Heart Disease and Stroke Statistics—2007 Update

A Report From the American Heart Association Statistics Committee and Stroke Statistics Subcommittee

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*The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the Centers for Disease Control and Prevention.

The online-only Data Supplement, which consists of 3 supplemental charts, is available with this article at http://circ.ahajournals.org/cgi/content/full/115/5/e69/DC1.

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1. About These Statistics

The American Heart Association (AHA) works with the Centers for Disease Control and Prevention's National Center for Health Statistics (CDC/NCHS); the National Heart, Lung, and Blood Institute (NHLBI); the National Institute of Neurological Disorders and Stroke (NINDS); and other government agencies to derive the annual statistics in this Update. This chapter describes the most important sources and the types of data we use from them. For more details and an alphabetical list of abbreviations, see Chapter 21 of this document, the Glossary and Abbreviation Guide.

The surveys used are:

National Health and Nutrition Examination Survey (NHANES)—disease and risk factor prevalence and nutrition statistics
National Health Interview Survey (NHIS)—disease and risk factor prevalence
National Hospital Discharge Survey (NHDS)—hospital inpatient discharges (alive, dead, or unknown)
National Ambulatory Medical Care Survey (NAMCS)—physician office visits
National Hospital Ambulatory Medical Care Survey (NHAMCS)—hospital outpatient and emergency department visits
National Nursing Home Survey (NNHS)—nursing home visits
National Vital Statistics—national and state mortality data
Behavioral Risk Factor Surveillance Survey (BRFSS)—ongoing telephone health survey system

Abbreviations Used in Chapter 1

AHA	American Heart Association
AP	angina pectoris
ARIC	Atherosclerosis Risk in Communities study
BP	blood pressure
BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CHS	Cardiovascular Health Study
CVD	cardiovascular disease
FHS	Framingham Heart Study
GCNKSS	Greater Cincinnati/Northern Kentucky Stroke Study
HF	heart failure
ICD	International Classification of Diseases
MI	myocardial infarction
NAMCS	National Ambulatory Medical Care Survey
NCHS	National Center for Health Statistics
NHAMCS	National Hospital Ambulatory Medical Care Survey
NHANES	National Health and Nutrition Examination Survey
NHDS	National Hospital Discharge Survey
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute
NINDS	National Institute of Neurological Disorders and Stroke
NNHS	National Nursing Home Survey

Disease Prevalence

Prevalence is an estimate of how many people have a disease at a given point or period in time. The NCHS conducts health examination and health interview surveys that provide estimates of the prevalence of diseases and risk factors. In this Update, the health interview part of the NHANES is used for the prevalence of cardiovascular diseases (CVD). NHANES is used more than the NHIS because in NHANES, angina pectoris (AP) is based on the Rose Questionnaire; estimates are made regularly for heart failure (HF); hypertension is based on blood pressure (BP) measurements and interviews; and an estimate can be made of total CVD to include myocardial infarction (MI), AP, HF, stroke, and hypertension.

A major emphasis of this Update is to present the latest estimates of the number of persons in the United States who have specific conditions to provide a more realistic estimate of burden. Most estimates based on NHANES prevalence rates are based on data collected from 1999 to 2004 (in most cases, these are the latest published figures). These are applied to census population estimates for 2004. Differences in population estimates based on extrapolations of rates beyond the data collection period by using more recent census population estimates cannot be used to evaluate possible trends in prevalence. Trends can only be evaluated by comparing data across surveys conducted in different years.

Risk Factor Prevalence

The NHANES 1999–2004 data are used in the Update to present estimates of the percentage of persons with high lipid values, diabetes, overweight, and obesity. The NHIS is used for the prevalence of cigarette smoking and physical inactivity. Data for students in grades 9 through 12 are obtained from the Youth Risk Factor Surveillance System.

Incidence and Recurrent Attacks

An incidence rate refers to the number of new cases of a disease that develop in a population per unit of time. Incidence is not just per 1 year, although that is often how we refer to it. For some statistics, new and recurrent attacks or cases are combined. Our national incidence estimates for the various types of CVD are extrapolations to the US population from the Framingham Heart Study (FHS), the Atherosclerosis Risk in Communities (ARIC) study, the Cardiovascular Health Study (CHS) conducted by the NHLBI, and the Greater Cincinnati/Northern Kentucky Stroke Study (GCNKSS) funded by the NINDS. The rates change only when new data are available; they are not computed annually. Do not compare the incidence or the rates with those in past issues of the Heart and Stroke Statistical Update (renamed Heart Disease and Stroke Statistics Update). Doing so can lead to serious misinterpretation of time trends.

Mortality

Mortality data are grouped according to the underlying cause of death. "Total-mention" mortality, however, includes deaths for which the given cause was listed anywhere on the death certificate or was selected as the underlying cause. For many deaths classified as attributable to CVD, selection of the most likely single underlying cause can be difficult when several major comorbidities are present, as is often the case in the elderly population. It is, therefore, useful to know the extent of mortality from a given cause, whether it is the underlying cause or a contributing (secondary) cause—ie, its "total mentions."

Hospital Discharges and Ambulatory Care Visits

Estimates of the numbers of hospital discharges and numbers of procedures performed are for inpatients discharged from short-stay hospitals. Discharges include those discharged alive, dead, or with unknown status. Unless otherwise specified, discharges are according to the first-listed (primary) diagnosis, and procedures are listed according to the all-listed diagnosis (primary plus secondary). These estimates are from the NHDS of the NCHS unless otherwise noted. Ambulatory care visits include patient visits to hospital emergency or outpatient departments and visits to physicians' offices.

International Classification of Diseases

Morbidity (illness) and mortality (death) data in the United States use a standard classification system: the International Classification of Diseases (ICD). About every 10 to 20 years, the ICD codes are revised to reflect changes over time in medical technology, diagnosis, or terminology. Where necessary for comparability of mortality trends across the 9th and 10th ICD revisions, comparability ratios computed by NCHS are applied as noted.[1] Effective with mortality data for 1999, we are using the 10th revision (ICD-10). It will be few more years before the 10th revision is used for hospital discharge data.

Age Adjustment

Prevalence and mortality estimates for the United States or individual states comparing demographic groups or estimates over time either are age specific or are age adjusted to the 2000 standard population by the direct method.[2] International mortality data are age adjusted to the European standard.[3]

Data Years for National Estimates

In this Update we estimate the annual number of new (incidence) and recurrent cases of a disease in the United States by extrapolating to the US population in 2004 from rates reported in a community- or hospital-based study or multiple studies. Age-adjusted incidence rates by sex and race are also given in this report as observed in the study or studies. For US *mortality,* most numbers and rates are for 2004 and are preliminary. The methods used annually by NCHS to collect preliminary mortality counts for a given year make the preliminary counts nearly identical to the final tabulations. Mortality data for the less common causes of death and for some demographic groups have not yet been reported by NCHS for 2004, so we use the 2003 NCHS data and note this substitution where it occurs. Total-mention mortality is for 2002. For disease and risk factor *prevalence,* most rates in this report are calculated from the 1999–2004 NHANES. Rates by age and sex are also applied to the US population in 2004 to estimate the numbers of persons with the disease or risk factor in that year. Because NHANES is conducted only in the noninstitutionalized population, we extrapolated the rates to the total US population in 2004, recognizing that this probably underestimates total prevalence given the relatively high prevalence in the institutionalized population. The numbers and rates of *hospital inpatient discharges* for the United States are for 2004, as are many of the numbers of *physician office visits and visits to hospital emergency and outpatient departments*. Except as noted, *economic cost* estimates are projected to 2007.

Cardiovascular Disease

For data on hospitalizations, physician office visits, and mortality, CVD is defined according to ICD codes given in Chapter 21 of the present document. This definition includes all diseases of the circulatory system and congenital CVD. Unless so specified, an estimate for total CVD does not include congenital CVD.

Race

Data published by governmental agencies for some racial groups are considered unreliable because of the small sample size in the studies. Because we try to provide data for as many racial groups as possible, we show these data for informational and comparative purposes.

Contacts

If you have questions about statistics or any points made in this Update, please contact the Biostatistics Program Coordinator at the American Heart Association National Center (e-mail nancy.haase@heart.org, phone 214-706-1423). Direct all media inquiries to News Media Relations at inquiries@heart.org or 214-706-1173.

We do our utmost to ensure that this Update is error free. If we discover errors after publication, we will provide corrections at our Web site, http://www.americanheart.org/statistics, and in the journal *Circulation*.

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1. National Center for Health Statistics. *Health, United States, 2005, With Chartbook on Trends in the Health of Americans*. Hyattsville, Md: National Center for Health Statistics; 2005. Available at: http://www.cdc.gov/nchs/data/hus/hus05.pdf. Accessed October 25, 2006.
2. Anderson RN, Rosenberg HM. Age standardization of death rates: implementation of the year 2000 standard. *Natl Vital Stat Rep*. 1998;47:1–16, 20.
3. World Health Organization. *World Health Statistics Annual*. Geneva, Switzerland: World Health Organization; 1998.

2. Cardiovascular Diseases

ICD-9 390–459, 745–747; ICD-10 I00–I99, Q20–Q28; see Glossary (Chapter 21) for details and definitions. See Tables 2-1, 2-2, and 2-3 and Charts 2-1 through 2-19. Also see Charts 2-20 and 2-21 in the online-only Data Supplement.

Prevalence

An estimated 79 400 000 American adults (1 in 3) have 1 or more types of CVD. Of these, 37 500 000 are estimated to be age 65 or older (extrapolated to 2004 from NCHS NHANES 1999–2004). (Total CVD includes diseases in the bullet points below except for congenital CVD.) Except as noted, the estimates were extrapolated to the US population in 2004 from NHANES 1999–2004. Because of overlap, it is not possible to add these conditions to arrive at a total.

- High blood pressure (HBP)—72 000 000. (Defined as systolic pressure 140 mm Hg or greater and/or diastolic pressure 90 mm Hg or greater, taking antihypertensive medication, or being told at least twice by a physician or other health professional that one has HBP.)
- Coronary heart disease (CHD)—15 800 000.
  - MI (heart attack)—7 900 000.
  - AP (chest pain)—8 900 000.
- HF—5 200 000.
- Stroke—5 600 000.
- Congenital cardiovascular defects—650 000 to 1 300 000 (see Chapter 6).
- The following prevalence estimates are for people age 18 and older from NCHS NHIS, 2004[1]:
  - Among whites only, 11.9% have heart disease, 6.6% have CHD, 21.2% have hypertension, and 2.5% have had a stroke.
  - Among blacks or African Americans only, 9.6% have heart disease, 5.2% have CHD, 29.2% have hypertension, and 3.2% have had a stroke.
  - Among Hispanics or Latinos, 9.2% have heart disease, 6.0% have CHD, 19.6% have hypertension, and 2.8% have had a stroke.
  - Among Asians, 6.7% have heart disease, 4.2% have CHD, 16.9% have hypertension, and 2.4% have had a stroke.
  - Among Native Hawaiians or other Pacific Islanders, 13.8% have heart disease, 13.8% have CHD, 20.7% have hypertension, and 8.1% have had a stroke.
  - Among American Indians or Alaska Natives, 11.6% have heart disease, 7.6% have CHD, 25.4% have hypertension, and 5.1% have had a stroke.
- Data from the Agency for Healthcare Research and Quality (AHRQ) show that 11.6% (12.9 million) of women and 11.4% (11.7 million) of men age 18 and older reported being told by a doctor that they have CVD. CVD includes CHD, congestive HF (CHF), MI, and stroke. (Note: These data do not include hypertension as a separate condition.)[2]

Abbreviations Used in Chapter 2

AF	atrial fibrillation
AHRQ	Agency for Healthcare Research and Quality
AP	angina pectoris
BMI	body mass index
BP	blood pressure
BRFSS	Behavioral Risk Factor Surveillance Survey
CHD	coronary heart disease
CHF	congestive heart failure
CVD	cardiovascular disease
EMS	emergency medical services
FHS	Framingham Heart Study
HBP	high blood pressure
ICD	International Classification of Diseases
MI	myocardial infarction
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute

Incidence

- On the basis of the NHLBI's FHS in its 44-year follow-up of participants and the 20-year follow-up of their offspring[3]:
  - The average annual rates of first major cardiovascular events rise from 7 per 1000 men at ages 35 to 44 years to 68 per 1000 at ages 85 to 94 years. For women, comparable rates occur 10 years later in life. The gap narrows with advancing age.
  - Before age 75, a higher proportion of CVD events due to CHD occur in men than in women, and a higher proportion of events due to CHF occur in women than in men.
- Among American Indian men ages 45 to 74 years, the incidence of CVD ranges from 15 to 28 per 1000 population. Among women, it ranges from 9 to 15 per 1000.[4]
- Data from the FHS indicate that the lifetime risk for CVD is 2 in 3 for men and more than 1 in 2 for women at age 40 (personal communication, Donald Lloyd-Jones, MD, Northwestern University, Chicago, Ill).
- A study of data from the first NHANES Epidemiologic Follow-up Study, which includes participants ages 35 to 74 years, from 1971–1982 and 1982–1992 cohorts, found that the decrease in CVD mortality was due to declines in both the incidence and case fatality rates in this national sample. These findings suggest that both primary and secondary prevention and treatment contributed to the decline in CVD mortality in the United States.[5]

Mortality

ICD-10 I00–I99 for CVD; C00–C99 for cancer; C33–C34 for lung cancer; C50 for breast cancer; J40–J47 for chronic obstructive pulmonary disease; G30 for Alzheimer's disease; E10–E14 for diabetes; and V01–X59, Y85–Y86 for accidents.

- Mortality data show that CVD (I00–I99) as the underlying cause of death accounted for 36.3% (871 517) of all 2 398 000 deaths in 2004, or 1 of every 2.8 deaths in the United States. CVD total mentions (1 408 000 deaths in 2002) constituted about 58% of all deaths that year.[6]
- In every year since 1900 except 1918, CVD accounted for more deaths than any other single cause or group of causes of death in the United States.
- Nearly 2400 Americans die of CVD each day, an average of 1 death every 36 seconds. CVD claims more lives each year than cancer, chronic lower respiratory diseases, accidents, and diabetes mellitus combined.[6]
- The 2004 overall death rate from CVD (I00–I99) was 288.6. The rates were 335.7 for white males, 448.9 for black males, 239.3 for white females, and 331.6 for black females. From 1994 to 2004, death rates from CVD (ICD-10 I00–I99) declined 25%. In the same 10-year period, actual CVD deaths declined 8%.[6]
- Among other causes of death in 2004, cancer caused 550 270 deaths; accidents, 108 694; Alzheimer's disease, 65 829; and HIV (AIDS), 12 995.[6]
- The 2004 CVD death rates were 341.8 for males and 246.3 for females. Cancer (malignant neoplasms) death rates were 226.4 for males and 156.2 for females. Breast cancer claimed the lives of 40 539 females in 2004; lung cancer claimed 67 838. Death rates for females were 24.2 for breast cancer and 40.5 for lung cancer. One in 30 female deaths was from breast cancer, whereas 1 in 6 was from CHD. By comparison, 1 in 4.6 women died of cancer, whereas 1 in 2.6 died of CVD. On the basis of 2004 mortality, CVD caused about 1 death a minute among females—more than 460 000 female lives in 2004. That represents more female lives than were claimed by cancer, chronic lower respiratory disease, Alzheimer's disease, diabetes, and accidents combined (NCHS, unpublished mortality tables, 2004; personal communication with NHLBI).
- More than 147 000 Americans killed by CVD in 2004 were under age 65. In 2004, 32% of deaths from CVD occurred prematurely (ie, before age 75, which is close to the average life expectancy of 77.9 years).[6]
- In 2003, the age-adjusted death rates for diseases of the heart in American Indians or Alaska Natives were 203.2 for males and 127.5 for females; for Asians or Pacific Islanders, they were 158.3 for males and 104.2 for females; for Hispanics or Latinos, they were 206.8 for males and 145.8 for females.[8]
- According to the NCHS, if all forms of major CVD were eliminated, life expectancy would rise by almost 7 years. If all forms of cancer were eliminated, the gain would be 3 years. According to the same study, the probability at birth of eventually dying from major CVD (I00–I78) is 47%, and the chance of dying from cancer is 22%. Additional probabilities are 3% for accidents, 2% for diabetes, and 0.7% for HIV.[9]

Out-of-Hospital Cardiac Arrest

There is a wide variation in the reported incidence and outcome for out-of-hospital cardiac arrest. These differences are due in part to differences in definition and ascertainment of cardiac arrest, as well as differences in treatment after its onset.

Cardiac arrest is the cessation of cardiac mechanical activity, as confirmed by the absence of signs of circulation.[11] Available epidemiological databases do not adequately characterize cardiac arrest or the subset of cases that occur with sudden onset (sudden cardiac arrest). Therefore, surrogate data are often used for epidemiological purposes to estimate the incidence of cardiac arrest, especially in the out-of-hospital setting. Those surrogate data include deaths due to "coronary heart disease" (ICD codes I20–I25) and "cardiac arrest," defined as coronary death that occurred within 1 hour of symptom onset in the out-of-hospital setting and without other probable cause of death.[12] Datasets based on either definition are not optimal. Out-of-hospital data that are based on the latter definition of cardiac arrest can be especially unreliable because of the difficulty in determining the duration of symptoms before the onset of the episode. The following information summarizes representative data from several sources in an attempt to characterize the incidence and outcome of out-of-hospital cardiac arrest and demonstrate the need for a comprehensive system of capturing more meaningful data.

