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Nutrition in Public Health and Preventive Medicine

Marion Nestle

The role of nutrition in public health and preventive medicine is self-evident: people must eat to live. Both inadequate and excessive food intake can adversely affect health, and both contribute to the leading causes of morbidity and mortality in every nation, developing as well as industrialized. Because all people consume food, all have an interest in the effects of diet on health. Nutrition, therefore, becomes an unusually accessible entry point into public health education and intervention programs. Because food intake is determined not only by individual choice but also by cultural and social norms, economic status, and agricultural and food policies, public health approaches to dietary intervention are not only appropriate, but necessary.

This chapter discusses diet and nutrition within the broad context of public health. It describes the health impact of dietary intake below and above recommended levels of energy and essential nutrients. It reviews current standards and guidelines for patterns of food intake that best meet nutritional requirements, improve nutritional status, and promote health. Finally, it suggests public health strategies to address behavioral and environmental barriers to consumption of healthful diets by individuals and populations.

▸ DIETARY REQUIREMENTS AND ALLOWANCES

People require a continuous supply of external food sources of energy and essential nutrients to maintain life, grow, and reproduce.[1,2] By definition, essential nutrients are those that cannot be synthesized in adequate amounts by the body; their dietary or metabolically induced deficiency causes recognizable symptoms that disappear when they are replaced. The list of nutrients essential or otherwise useful to human physiology is long, complex, and almost certainly incomplete. It includes the more than 40 distinct substances listed in Table 72-1: sources of energy, amino acids, fatty acids, vitamins, minerals and trace elements, fiber, and water. As indicated in Table 72-1, other nutrients also may be required under certain conditions.

Malnutrition refers to excessive and unbalanced—as well as deficient—intake of essential nutrients. Fat-soluble vitamins and virtually all of the mineral elements cause disease symptoms when consumed or absorbed in excess. The adverse effects of overconsumption of energy, saturated fat, cholesterol, salt, sugars, and alcohol are important public health concerns. For each nutrient, a certain range of intake meets physiologic requirements but does not induce harmful symptoms.[3] Optimal levels of intake of specific nutrients for individuals, however, can only be estimated. Individuals vary in nutrient requirements, and research on human nutritional requirements is incomplete.

Many countries have developed standards of nutrient adequacy for their populations for purposes such as nutrition education, nutrition counseling, food labeling, and dietary intervention programs. Because standards are based on interpretation of the existing research, they differ from one country to another.[4] Until the late 1980s in the United States, the National Academy of Sciences' Food and Nutrition Board (now in the Institute of Medicine) estimated levels of nutrient intake "adequate to meet the known nutritional needs of practically all healthy persons," and published them every decade or so as recommended dietary allowances (RDAs).[5] The RDAs were (and continue to be) set at levels that prevent overt signs of nutritional deficiency in 97–98% of the population—two standard deviations above mean requirements. Although lower levels of intake meet the nutritional needs of most individuals, RDAs were widely misinterpreted to be *minimal* requirements. For this reason, and because the RDAs addressed nutrient deficiencies but not excesses that might raise risks for chronic diseases, the Food and Nutrition Board (FNB) replaced them beginning in 1997 with new standards—Dietary Reference Intakes (DRIs)—developed jointly with Canada (Fig. 72-1).

The FNB developed the DRIs in line with the current direction of nutrition science toward increasing complexity and individualization of dietary standards and recommendations, a trend much at odds with public health approaches. Although the 1989 RDAs appeared in a slim volume of under 300 pages easily summarized in two tables, the DRIs comprise six volumes of 400–800 printed pages each.[6–11] The DRIs include the former RDAs, but also introduce three new components: adequate intake (AI), tolerable upper intake level (UL), and estimated average requirement (EAR). Table 72-2 defines these standards and summarizes how they are meant to be used for diet assessment and planning.

The DRIs are individualized into values for 10 age categories (among infants, children, males, and females) and for pregnant and lactating women. They are based on biochemical, epidemiological, and clinical research, but such data are limited and many values have had to be estimated or extrapolated, especially for younger and older age groups. Thus, the DRIs are subject to many of the same criticisms that had been applied to the former RDAs. As Table 72-2 shows, the RDA (or the AI) continues to be used as a goal for individual intake even though it greatly exceeds average requirements.

