Table 1-2 (continued)

1843	Chossat studied the effect of starvation on the body using pigeons.
1848	Addison described pernicious anemia.
1849–57	Bernard elucidated digestive action of pancreatic juices and glycogenic function of liver.
1850	Livingstone described xerophthalmia (due to vitamin A deficiency) in Africa.
1850–52	Chatin in France used iodine to prevent goiter.
1866–81	Voit and Pettenkofer explained protein metabolism.
1867	Boussingault recognized iron as essential nutrient.
1877	Pavlov began classic studies on digestion in dogs.
1885	Takaki demonstrated in controlled dietary experiments with Japanese Navy sailors that beriberi could be prevented.
1896	Atwater and Bryant introduced their basic reference, *Chemical Composition of American Food Materials.*
1897	Eijkman published his work on causes of beriberi.
1902	Rubner showed that food components increased metabolism by different amounts.
1909–28	Osborne and Mendel studied the nutritive value of protein.
1912	Funk coined the term "vitamine."
1914	Goldberger established dietary cause of pellagra.
1916	McCollum and Davis and Osborne and Mendel discovered accessory dietary factors "fat-soluble A" and "water-soluble B."
1918	Mellanby showed that experimental rickets in dogs is due to lack of fat-soluble vitamin.
1919–22	Water-soluble B factor shown to be more than one factor.
1921–24	Blindness in children shown to be result of lack of vitamin A.
1922	McCollum identified vitamin D in cod liver oil.
1928	Goldberger identified pellagra-preventing factor in yeast.
1929	Role of intrinsic and extrinsic factors in pernicious anemia discovered.
1931–37	Fluoride content of drinking water identified as cause of mottled enamel of teeth and prevention of tooth decay.
1932	Vitamin C isolated from lemon juice. Warburg and Christian identified riboflavin and defined its molecular function.
1933	Williams identified kwashiorkor as a nutritional disease.

Table 1-2 (continued)

1938	Rose classified amino acids as essential and nonessential.
1941	Evidence provided for the influence of prenatal diet on the health of the newborn infant.
1944–46	Keys and coworkers studied effects on young men of experimentally induced semistarvation and methods of dietary rehabilitation.
1945	Grand Rapids, Michigan, becomes the first city in the world to fluoridate its drinking water to prevent tooth decay.
1948–49	Crystalline vitamin B_{12} isolated from liver extract and shown to contain cobalt.
1949	Framingham Study of coronary heart disease risk factors begins.

Sources: Darby 1985; McCollum 1957; Murlin 1948; Olson 1978; Todhunter 1962, 1973, 1976.

food ingested (Lusk 1933). In the 19th century, European and American scientists isolated and began to identify the major groups of nutrients in the diet, to develop the first estimates of nutrient requirements, and to explore the basics of energy metabolism. For example, in 1816, Magendie of France established that nitrogen-containing compounds were essential in the diet of dogs; in 1838, these compounds were given the name protein (from the French word for "primary substance"). In 1814, the French chemist Chevreul discovered that fats consisted of fatty acids attached to a glycerol molecule. By 1834, the London physician Prout was able to introduce the idea that food consists of substances called saccharine, oily, and albuminous—today called carbohydrates, fats, and proteins (Todhunter 1959). Later in the century, Rubner of Germany and Atwater of the United States established the energy values of these substances as approximately 4, 9, and 4 kcal/g, respectively (McCollum 1957).

Thus, from the time of Lavoisier to the end of the 19th century, knowledge of nutritional science grew to encompass the metabolic basis of energy production from food, the classification of nutrients and sources of energy, the dependence of energy requirements on physical activity, the influence of diet on body weight and of fevers on metabolism of food substances, the principles of metabolic homeostasis, and the roles of specific essential nutrients in human physiology (Murlin 1948). During this period, lemon juice was found to prevent scurvy, iodine to prevent goiter, and incompletely milled rice to prevent beriberi. Despite these advances, the most fundamental concepts about nutrition were still poorly developed at the beginning of the 20th century. It was not until the first half of this

century that scientists identified human nutritional requirements, characterized the nutritional value of proteins, and identified the amino acids, vitamins, fatty acids, and minerals essential in the human diet (Todhunter 1976). For example, Osborne and Mendel of Yale University elucidated the differences between complete and incomplete proteins during the first decades of this century. Later, Rose of the University of Illinois established which of the amino acids were essential and estimated how much of each was required each day.

The diseases of scurvy, beriberi, rickets, and pellagra had been described in very early writings, but their specific causes were not identified until after 1900. In 1906, Hopkins of Cambridge University suggested that food contained certain accessory factors necessary for prevention of these conditions. In 1912, Funk named these factors "vitamines," later called vitamins as more was learned about their chemical structure (Rosen 1958).

Early in the century, the dietary cause of pellagra was established by Goldberger, a PHS physician, and fat- and water-soluble vitamins were isolated and characterized (McCollum 1957). Also during this period, kwashiorkor was identified as a nutritional disease and the importance of prenatal diet on the health of newborn infants began to be appreciated (Darby 1985). Over the next three decades, all of the vitamins were identified, starting with the isolation of a fat-soluble substance in egg yolk by McCollum at the University of Wisconsin, now known as vitamin A, and continuing with the discoveries of folic acid, vitamin B_{12}, and other B vitamins in the 1930's and 1940's (McCollum 1957). The essential nature of trace elements such as selenium and zinc were finally recognized in the 1950's and 1960's (Darby 1985).

After World War II, the major focus of attention in nutrition began to shift away from acute nutrient deficiency diseases. The advent of improved transportation systems and home refrigeration and frozen foods expanded the year-round availability of fresh and wholesome foods, and food fortification helped to increase the availability of previously scarce nutrients. At the same time, vaccines, antibiotics, and other advances in medicine and health prevented and controlled many of the infectious diseases that had previously shortened the human lifespan. Thus, chronic degenerative diseases became more important as causes of illness and death. Nutrition scientists began to examine the relationship of modern dietary patterns and practices to these chronic diseases—cardiovascular disease, cancer, and diabetes, for example—that were becoming increasingly prevalent among

Americans in middle and late life, and attention shifted to the effects of specific nutrients and dietary factors on the long, slow development of these conditions.