- According to NCHS Data Warehouse mortality data, 325 000 CHD deaths occur out of hospital or in hospital emergency departments annually (2003) (ICD-10 codes I20–I25).[13]
- The annual incidence of out-of-hospital cardiac arrest in North America is about 0.55 per 1000 population.[15,16] With an estimated US population of 299 210 182,[17] this implies that about 164 600 out-of-hospital cardiac arrests occur annually in the United States.
- About two thirds of unexpected cardiac deaths occur without prior recognition of cardiac disease.[18]
- About 60% of unexpected cardiac deaths are treated by emergency medical services (EMS).[19]
- In a population aged at least 20 years, incidence of EMS-treated out-of-hospital cardiac arrest is 36/100 000 to 81/100 000.[19,20] This implies EMS treats 77 000 to 174 000 cardiac arrests in the United States annually.
- Of these, 20% to 38% have ventricular fibrillation or ventricular tachycardia as the first recorded rhythm. This implies 15 500 to 66 100 ventricular fibrillation arrests annually.[15,20]
- The incidence of cardiac arrest with an initial rhythm of ventricular fibrillation is decreasing over time.[20] However, the incidence of cardiac arrest with any initial rhythm is decreasing.[13]
- The median reported survival to discharge after any first recorded rhythm is 6.4%.[21] Survival during a recent 1-year experience in Seattle, Wash, of all treated cardiac arrests considered to be of cardiac origin was reported to be 20% (personal communication, L. Cobb, Seattle Medic One, December 7, 2005).
- The average proportion of cases of out-of-hospital cardiac arrest that receive bystander cardiopulmonary resuscitation is 27.4%.[21]

- The incidence of lay responder defibrillation is low (2.05% in 2002) but increasing over time.[22]
- Unexpected death in the pediatric patient is usually due to trauma, sudden infant death syndrome, respiratory causes, or submersion.[23] Ventricular fibrillation is an uncommon cause of cardiac arrest in children, but it is observed in approximately 5% to 15% of children with out-of-hospital cardiac arrest.[24]
- The reported incidences of out-of-hospital pediatric cardiac arrest vary widely (from 2.6 to 19.7 annual cases per 100 000).[25]
- Because there are 72 293 812 individuals under age 18 in the United States,[17] this implies that there are 1900 to 14 200 pediatric out-of-hospital cardiac arrests annually from all causes (including trauma, sudden infant death syndrome, respiratory causes, cardiovascular causes, and submersion).
- Studies that document voluntary reports of deaths among high school athletes suggest that the incidence of out-of-hospital cardiac arrest ranges from 0.28 to 1.0 deaths per 100 000 high school athletes annually nationwide.[26,27] Although incomplete, these numbers provide a basis for estimating the number of deaths in this age range.
- The reported average survival to discharge after pediatric out-of-hospital cardiac arrest is 6.7%.[25]
- The incidence of in-hospital cardiac arrest is unknown.
- The rates of survival to discharge after in-hospital cardiac arrest are 27% among children and 18% among adults. However, children and adults with an initial rhythm of ventricular fibrillation or ventricular tachycardia have a similarly favorable prognosis (30% versus 32% survival to discharge).[28]

Risk Factors

- Data from the 2003 CDC BRFSS survey of adults age 18 and older showed the prevalence of respondents reporting 2 or more risk factors for heart disease and stroke increased among successive age groups. The prevalence of having 2 or more risk factors was highest among blacks (48.7%) and American Indians/Alaska Natives (46.7%) and lowest among Asians (25.9%); prevalence was similar in women (36.4%) and men (37.8%). The prevalence of multiple risk factors ranged from 25.9% among college graduates to 52.5% among those with less than a high school diploma (or its equivalent). Persons reporting household income of $50 000 or more had the lowest prevalence (28.8%), and those reporting $10 000 or less had the highest prevalence (52.5%). Adults who reported being unable to work had the highest prevalence (69.3%) of 2 or more risk factors, followed by retired persons (45.1%), unemployed adults (43.4%), homemakers (34.3%), and employed persons (34.0%). Prevalence of 2 or more risk factors varied by state/territory and ranged from 27.0% (Hawaii) to 46.2% (Kentucky). Twelve states and 2 territories had a multiple–risk-factor prevalence of 40% or more: Alabama, Arkansas, Georgia, Indiana, Kentucky, Louisiana, Mississippi, North Carolina, Ohio, Oklahoma, Tennessee, West Virginia, Guam, and Puerto Rico.[29]
- Data from the BRFSS (CDC) showed that young women and men ages 18 to 24 had comparatively poor health profiles and experienced adverse changes from 1990 to 2000. After adjustment for education and income, these young people had the highest prevalence of smoking (34% to 36% current smokers among whites); the largest increases in smoking (10% to 12% among whites and 9% among Hispanic women); and large increases in obesity (4% to 9% increase in all groups). All groups had high levels of sedentary behavior (approximately 20% to 30%) and low vegetable or fruit intake (approximately 35% to 50%). In contrast, older Hispanics and older black men, ages 65 to 74, showed some of the most positive changes. They had the largest decreases in smoking (Hispanic women) and sedentary behavior (Hispanic women and black men) and the largest increases in vegetable or fruit intake (Hispanic women and black men).[30]
- Data from the Chicago Heart Association Detection Project (1967–1973, with an average follow-up of 31 years) showed that in younger women (ages 18 to 39) with favorable levels for all 5 major risk factors (blood pressure [BP], serum cholesterol, body mass index [BMI], diabetes, and smoking), future incidence of CHD and CVD is rare, and long-term and all-cause mortality are much lower, as compared with those who have unfavorable or elevated risk factor levels at young ages. Similar findings applied to men in this study.[31,32]
- Data from the BRFSS (CDC) showed that in adults age 18 and older, disparities were common in all risk factors examined. In men, the highest prevalence of obesity (29.7%) was found in Mexican Americans who had completed a high school education. Black women with or without a high school education had a high prevalence of obesity (48.4%). Hypertension prevalence was high among blacks (41.2%) regardless of sex or educational status. Hypercholesterolemia was high among white and Mexican-American men and white women in both groups of educational status. CHD and stroke were inversely related to education, income, and poverty status. Hospitalization was greater in men for total heart disease and acute MI but greater in women for CHF and stroke. Among Medicare enrollees, CHF hospitalization was higher in blacks, Hispanics, and American Indians/Alaska Natives than among whites, and stroke hospitalization was highest in blacks. Hospitalizations for CHF and stroke were highest in the southeastern United States. Life expectancy remains higher in women than in men, and higher in whites than blacks, by about 5 years. CVD mortality at all ages tended to be highest in blacks.[33]
- In respondents ages 18 to 74 years, data from the 2000 BRFSS (CDC) showed the prevalence of healthy lifestyle characteristics was as follows: no smoking, 76.0%; healthy weight, 40.1%; consumption of 5 fruits and vegetables per day, 23.3%; and regular physical activity, 22.2%. The overall prevalence of the healthy lifestyle indicator (ie, having all 4 healthy lifestyle characteristics) was only 3%, with little variation among subgroups.[34]

- Analysis of 5 cross-sectional, nationally representative surveys from NHES 1960–1962 to NHANES 1999–2000 showed that the prevalence of key risk factors (ie, high cholesterol, HBP, current smoking, and total diabetes) decreased over time across all BMI groups, with the greatest reductions observed among overweight and obese groups. Total diabetes prevalence was stable within BMI groups over time. However, the trend has leveled off or been reversed for some of the risk factors in more recent years.[35]
- The aging of the population will undoubtedly result in an increased number of cases of chronic diseases, including coronary artery disease, HF, and stroke.[36]
  - The US Census estimates that there will be 40 million Americans age 65 and older in 2010.
  - There has been an explosive increase in the prevalence of obesity and type 2 diabetes. Their related complications—hypertension, hyperlipidemia, and atherosclerotic vascular disease—also have increased.
  - An alarming increase in unattended risk factors in the younger generations will continue to fuel the cardiovascular epidemic for years to come.
- Analysis of FHS data among participants free of CVD at age 50 showed the lifetime risk for developing CVD was 51.7% for men and 39.2% for women. Median overall survival was 30 years for men and 36 years for women.[47]

Impact of Healthy Lifestyle and Low Risk Factor Levels

Much of the literature on CVD has focused on factors associated with increasing risk for CVD and on factors associated with poorer outcomes in the presence of CVD. However, in recent years, a number of studies have defined the beneficial effects of healthy lifestyle factors and lower CVD risk factor burden on CVD outcomes and longevity. These studies suggest that prevention of risk factor development at younger ages may be the key to "successful aging," and they highlight the need for intensive prevention efforts at younger and middle ages once risk factors develop in order to improve healthy longevity.

- The lifetime risk for CVD and median survival were highly associated with risk factor burden at age 50 among more than 7900 men and women from the FHS followed up for 111 000 person-years. In this study, "optimal" risk factor burden at age 50 was defined as BP <120/80 mm Hg, total cholesterol <180 mg/dL, absence of diabetes, and absence of smoking. Elevated risk factors were defined as Stage 1 hypertension or borderline cholesterol (200 to 239 mg/dL). Major risk factors were defined as Stage 2 hypertension, elevated cholesterol (≥ 240 mg/dL), current smoking, and diabetes. Remaining lifetime risks for atherosclerotic CVD events were only 5.2% in men and 8.2% in women with optimal risk factors at age 50, compared with 68.9% in men and 50.2% in women with 2 or more major risk factors at age 50. In addition, men and women with optimal risk factors had a median life expectancy at least 10 years longer than those with 2 or more major risk factors at age 50.[47]
- In another study, FHS investigators followed up 2531 men and women who were examined between the ages of 40 and 50 years and observed their overall rates of survival and survival free of CVD to age 85 and beyond. Low levels of the major risk factors in middle age predicted overall survival and morbidity-free survival to age ≥85 years.[48]
  - Overall, 35.7% survived to age 85, and 22% survived to age 85 free of major morbidities.
  - Factors associated with survival to age 85 included female sex, lower systolic BP, lower total cholesterol, better glucose tolerance, absence of current smoking, and higher level of education attained. Factors associated with survival to age 85 free of MI, unstable angina, HF, stroke, dementia, and cancer were nearly identical.
  - When adverse levels of 4 of these factors were present in middle age, fewer than 5% of men and approximately 15% of women survived to age 85.
- A study of 366 000 men and women from the Multiple Risk Factor Intervention Trial (MRFIT) screenee and Chicago cohorts defined low risk status as follows: serum cholesterol level <200 mg/dL, untreated BP ≤120/80 mm Hg, absence of current smoking, absence of diabetes, and absence of major electrocardiographic abnormalities. Compared with those who did not have low risk factor burden, those with low risk factor burden had between 73% and 85% lower risk for CVD mortality, 40% to 60% lower total mortality, and 6 to 10 years greater life expectancy.[32]
- A study of 84 129 women enrolled in the Nurses' Health Study identified 5 healthy lifestyle factors, including absence of current smoking, drinking ½ glass or more of wine per day (or equivalent alcohol consumption), ½ hour or more per day of moderate or vigorous physical activity, BMI <25 kg/m^2, and dietary score in the top 40% (including diets with lower amounts of *trans* fats, lower glycemic load, higher cereal fiber, higher marine omega-3 fatty acids, higher folate, and higher polyunsaturated to saturated fat ratio). When 3 of the 5 healthy lifestyle factors were present, risk for CHD over 14 years was reduced by 57%; when 4 were present, risk was reduced by 66%; and when all 5 factors were present, risk was reduced by 83%.[49]
- Among individuals ages 70 to 90 years, adherence to a Mediterranean-style diet and greater physical activity are associated with 65% to 73% lower rates of all-cause mortality, as well as mortality due to CHD, CVD, and cancer.[50]
- Seventeen-year mortality data from the NHANES II Mortality Follow-Up Study indicate that the risk for fatal CHD was 51% lower for men and 71% lower for women with none of 3 major risk factors (hypertension, current smoking, and elevated total cholesterol ≥240 mg/dL) compared with those with 1 or more risk factors. Had all 3 major risk factors not occurred, it is estimated that 64% of all CHD deaths among women and 45% of CHD deaths in men could have been avoided.[51]
- Investigators from the Chicago Heart Association Detection Project in Industry have also observed that risk factor burden in middle age is associated with better quality of life at follow-up in older age (about 25 years later) and lower average annual Medicare costs at older ages.
  - A greater number of risk factors in middle age is associated with lower scores at older ages on assessment

of social functioning, mental health, walking, and health perception in women, with similar findings in men.[52]

- Similarly, a greater number of risk factors in middle age is associated with higher average annual CVD-related and total Medicare costs (once Medicare eligibility is attained).[53]

Hospital Discharges, Ambulatory Care Visits, and Nursing Home Visits

- From 1979 to 2004, the number of inpatient discharges from short-stay hospitals with CVD as the first-listed diagnosis increased 30% to 6 363 000 discharges (NCHS, NHDS). In 2004, CVD ranked highest among all disease categories in hospital discharges.[54]
- In 2004, there were 72 648 000 physician office visits with a primary diagnosis of CVD (NCHS, NAMCS).[55]
- In 2004, there were 4 164 000 visits to emergency departments with a primary diagnosis of CVD (NCHS, NHAMCS).[56]
- In 1999, 23% of nursing home residents age 65 or older had a primary diagnosis of CVD at admission. This was the highest disease category for these residents (NCHS, NNHS).[57]
- In 2004, there were 6 369 000 outpatient department visits with a primary diagnosis of CVD (NHAMCS).[58]

Cost

- The estimated direct and indirect cost of CVD for 2007 is $431.8 billion.
- In 2001, $29.3 billion in program payments were made to Medicare beneficiaries discharged from short-stay hospitals with a principal diagnosis of CVD. That was an average of $8354 per discharge.[59]
- A study of the 1987 National Medicaid Expenditure Survey and the 2000 Medical Expenditure Panel Survey, Household Component, showed the 15 most costly medical conditions and the estimated percentage increase in total healthcare spending for each condition from 1987 to 2000. The following are some of the top 15 conditions, in rank order, and their percentage impact on healthcare spending: heart disease (1) +8.06%; cancer (4) +5.36%; hypertension (5) +4.24%; cerebrovascular disease (7) +3.52%; diabetes (9) +2.37%; and kidney disease (15) +1.03%.[60]

Operations and Procedures

- In 2004, an estimated 6 363 000 inpatient cardiovascular operations and procedures were performed in the United States; 3.2 million were performed on males, and 3.1 million were performed on females (NHDS).[54]

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TABLE 2-1. Cardiovascular Disease

Population Group	Prevalence 2004 Age 20+	Mortality 2004 All Ages*	Hospital Discharges 2004 All Ages	Cost 2007
Both sexes	79 400 000 (37.1%)	871 517	6 363 000	$431.8 billion
Males	37 300 000 (37.5%)	410 365 (47.1%)†	3 227 000	. . .
Females	42 100 000 (36.6%)	461 152 (52.9%)†	3 136 000	. . .
NH white males	37.2%	353 517	. . .	. . .
NH white females	35.0%	398 776	. . .	. . .
NH black males	44.6%	47 476	. . .	. . .
NH black females	49.0%	53 513	. . .	. . .
Mexican-American males	31.6%	. . .	. . .	. . .
Mexican-American females	34.4%	. . .	. . .	. . .

Ellipses (. . .) indicate data not available; NH, non-Hispanic.

*Mortality data are for whites and blacks.

†These percentages represent the portion of total CVD mortality that is for males vs females.

Sources: Prevalence: NHANES 1999–2004 NCHS and NHLBI. Percentages for racial/ethnic groups are age adjusted for Americans age 20 and older. These data are based on self-reports. Estimates from NHANES 1999–2004 are applied to 2004 population estimates. Mortality: NCHS. These data represent underlying cause of death only. Data for white and black males and females include Hispanics; data for Mexican Americans are for 2003; data include congenital CVD mortality. Hospital discharges: NHDS, NCHS. Data include those inpatients discharged alive, dead, or of unknown status. Cost: NHLBI. Data include estimated direct and indirect costs for 2007.

TABLE 2-2. 2003 Age-Adjusted Death Rates for CVD, CHD, and Stroke by State (Includes District of Columbia and Puerto Rico)

	CVD*			CHD†			Stroke‡		
State	Rank§	Death Rate	% Change# 1993 to 2003	Rank§	Death Rate	% Change# 1993 to 2003	Rank§	Death Rate	% Change# 1993 to 2003
Alabama	49	378.4	−11.5	22	143.0	−23.9	47	66.5	−5.8
Alaska	16	273.7	−23.6	4	114.2	−35.5	40	60.9	−19.7
Arizona	9	261.5	−22.7	24	149.2	−27.6	8	44.4	−22.7
Arkansas	43	353.2	−15.6	45	181.9	−22.6	51	70.7	−20.0
California	27	298.0	−20.1	34	164.3	−29.1	30	56.7	−16.4
Colorado	4	258.1	−19.9	6	118.8	−32.2	16	50.9	−16.0
Connecticut	6	260.1	−26.9	11	134.2	−31.8	5	42.7	−21.7
Delaware	32	311.1	−20.9	41	176.7	−25.4	13	48.7	−13.2
District of Columbia	44	357.9	−12.6	48	204.5	+26.7	11	45.4	−39.8
Florida	20	277.4	−20.2	29	162.2	−26.4	6	43.6	−22.4
Georgia	42	348.5	−18.3	20	142.0	−33.0	44	65.2	−17.3
Hawaii	2	241.7	−20.9	1	96.0	−34.5	19	52.6	−9.9
Idaho	17	275.6	−20.0	13	135.3	−28.5	35	59.0	−17.1
Illinois	31	310.0	−25.0	30	162.9	−34.6	24	54.1	−21.5
Indiana	37	326.5	−22.9	32	163.1	−32.0	33	57.4	−23.8
Iowa	24	284.4	−22.4	31	162.9	−30.8	23	53.7	−14.0
Kansas	26	296.0	−19.3	12	134.5	−30.6	32	56.8	−13.6
Kentucky	46	362.6	−16.3	43	179.9	−25.7	42	61.3	−15.6
Louisiana	45	362.4	−18.6	38	172.9	−30.2	41	61.0	−15.0
Maine	15	273.4	−18.6	17	138.9	−35.3	17	51.7	−12.1
Maryland	29	306.3	−17.7	37	169.2	−21.6	21	53.1	−13.4
Massachusetts	8	260.3	−24.9	10	128.7	−34.8	10	45.1	−16.2
Michigan	38	327.2	−21.4	42	179.2	−30.4	20	52.7	−21.8
Minnesota	1	221.2	−31.7	2	97.0	−42.9	12	47.2	−32.4

TABLE 2-2. Continued

	CVD*			CHD†			Stroke‡		
State	Rank§	Death Rate	% Change# 1993 to 2003	Rank§	Death Rate	% Change# 1993 to 2003	Rank§	Death Rate	% Change# 1993 to 2003
Mississippi	51	405.9	−16.0	40	176.1	−28.6	43	63.6	−12.3
Missouri	41	344.3	−18.5	44	181.2	−27.0	34	57.7	−16.4
Montana	10	267.5	−21.4	8	119.9	−30.7	28	55.3	−19.1
Nebraska	19	277.1	−26.7	5	114.6	−37.5	25	54.2	−17.7
Nevada	39	327.4	−20.1	18	139.4	−36.4	31	56.7	−13.6
New Hampshire	12	270.8	−25.5	26	154.0	−30.9	3	41.4	−31.3
New Jersey	25	292.4	−22.3	36	168.5	−28.6	4	41.8	−25.1
New Mexico	3	255.0	−20.1	16	137.2	−21.8	7	44.1	−26.1
New York	33	319.1	−27.0	50	213.4	−30.2	1	35.0	−29.1
North Carolina	34	321.9	−21.3	28	158.0	−31.2	46	65.8	−21.6
North Dakota	22	277.6	−23.3	27	154.6	−20.5	29	55.4	−18.8
Ohio	36	324.7	−20.4	39	173.6	−28.5	27	55.0	−11.2
Oklahoma	50	400.7	−8.6	51	228.1	−9.1	48	69.0	−5.9
Oregon	11	270.5	−22.1	7	119.5	−36.4	45	65.4	−16.4
Pennsylvania	30	308.9	−23.8	33	163.3	−32.1	15	50.8	−18.1
Puerto Rico	...	233.7	...	...	116.5	...	...	46.2	...
Rhode Island	23	280.9	−22.7	46	188.5	−22.8	2	41.2	−27.1
South Carolina	40	328.9	−25.2	23	148.8	−35.7	50	69.5	−23.5
South Dakota	18	275.9	−24.1	25	152.8	−33.0	14	49.9	−17.9
Tennessee	48	373.6	−15.5	49	205.0	−21.1	49	69.0	−20.3
Texas	35	322.1	−16.1	35	168.0	−24.7	37	60.6	−13.9
Utah	5	258.7	−18.2	3	100.3	−37.5	26	54.2	−12.8
Vermont	7	260.2	−30.0	21	142.1	−36.1	9	45.0	−28.3
Virginia	28	300.5	−25.5	15	136.4	−31.4	36	59.4	−20.9
Washington	13	271.3	−21.2	19	139.6	−24.6	39	60.7	−15.0
West Virginia	47	373.4	−17.1	47	201.0	−24.7	38	60.6	−9.2
Wisconsin	21	277.4	−23.7	14	135.7	−33.7	18	52.1	−23.5
Wyoming	14	272.5	−21.6	9	121.6	−33.1	22	53.4	−26.2
Total United States		307.7	−22.2		162.9	−29.3		53.5	−19.5

Ellipses (. . .) indicate data not available.

