45 CHAPTER

Dietary Recommendations for Health Promotion and Disease Prevention

Food is the fuel on which the human body runs. It simply stands to reason that the quality of the diet has the potential to influence virtually every aspect of the quality of health. A high-performance body runs best on high-performance fuel. To the extent that the pervasive linkages between the quality of diet and the quality of health are other than self-evident, the content of this and other nutrition texts, and the primary literature on which it is based, makes a strong case.

While much can be said about the universal fundamentals of healthful eating, it is equally important to note aspects of dietary quality that are context specific. In a world of subsistence, for example, higher-energy-density foods offer an advantage by helping to forestall a potential caloric deficit. In a world of dietary excess and epidemic obesity, however, foods that provide nutrient density in conjunction with relatively few calories may offer an advantage. The quantity of dietary protein is of primary concern in populations subject to protein deficiency; the specific foods sources of protein and their other nutritional properties (e.g., saturated fat content of red meat) take on primacy in populations with consistent access to more than sufficient total protein. Given that overnutrition now afflicts more of the global population than undernutrition (1), the effects of dietary pattern on weight control are an obligatory consideration in attempting to characterize healthful eating.

Contextualizing the characteristics of a health-promoting diet need not end at the population level. The tantalizing promise of nutrigenomics—dietary guidance tailored to an individual on the basis of specific genetic polymorphisms—invites consideration of individualized recommendations for dietary health.

Regardless of whether the target is a population or an individual, the application of diet for health promotion follows two prerequisites. The first is the assertion with confidence of characteristics of a healthful, or even optimally healthful, diet on the basis of a reliable and consistent base of evidence. The second is a reliable means of translating the evidence in support of a particular dietary pattern into behavior. There are, at present, certain controversies and uncertainties concerning the former; challenges to the latter are considerably more formidable. Nonetheless, the potential benefits of successful dietary health promotion justify a vigorous approach in clinical practice. Knowledge of diet and health and of effective behavioral counseling techniques (see Chapters 46 and 47) are both perennially works in progress but sufficiently advanced to support constructive application. The magnitude of the influence of diet on health and the urgency of diet-related disease trends in modern society are sufficiently great to preclude anything else.

Heart disease, the leading killer of adults in the United States, is amenable to dramatic risk reduction through diet by a variety of mechanisms (see Chapter 7). The estimate of Doll and Peto that more than one-third of all cancers are potentially preventable through dietary manipulations is widely accepted (2), if not wholly substantiated

(see Chapter 12). Obesity in the United States, increasingly a hybrid endemic and epidemic threat to both adults and children, is directly linked to diet and activity patterns (see Chapter 5). Stroke, hypertension, diabetes, pregnancy outcomes, degenerative arthritis, and innumerable other diseases, as well as general perceptions of well-being, are responsive to dietary influences.

There is currently considerably more consensus than controversy with regard to a health-promoting diet. Controversy persists and arises in areas of ongoing study, such as the health effects of specific nutrients or the optimal diet for the prevention or reversal of specific diseases. Therefore, such controversies tend to be nutrient or disease specific. An extensive review of the diverse influences of diet on health serves to mitigate such controversies by providing contiguous lines of evidence that encircle an area of overlapping recommendations. Elucidating that area of overlap is the principal aim of this chapter.

Behavior change is often facilitated in the context of established disease; individuals with disease perceive risk more acutely and therefore are more motivated to change behavior (see Chapters 46 and 47). Dietary recommendations in the setting of clinical disease are similar to those for health promotion, but they may be more extreme both in response to the greater acuity and in response to the patient's greater willingness to adhere to recommendations. The clustering of risk factors for various chronic diseases and of the diseases themselves requires that dietary manipulations for secondary and tertiary prevention not be overly disease specific. An obese patient with type 2 diabetes, for instance, is at increased risk for heart disease, cancer, respiratory disease, and renal insufficiency. Therefore, although specific dietary intervention may be targeted to a single disease, the dietary pattern usually remains consistent with recommendations for general health promotion. Exceptions arise only when disease-specific dietary modifications in the context of organ-system failure require departures from the basic pattern of healthful eating (e.g., protein restriction in liver or renal failure, see Chapters 16 and 17; carbohydrate restriction to reduce the respiratory quotient for pulmonary insufficiency, see Chapter 15).

This chapter characterizes the dietary recommendations that may be offered with confidence in the delivery of clinical care to virtually all patients.

■ DIETARY RECOMMENDATIONS FOR HEALTH PROMOTION

Consensus Recommendations

Consensus regarding the optimal diet for the maintenance and promotion of health is reflected in guidelines generated by diverse expert bodies.

On the basis of its review of evidence linking dietary pattern to health outcomes, the US Preventive Services Task Force advises clinicians to endorse to all patients over age 2 a diet restricted in fat, particularly saturated fat, and abundant in fruits, vegetables, and whole grains (3). These recommendations are highly concordant with those of the National Heart, Lung, and Blood Institute at the National Institutes of Health (4). The *Dietary Guidelines for Americans, 2005* (5) and the corresponding US Department of Agriculture food guide pyramid (6) emphasize abundant intake of whole grains, vegetables, fruits, and low-fat or nonfat dairy and restricted intake of simple sugars, saturated and trans fat, dietary cholesterol, and salt. The National Cancer Institute and the Centers for Disease Control and Prevention cosponsor the "5-a-day" program, encouraging fruit and vegetable intake and endorsing dietary guidelines that include 20 to 35 g of fiber per day, with 30% or fewer calories from fat (7). The American Heart Association offers dietary recommendations that call for efforts to balance caloric intake and physical activity to achieve and maintain a healthy body weight; consume a diet rich in vegetables and fruits; choose whole-grain, high-fiber foods; consume fish, especially oily fish, at least twice a week; limit intake of saturated fat to less than 7% of energy, trans fat to less than 1% of energy, and cholesterol to less than 300 mg per day by choosing lean meats and vegetable alternatives, fat-free (skim) or low-fat (1% fat) dairy products; minimize intake of partially hydrogenated fats; minimize intake of beverages and foods with added sugars; choose and prepare foods with little or no salt; if consuming alcohol at all, do so in moderation; and apply these recommendations when eating out as well as when eating at home (8).