Evolution of Federal Nutrition Policy

As knowledge developed in the nutrition sciences and on the health effects of food, and as food availability and consumption patterns became more apparent, nutrition assumed an increasingly visible role in public policy. By 1979, the Federal Government was involved in efforts to ensure an adequate, safe, and nutritious food supply for Americans through sponsorship of more than 350 programs in key areas of nutrition policy: agricultural support, food safety and regulation, food fortification, food assistance, nutrition services and training, food intake and nutritional status monitoring, food and nutrition research, and food and nutrition education (Comptroller General 1979). Some of these programs had roots that reached back to the turn of the century, but since World War II the Government's efforts have increasingly focused on meeting the needs of high-risk groups and on the role of diet in health promotion and disease prevention. Table 1-3 presents a chronological listing of selected events in the development of Federal domestic nutrition policies; the history of Federal initiatives in the major areas of nutrition policy is reviewed below.

Table 1-3
Selected Federal Domestic Nutrition Policy Initiatives, 1862–1988

1862	U.S. Department of Agriculture (USDA) created. Morrill Act establishes land grant colleges.
1867	Office of Education established with responsibilities for nutrition education within public schools.
1887	Hatch Act establishes agricultural experiment stations. Federal research laboratory established at Staten Island. Name is changed to the National Institute of Health in 1930.
1889	U.S. Public Health Service Commissioned Corps authorized for duty on communicable, nutritional, and other diseases.
1893	USDA authorized by Congress to conduct research on agriculture and human nutrition.
1906	The Pure Food and Drug (Wiley) Act prohibits interstate commerce and misbranded and adulterated foods, drinks, and drugs. Federal Meat Inspection Act passed.
1914	Cooperative Extension Service created as part of USDA.
1916	USDA publishes *Food for Young Children*, first dietary guidance pamphlet.

Table 1-3 (continued)

1917	U.S. Food Administration established to supervise World War I food supply. First dietary recommendations issued by USDA—*Five Food Groups*.
1921–29	Maternity and Infancy Act enabled State health departments to employ nutritionists.
1924	Addition of iodine to salt to prevent goiter is first U.S. food fortification program.
1927	Food, Drug, and Insecticide Administration established. Name is changed to Food and Drug Administration (FDA) in 1932.
1930	USDA and Federal Emergency Relief Administration buy and distribute surplus agricultural commodities as food relief. Public Health Service Hygienic Laboratory designated as National Institute of Health (later changes to National Institutes of Health).
1933	Agricultural Act amendments permit purchase of surplus commodities for donation to child nutrition and school lunch programs.
1935	Food Distribution Program established. Social Security Act authorizes grants to States for nutrition services to mothers and children.
1936–37	USDA conducts first Nationwide Food Consumption Survey (NFCS).
1938	The Food, Drug and Cosmetic (FD&C) Act includes provisions for food standards. FDA nutrition research program established. Social Security Act provides support for role of nutrition in health.
1939	Federal Surplus Commodities Corporation initiates experimental Food Stamp Program.
1940	National Defense Advisory Commission draws attention to malnutrition in the United States.
1941	President Roosevelt calls National Nutrition Conference, with announcement of the first Recommended Dietary Allowances by the Food and Nutrition Board. FDA promulgates standards for enrichment of flour and bread with B-complex vitamins and iron.
1946	National School Lunch Program established.
1947	Laboratories of Nutrition, Chemistry, and Pathology of the National Institutes of Health incorporated into Experimental Biology and Medicine Institute.
1954	Special Milk Program established.

Table 1-3 (continued)

1955	Interdepartmental Committee on Nutrition for National Defense established (discontinued 1967).
1956	Title VII of the Public Health Service Act authorizes funds to support graduate training in public health nutrition.
1958	Food Additives Amendment to FD&C Act prohibits use of a food additive until safety established by manufacturer. Delaney Clause prohibits carcinogenic additives. GRAS (Generally Recognized As Safe) list established.
1961	President Kennedy expands the use of surplus food for needy people at home and abroad and announces a new pilot Food Stamp Program.
1963 and 1965	Maternal and Child Health and Mental Retardation Planning Amendments to the Social Security Act allow for an expanded number of nutritionists in health care programs.
1965	Food Stamp Act passed by Congress. Nationwide Food Consumption Survey collects first data on dietary intake of individuals.
1966	Child Nutrition Act passed. School Breakfast Program established. President Johnson outlines Food for Freedom Program, the "war on hunger." Allied Health Professions Personnel Training Act includes support for training of dietitians.
1966–70	The Department of Health, Education, and Welfare (DHEW), which later becomes the Department of Health and Human Services (DHHS), sponsors a National Academy of Sciences study, Maternal Nutrition and the Course of Pregnancy, which makes major recommendations related to the role of nutrition in human reproduction.
1968	U.S. Senate Select Committee on Nutrition and Human Needs established.
1968–70	DHEW sponsors Preschool and Ten-State Nutrition Surveys that report evidence of hunger and malnutrition in poverty groups in the United States.
1969	President Nixon calls White House Conference on Food, Nutrition, and Health. Secretary of Agriculture establishes the Food and Nutrition Service to administer Federal food assistance programs.
1971–74	The National Center for Health Statistics conducts the first National Health and Nutrition Examination Survey (NHANES) to measure the nutritional status of the U.S. population. This is followed by NHANES II in 1976–80, Hispanic HANES in 1982–84, and NHANES III in 1988.