*CVD is defined here as ICD-10 I00–I99.

†CHD is defined here as ICD-10 I20–I25.

‡Stroke is defined here as ICD-10 I60–I69.

§Rank is lowest to highest. Comparable data for Puerto Rico were not available for 2003; therefore, it was not included in the rank. Data shown for Puerto Rico are for 2002.

#Percent change is based on log linear slope of rates for each year, 1993–2003. For stroke, the death rates in 1993–1998 were comparability modified, using the ICD-10 to ICD-9 comparability ratio of 1.0502.

Source: NCHS compressed mortality file 1979–2003. Data provided by personal communication with NHLBI.

Note: The AHRQ has released state-level data for heart disease for all 50 states and the District of Columbia. The data are taken from the congressionally mandated 2004 National Healthcare Quality Report (NHQR) at http://www.qualitytools.ahrq.gov/qualityreport/2005/state/summary/intro.aspx. In addition, the Women's Health and Mortality Chartbook of the NCHS has state-related data for women at http://www.cdc.gov/nchs/data/healthywomen/womenschartbook_aug2004.pdf. Also, at http://apps.nccd.cdc.gov/brfss-smart/index.asp, Metropolitan/Micropolitan Area Risk (MMSA) data are available for 500 such areas nationwide. BRFSS data are also collected within each state (www.cdc.gov/brfss). In addition, the NCHS has "Health Data for All Ages by State": http://www.cdc.gov/nchs/health_data_for_all_ages.htm.

TABLE 2-3. Remaining Lifetime Risks for CVD and Other Diseases Among Men and Women Free of Disease at 40 and 70 Years of Age

	Remaining Lifetime Risk at Age 40		Remaining Lifetime Risk at Age 70	
Diseases	Men	Women	Men	Women
Any CVD*	2 in 3	>1 in 2	>1 in 2	1 in 2
CHD[37]	1 in 2	1 in 3	1 in 3	1 in 4
AF[38]	1 in 4	1 in 4	1 in 4	1 in 4
CHF[39]	1 in 5	1 in 5	1 in 5	1 in 5
Stroke[40]	1 in 6†	1 in 5†	1 in 6	1 in 5
Dementia[40]	...	...	1 in 7	1 in 5
Hip fracture[41]	1 in 20	1 in 6	...	...
Breast cancer[42,43]	1 in 1000	1 in 8	...	1 in 14
Prostate cancer[42]	1 in 6	...	...	...
Lung cancer[42]	1 in 12	1 in 17	...	...
Colon cancer[42]	1 in 16	1 in 17	...	...
Diabetes[44]	1 in 3	1 in 3	1 in 9	1 in 7
Hypertension[45]	9 in 10†	9 in 10†	9 in 10‡	9 in 10‡
Obesity[46]	1 in 3	1 in 3	...	...

Ellipses (. . .) indicate not estimated; AF, atrial fibrillation.
*Personal communication from D. Lloyd-Jones, based on FHS data.
†Age 55.
‡Age 65.

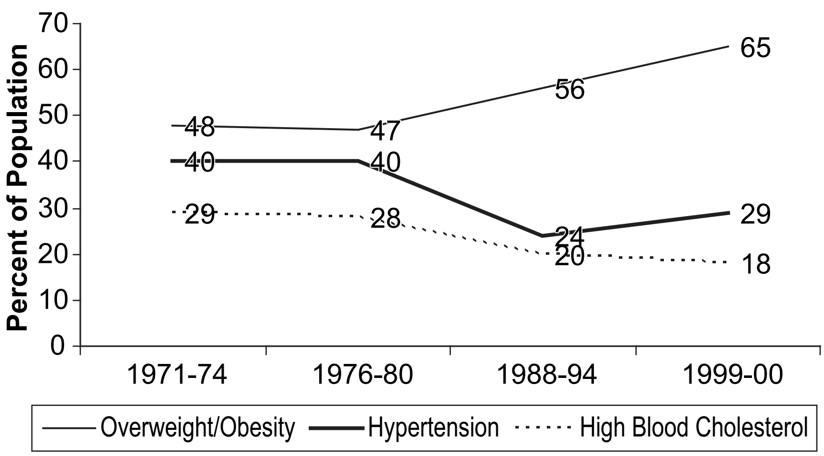


Chart 2-1. Trends in the age-adjusted prevalence of health conditions, US adults ages 20 to 74 (NHANES: 1971–1974 to 1999–2000). Source: Briefel and Johnson.[61] Printed with permission from the Annual Review of Nutrition.

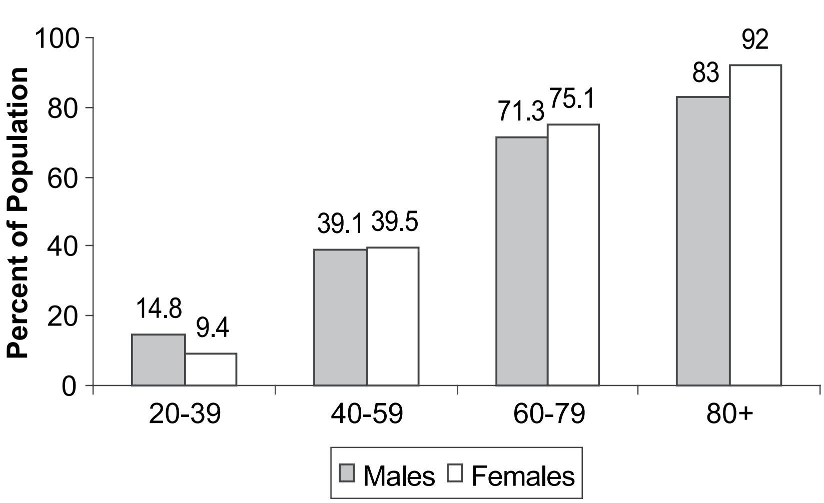


Chart 2-2. Prevalence of CVDs in adults age 20 and older by age and sex (NHANES: 1999–2004). Source: NCHS and NHLBI. These data include CHD, HF, stroke, and hypertension.

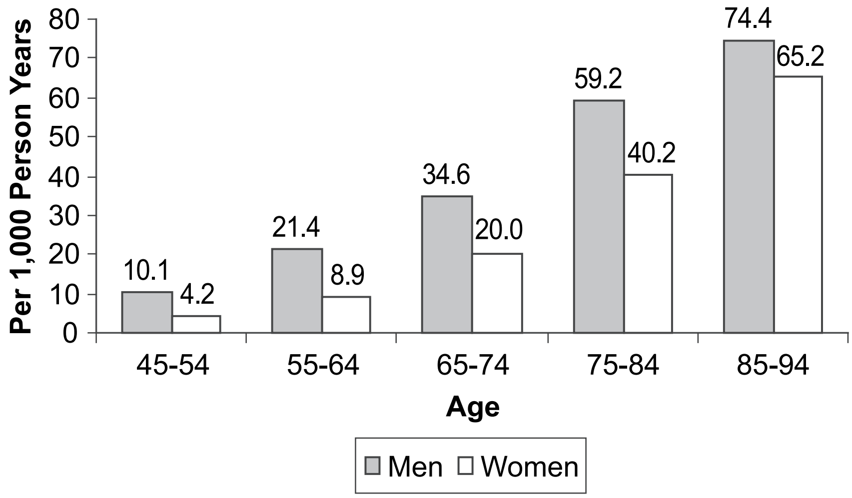


Chart 2-3. Incidence of CVD* by age and sex (FHS, 1980–2003). *CHD, HF, stroke, or intracerebral hemorrhage. Does not include hypertension alone. Source: NHLBI.[62]

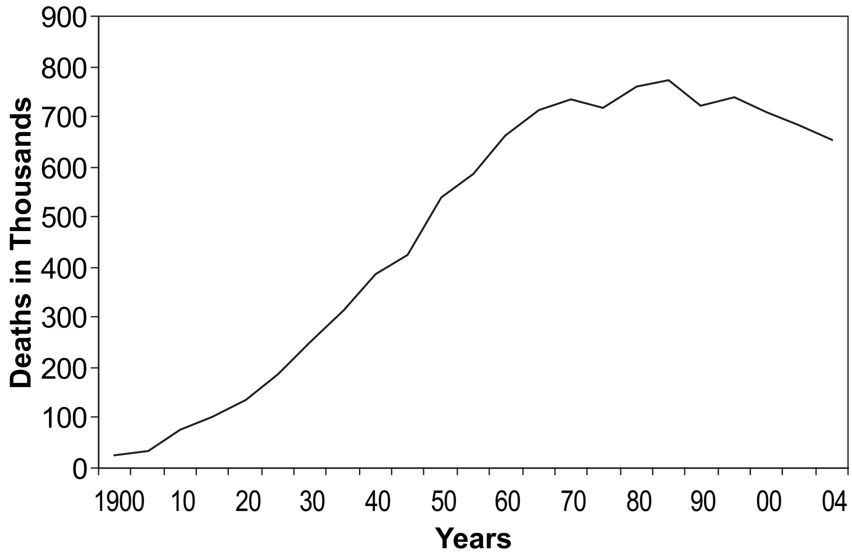


Chart 2-4. Deaths from diseases of the heart (United States: 1900–2004). Note: See Glossary for an explanation of "Diseases of the Heart." Total CVD data were not available for much of the period covered by this chart. Source: Respective NVSR reports. NCHS and NHLBI.

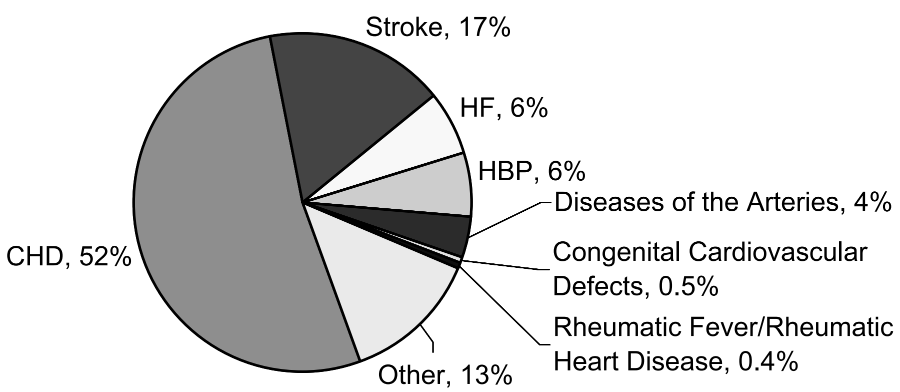


Chart 2-5. Percentage breakdown of deaths from CVDs (United States: 2004). Source: NCHS and NHLBI.

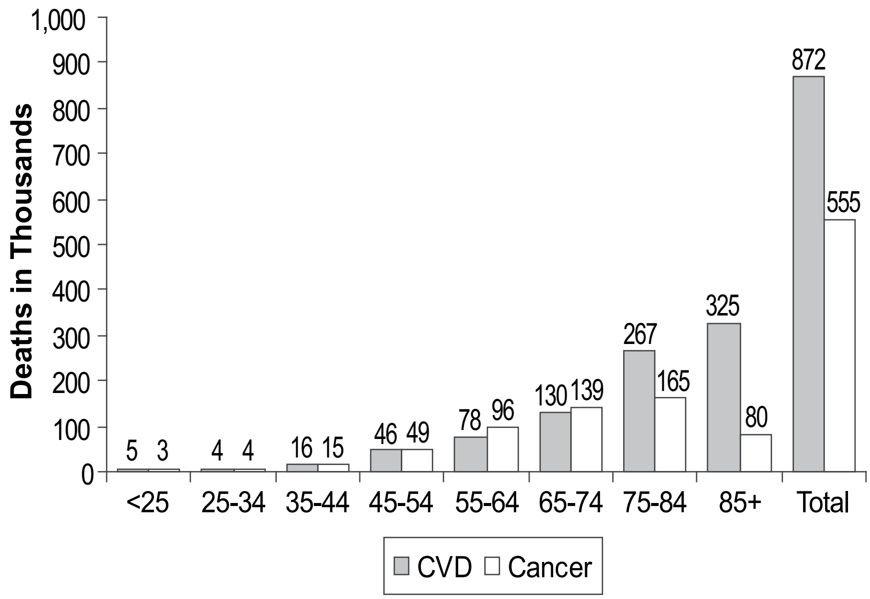


Chart 2-6. CVD deaths vs cancer deaths by age (United States: 2004). Source: NCHS and NHLBI. Charts 2-6, 2-7, 2-8, and 2-9 present a comparison of total CVD deaths with total cancer deaths for the total US population and also by specific age groups. Overall, there are an estimated 79.4 million people in the United States living with CVD, which causes more than 870 000 deaths annually compared with more than 550 000 cancer deaths.

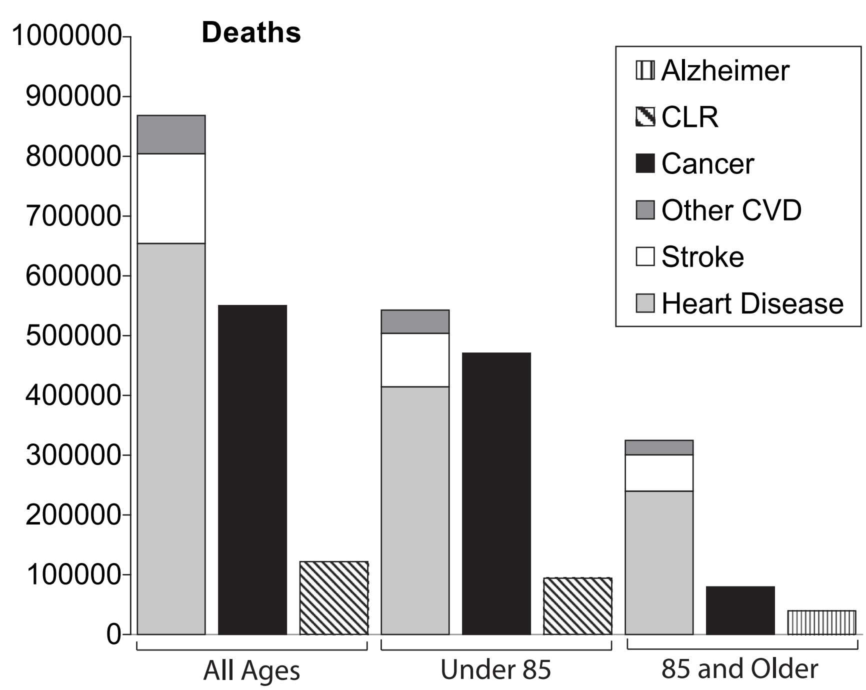


Chart 2-7. CVD and other major causes of death: total, under age 85, and 85 and older. Deaths: both sexes, United States 2004. Source: NCHS and NHLBI.

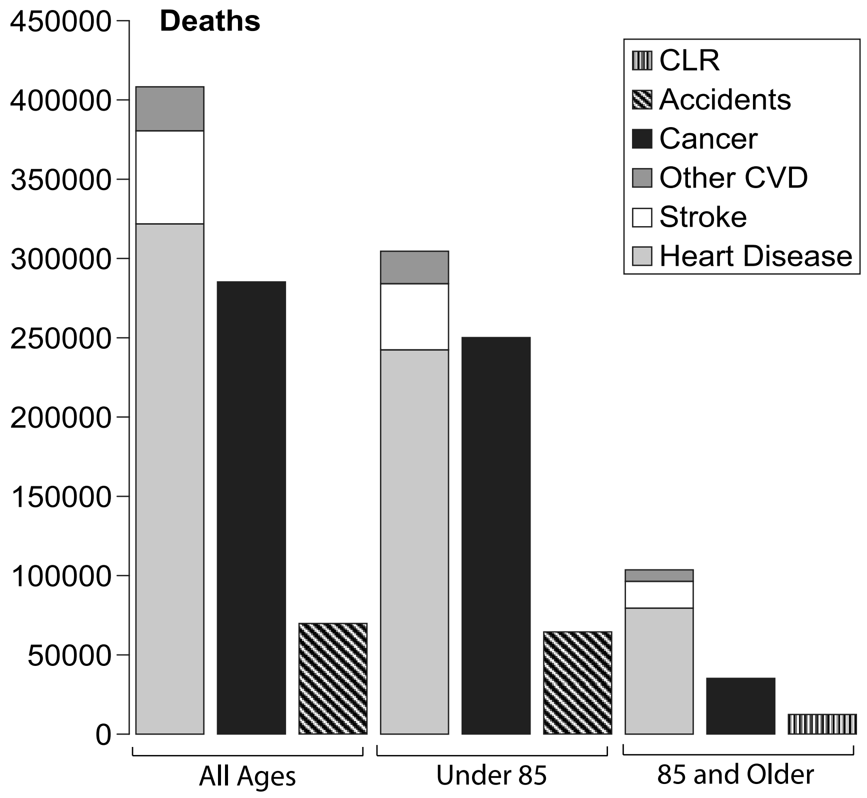


Chart 2-8. CVD and other major causes of death: total, under age 85, and 85 and older. Deaths in males, United States 2004. Source: NCHS and NHLBI.

