salt added at the table.
[c]Recommended Energy Intake (NRC 1980); Source of percentages: NFCS, CSFII Report Nos. 85–1 and 85–3 (USDA 1985, 1986).
[d]Recommended Dietary Allowance (NRC 1980); Source of percentages: NFCS, CSFII Report Nos. 85–1 and 85–3 (USDA 1985, 1986).
[e]Estimated Safe and Adequate Daily Dietary Intake (NRC 1980).

Dietary Fiber. Estimated mean intakes were 10 g/day for children, 12 g for women, and 18 g for men. For all three groups, these intake values corresponded to levels of about 7 g/1,000 kcal.

Calcium. Children and men had estimated mean intakes of 105 and 115 percent of the RDA, respectively. For women, estimated mean intakes were 78 percent of the RDA.

Iron. For women and children, estimated mean intakes were 61 percent and 88 percent of the RDA, respectively. For men, the estimated mean intake was 159 percent of the RDA.

Sodium and Potassium. For men and children, estimated mean intakes of sodium from foods alone (excluding salt added at the table) exceeded the upper limit of the Estimated Safe and Adequate Daily Dietary Intake (ESADDI) (Table 1-7). For women, the estimated mean intake of sodium was within the ESADDI. For children 1 to 3 years, the estimated mean intake of potassium exceeded the ESADDI. For children 4 to 5 years, men, and women, the estimated mean intake of potassium was within the ESADDI.

Other Nutrients. The estimated mean intakes for the following nutrients were close to or above 100 percent of the RDA for men, women, and children: vitamin A, vitamin E, vitamin C, thiamin, riboflavin, niacin, vitamin B_{12}, and phosphorus.

Nutrients for which estimated mean intakes were below recommended levels for one or more groups were vitamin B_6 (women had a mean intake of less than 70 percent of the RDA; men had mean intake of less than 90 percent of the RDA), folacin (women had a mean intake of less than 60 percent of the RDA; men had a mean intake of less than 90 percent of the RDA), zinc (women had a mean intake of less than 70 percent of the RDA; children had a mean intake of less than 90 percent of the RDA), and copper (men, women, and children had mean intakes below the lower limit of the ESADDI).

Use of Nutrient Supplements

Between 35 and 40 percent of the U.S. population took vitamin or mineral supplements in the late 1970's and early 1980's (Koplan et al. 1986; Stewart et al. 1985). In the 1985 CSFII, 58 percent of women and 60 percent of children reported using supplements on a regular or occasional basis, levels that are 19 and 12 percentage points higher, respectively, than those for comparable age and gender groups in the 1977–78 NFCS (USDA 1985).

An FDA telephone survey on the levels of 21 nutrients consumed from supplements indicated that median intake ranged from the RDA level to about six times the RDA. For some nutrients, intake levels for some people were as much as 60 times the RDA. The most commonly consumed nutrient (91 percent of users) was vitamin C, either used alone or as a component of other supplements (Stewart et al. 1985).

Supplement use is higher among females than among males, higher in the West than in other regions of the United States, and higher in whites than in nonwhites (Koplan et al. 1986; Read et al. 1981; Read et al. 1986; Schutz et al. 1982; Stanton 1983; Worthington-Roberts and Breskin 1984; Block et al. 1988). Higher use of vitamin supplements is also associated with older ages, higher incomes, and higher educational levels (Koplan et al. 1986; Garry et al. 1982; Read and Graney 1982). Limited information is available on supplement use by children. The National Health Interview Survey reported that 36 percent of children to age 17 took a vitamin/mineral supplement during a 2-week period in 1981. Use of supplements was highest among younger children (46 percent of children to age 2 and 49 percent of children ages 3 to 6) and was higher in the winter than in any other season (Kovar 1985).

NHANES II data show a correlation between dietary intake of nutrients and nutrient supplementation. Persons with higher nutrient intakes from foods alone are more likely to take supplements than those with deficient intakes, even after adjusting for the effects of other variables (Koplan et al. 1986). Analysis of types of foods consumed by people who take nutrient supplements showed similar results. Supplement users tended to consume more of all types of fruits and vegetables and, therefore, more dietary vitamin C (Looker et al. 1987). A recent review of surveys of supplement usage in the United States concluded further that use of supplements is frequently inappropriate, that exceptionally high intake among certain population groups raises concerns about the potential for toxicity, and that nutrition education and research are needed to combat supplement abuse (McDonald 1986).

Criteria for Scientific Judgment

Research on the relationship of dietary factors to disease is often complicated by the complexity of the variables, the intricacy of the interactions, and the disparate nature of the analytical tools. Thus, for many nutritional research questions, proof of causality in the classic scientific sense (i.e., uniform causality or absolute protection) is often not attainable. Whereas classic nutritional disorders such as beriberi, pellagra, or scurvy could be clearly and directly demonstrated to be deficiencies of single identifiable nutrients, it has proved far more difficult to demonstrate that associations between specific dietary factors and chronic diseases are causally related.

Development of the major chronic disease conditions—coronary heart disease, stroke, diabetes, or cancer—is affected by multiple genetic, environmental, and behavioral factors among which diet is only one—albeit an important—component. These other factors interact with diet in ways that are not completely understood. In addition, foods themselves are complex; they may contain some factors that promote disease as well as others that are protective. The relationship of dietary fat intake to causation of atherosclerotic heart disease is a prominent example. An excess intake of total fat, if characterized by high saturated fat, is associated with high blood cholesterol levels and therefore an increased risk for coronary heart disease in many populations. A higher proportion of mono- and polyunsaturated fats in relation to saturated fats is associated with lower blood cholesterol levels and, therefore, with a reduced risk for coronary heart disease.

