PREVENTIVE NUTRITION
THE COMPREHENSIVE GUIDE
FOR HEALTH PROFESSIONALS

Edited by
ADRIANNE BENDICH, PhD
Hoffmann-La Roche, Paramus, NJ

and

RICHARD J. DECKELBAUM, MD
Columbia University, New York, NY

FOREWORD BY CHARLES H. HENNEKEN, MD, DRPH
AND JOANN E. MANSON, MD

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Public Health Implications of Preventive Nutrition

Jeffrey B. Blumberg

1. INTRODUCTION

The recent debate about health care reform has focused largely on issues of equal access, cost containment, and delivery of primary care with some minor appreciation of the need for continued support for research and development. The central paradigm of this discussion is universal coverage and ways to finance it. Largely absent from consideration is the recognition that public health policies must drastically reduce the current disease-oriented treatment approach by encouraging significant changes in provider and consumer attitudes toward health promotion and health maintenance. Abundant evidence indicates that a health care system with a goal of promoting health and preventing illness will cost less than the present system, which basically operates to respond to the presence of illness with expensive diagnostic and therapeutic interventions. Consensus reports, like those from the US Surgeon General and National Research Council, clearly support the notion of preventive nutrition: that the most important choice people can make to influence their long-term health prospects is the choice of diet (1-3). Importantly, the modalities of this choice extend beyond a knowledgeable selection of food items and include nutrient enrichment, fortification, supplementation, and most recently, the potential of functional foods (4).

The accumulating evidence of a link between diet and disease, particularly the chronic degenerative diseases, has led to an expansion in the focus of nutrition recommendations. The first major sources of nutrition guidance in North America, the US Recommended Dietary Allowances (RDA) and the Canadian Recommended Nutrient Intakes, were developed to recommend amounts of essential nutrients principally according to age and sex (3,5). More recent nutrition recommendations, such as the USDA/DHHS Dietary Guidelines for Americans (6) and those promulgated by the National Cancer Institute (7), go well beyond standards for the prevention of nutrient deficiencies and target the reduction in risk of such conditions as heart disease, hypertension, stroke, diabetes, and some forms of cancer. Recently, the Institute of Medicine’s Food and Nutrition Board has questioned whether the RDA should be revised to accommodate this link and include the concept of chronic disease prevention in the development of nutrient allowances (8).

Translating nutritional recommendations to public health policy will also require going beyond judgments based on the relative strength of the associations between diet and disease, and also take into account the current patterns of morbidity and mortality.
For example, a weak association between a dietary component and a disease having a major impact on the health of a population should merit greater consideration than evidence suggesting a stronger alteration in risk for a rare condition. Although nutritional guidelines for public health should always be conservative, with the potential benefits and efficacy of changes defined in the near absence of risk, there is little evidence to suggest any adverse consequence to such recommendations. Importantly, the recommendations must be developed such that people will accept the changes proffered and try, if only with partial success, to incorporate them into their lives. Of course, certain preventive nutrition approaches, e.g., fortification of the food supply, largely circumvent this obstacle to compliance.

There are subtle but important differences between health and the absence of disease and between health promotion and disease prevention. The Constitution of the World Health Organization states in its preamble that “health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.” Definitions of health promotion and disease prevention promulgated by the US Department of Health and Human Services differ in terms of personal behavior, level of prevention, and sense of well-being (2). Health promotion is defined as personal, environmental, or social interventions that facilitate behavioral adaptations conducive to improved health, level of function, and sense of well-being. Disease prevention is defined as personal, environmental, or social interventions that impede the occurrence of disease, injury, disability, or death, or the progression of detectable but asymptomatic disease.

The historical goal of nutrition recommendations has been directed to diets that provide all the essential nutrients and just enough energy to meet individual requirements (5). This objective represented a reasonable approach to the major causes of morbidity and death through the midpoint of this century. Public health measures, such as the creation of a safe water supply and the medical contribution of vaccines and antibiotic therapies, have done much to eliminate or reduce the threats of smallpox, tuberculosis, and other virulent infectious diseases of the past. In the nutrition arena, public health measures, such as enriching grains with B vitamins and iron, iodizing salt, fortifying margarine with vitamin A and milk with vitamins A and D, and adding vitamin C to fruit juices, have helped to eliminate the previously common risks of beri-beri, pellagra, goiter, rickets, and scurvy. Despite the success of these efforts, it is important to recognize that risks of nutritional deficiencies have not been totally eliminated, e.g., the marked prevalence of inadequate intakes of calcium, iron, vitamin D, and folate among women. Indeed, the National Health Promotion and Disease Prevention Objectives, Healthy People 2000, continues to target increased intakes of calcium and iron as high priority public health issues (9), and the Public Health Service has promulgated recommendations for folic acid to reduce the incidence of neural tube birth defects among women of childbearing age (10). Some health authorities suggest that supplementation may be the most practical way for women to increase their folic acid intake (11,12), particularly because plans to fortify the food supply with the vitamin have not yet been implemented. Without any intent to minimize the critical contribution to be made by folic acid in protecting against birth defects, this chapter will focus on the impact of preventive nutrition on chronic diseases.