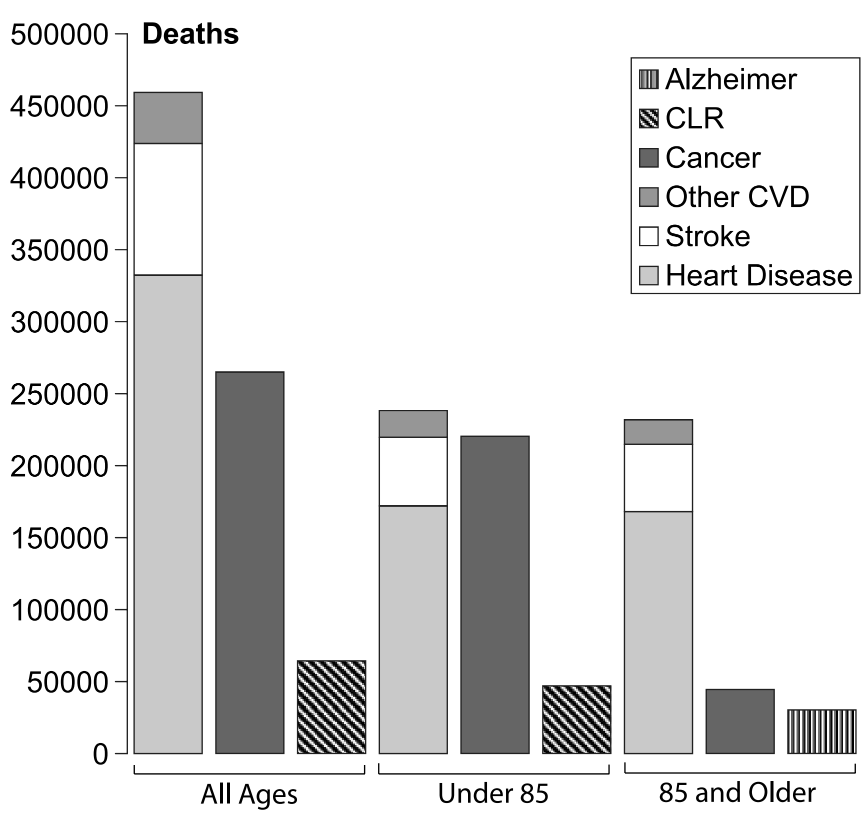


Chart 2-9. CVD and other major causes of death: total, under age 85, and 85 and older. Deaths in females, United States 2004. Source: NCHS and NHLBI.

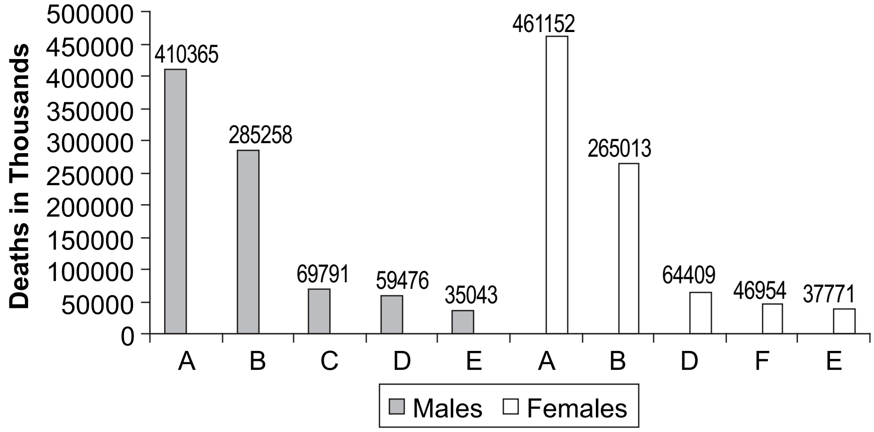


Chart 2-10. CVD and other major causes of death for all males and females (United States: 2004). Bars: A, Total CVD; B, cancer; C, accidents; D, chronic lower respiratory disease; E, diabetes; F, Alzheimer's. Source: NCHS and NHLBI

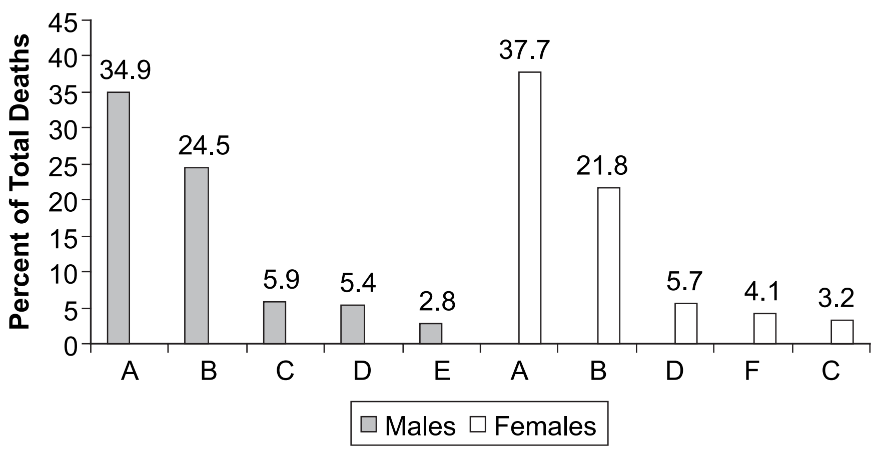


Chart 2-11. CVD and other major causes of death for white males and females (United States: 2004). Bars: A, Total CVD; B, cancer; C, accidents; D, chronic lower respiratory disease; E, diabetes; F, Alzheimer's. Note: Using "Diseases of the Heart and Stroke," which do not constitute total CVD, the percentages of the "A" bars would be 32.6 for males and 34.9 for females. Source: NCHS and NHLBI.

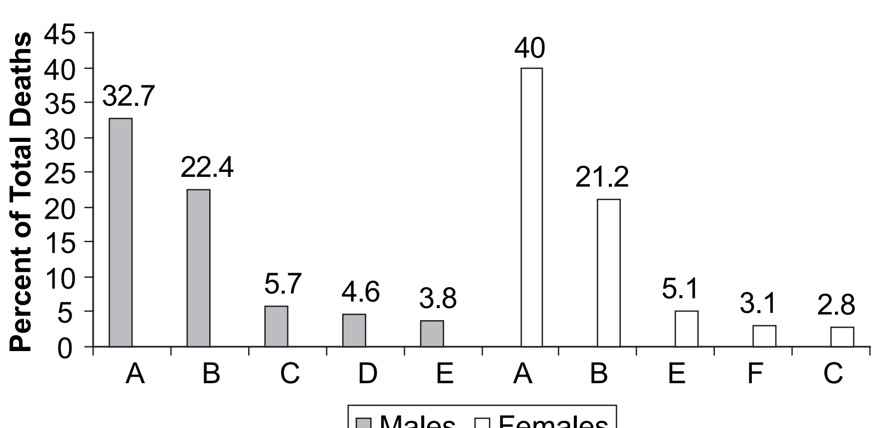


Chart 2-12. CVD and other major causes of death for black males and females (United States: 2004). Bars: A, Total CVD; B, cancer; C, accidents; D, assault (homicide); E, diabetes; F, nephritis, nephrotic syndrome, and nephrosis. Note: Using "Diseases of the Heart and Stroke," which do not constitute total CVD, the percentages of the "A" bars would be 30.0 for males and 34.4 for females. Source: NCHS and NHLBI.

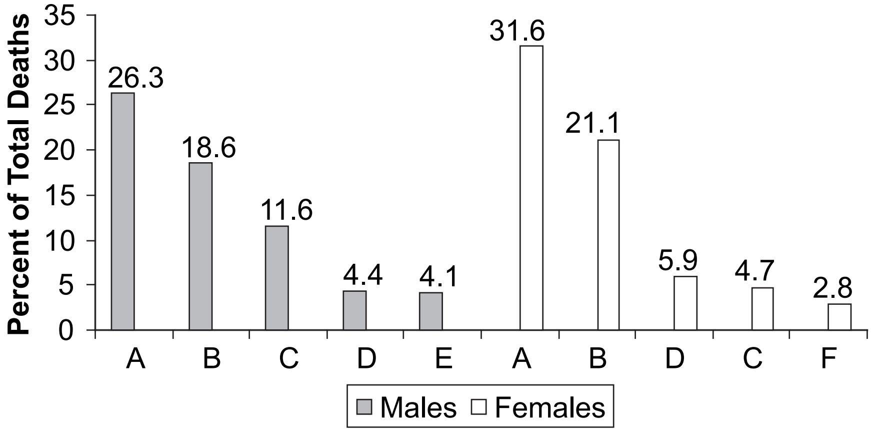


Chart 2-13. Diseases of the heart and stroke and other major causes of death for Hispanic or Latino males and females (United States: 2003). Bars: A, Diseases of the heart and stroke; B, cancer; C, accidents; D, diabetes; E, assault (homicide); F, influenza and pneumonia. Note: Data for total CVD are not available. Source: NCHS and NHLBI.

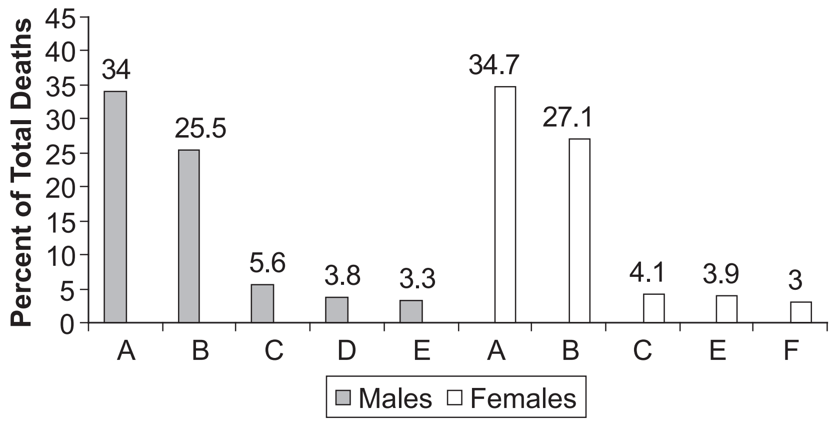


Chart 2-14. Diseases of the heart and stroke and other major causes of death for Asian or Pacific Islander males and females (United States: 2003). Bars: A, Diseases of the heart and stroke; B, cancer; C, accidents; D, chronic lower respiratory disease; E, diabetes; F, influenza and pneumonia. Note: "Asian or Pacific Islander" is a heterogeneous category that includes people at high CVD risk (eg, South Asian) and people at low CVD risk (eg, Japanese). More specific data on these groups are not available. Mortality data for total CVD are not available. Source: NCHS and NHLBI.

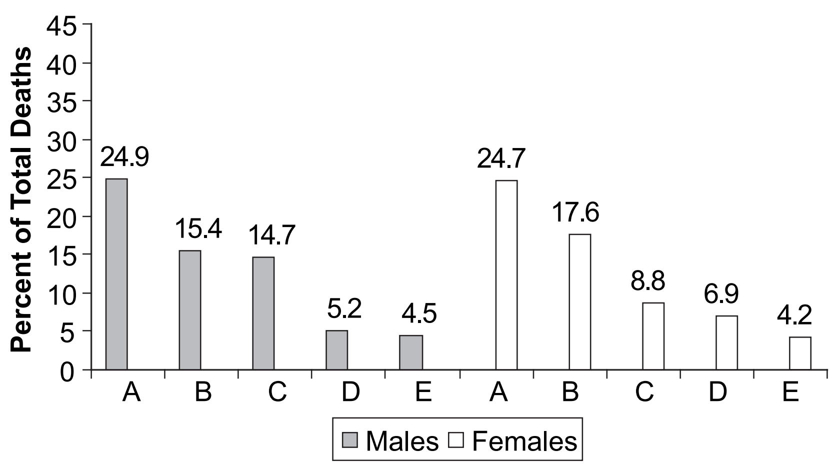


Chart 2-15. Diseases of the heart and stroke and other major causes of death for American Indian or Alaska Native males and females (United States: 2003). Bars: A, Diseases of the heart and stroke; B, cancer; C, accidents; D, diabetes; E, chronic liver disease and cirrhosis. Note: Data for total CVD are not available. Source: NCHS and NHLBI.

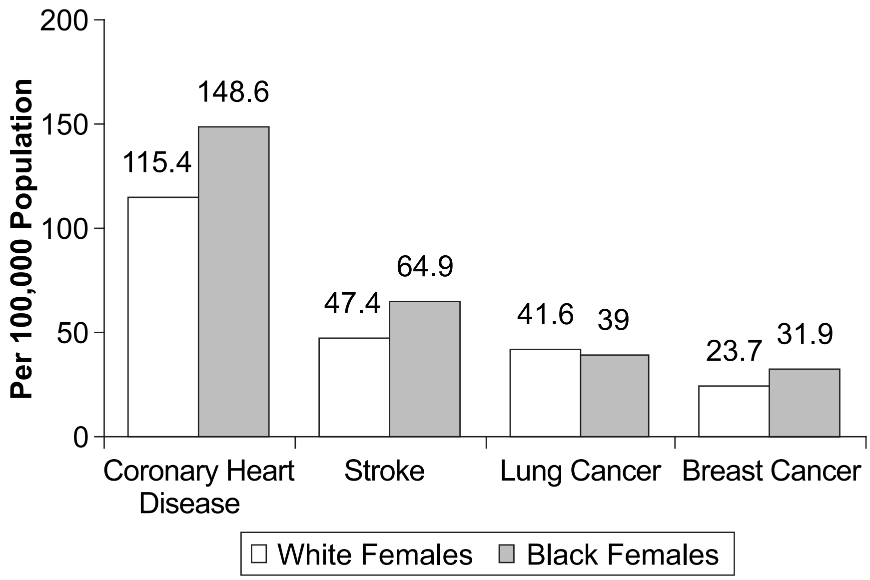


Chart 2-16. Age-adjusted death rates for CHD, stroke, and lung and breast cancer for white and black females (United States: 2004). Source: NCHS and NHLBI.

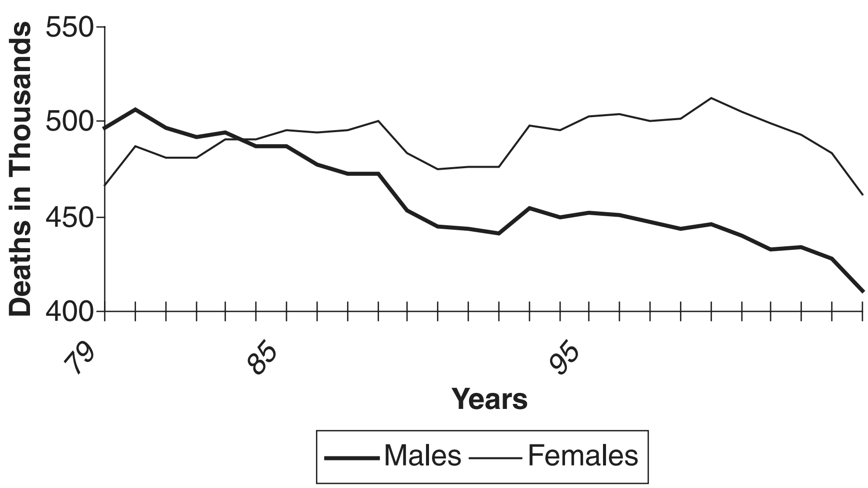
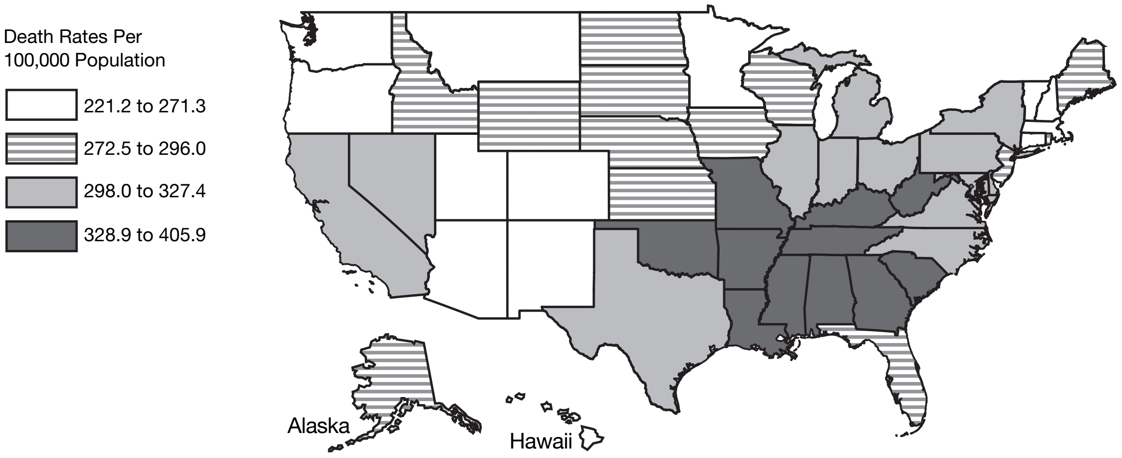


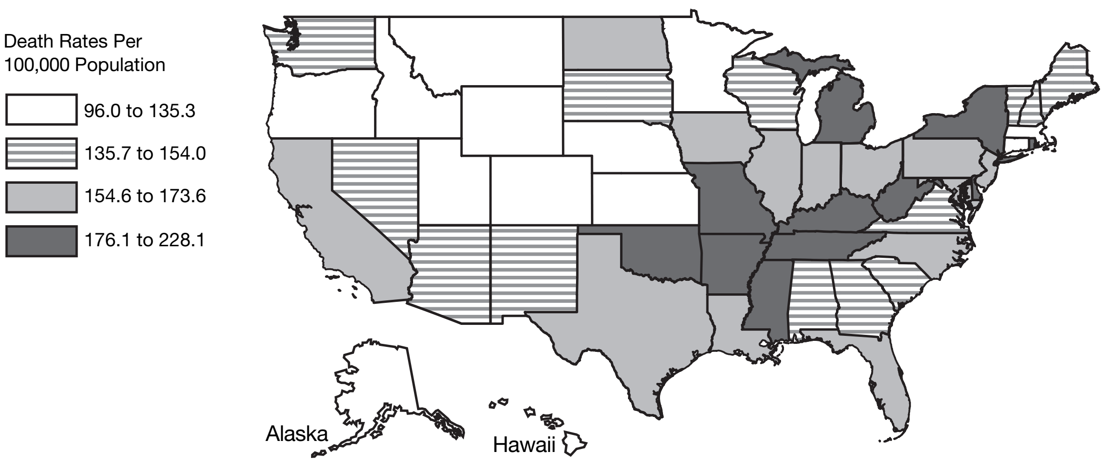
Chart 2-17. CVD mortality trends for males and females (United States: 1979–2004). Source: Annual Final Mortality. NCHS and NHLBI. Note: The overall comparability for CVD between the ICD-9 (1979–1998 and ICD-10 (1999–2004) is 0.9962. No comparability ratios were applied.

