

## Chapter 1

# High Costs Of Poor Eating Patterns In the United States

**Elizabeth Frazão**

*Dietary patterns in the United States are associated with increased risk of several chronic diseases such as coronary heart disease, cancer, stroke, diabetes, hypertension, overweight, and osteoporosis. This chapter looks only at the first four conditions, which account for over half of all deaths in the United States each year. After accounting for comorbidity and potential double-counting, it is estimated that healthier diets might prevent \$71 billion per year in medical costs, lost productivity, and the value of premature deaths associated with these conditions.*

## Introduction

Scientific research increasingly confirms that what we eat may have a significant impact on our health, quality of life, and longevity. In the United States, high intakes of fat and saturated fat, and low intakes of calcium and fiber-containing foods—such as whole grains, vegetables, and fruits—are associated with several chronic health conditions that can impair the quality of life and hasten mortality. In particular, 14 percent of all deaths have been attributed to poor diets and/or sedentary lifestyles (McGinnis and Foege, 1993).

Diet is a significant factor in the risk of coronary heart disease (CHD), certain types of cancer, and stroke—the three leading causes of death in the United States, and responsible for over half of all

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Frazão is an agricultural economist with the Food and Rural Economics Division of the Economic Research Service, U.S. Department of Agriculture.

**Table 1—Leading causes of death in the United States, 1994**

Cause of death	Deaths	Share of all deaths
	<i>Number</i>	<i>Percent</i>
1. Heart disease	732,409	32.1
<b>Coronary heart disease</b>	<b>481,458</b>	<b>21.1</b>
<b>2. Cancer</b>	<b>534,310</b>	<b>23.4</b>
<b>3. Stroke</b>	<b>153,306</b>	<b>6.7</b>
4. Chronic obstructive pulmonary diseases and allied conditions	101,628	4.5
5. Accidents and adverse effects	91,437	4.0
6. Pneumonia and influenza	81,473	3.6
<b>7. Diabetes mellitus</b>	<b>56,692</b>	<b>2.5</b>
8. Human immunodeficiency virus infection	42,114	1.4
9. Suicide	31,142	1.4
10. Chronic liver disease/cirrhosis	25,406	1.1
All causes	2,278,994	100.0

Bold = Health condition influenced by diet (excluding alcohol).

Source: USDA/ERS, from Singh and others, 1996.

deaths in 1994 (table 1). Diet also plays a major role in the development of diabetes (the seventh leading cause of death), hypertension, and overweight.<sup>1</sup> These six health conditions incur considerable medical expenses, lost work, disability, and premature deaths—much of it unnecessary, since a significant proportion of these conditions is believed to be preventable through improved diets (Frazão, 1995, 1996).

However, no estimates are currently available on the total economic costs that might be associated with food consumption patterns in the United States and the economic benefits that might derive from improved diets. This is partly because of the difficulties involved in estimating the direct effect of diet on health conditions. For example, an individual's risk for chronic disease can be increased by genetic predisposition, stress levels, smoking, and activity level, as well as diet. Further, because these chronic diseases occur in middle

<sup>1</sup> Diet also plays an important role in the risk for osteoporosis, neural tube birth defects, and other health conditions that are not addressed in this study.

age or later in life, and because dietary patterns tend to change over time, it is not clear which dietary patterns may be more important in establishing the risk for chronic disease: is it eating patterns during infancy? during early childhood? during adolescence? during adulthood?

Efforts to improve dietary patterns could markedly decrease morbidity and mortality associated with chronic health conditions. These benefits would result in lower medical care costs, lower institutional care costs, less lost productivity, improved quality of life, and increased life span. For example, studies have found that even fairly small reductions in intakes of fat, saturated fat, and cholesterol would likely yield substantial benefits (Browner, Westenhouse, and Tice, 1991; Zarkin and others, 1991). The economic impact analysis for the 1993 nutrition labeling regulations estimated that a 1-percent reduction in intake of fat and saturated fat and a 0.1-percent reduction in intake of cholesterol would prevent over 56,000 cases of CHD and cancer, avoid over 18,000 deaths, and save over 117,000 life-years over 20 years (USDA, 1993; DHHS, 1993a).

This study uses estimates from the medical literature on the likely effects of diet on specific chronic health conditions to estimate the medical costs and lost productivity that could be prevented through improved dietary patterns. The study also provides a more complete estimate of the total economic costs associated with diet by estimating the value of diet-related premature deaths. It should be noted, however, that the methodology for estimating the value of diet-related premature mortality is still being refined, and further work is needed to assess the appropriateness and relevance of the social values that have been incorporated in the estimates.

## **Health Consequences Of Poor Eating Patterns**

### **Coronary Heart Disease<sup>2</sup>**

Mortality data for 1994 show that coronary heart disease (CHD) was the cause of over 480,000 deaths in the United States—nearly two-

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<sup>2</sup> Although mortality statistics list “heart disease” as the leading cause of death, this paper focuses on coronary heart disease (CHD), also known as ischemic heart disease, the type commonly associated with diets.