Prevention can occur at various times during the natural history of a disease (13). Primary prevention involves risk factor modification to prevent the occurrence of disease,
such as increasing dietary fiber intake to reduce the incidence of colorectal cancer (14). Secondary prevention involves screening for a disease before it is symptomatic, such as the routine use of serum cholesterol testing to assess risk of coronary heart disease (CHD), with an appropriate follow-up intervention, such as decreasing dietary fat, niacin therapy, and so forth (15). Tertiary prevention involves treating and minimizing the complications of a disease once it has occurred, an apparent example being the use of antioxidant supplements to minimize coronary artery lesion progression in patients with coronary artery bypass grafts (16). Within the context of tertiary preventive nutrition, it important to also note that nearly 17 million Americans are treated for illnesses or injuries that place them at high risk of being malnourished (17). Thus, dietary changes and other nutritional interventions appear capable of playing a significant role in each facet of prevention strategies.

2. PATTERNS OF MORBIDITY AND MORTALITY AND THE INFLUENCE OF NUTRITION

The illness burden has shifted during this century from acute to chronic illness and from younger to older individuals. About 75% of deaths in people over the age of 65 are now from heart disease, cancer, and cerebrovascular disease (Table 1) (18,19). In contrast, at the turn of the century infectious disease was responsible for 50% of deaths whereas heart disease, cancer, and stroke combined contributed 35%. Preventive measures apparently have had major positive effects in increasing life expectancy (20). A significant portion of the decline in the mortality rate observed since 1960 has been the postponement of death from chronic diseases. Nonetheless, the wider spread knowledge and more successful implementation of preventive measures related to these diseases could further decrease premature deaths. It is worthwhile to briefly consider some of the leading causes of morbidity and mortality in the context of preventive nutrition.

2.1. Coronary Heart Disease

The incidence of CHD increases with age and is responsible for approx 24% of total deaths in the United States. CHD had become a major cause of death by 1920 and increased by 1–2% / yr to 300 deaths / 100,000 population in the mid 1960s; CHD mortality rates began to decrease around 1968, and today are about 30% lower (21). This decline follows a pattern that is compatible with a drop in incidence caused by the adoption of preventive health practices (20). Although an increased awareness of some of the risk factors associated with CHD with subsequent nutritional and other behavioral modifications must be partly responsible for the improvement, some reports argue that empirical proof is lacking to indicate this trend has resulted from risk factor modification (22,23). Although some of the decrease in mortality rates may be secondary to improved long-term survival after a myocardial infarction, most studies do not support this contention or otherwise suggest that advances in medical treatment account for a significant proportion of the change (24,25). The annual economic cost of CHD is currently estimated at greater than $80 billion, with total cardiovascular disease costs exceeding $138 billion.