The American Diabetes Association recommends a generous intake of fruits and vegetables,

beans, fish, whole grains, and nonfat dairy, along with judicious portion control and restriction of snack foods, sugar, and sweet consumption (9). The American Dietetic Association supports the US Department of Agriculture dietary guidelines and recommends a variety of grains, at least five servings of fruits and vegetables daily, restriction of saturated fat and cholesterol, and limited sugar and sweet consumption (10). Differing only in detail, all these recommendations are substantially congruent.

In 2002, the National Academy of Sciences's Institute of Medicine (IOM) released dietary guidelines calling for 45% to 65% of calories from carbohydrate, 20% to 35% from fat, and 10% to 35% from protein, in conjunction with 60 minutes each day of moderately intense physical activity (11). The IOM guidelines further emphasize the restriction of saturated and trans fat and their replacement with monounsaturated and polyunsaturated fat. Also in 2002, on the basis of consensus opinion, the American College of Preventive Medicine formally adopted a position in support of dietary recommendations within the IOM ranges, and in opposition to carbohydrate restriction for purposes of weight control (12).

In its *Global Strategy on Diet, Physical Activity and Health*, the World Health Organization calls for an emphasis on energy balance and healthy weight: limiting total fat intake, attempting to eliminate trans fats, and shifting from saturated to unsaturated fats; increasing intake of fruits, vegetables, legumes, nuts, and whole grains; and limiting intake of sugar and salt (13). The concordance of these guidelines for global dietary health with those of leading organizations in the United States is noteworthy.

Table 45-1 provides a brief list of healthful modifications to the typical American diet supported by prevailing opinion.

TABLE 45-1 STEPS TO IMPROVING THE TYPICAL AMERICAN DIET THAT ARE WIDELY SUPPORTED IN THE NUTRITION COMMUNITY

- Reduce trans fat
- Reduce saturated fat
- Reduce sodium
- Increase fruits and vegetables
- Increase whole grains
- Reduce refined starches and simple sugars
- Replace "bad" fats with "good" fats
- Increase fiber
- Increase micronutrients
- Control portion size and total calories
- Increase physical activity

Source: From Katz DL. Presentation at *TIME Magazine*/ ABC News summit on obesity. Williamsburg, VA, June 2004.

Recommendations Supported by Confluent Evidence

Weight Control

There are numerous reviews on the subject of diet for weight loss (see Chapter 5). In the aggregate, this literature lends strongest support to diets abundant in fruits, vegetables, and whole grains and relatively restricted in refined starches, added sugar, and total fat (14). Recent studies lend support to the Mediterranean dietary pattern and diets characterized by a low glycemic load (see Chapters 5–7). Whereas dietary deficiencies have long been the predominant nutritional threat to health, caloric excess is especially prevalent globally (15). Strategies for the achievement of energy balance are beyond the scope of this discussion (see Chapters 5, 38, and 47), but given the increasing global significance of overweight and obesity, portion control and energy balance clearly figure among the key principles of healthful eating.

Dietary Fat

There is ongoing debate regarding the relative benefits of a diet restricted in total fat as compared to a diet with liberal fat intake but relatively rich in polyunsaturated and monounsaturated fatty acids (see Chapters 2 and 6). Studies by Ornish et al. (16) provide support for the extremely low-fat diet, at least for the prevention of cardiovascular events. Results from the Lyons Heart Study offer similar support for the Mediterranean diet (17).

Estimates of our Paleolithic dietary intake suggest that we are adapted to a fat intake of approximately 25% of total calories (18), which is below the typical level in the United States today and below the liberal fat intake of Mediterranean countries but well above the intake advocated by Ornish and others. Further, our ancestral intake of trans fat was negligible, and intake of saturated fatty acids is thought to have made up less than 5% of total calories.

Based on the best available estimates, nearly half of the fat in our "natural" diets derived from polyunsaturated fat, with an n-3 to n-6 ratio between 1:1 and 1:4. The other half derived from monounsaturated fat. There is preliminary evidence of a benefit of supplementing n-3 fatty acid intake in areas ranging from cognitive development (see Chapter 35) to the control of rheumatoid arthritis (see Chapter 20). Although definitive evidence of n-3 fatty acid deficiency or of the benefits of supplementation may be lacking for any single disease, the weight of evidence overwhelmingly suggests a prevailing relative deficiency in the modern Western diet. On this basis, a recommendation may be made to consume approximately 25% of total calories as fat, in a nearly even distribution between polyunsaturates and monounsaturates. The combination of trans fat and saturated fat should be kept below 5% of total calories, an effect that can be achieved in part by following the consensus recommendations specified earlier.

Unless fish consumption is very consistent, n-3 fatty acid intake is apt to be lower than optimal, given the near-complete elimination of n-3 fatty acids from the flesh of domestic food animals. Consumption of nuts and seeds, particularly flaxseed, as a means of raising n-3 fatty acid intake is recommended. The use of flaxseed oil, totaling about 1 tablespoon per day for adults, is an easy way to increase n-3 consumption. Of note, n-3 fat from plant sources is generally alpha linolenic acid, the conversion of which to EPA and DHA (see Chapter 2 and Section VIE) is variable. The fat and calories added to the diet in the form of n-3 polyunsaturated fat should be compensated by reduced intake of fat from other sources.

A health-promoting diet may derive as little as 10% and as much as 40% of calories from fat, provided that fat is well chosen. The energy density and low satiety index of fat suggest that intake toward the high end of this range may pose difficulties for those struggling with weight control (see Chapter 5).

Dietary Protein

Although the evidence that high intake of dietary protein is harmful in the context of impaired renal function and that protein consumption may accelerate the age-related decline in glomerular filtration rate is convincing, the harmful effects of protein independent of other lifestyle and dietary hazards are uncertain. There is some concern that high intake of protein may accelerate age-related osteopenia (see Chapter 14). If the overall dietary and lifestyle pattern are judicious, a relatively higher protein intake may be tolerated without sequelae, however; regular, weight-bearing activity in particular attenuates the risk of osteopenia and osteoporosis. Even in studies of competitive athletes, however, there is little evidence of benefit from very high protein intake.