**Table 2—Number of deaths, by age, from four major causes influenced by diet, 1994**

Cause of death	Age at death				Total <sup>1</sup>
	< 55	55-64	65-74	75 +	
<i>Total number of deaths</i>					
Coronary heart disease	28,549	45,567	104,184	303,123	481,458
Cancer	68,857	89,251	163,795	212,391	534,310
Stroke	9,382	9,577	25,386	108,954	153,306
Diabetes	6,306	7,784	15,744	26,856	56,692
<b>All 4 causes</b>	<b>113,094</b>	<b>152,179</b>	<b>309,109</b>	<b>651,324</b>	<b>1,225,766</b>

<sup>1</sup> Numbers may not add up to total number of deaths because no age is reported for some deaths.

Source: USDA/ERS, from Singh and others, 1996.

thirds of all deaths from heart disease, and more than one of every five deaths (table 1). Individuals 55-74 years of age accounted for 31 percent of all CHD deaths in 1994, and individuals 75 years and older accounted for 63 percent of these deaths (table 2).

The American Heart Association (1997) estimates that as many as 1.1 million Americans suffer a new or recurrent heart attack each year, that over 13.9 million people alive today have a history of CHD, and that someone dies from a heart attack about every minute. And although heart attacks affect mainly the elderly, 40 percent occur in people age 40-64 (American Heart Association, 1996a).

Although genetics plays an important role in an individual's risk of CHD, environmental factors are also significant. Major modifiable risk factors for CHD include high blood cholesterol levels, diabetes, overweight, hypertension, physical inactivity, and smoking. Diet—in particular, consumption of saturated fats—can influence blood cholesterol levels in some people. New research also suggests that increased intake of antioxidants and folic acid—a vitamin available in dry beans, and many fruits and vegetables—may reduce the risk of CHD (Boushey and others, 1995; Willett, 1994; Plotnick, Corretti, and Vogel, 1997). And diet can also influence other risk factors for CHD, such as diabetes, hypertension, and overweight (see below).

Although CHD currently represents over 20 percent of all deaths in the United States, mortality rates from heart attacks have been declin-

ing since the 1950's. However, it is not clear that the incidence of heart disease has been declining. Rothenberg and Koplan (1990), for example, found that the frequency of hospitalization for CHD was increasing in spite of downward trends in mortality, while hospitalization from stroke increased 24 percent from 1979 to 1995 (American Heart Association, 1997). Hunink and others (1997) examined the decline in mortality from CHD between 1980 and 1990 and determined that 25 percent of the decline was explained by primary prevention and an additional 29 percent was explained by secondary reduction in risk factors in patients with coronary disease. Other improvements in treatment explained 43 percent of the decline in mortality. They concluded that more than 70 percent of the overall decline in mortality occurred among patients with coronary disease. An analysis conducted at the Harvard Center for Risk Analysis also suggests that most of the decline in mortality from CHD between 1980 and 1990 was due to improvements in the management of patients who already had the disease rather than due to reduced incidence of CHD (Goldman and Hunink, 1997). It is difficult to isolate the effect of dietary changes, because of other concomitant practices—such as lower-dose oral contraceptives, and increased use of cholesterol-lowering drugs and postmenopausal estrogen replacement therapy—that also reduce blood cholesterol levels (Johnson and others, 1993).

## **Cancer**

Cancer claimed over 530,000 lives in the United States in 1994 (table 1). Individuals 55-74 years of age accounted for nearly half (47 percent) of all cancer deaths, while individuals 75 years and older accounted for an additional 40 percent (table 2).

The American Cancer Society (1997) estimates that over 1 million new cancer cases are diagnosed each year, and that about 560,000 people will die of cancer in 1997—more than 1,500 people per day.

Even though genetics is an important factor in cancer risk, epidemiologic studies suggest that cancer is not an inevitable consequence of aging (World Cancer Research Fund and American Institute for Cancer Research, 1997; Wynder and Gori, 1977; American Cancer Society, 1997). Changes in cancer patterns over time—such as the sharp increase in incidence of breast and lung cancer and the decline in stomach cancer in the United States in the past decades—support

the hypothesis that environmental and lifestyle factors may play an important role in the occurrence of cancer. This hypothesis is further strengthened by studies showing that when populations migrate, their cancer patterns change in a fairly short time to approximate the patterns prevalent in the new area of residence (Higginson and Muir, 1979; Doll and Peto, 1981; National Research Council, 1982; Page and Asire, 1985).

Studies increasingly demonstrate a strong protective effect against cancer associated with increased consumption of fruits and vegetables (Block, Patterson, and Subar, 1992; World Cancer Research Fund and American Institute for Cancer Research, 1997); the evidence on the role of high-fat diets and cancer risk is less clear. The increased risk of cancer attributed to a high-fat diet may really be due to low intake of something else—such as fruits and vegetables (Subar and others, 1994) or due to the increased risk of obesity associated with high-fat diets (World Cancer Research Fund and the American Cancer Research Institute, 1997).