Dietary changes, particularly a reduction in total and saturated fat and an increase in soluble fiber, is considered the cornerstone of therapy to reduce borderline and high-risk serum cholesterol levels whether or not drug therapy is eventually added to the regimen
Table 1
Estimated Total Deaths and Percent of Total Deaths for the 10 Leading Causes of Death in the United States (19)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cause of death</th>
<th>Number</th>
<th>Percent of total deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a</td>
<td>Heart diseases</td>
<td>759,400</td>
<td>35.7</td>
</tr>
<tr>
<td></td>
<td>Coronary heart disease</td>
<td>511,700</td>
<td>24.1</td>
</tr>
<tr>
<td></td>
<td>Other heart disease</td>
<td>247,700</td>
<td>11.6</td>
</tr>
<tr>
<td>2a</td>
<td>Cancers</td>
<td>476,700</td>
<td>22.4</td>
</tr>
<tr>
<td>3a</td>
<td>Strokes</td>
<td>148,700</td>
<td>7.0</td>
</tr>
<tr>
<td>4b</td>
<td>Unintentional injuries</td>
<td>92,500</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>Motor vehicle</td>
<td>46,800</td>
<td>2.2</td>
</tr>
<tr>
<td></td>
<td>All others</td>
<td>45,700</td>
<td>2.2</td>
</tr>
<tr>
<td>5</td>
<td>Chronic obstructive lung diseases</td>
<td>78,00</td>
<td>3.7</td>
</tr>
<tr>
<td>6</td>
<td>Pneumonia and influenza</td>
<td>68,600</td>
<td>3.2</td>
</tr>
<tr>
<td>7a</td>
<td>Diabetes mellitus</td>
<td>37,800</td>
<td>1.8</td>
</tr>
<tr>
<td>8b</td>
<td>Suicide</td>
<td>29,600</td>
<td>1.4</td>
</tr>
<tr>
<td>9b</td>
<td>Chronic liver disease and cirrhosis</td>
<td>26,000</td>
<td>1.2</td>
</tr>
<tr>
<td>10b</td>
<td>Atherosclerosis</td>
<td>23,100</td>
<td>1.1</td>
</tr>
<tr>
<td>All causes</td>
<td></td>
<td>2,125,100</td>
<td>100.0</td>
</tr>
</tbody>
</table>

\(^{a}\)Causes of death in which diet plays a part.
\(^{b}\)Causes of death in which excessive alcohol consumption plays a part.

(15). Recent research has substantially expanded the classic cholesterol-heart disease relationship by indicating a significant protective impact and a potential therapeutic role for vitamins C, E, and \(\beta\)-carotene and other antioxidant phytochemicals (26) and vitamins B6, B12, and folate (27) (Figs. 1 and 2).

2.2. Cancer

Cancer is the cause of death in 22% of Americans. It has been estimated that at least a third of cancer mortality is related to dietary factors. Unlike heart disease, mortality rates for cancer continue to rise. Overall, cancer mortality is increasing at a rate of 0.5% /yr for men with no change for women; the total cancer incidence each year is increasing by 1.8% for men and 0.8% for women (28,29). The complete figures are complex, since the incidence of cancer at some sites associated with diet (e.g., breast, colon, prostate) has increased, whereas at other sites (most notably the stomach), it has decreased. However, these figures are revealing, because it is particularly changes in incidence rates that are indicative of disease prevention. Although a decline in the mortality rate may suggest some success with a preventive strategy, it may also be a consequence of improved treatment leading to increased survival times following diagnosis. The annual economic cost of cancer is currently estimated at greater than $104 billion.

Efforts to decrease the incidence of lung cancer, potentially one of the most preventable cancers, and the most common cause of cancer deaths for both men and women, has proven difficult. Although tobacco use and environmental exposures are the most important risk factors, sufficient progress has not been made in either the behavioral or the political aspects of controlling these elements to affect the subsequent
Fig. 1. The divergent capacity of folic acid for disease prevention.

Fig. 2. The convergent capacity of nutrients to affect cardiovascular disease.
morbidity and mortality. Interestingly, screening for lung cancer, a secondary prevention step, is not recommended because it is ineffective (30). An attempt to reverse the risk of lung cancer in life-long smokers with β-carotene and vitamin E supplementation proved ineffective, although this method may work in nonsmokers (31,32).

Various studies indicate that a high intake of total fat increases the risk of some types of cancer, notably cancer of the breast and colon, but also of the prostate, rectum, and ovaries. Other dietary factors, including smoked, salt-cured, and nitrate-cured foods, alcohol, and naturally occurring contaminants, such as aflatoxins and N-nitroso compounds, also pose a potential cancer risk. Dietary patterns emphasizing foods high in fiber are associated with low rates of certain cancers, especially breast and colon cancer. Fruits and green and yellow vegetables, important sources of the antioxidant vitamins, putative chemopreventive phytochemicals like phenols and indoles, as well as fiber, are also associated with reduced risk of several forms of cancer. For example, high intakes of β-carotene appear to reduce the incidence of lung, breast, oral mucosa, bladder, and esophageal cancers (33). Vitamin C appears to have a protective effect against esophageal, stomach, cervical, breast, and lung cancers (34). Low intakes of vitamin E are strongly correlated with risk of cancer in several organs (35). Evidence also suggests that calcium and selenium have protective effects against cancer (36).