Death Rates by State — Statistics
(*Includes District of Columbia)

2003 Total Cardiovascular Disease Age-Adjusted Death Rates by State



2003 Coronary Heart Disease Age-Adjusted Death Rates by State



2003 Stroke Age-Adjusted Death Rates by State

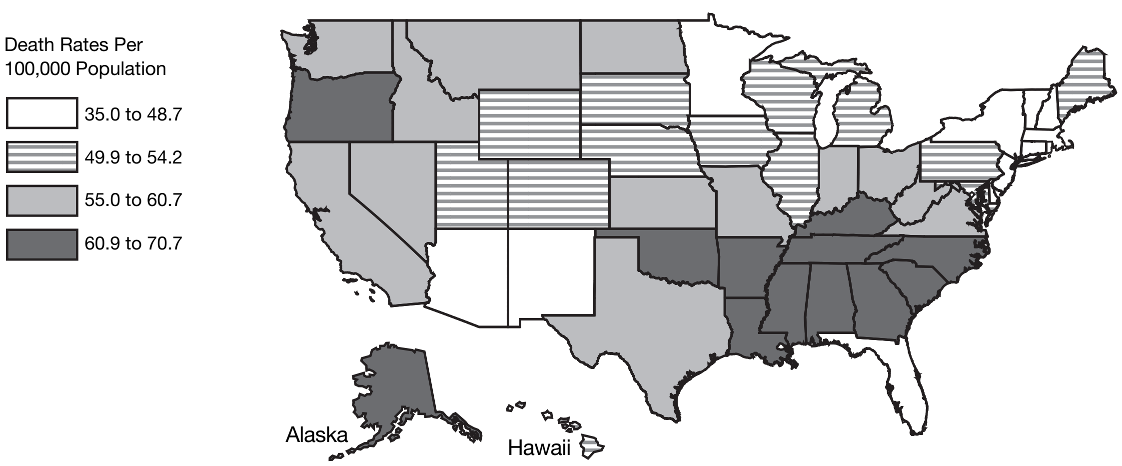
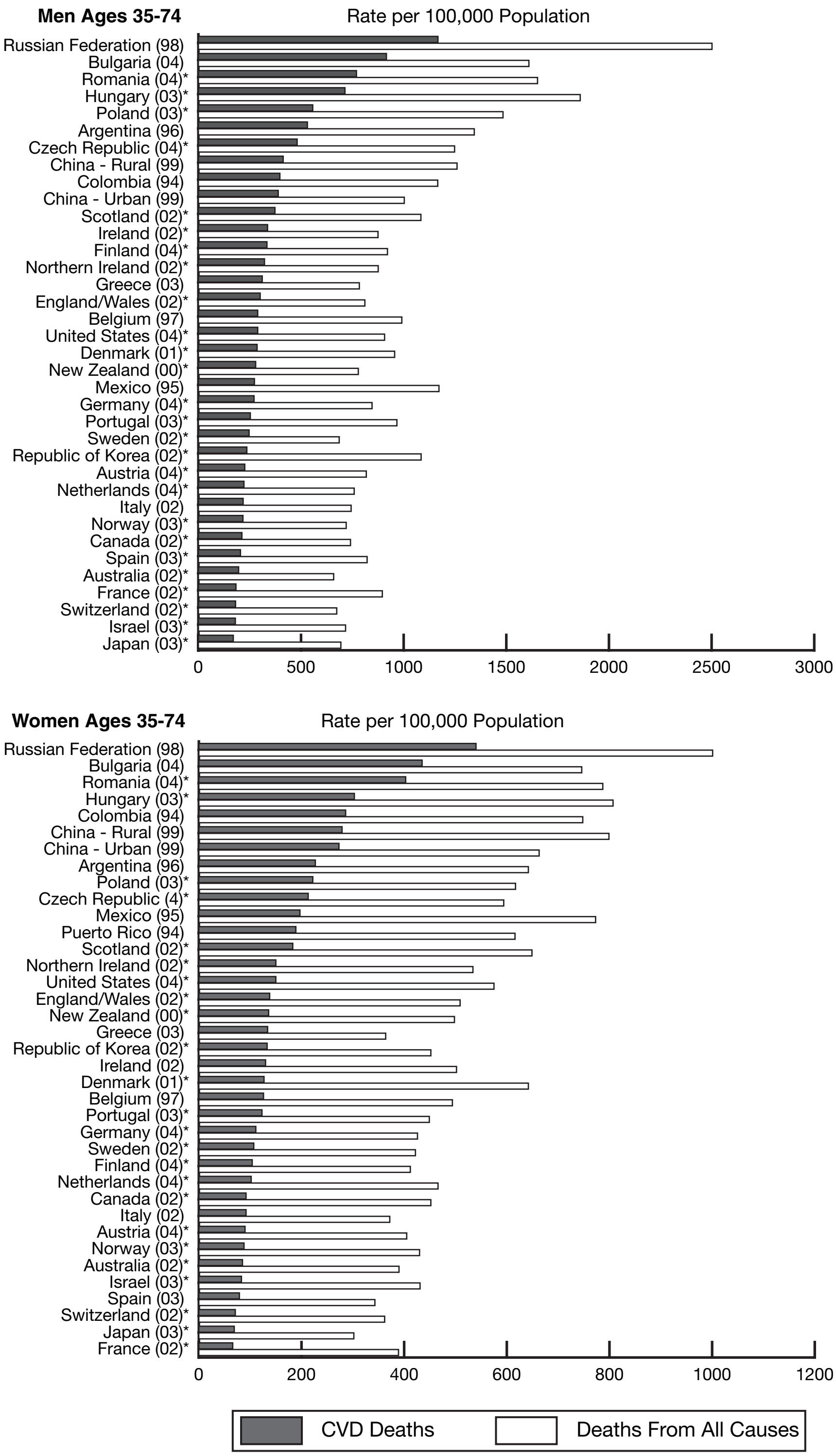


Chart 2-18. US maps corresponding to state death rates.

International Cardiovascular Disease Statistics

Death Rates for Total Cardiovascular Disease, Coronary Heart Disease, Stroke and Total Deaths in Selected Countries (most recent year available) (Revised 2006)



Men Ages 35-74

Country	CVD Deaths	CHD Deaths	Stroke Deaths	Total Deaths
Russian Federation (98)	1167	639	361	2502
Bulgaria (04)	916	273	227	1610
Romania (04)*	770	314	251	1652
Hungary (03)*	714	358	181	1860
Poland (03)*	557	228	118	1484
Argentina (96)	531	140	116	1344
Czech Republic (04)*	481	231	94	1248
China - Rural (99)	413	64	243	1260
Colombia (94)	397	190	90	1166
China - Urban (99)	389	106	217	1003
Scotland (02)*	373	247	61	1084
Ireland (02)*	337	217	41	874
Finland (04)*	334	211	54	921
Northern Ireland (02)*	322	217	53	876
Greece (03)	311	166	68	784
England/Wales (02)*	301	196	49	811
Belgium (97)	289	143	50	991
United States (04)*	**289**	**174**	**35**	**907**
Denmark (01)*	286	142	52	956
New Zealand (00)*	279	190	40	779
Mexico (95)	273	137	61	1172
Germany (04)*	270	142	39	846
Portugal (03)*	253	97	96	967
Sweden (02)*	247	151	44	686
Republic of Korea (02)*	236	57	143	1085
Austria (04)*	226	131	34	818
Netherlands (04)*	222	96	37	759
Italy (02)	218	101	41	744
Norway (03)*	217	125	36	720
Canada (02)*	212	142	28	741
Spain (03)*	205	101	43	822
Australia (02)*	196	127	30	659
France (02)*	183	73	35	896
Switzerland (02)*	181	97	23	674
Israel (03)*	180	95	38	717
Japan (03)*	170	53	66	694

Women Ages 35-74

Country	CVD Deaths	CHD Deaths	Stroke Deaths	Total Deaths
Russian Federation (98)	540	230	229	1001
Bulgaria (04)	435	100	133	746
Romania (04)*	403	134	166	787
Hungary (03)*	303	133	91	807
Colombia (94)	286	110	84	748
China - Rural (99)	279	41	152	799
China - Urban (99)	273	71	147	663
Argentina (96)	227	39	63	642
Poland (03)*	222	68	63	617
Czech Republic (4)*	213	82	52	594
Mexico (95)	197	73	52	773
Puerto Rico (94)	189	78	25	616
Scotland (02)*	183	98	48	649
Northern Ireland (02)*	150	79	41	534
United States (04)*	**150**	**73**	**27**	**575**
England/Wales (02)*	138	68	36	509
New Zealand (00)*	136	71	33	498
Greece (03)	134	46	44	364
Republic of Korea (02)*	133	24	87	452
Ireland (02)	130	66	27	502
Denmark (01)*	127	51	37	642
Belgium (97)	126	44	35	494
Portugal (03)*	123	35	55	449
Germany (04)*	111	45	23	426
Sweden (02)*	107	51	30	422
Finland (04)*	104	48	32	412
Netherlands (04)*	102	34	26	466
Canada (02)*	92	48	20	452
Italy (02)	92	29	25	372
Austria (04)*	90	42	19	405
Norway (03)*	88	38	25	430
Australia (02)*	85	43	20	390
Israel (03)*	83	31	22	431
Spain (03)	79	26	23	343
Switzerland (02)*	71	27	15	362
Japan (03)*	69	16	31	302
France (02)*	66	16	18	389

Note: Rates adjusted to the European Standard population. ICD/9 codes are 390-459 for cardiovascular disease; 410-414 for coronar y heart disease; and 430-438 for stroke. Countries using ICD/10 are noted with *.

* ICD/10 codes are I00-I99 for cardiovasculardisease; I20-I25 for coronary heartdisease; and I60-I69 for stroke.

Source: The World Health Organization Web page, ***who.int/whosis/****, NCHS and NHLBI.*

Chart 2-19. International Death Rates.

3. Coronary Heart Disease, Acute Coronary Syndrome, and Angina Pectoris

Coronary Heart Disease

ICD-9 410–414, 429.2; ICD-10 I20–I25; see Glossary (Chapter 21) for details and definitions. See Table 3-1 and Charts 3-1 through 3-6. Also see Chart 3-7 in the online-only Data Supplement.

Prevalence

- Among Americans ages 40 to 74 years, NHANES data found the age-adjusted prevalence of self-reported MI and electrocardiographically verified MI to be higher among men than women but AP prevalence to be higher in women than in men. Age-adjusted rates of self-reported MI increased among African-American men and women and Mexican-American men but decreased among white men and women.[1]

Incidence

- This year, an estimated 700 000 Americans will have a new coronary attack and about 500 000 will have a recurrent attack. It is estimated that an additional 175 000 silent first MIs occur each year (NHLBI: based on unpublished data from the ARIC study and the CHS).[2]
- The estimated annual incidence of MI is 565 000 new attacks and 300 000 recurrent attacks annually (NHLBI: based on unpublished data from the ARIC study and the CHS).[2]
- Average age at first MI is 65.8 years for men and 70.4 years for women (NHLBI: based on unpublished data from the ARIC study and the CHS).

Abbreviations Used in Chapter 3

ACS	acute coronary syndrome
AHA	American Heart Association
AP	angina pectoris
ARIC	Atherosclerosis Risk in Communities study
BP	blood pressure
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CHS	Cardiovascular Health Study
CI	confidence interval
CVD	cardiovascular disease
EMS	emergency medical services
FHS	Framingham Heart Study
HBP	high blood pressure
HF	heart failure
ICD	International Classification of Diseases
MET	metabolic equivalent
MI	myocardial infarction
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHLBI	National Heart, Lung, and Blood Institute
LDL	low-density lipoprotein
PA	physical activity
UA	unstable angina

- On the basis of the NHLBI's FHS, in its 44-year follow-up of participants and 20-year follow-up of their offspring[4]:
  - CHD comprises more than half of all cardiovascular events in men and women under age 75.
  - The lifetime risk of developing CHD after age 40 years is 49% for men and 32% for women.[5]
  - The incidence of CHD in women lags behind men by 10 years for total CHD and by 20 years for more serious clinical events such as MI and sudden death.
- In the NHLBI's ARIC study, average age-adjusted CHD incidence rates per 1000 person-years were as follows: white men, 12.5; black men, 10.6; white women, 4.0; and black women, 5.1. Incidence rates excluding revascularization procedures were as follows: white men, 7.9; black men, 9.2; white women, 2.9; and black women, 4.9. Hypertension was a particularly powerful risk factor for CHD in black persons, especially in black women. Diabetes was a weaker predictor of CHD in black than in white persons. In a multivariable analysis, hypertension was a particularly strong risk factor in black women, with hazard rate ratios (95% confidence interval [CI]) as follows: black women 4.8 (2.5 to 9.0); white women, 2.1 (1.6 to 2.9); black men, 2.0 (1.3 to 3.0); and white men, 1.6 (1.3 to 1.9). Diabetes mellitus was somewhat more predictive in white women than in other groups. Hazard rate ratios were as follows: black women 1.8 (1.2 to 2.8); white women, 3.3 (2.4 to 4.6); black men, 1.6 (1.1 to 2.5); and white men, 2.0 (1.6 to 2.6).[6]
- The annual age-adjusted rates per 1000 population of first MI, 1987 to 2001, in ARIC Surveillance were 4.2 in black men, 3.9 in white men, 2.8 in black women, and 1.7 in white women (NHLBI *Incidence & Prevalence: 2006 Chart Book on Cardiovascular and Lung Diseases*).
- Combining the rates for possible and definite CHD shows that 17 to 25 of every 100 American Indian men ages 45 to 74 had some evidence of heart disease.[7]
- Among American Indians ages 65 to 74, the annual rates per 1000 population of new and recurrent MIs are 7.6 for men and 4.9 for women (Strong Heart Study [1989–2002], personal communication with NHLBI).
- CHD rates in women after menopause are 2 to 3 times those of women the same age before menopause.[8]

Mortality

CHD caused 1 of every 5 deaths in the United States in 2004. CHD total-mention mortality in 2002 was 653 000. MI total-mention mortality in 2002 was 221 000 (Vital Statistics of the United States, NCHS). CHD is the *single* largest killer of American males and females. About every 26 seconds, an American will suffer a coronary event, and about every minute someone will die from one. About 38% of the people who experience a coronary attack in a given year will die from it (AHA computation).

- A study of 1275 HMO enrollees ages 50 to 79 years who had cardiac arrest showed the incidence of out-of-hospital cardiac arrest was 6.0/1000 subject-years in subjects with any clinically recognized heart disease, as compared with 0.8/1000 subject-years in subjects without heart disease. In subgroups with heart disease, incidence was 13.6/1000 subject-years in subjects with prior MI and 21.9/1000 subject-years in subjects with HF.[9]

- An analysis of data from the FHS from 1950–1999 showed that overall CHD death rates decreased by 59%. Nonsudden CHD death decreased by 64%, and sudden cardiac death fell by 49%. These trends were seen in men and women, in subjects with and without a prior history of CHD, and in smokers and nonsmokers.[10]
- From 1994 to 2004, the death rate from CHD declined 33%, but the actual number of deaths declined only 18%. In 2004, the overall CHD death rate was 150.5 per 100 000 population. The death rates were 194.4 for white males and 222.2 for black males; for white females, the rate was 115.4, and for black females it was 148.6 (NCHS and NHLBI). The 2003 age-adjusted death rates for CHD were 130.0 for Hispanics or Latinos, 114.1 for American Indians or Alaska Natives, and 92.8 for Asians or Pacific Islanders.[11]
- About 83% of people who die of CHD are age 65 or older (NCHS) (AHA computation).
- The estimated average number of years of life lost due to an MI is 15.[12]
- On the basis of data from the FHS of the NHLBI[4]:

  - Fifty percent of men and 64% of women who died suddenly of CHD had no previous symptoms of this disease. Between 70% and 89% of sudden cardiac deaths occur in men, and the annual incidence is 3 to 4 times higher in men than in women. However, this disparity decreases with advancing age.
  - People who have had an MI have a sudden death rate 4 to 6 times that of the general population.
  - Sudden cardiac death accounts for 19% of sudden deaths in children ages 1 to 13 and 30% between 14 and 21 years of age. The overall incidence is low, 600 cases per year.