## **Stroke**

Stroke (cerebrovascular disease) affects over 500,000 people each year—averaging nearly one every minute—and killed over 150,000 people in 1994 (table 1). Individuals 55-74 years of age accounted for 23 percent of stroke deaths in 1994, while individuals 75 years and older accounted for 71 percent of stroke deaths in 1994 (table 2).

According to the American Heart Association (1997), stroke is the leading cause of serious long-term disability, and accounts for half of all patients hospitalized for acute neurological disease. Mortality rates from stroke have been steadily declining since 1950 (Singh, Kochanek, and MacDorman, 1996). Some of this decline has been attributed to improvements in the detection and treatment of hypertension (see below).

## **Diabetes**

Diabetes is the seventh leading cause of death in the United States, directly responsible for 56,000 deaths in 1994 (table 1). Forty-two percent of these deaths occurred among individuals 55-74 years of age; an additional 47 percent occurred among individuals 75 years and older (table 2). However, because people often die of the com-

plications of diabetes rather than from diabetes itself, mortality statistics tend to underreport the true impact of diabetes (Centers for Disease Control and Prevention, 1997a; Geiss, Herman, and Smith, 1995; Rothenberg and Koplan, 1990; Herman, Teutsch, and Geiss, 1987). The American Diabetes Association (1998) estimates that diabetes contributes to at least an additional 100,000 deaths each year (100,000 more deaths than the 56,000 currently attributed to diabetes). For example, diabetes is the single leading cause of end-stage renal disease, and a risk factor for CHD, stroke, and hypertension. People with diabetes are two to four times more likely to have heart disease and to suffer a stroke (American Diabetes Association, 1998) and twice as likely to have hypertension as people who do not have diabetes (American Diabetes Association, 1993; Herman, Teutsch, and Geiss, 1987). Diabetes is also the leading cause of blindness, and the leading cause of nontraumatic lower limb amputation (American Diabetes Association, 1998).

Diabetes affects more than 15 million people in the United States, although one-third are not aware they have the condition. Approximately 2,200 people are diagnosed with diabetes each day (American Diabetes Association, 1998). Both prevalence and incidence are higher among blacks and Hispanics than among whites—probably due to a combination of genetic factors and higher prevalence of risk factors such as obesity (American Diabetes Association, 1993).

There are two main types of diabetes. Type I, also called insulin-dependent or juvenile-onset diabetes, is characterized by an absolute deficiency of insulin and usually appears before age 40. Type II diabetes, also called noninsulin-dependent or adult-onset diabetes, appears in midlife, most often among overweight or obese adults. Many times it can be controlled by diet and exercise alone. Over 90 percent of the diagnosed cases of diabetes are Type II. Undiagnosed cases are likely to be Type II, since the severity of Type I symptoms requires medical intervention.

The only therapeutic interventions known to be effective in noninsulin-dependent diabetes are the maintenance of desirable body weight and exercise (DHHS and USDA, 1992; American Diabetes Association, 1993). About 80 percent of people with Type II diabetes have a history of being overweight (DHHS, 1992; Herman, Teutsch, and Geiss, 1987). McGinnis and Foege (1993) estimate that half of

Type II diabetes can be prevented by controlling weight (perhaps through dietary improvement and physical activity).

## Hypertension

Hypertension, or high blood pressure, affects as many as 50 million people in the United States (American Heart Association, 1996).<sup>3</sup> Mortality statistics for 1994 list 23,943 deaths from hypertensive heart disease, 2,494 deaths from hypertensive heart and renal disease, and 11,765 deaths from hypertension with or without renal disease (Singh, Kochanek, and MacDorman, 1996). If listed together, these three categories would add to 38,202 deaths and would comprise the ninth leading cause of death. But mortality statistics report the two types of hypertensive heart disease under “diseases of the heart” and list hypertension with or without renal disease as a separate category.

Furthermore, because hypertension is a common and important risk factor for CHD, stroke, and renal disease (DHHS, 1993c), mortality statistics grossly underestimate the impact of hypertension on mortality (Weinstein and Stason, 1976). Milio (1981) estimates that hypertension contributes to 50 percent of stroke deaths and 6 percent of CHD deaths. The American Heart Association (1997) estimates that as many as 30 percent of all deaths in hypertensive black men and 20 percent of all deaths in hypertensive black women may be attributable to high blood pressure. In 1993, hypertension was listed as a contributing cause of death on more than 180,000 death certificates of stroke, heart attack, and heart failure victims (American Heart Association, 1996b).

Each year, some 2 million people start treatment for hypertension (DHHS, 1993b). Yet, 1988-91 data from the National Health and Nutrition Examination Survey show that 35 percent of those with high blood pressure were unaware of their condition. In addition, only 44 percent were on hypertensive medication, and only 21 percent were on adequate therapy and had their hypertension under control. Surveys conducted in 1991-92 estimated that 2.2 million Americans age 15 and over had disabilities resulting from high blood pressure (American Heart Association, 1996a).

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<sup>3</sup> Hypertension, or sustained high blood pressure, is defined as systolic blood pressure (SBP) of 140 mm Hg or greater and/or diastolic blood pressure (DBP) of 90 mm Hg or greater.