The DRIs are meant to apply to nutrient intake from food, but some RDAs or AIs are set so high that it would be difficult, if not impossible, to meet them through normal dietary intake. For example, on the basis of levels required for maximum retention, the AI for calcium is set at 1200 mg per day for older adults, an amount obtainable only by consuming large amounts of dairy foods, supplements,

TABLE 72-1. DIETARY COMPONENTS CONSIDERED ESSENTIAL FOR HUMAN HEALTH*

Category	*Examples*
Energy sources	Carbohydrate, fat, protein, alcohol†
Essential amino acids	Isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine, histidine
Essential fatty acids	Linoleic acid, linolenic acid‡
Vitamins	
Water-soluble	Biotin,§ choline,¶ folate, niacin, pantothenic acid, riboflavin, thiamin, vitamin B_6 (pyridoxine), vitamin B_{12} (cobalamins), vitamin C (ascorbates)
Fat-soluble	Vitamins A[a], D[b], E, K§
Minerals	Calcium, chloride, magnesium, phosphate, potassium, sodium
Trace elements	Chromium, cobalt,[c] copper, fluoride, iodine, iron, manganese, molybdenum, selenium, zinc
Fiber	
Water	

*See references 6-11.
†Carbohydrates (starches and sugars), proteins, fat, and alcohol contribute about 4, 4, 9, and 7 kcal/g, respectively.
‡Other fatty acids in the omega-3 series may have essential functions.
§Synthesized by intestinal bacteria in uncertain amounts.
¶ Synthesized in the body, but not always in adequate amounts.
[a]Includes beta-carotene, alpha-carotene, and beta-cryptoxanthin precursors.
[b]Synthesized through the action of sunlight on skin, but required in the diet if sun exposure is limited.
[c]Consumed as part of vitamin B_{12}.

TABLE 72-2. DIETARY REFERENCE INTAKES: DEFINITIONS AND USE

■ ***Definitions***

Recommended Dietary Allowance (RDA): Average daily dietary intake level sufficient to meet the nutrient requirement of nearly all (97–98%) healthy individuals in a group

Adequate Intake (AI): An estimate of the RDA based on observed or experimentally determined approximations of nutrient intake by a group (or groups) of healthy people

Tolerable Upper Intake Level (UL): Highest level of daily nutrient intake likely to pose no risks of adverse health effects to almost all individuals in the general population

Estimated Average Requirement (EAR): Nutrient intake value estimated to meet the requirement of half the healthy individuals in a group

■ ***Use in Assessment and Planning***

Type of Use	*For Individuals*	*For Groups*
■ ***Assessment***		
EAR	Probability of inadequate intake (intake at EAR means 50% probability of inadequacy)	Prevalence of inadequate intake (defined as < EAR)
RDA	Low probability of inadequacy at RDA level	Do not use
AI	Low probability of inadequacy at AI level	Intake at AI implies low prevalence of inadequacy
UL	Intake above UL increases risk of adverse effects	Prevalence of population at risk of excess intake
■ ***Planning***		
EAR	Do not use	Intake distribution with low prevalence of inadequacy
RDA	Aim for this intake	Do not use
AI	Aim for this intake	Mean intakes
UL	Guide for limiting intake	Intake distributions with low prevalence of adverse effects

or fortified foods. Ideally, the DRI would relate calcium intake to prevention of osteoporosis, but data are inadequate to do so (hence: AI, not RDA). It is uncertain whether a level this high is reasonable, or instead is needed to compensate for the effects of consuming diets high in protein, sodium, and phosphorus, all of which promote calcium excretion. In contrast, international standards relate calcium to animal protein intake and, as a result, range widely; the lower the amount of animal protein (and the phosphorus that goes with it) in the diet of a population, the less calcium is recommended.[4] Because DRI levels so depend on the criteria and assumptions used in establishing them, careful interpretation is essential.[6,7]

The UL component has two purposes. For vitamins and minerals, which rarely are consumed in excess from food (a rare exception is vitamin A toxicity from eating polar bear liver), the UL sets limits on intake of dietary supplements. The UL also addresses dietary risks for chronic disease from overconsumption of such nutrients as energy, sugars, and sodium. For example, more than 95% of men and 75% of women in the United States consume sodium at levels that exceed the UL; not coincidentally, nearly one-fourth of the population has hypertension. Because practically all dietary sodium comes from salt added to processed foods, the UL has implications for the food industry. The lower the UL, the more pressure on food companies to reduce salt in their products.[8] Upper limits on sources of energy such as saturated fat, *trans* fat, cholesterol, and sugars are especially controversial because avoiding them means consuming less of their main food sources.[9]

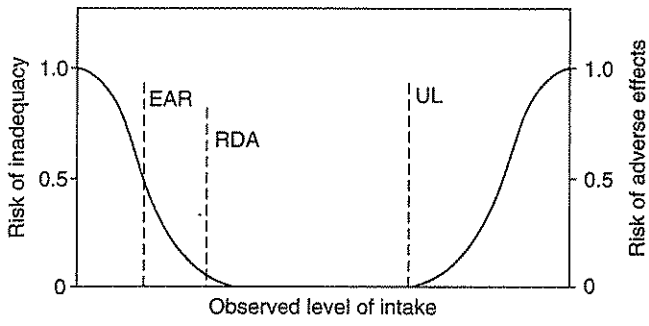

Figure 72-1. Dietary reference intakes. The risk of inadequate intake increases as it approaches the EAR. The AI is not pictured because it does not bear a consistent relationship to the EAR or RDA. The RDA meets the requirements of most people in a population. At levels of intake above the UL, risks of excess intake increase. See Table 72-2 for an explanation of abbreviations.