Table 1-3 (continued)

1972	USDA establishes Special Supplementary Food Program for Women, Infants, and Children (WIC). Agriculture and Consumer Protection Act provides price supports to farmers. Amendments to the Older Americans Act of 1965 establish a congregate and home-delivered meals program for older Americans.
1974	U.S. Senate Select Committee on Nutrition and Human Needs issues *Guidelines for a National Nutrition Policy*, prepared by the National Nutrition Consortium. Safe Drinking Water Act passed.
1975	National Institutes of Health establishes Nutrition Coordinating Committee.
1977	U.S. Senate Select Committee on Nutrition and Human Needs issues two editions of *Dietary Goals for the United States*. Food and Agricultural Act and Child Nutrition and National School Lunch Amendments passed.
1978	Joint Subcommittee on Human Nutrition Research established in Office of Science and Technology Policy (in 1983 becomes Interagency Committee on Human Nutrition Research under joint direction of USDA and DHHS). DHEW and USDA submit proposal to Congress for National Nutrition Monitoring System.
1979	DHEW establishes Department-wide Nutrition Policy Board and issues *Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention*.
1980	USDA and DHHS jointly issue *Nutrition and Your Health: Dietary Guidelines for Americans*. A second edition follows in 1985. DHHS issues *Promoting Health/Preventing Disease: Objectives for the Nation*, which contains 17 nutrition objectives to be achieved by the year 1990. The Surgeon General's Workshop on Maternal and Infant Health makes recommendations about improving nutrition for these vulnerable groups.
1981	DHHS and USDA issue *Joint Implementation Plan for a Comprehensive National Nutrition Monitoring System*, revised in 1987 as the *Operational Plan for the National Nutrition Monitoring System*. The Select Panel for the Promotion of Child Health, created by Public Law 95-626, submits to Congress and the Secretary of DHHS its report, which includes recommendations on nutrition.
1984	The Surgeon General's Workshop on Breastfeeding and Human Lactation develops strategies for promoting breastfeeding.
1985	USDA initiates Continuing Survey of Food Intakes by Individuals, repeated in 1986.

Table 1-3 (continued)

1986	DHHS and USDA issue *Nutrition Monitoring in the United States*, the report of the Joint Nutrition Monitoring Evaluation Committee.
1988	DHHS publishes *The Surgeon General's Report on Nutrition and Health*.

Agricultural Support. The earliest Federal nutrition policies in this area were designed to strengthen the agricultural production system and to ensure a consistent and adequate food supply. In 1862, the U.S. Department of Agriculture (USDA) was created, and the Morrill Act established land grant universities as sites for agricultural training and research. The Hatch Act of 1887 authorized the creation of agricultural experiment stations. As a result of these and other policies, food production increased and farmers began to produce more food than could be consumed. Eventually, a system of commodity price and income supports was developed to stabilize the economic condition of the farm sector. The Agricultural and Consumer Protection Act of 1973 and the Food and Agriculture Act of 1977 established the basis for current agricultural support policies (Stucker and Boehm 1978; Boehm 1979).

Food Safety and Regulation. The pure food movement of the late 1800's, led by Dr. Harvey Wiley, chief of the Government's Bureau of Chemistry, and popularized by the publication of Upton Sinclair's novel of 1906, *The Jungle*, led Congress to pass the Pure Food and Drug Act of 1906—then known as the Wiley Act—which prohibited interstate transport and sale of misbranded or adulterated foods (Ziporyn 1985). This Act and the Federal Meat Inspection Act, also passed that year, extended Federal responsibility into the arena of food safety. Significant revisions to the legislation occurred in 1938 when the Food, Drug, and Cosmetic Act established standards of identity and quality for certain foods, required ingredient listings on food labels, and prohibited sales of foods that were determined to be harmful to health. In 1958, the Food Additives Amendment to the 1938 Act shifted the burden of proof of safety to the manufacturer, required that additives known to cause cancer in either humans or animals be deemed unsafe (the Delaney Clause), and established the list of ingredients in common use that were "Generally Recognized As Safe" (GRAS) for human consumption. A 1960 Color Additives Amendment applied the Delaney Clause to all chemical food coloring agents. Since 1969, a major review has been under way of the safety of substances on the GRAS list (Smith and Rulis 1981). Regulation of food safety is a shared responsibility

of several Federal agencies, primarily the USDA for plant, animal, poultry production; the Food and Drug Administration (FDA) for all c foods and additives; and the Environmental Protection Agency pesticide contaminants.

The food labeling provisions of the 1906 and 1938 Acts were designe protect consumers against fraudulent misbranding of foods, and this pc was extended by the Fair Packaging and Labeling Act of 1966, which ca for accurate ingredient labeling on foods in interstate commerce (Pc 1987). More recently, interest has grown in the use of food labels to edu consumers about the nutritional quality of food and the role of nutritic health. Regulations published in 1973 authorized voluntary nutrition la ing and required nutrition labeling for fortified foods and those for wl nutritional claims were made (Hutt 1981). In 1987, the FDA proposed a policy for public health messages on food labels to permit health claim package labels when the information is true and certain criteria are (FDA 1987). Responsibility for regulating labeling and marketing pr dures related to foods is shared by the USDA (meat, poultry, eggs), F (all other foods) and, for advertising, the Federal Trade Commission (ter 1987).

Food Fortification. The onset of World War I brought new nutriti concerns and focused attention on the need for an overall improvemer the availability of nutrients to the general population. The first food tification program, instituted in 1924, was the addition of iodine to sal prevent goiter. During the Second World War, this program was extende include enrichment of wheat flour with iron and the vitamins thian niacin, and riboflavin. Also during the 1940's, milk was fortified v vitamin D and margarine with vitamin A.