Because hypertension can be controlled, but not cured, treatment is often costly. Further, since there are usually no symptoms associated with hypertension, and since the medication may cause side effects, compliance with the medication is not very good (DHHS, 1993b). Little is known about the implications of long-term drug therapy for the millions of people who take medication to try to control their hypertension (DHHS, 1988).

Age-related increases in blood pressure, as occur in the United States, are associated with overweight and physical inactivity, high intakes of sodium and alcohol, and low potassium intake (DHHS, 1993b).<sup>4</sup> The National Heart, Lung, and Blood Institute estimates that 20-30 percent of hypertension cases can be attributed to overweight (DHHS, 1993c), and a recent study suggests that efforts to prevent hypertension should focus on energy intake and preventing or controlling overweight (Pickering, 1997). Although not all individuals are equally susceptible to the effects of sodium, a lower sodium intake might also prevent blood pressure from increasing with age in the United States (DHHS, 1990). New research at Johns Hopkins University also suggests that increased consumption of fruits and vegetables can lower high blood pressure as effectively as some medications (Appel and others, 1997).

Improvements in the detection, treatment, and control of hypertension are believed to have contributed substantially to the decline in mortality rates from stroke and CHD in the past two decades. The National High Blood Pressure Education Program, launched in 1992, is credited with improving the number of hypertensives aware of their condition and receiving treatment for it (DHHS, 1993b).

## **Overweight**

Being overweight is associated with increased risk for morbidity and mortality from a number of chronic health conditions, including CHD, high blood pressure, noninsulin-dependent diabetes, and some types of cancer (Centers for Disease Control and Prevention, 1997a; American Heart Association, 1998). Although not an official cause

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<sup>4</sup> In nonindustrialized countries, there is little increase in blood pressure with age (DHHS, 1993b). In the United States, high blood pressure affects men more than women until early middle age, and then reverses. The prevalence of high blood pressure is greater for blacks than for whites, and is greater among less educated than more educated people.

of death, being overweight is considered by some experts to be one of the leading precursors of premature deaths in the United States (Amler and Eddins, 1987; McGinnis and Foege, 1993). Prevention of obesity could reduce the incidence of hypertension by 20 percent (Pickering, 1997) and Type II diabetes by 50 percent (Herman, Teutsch, and Geiss, 1987).

Despite efforts to address overweight as a public health problem, and the enormous consumer interest in weight loss programs and in reduced-fat foods, the prevalence of overweight has increased dramatically in the United States in the past two decades. Between 1976-80 and 1988-94, there was an increase of 10 percentage point in the proportion of the population classified as overweight (Centers for Disease Control and Prevention, 1997b).<sup>5</sup> The magnitude of the problem becomes even more severe using the American Heart Association's recently released definition (1998)—that individuals with a BMI of 25 and above are overweight.<sup>6</sup> This results in over half of all U.S. adults being classified as overweight in 1988-94: 59.4 percent of the men and 50.7 percent of women (Kuczmarski and others, 1997).

Since overweight is an important risk factor for CHD, stroke, some types of cancer, hypertension, and diabetes, the adverse health implications of this increasing weight problem are significant. In particular, there is some concern that as the prevalence of overweight increases among children and teenagers, the chronic diseases that have typically been associated with people in their 50's may begin to appear at an earlier age (DeBrosse, 1997).

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<sup>5</sup> Being overweight was defined in that study as a body mass index (BMI, calculated as weight in kilograms, divided by height, in meters, squared) value of at least 27.3 for women and at least 27.8 for men. Children and adolescents were classified as overweight when their BMI's were at or above sex- and age-specific 95th-percentile BMI cutoff points derived from the National Health Examination Surveys (Centers for Disease Control and Prevention, 1997b).

<sup>6</sup> This definition for overweight was incorporated in the 1995 edition of the *Dietary Guidelines for Americans*, based on studies that mortality increased significantly above a BMI of 25 (USDA, 1995).

# Economic Consequences Of Poor Eating Patterns

## Methodology and Data

This study follows the “cost-of-illness” methodology, in which the direct and indirect costs associated with a particular illness are estimated and then summed to obtain total economic costs. The direct costs measure resources used in the prevention, diagnosis, treatment, and continuing care of the disease, such as expenditures on medical care and services. The indirect costs represent the time and output lost from employment, housekeeping, volunteer activities, and/or leisure, either due to morbidity or due to death.

Measures of lost productivity, however, ignore other less tangible dimensions associated with the illness, such as deterioration in the quality of life, pain and suffering, and reduced life span (Brown, Hodgson, and Rice, 1996). In some cases, these intangibles may be more important than the lost wages.

Methods for valuing deaths have been developed that provide a more comprehensive measure of the value consumers attach to postponing death, or “value of life,” than is provided by estimates of lost productivity due to death. Therefore, this study uses the data available on medical costs and lost productivity from disability associated with chronic health conditions that are affected by diet, but estimates its own value of diet-related deaths without using the data available in the literature on lost productivity due to deaths.