The available evidence in the aggregate supports protein consumption in the range 0.6 to 1 g per kg body weight in adults. Intakes up to approximately 2 g per kg may offer some advantages to vigorously active individuals, although this is uncertain (see Chapter 32). Higher intakes appear to be ill advised (see Chapters 3, 16, and 32). High-protein diets advocated for control of insulin resistance and weight loss are not supported by evidence of long-term health benefits and, in general, should be discouraged in favor of the pattern described (see Chapters 5 and 6). While there are studies to suggest cardiometabolic benefits of shifting calories from carbohydrate to protein, those benefits appear to be at least as great with high-carbohydrate but low–glycemic load diets (19). Protein does offer the advantage of a high satiety index (see Table 45-2), and thus a modest increase in the percentage of calories from protein may offer weight control benefits to some (see Chapter 5).

Dietary Fiber

A diet consistent with consensus recommendations will result in considerably greater fiber intake than is typical in the United States (see Chapter 1 and Section VIE). Although recommendations include a fiber intake of approximately 30 g per day, the weight of evidence also supports a specific effort to increase consumption of soluble, or viscous, fiber. Soluble fiber is found abundantly in beans and legumes and in a variety of fruits, vegetables, and oats and other grains. Consumption of soluble fiber tends to lower serum lipids and reduce the postprandial rise in both glucose and insulin. A specific recommendation to consume a variety of beans, lentils, apples, and oat-based products is supported by the available evidence.

Micronutrient Supplements

Nominal micronutrient deficiencies persist despite the abundance of the US diet. Elevated

TABLE 45-2 A COMPARISON OF THE ENERGY DENSITY AND SATIETY INDICES OF THE MACRONUTRIENT CLASSES[1]

MACRONUTRIENT CLASS	ENERGY DENSITY	SATIETY INDEX	COMMENTS
Fat	Highest; 9 kcal/g	Lowest	The notion seems to prevail that fat is filling, but on a calorie-for-calorie basis, it is the least satiating of the macronutrient classes.
Carbohydrate, simple[2]	4 kcal/g	Intermediate; lower than for complex carbohydrate	The satiety threshold for sugar is higher than that for other nutrients, thus making sugar an important contributor to caloric excess in most people.
Carbohydrate, complex[2]	<4 kcal/g	Intermediate; higher than for simple carbohydrate	Sources of complex carbohydrate—whole grains, fruits, and vegetables—are rich in water and fiber, both of which increase food volume and contribute to satiety yet provide no calories.
Protein	3–4 kcal/g	Highest	Protein is generally more filling, calorie-for-calorie, than other food classes, although this may not be true when compared to complex carbohydrate very high in fiber and/or water content.

[1] The satiety index is a measure of how filling a food is, based on comparison of isoenergetic servings (see Chapter 38).

[2] For purposes of this chart, *simple* and *complex* carbohydrate refer to the metabolic response to foods rather than their biochemical properties. For detailed discussion of this topic, see Chapter 1.

homocysteine levels are reduced with supplements of vitamin B_6 and folate, although recent trials suggest that this effect may not translate into cardiovascular benefits as hoped (see Chapter 7). Folate supplementation before conception reduces the incidence among neonates of neural tube defects. Supplements of zinc appear to enhance immune function, and chromium supplements may improve insulin metabolism.

Teleologically, we may be adapted to a higher intake of micronutrients given the higher energy needs of our physically active ancestors and the calorie-dilute, nutrient-dense foods available to them (see Chapter 44). In addition, a large body of confluent evidence suggests, although it does not as yet not clearly establish, a benefit of antioxidant supplementation—in particular, a combination of fat- and water-soluble antioxidants. There is increasing evidence in support of vitamin D supplementation, and the combination of calcium and vitamin D in supplement form may be of meaningful benefit in the prevention of osteoporosis (see Chapter 14). The role of calcium supplementation in the protection of bone is controversial, but other benefits of calcium supplementation are convincing (see Chapters 14, 28, and 34). Iron supplementation is probably not of universal benefit in the United States but is of potential importance for menstruating women with low intake of red meat.

Given the lack of discernible toxicity and the potential benefits, the consumption of a multivitamin/multimineral supplement by all adults is a reasonable recommendation. Patients should be discouraged from using such a supplement as justification to comply less completely with dietary recommendations. The benefits of micronutrient supplementation are not nearly as well established as the benefits of a dietary pattern approximating recommendations. Inclusion of antioxidants in a supplement may offer specific benefits. Specific supplementation with high doses of single nutrients lacks supporting evidence for primary prevention but may be appropriate for more targeted

disease prevention efforts. A fish oil supplement as a source of n-3 fatty acids may be generally advisable for both adults and children who do not routinely consume fatty fish. Dosing recommendations are offered in Section VIL.

Distribution of Meals

There is limited evidence that the consumption of frequent, small meals precipitates less insulin release than does the consumption of comparable calories in larger meals spaced further apart and that a "nibbling" pattern may offer other metabolic benefits (20,21). Recent trials suggest that this apparent benefit may relate to dietary composition rather than distribution (22,23); but if meal and snack distribution influence composition, this distinction may be of limited practical importance. For the majority of adults who would benefit from at least modest weight loss, frequent snacking may blunt appetite and help prevent bingeing, although this, too, is controversial. As discussed in Chapter 47, the psychological benefits of frequent eating may be considerable for patients working at weight loss or weight maintenance.

Energy Restriction

The evidence that total energy restriction may reduce all-cause morbidity and mortality is provocative although not definitive for humans. Long-term compliance with low-energy diets (i.e., calorie restriction) is unlikely in all but the most highly motivated individuals, given the obvious difficulty most people have maintaining calorie intake at an appropriate level. Therefore, while of theoretical interest, a recommendation to patients to restrict calories to below normal levels as a health promotion strategy is of limited practical value.

■ RECOMMENDATIONS FOR DISEASE PREVENTION

Cardiovascular Disease

Patients with established coronary artery disease are encouraged to comply with dietary recommendations offered by the American Heart Association (24,25) (see Chapter 7). However, the American Heart Association Step 1 guidelines, and even the more restrictive Step 2 guidelines, modify the prevailing US diet less than is optimal for the prevention of coronary events. Events have been prevented both with an extremely fat-restricted diet (16) and with a Mediterranean dietary pattern (26). Jenkins et al. (27) have demonstrated that a diet specifically designed to lower lipids can do so as effectively as statin drugs, but adherence to such a diet is unlikely under real-world conditions.