2.3. Stroke

Stroke is the third leading cause of death among older adults, with the rate increasing with the age of the population. However, a trend of decreasing incidence of stroke has been observed over the last few decades (37). Since short-term fatality and survival rates for hospitalized stroke patients have not changed appreciably during this period, this decline in incidence suggests an effect of such preventive measures as hypertension control, although modification of this risk factor does not explain all of the observed change (38,39). The prevalence of stroke approximates 2 million cases, with about 15% as short-term case fatalities, 16% requiring institutional care, and 50% of survivors permanently disabled (38). The annual economic cost of stroke is currently estimated at greater than $30 billion.

Animal fat, saturated fatty acids, and total fat have been positively related to the risk of cerebral infarct, but inversely correlated with the incidence of cerebral hemorrhage in some but not all studies (40–42). Recently, a poor nutritional status of folate and vitamin B6 and high plasma homocysteine concentrations have been strongly correlated with an increased risk of extracranial carotid-artery stenosis in older adults, suggesting an important role for these two vitamins in stroke prevention (43). Vitamin E has been associated with a reduced risk of ischemic stroke but an increased risk of hemorrhagic stroke (31).

2.4. Type II Diabetes Mellitus

Type II (noninsulin-dependent) diabetes mellitus has been diagnosed in approx 2.4% of the total population, with almost 9% of those 65 and older presenting with this condition and an estimated 4–5 million individuals believed to have undiagnosed diabetes (44). The complications of this disease, particularly nephropathy, neuropathy, retinopathy, and cardiovascular disease, have a major impact on the diabetic’s functional status and active life expectancy. These complications are a major reason why diabetes consumes one of every seven health care dollars, almost $100 billion annually.
Relative body weight is the only factor consistently related to the prevalence of type II diabetes, but diet, weight loss, and exercise can normalize blood sugars in most patients and appear to serve to delay the onset of the diabetic sequela. Diabetics are generally counseled to substitute carbohydrates from fruits and vegetables for fats in the diet, increase intake of soluble fiber, and avoid high protein consumption. Micronutrient intake may be a factor in primary and secondary prevention, since supplemental chromium (45) and vitamin E (46) have been noted to improve glucose tolerance, insulin action, and the nonoxidative metabolism of glucose in hyperglycemic and nondiabetic individuals.

2.5. Osteoporosis

Osteoporosis occurs most frequently in postmenopausal white women and in the elderly of both sexes. Approximately 20% of American women suffer one or more osteoporotic fractures before age 65, and as many as 40% sustain fractures later in life (47). Osteoporosis is not frequently observed in men and black women until after age 60, after which fracture rates progressively increase in these groups. Importantly, those persons who sustain a hip fracture have an excess of 12–20% age-adjusted 1 yr mortality. Almost 50% of those who sustain a fracture need long-term care services. The annual cost of caring for osteoporosis patients in the United States has been estimated at $10 billion and, without intervention, these costs are projected to rise during the next 25 yr to $30–60 billion.

Substantial evidence supports a role for calcium and vitamin D as protective agents against osteoporosis (36). High calcium intake during early years contributes to greater peak bone mass and during later years, together with vitamin D, prevents negative calcium balance and reduces the rate of bone loss (48). Although there is a lack of concordance in epidemiologic studies associating calcium and vitamin D intake and fracture risk, because of the limitations of observational research, clinical trials with daily supplements of these nutrients clearly demonstrate a significant reduction in the rate of age-related bone loss and secondary hyperparathyroidism and the incidence of fractures, especially of the hip (49–51). In addition to calcium, other minerals, including boron, copper, magnesium, manganese, and zinc, appear to contribute to the maintenance of bone density with age (52–54). Although not well established, dietary risk factors for osteoporosis include excess consumption of caffeine, protein, and/or alcohol.