▶ NUTRITIONAL DEFICIENCIES: CAUSES AND CONSEQUENCES

Inadequate dietary intake is only one cause of nutrient deficiency. Symptoms also result from conditions that interfere with appetite; impair nutrient digestion, absorption, or metabolism; or substantially increase nutrient requirements or losses. Deficiencies may appear clinically as starvation, protein-energy malnutrition, syndromes of deficiency of single nutrients (e.g., pellagra, scurvy, iron-deficiency anemia), or as a wide range of less-specific symptoms.[1,2]

The number of people throughout the world who suffer from nutritional deficiencies can only be estimated. About 900 million

people, most of them in low-income countries, are considered to be chronically undernourished and food insecure, based on a food supply cut point of 2300 kcal per day or uncertain ability to obtain food due to lack of money or other resources.[10,11] Widespread nutritional deficiencies occur most often when income, education, and housing are inadequate, where water supplies are contaminated with infectious organisms that induce diarrheal diseases, or where populations are at war or under siege.[12] In countries where such conditions predominate, more than one-third of children under the age of 5 years suffer from some degree of malnutrition.[13,14] Malnutrition is usually a direct consequence of poverty. Except in the very poorest or most conflicted countries, food production is adequate to meet energy requirements, but the segments of the population most in need are unable to purchase or use foods appropriately.

In industrialized countries, dietary deficiencies are less prevalent. Food insecurity, defined as an inability to acquire adequate food in socially acceptable ways, affects an estimated 11.0% of the U.S. population; food insecurity with involuntary hunger affects an estimated 3.9%.[15] Such findings, however, are only rarely accompanied by clinical signs of nutrient deficiencies. When clinical signs do occur, they are usually associated with the additional nutritional requirements of pregnancy, infancy, early childhood, or aging, the toxic effects of alcohol or drug abuse, or illness, injury, or hospitalization.[1,2]

Regardless of cause, inadequate dietary intake profoundly affects human function. It induces rapid and severe losses of body weight and electrolytes, decreases in blood pressure and metabolic rate, electrocardiogram abnormalities, losses in muscle strength and stamina, and gastrointestinal and behavioral changes.[1] The result is a generalized lack of vigor, alertness, and vitality that reduces productivity and impairs the ability of people to escape the consequences of poverty. Of special concern is the loss of immune function that accompanies starvation. Malnourished individuals lose cellular immune competence and demonstrate poor resistance to infectious disease. Infections, in turn, increase nutrient losses and requirements, and, in the absence of adequate nutrient intake, induce further malnutrition. This cycle is the principal cause of death among young children in developing countries and is an important cause of morbidity in malnourished children and adults everywhere.[16,17]

Protein-energy malnutrition is the collective term for the clinical effects of this cycle on young children. Survivors display typical effects of starvation: depression, apathy, irritability, and growth retardation. Protein-energy malnutrition usually is classified into two entities—kwashiorkor and marasmus—on the basis of clinical signs and on the relative intake of protein to energy. Kwashiorkor is characterized by edema and fatty infiltration of the liver and is associated with a relative deficit of protein to energy. Marasmus is manifested as generalized wasting due to overall nutritional deprivation. In practice, such distinctions blur. Undernourished children exhibit symptoms that fall between the two extremes, and similar diets contribute to either form.[1]

Numerous methods to prevent poverty-associated malnutrition in adults and children by improving household food security have been demonstrated to be effective in developing countries. Among them are programs that redistribute income, subsidize food prices, promote agricultural production, provide food supplements, and educate.[18,19] Improvements in sanitation and in primary health care are also essential components of programs to reduce nutritional deficiencies.[20] Addressing the factors that raise risks for malnutrition would improve health and life expectancy for large segments of low-income populations.[21]

▸ DIET AND CHRONIC DISEASE

As nutritional deficiencies decline in prevalence in industrialized as well as developing countries, they are replaced rapidly by chronic conditions of dietary excess and imbalance. In the late 1980s, three comprehensive reports reviewed the entire spectrum of evidence linking diet to chronic diseases, and estimated the incidence and prevalence, cost to society, and overall public health impact of these conditions in the United States and Europe.[28–30] More recent reports document the increasing burden of disease from chronic, noncommunicable diseases due in part to excessive intake of food and energy.[22,23] In today's era of rapid globalization, populations in developing countries move quickly from classic patterns of malnutrition to rising rates of chronic diseases.[24] This "nutrition transition" means that as in industrialized countries, overweight and obesity now predominate as diet-related health problems in countries where undernutrition still exists among large segments of their populations.[34–36]