A recent trial by McMillan-Price et al. (19) highlights the importance of specific food choices as opposed to just macronutrient distribution in the mitigation of cardiovascular risk. Two diets relatively high in carbohydrate and two diets relatively high in protein (and thus lower in carbohydrate) were compared on the basis of differing glycemic loads. The glycemic load, which considers both the glycemic index and the concentration of carbohydrate in a food source (see Chapter 6), has been shown in numerous trials to have potentially important implications for insulin metabolism, weight management, and cardiac risk. The study in question showed, as most do, that restricting calorie intake by any means led to roughly comparable weight loss in the short term, although trends hinted at a benefit of low glycemic load. The percentage of subjects achieving an at least 5% weight reduction was significantly greater on the low-GL diets whether they were high carbohydrate or high protein than on their higher-GL counterparts. Similarly, body fat loss was enhanced, at least among women, by the low-GL diets. Whereas LDL cholesterol decreased significantly on the high-carbohydrate, low-GL diet, it actually increased on the high-protein, low-GL diet.

A low-GL diet can be achieved by minimizing carbohydrate intake, but this approach may toss out the baby with the bathwater. High-carbohydrate foods such as most whole grains, beans, legumes, vegetables, and even fruits can contribute to a low-GL dietary pattern. Such foods also provide a diversity of micronutrients of potential importance to overall health, and cardiovascular health specifically (antioxidants flavonoids and carotenoids noteworthy among them). By demonstrating that a high-carbohydrate, low-GL diet may offer particular cardiac benefit, the McMillan-Price et al. study points toward a diet in which choice within macronutrient categories is given at least as much consideration as choice among those categories. This perspective is concordant with a large volume of research

suggesting that cardiac risk may be mitigated by reducing dietary fat and by shifting fat intake from saturated and trans fatty acids to monounsaturates and polyunsaturates. Cardiac health at the population level will likely be well served when dietary guidance is consistently cast in terms of healthful, wholesome foods rather than competition among the three macronutrient classes from which a diet is composed.

In light of all currently available evidence, patients at high risk for or with known coronary artery disease should be encouraged to adopt a basic dietary pattern matching that advocated for health promotion. Total fat intake should be reduced from the current US mean of 34% to approximately 25% of calories. A particular emphasis should be placed on the reduction of saturated and trans fat intake and on shifting fat calories to unsaturated plant oils. Restriction of dietary cholesterol is of lesser importance and may not confer benefit (see Chapter 7). Frequent fish consumption, inclusion of flaxseed in baked goods, and use of flaxseed oil on salad should be encouraged. Cooking should be done with olive and/or canola oil.

Consumption of one alcoholic beverage per day is recommended; men may benefit from up to two drinks. Although the benefits of alcohol pertain to all ethanol, polyphenols in the skins of grapes have antioxidant properties; therefore, red wine may offer additional benefits. Patients with hyperlipidemia should make a particular effort to increase intake of soluble fiber. They may do so by eating oatmeal, and particularly oat bran, consistently with breakfast; by eating oat-based breads and baked goods; and by eating beans, lentils, and apples. The use of spreads containing plant stanols and/or sterols at a dose of approximately 2 g per day may be advisable for such patients as well.

A multivitamin and fish oil supplement are generally worthy of consideration.

Cerebrovascular Disease

Cardiovascular disease and cerebrovascular disease share risk factors. Despite one study suggesting that high fat intake may reduce the risk of stroke (28), the weight of evidence favors comparable recommendations for the prevention of all sequelae of atherosclerotic disease (see Chapters 7, 10, and 20). There is insufficient basis to justify modifying the recommendations for prevention of cardiovascular disease in patients at risk for or with a history of cerebrovascular disease. The only caveat here pertains to patients with a history of intracranial bleeding, in whom fish oil and possibly vitamin E should be avoided, depending on the etiology of the bleed, to avoid platelet inhibition.

The best-established means of preventing first or recurrent stroke is blood pressure control. The dietary recommendations for the control of blood pressure are provided in Chapter 8. In general, generous intake of calcium, magnesium, and potassium and restricted intake of sodium are recommended. A diet adhering to the pattern described for health promotion will offer these characteristics and facilitate control of blood pressure (29).

Diabetes Mellitus

The Diabetes Prevention Program (30) provides convincing evidence that a diet conforming to basic guidance for overall health promotion, in combination with moderate physical activity, offers a powerful defense against diabetes in vulnerable patients. Specific benefits may be derived from a generous intake of soluble fiber from oats, beans, lentils, apples, and berries. A dietary pattern characterized by a low glycemic load offers likely benefit as well, although this is readily achieved by adopting a healthful and substantially plant-based diet, with a relatively low intake of processed foods and refined grains. Additional details are addressed in Chapter 6.

Cancer

The maintenance of ideal body weight, low total energy consumption, and intake of a variety of fruits and vegetables appear to offer protection against a wide range of, perhaps even most, cancers. These recommendations are consistent with those for health promotion and the prevention of other leading diseases. One departure is alcohol, which may reduce the risk of cardiovascular disease but appears to promote cancers of the breast, head, neck, and other sites. Women at high risk of breast cancer, or individuals with a cancer history, are advised to abstain from alcohol. In such individuals also at risk for or suffering from heart disease, alternative means should be sought to provide the benefits of alcohol. Specifically, exercise and avoidance of refined carbohydrate may raise high-density lipoprotein, whereas aspirin

and n-3 fatty acids may inhibit platelet aggregation. The antioxidants concentrated in red wine are readily obtained from fruits and vegetables, fruit juices (notably purple grape juice), green tea, and dark chocolate.

The benefits of energy restriction appear to pertain particularly to cancer prevention. Patients at high risk for or with a history of cancer should be encouraged to restrict calories to bring weight down to near ideal. In such situations, the use of micronutrient supplements is particularly important. In advanced cancer, nutritional goals should be shifted to weight maintenance, and energy restriction should be abandoned. See Chapter 12 for additional discussion.

Inflammatory Diseases

Although food intolerance may play a role for some individuals in the etiology of chronic inflammatory and autoimmune diseases, there is no evidence of such an association for the majority of patients. The most promising nutritional approach to chronic inflammation is improving the distribution of fats in the diet by reducing intake of saturated and trans fat, favoring intake of monounsaturates and polyunsaturates, and supplementing intake of n-3 fatty acids (see Chapter 20). A generous intake of fruits and vegetables is of likely benefit. Therefore, the dietary recommendations for health promotion need not be altered for patients at risk for or with chronic inflammatory conditions. Use of nutriceutical proteoglycans, such as glucosamine sulfate, for control of pain and inflammation is of uncertain benefit.