Food Assistance. As early as 1918, the idea of targeting food assistanc vulnerable population groups was proposed in the Children's Bureau p lication *Milk—The Indispensable Food for Children.* Milk supplies l decreased and prices increased due to the effects of World War I, and Children's Bureau advocated that children be given priority in allocat milk supplies. Charitable organizations established milk stations and cc munity kitchens to provide food supplements to the poor and to help peo with limited income choose and prepare an adequate diet (Egan 1980

Widespread unemployment and poverty during the 1930's stimulated t development of new Federal programs to provide food assistance to t poor. At first, these programs focused exclusively on distribution of surp agricultural commodities. In 1930, for example, the USDA and the Fede

Emergency Relief Administration began a distribution program as food relief. The donation of surplus foods to child nutrition and school lunch programs was authorized by amendments to the Agricultural Act in 1933. The more formally organized Food Distribution Program was established in 1935. An experimental Food Stamp Program was initiated by the Surplus Commodities Corporation in 1939. The National School Lunch Program was established in 1946, and the Special Milk Program was added in 1954 (U.S. Senate 1976).

In the early 1960's, as a result of surveys and assessments indicating special needs among low-income populations (Citizens' Board 1968), the Federal Government expanded its involvement in income support and direct delivery of food services. A pilot study in 1961 led to the Food Stamp Act of 1965, which authorized a small-scale program to meet limited needs for food assistance. The Child Nutrition Act of 1966 established the School Breakfast Program. Following the 1969 White House Conference on Food, Nutrition, and Health (White House Conference 1970), eligibility and benefits were enlarged for the Food Stamp, School Lunch, School Breakfast, Special Milk, and Summer Food Programs; the Special Supplemental Food Program for Women, Infants, and Children (WIC) was created; general assistance reimbursements were increased (for the School Breakfast and School Lunch Programs); and the Nutrition Program for the Elderly was established through an amendment to the Older Americans Act. From 1969 to 1977, Federal expenditures for these programs increased from about $1.2 to $8.3 billion (U.S. Senate 1977a). By 1986, as many as 50 million Americans (the exact number is uncertain due to overlapping benefits) were served by food assistance programs administered by the USDA. The cost of these programs exceeded $18.8 billion in 1986 and $20 billion in 1987 (Matsumoto 1987).

Nutrition Services and Training. In the 1920's under the Federal Maternity and Infancy Act, nutrition services were launched in nine State departments of public health. Enactment of the Social Security Act in 1935, authorizing grants-in-aid to the States for health services for mothers and children, was a major impetus for the further development of nutrition services in State health agencies. By 1945, all but three States had one or more nutrition consultant positions included in their budgets. Nutrition services began to extend beyond maternal and child health during the late 1950's and early 1960's in response to new mental retardation, chronic disease control, home health service, and nursing home and other extended care programs. Initiatives in primary health care, family planning, and comprehensive health planning during the 1970's further expanded the availability of nutrition services (Nutrition Services Project Committee

1983), as did establishment of the Community Food and Nutrition Program (CFN) in the 1980's to provide nutrition services to low-income populations (Office of Community Services 1987).

To ensure an adequate supply of health professionals to serve the population, the Federal Government also supports health professions education in primary care as well as public health practice. Since the 1940's, funds have been available from Title V of the Social Security Act for nutrition training of health professionals, and since 1957, various authorities under Title VII of the Public Health Service Act have supported health professions students and curriculum development in applied nutrition, including capitation grants to schools of public health that support traineeships for public health nutrition students.

Food Intake and Nutrition Status Monitoring. The involvement of the Federal Government in monitoring of food intake dates back to 1893 when the USDA received an appropriation for this purpose (Porter 1986). The USDA first began to collect data on the wholesale availability or "disappearance" of food commodities in 1909. The subsequent annual collection of such data has provided an important source of information on trends in the availability of food, an indirect indicator of food use by the population (Bunch 1987). Attempts to estimate actual food intake by the population began in the 1930's. For example, household food purchases were examined by the USDA in 1936–37 through the first Nationwide Food Consumption Survey (NFCS); such surveys have been conducted about every 10 years since, most recently in 1987–88 (USDA 1986, 1987a, 1987b). Estimations of the per capita nutrient content of the food supply began in the 1940's and are now reported annually (Marston and Raper 1986). The first collections of data on the food consumption habits of individuals in sampled households were performed by the USDA in 1965 (NRC 1984). Examples of food intake and availability data are given later in this chapter in the section on dietary patterns.

Assessment of nutritional status emerged as a concern as early as 1918 when infants and children were weighed and measured during the opening event of the Children's Year Campaign (initiated to "protect children from the effects of war"). The impetus for this activity was the high percentage of Selective Service rejections in World War I caused by conditions that might have been prevented or corrected by adequate nutrition in early childhood. The first studies of nutrition and child health were conducted by the Children's Bureau in a mountainous section of Kentucky in 1920 and in the industrial area of Gary, Indiana, in 1922 (Egan 1980).

Much of the recent expertise in measuring human nutritional status was developed through the work of the Interdepartmental Committee on Nutrition for National Defense, which conducted nutrition surveys in more than 30 countries during the 1950's and 1960's. Attempts to evaluate the nutritional status of the U.S. population began in 1956 when Congress authorized the Department of Health, Education, and Welfare (DHEW) to conduct periodic national health examination surveys; with the addition in 1971 of additional status measures, including a dietary intake component, these surveys evolved into the National Health and Nutrition Examination Surveys (NHANES). The first NHANES was conducted from 1971–74, the second from 1976–80, and the Hispanic HANES from 1982–84 (DHHS/USDA 1986). The third NHANES started in 1988. In 1968–70, in response to increasing concern about the nutritional status of low-income populations, DHEW sponsored the Preschool (Owen et al. 1974) and Ten-State (DHEW 1972) Nutrition Surveys and identified evidence of malnutrition in these populations.

The dietary intake, health, and nutritional status surveys and surveillance systems listed in Table 1-4 and described above are components of the National Nutrition Monitoring System—a complex assortment of interconnected activities that provide regular information about dietary intake and nutritional status to the health of the American people and about factors that affect diet and nutritional status (DHHS/USDA 1987). The present system was proposed in 1978 in response to a congressional request in the 1977 Food and Agriculture Act that the Secretaries of Agriculture and of Health, Education, and Welfare, now Health and Human Services (DHHS), develop a joint proposal for a comprehensive system that would monitor the nutritional status of the American people. In 1981, a *Joint Implementation Plan* (revised in 1987) committed the two Departments to close coordination of survey methods and to submission of reports to Congress every 3 years on information gained from monitoring activities. The National Nutrition Monitoring System includes efforts by several Federal agencies to provide information about health and nutritional status, food consumption, food composition, dietary knowledge and attitudes, and food safety and quality.