In the United States, four of the ten leading causes of death—coronary heart disease, cancer, stroke, and diabetes—are chronic diseases related in part to diets containing excessive energy, fat, saturated fat, cholesterol, salt, or alcohol, and too little fiber, along with too sedentary a lifestyle. These conditions account for more than 60% of annual deaths, but because they have multiple causes, the proportion attributable to diet alone is difficult to determine. One estimate attributes 18.1% of annual deaths to tobacco abuse, 16.6% to poor diet and physical activity (later corrected to 15.2%[25]), and 3.5% to alcohol abuse.[26]

Imprecision in such estimates is inevitable given the difficulties inherent in design, conduct, and evaluation of research on diet and disease. Nutrition research is complicated by individual variations in dietary requirements, limitations in the ability of investigators to obtain accurate information about the dietary intake of individuals or populations, and by other endlessly debated methodologic issues. Dietary changes over time are especially difficult to estimate. Firm proof of dietary causality is virtually impossible to demonstrate for diseases affected by so many other risk factors—genetic, environmental, and behavioral. Instead, investigators identify associations between diet and disease from studies of laboratory animals and from biochemical, epidemiologic, and clinical investigations in humans.[27] Because each of these methods has limitations, diet-disease associations are usually inferred from the totality of available evidence and are considered most compelling when data from all sources are consistent, strongly correlated, highly specific, dose-related, and biologically plausible.[28] Despite the difficulties, health authorities repeatedly reach the same conclusion about diet and disease risk: the preponderance of evidence supports the health benefits of diets that balance energy intake with physical activity, emphasize consumption of foods from plant sources, and minimize consumption of foods high in saturated and *trans* fats, carbohydrates, and alcohol.

▸ DIETARY RECOMMENDATIONS

An ideal diet provides energy and essential nutrients within optimal ranges from foods that are available, affordable, and palatable. Until the mid-1970s, government and health agencies in the United States advised the public to select diets from specific groups of foods (e.g., dairy, meat, fruits and vegetables, grains) in order to ensure adequate intake of nutrients most likely to be consumed at below-standard levels.[9] As chronic diseases replaced nutrient deficiencies as public health problems, dietary recommendations shifted to address prevention of these increasingly prevalent conditions.

Dietary Goals and Guidelines

The first U.S. report to reflect this new focus established numerical targets for dietary changes to reduce chronic disease risk: reduce intake of fat (to 30% or less of total energy), saturated fat (10%), sugar (10%), cholesterol (300 mg/day or less), and salt (5 g/day); increase intake of foods containing naturally occurring sugars and starches (48%); consume alcoholic beverages in moderation; and balance energy intake against expenditure to maintain appropriate body weight. To achieve these targets, the report advised the public to consume more fruits, vegetables, and grains, and to select meat and dairy foods low in fat.[29] This advice proved so controversial that subsequent federal nutrition policies have tended to omit explicit percentage goals.[9]

U.S. dietary guidance policy is expressed in the Dietary Guidelines for Americans, a joint publication of the U.S. Department of Agriculture (USDA) and the Department of Health and Human Services (HHS), issued at 5-year intervals since 1980.[30] Like the development of Dietary Reference Intakes (DRIs) from RDAs, the guidelines have evolved toward the increasingly complex and individualized. The first four editions contained just seven precepts; the fifth edition added three more. The sixth edition in 2005 contained 41 recommendations—23 for the general population and 18 for specific population groups such as overweight children, pregnant women, or older adults.[31] The increasing complexity is best illustrated by the sugar guideline. In 1980, it was "Avoid too much sugar"; in 2005, it was "Choose and prepare foods and beverages with little added sugars or caloric sweeteners, such as amounts suggested by the USDA Food Guide and the DASH Eating Plan." As for increasing individualization: the USDA Food Guide lists serving numbers and sizes for foods in 11 groups at 12 levels of energy intake; the DASH (Dietary Approaches to Stop Hypertension) diet lists food servings in 8 groups at 4 levels of energy intake.

The movement away from public health approaches to dietary advice is due to two factors: science and politics. Nutrition science is increasingly focused on identification of genetic profiles that can be used as a basis for individualized dietary intervention. This approach is known variously as nutrigenomics,[32] nutrigenetics,[33] or, when it involves identification of metabolic components of body fluids or tissues, metabolomics[34] (hence the drive to produce nutraceutical foods and supplements).[35] Politics is involved when food companies exert political pressure to prevent governments from issuing dietary advice that might result in reduced sales of their products. In 2004, for example, sugar lobbying groups pressed HHS to threaten withdrawal of funding from the World Health Organization (WHO), which was considering advising member countries to restrict intake of added sugars to 10% of daily energy intake.[36] Lobbying groups successfully pressured WHO member states to reject inclusion of that recommendation in a resolution to institute measures to prevent mortality, morbidity, and disabilities resulting from noncommunicable diseases.[37,38]