Infectious Disease

The principal effect of nutrition on the course of infectious disease is mediated through effects on immune system function. The one exception is in chronic infectious disease, such as HIV and AIDS, where cachexia may become an independent threat to health. A variety of micronutrients serve as cofactors in metabolic activities germane to immune function. Certain minerals important to the immune system, including zinc and magnesium, tend to be at nominal levels in the typical American diet.

A micronutrient supplement including minerals is reasonable, although of uncertain benefit, for the prevention of infectious disease and in all individuals with chronic infectious disease. The increased metabolic demands of infection, particularly when fever is present, require increased energy intake to maintain body mass. There is no evidence to suggest that the overall dietary pattern recommended for health promotion should be altered for purposes of preventing or managing infectious disease (see Chapter 11).

Renal Insufficiency

The most widely supported dietary manipulation for the management of renal insufficiency is restriction of protein to 0.6 g per kg (see Chapter 16). This intake level falls within the range recommended for health promotion and, therefore, may be advocated without concern of ill effects. The leading causes of renal failure in the United States are diabetes mellitus and hypertension, both of which are amenable to dietary management as described earlier and elsewhere (see Chapters 6 and 8).

Liver Disease

The principal dietary manipulations in patients with chronic liver disease are protein restriction and avoidance of alcohol. Moderate protein restriction relative to levels that prevail in the United States may be advisable for health promotion, whereas the optimal dose of dietary ethanol varies with individual circumstances. Thus, patients with liver disease should, for the most part, adhere to a diet consistent with recommendations for health promotion, while abstaining from alcohol. Supplementation with B vitamins generally is indicated and is provided if a multivitamin is taken daily. Preliminary evidence for nutriceuticals such as silymarin is discussed elsewhere (see Chapter 17).

Nutgrigenomics

At present, dietary guidance for health promotion is based on principles of sound nutrition for the population at large. Recommendations are then further tailored on the basis of individual health and risk factor status. Family history may provide some insight regarding specific individual vulnerabilities before the advent of any overt manifestations.

Nutrigenomics is a nascent field devoted to linking dietary guidance to individual vulnerabilities discernible through genetic testing and the identification of specific polymorphisms (31,32).

Genetic polymorphisms may account for variable susceptibility to adverse effects of dietary sodium or cholesterol, for example; for variable susceptibility to insulin resistance; and for variable micronutrient requirements.

While the day of routine genomic testing as a basis for individualized dietary guidance may dawn, as of yet it has not. To the extent that genomics may allow for more perfect dietary guidance, anticipation of that advance should not interfere with the good dietary guidance that can be offered right now.

Of note, *Homo sapiens* is a species with a native dietary habitat like other species (see below and Chapter 44). While there is doubtless genomic variation among, for example, lions, it is still self-evident that there is a basic dietary pattern suitable for lions—as there is for horses, koala bears, and tropical fish. While the pursuit of optimal health and cultural diversity complicate the formula for dietary health for humans, the principle that salutary dietary patterns are to some extent species relevant is still germane. The particular value of nutrigenomics may reside more in the motivational power of individualized health messaging (see Chapter 47) than in characterizing the dietary pattern conducive to health. While the relative importance of various aspects of diet may vary with alleles, in general, the fundamentals of nutrition that support health at the population level are apt to do so at the individual level as well. When available, the promise of nutrigenomics should be fully exploited. At present, however, the allure of that promise should not distract from dietary guidance that can and should be provided to virtually all patients with considerable confidence.

Evolutionary Biology

There is no denying that the base of evidence on which dietary recommendations for human health promotion are based is incomplete. There is, of course, substantially less scientific evidence to guide the development of dietary patterns for species other than our own, yet paradoxically, we seem to be far more confident when doing so. There is little controversy regarding the suitable diets for a wide range of domestic animals or, for that matter, wild animals held in zoos. The guiding principle on which that confidence is based is the "native" diet of each species. Lions in a zoo are not subjected to clinical trials to determine what they should be fed; they are fed something that approximates their diet in the wild. This approach, deemed reasonable and robust for diverse species, deserves application to humans as well. Consideration of our native diet is a useful construct for filling gaps in the science of human nutrition until or unless research advances fill those gaps.

Eaton (33) has made this very suggestion quite persuasively. The approach garners support from the fundamental confluence between dietary recommendations based on modern trials and epidemiological evidence and those based on methods of paleoanthropology to estimate our ancestral dietary pattern, which was rich in fruits and vegetables, high in fiber in micronutrients, low in salt and sugar, essentially free of trans fats, and low in saturated fat. The value of considering the dietary pattern to which our species is adapted in confronting the challenges of nutritional health today is addressed more fully in Chapter 44.

■ SUMMARY

The myriad effects of nutrition on health outcomes are documented in a vast literature of widely divergent quality. In certain vital areas, consensus has yet to develop. Sufficient evidence has been gathered, however, to permit the generation of dietary recommendations for health promotion and disease prevention with considerable confidence. There is overwhelming consensus in support of a diet characterized by a generous intake of vegetables and fruits, whole grains, beans, lentils, nuts, and seeds; an emphasis on fish and skinless poultry or plant foods as protein sources; restriction of trans fat, saturated fat, refined starch, added sugar, and salt; a shift from animal and other saturated fats to unsaturated plant oils; and portion control conducive to energy balance and the maintenance of a healthy weight. Recommendations to include nonfat dairy in the diet are less universal but nonetheless predominant.

The same dietary pattern is appropriate for the prevention of most diseases. This has not always been evident and is worthy of note. Patients with cardiovascular disease often have diabetes, also may have cerebrovascular disease, often have hypertension, may have renal insufficiency, may have had or have cancer, and are constantly vulnerable to infectious disease. If each disease required a different diet, consistent recommendations could not be made to an individual, let

alone to a population. The emergence of a "one diet" approach to nutritional health is a logical outgrowth of confluent lines of evidence and the clinical imperative for consistent and practicable advice. The benefits of a health-promoting diet should be combined with regular physical activity for maximal benefit; a sedentary lifestyle may undermine many of the potential health benefits of an otherwise salutary dietary pattern.