Food and Nutrition Research. The Federal role in nutrition research began in 1887 with the development of the forerunner of the National Institutes of Health (NIH) as a one-room laboratory on Staten Island. In 1893, the USDA was authorized to perform agricultural and human research. The PHS Hygienic Laboratory developed into the first National Institute of Health in 1930; subsequently, it was joined by other laboratories to create

Table 1-4
National Nutrition Surveillance Activities

Category	Activity	Department[a]	Agency[a]	Population	Timing
Health and Nutritional Status Measurements	National Health and Nutrition Examination Surveys	DHHS	CDC/NCHS	U.S. population, special groups	
	NHANES I			1–74 yrs	1971–74
	NHANES II			6 mo–74 yrs	1976–80
	Hispanic HANES			6 mo–74 yrs	1982–84
	NHANES III			2 mo+	1988–94
	National Health Interview Survey	DHHS	CDC/NCHS	U.S.	Annual
	NHIS Special Topics	DHHS	CDC/NCHS	U.S.	Selected topics
	NHANES I Epidemiologic Followup	DHHS	CDC/NCHS	NHANES I older persons	1982–84, 1986, 1987
	National Survey of Family Growth	DHHS	CDC/NCHS	Women 15–44 yrs	1976, 1983, 1987
	National Maternal and Infant Health Survey	DHHS	CDC/NCHS		Planned 1988
	National Mortality Survey	DHHS	CDC/NCHS		Annual 1961–68, 1986
	Vital Statistics	DHHS	CDC/NCHS	U.S. States, counties, local areas	Annual

Health and Nutritional Status Measurements (continued)	Coordinated State Surveillance System	DHHS	CDC/CHPE	Pregnant women, children	Continuous
	Behavioral Risk Factor Surveillance System	DHHS	CDC/CHPE	Adults	Continuous
	Nutrition Research in Support of Nutrition Monitoring[b]	DHHS USDA	NIH ARS CDC/CHPE FDA	Varies	Ongoing
Food Consumption Measurements	Nationwide Food Consumption Survey (NFCS)	USDA	HNIS	U.S., low-income sample	Every 10 years, current 1987–88
	Continuing Survey of Food Intakes by Individuals (CSFII)	USDA	HNIS		
	1985 and 1986			Women 19–50, their children, men, low-income sample	Annual
	1989 and beyond			U.S. population, low-income sample, other	Annual (planned)
	NHANES	DHHS	CDC/NCHS	U.S. population	1971–74, 1976–80, 1982–84, 1988–94

Table 1-4 (continued)

Food Consumption Measurements (continued)	Total Diet Study	DHHS	FDA	Specific age-sex groups	Annual
	Vitamin/Mineral Supplement Adverse Reactions	DHHS	FDA	U.S.	Continuous
Food Composition Measurements	Nutrient Data Bank	USDA	HNIS		Continuous
	Nutrient Composition Laboratory	USDA	ARS		Continuous
	Food Labeling and Package Survey	DHHS	FDA		Annual and biennial parts
	Total Diet Study	DHHS	FDA		Annual
	Fiber, Carotenoid, and Vitamin A Comp. Studies;	DHHS	NIH/NCI		Ongoing
	Taurine and Biotin Comp. Studies		NIH/ NIDDK		Ongoing
Dietary Knowledge and Attitude Assessment	Health and Diet Survey	DHHS	FDA	U.S. adults	• 18–22 mo intervals
	Survey of Infant Feeding Practices	DHHS	FDA	Pregnant women	1988 or 1989
	Survey of Weight-Loss Practices	DHHS	FDA NIH/ NHLBI	U.S. adults	1987 or 1988
	Cholesterol Awareness Survey	DHHS	NIH/ NHLBI + FDA	Physicians Adults	1986

Dietary Knowledge and Attitude Assessment (continued)	Nursing and Dietitian Survey	DHHS	NIH/ NHLBI	Nurses, dietitians	1986, 1987
	NHIS Special Topics	DHHS	CDC/NCHS	U.S. adults	
	Health Promotion/ Disease Prevention				1985
	Vit/Min Supplement				1986
	Cancer Control		+ NIH/NCI		1987
	CSFII Followup (Consumer Perceptions Survey)	USDA/DHHS	HNIS FSIS FDA	U.S. population	Planned 1989–96
	Physician Knowledge Survey on Hypertension	DHHS	NIH/NHLBI	Physicians	1978–88
	Cancer Prevention Awareness Program	DHHS	NIH/NCI	U.S. adults	1984 + ongoing
Food Supply Determinations	Demand Studies	USDA	ERS	U.S. population	Continuous

[a]ARS = Agricultural Research Service, CDC = Centers for Disease Control, CHPE = Center for Health Promotion and Education, DHHS = Department of Health and Human Services, ERS = Economic Research Service, FDA = Food and Drug Administration, FSIS = Food Safety and Inspection Service, HNIS = Human Nutrition Information Service, NCHS = National Center for Health Statistics, NCI = National Cancer Institute, NHIS = National Health Interview Survey, NHLBI = National Heart, Lung, and Blood Institute, NIDDK = National Institute of Diabetes and Digestive and Kidney Diseases, NIH = National Institutes of Health, USDA = U.S. Department of Agriculture.

[b]Includes research on nutritional status assessment and requirements throughout the life cycle. The nutritional status research focuses on (1) indices of nutritional status, (2) micromethods to measure nutrient concentrations in various tissues and plasma, and (3) methods that improve accuracy of dietary intake data.