## Value of Life

Consumers, often without realizing, demonstrate the value they place on life and health when they pay more for safer products or earn higher wages for riskier jobs (Aldrich, 1994). Economists have translated these actual behaviors—particularly through statistical analysis of wage premiums necessary for workers to accept riskier jobs or from consumer market studies for observable tradeoffs people make between risks and benefits (such as the decision to use automobile seat belts or smoke detectors)—into estimates of consumer willingness to pay to avoid death, or “value of life.” Willingness-to-pay estimates can also be derived from contingent valuation surveys in which respondents are given a hypothetical situation and asked how

much they would be willing to pay to reduce their risk of premature death by a specified small amount. In a survey of 24 wage-risk studies, Viscusi (1993) concluded that most estimates of the “value of life” fell between \$3 million and \$7 million per life, in 1990 dollars.<sup>7</sup> Updated to 1995 dollars, these estimates range from \$3.6 million to \$8.4 million per life.

Estimates of the “value of life” do not measure the value of life of any one identified individual, but represent the total amount that a group of individuals is willing to pay for small reductions in the probability of death. For example, if 100,000 people are each willing to pay \$250 for a program that is expected to reduce the overall probability of death from 90 in 100,000 to 80 in 100,000, the implied value of life for the 10 “statistical” (or unidentified) lives saved is \$25 million. This translates into \$2,500,000 per each “statistical life” saved, or a “value of life” of \$2.5 million.

An individual’s willingness to pay to avoid illness or premature death may be highly dependent on the expected risk or change in risk, as well as the individual’s age, income, and/or health condition. Therefore, it is not clear that the “value-of-life” estimate obtained for one group of individuals can be applied to groups of individuals with different characteristics, or facing different risk choices or levels. In practice, however, because of the difficulties in obtaining value-of-life estimates, available estimates are applied. Of particular concern is the use of the same value of life regardless of age at time of death. The implicit assumption is that the value of life is the same for an individual who dies at the age of 5, 25, or 95. From a human capital perspective, age is clearly important, since an individual who loses 30 years of life incurs a larger productivity loss than an individual who loses 5 years of life. This remains a controversial issue.

Landefeld and Seskin (1982) developed age-specific estimates of the value of life by adjusting their estimates of lost productivity with a measure of willingness-to-pay for small changes in risk of death based on life insurance data. However, their estimates still do not include a measure of other intangible factors, such as pain and suffer-

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<sup>7</sup> Estimates vary because of variations across studies in populations, their levels of risk aversion, mean levels of fatal and nonfatal risks, omission of nonpecuniary job attributes, etc.

ing or the quality of remaining years of life, and therefore should be viewed as a conservative measure of the “true” value of life.<sup>8</sup>

For this study, estimates derived from Landefeld and Seskin’s (1982) age-specific value of life are applied to mortality data to obtain the value of diet-related deaths.

## Medical Costs

Data on medical costs were obtained from the literature and updated to 1995 dollars using the consumer price index (CPI) for medical care. Note, however, that the data available (and presented in table 3) represent medical costs for all cases of each health condition. Because diet is only one of the many factors that influence an individual’s risk for any of these health conditions, only a portion of the costs listed in table 3 may be attributable to diet. Further, the costs listed in table 3 should not be added, since they likely include considerable double-counting associated with the joint occurrence of more than one health condition in the same individual (comorbidity). For example, 55 percent of diabetics die from cardiovascular disease (Javitt and Chiang, 1995). This suggests that the costs of cardiovascular disease in diabetics are likely included under both diabetes and cardiovascular diseases (which include CHD and stroke).

Before adjusting for double-counting, it is interesting to note that table 3 provides a very different picture of the disease burden associated with each of the six health conditions than the picture provided by the mortality statistics in table 1. Medical costs associated with diabetes and obesity are considerably higher than those for heart disease and cancer, the two leading causes of death in the United States. The high cost burden associated with diabetes is consistent with the assertions by many experts that mortality statistics underestimate the true health impact of diabetes (American Diabetes Association, 1993; Herman, Teutsch, and Geiss, 1987). Rothenberg and Koplan (1990), for example, found that of all the times diabetes appeared in a death certificate, it was listed as the underlying cause of death less than 25

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<sup>8</sup> A measure has been developed, quality-adjusted life years (QALY), that adjusts the remaining years of life for their quality. The Panel on Cost-Effectiveness in Health and Medicine, created by the Office of Disease Prevention and Health Promotion of the U.S. Public Health Service, recommends using a QALY measure in cost-effectiveness studies of health interventions (Harvard Center for Risk Analysis, 1996). However, data on QALY are not incorporated in Landefeld and Seskin’s age-specific values of life.

**Table 3—Medical costs for six health conditions, 1994<sup>1,2</sup>**

Health condition	Costs, all cases <sup>3</sup>
	<i>\$ billion (1995)</i>
Coronary heart disease	39.8
Cancer	47.4
Stroke	21.9
Diabetes	52.5
Hypertension <sup>4</sup>	18.3
Obesity	62.3

<sup>1</sup> Includes hospital and nursing services, physician services, drugs, rehabilitation and institutional care, and special services.