All patients, with or without chronic disease or risk factors, should be encouraged to comply with a health-promoting diet. Patients with one or more predominant risk factors or diseases may benefit from modest disease- or factor-specific dietary adjustments. Although the advice may not change much with the development of disease, the conviction and frequency with which counseling is provided, and the willingness of the patient to change, should both increase.

An overview of dietary and related lifestyle recommendations for health promotion is provided in Tables 45-3, 45-4, and 45-5.

TABLE 45-3 RECOMMENDED DIETARY PATTERN FOR OPTIMAL HEALTH AND WEIGHT CONTROL

NUTRIENT CLASS/NUTRIENT			RECOMMENDED INTAKE
Carbohydrate, predominately complex			Approximately 45% to 60% of total calories
Fiber, both soluble and insoluble			At least 25 g per day, with additional potential benefit from up to 50 g per day
Protein, predominantly plant-based sources			Up to 25% of total calories
Total fat			Up to 30%, and preferably approximately 25% of total calories
	Types of fat	Monounsaturated fat	10% to 15% of total calories
		Polyunsaturated fat	Approximately 10% of total calories
		Omega-3 and omega-6 fat	1:1 to 1:4 ratio
		Saturated fat and trans fat (partially hydrogenated fat)	Ideally, less than 5% of total calories; trans fat intake should be negligible
Sugar			Less than 10% of total calories
Sodium			Up to 2,400 mg per day
Cholesterol			Up to 300 mg a day
Water			8 glasses a day/64 oz/2 liters, to vary with activity level, environmental conditions, and the fluid content of foods (e.g., fruits)
Alcohol, moderate intake if desired			Up to one drink per day for women, up to two drinks per day for men
Calorie level			Adequate to achieve and maintain a healthy weight
Physical activity/exercise			Daily moderate activity for 30 minutes or more Strength training twice weekly

Note: When absolute amounts are provided, they are referable to a prototypical 2,000 kcal/day diet.

Source: Adapted from Katz DL, Gonzalez MH. *The way to eat.* Naperville, IL: Sourcebooks, Inc., 2002:213.

TABLE 45-4 RECOMMENDED FOODS AND OVERALL DIETARY PATTERN TO MEET NUTRITIONAL OBJECTIVES FOR HEALTH PROMOTION

FOOD GROUP	FOODS TO CHOOSE
Whole grains	At least seven to eight servings per day of whole grain breads, cereals, and grains with 2 g or more fiber per serving. Include oatmeal, oat bran, brown and wild rice varieties, semolina and whole wheat pasta, couscous, barley, and bulgur wheat.
Fruits	Four to five servings per day from a rainbow of colors, especially deep yellow, orange, and red: berries, apples, oranges, apricots, melons, mangos, and so on. Select from fresh, frozen, canned packed in juice, and dried varieties. Buy locally grown in season whenever possible.
Vegetables	Four to five servings per day from a rainbow of colors, especially deep yellow, orange, red, and leafy green: yellow, red, and green bell peppers; squash, carrots, tomatoes, spinach, sweet potatoes, broccoli, kale, Swiss chard, Brussels sprouts, eggplant, and so on. Select from fresh, frozen, and canned varieties but be mindful of the higher sodium content of canned. Buy locally grown in season whenever possible.
Beans and legumes	Include three to four times per week. Beans and legumes make a good alternative to meat. Include a variety of beans and legumes in your diet: black, red, kidney, white, cannelloni, garbanzo (chick pea), navy, pinto, lentils, split peas, black-eyed peas, and soy.
Fish[1] (and other seafood)	Include as often as three to four times per week. Fish is generally an excellent, lean source of high-quality protein, and several varieties (e.g., tuna, salmon, mackerel, halibut, and cod) are excellent sources of omega-3 fatty acids. Seafood, such as shrimp and scallops, tends to be relatively high in cholesterol but is low in fat and also a good source of omega-3 fatty acids.
Chicken and turkey[1]	Include up to one to two times per week. Skinless breast meat is preferred.
Lean beef, pork, lamb[1]	Moderate intake of meat, working toward a goal of roughly one to two meat-based meals per week, or four to eight per month, if desired. Select lean meats preferentially; the loin and round cuts are the leanest.
Milk and cheese[1]	Choose at least two servings per day from fat-free, skim, or low-fat versions.
Vegetable oils and other added fats	Choose monounsaturated and polyunsaturated sources daily, used in small amounts to avoid excess of calories: olive oil, canola oil, olives, avocados, almond butter, and peanut butter.
Nuts and seeds	Include four to five times per week in small amounts of unsalted raw or dry roasted types: almonds, walnuts, pistachios, peanuts, pecans, cashews, soy nuts, sunflower seeds, pumpkin seeds, and sesame seeds. Mix 1 tablespoon of ground flaxseed daily into other cooked foods.
Eggs[1]	Up to one egg per day on average (more egg white is fine). Preferably, choose an omega-3 fatty acid–enriched brand.
Sweets	In moderation. Choose low-fat or nonfat varieties whenever reasonable. Dark chocolate (see Chapter 39) offers nutritional benefits.

[1] Optional items. Well-balanced vegetarian and vegan diets would omit these items. Note that fish is recommended for particular health benefits; flaxseed and/or an omega-3 fatty acid supplement is especially recommended to those who don't eat fish.

Source: Adapted from Katz DL, Gonzalez MH. *The way to eat*. Naperville, IL: Sourcebooks, Inc., 2002.

TABLE 45-5 PORTION SIZE GUIDE

FOOD GROUP	STANDARD SERVING SIZE
Whole grains	• 1 slice bread • 3/4 –1 cup breakfast cereal • 1/2 cup cooked cereal, grains, or pasta
Fruits	• 1 medium piece of fresh fruit • 4 oz 100% fruit juice • 1/2 cup canned, cooked, or chopped fruit • 1/4 cup dried fruit; about one small handful
Vegetables	• 1/2 cup cooked vegetables (about the size of a tennis ball) • 1 cup raw vegetable or salad (about the size of your fist) • 6 oz vegetable juice
Vegetable oils and added fats	• 1 teaspoon oil • 1/8 avocado • 1 tablespoon salad dressing • 1 teaspoon soft margarine
Nuts and seeds	• 1 oz or 1/4 cup • 1 tablespoon peanut or almond butter (about the size of the tip of your thumb)
Beans and legumes	• 1/2 cup cooked beans, lentils, or peas • 1/2 cup tofu • 1 cup soymilk
Fish, chicken, turkey, beef, pork, lamb	• 3 oz cooked (about the size of a deck of cards)
Dairy	• 1 cup milk or yogurt • 1 1/2 oz low-fat cheese (about the size of four stacked dice) • 1/2 cup ricotta cheese