Source: U.S. Department of Health and Human Services and U.S. Department of Agriculture 1987.

the present research enterprise of NIH (Simopoulos 1986). In 1975, the NIH Nutrition Coordinating Committee was established to address NIH nutrition issues that span the goals and purposes of 12 Institutes, 2 Divisions, and 2 Centers within the agency. The FDA began conducting nutrition research in 1938. By 1976, Federal expenditures for nutrition research and research training exceeded $73 million (U.S. Senate 1976). The amount was reported as nearly $200 million by 1979 (JSHNR 1980) and $270 million in 1984, of which nearly $200 million represented research supported by NIH (ICHNR 1986; NIH 1987). In 1987, NIH expended a total of $261 million, reinforcing its longstanding position as the major Federal agency in biomedical and behavioral nutrition research and training support. This nutrition research encompasses a broad range of topics, including health maintenance, human development throughout the life cycle, disease prevention, and disease treatment.

The Interagency Committee on Human Nutrition Research (ICHNR) was established by the Secretaries of DHHS and USDA to succeed the Joint Subcommittee on Human Nutrition Research that operated out of the White House Office of Science and Technology Policy to coordinate all Federal nutrition research activities. The ICHNR produced a 5-year plan for human nutrition research that reviewed the research activities of eight Federal agencies, listed research priorities, and identified six areas for expanded research investigation: nutritional requirements at various stages of the life cycle, nutrition interactions and bioavailability, nutrition and chronic diseases, energy regulation and eating disorders, nutrition monitoring, and nutrition education methodology (ICHNR 1986).

Dietary Guidance and Nutrition Education. The Federal Government has supported efforts to teach the public about nutrition since 1867 when the Office of Education was established with responsibility for nutrition education within the public schools. The Children's Bureau of the Department of Labor published *Prenatal Care* in 1913 and *Infant Care* in 1914 to provide dietary guidance to mothers. These books have been in publication ever since and are all-time best sellers of the U.S. Government Printing Office.

The USDA also had an early role and published its first food selection guide, designed to help parents meet the nutritional needs of young children, in 1916 (Hunt 1916). Since that time, federally supported dietary guidance materials have been issued and revised regularly to meet the needs of specific target audiences and to reflect emerging knowledge of nutritional science. A list of Federal dietary guidance publications for the general public since 1917 is presented in Table 1-5.

Table 1-5
Federal Dietary Recommendations for the General Public, 1917–1988

Year	Agency[b]	Publication	Recommendation[a]							
			Variety	Maintain Ideal Body Weight	Include Starch and Fiber	Limit Sugar	Limit Fat	Limit Cholesterol	Limit Salt	Limit Alcohol
1917	USDA	What the Body Needs—Five Food Groups	+		+	*	*			
1942	USDA	Food for Freedom—Daily Eight	+		+		*			
1943	USDA	National Wartime Nutrition Guide—Basic Seven	+		+		*			
1946	USDA	National Food Guide—Basic Seven	+		+		*			
1946	USDA	Food for Growth—Four Food Groups	+		+					
1958	USDA	Food for Fitness—Four Food Groups	+		+					
1977	U.S. Senate	Dietary Goals for the U.S.		+	+	+	+	+	+	
1979	USDA	Building a Better Diet—Five Food Groups	+	+	+	+	+	+	+	+
1979	DHEW	Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention	+	+	+	+	+	+	+	+
1979	DHEW/NCI	Statement on Diet, Nutrition, and Cancer—Prudent Interim Principles	+	+	+		+			+

Table 1-5 (continued)

Year	Agency[b]	Publication	Recommendation[a]							
			Variety	Maintain Ideal Body Weight	Include Starch and Fiber	Limit Sugar	Limit Fat	Limit Cholesterol	Limit Salt	Limit Alcohol
1980	USDA/DHHS	Dietary Guidelines for Americans	+	+	+	+	+	+	+	+
1980	DHHS	National 1990 Nutrition Objectives	+	+	+	+	+	+	+	+
1984	DHHS/NHLBI	Recommendations for Control of High Blood Pressure		+			+		+	+
1985	USDA/DHHS	Dietary Guidelines for Americans, 2nd edition	+	+	+	+	+	+	+	+
1986	DHHS/NCI	Cancer Control Nutrition Objectives for the Nation: 1985–2000		+	+		+			+
1987	DHHS/NHLBI	National Cholesterol Education Program Guidelines	+	+	+		+	+		+
1988	DHHS/NCI	Dietary Guidelines for Cancer Prevention	+	+	+		+		+	+

*Recommended for *inclusion* in the daily diet, as opposed to subsequent recommendations to *limit* intake.

[a]Other recommendations include: increased consumption of foods containing vitamins and minerals (USDA 1917–1958; NCI 1986), increased physical activity (USDA/DHHS 1980, 1985; DHHS 1980), and reduced intake of salt-cured or smoked foods (NCI 1988).

[b]USDA = U.S. Department of Agriculture, U.S. Senate = U.S. Senate Select Committee on Nutrition and Human Needs, DHEW = Department of Health, Education, and Welfare, DHHS = Department of Health and Human Services, NCI = National Cancer Institute, NHLBI = National Heart, Lung, and Blood Institute.

The earliest federally sponsored guidelines advised the public to consume portions from a variety of food groups every day to obtain sufficient energy and to avoid nutritional deficiencies. As more was learned about nutrients essential in the diet, recommendations began to emphasize consumption of foods containing vitamins, minerals, and other "protective" dietary components (Hertzler and Anderson 1974). In response to the economic crisis of the 1930's, the USDA began to develop meal plans for consumers at different levels of income to address issues of cost (Haughton, Gussow, and Dodds 1987).

The first Recommended Dietary Allowances (RDA's) for intake of energy and eight nutrients were developed by the National Research Council and adopted at the wartime National Nutrition Conference in 1941 (Roberts 1958). RDA's have been published periodically since; the most recent (ninth) edition appeared in 1980 (NRC 1980). Its recommendations are reviewed later in this chapter. Also in 1941, the USDA, in cooperation with the Office of Education and the PHS, published the first Federal guide to incorporate information on specific vitamins and minerals and the first to use the term "enriched." Meal plans and dietary guidelines published since the 1940's have been designed increasingly to translate the RDA's into terms usable by consumers (Hertzler and Anderson 1974). The USDA's 1958 *Food for Fitness—A Daily Food Guide*, written in terms of four food groups, was the first to promote intake of specific nutrients—calcium, vitamin A, and vitamin C—that were commonly consumed in amounts substantially below RDA levels (Haughton, Gussow, and Dodds 1987).