- According to data from the National Registry of Myocardial Infarction[13]:

  - From 1990 to 1999, in-hospital acute MI mortality declined from 11.2% to 9.4%.[14]
  - Mortality increases for every 30 minutes that elapse before a patient with ST-segment elevation is recognized and treated.[15]
  - The median door-to-drug time for thrombolytic therapy was reduced by nearly half, from 61.8 to 37.8 minutes. However, many hospitals are still working to meet the goal of 30 minutes set in 1991 (www.nrmi.org).
  - Women under 50 years of age are twice as likely to die after an acute MI as are men in the same age group.[16]

Risk Factors

- A study of men and women in 3 prospective cohort studies found that antecedent major CHD risk factor exposures were very common among those who developed CHD. About 90% of the CHD patients have prior exposure to at least 1 of these major risk factors, which include high total blood cholesterol levels or current medication with cholesterol-lowering drugs, hypertension or current medication with BP-lowering drugs, current cigarette use, and clinical report of diabetes.[17]
- According to a case–control study of 52 countries (INTERHEART), 9 easily measured and potentially modifiable risk factors account for more than 90% of the risk of an initial acute MI. The effect of these risk factors is consistent in men and women across different geographic regions and by ethnic group, which makes the study applicable worldwide. These 9 risk factors include cigarette smoking, abnormal blood lipid levels, hypertension, diabetes, abdominal obesity, a lack of physical activity (PA), low daily fruit and vegetable consumption, alcohol overconsumption, and psychosocial index.[18]
- A study of more than 3000 members of the FHS offspring cohort without CHD showed that among men with 10-year predicted risk for CHD of 20%, both failure to reach target heart rate and ST-segment depression more than doubled the risk of an event, and each MET (metabolic equivalent) increment in exercise capacity reduced risk by 13%.[19]
- Low CHD risk is defined as BP <120/80 mm Hg, cholesterol <200 mg/dL, and absence of current smoking. Age-adjusted prevalence was estimated in nondiabetic persons without a history of MI participating in 4 NHANES surveys conducted in 1971–1975, 1976–1980, 1988–1994, and 1999–2000.[20]

  - The prevalence of low risk rose from 6% in 1971–1975 to 17% in 1988–1994 and 1999–2000.
  - Prevalence of low risk was about twice as high in women as in men throughout the period.
  - Prevalence was initially higher in whites than in blacks (7% versus 3% in 1971–1975); it increased more with time in blacks (17% versus 15% in 1999–2000).
  - Prevalence of low risk in 1999–2000 was lowest in those ages 65 to 74 (3%) and was progressively greater at younger ages (29% at ages 25 to 34), with similar increases in prevalence over time across age groups.
  - The greatest changes in the components of low risk from 1971 to 2000 were in prevalence of favorable diastolic BP (from 38% to 71%), as compared with favorable systolic BP (from 32% to 47%), nonsmoking (from 60% to 79%), and favorable cholesterol (from 33% to 46%).

- Taking into account CHD risk factors in combination provides a very potent predictor of 10-year risk of CHD, as compared with individual risk factors. Among participants ages 20 to 79 in the NHANES III study of the NCHS without self-reported CHD, stroke, peripheral vascular disease, and diabetes, 81.7% had a 10-year risk for CHD <10%, 15.5% had a risk of 10% to 20%, and 2.9% had a risk >20%. Among participants age 60 and older, 40.3% of men and 8.2% of women were at "intermediate risk" (10% to 20%). The proportion of participants with a 10-year risk of CHD >20% increased with advancing age and was higher among men than women but varied little with race or ethnicity.[21]
- A study of non-Hispanic white persons ages 35 to 74 in the FHS and the NHANES III studies showed that 26% of men and 41% of women had at least 1 borderline risk factor in NHANES III. It is estimated that more than 90% of CHD events will occur in individuals with at least 1 elevated risk factor and approximately 8% will occur in people with only borderline levels of multiple risk factors. Absolute 10-year CHD risk exceeded 10% in men older than age 45 who had 1 elevated risk factor and 4 or more borderline risk factors and in those who had at least 2 elevated risk factors. In women, absolute CHD risk exceeded 10% only in those over age 55 who had at least 3 elevated risk factors.[22]

- Analysis of data from the Cardiovascular Health Study (NHLBI) among participants age 65 and older at entry into the study showed that subclinical CVD is very prevalent among older individuals, is independently associated with risk of CHD (even over a 10-year follow-up period), and substantially increases the risk of CHD among participants with hypertension or diabetes mellitus.[23]

Awareness of Warning Signs and Risk Factors for Heart Disease

- Surveys conducted by the AHA between 1997 and 2003 showed that awareness of heart disease as the leading cause of death in women rose from 30% in 1997 to 46% in 2003. Awareness in white women (55%) was nearly twice as high as among African-American (30%) and Hispanic (27%) women.[24]
- In 2003, 46% of respondents to a nationally representative telephone survey of women age 25 and older identified heart disease as the leading killer of women, up from 30% in 1997 and 34% in 2000.[24]
- In 1997, a telephone survey of 1000 US households found that only 8% of women respondents identified heart disease as their greatest health concern; fewer than 33% of respondents identified heart disease as the leading cause of death.[25]
- Data from the Women Veteran Cohort, age 35 and older, showed 42% of women were concerned about heart disease. Only 8% to 20% were aware that coronary artery disease is the major cause of death for women.[26]
- Data from the 2001 BRFSS (CDC) survey showed that 95% of respondents recognized chest pain as an MI symptom. However, only 11% correctly classified all symptoms and knew to call 9-1-1 when someone was having an MI. This random digit–dialed telephone survey was conducted in 17 states and the US Virgin Islands.[27]
- A study of public knowledge of CVD risk factors and risk-reduction techniques in 2 New England communities showed that prevention knowledge improved significantly over time in both locations and in every demographic subgroup. Scores were higher for native-born citizens, women, more educated individuals, and English-speaking people. There was an increase in the identification of physical inactivity, high blood cholesterol, and high-fat diet as CVD risk factors, while there was a decrease in the identification of overweight and HBP.[28]
- A 2004 national study of physician awareness and adherence to CVD prevention guidelines showed that fewer than 1 in 5 physicians knew that more women than men die each year from CVD.[29]
- A recent community surveillance study in 4 US communities reported that in 2000, the overall proportion of persons with delays of 4 or more hours from onset of symptoms of acute MI to hospital arrival was 49.5%. The study also reported that from 1987 to 2000 there was no statistically significant change in the proportion of patients delaying 4 or more hours, which indicates that there has been little improvement in the speed at which patients with MI symptoms arrive at the hospital after onset. Although the proportion of MI patients who arrived at the hospital by EMS increased over this period, from 37% in 1987 to 55% in 2000, the total time between onset and hospital arrival did not change appreciably.[30]
- Although age-adjusted prevalence of hypertension is lower among Hispanics than among blacks or non-Hispanic whites, recent data indicate that certain Hispanic subpopulations (Mexican Americans, Puerto Rican Americans, Cuban Americans, and other Hispanic Americans) are characterized by low levels of hypertension awareness, treatment, and control. CDC analysis of death certificate data from 1995 and 2002 indicated that Puerto Rican Americans had consistently higher hypertension-related mortality rates than all other Hispanic subpopulations and non-Hispanic whites.[31]
- Among ever-smokers who had 1 circulatory disorder, 52.1% were current smokers, and among those who reported that they had 3 or more circulatory disorders, 28% were current smokers at the time of the interview. The adjusted odds of being a current smoker were lower for individuals who had ever smoked in life and had 2 or more central circulatory disorders, such as MI, HF, or stroke, than for ever-smokers without a central circulatory disorder.[32]
- A nationally representative study of more than 1000 women showed awareness of CVD as the leading cause of death nearly doubled from 1997 to 2003 (55% versus 30%), was greater for whites than blacks or Hispanics (62% versus 38% and 34% respectively), and was independently correlated with increased PA and weight loss. Fewer than half of respondents were aware of healthy levels of risk factors.[33]
- Using the Healthstyles 2002 survey, about 20% of respondents reported that they had HBP, and 53% of these were taking medications to lower BP. Black men had the highest adjusted prevalence of HBP (32%). Medication use among persons with HBP was lower among Hispanics (45%) than among blacks (54%) and whites (54%). Persons with HBP were 5 times more likely to report having been told to go on a diet or change eating habits and reduce salt or sodium in their diet but 5 times less likely to have received advice to exercise than those reporting not having HBP.[34]
- A study of more than 300 women in Wisconsin showed a need for significant improvement in BP and low-density lipoprotein (LDL) levels. Of the screened participants, 35% were not at BP goal, 32.4% were not at LDL goal, and 53.5% were not at both goals.[35]

Aftermath

- Depending on their gender and clinical outcome, people who survive the acute stage of an MI have a chance of illness and death 1.5 to 15 times higher than that of the general population. The risk of another MI, sudden death, AP, HF, and stroke—for both men and women—is substantial (FHS, NHLBI).[4]
- A Mayo Clinic study found that cardiac rehabilitation after an MI is underused, particularly in women and the elderly. Women were 55% less likely than men to participate in cardiac rehabilitation, and older study patients were less likely than younger participants. Only 32% of men and women age 70 or older participated in cardiac rehabilitation, in comparison to 66% of 60- to 69-year-olds and 81% of those under age 60.[36]
- On the basis of pooled data from the FHS, ARIC, and CHS studies of the NHLBI, within 1 year after a first MI:
  - At age 40 and older, 18% of men and 23% of women will die.
  - At ages 40 to 69, 8% of white men, 12% of white women, 14% of black men, and 11% of black women will die.

- At age 70 and older, 27% of white men, 32% of white women, 26% of black men, and 28% of black women will die.
- In part because women have MIs at older ages than men do, they are more likely to die from MIs within a few weeks.

• Within 5 years after a first MI:

- At age 40 and older, 33% of men and 43% of women will die.
- At ages 40 to 69, 15% of white men, 22% of white women, 27% of black men, and 32% of black women will die.
- At age 70 and older, 50% of white men, 56% of white women, 56% of black men, and 62% of black women will die.

• Of those who have a first MI, the percentage with a recurrent MI or fatal CHD within 5 years is:

- at ages 40 to 69, 16% of men and 22% of women.
- at age 70 and older, 24% of men and 25% of women.
- at ages 40 to 69, 14% of white men, 18% of white women, 27% of black men, and 29% of black women.
- at age 70 and older, 24% of white men and women, 30% of black men, and 32% of black women.

• The percentage of persons with a first MI who will have HF in 5 years is:

- at ages 40 to 69, 7% of men and 12% of women.
- at age 70 and older, 22% of men and 25% of women.
- at ages 40 to 69, 7% of white men, 11% of white women, 11% of black men, and 14% of black women.
- at age 70 and older, 21% of white men, 25% of white women, 29% of black men, and 24% of black women.

• The percentage of persons with a first MI who will have a stroke within 5 years is:

- at ages 40 to 69, 4% of men and 6% of women.
- at age 70 and older, 6% of men and 11% of women.
- at ages 40 to 69, 3% of white men, 5% of white women, 8% of black men, and 9% of black women.
- at age 70 and older, 6% of white men, 10% of white women, 7% of black men, and 17% of black women.

• The percentage of persons with a first MI who will experience sudden death in 5 years is:

- at ages 40 to 69, 1.1% of white men, 1.9% of white women, 2.5% of black men, and 1.4% of black women.
- at age 70 and older, 6.0% of white men, 3.5% of white women, 14.9% of black men, and 4.8% of black women.

• The median survival time (in years) after a first MI is:

- at ages 60 to 69, data not available for men and 7.4 for women.
- at ages 70 to 79, 7.4 for men and 10.4 for women.
- at age 80 and older, 2.0 for men and 6.4 for women.

Hospital Discharges and Ambulatory Care Visits

- From 1979 to 2004, the number of inpatient discharges from short-stay hospitals with CHD as the first-listed diagnosis increased 14% to 1 981 000 (annual issues of the National Hospital Discharge Survey, NCHS; AHA computation).
- From 1990 to 1999, the median duration of hospital stays related to acute MI dropped from 8.3 to 4.3 days, according to an analysis of the National Registry of Myocardial Infarction. Findings were similar both for patients receiving primary percutaneous transluminal coronary angioplasty and for those receiving thrombolytic therapy.[14]
- Data from Ambulatory Care Visits to Physician Offices, Hospital Outpatient Departments, and Emergency Departments: US, 1999–2000, showed the number of visits for CHD as 12.2 million (NAMCS, NHAMCS).[37]

Cost

- The estimated direct and indirect cost of CHD for 2007 is $151.6 billion.
- In 2001, $11.6 billion was paid to Medicare beneficiaries for in-hospital costs where CHD was the principal diagnosis ($11 201 per discharge for acute MI, $11 308 per discharge for coronary atherosclerosis, and $3513 per discharge for other ischemic heart disease).[38]

Operations and Procedures

- In 2004, an estimated 1 285 000 inpatient angioplasty procedures, 427 000 inpatient bypass procedures, 1 471 000 inpatient diagnostic cardiac catheterizations, 68 000 inpatient implantable defibrillators, and 170 000 pacemaker procedures were performed for inpatients in the United States (unpublished data from the NHDS 2004, NCHS; personal communication, May 17, 2006).

Acute Coronary Syndrome

ICD-9 codes 410, 411.

The term “acute coronary syndrome” (ACS) is increasingly used to describe patients who present with either acute MI or unstable angina. (Unstable angina [UA] is chest pain or discomfort that is unexpected and usually occurs while at rest. The discomfort may be more severe and prolonged than typical AP or may be the first time a person has AP.)

- A conservative estimate for the number of discharges with ACS from hospitals in 2004 is 840 000. Of these, an estimated 476 000 are male and 364 000 are female. This estimate is derived by adding the first-listed inpatient hospital discharges for MI (732 000) to those for UA (108 000) (NHDS, NCHS).
- When including secondary discharge diagnoses in 2004, the corresponding numbers of inpatient hospital discharges were 1 565 000 unique hospitalizations for ACS, 896 000 for MI, and 669 000 for UA (21 000 hospitalizations received both diagnoses) (NCHS).

Decisions about medical and interventional treatments are based on specific findings noted when a patient presents with ACS. Such patients are classified clinically into 1 of 3 categories, according to the presence or absence of ST-segment elevation on the presenting electrocardiogram and abnormal (“positive”) elevations of myocardial biomarkers, such as troponins, as follows:

- ST-elevation MI

- non–ST-elevation MI
- unstable angina

According to studies, 21% of ACS patients have ST-elevation MI.[40] These are only preliminary estimates, in part because of dramatically changing practices in the UA discharge diagnosis in the past decade. Factors affecting UA diagnosis include changes in reimbursement policies, the advent of more sensitive assays for myocardial injury (leading to increased diagnosis of MI over UA), and greater care of patients in same-day "chest pain units" and same-day catheterization procedures.

- A study of more than 1300 elderly patients admitted to all intensive cardiovascular care units and cardiology departments in Israel showed that the mean age of women versus men was comparable. Comorbidities were more frequent in women, whereas previous coronary disease and typical anginal pain on admission were more frequent in men. Medical treatment and revascularization procedures during the index hospitalization were comparable. Crude and covariate-adjusted mortality rates were higher in women at 7 days but not at 6 months. This difference was attributed to ST-elevation ACS in women versus men. Seven-day mortality rates were higher in patients with ST-elevation ACS who were denied coronary angiography, especially women.[41]

Angina Pectoris

ICD-9 413; ICD-10 I20. See Table 3-2.

Prevalence

- A study of 4 national cross-sectional health examination studies found that among Americans ages 40 to 74, the age-adjusted prevalence of AP was higher among women than men. Increases in the prevalence of AP occurred for Mexican-American men and women and African-American women but were not statistically significant for the latter.[1]

Incidence

- Only 18% of coronary attacks are preceded by long-standing AP (NHLBI computation of FHS follow-up since 1986).
- The annual rates per 1000 population of new episodes of AP for non-black men are 28.3 for ages 65 to 74, 36.3 for ages 75 to 84, and 33.0 for age 85 and older. For non-black women in the same age groups, the rates are 14.1, 20.0, and 22.9, respectively. For black men, the rates are 22.4, 33.8, and 39.5, and for black women, the rates are 15.3, 23.6, and 35.9, respectively (CHS, NHLBI).[43]
- On the basis of 1987–2001 data from the ARIC study of the NHLBI, the annual rates per 1000 population of new episodes of AP for non-black men are 8.5 for ages 45 to 54, 11.9 for ages 55 to 64, and 13.7 for ages 65 to 74. For non-black women in the same age groups, the rates are 10.6, 11.2, and 13.1, respectively. For black men, the rates are 11.8, 10.6, and 8.8, and for black women, the rates are 20.8, 19.3, and 10.0, respectively.[43]
- In a study conducted in the United Kingdom, the age-standardized annual incidence of AP was 2.03 in men and 1.89 in women per 100 population. The sex ratio was 1.07. Stable AP in women was associated with excess coronary mortality relative to women in a general population, and among groups with diabetes and high nitrate use, the coronary event rates were similar among men and women.[44]

Mortality

A small number of deaths due to CHD are coded as being from AP. These are included as a portion of total deaths from CHD.

Cost

For women with nonobstructive CHD enrolled in the Women's Ischemia Syndrome Evaluation (WISE) study of the NHLBI, the average lifetime cost estimate was about $770 000 and ranged from $1.0 to $1.1 million for women with 1-vessel to 3-vessel CHD.[45]

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TABLE 3-1. Coronary Heart Disease

Population Group	Prevalence CHD 2004 Age 20+	Prevalence MI 2004 Age 20+	New and Recurrent MI and Fatal CHD Age 35+	New and Recurrent MI Age 35+	Mortality CHD 2004 All Ages*	Mortality MI 2004 All Ages*	Hospital Discharges CHD 2004 All Ages	Cost CHD 2007
Both sexes	15 800 000 (7.3%)	7 900 000 (3.7%)	1 200 000	865 000	452 327	157 559	1 981 000	$151.6 billion
Males	8 500 000 (8.9%)	4 900 000 (5.1%)	715 000	520 000	233 271 (51.6%)†	83 080 (52.7%)†	1 180 000	...
Females	7 200 000 (6.1%)	3 000 000 (2.5%)	485 000	345 000	219 056 (48.4%)†	74 479 (47.3%)†	801 000	...
NH white males	9.4%	5.4%	650 000	...	205 472	73 631	...	...
NH white females	6.0%	2.5%	425 000	...	191 505	64 721	...	...
NH black males	7.1%	3.9%	65 000	...	22 861	7797	...	...
NH black females	7.8%	3.3%	60 000	...	23 604	8405	...	...
Mexican-American males	5.6%	3.1%	...	...	...	...	...	...
Mexican-American females	5.3%	2.1%	...	...	...	...	...	...
Hispanic or Latino‡ age 18+	6.0%	...	...	...	...	...	...	...
Asian‡ age 18+	4.2%	...	...	...	...	...	...	...
American Indian/Alaska Native‡ age 18+	7.6%	...	...	...	...	...	...	...