■ REFERENCES

1. World Health Organization. *Obesity and overweight*. Available at http://www.who.int/mediacentre/factsheets/fs311/en/index.html; accessed 1/07.
2. Doll R, Peto R. The causes of cancer: quantitative estimates of avoidable risks of cancer in the United States today. *J Natl Cancer Inst* 1981;66:1191–1308.
3. Agency for Healthcare Research and Quality. *Counseling for a healthy diet*. Available at http://www.ahrq.gov/clinic/uspstf/uspsdiet.htm; accessed 1/07.
4. National Heart, Lung, and Blood Institute. *The practical guide: identification, evaluation, and treatment of overweight and obesity in adults*. Available at http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_b.pdf; accessed 11/8/07.
5. US Department of Health & Human Services. *Dietary guidelines for Americans, 2005*. Available at http://www.health.gov/dietaryguidelines/dga2005/document/; accessed 1/07.
6. US Department of Agriculture. *Steps to a healthier you*. Available at http://www.mypyramid.gov; accessed 1/07.
7. Centers for Disease Control and Prevention, National Cancer Institute. *Introducing the next generation of 5 a day!* Available at http://www.5aday.gov; accessed 1/07.
8. Lichtenstein AH, Appel LJ, Brands M, et al. Diet and lifestyle recommendations revision 2006. A scientific statement from the American Heart Association Nutrition Committee. *Circulation* 2006;114:82–96.
9. American Diabetes Association. *Making healthy food choices*. Available at http://www.diabetes.org/nutrition-and-recipes/nutrition/healthyfoodchoices.jsp; accessed 1/07.
10. American Dietetic Association. Weight management—position of ADA. *J Am Diet Assoc* 2002;102:1145–1155.
11. Institute of Medicine. *Dietary Reference Intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids (macronutrients)*. Washington, DC: National Academy Press, 2002.
12. American College of Preventive Medicine. *Diet in the prevention and control of obesity, insulin resistance, and type II diabetes*. Available at http://www.acpm.org/2002-057(F).htm; accessed 11/8/07.
13. World Health Organization. *Global strategy on diet, physical activity and health*. Available at http: //www.who.int/gb/ebwha/pdf_files/WHA57/A57_R17-en.pdf; accessed 1/07.
14. Katz DL. Competing dietary claims for weight loss: finding the forest through truculent trees. *Annu Rev Public Health* 2005;26:61–88.

15. USA Today. *Experts at International Congress on Obesity warn of deadly global pandemic*. Available at http:// www .usatoday.com/news/health/2006-09-03-obesity-conference_ x.htm; accessed 11/8/07.
16. Ornish D, Scherwitz L, Billings J, et al. Intensive lifestyle changes for reversal of coronary heart disease. *JAMA* 1998;280:2001–2007.
17. de Lorgeril M. Mediterranean diet in the prevention of coronary heart disease. *Nutrition* 1998;14:55–57.
18. Eaton S, Konner M. Paleolithic nutrition revisited: a twelve-year retrospective on its nature and implications. *Eur J Clin Nutr* 1997;51:207–216.
19. McMillan-Price J, Petocz P, Atkinson F, et al. Comparison of 4 diets of varying glycemic load on weight loss and cardiovascular risk reduction in overweight and obese young adults: a randomized controlled trial. *Arch Intern Med* 2006;166:1466–1475.
20. Jenkins DJ, Wolever TM, Vuksan V, et al. Nibbling versus gorging: metabolic advantages of increased meal frequency. *N Engl J Med* 1989;321:929–934.
21. Jenkins DJ, Khan A, Jenkins AL, et al. Effect of nibbling versus gorging on cardiovascular risk factors: serum uric acid and blood lipids. *Metabolism* 1995;44:549–555.
22. Bellisle F, McDevitt R, Prentice AM. Meal frequency and energy balance. *Br J Nutr* 1997;77:s57–s70.
23. Murphy MC, Chapman C, Lovegrove JA, et al. Meal frequency; does it determine postprandial lipaemia? *Eur J Clin Nutr* 1996;50:491–497.
24. Geil P, Anderson J, Gustafson N. Women and men with hypercholesterolemia respond similarly to an American Heart Association Step 1 diet. *J Am Diet Assoc* 1995;95: 436–441.
25. Schaefer E, Lichtenstein A, Lamon-Fava S, et al. Efficacy of a National Cholesterol Education Program Step 2 diet in normolipidemic and hypercholesterolemic middle-aged and elderly men and women. *Arterioscler Thromb Vasc Biol* 1995;15:1079–1085.
26. deLorgeril M, Salen P, Martin J, et al. Mediterranean diet, traditional risk factors, and the rate of cardiovascular complications after myocardial infarction: final report of the Lyon Diet Heart Study. *Circulation* 1999;99:779–785.
27. Jenkins DJ, Kendall CW, Marchie A, et al. Effects of a dietary portfolio of cholesterol-lowering foods vs lovastatin on serum lipids and C-reactive protein. *JAMA* 2003;290:502–510.
28. Gillman M, Cupples L, Millen B, et al. Inverse association of dietary fat with development of ischemic stroke in men. *JAMA* 1997;278:2145–2150.
29. Moore T, Vollmer W, Appel L, et al. Effect of dietary patterns on ambulatory blood pressure: results from the Dietary Approaches to Stop Hypertension (DASH) Trial. DASH Collaborative Research Group. *Hypertension* 1999; 34:472–477.
30. Knowler WC, Barrett-Connor E, Fowler SE, et al. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. *N Engl J Med* 2002; 346:393–403.
31. Stover PJ. Influence of human genetic variation on nutritional requirements. *Am J Clin Nutr* 2006;83:436s–442s.
32. Mathers JC. Nutritional modulation of ageing: genomic and epigenetic approaches. *Mech Ageing Dev* 2006;127: 584–589.
33. Eaton SB. The ancestral human diet: what was it and should it be a paradigm for contemporary nutrition? *Proc Nutr Soc* 2006;65:1–6.