2.6. Other Chronic Conditions

A growing body of evidence suggests that preventive nutrition strategies may also play a significant role in other chronic conditions that are not necessarily directly associated with risk of fatality, but that do release independence and the quality of life and affect national health care expenditures. For example, studies have demonstrated that supplementation with antioxidant vitamins, vitamin B6, and/or multivitamin/mineral formulations can enhance immune responses in older people. This action appears to be associated with reduced risk and duration of infectious disease episodes in older adults (55–57). Evidence has accumulated suggesting an important relationship between the incidence of age-related cataract and nutritional status, particularly of the antioxidants (58). In two prospective, randomized clinical trials conducted in China, supplementation with a multivitamin preparation or a riboflavin/niacin formula was found to significantly reduce the prevalence of nuclear cataract in older subjects relative to placebo.
controls (59). Recently, epidemiologic studies have indicated an inverse association between generous intakes of dietary carotenoids and vitamins C and E with the incidence of age-related macular degeneration, the leading cause of irreversible blindness among older adults (60,61). Several studies have suggested that mild or subclinical vitamin deficiency in free-living populations play a role in the pathogenesis of declining neurocognitive function with age. Healthy older adults with low blood levels of some vitamins, particularly folate, vitamin B12, vitamin C, and riboflavin, have been found to score poorly on tests of memory and nonverbal abstract thinking (62). Significant correlations have also been reported between poor indices of thiamin, riboflavin, and iron nutrition and impaired cognitive performance and electroencephalographic indices of neuropsychological function (63). As mentioned above, the inverse correlation between plasma homocysteine levels and carotid artery stenosis suggests that low B vitamin status may be related to the risk of cerebrovascular disease with its associated changes in cognitive function (Fig. 1) (43).

3. ASSESSMENT OF NUTRITION-DISEASE RELATIONSHIPS

When reviewing the value of preventive nutrition interventions, it is worthwhile discussing the basis for the association between dietary factors and risk of chronic disease. A risk factor is an attribute or exposure that is associated with an increased probability of disease. A nutritional risk factor can be established as a major contributor to pathogenesis or prevention if a difference in intake between groups is significantly associated with a change in the incidence of the disease under study. The complexity that arises in identifying which nutrients or other dietary components influence disease etiology becomes clear when the issues that must be addressed are considered. In studies of chronic degenerative conditions it is difficult to identify a specific component of the diet and conclude with confidence that an inadequate or a generous intake directly influenced the incidence of the disease. Some risk factors are readily amenable to comparison or intervention, e.g., cigarette smoking, where there are populations with varying degrees of exposure and others with none, and at least some of the former can be engaged to stop the behavior. The no-exposure situation obviously does not exist with diet, and assessing the precise intake of nutrients is seriously limited by the accuracy of self-reports, the extent of the nutrient databases, and the long latent period associated with chronic diseases.

Clinical signs and symptoms of chronic disease are not generally apparent until middle age, although they are a consequence of pathogenic events occurring in early adulthood or even in adolescence. Thus, age at onset of disease is almost impossible to determine. This situation makes it difficult to ascertain whether exposure to the suspected "cause" actually preceded the disease. Chronic diseases also have several other environmental and heritable risk factors that influence their pathogenesis, so research efforts must be directed at identifying the characteristics of individuals who are susceptible; further, there are often interrelationships between the risk factors (64).

Several criteria must be met to establish a causative relationship between a dietary factor and a chronic disease (65). Whereas the strength of the association is usually indicated by the magnitude of the relative risk, particularly in linking cause and effect, the attributable risk (the size of the difference in risk) may often be a more important measure of the impact of the relationship on public health. The association should also
be consistently observed in different studies with different populations, even though variations in the magnitude of the relative risk are to be expected, to provide confidence in the observation. The temporal relationship of the association must also be logical, with exposure of the suspected causal factor preceding the onset of the disease and usually accompanying the entire pathogenic process. Although specificity of the association is a usual criterion for determining causality, the known risk factors for chronic diseases seldom have a single effect, so lack of specificity should not rule out a contributing causal effect by a nutrient. Finally, there must be a biological plausibility in support of the association.