Typically, an adequate diet has been defined as providing the basic food groups that would contain amounts of essential nutrients—protein, vitamins, and minerals—sufficient to prevent deficiency diseases. In the mid-1970's, however, the focus of national policy objectives expanded to encompass the role of overconsumption of fat, cholesterol, salt, sugar, and alcohol as dietary factors associated with chronic disease. The increasing scientific interest in these relationships led the U.S. Senate to hold hearings on diet and health from 1973 through 1977 (U.S. Senate 1977a). Expanding knowledge of the role of diet in health maintenance also led to the development in 1975 of a DHEW Policy Statement on Health Aspects of Nutrition (U.S. Senate 1976). Thus, dietary adequacy began to include consideration of the most reasonable proportions of dietary factors for prevention of chronic—rather than deficiency—diseases.

This new perspective was reflected in the two editions of the 1977 report *Dietary Goals for the United States*, produced by the Senate Select Committee on Nutrition and Human Needs (U.S. Senate 1977b, 1977c). These

reports recommended significant changes in average dietary intake patterns to improve protection against the principal chronic diseases. To accomplish this goal, they established quantitative targets for consumption of complex carbohydrates and naturally occurring sugars (greater than 48 percent of energy), refined and processed sugars (10 percent of energy), total fats (less than 30 percent of energy), saturated fat (less than 10 percent of energy), cholesterol (less than 300 mg/day), and salt (less than 5 g/day) (U.S. Senate 1977c).

These principles, although not the quantitative targets, were supported and expanded in the 1979 report *Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention* (DHEW 1979) and by the 1980 publication *Nutrition and Your Health: Dietary Guidelines for Americans*, jointly issued and revised in 1985 by the Departments of Agriculture and of Health and Human Services (USDA/DHHS 1985). The *Guidelines* recommend:

- Eat a variety of foods.
- Maintain desirable weight.
- Avoid too much fat, saturated fat, and cholesterol.
- Eat foods with adequate starch and fiber.
- Avoid too much sugar.
- Avoid too much sodium.
- If you drink alcoholic beverages, do so in moderation.

This approach reflects the increase in interest in the relation between nutrition and prevention of chronic diseases, a development that has shaped and mandated Federal nutrition education activities of the past decade (see Table 1-4) and is the principal focus of the discussion, conclusions, and recommendations of this Report.

Scientific Background

Human Nutritional Requirements

Essential nutrients must be obtained from the diet in the proper amounts and proportions to maintain good health and to prevent deficiency diseases. A deficiency of an essential nutrient causes signs and symptoms that can be prevented or cured by an increased intake of the nutrient. Such deficiencies may be due to inadequate dietary intake, or they may be

induced by either inherited or acquired inabilities to absorb, transport, store, or metabolize nutrients or by excessive losses of nutrients from the body (for example, from vomiting, bleeding, or diarrhea).

Just as a deficiency of a nutrient can cause disease, too much of a nutrient can also lead to disease. For example, as discussed throughout this Report, the excessive consumption of energy, fat (especially saturated fat), and alcohol have been associated with the development of specific chronic disease conditions in some individuals. Excessive intake of some vitamins and most of the minerals also has been shown to result in either acute or long-term disorders. For most nutrients, there appears to be a safe and adequate range of dietary intake that satisfies nutritional requirements but does not cause untoward symptoms. This concept is illustrated in Figure 1-1. Ideally, the diet should contain energy and all of the essential nutrients in amounts that fall within these ranges of intake.

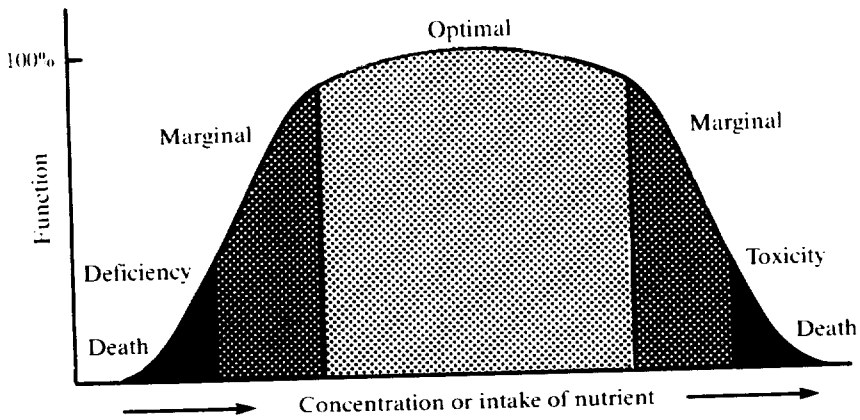

Figure 1-1. Dependence of biologic function or tissue concentration on intake of a nutrient. For nutrients and energy sources, there is a range of intake that confers optimal physiologic function. Below this range, deficiencies can cause disease or death. Excessive intake also can lead to increasing symptoms of toxicity. The optimal range varies for each nutrient and is affected by many individual and environmental factors.

Source: Mertz, W. 1981. The essential trace elements. *Science* 213:1332-38. Copyright 1981 by the American Association for the Advancement of Science, reprinted with permission.