■ SUGGESTED READING

Albert NM. We are what we eat: women and diet for cardiovascular health. *J Cardiovasc Nurs* 2005;20:451–460.
Alvarez-Leon EE, Roman-Vinas B, Serra-Majem L. Dairy products and health: a review of the epidemiological evidence. *Br J Nutr* 2006;96:s94–s99.
Bazzano LA, Serdula MK, Liu S. Dietary intake of fruits and vegetables and risk of cardiovascular disease. *Curr Atheroscler Rep* 2003;5:492–499.
Bengmark S. Impact of nutrition on ageing and disease. *Curr Opin Clin Nutr Metab Care* 2006;9:2–7.
Cassidy A. Diet and menopausal health. *Nurs Stand* 2005; 19:44–52.
Chahoud G, Aude YW, Mehta JL. Dietary recommendations in the prevention and treatment of coronary heart disease: do we have the ideal diet yet? *Am J Cardiol* 2004;94:1260–1267.
Cordain L, Eaton SB, Sebastian A, et al. Origins and evolution of the Western diet: health implications for the 21st century. *Am J Clin Nutr* 2005;81:341–354.
Diet, nutrition and the prevention of chronic diseases. *World Health Organ Tech Rep Ser* 2003;916:i–viii, 1–149, back cover.
Ding EL, Mozaffarian D. Optimal dietary habits for the prevention of stroke. *Semin Neurol* 2006;26:11–23.
Dirks AJ, Leeuwenburgh C. Caloric restriction in humans: potential pitfalls and health concerns. *Mech Ageing Dev* 2006;127:1–7.
Dwyer J. Starting down the right path: nutrition connections with chronic diseases of later life. *Am J Clin Nutr* 2006; 83:415s–420s.
Giugliano D, Ceriello A, Esposito K. The effects of diet on inflammation: emphasis on the metabolic syndrome. *J Am Coll Cardiol* 2006;48:677–685.
Halton TL, Willett WC, Liu S, et al. Low-carbohydrate-diet score and the risk of coronary heart disease in women. *N Engl J Med* 2006;355:1991–2002.
Heilbronn LK, de Jonge L, Frisard MI, et al; Pennington CALERIE Team. Effect of 6-month calorie restriction on biomarkers of longevity, metabolic adaptation, and oxidative stress in overweight individuals: a randomized controlled trial. *JAMA* 2006;295:1539–1548.
Holmes S. Nutrition and the prevention of cancer. *J Fam Health Care* 2006;16:43–46.
Ding EL, Mozaffarian D. Optimal dietary habits for the prevention of stroke. *Semin Neurol* 2006;26:11–23.
Howard BV, Van Horn L, Hsia J, et al. Low-fat dietary pattern and risk of cardiovascular disease: the Women's Health Initiative Randomized Controlled Dietary Modification Trial. *JAMA* 2006;295:655–666.
Hu FB, Willett WC. Diet and coronary heart disease: findings from the Nurses' Health Study and Health Professionals' Follow-up Study. *J Nutr Health Aging* 2001;5:132–138.
Hu FB, Willett WC. Optimal diets for prevention of coronary heart disease. *JAMA* 2002;288:2569–2578.
Jolly CA. Diet manipulation and prevention of aging, cancer and autoimmune disease. *Curr Opin Clin Nutr Metab Care* 2005;8:382–387.

Katz DL. Competing dietary claims for weight loss: finding the forest through truculent trees. *Annu Rev Public Health* 2005;26:61–88.

Katz DL. Pandemic obesity and the contagion of nutritional nonsense. *Public Health Rev* 2003;31:33–44.

Kennedy ET. Evidence for nutritional benefits in prolonging wellness. *Am J Clin Nutr* 2006;83:410s–414s.

Knowler WC. Optimal diet for glycemia and lipids. *Nestle Nutr Workshop Ser Clin Perform Programme* 2006;11:97–102.

McKevith B. Diet and healthy ageing. *J Br Menopause Soc* 2005;11:121–125.

Meyskens FL, Jr., Szabo E. Diet and cancer: the disconnect between epidemiology and randomized clinical trials. *Cancer Epidemiol Biomarkers Prev* 2005;14:1366–1369.

Moore VM, Davies MJ. Diet during pregnancy, neonatal outcomes and later health. *Reprod Fertil Dev* 2005;17:341–348.

Raatz S. Diet and nutrition—what should we eat? *Minn Med* 2003;86:28–33.

Schaefer EJ. Lipoproteins, nutrition, and heart disease. *Am J Clin Nutr* 2002;75:191–212.

Ramaa CS, Shirode AR, Mundada AS, et al. Nutraceuticals—an emerging era in the treatment and prevention of cardiovascular diseases. *Curr Pharm Biotechnol* 2006;7:15–23.

Srinath Reddy K, Katan MB. Diet, nutrition and the prevention of hypertension and cardiovascular diseases. *Public Health Nutr* 2004;7:167–186.

Stoeckli R, Keller U. Nutritional fats and the risk of type 2 diabetes and cancer. *Physiol Behav* 2004 30;83:611–615.

Strychar I. Diet in the management of weight loss. *CMAJ* 2006;174:56–63.

Tapsell LC, Hemphill I, Cobiac L, et al. Health benefits of herbs and spices: the past, the present, the future. *Med J Aust* 2006;185:s4–s24.

Uauy R, Solomons N. Diet, nutrition, and the life-course approach to cancer prevention. *J Nutr* 2005;135: 2934s–2945s.

Walker AR, Walker BF, Adam F. Nutrition, diet, physical activity, smoking, and longevity: from primitive hunter-gatherer to present passive consumer—how far can we go? *Nutrition* 2003;19:169–173.

Willett WC. Diet and health: what should we eat? *Science* 1994;264:532–537.

Willett WC, Sacks F, Trichopoulou A, et al. Mediterranean diet pyramid: a cultural model for healthy eating. *Am J Clin Nutr* 1995;61:1402s–1406s.

Willett WC, Stampfer MJ. Foundations of a healthy diet. In: Shils ME, Shike M, Ross AC, et al., eds. *Modern nutrition in health and disease,* 10th ed. Philadelphia: Lippincott Williams & Wilkins, 2006:1625–1637.

Williams MT, Hord NG. The role of dietary factors in cancer prevention: beyond fruits and vegetables. *Nutr Clin Pract* 2005;20:451–459.