It is necessary to appreciate that in most cases increases in disease risk associated with a particular dietary factor are not dramatic in their magnitude, often being only twice or less that of the group with the lowest (or highest) intake. In contrast, risk of lung cancer is 32 times greater for people who smoke more than 25 cigarettes/d compared to nonsmokers (66). It is unlikely that any diet-disease relationship will approach this magnitude. Nonetheless, as noted above, a weak association between a dietary component and a disease having a major impact on the health of a population could have a significant impact on health promotion and disease prevention. One reason for the reported more modest impact of dietary factors on chronic disease is that levels of intake, particularly within a national population or culture, are simply not large enough to allow for strong associations. For example, some of the more compelling evidence about the relationship between dietary fat and disease has been derived from crosscultural, international studies where intakes cover a much broader range than found within a single country (67). Studies of micronutrient intake offer an advantage in that the use of vitamin and mineral supplements can create substantial differences in intake between users and nonusers. For example, an examination of the Health Professionals Follow-up Study revealed median intakes of vitamin E from 6–420 IU/d among quintiles and significant trends for reduced CHD risk across all quintiles, but only the suggestion of an inverse relationship between dietary vitamin E consumption and CHD (68). Additionally, micronutrient supplementation allows for relatively short-term human studies examining intermediary biomarkers or other proxy measures of chronic disease that can help provide the biologic plausibility necessary to strengthen epidemiologic observations, e.g., the dose-dependent inhibition of the oxidative modification of low-density lipoprotein cholesterol by vitamin E (69). As a consensus about the validity of specific biomarkers for chronic disease is developed, the use of these measures will substantially decrease the time and cost associated with translating new knowledge derived from clinical trials to recommendations for public health.

4. PREVENTIVE NUTRITION AND THE HEALTH SPAN

It is not unreasonable to suggest that the most efficient way to reduce health care costs is to institute prevention to avoid the premature diseases common among older adults (70–73). This change might also result in further gains in life expectancy, although such an effect is likely to be modest (74). Although simply prolonging life does not imply better health, evidence suggests that effective prevention does not trade longer life for an extended period of frailty and dependency. Thus, preventive nutritional interventions offer the potential for maintaining physiological function and preserving the independence of older people (75).
Increasing life expectancy has been a traditional measure of the success of a health care system. Indeed, life expectancy is a standard yardstick used to compare the quality of medical care in one country with that in another. However, a more relevant goal for a health care system should be assisting individuals to remain in vigorous good health for the length of their biologic life-span. Use of recently developed and validated measures of functional well-being could assist greatly in more appropriately defining health status (76). Leaf (73) has suggested that just establishing criteria for optimal health would focus medical and public attention on what interventions are likely to promote it, and help clarify which measures are the responsibility of the individual and which depend on the medical care system. Such an effort would help balance the current preoccupation of the medical care system with “curative” (more often palliative) measures with an involvement in health promotion and disease prevention. It is worth noting that the impressive, albeit usually expensive, achievements of the technologically advanced treatments for chronic diseases, e.g., drugs, surgeries, and devices like cardiac pacemakers, are palliative and not curative. Thus, these interventions, even when efficacious, do nothing about the underlying cause of the disease and thus will have no impact on the next generation of 30-, 40-, or 50-year olds.

One of the compelling and cost-effective aspects of preventive nutrition is the convergence of nutritional recommendations for so many diseases with very similar dietary guidelines proffered by the American Heart Association, National Cancer Institute, the US Surgeon General, the Department of Agriculture, and others (Fig. 3). The convergent capacity of several nutrients to reduce disease risk similarly underscores the broad potential of benefits for preventive nutrition—this is not a “one nutrient, one disease” situation. For example, generous intakes of calcium and vitamin D have been associated with decreased risk of osteoporosis, hypertension, colon cancer, and lead poisoning. Dietary antioxidants, including vitamins C and E and β-carotene, have been associated with decreased risk of some cancers, cataract, hypertension, infectious disease, and heart disease, as well as injury from pro-oxidant environmental pollutants. Vitamins B6, B12, and folic acid are associated with reduced risk of some cancers, cognitive impairments, and heart disease, as well as neural tube birth defects (Fig. 1). A reduction in total and saturated dietary fats is inversely associated with atherosclerosis and cardiovascular disease, hypertension, gallbladder disease, obesity, and cancer. It is important to recognize the public health implications of the divergent capacity of single nutrients, e.g., the potential benefits associated with folic acid intake, when considering such interventions as fortification and supplementation (Fig. 1).

Fries (75,77–79) has proposed that, because our life-span is finite and the onset of chronic disease is relatively easily delayed, the period between the onset of chronic infirmity and illness to death can be greatly shortened. Implicit in this “compression of morbidity” paradigm is the need to emphasize preventive approaches to health. In contrast, some reports present an opposite “increasing misery” scenario in which life is seen as longer but health worse (81–84). However, evidence is available that prevention is effective in reducing morbidity, more so than mortality (20,84,85). Interestingly, it is in middle-aged and older adults rather than young people that the greatest leverage from health promotion practices can be obtained, because the targeted conditions for prevention are more likely to occur, appear sooner, and cost more to treat in this group (86–88). As noted above, even small changes in these populations would yield substantial and rapid differences in health and economic endpoints. A 5-yr delay in the onset of cardio-
vascular disease could save about $69 billion annually. A delay in the onset of strokes by 5 yr would be associated with annual savings of $15 billion. A 5-yr delay in the occurrence of hip fracture annually could cut the number of events by 140,000 each year and save an estimated $5 billion annually. The annual cost of lens extractions is almost $5 billion, but if the rate of cataract development could be delayed 10 yr, 50% of these operations could be avoided and $2.5 billion could be saved annually.