<sup>2</sup> Estimates updated to 1995 dollars using the Bureau of Labor Statistics CPI for general medical care; estimates for obesity were updated to 1995 dollars using the Bureau of Labor Statistics CPI for all goods.

<sup>3</sup> Numbers should not be added since they likely include some double counting.

<sup>4</sup> Includes only costs associated with hypertension with and without renal disease; does not include costs associated with hypertensive heart disease or hypertensive heart and renal disease.

Sources: For coronary heart disease, stroke, and hypertension: American Heart Association, 1996 and conversation with Dr. Hodgson, 1997; for cancer: American Cancer Society, 1997; for diabetes: adapted from American Diabetes Association, 1993; for obesity: adapted from Colditz, 1992; and Colditz and Wolf, 1996.

percent of the time. Similarly, mortality statistics ignore the true health impact of hypertension and obesity—conditions strongly moderated by diet and which increase the risk of coronary heart disease, cancer, stroke, and/or diabetes, although neither condition is considered a major cause of death.

Although correlations between mortality and medical care expenditures tend to be poor (Hodgson, 1997), the simplest way to adjust for the double-counting in table 3 is to assume that the 55 percent of diabetics who die from cardiovascular disease account for 55 percent of the costs associated with diabetes in table 3, and that these costs are already fully accounted for under CHD and stroke. Based on these assumptions, only the remaining 45 percent of the costs associated with diabetes represent incremental costs. This also assumes that the only significant comorbidity occurs between diabetes, CHD, and stroke.

The adjusted numbers, however, may not present an accurate reflection of the disease burden associated with specific health conditions.

**Table 4—Adjusted and diet-related medical costs, four health conditions, 1994<sup>1</sup>**

Health condition	All cases, adjusted costs <sup>2</sup>	Diet-related costs <sup>3</sup>
	<i>\$ billion (1995)</i>	
Coronary heart disease, stroke, and diabetes	85.3	19.4
Cancer	47.4	14.2
All 4 causes	132.7	33.6

<sup>1</sup> Includes hospital and nursing services, physician services, drugs, rehabilitation and institutional care, and special services.

<sup>2</sup> Numbers have been adjusted for double-counting by including only 45 percent of the costs associated with diabetes (see text).

<sup>3</sup> Attributes to diet 20 percent of CHD and stroke costs and 30 percent of cancer and diabetes costs (see text).

Source: USDA/ERS from numbers in table 3.

For this reason, the adjusted costs, as well as the diet-related costs presented below, are estimated in the aggregate for CHD, stroke, and diabetes. Furthermore, due to lack of data, the study focuses from this point on only on the costs associated with four health conditions—CHD, cancer, stroke, and diabetes.

Adjusted medical costs of CHD, cancer, stroke, and diabetes are presented in table 4. However, these costs still apply to all cases of each disease. Studies suggest that improved diets could reduce CHD and stroke mortality by at least 20 percent, and cancer and diabetes mortality by at least 30 percent (McGinnis and Foege, 1993; Willett, Colditz, and Mueller, 1996; and Trichopoulos, Li, and Hunter, 1996). These estimates are consistent with other estimates on the potential reduction in mortality based on risk removal (Rothenberg and Koplan, 1990; Gori and Richter, 1978). For lack of better data, we assume that if diet can reduce mortality by a certain percentage, it can also reduce the incidence of the disease by the same percentage—and that the same effect applies to costs. Therefore, this study attributes to diet 20 percent of the adjusted medical costs associated with CHD and stroke, and 30 percent of the adjusted medical costs associated with cancer and diabetes. Based on these assumptions,

**Table 5—Lost productivity from disability for six health conditions, 1994<sup>1</sup>**

Health condition	All cases <sup>2</sup>
	<i>\$ billion (1995)</i>
Coronary heart disease	5.8
Cancer	14.4
Stroke	4.5
Diabetes	22.0
Hypertension <sup>3</sup>	4.2
Obesity	4.9

<sup>1</sup> Estimates updated to 1995 dollars using the average usual weekly earnings of employed part-time and full-time wage and salary workers of all ages, rounded to the nearest dollar.

<sup>2</sup> Numbers should not be added since they likely include some double-counting.

<sup>3</sup> Includes only costs associated with hypertension with and without renal disease; does not include costs associated with hypertensive heart disease or hypertensive heart and renal disease.

Source: USDA/ERS, see table 3.

over \$33 billion in medical costs associated with CHD, cancer, stroke, and diabetes each year may be attributed to diet (table 4).

## Lost Productivity Resulting From Disability

As with medical costs, data on lost productivity resulting from disability were obtained from the medical literature. The costs in table 5 represent the costs associated with all cases of each of six health conditions, updated to 1995 dollars using the Bureau of Labor Statistics average weekly earnings of employed full-time and part-time wage and salary workers. As with medical costs, these costs should not be added because they likely include double-counting. And as with medical costs, the unadjusted costs support the assertion that mortality data underestimate the true disease burden associated with diabetes.