The Current Consensus: Food Guides

Despite the scientific and political controversy, dietary recommendations for chronic disease prevention have remained much the same for decades. Virtually all say: vary food intake; balance food energy with physical activity to maintain weight; favor fruits, vegetables, and whole grains; choose lean meats and low-fat dairy foods; avoid foods high in fats, sugars, and salt; and drink alcohol in moderation, if at all.[39,40] The 2005 U.S. Dietary Guidelines do contain some quantitative recommendations: at least 30 minutes of daily physical activity, 20–35% of energy from total fat, less than 10% from saturated fatty acids, less than 300 mg per day of cholesterol, and less than 2300 mg sodium per day. They also advise minimal intake of *trans* fatty acids.[31] Similar recommendations have been issued by U.S. health organizations and agencies concerned with coronary heart disease and stroke,[41] cancer,[42] diabetes,[43] and hypertension.[44]

Many countries have attempted to translate such recommendations into public health advice presented in graphic forms such as plates, shopping carts, or pagodas.[45] The most common format is that exemplified by the USDA's now obsolete Food Guide Pyramid, a visual representation of recommendations to consume more foods from its base (grains, fruits, vegetables), and fewer from its upper sectors (meat, dairy, and foods high in fats and sugars).[46] This design generated controversy from the outset, first because of its implied restrictions on meat, dairy, and processed foods,[9] and later for its failure to distinguish healthful from less healthful fats and carbohydrates.[47] Translating the new 41 dietary guidelines into a consumer guide to food choices presented even more difficult challenges when the USDA replaced the pyramid in 2005. The USDA dealt with those challenges by stating that "One size does not fit all" and creating 12 separate pyramids for individuals of differing energy needs.[48] The basic pyramid design, which emphasizes exercise, self-education through use of a website, and individual prescriptions for food choices based on age, sex, and activity level, is shown in Fig. 72-2.

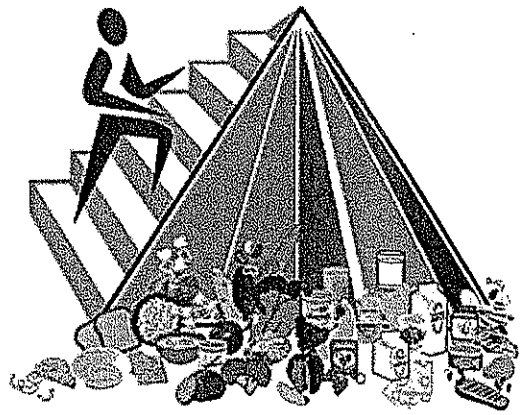

Figure 72-2. The pyramid design featured as part of the USDA's 2005 Food Guidance System emphasizes exercise and provides dietary advice for individuals through its website, www.MyPyramid.gov.

Despite ongoing debates about dietary advice, its consistency for so many chronic diseases has encouraged collaboration on common recommendations for primary prevention. These constitute a consensus,[49] now worldwide.[22] The obvious next step is to develop public policies to promote their implementation.[50] The recent increase in worldwide obesity, for example, calls for interventions that reduce barriers to following advice about healthful diets and activity patterns.[51,52]

▶ BARRIERS TO IMPLEMENTATION

Although the ultimate decisions targeted by dietary recommendations are personal food choices, individuals make such choices within the context of the social, economic, and cultural environments in which they live. Adults prefer foods that taste, look, and smell good, are familiar, and provide variety, but such preferences are strongly influenced by family and ethnic background, levels of education and income, age, and gender.[53] Food production, marketing, and the demand for convenience at low cost are strong determinants of food choices and create barriers to dietary change.[9]

Food Production

Food production, distribution, and marketing in the United States have undergone significant changes that affect food availability and, therefore, consumption patterns. In 2000, the U.S. food system accounted for nearly 8% of the Gross Domestic Product (GDP), employed 12% of the labor force, and generated nearly $800 billion in expenditures. The proportion of that amount going to the farm sector has declined steadily since the early 1970s and is now less than 20%[54] (the remaining 80% goes for marketing costs such as labor, packaging, transportation, other business expenses, profit, and advertising[55]). Since 1935, the number of U.S. farms fell from 7 million to under 2 million, but production became increasingly centralized and efficient; the largest 8% of farms account for 68% of production.[56] This trend has been accompanied by an increase in consumption of processed foods. In 1980, the average number of items in a supermarket was about 14,000; in 1999 it was more than 40,000.[54] In 2004, manufacturers introduced nearly 18,000 new food and beverage products, among them more than 2700 candies, 2600 snack foods, 1300 ice cream novelties, 700 soft drinks and waters, 600 fruit drinks, and 460 jams and sweet toppings.[57] Many such products are misleadingly advertised as "healthy" because they are reduced in fat or sugars or have vitamins added.[58]