Ellipses (. . .) indicate data not available. CHD includes acute MI (I21, I22), other acute ischemic (coronary) heart disease (I24), AP (I20), atherosclerotic CVD (I25.0), and all other forms of ischemic CHD (I25.1-I25.9).

*Mortality data are for whites and blacks.

†These percentages represent the portion of total CHD mortality that is for males vs females.

‡NHIS (2004)—data are weighted percentages for Americans age 18 and older. Estimates are considered unreliable.

Sources: Prevalence: NHANES (1999–2004, NCHS) and NHLBI. Total data are for Americans age 20 and older; percentages for racial/ethnic groups are age adjusted for age 20 and older. These data are based on self-reports. Estimates from NHANES 1999–2004 applied to 2004 population estimates. Incidence: ARIC (1987–2000), NHLBI. Mortality: NCHS; these data represent underlying cause of death only; mortality data for white and black males and females include Hispanics; data for Mexican Americans are for 2003. Hospital discharges: NHDS; data include those inpatients discharged alive, dead, or status unknown. Cost: NHLBI; data include estimated direct and indirect costs for 2007.

TABLE 3-2. Angina Pectoris

Population Group	Prevalence 2004 Age 20+	Incidence of Stable AP Age 35+	Hospital Discharges 2004* All Ages
Both sexes	8 900 000 (4.1%)	400 000	47 000
Males	4 300 000 (4.4%)	...	23 000
Females	4 600 000 (3.9%)	...	24 000
NH white males	4.8%	...	...
NH white females	3.9%	...	...
NH black males	3.4%	...	...
NH black females	4.3%	...	...
Mexican-American males	2.3%	...	...
Mexican-American females	3.3%	...	...

AP is chest pain or discomfort due to insufficient blood flow to the heart muscle. Stable AP is predictable chest pain on exertion or under mental or emotional stress. The incidence estimate is for AP without MI. Ellipses (. . .) indicate data not available.

*There were 123 000 days of care for discharges with AP from short-stay hospitals in 2002.[46]

Sources: Prevalence: NHANES (1999–2004, NCHS) and NHLBI; percentages for racial/ethnic groups are age adjusted for Americans age 20 and older. The prevalence of AP is based on responses to the Rose angina questionnaire and the question "Have you ever been told of having angina?" Estimates from NHANES 1999–2004 applied to 2004 population estimates. Incidence: FHS, NHLBI. Hospital discharges: NHDS, NCHS; data include those inpatients discharged alive, dead, or status unknown.

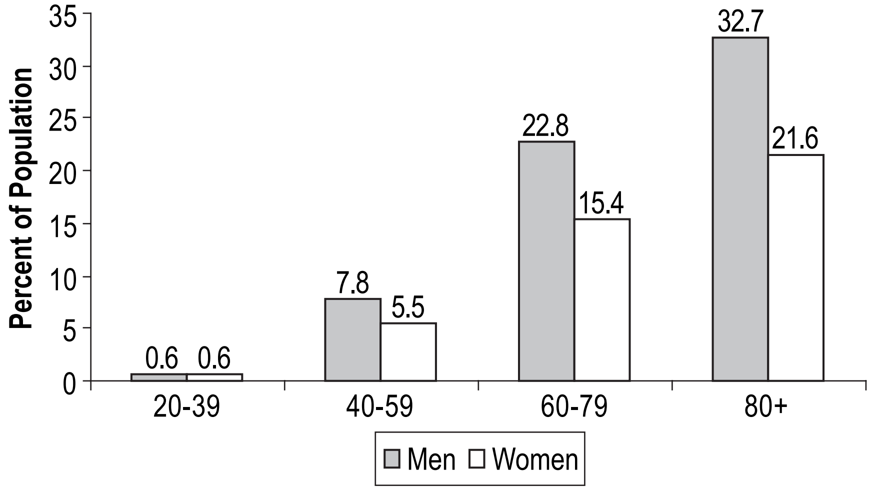


Chart 3-1. Prevalence of CHD by age and sex (NHANES: 1999–2004). Source: NCHS and NHLBI.

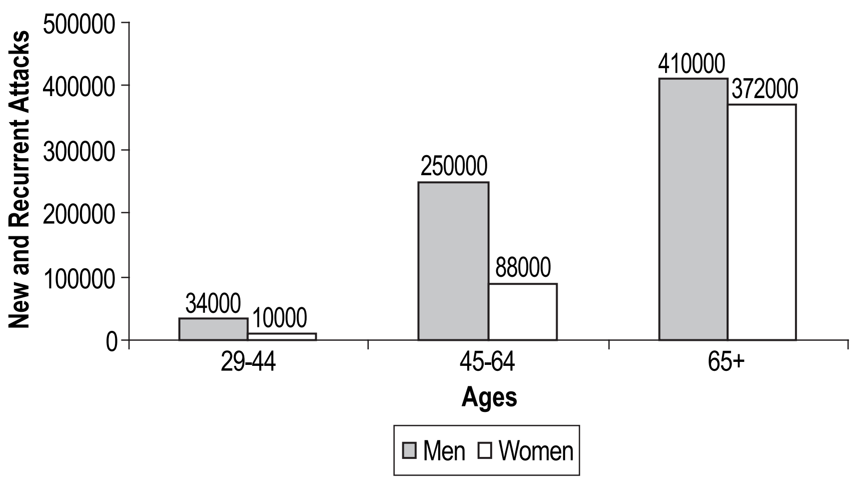


Chart 3-2. Annual number of Americans having diagnosed heart attack by age and sex (ARIC: 1987–2000). Source: Extrapolated from rates in the NHLBI's ARIC surveillance study, 1987–2000; personal communication with NHLBI. Heart attack includes MI and CHD death but not silent MI.

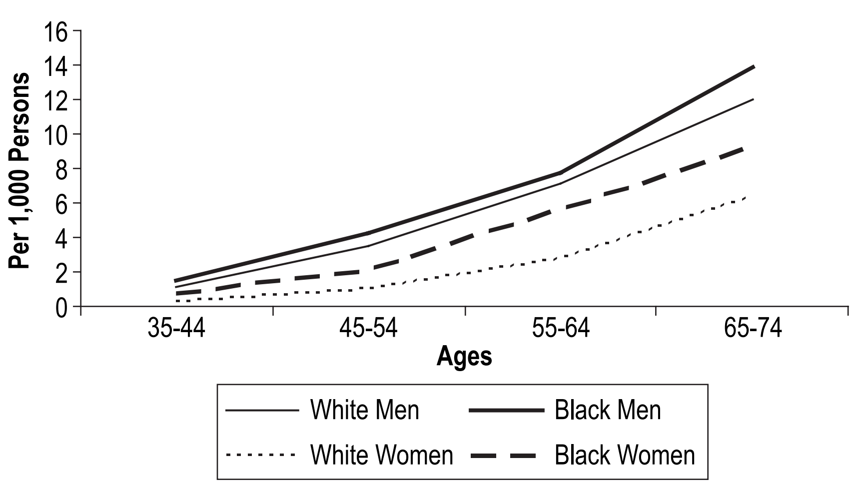


Chart 3-3. Annual rate of first MIs by age, sex, and race (ARIC: 1987–2000). Source: NHLBI's ARIC surveillance study, 1987–2000; personal communication with NHLBI.

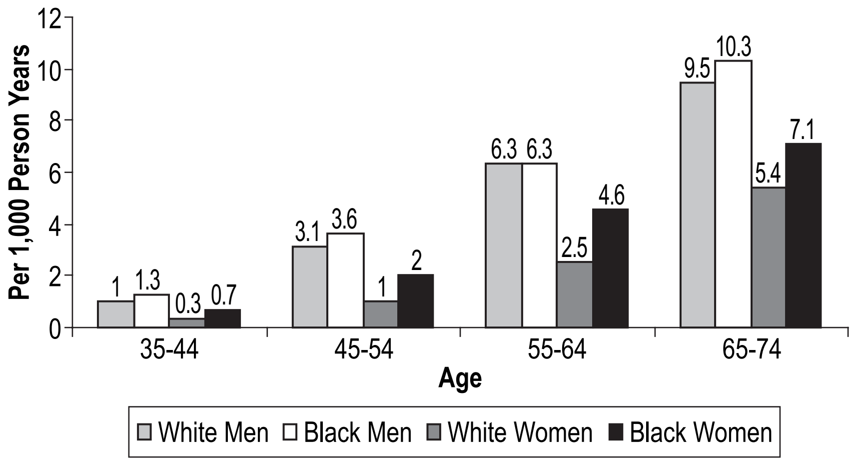


Chart 3-4. Incidence of MI* by age, race, and sex (ARIC Surveillance, 1987–2001). *MI diagnosis by expert committee based on review of hospital records. Source: NHLBI.[43]

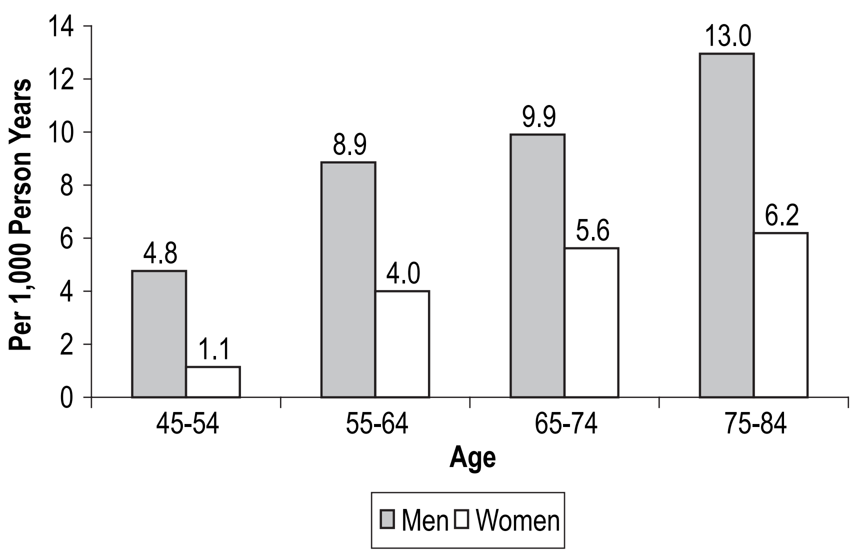
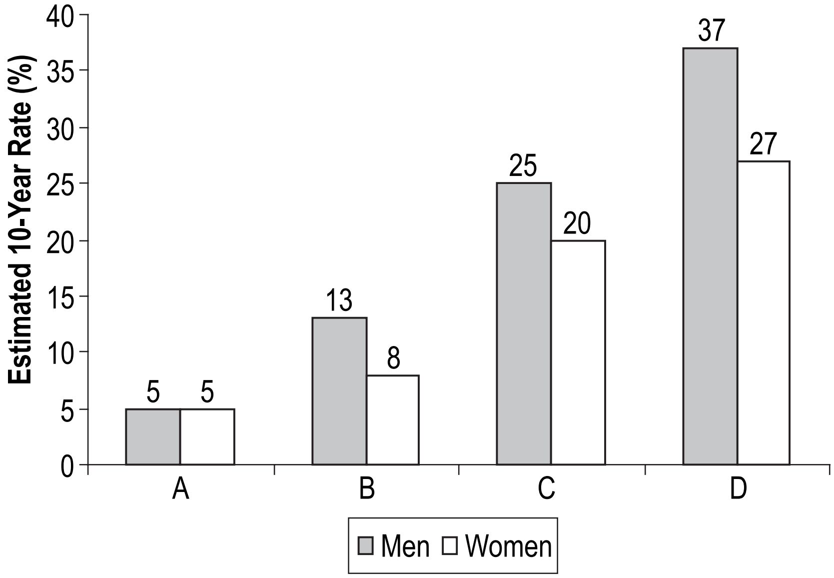


Chart 3-5. Incidence of AP* by age, race, and sex (FHS 1980–2003). *AP based on physician interview of patient. (Rate for women ages 45–54 considered unreliable.) Source: NHLBI.[43]



	A	B	C	D
BP, mm Hg	120/80	140/90	140/90	140/90
Total cholesterol, mg/dL	200	240	240	240
HDL cholesterol, mg/dL	50	50	40	40
Diabetes	No	No	Yes	Yes
Cigarettes	No	No	No	Yes

mm Hg indicates millimeters of Mercury; mg/dL, milligrams per deciliter of blood.

Chart 3-6. Estimated 10-year CHD risk in 55-year-old adults according to levels of various risk factors (Framingham Heart Study). Source: Wilson et al.[47]

4. Stroke

ICD-9 430–438, ICD-10 I60–I69. See Table 4-1[1] and Charts 4-1 through 4-6.

Prevalence

- Among American Indians/Alaska Natives age 18 and older, 5.1% have had a stroke. Among blacks or African Americans the rate was 3.2%, among whites it was 2.5%, and among Asians it was 2.4% (NHIS, NCHS).[2]
- A 2003 BRFSS survey (CDC) showed a higher prevalence of stroke in 10 southeastern states than in 13 non-southeastern states and the District of Columbia. Prevalence was higher in blacks than in whites. The highest age-adjusted prevalence of stroke was found among southeastern blacks, followed by non-southeastern blacks, southeastern whites, and non-southeastern whites.[3]
- The prevalence of silent cerebral infarction between ages 55 and 64 years is about 11%. This prevalence increases to 22% between ages 65 and 69, 28% between ages 70 and 74, 32% between ages 75 and 79, 40% between ages 80 and 85, and 43% above age 85. Applying these rates to 1998 US population estimates results in an estimated 13 million people with prevalent silent stroke.[4,5]
- The prevalence of stroke in American Indian men aged 45 to 74 years ranges from 0.2% to 1.4%. Among American Indian women in the same age group, the prevalence ranges from 0.2% to 0.7%.[6]

Abbreviations Used in Chapter 4

AF	atrial fibrillation
AHA	American Heart Association
ARIC	Atherosclerosis Risk in Communities study
BASIC	Brain Attack Surveillance in Corpus Christi
BMI	body mass index
BP	blood pressure
BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CHS	Cardiovascular Health Study
CVD	cardiovascular disease
FHS	Framingham Heart Study
GCNKSS	Greater Cincinnati/Northern Kentucky Stroke Study
HDL	high-density lipoprotein
HERS	Heart and Estrogen/progestin Replacement Study
HHP	Honolulu Heart Program
ICD	International Classification of Diseases
MI	myocardial infarction
NAMCS	National Ambulatory Medical Care Survey
NASCET	North American Symptomatic Carotid Endarterectomy Trial
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHAMCS	National Hospital Ambulatory Medical Care Survey
NHDS	National Hospital Discharge Survey
NHIS	National Health Interview Survey
NOMAS	Northern Manhattan Study
RR	relative risk
rtPA	recombinant tissue plasminogen activator
SHS	Strong Heart Study
SIPP	Survey of Income and Program Participation
STOP	Stroke Prevention Trial in Sickle Cell Anemia
TIA	transient ischemic attack
WEST	Women's Estrogen for Stroke Trial

Transient Ischemic Attack

- The prevalence of transient ischemic attack (TIA; a ministroke that lasts <24 hours) in men is estimated to be 2.7% for those 65 to 69 years of age and 3.6% for those 75 to 79 years of age. For women, TIA prevalence is estimated to be 1.6% for those 65 to 69 years of age and 4.1% for those 75 to 79 years of age.[7]
- Approximately 15% of all strokes are heralded by a TIA.[8]
- A third of spells characterized as TIAs according to the classic definition (focal neurological deficits resolving within 24 hours), would be considered infarctions on the basis of diffusion-weighted magnetic resonance imaging findings.[9]
- In population-based studies, the age- and gender-adjusted incidence rates for TIA range from 68.2 to 83/100 000. Males and blacks have higher rates of TIA.[10,11]
- Approximately half of patients who experience a TIA fail to report it to their healthcare providers.[12,13]
- After TIA, the 90-day risk of stroke is 3% to 17.3% and is highest within the first 30 days.[10–12,14,15]
- Within a year of TIA, up to a quarter of patients will die.[11,16]
- Individuals who have a TIA have a 10-year stroke risk of 18.8% and a combined 10-year stroke, MI, or vascular death risk of 42.8% (4% per year).[17]
- In the North American Symptomatic Carotid Endarterectomy Trial (NASCET) study, patients with a first-ever hemispheric TIA had a 90-day stroke risk of 20.1%. The risk of stroke after TIA exceeded the risk after hemispheric stroke.[18]

Incidence

- Each year about 700 000 people experience a new or recurrent stroke. About 500 000 of these are first attacks, and 200 000 are recurrent attacks (GCNKSS, FHS, ARIC, NHLBI).
- On average, every 45 seconds someone in the United States has a stroke (AHA computation based on latest available data).
- Each year, about 46 000 more women than men have a stroke (GCNKSS).
- Men's stroke incidence rates are greater than women's at younger ages but not at older ages. The male/female incidence was 1.25 in those 55 to 64 years of age, 1.50 in those 65 to 74 years of age, 1.07 in those 75 to 84 years of age, and 0.76 in those ≥85 years of age (ARIC and CHS studies, NHLBI).[19]