Adjustments for double-counting of the lost productivity estimates in table 5 are identical to the adjustments made to medical costs, and assume that only 45 percent of the costs of diabetes represent incremental costs (table 6). The proportion of productivity losses attributed to diet is the same as the proportion of medical costs attributed to diet: 20 percent of the costs associated with CHD and stroke, and



**Table 6—Adjusted and diet-related productivity losses from disability, four health conditions, 1994**

Health condition	All cases, adjusted costs <sup>1</sup>	Diet-related costs <sup>2</sup>
	<i>\$ billion (1995)</i>	
Coronary heart disease, stroke, and diabetes	20.2	5.0
Cancer	14.3	4.3
All 4 causes	34.5	9.3

<sup>1</sup> Numbers have been adjusted for double-counting by including only 45 percent of the costs associated with diabetes (see text).

<sup>2</sup> Attributes to diet 20 percent of CHD and stroke costs and 30 percent of cancer and diabetes costs (see text).

Source: USDA/ERS, estimated from numbers in table 5.

30 percent of the costs associated with cancer and diabetes. Over \$9 billion per year in lost productivity associated with morbidity from CHD, cancer, stroke, and diabetes is attributed to diet (table 6).

## Value of Diet-Related Premature Deaths

As with costs, diet-related deaths from CHD, cancer, stroke, or diabetes are a subset of all CHD, cancer, stroke, or diabetes deaths. Although studies suggest that improved diets could reduce CHD and stroke mortality by at least 20 percent, and cancer and diabetes mortality by at least 30 percent, this study did not consider that all deaths were equally affected by diet, and therefore imposed some constraints on those deaths that could be potentially affected by diet.

For example, because everyone must eventually die, the study determined that improved diets could postpone, but could not prevent, deaths. Therefore, for purposes of this study, only premature deaths could be attributable to diet. Following the American Heart Association (1996) convention, deaths occurring after the age of 75—the average life expectancy at birth—were not considered to be premature, and therefore were not considered to be affected by diet.

However, not all premature deaths from CHD, cancer, stroke, or diabetes can be attributed to diet, either. In particular, because the adverse health effects of diet are thought to be cumulative, they are

not likely to manifest themselves during the early years of life. Therefore, CHD, cancer, stroke, or diabetes deaths among young individuals are probably not a result of poor dietary habits. However, the age at which the cumulative effects of diet begin to manifest themselves is not known. According to Harper (1990), “a high proportion of those who die (from CHD) at ages below 55 suffer from genetic defects of lipid metabolism, which are not highly responsive to diets.” On the other hand, McGill and others (1997) observed differences in arterial lesions that were associated with serum level of low-density lipoproteins in individuals as young as 15 years who had died of external causes. To be on the conservative side, a premature CHD, cancer, stroke, or diabetes death was potentially associated with diet only if it occurred in individuals older than 55. In summary, for this study, only deaths among individuals 55-74 years of age were considered to be potentially related to diet.

In 1994, individuals 55-74 years of age accounted for 38 percent of all deaths from CHD, cancer, stroke, and diabetes (table 2). More specifically, this age group accounted for 31 percent of all deaths from CHD, 47 percent of all cancer deaths, 23 percent of all deaths from stroke, and 42 percent of all deaths from diabetes.

However, even among individuals age 55-74, not all CHD, cancer, stroke, and diabetes deaths can be attributed to diet. Following McGinnis and Foege (1993), 20 percent of CHD and stroke deaths and 30 percent of diabetes deaths were defined as being diet-related; following Trichopoulos, Li, and Hunter (1996) and Willett, Colditz, and Mueller (1996), 30 percent of cancer deaths were defined as being diet-related. Based on these definitions, there were 119,912 diet-related premature deaths in 1994 among individuals 55-74 years, accounting for 5.3 percent of all deaths in the United States (all deaths, among all ages, from all causes). Individuals 65-74 years accounted for 67 percent of all diet-related premature deaths from CHD, cancer, stroke, or diabetes.

The value of these diet-related premature deaths from CHD, cancer, stroke, or diabetes was estimated based on interpolations of the Landefeld and Seskin’s age-specific estimates (Buzby and others, 1996), averaged across genders and updated to 1995 values with usual weekly earnings of part-time and full-time employed wage and salary workers. We used the value of life at the midpoint of the relevant age ranges: \$412,751 for a death at age 60, and \$143,760 for a

**Table 7—Number and value of diet-related premature deaths, 1994**

Cause of diet-related death	Age at death	
	55-64	65-74
	<i>Number of diet-related deaths<sup>1</sup></i>	
Coronary heart disease	9,113	20,836
Stroke	1,915	5,077
Diabetes	2,335	4,723
Cancer	26,775	49,138
All 4 causes	40,138	79,774
	<i>\$ billion (1995)</i>	
Value <sup>2</sup>	16.6	11.4

<sup>1</sup> Defined as 20 percent of CHD or stroke deaths, and 30 percent of cancer or diabetes deaths, among those who died between ages 55 and 74.

<sup>2</sup> Deaths among those age 55-64 are valued at \$412,751 in 1995 dollars, and deaths among those age 65-74 are valued at \$143,760.