Because of these complexities, definitive scientific proof that specific dietary factors are responsible for specific chronic disease conditions is difficult—and may not be possible—to obtain, given available technology. An ideal study to demonstrate a causal association between a specific dietary factor and cancer, for example, would feed otherwise identical diets varying only in that factor to two large groups of children with comparable family histories, environments, and behavioral patterns. The study would then compare cancer rates in each group for the 30 to 50 years or more that it might take the disease to develop. Although this study would constitute a direct test of the hypothesis, it is evident that such research would be impractical and prohibitively expensive, as well as slow in yielding results.

For these reasons, researchers generally identify a relationship between a dietary factor and disease from studies in laboratory animals and from observations in humans. Data sources for human studies include laboratory measurements of blood nutrient levels or other biochemical measures of nutritional or risk status, population estimates of dietary intakes, and estimates of individual dietary intake based on recall. Epidemiologic studies using these data sources can compare dietary intake and disease rates in different countries or in defined groups within the same country (ecologic correlation studies). Another approach compares levels of dietary or biochemical indicators in persons with a specific condition to those observed in persons without the condition (case-control studies). And it is sometimes possible to conduct prospective studies that compare dietary intake and disease rates in defined groups over time.

Biochemical, epidemiologic, and dietary intake studies can provide useful information, but each has important limitations. Interpretation of animal studies is always limited by uncertainties about their applicability to humans. Laboratory measurements reveal only a small part of the complex physiologic processes involved and do not always reflect current nutritional status. Dietary surveys depend on recall of the types and portion sizes of consumed foods (Basiotis et al. 1987). Epidemiologic studies can only demonstrate an association or correlation between a dietary risk factor and a disease; they cannot prove that the dietary factor causes the disease. For example, a study might show that populations consuming high-fat diets have higher rates of breast cancer than populations consuming low-fat diets. Although such a study demonstrates an association between fat and breast cancer, it may be that some genetic, environmental, or other dietary factor might be the true cause of the apparent relationship between fat and breast cancer. Prospective studies must be conducted with precisely comparable populations under strictly controlled conditions that may be difficult to achieve or to maintain for a sufficiently long period of time to observe significant differences in disease rates.

For these reasons, the relationship between diet and disease is usually inferred from the totality of existing laboratory, animal, dietary, genetic, metabolic, and epidemiologic evidence. Such inferences must be based on the application of established principles for making determinations of the quality of scientific evidence (Lilienfeld and Lilienfeld 1980). These principles include:

Consistency of the Association. Evidence gathered from a range of biochemical, animal, epidemiologic, and clinical studies should all produce results that support the possibility that a dietary factor is causally associated with increased disease risk. Repeated findings in different population groups and in different countries should consistently yield similar results.

Strength of the Association. The more powerful the correlation between dietary intakes and a health outcome, the more convincing the evidence. A causal relationship between dietary fat and coronary heart disease, for example, would be more credible if all individuals with coronary heart disease—but no healthy individuals—routinely consumed high-fat diets. Most diseases, however, are caused by multiple factors, and perfect correspondence cannot be expected. Instead, the strength of association is expressed as a correlation between levels of exposure and disease rates in a population. The greater the correlation between dietary fat and coronary heart disease in a population, the more that correlation supports an inference that dietary fat increases coronary risk. Strength of association also can be expressed as a relative risk—the ratio of disease rates in the population exposed to the dietary factor (e.g., consuming high-fat diets) to the population that has not been exposed (e.g., consuming low-fat diets). A high relative risk supports an inference that a dietary factor increases disease risk.

Specificity of the Association. Demonstration of specificity in an association makes a causal hypothesis more convincing. Complete specificity only occurs, however, when a single cause is totally responsible for one—and only one—disease or condition and is, therefore, both necessary and sufficient. Because few nutritional factors act in complete independence of other factors, and many have roles in more than one disease, this criterion has limited applicability to evaluation of nutritional evidence.

Degree of Exposure to a Factor. If a dietary factor causes a disease, the risk for developing the disease should increase with the degree of exposure to the factor. The higher the fat intake in a population, for example, the greater should be the rate of coronary heart disease. While evidence of such dose-response relationships increases the plausibility of associations between dietary factors and disease, dose responses are often difficult to demonstrate because of variations in dietary intake and uncertainties in evaluating food and nutrient consumption.

Biological Credibility. There should be a reasonable physiologic explanation for the relationship between the dietary factor and the health outcome. Exposure to the dietary factor should precede the onset of disease, with appropriate latent or induction periods.

Experimentation and elucidation of physiologic and molecular mechanisms provide the most direct evidence for a causal relationship between a dietary factor and a specific disease condition. Epidemiologic studies provide evidence in support of such associations. Although this evidence usually is indirect, it can accumulate in quantity and quality to the point where a causal relationship appears sufficiently probable to provide a reasonable basis for public health action.

Application of these principles to development of a dietary recommendation for reduction of risk for a given disease must consider the effect of that recommendation on the risk for other chronic diseases and on requirements for energy and nutrients. The evidence presented in this Report suggests that similar dietary patterns affect the risk for several chronic diseases. For example, diets containing a large proportion of calories from foods high in fat but low in complex carbohydrates and fiber are associated not only with increased risk for coronary heart disease, but also with increased risk for some types of cancer, diabetes, and obesity. Evidence also suggests that potentially competing risks can be accommodated within recommended changes in such patterns. For example, the recommendations to consume adequate calcium yet reduce overall fat intake can be accommodated by advice to select low-fat dairy products. Consequently, the interdependent nature of dietary changes to reduce disease risk have been considered along with the criteria described above in developing the overall findings and recommendations of this Report.