Food Marketing

Advertising promotes consumption of entire categories of foods, stimulates food production, processing, and marketing, and builds brand loyalty among adults and children.[59,60] Direct (measurable) advertising costs are estimated at nearly $12 billion annually, much of it for television commercials for food and beverages purchased outside the home; for every "measured" dollar, companies spend an additional $2 on supermarket fees, coupon campaigns, trade shows, Internet marketing, and other such indirect methods, bringing the total to about $36 billion.[54] In 2003, for example, McDonald's spent $619 million in measured dollars on U.S. advertising, PepsiCo spent $208 million on soft drinks alone, M&M Mars spent $77 million for its candies, and Altria spent $25 million just to advertise Kool-Aid.[61] Some marketing methods are more subtle and involve changes in societal norms favoring larger portions and more frequent eating occasions.[62] The influence of food marketing on consumption patterns, particularly of children, is of great concern as the advertisements rarely display foods consistent with dietary guidelines, and evidence increasingly links consumption of fast food and soft drinks to higher energy consumption, overweight, and poor diet quality, especially among children.[63,64]

Demand for Convenience and Low Cost

More than half of U.S. women with children under 1 year of age work outside the home, a trend sufficient to explain why convenience is so prominent a motive for food selection.[65] Higher disposable incomes in two-income families, and less leisure time, also contribute to demands for convenience. Thus, the share of food expenditures for foods prepared outside the home increased from about 26% in 1960 to 47% in 2000.[54] Although the fastest growth in sales occurred among fast-food or quick-service restaurants, future growth is expected to occur in full-service restaurants.[66] In 2003, McDonald's alone generated $17 billion in annual sales from more than 31,000 outlets serving nearly 50 million people in more than 119 countries each day.[67] Low prices are an incentive for consumption, and energy-dense fast-foods cost less per kcal than do fruits and vegetables.[68] Advice to consume more healthful diets confronts such barriers.

▸ THE ENVIRONMENT OF FOOD CHOICE

Americans perceive that they are well informed about the effects of diet on health and want to eat healthfully, but say they are confused by the variety of nutrition messages given by government, industry, health authorities, and the media, especially since most come from food companies and media. Qualitative research reveals considerable consumer skepticism about dietary advice and tendencies to ignore recommendations seen as inconsistent or difficult to follow.[69] This research confirms the well-established principle that education alone is insufficient to change behavior; environmental changes are needed to facilitate more healthful food choices.[70]

If nutrition messages are perceived as confusing, they also are perceived as requiring unacceptable changes in eating patterns, preparation effort, or cost. For example, the major sources of saturated fat in the U.S. diet in 1999 were dairy foods (24%), meat (21%), shortenings (15%), and salad and cooking oils (12%).[71] Cheese alone provided 11% of the saturated fat. To reduce saturated fat to 10% of energy or less, it is necessary to eat less of those foods or to replace them with fruits, vegetables, and grains. In 2000, the leading sources of energy in U.S. diets were soft drinks, cakes and pastries, hamburgers, pizza, and potáto and corn chips; these five food groups accounted for 20% of cumulative energy intake.[72] Advice to eat less of them confronts the economic interests of their producers.

Food supply data (an indirect measure of dietary intake) do indicate some favorable shifts since the 1970s: a slight decline in the availability of red meat, replacement of whole with low-fat and skim milk, replacement of animal fats with vegetable oils, and increases in availability of fruits and vegetables.[73] However, the per capita availability of total energy in the food supply increased from 3300 to 3900 kcal per day from 1970 to 2000,[74] and dietary intake surveys report an increase of 200 kcal per day, nearly all derived from carbohydrates.[75]

Such observations reflect the environment of food intake in the United States. Consumers who are well informed about nutrition—and make choices based on this information—tend to be older, better educated, and wealthier, demonstrating that diet is an indicator of social class. For many people, convenience and low cost take precedence over nutritional quality. Markets selling healthful foods are rarely located in low-income communities.[76] Because meals are increasingly purchased at restaurants and at fast-food and takeout places, and because foods high in processed oils and sugars are inexpensive to produce and profitable to market, the food industry has an increasing influence over dietary choices. In this situation, public health strategies to improve dietary intake are especially desirable.

▸ ASSESSMENT OF NUTRITIONAL STATUS

As with any other public health campaign, the first step in dietary intervention is to identify the nutritional problems and, therefore, the needs of the population at risk.[50] Evaluation of nutritional status is complicated by the many genetic, medical, behavioral, and environmental factors that influence development of diet-related conditions, by the multiplicity of signs and symptoms of malnutrition, by the lack of suitable biochemical or clinical markers for these signs and symptoms,[1,2] and by the lack of precision in available assessment methods.[27] Assessment is also complicated by the variety of personal, cultural, and economic factors that influence food choice as well as the many social factors that lead to health inequalities.[77,78]

Assessment Methods: Individuals and Populations

To date, no single, independent measurement of dietary, biochemical, or clinical status has been found adequate to confirm the nutritional status of individuals or populations. Instead, nutritional risk is defined by a combination of methods: nutritional history, medical history and physical examination, body measurements, and laboratory tests.[79,80] Table 72-3 lists examples of elements of these