Source: USDA/ERS, adapted from Singh and others, 1996.

death at age 70.<sup>9</sup> Multiplying these values by the appropriate number of diet-related premature deaths from CHD, cancer, stroke, or diabetes yields an economic value of \$28 billion per year (table 7).

## Conclusion

Total economic costs attributed to diet in the United States were obtained by adding diet-related medical costs, diet-related productivity losses from disability, and the economic value of diet-related premature deaths. The total economic cost attributable to diet associated with CHD, cancer, stroke, and diabetes add to \$70.9 billion (table 8). Medical costs account for nearly half of the total (47 percent), premature deaths account for 39 percent, and lost productivity associated with morbidity accounts for the remaining 13 percent.

The conservative assumptions used in this study suggest that the \$70.9-billion estimate understates the true costs associated with current dietary patterns in the United States. For example, diet-related

<sup>9</sup> These values are considerably lower than the \$3.6-million lower bound of the “value of life” obtained by willingness-to-pay studies.

**Table 8—Diet-related costs for four health conditions exceed \$70 billion, 1994**

Diet-related health condition	Medical costs	Lost productivity	Premature deaths	Total economic costs
<i>\$ billion (1995)</i>				
Coronary heart disease, stroke and diabetes	19.4	5.0	9.9	34.3
Cancer	14.2	4.3	18.1	36.7
All 4 causes	33.6	9.3	28.0	70.9

Source: USDA/ERS, estimated from tables 4, 6, and 7.

premature deaths from CHD, cancer, stroke, or diabetes, as defined in this study, accounted for only 5.3 percent of all deaths in the United States, considerably less than the 14 percent of all deaths attributed to diet and/or inactivity by McGinnis and Foege (1993). Furthermore, the estimates do not include diet-related costs associated with osteoporosis, hypertension, overweight, and neural tube birth defects, which would clearly increase the costs associated with diets. For example, including the costs of diet-related osteoporosis hip fractures would add \$5.1-\$10.6 billion each year to the costs associated with poor diets (Barefield, 1996).

In addition, although the dollar values of medical costs and lost productivity were updated to reflect changes in the price level of wages, earnings, and productivity, they do not reflect the increased number of cases associated with these health conditions. Although age-adjusted death rates are declining for most of the diet-related health conditions, the number of cases is increasing because of the aging of the population. For example, the American Cancer Society (1997) estimates there are 1 million new cases of cancer diagnosed each year (1 million more in 1990 than in 1989; 1 million more in 1991 than in 1990, etc.).

Nor do the estimates reflect technological advances that improve treatment—but may also increase the cost of treatment as well as affect the quality of life of the remaining years. These may be particularly important issues for CHD and stroke, in particular, where declines in mortality appear to be due more to improvements in medical management and technology than to primary prevention and

reduced incidence (Goldman and Hunink, 1997, Hunink and others, 1997). Survivors might have to cope with increased disability during their remaining years. The increased frequency of hospitalization associated with CHD and stroke that has accompanied the drop in mortality rates suggests that a large proportion of increased life expectancy may be associated with a gain in “disabled” years (Rothenberg and Koplan, 1990). However, the “value-of-life” estimates used in this study do not account for quality-of-life issues, and are considerably lower than the \$3.6-\$8.4 million per life (in 1995 dollars) obtained from willingness-to-pay studies (Viscusi, 1993). Valuing each of the 119,912 diet-related premature deaths at \$3.6 million results in total economic costs of more than \$474 billion each year attributable to diet (this includes the \$43 billion in medical costs and lost productivity).

With the U.S. population growing older, the number of those affected by chronic health conditions is expected to increase, with important consequences for health expenditures and quality of life during the older years. The National Osteoporosis Foundation has estimated that, because osteoporosis affects primarily the elderly, the direct medical costs of osteoporosis will increase six-fold by the year 2000 and 20-fold by the year 2040 (McBean, Forgas, and Finn, 1994).

In addition, the increasing weight problem in the United States—and, in particular, the increased prevalence of overweight among children and teenagers—is anticipated to bring about an increase in the prevalence of chronic health problems for which overweight is a predisposing or risk factor, such as CHD, cancer, stroke, diabetes, and hypertension. It is also possible that these chronic problems will begin to manifest themselves at an earlier age (DeBrosse, 1997). Both of these outcomes would lead to increased diet-related costs.

All of these factors suggest that the \$70.9 billion in costs attributed to diet represent a low estimate, and that considerably larger economic benefits might result from more healthful dietary patterns. With health care spending topping \$1 trillion in 1996 and accounting for over 13 percent of gross domestic product (Levit and others, 1998), the potential for large savings in health care costs from more healthful diets merits closer attention.

However, in spite of efforts by public and private agencies to educate consumers about more healthful diets and how to achieve them,

Americans are far from the mark. For many, dietary improvements are offset by pitfalls (see chapters 3, 4, 5, 6, 7). Continued and improved efforts are needed to further inform, educate, and motivate consumers to make appropriate dietary changes.

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