5. THE CHALLENGE OF PREVENTIVE NUTRITION FOR THE HEALTH CARE SYSTEM

Each year the United States devotes more of its resources to health care. In 1960, health care expenditures were 5.2% of the gross national product (GNP); by 1990, health care expenditures reached 12.2% of the GNP, almost $700 billion. These costs are not divided evenly among the population: 1992 per capita health care expenditures for people 65 and older ($9125) was nearly four times that of younger people ($2350) with 38% of the year’s $800 billion national health care bill directed to older adults. Total health care costs in the United States are projected to surpass $1 trillion in 1995.

It has been estimated that approx 0.25% of health care expenditures are invested in prevention (72). Establishing a new balance between the “curative” and preventive approach to public health will require substantial cultural changes on the part of health care providers and the public. Health care providers will have to avoid perpetuating the concept that when illness strikes medicine will make available a pill or operation to erase the adverse health effects of a lifetime of self-abuse. Practitioners will have to learn how to counsel both patients and the public at large on preventing disease. The public will also have to accept more responsibility individually for their own health through choices they make and the lifestyles they pursue.

At least some signs suggest a growing consumer interest in nutrition and new labeling of foods and supplements have further served to heighten the public’s interest in products with claims of specific health benefits. Another force acting to increase consumer interest in nutrition-related health issues is the frequent association of nutritional interventions with the perceived efficacy of alternative medical therapies. Eisenberg et al. (89) included the use of nutrition products in their survey of unconventional medicine in the United States and noted that respondents who used commercial diet supplements and megavitamins reported out-of-pocket expenditures averaging $228 and $203 per person per year (yielding national projections of approx $1.2 and $0.8 billion, respectively. Although this pattern does not necessarily reflect rational use of such products, it does indicate an interest and willingness of people to adopt nutritional strategies in health promotion.
It has been suggested that too many physicians are trained in the medical specialties and that an increase in the number of primary general physicians would better serve the national need to establish preventive medical practices. Unfortunately, nutrition education for physicians and other health care providers remains an orphan discipline and little improvement has occurred since the recognition of this situation more than two decades ago (90,91). However, the failure to shift the public health paradigm from treatment to prevention is not solely the fault of medical education. A significant basis of the problem lies in the current reimbursement system for health care providers. Leaf (73) has suggested that as long as procedure-oriented physicians are reimbursed, often at several-fold the rate of general practitioners, internists, and pediatricians, the ranks of the former specialties will swell at the expense of the latter. This situation would be readily corrected if government and third-party medical insurers made the necessary changes in remuneration policies. It is worth noting that Blue Cross/Blue Shield and Medicare will pay $30,000 for coronary bypass graft operations and more than $100,000 for heart transplant surgery, but not for a $1000 cardiac rehabilitation program. Medicare specifically eschews reimbursement for preventive measures. Because there is virtually no reimbursement available for preventive medicine or nutrition, it is not surprising that beneficial and effective health promotion measures receive short shrift in medical education and practice.

Shifting the health care system from its current emphasis on treatment to prevention will take time. Even as such changes are implemented, more time will be required before its impact on chronic disease mortality will become apparent because of long latency periods, although a delay in the onset of clinical symptoms will be detected earlier. The dividends of prevention in reducing the population illness burden and enhancing the quality of life can be substantial. Efforts must be strengthened to encourage all segments of the population to adopt preventive nutrition strategies, not just those who are high risk. Food habits develop early in life, and this is a useful time to adopt preventive nutrition behaviors, although an emphasis on older adults appears more critical at this juncture, since by 2004 the cost of health care for those over 65 is projected to constitute 50% of the total national health care bill. Together with an increase in physical activity and the cessation of tobacco use, dietary modification and improvements in nutritional status present us with the greatest potential for reducing the incidence of chronic disease, improving public health, and limiting the growth of health care expenditures.

6. REFERENCES


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