TABLE 72-3. SURVEY ELEMENTS FOR NUTRITIONAL STATUS EVALUATION

Nutritional History	*Medical History & Physical*
■ ***Dietary Intake***	■ ***Signs of Undernutrition***
• Food record	• Low weight for height
• 24-hour recall	• Recent weight loss
• Food frequency	• Clinical signs of malnutrition
• Diet history	• Chronic or acute conditions
• Use of supplements	• Medication use
• Eating habits	• Substance abuse
■ ***Related Social Factors***	■ ***Chronic Disease Risk Factors***
• Income	• Overweight
• Educational level	• Elevated blood glucose
• Ethnicity	• High blood pressure
• Use of food assistance	• High blood cholesterol
• Medications	• Waist-hip ratio
• Activity levels	
Body Measures	***Laboratory Tests***
• Height	• Hemoglobin, hematocrit
• Weight	• Iron and iron-binding
• Skinfolds	• Serum vitamins and minerals
• Waist circumference	• Blood glucose
• Hip circumference	• Blood cholesterol
	• Lipoproteins
	• C-reactive protein

methods used in population surveys. In practice, surveys rarely use the full range of nutritional assessment methods; many of them are too imprecise, inconvenient, or expensive for frequent use. Instead, professional judgment is needed to evaluate the severity of selected nutritional risk factors.

Short of duplicate meal analysis (and even this method has limitations), techniques to determine the usual dietary intake of individuals are imprecise; standard methods yield estimates that cannot be interpreted too literally. These include a record of foods consumed during a specified time period (Food Record), retrospective recall of foods consumed within a recent time period (24-Hour Recall, or longer), and measures of the frequency of consumption of specific index foods (Food Frequencies).[27] The nutrient content of foods identified by these methods is obtained from tables of food composition, which also are imprecise estimates.[81] The diets are compared to standards of nutrient intake such as the DRIs[82] or to recommended patterns of food consumption described by dietary guidelines or food guides. Each of these methods, used singly or in combination, has strengths and weaknesses. All yield useful, if imprecise, information.[28] Demographic and socioeconomic data are especially useful as indirect indicators of nutritional risk in community surveys where detailed diet histories, physical examinations, and laboratory tests would be impractical.

The simplest and most useful indicator of undernutrition is low weight for height. Other clinical signs listed in Table 72-3 are useful for assessing the nutritional status of hospital patients.[1] Evaluation of chronic disease risk is accomplished through measurements of blood glucose, blood pressure, blood cholesterol, and body weight. The high prevalence of these risk factors is the basis of large-scale public health campaigns such as the U.S. National Cholesterol Education Program.[83] Because no simple screening measure is available for evaluation of diet-related cancer risk, promotion of healthier diets to the entire population is a reasonable public health strategy.

National Nutrition Monitoring

The prevalence of diet-related risk factors and conditions in the United States is determined by remnants of the 1990 National Nutrition Monitoring and Related Research Program, now expired. The program coordinated the monitoring activities of 40 surveys conducted by 22 federal agencies that measured health and nutritional status, food and nutrient consumption, food composition, dietary knowledge and attitudes, foods available for purchase, and socioeconomic indicators related to dietary intake.[84] Early concerns about the limited ability of the program to provide data on trends in dietary intake patterns, hunger prevalence, and dietary patterns of minority groups[85] were eventually addressed. Its principal surveys were the National Center for Health Statistics' National Health and Nutrition Examination Survey (NHANES) and USDA's Continuing Survey of Food Intake of Individuals (CSFII). NHANES collected data from dietary interviews, physical examinations, and biochemical and hematological tests from a probability sample of the U.S. population from 1971 to 1974 (NHANES I), 1976 to 1980 (NHANES II), 1988 to 1994 (NHANES III), and later. It surveyed the Hispanic population from 1982 to 1984 (HHANES).[86] The CSFII collected information about household food consumption along with measures of knowledge and attitudes about nutrition and health.[87] In 2002, the surveys were merged into one continuous survey called "What We Eat in America."[88] Without reenactment of the legislation mandating and funding these surveys, their future is uncertain.[89]

Community Nutrition Assessment

Methods for assessment of the nutritional needs of communities vary only slightly from conventional means of community health assessment. Table 72-4 lists the principal data elements used to evaluate the level of nutritional risk in communities. These elements inclu geographic, demographic, socioeconomic, and health descriptors. Th also include descriptors of food and nutrition resources in the comm nity, utilization rates for such resources, and indicators of food ava ability, intake, and nutritional status obtained from nutrition monit ing surveys.