Recommended Dietary Allowances

The need to establish goals for good nutrition in the United States was recognized in the 1930's and led to the establishment in 1940 of the Committee on Food and Nutrition, now called the Food and Nutrition Board, of the National Research Council, National Academy of Sciences. The Committee's initial purpose was to make sure that the population was adequately nourished during World War II, and one of its early functions was to recommend quantities of nutrients that should be provided to the Armed Forces and the general population. These recommendations led to the development of goals for intake of nine specific nutrients that would meet the known nutritional requirements of men, women, and children of varying ages. These first RDA's were adopted in 1941 (Roberts 1958), and they have been published at 5- to 10-year intervals since 1943. Although the original purpose of the RDA's was to promote nutritional health during wartime, their purpose has expanded over the years to include use for development of standards for food assistance programs, food labels, and evaluation of dietary adequacies.

Because research on human nutritional requirements is often incomplete or inconsistent, and because of variability in individual nutrient requirements, the RDA's represent an estimated, rather than an absolute, standard of dietary adequacy, and they are revised periodically to reflect current scientific evaluation of the available nutrition research. The most recent revision was published in 1980 and is presented in Table 1-6 (NRC 1980). The RDA's are defined as ". . . the levels of intake of essential nutrients considered, in the judgment of the Committee on Dietary Allowances of the Food and Nutrition Board on the basis of available scientific knowledge, to be adequate to meet the known nutritional needs of practically all healthy persons." Thus, each RDA is deliberately set higher than the actual requirement for that nutrient in most individuals.

Specific RDA's have been established for protein, 10 vitamins, and 6 minerals; they are presented in categories that vary according to body size, gender, and energy consumption (NRC 1980). RDA's are usually higher for males than for females, except for women who are pregnant or lactating. For 12 additional nutrients, research has been too limited to establish specific RDA's and the Food and Nutrition Board has proposed ranges of daily intake that are considered "safe and adequate." These are presented in Table 1-7. The RDA's are designed to exceed the nutrient requirements of most individuals, but the allowances for energy are designed to reflect average needs for people of different heights and weights, ages, and activity levels.

Table 1-6
Food and Nutrition Board, National Academy of Sciences-National Research Council Recommended Daily Dietary Allowances,[a] Revised 1980
Designed for the maintenance of good nutrition of practically all healthy people in the U.S.A.

	Age (years)	Weight (kg)	Weight (lb)	Height (cm)	Height (in)	Protein (g)	Fat-Soluble Vitamins: Vitamin A (μg RE)[b]	Fat-Soluble Vitamins: Vitamin D (μg)[c]	Fat-Soluble Vitamins: Vitamin E (mg α-TE)[d]
Infants	0.0–0.5	6	13	60	24	kg × 2.2	420	10	3
	0.5–1.0	9	20	71	28	kg × 2.0	400	10	4
Children	1–3	13	29	90	35	23	400	10	5
	4–6	20	44	112	44	30	500	10	6
	7–10	28	62	132	52	34	700	10	7
Males	11–14	45	99	157	62	45	1000	10	8
	15–18	66	145	176	69	56	1000	10	10
	19–22	70	154	177	70	56	1000	7.5	10
	23–50	70	154	178	70	56	1000	5	10
	51+	70	154	178	70	56	1000	5	10
Females	11–14	46	101	157	62	46	800	10	8
	15–18	55	120	163	64	46	800	10	8
	19–22	55	120	163	64	44	800	7.5	8
	23–50	55	120	163	64	44	800	5	8
	51+	55	120	163	64	44	800	5	8
Pregnant						+30	+200	+5	+2
Lactating						+20	+400	+5	+3

[a]The allowances are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods to provide other nutrients for which human requirements have been less well defined.

[b]Retinol equivalents; 1 RE = 1 μg retinol or 6 μg β carotene.

[c]As cholecalciferol; 10 μg cholecalciferol = 4000 IU of vitamin D.

[d]α-tocopherol equivalents; 1 mg *d*-α tocopherol = 1 α-TE.

Table 1-6 (continued)

	Age (years)	Weight (kg)	Weight (lb)	Height (cm)	Height (in)	Water-Soluble Vitamins: Vitamin C (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg NE)[e]	Vitamin B_6 (mg)	Folacin[f] (μg)	Vitamin B_{12} (μg)
Infants	0.0–0.5	6	13	60	24	35	0.3	0.4	6	0.3	30	0.5[g]
	0.5–1.0	9	20	71	28	35	0.5	0.6	8	0.6	45	1.5
Children	1–3	13	29	90	35	45	0.7	0.8	9	0.9	100	2.0
	4–6	20	44	112	44	45	0.9	1.0	11	1.3	200	2.5
	7–10	28	62	132	52	45	1.2	1.4	16	1.6	300	3.0
Males	11–14	45	99	157	62	50	1.4	1.6	18	1.8	400	3.0
	15–18	66	145	176	69	60	1.4	1.7	18	2.0	400	3.0
	19–22	70	154	177	70	60	1.5	1.7	19	2.2	400	3.0
	23–50	70	154	178	70	60	1.4	1.6	18	2.2	400	3.0
	51+	70	154	178	70	60	1.2	1.4	16	2.2	400	3.0
Females	11–14	46	101	157	62	50	1.1	1.3	15	1.8	400	3.0
	15–18	55	120	163	64	60	1.1	1.3	14	2.0	400	3.0
	19–22	55	120	163	64	60	1.1	1.3	14	2.0	400	3.0
	23–50	55	120	163	64	60	1.0	1.2	13	2.0	400	3.0
	51+	55	120	163	64	60	1.0	1.2	13	2.0	400	3.0
Pregnant						+20	+0.4	+0.3	+2	+0.6	+400	+1.0
Lactating						+40	+0.5	+0.5	+5	+0.5	+100	+1.0

[e]Niacin equivalent; 1 NE = 1 mg of niacin or 60 mg of dietary tryptophan.

[f]The folacin allowances refer to dietary sources as determined by *Lactobacillus casei* assay after treatment with enzymes (conjugates) to make polyglutamyl forms of the vitamin available to the test organism.

[g]The recommended dietary allowance for vitamin B_{12} in infants is based on average concentration of the vitamin in human milk. The allowances after weaning are based on energy intake (as recommended by the American Academy of Pediatrics) and consideration of other factors, such as intestinal absorption.