TABLE 72-4. DATA ELEMENTS FOR COMMUNITY NUTRITION ASSESSMENT

- ***Community Descriptors***
  - Geographical position, boundaries
  - Population within boundaries, density
  - Community agencies, services
  - Community health-care services
  - Hospitals, clinics
  - Educational institutions
- ***Population Descriptors***
  - Age, gender, racial, and ethnic distribution
  - Income
  - Education
  - Employment
  - Length of time in location
  - Primary language
- ***Health Status Indicators***
  - Infant mortality
  - Low birth weight
  - Life expectancy
  - Chronic disease rates
  - Leading causes of death
- ***Nutritional Status Indicat***
  - See Table 72-3
- ***Food and Nutrition Resour***
  - Use of federal food assistan
  - Nonparticipation rates for elig persons
  - Soup kitchens, food pantries food banks
  - Food markets: number, kind location
  - Nutrition education and train programs
  - Food and nutrition advocacy groups
  - Weight control programs
  - Worksite wellness programs

In developing countries with high rates of clinically appare conditions of undernutrition, investigators have selected elemer from this list to develop rapid, convenient, and relatively inexpensi screening instruments to evaluate nutritional risk under field conc tions. These methods, which range from a graded series of bracele to measure arm circumference to comprehensive surveys, have be used successfully to identify children and adults at high nutrition risk who can be targeted for intervention.[90] In the United States, adv cates for the poor in more than 250 communities since 1980 ha developed methods to document the need for federal food assistanc these typically include data on poverty levels, the severity of ind vidual and family food insecurity, nonparticipation of eligible perso in food assistance programs, and increasing demands for private-sect soup kitchens and food pantries.[91]

▶ POLICY RECOMMENDATIONS AND IMPLEMENTATION STRATEGIES

The quantity, strength, and consistency of evidence that relates dietar factors to chronic diseases, and the substantial impact of these condi tions on health, are reasons enough to promote policies to make it eas ier for people to consume more healthful diets (and be more active). Current policies could be altered to address environmental as well as behavioral barriers to dietary change. Table 72-5 outlines some suggestions for policy changes aimed at reducing dietary risks for chronic diseases.

Public health strategies begin with public education. Although education may not be sufficient to improve dietary behavior, it can facilitate change, especially when education interventions involve the target audience in the design, conduct, and evaluation of their own dietary plans, employ multiple educational strategies, and use a team approach.[70] Currently, most public information about nutrition derives from food industry marketing, and no government agency can compete with that level of funding. The success of the National Cholesterol Education Program is evidence that well-funded campaigns can be

TABLE 72-5. PUBLIC HEALTH POLICIES TO REDUCE DIETARY RISKS FOR CHRONIC DISEASE

Educate the Public
- Replace energy-dense foods of minimal nutritional value ("junk" foods) with fruits and vegetables
- Eat smaller portions, fewer snacks
- Recognize misleading advertising and health claims

Educate Children
- Integrate nutrition education into school curricula
- Provide school meals consistent with Dietary Guidelines
- Recognize food marketing strategies
- Distinguish commercial from educational messages

Health Professionals: Counseling and Practice
- Use nutrition in health promotion and disease prevention
- Counsel patients about diet, nutrition, and health
- Counsel patients to address environmental as well as behavioral determinants of dietary choices
- Obtain reimbursement for nutrition counseling and services

Federal Agencies: Regulations and Guidance
- Nutrition information readily available at fast-food restaurants
- Energy (calorie) labeling on takeout containers
- Total energy content labeled on single-serve packages
- Enforceable guidelines for health claims on food package labels
- Enforceable guidelines for television advertising of foods during children's viewing hours
- More fruits and vegetables for recipients of food assistance
- Unambiguous dietary recommendations focused on food choices

Congress: Legislative Actions
- Farm subsidies for fruit and vegetable production
- Campaign contribution reforms (so legislators can make decisions independent of corporations)
- Restrict vending of "junk" foods in schools
- Restrict food marketing to children
- More comprehensive nutrition monitoring
- Mandate and fund research on the nutrient composition of food, dietary intake methods, environmental determinants of food choice, and effective interventions in dietary behavior

ffective,[83] and similar levels of funding for nutrition education ould prove equally successful.[92] Public education campaigns that ransmit culturally sensitive messages designed to address the needs nd attitudes of specific target groups have been applied successfully promote breastfeeding and other dietary improvements in develop- ig countries, and use of these techniques has shown promise in nproving the nutritional status of low-income homemakers, increas- ig the prevalence of breastfeeding, and improving health and func- on among the elderly and minority groups.[52] As always, education ethods that empower community members to determine their own ietary needs and interventions are most likely to be effective.

Beyond education, public health strategies must address the nvironment of food choice. The current environment promotes food verconsumption, especially by young children. Educating the pub- about personal responsibility in dietary choice is necessary but not fficient; it also is necessary to provide information to permit formed choices and to make the food environment more conducive making such choices. The suggestions in Table 72-5, remote from rsonal choice as they may seem, address such approaches. They int to the need for further research as a basis for program develop- ent. More comprehensive information about the nutrient composi- n of food, dietary intake, the environmental determinants of food oice, and the effects of those determinants on health would estab- h a more rigorous basis for policies and programs to improve the tritional health of the population.

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