- Blacks have a risk of first-ever stroke that is almost twice that of whites. The age-adjusted stroke incidence rates in those 45 to 84 years of age are 6.6 per 1000 population in black males, 3.6 in white males, 4.9 in black females, and 2.3 in white females (ARIC).[19] On the basis of 1987–2001 data from the ARIC study of the NHLBI, stroke/TIA incidence rates (per 1000 person-years) are 2.4 for white males 45 to 54 years of age, 6.1 for white males 55 to 64 years of age, and 12.2 for white males 65 to 74 years of age. For white women in the same age groups, the rates are 2.4, 4.8, and 9.8 respectively. For black men in the same age groups, the rates are 9.7, 13.1, and 16.2, and for black women the rates are 7.2, 10.0, and 15.0, respectively.[19]
- Of all strokes, 87% are ischemic; intracerebral and subarachnoid hemorrhage strokes account for the remainder (NHLBI: pooled data from ARIC, CHS, and FHS).[19]
- The Brain Attack Surveillance in Corpus Christi project (BASIC) clearly demonstrated an increased incidence of stroke among Mexican Americans as compared with non-Hispanic whites in this community. The crude cumulative incidence was 168/10 000 in Mexican Americans and 136/10 000 in non-Hispanic whites. Specifically, Mexican Americans have an increased incidence of intracerebral hemorrhage and subarachnoid hemorrhage as compared with non-Hispanic whites, adjusted for age, as well as an increased incidence of ischemic stroke and TIA at younger ages when compared with non-Hispanic whites.[20]
- The age-adjusted annual incidence rate (per 1000) for total stroke in Japanese-American men has declined markedly from 5.1 to 2.4; for thromboembolic stroke, from 3.5 to 1.9; and for hemorrhagic stroke, from 1.1 to 0.6. The estimated average annual declines are 5% for total stroke, 3.5% for thromboembolic stroke, and 4.3% for hemorrhagic stroke. The decline in stroke mortality in the Honolulu Heart Program (HHP) target population was similar to that reported for US white males 60 to 69 years of age during the same period (during the 1969–1988 follow-up period of the HHP) (NHLBI).
- Among American Indians 65 to 74 years of age, the annual rates per 1000 population of new and recurrent strokes are 6.1 for men and 6.6 for women (Strong Heart Study [SHS] 1989–2002; NHLBI).
- The age-adjusted incidence of first ischemic stroke per 100 000 was 88 in whites, 191 in blacks, and 149 in Hispanics, according to data from the Northern Manhattan Study (NOMAS). Among blacks, as compared with whites, the relative rate of intracranial atherosclerotic stroke was 5.85; extracranial atherosclerotic stroke, 3.18; lacunar stroke, 3.09; and cardioembolic stroke, 1.58. Among Hispanics, compared with whites, the relative rate of intracranial atherosclerotic stroke was 5.00; extracranial atherosclerotic stroke, 1.71; lacunar stroke, 2.32; and cardioembolic stroke, 1.42.[21]

Mortality

Stroke accounted for about 1 of every 16 deaths in the United States in 2004. About 50% of stroke deaths in 2003 occurred out of hospital. Stroke total-mention mortality in 2002 was about 273 000.[22]

- When considered separately from other CVDs, stroke ranks No. 3 among all causes of death, behind diseases of the heart and cancer (NCHS mortality data).
- On average, every 3 to 4 minutes someone dies of a stroke (NHLBI).
- Among persons 45 to 64 years of age, 8% to 12% of ischemic strokes and 37% to 38% of hemorrhagic strokes result in death within 30 days, according to the ARIC study of the NHLBI.[23]
- In a study of persons ≥65 years of age recruited from a random sample of Health Care Financing Administration Medicare Part B eligibility lists in 4 US communities, the 1-month case fatality was 12.6% for all strokes, 8.1% for ischemic strokes, and 44.6% for hemorrhagic strokes.[24]
- From 1994 to 2004, the stroke death rate fell 20.4%, and the actual number of stroke deaths declined 6.7% (NCHS; NHLBI).
- The 2004 overall death rate for stroke was 50.0. Death rates were 48.1 for white males, 73.9 for black males, 47.4 for white females, and 64.9 for black females.
- In 2003, age-adjusted death rates for stroke were 43.0 for Hispanic or Latino males and 38.1 for females; 48.5 for Asian or Pacific Islander males and 42.6 for females; and 34.9 for American Indian/Alaska Native males and 34.2 for females (Health, United States, 2005, NCHS).
- Because women live longer than men, more women than men die of stroke each year. Women accounted for 61.0% of US stroke deaths in 2004 (AHA computation).
- From 1995 to 1998, age-standardized mortality rates for ischemic stroke, subarachnoid hemorrhage, and intracerebral hemorrhage were higher among blacks than whites. Death rates from intracerebral hemorrhage were also higher among Asians/Pacific Islanders than among whites. All minority populations had higher death rates from subarachnoid hemorrhage than did whites. Among adults 25 to 44 years of age, blacks and American Indians/Alaska Natives had higher risk ratios than did whites for all 3 stroke subtypes.[25]
- In 2002, death certificate data showed that the mean age at stroke death was 79.6 years; however, males had a younger mean age at stroke death than females. Blacks, American Indians/Alaska Natives, and Asians/Pacific Islanders had younger mean ages than whites, and the mean age at stroke death was also younger among Hispanics than non-Hispanics.[3]
- Age-adjusted stroke mortality rates began to level in the 1980s and stabilized in the 1990s for both men and women, according to the Minnesota Heart Study. Women had lower rates of stroke mortality then men did throughout the period. Some of the improvement in stroke mortality may be the result of improved acute stroke care, but most is thought to be the result of improved detection and treatment of hypertension.[27]

Stroke Risk Factors

- TIAs carry a substantial short-term risk of stroke, hospitalization for cardiovascular events, and death. Of 1707 TIA patients evaluated in the emergency department of a large healthcare plan, 180 patients, or 10%, developed stroke within 90 days. Ninety-one patients, or 5%, did so within 2 days. Predictors of stroke included: age >60 years; having diabetes mellitus; focal symptoms of weakness or speech impairment; and TIA lasting longer than 10 minutes.[28]
- The relative risk (RR) of stroke in heavy smokers (more than 40 cigarettes a day) is twice that of light smokers (less than 10 cigarettes per day). Stroke risk decreases significantly 2 years after cessation of cigarette smoking and is at the level of nonsmokers by 5 years.[29]
- AF is an independent risk factor for stroke, increasing risk about 5-fold.[30]
- In adults over 55 years of age, the lifetime risk for stroke is greater than 1 in 6. Women have a higher risk than men, perhaps because of women's survival advantage. BP is a powerful determinant of stroke risk. Subjects with BP less than 120/80 mm Hg have about half the lifetime risk of stroke of subjects with hypertension.[31]
- Ischemic stroke patients with diabetes are younger, more likely to be African American, and more likely to have hypertension, MI, and high cholesterol than are nondiabetic patients, according to data from the GCNKSS study. Age-specific incidence rates and rate ratios show that diabetes increases ischemic stroke incidence at all ages, but this risk is most prominent before age 55 in African Americans and before age 65 in whites. One-year case fatality rates after ischemic stroke are not different between those patients with and without diabetes.[32]
- A study of more than 37 000 women age 45 or older participating in the Women's Health Study suggests that a healthy lifestyle consisting of abstinence from smoking, low BMI, moderate alcohol consumption, regular exercise, and healthy diet were associated with a significantly reduced risk of total and ischemic stroke but not of hemorrhagic stroke.[33]
- From a recent ARIC study of a biracial population 45 to 64 years of age, with an average follow-up of 13.4 years, researchers found that African Americans had a 3-fold higher multivariate-adjusted risk ratio of lacunar stroke compared with whites, while no difference in nonlacunar strokes was found after adjusting for prevalent risk factors between these 2 groups. The top 3 risk factors based on population-attributable fraction for lacunar stroke are hypertension (population-attributable fraction=33.9%), diabetes mellitus (26.3%), and current smoking (22.0%). The top 3 risk factors for nonlacunar stroke are hypertension (35.3%), current smoking (11.4%), and diabetes mellitus (11.3).[34]
- In the Women's Health Initiative trial of estrogen alone, among 10 739 women with hysterectomy, it was found that conjugate equine estrogen alone increased risk of ischemic stroke by 55% and there was no significant effect on hemorrhagic stroke. The excess risk of total stroke conferred by estrogen alone was 12 additional strokes per 10 000 person-years.[35]

Pregnancy as a Risk Factor for Stroke

- The risk of ischemic stroke or intracerebral hemorrhage during pregnancy and the first 6 weeks postpartum was 2.4 times greater than for nonpregnant women of similar age and race, according to the Baltimore–Washington Cooperative Young Stroke Study. The risk of ischemic stroke during pregnancy was not increased during pregnancy per se, but was increased 8.7-fold during the 6 weeks postpartum. Intracerebral hemorrhage showed a small RR of 2.5 during pregnancy but increased dramatically to an RR of 28.3 in the 6 weeks postpartum. The excess risk of stroke (all types except subarachnoid hemorrhage) attributable to the combined pregnant/postpregnant period was 8.1 per 100 000 pregnancies.[36]
- Using Swedish administrative data, it was found that ischemic stroke and intracerebral hemorrhage, including subarachnoid hemorrhage, are increased in association with pregnancy. Compared with the risk of stroke among women who were not pregnant or in early pregnancy (up to the first 27 gestational weeks), women in the peripartum (from 2 days before to 1 day after delivery) and the puerperium (from 2 days before to 6 complete weeks after delivery) periods were at increased risk for all 3 major stroke types. The 3 days surrounding delivery were the time of highest risk.[37]
- Data from the HHP found that in elderly Japanese men 71 to 93 years of age, low concentrations of high-density lipoprotein (HDL) cholesterol were more likely to be associated with a future risk of thromboembolic stroke than were high concentrations.[38]
- In the US Nationwide Inpatient Sample from 2000 to 2001, the rate of events per 100 000 pregnancies was 9.2 for ischemic stroke, 8.5 for intracerebral hemorrhage, 0.6 for cerebral venous thrombosis, and 15.9 for the ill-defined category of pregnancy-related cerebrovascular events, or a total rate of 34.2/100 000, not including subarachnoid hemorrhage. The risk was increased in African Americans and among older women. Death occurred during hospitalization in 4.1% of women with these events and in 22% of survivors after discharge to a facility other than home.[39]

Postmenopause as a Risk Factor for Stroke

- Stroke is a major health issue for women, particularly for postmenopausal women, which raises the questions of whether increased incidence is due to aging or to hormone status and whether hormone therapy affects risk.[40,41]
- Among postmenopausal women who are generally healthy, the Women's Health Initiative primary prevention clinical trial among 16 608 women (95% of whom had no preexisting CVD) found that estrogen plus progestin increased ischemic stroke risk by 44%, with no effect on hemorrhagic stroke. The excess risk was apparent in all age groups, in all categories of baseline stroke risk, and in women with and without hypertension or prior history of CVD.[42]

- In postmenopausal women with known CHD, the Heart and Estrogen/progestin Replacement Study (HERS), a secondary CHD prevention trial, found that a combination of estrogen plus progestin (conjugated equine estrogen [0.625 mg] and medroxyprogesterone acetate [2.5 mg]) hormone therapy did not reduce stroke risk.[43]
- The Women's Estrogen for Stroke Trial (WEST) found that estrogen alone (1 mg of 17B-estradiol) in women with a mean age of 71 years also had no significant overall effect on recurrent stroke or fatality, but there was an increased rate of fatal stroke and an early rise in overall stroke rate in the first 6 months.[44]
- Clinical trial data indicate that estrogen plus progestin, as well as estrogen alone, increase stroke risk in postmenopausal, generally healthy women, and provide no protection for women with established heart disease.[42,45]

Physical Inactivity as a Risk Factor for Stroke

- The association between type of physical activity and stroke risk has been investigated in several studies. In an evaluation of walking and sports participation in a cohort of 73 265 men and women in Japan, risk of stroke death in the highest category of walking and sports participation was reduced by 29% and 20%, respectively.[46] In a study of 47 721 men and women in Finland, the effect of leisure-time, occupational, and commuting physical activity on incident stroke was investigated. Significant trends toward lower risk of stroke were associated with moderate and high levels of leisure-time activity and active commuting, with the strongest trend seen for ischemic stroke; a smaller but still significant benefit to occupational activity was seen.[47] A meta-analysis of reports of 31 observational studies conducted mainly in the United States and Europe found that moderate and high levels of leisure-time and occupational physical activity protected against total stroke, hemorrhagic stroke, and ischemic stroke.[48]
- Physical activity reduces stroke risk. Results from the Physicians' Health Study showed a lower stroke risk associated with vigorous exercise among men (total stroke RR=0.86 for exercise 5 times a week or more).[49] The Harvard Alumni Study showed a decrease in total stroke risk in men who were highly physically active (RR=0.82).[50]
- For women in the Nurses' Health Study, RRs for total stroke from the lowest to the highest physical activity levels were 1.00, 0.98, 0.82, 0.74, and 0.66, respectively.[51]
- The Northern Manhattan Study (NOMAS)—which included whites, blacks, and Hispanics and men and women in an urban setting—showed a decrease in ischemic stroke risk associated with physical activity levels across all racial/ethnic and age groups and for each gender (odds ratio 0.37).[52]
- Physical activity—be it in sports, during leisure time, or at work—was related to reduced risk of ischemic stroke, according to a follow-up of the ARIC cohort.[53]

Awareness of Stroke Warning Signs and Risk Factors

- Data from 2001 from the BRFSS survey in 17 states and the US Virgin Islands showed that public awareness of the major stroke warning signs was high.
  - Sudden numbness or weakness of the face, arm, or leg—94.1%
  - Sudden confusion, trouble speaking, or trouble understanding—87.9%
  - Sudden trouble walking, dizziness, or loss of balance or coordination—85%
  - Sudden trouble seeing in 1 or both eyes—68.1%
  - Sudden severe headache with no known cause—61.3%
  - Of the respondents, 37.8% incorrectly reported sudden chest pain as a sign of stroke.[54]
- A study was conducted of patients admitted to an emergency department with possible stroke to determine their knowledge of the signs, symptoms, and risk factors of stroke. Of the 163 patients able to respond, 39% did not know a single sign or symptom. Patients more than 65 years of age were less likely than those under 65 to know a sign or symptom of stroke (47% versus 28%), and 43% did not know a single risk factor. Overall, almost 40% of patients did not know the signs, symptoms, and risk factors of stroke.[55]
- A study of more than 2100 respondents to a random-digit telephone survey in Cincinnati, Ohio, in 2000, showed that 70% of respondents correctly named at least 1 established stroke warning sign (versus 57% in 1995) and 72% correctly named at least 1 established risk factor (versus 68% in 1995).[56]
- The Heart and Stroke Foundation of Ontario, Canada, conducted a public opinion poll in 4 communities to determine the level of awareness of the warning signs of stroke and to determine the impact of different media strategies. Although television advertising significantly increased the ability to name the warning signs, there was no significant change in communities receiving print advertising.[57]
- Only 17.2% of adults overall correctly classified all stroke symptoms and indicated that they would call 9-1-1 if they thought someone was having a stroke, according to 2001 BRFSS data from more than 61 000 adults.[58]
- In 1995, a telephone survey was conducted in the Greater Cincinnati area. Fifty-seven percent of demographically eligible individuals correctly listed at least 1 of the established stroke warning signs and 68% correctly listed 1 of the established risk factors. Respondents age 75 or older were less likely to correctly list 1 warning sign and to list 1 risk factor.[59]
- Among patients recruited from the Academic Medical Center Consortium, the CHS, and United HealthCare, only 41% were aware of their increased risk for stroke. About 74% recalled being told of their increased stroke risk by a physician, in comparison with 28% who did not recall. Younger patients, depressed patients, those in poor current health, and those with a history of TIA were most likely to be aware of their risk.[60]
- An AHA-sponsored random-digit dialing telephone survey was conducted in mid-2003. Only 26% of women older than age 65 reported being well informed about stroke. Correct identification of the warning signs of stroke was low among all racial/ethnic and age groups.[61]

- Among participants in a study by the National Stroke Association, 2.3% reported having been told by a physician that they had had a TIA. Of those with a TIA, only 64% saw a physician within 24 hours of the event, only 8.2% correctly related the definition of TIA, and 8.6% could identify a typical symptom. Men, nonwhites, and those with lower income and fewer years of education were less likely to be knowledgeable about TIA.[10]
- Participants in the 1999 World Senior Games received 1 or more free screening tests and completed an awareness questionnaire. Results indicate that stroke education should be targeted at the very elderly, those who have less than a college education, and those who do not have a history of chronic disease. It also may be effectively directed toward those with higher cholesterol.[62]
- Insufficient awareness persists in the general medical community with regard to risk factors, warning signs, and prevention strategies for stroke. A survey of 308 internal medicine residency programs showed only 46% required the study of neurology, as compared with 97% for cardiology. Underrepresentation of neurology in internal medicine residency programs may contribute to stroke outcome.[63]
- In 2004, 800 adults age 45 and older were surveyed to assess their perceived risk for stroke and their history of stroke risk factors. Overall, 39% perceived themselves to be at risk. Younger age, current smoking, a history of diabetes, high BP, high cholesterol, heart disease, and stroke/TIA were independently associated with perceived risk for stroke. Respondents with AF were no more likely to report being at risk than were respondents without AF. Perceived risk for stroke increased as the number of risk factors increased. However, 46% with 3 or more risk factors did not perceive themselves to be at risk.[64]
- A study of more than 28 000 residents of Berlin, Germany, showed that 68% were unable to name more than 1 stroke risk factor and 13% named 4 correct risk factors; 82% named mass media as their source of information, followed by family/friends (45%) and general physicians (20%).[65]
- Patients attending an outpatient clinic in Switzerland after stroke were surveyed to analyze their awareness and knowledge of stroke risk factors. Only 13% mentioned 1 or more risk factors as relevant for their stroke. Only one third had visited a specialist, and 27% had not visited their general practitioners at all since their stroke. Awareness was inversely correlated with older age and good recovery. More than half were above BP limits at the time of follow-up. These high values were correlated with poor awareness.[66]
- A study of patients in Sydney, Australia, showed the median delay time from symptom onset to hospital admission was 4.5 hours. Although 41% delayed less than 3 hours, more than 45% delayed more than 6 hours. Independent predictors of delay time included mode of arrival at hospital, with those taking an ambulance having a median delay time of 2.7 hours, versus 15.4 hours for those arriving by private car. Gender also predicted delay, with women delaying longer. Patients who called the emergency services number or were taken to the hospital had the shortest patient delays.[67]
- A telephone survey of adults age 45 and older in 2 Montana counties showed that more than 70% were able to correctly name 2 or more warning signs for stroke. More than 45% were able to name 2 or more risk factors. Respondents 45 to 64 years of age, women, those with 12 or more years of education, and those with high cholesterol were more likely to correctly identify 2 or more warning signs than were those without these characteristics. Women and respondents 45 to 64 years of age were also more likely to correctly identify 2 or more stroke risk factors, as compared with men and older respondents.[68]

Aftermath

- Stroke is a leading cause of serious, long-term disability in the United States (Survey of Income and Program Participation [SIPP]; a survey of the US Bureau of the Census).[69]
- The median time from stroke onset to arrival in an emergency department is between 3 and 6 hours, according to a study of at least 48 unique reports of prehospital delay time for patients with stroke, TIA, or stroke-like symptoms. The study included data from 17 countries, including the United States. Improved clinical outcome at 3 months was seen for patients with acute ischemic stroke when intravenous thrombolytic treatment was started within 3 hours of the onset of symptoms.[70]
- In 1999, more than 1 100 000 American adults reported difficulty with functional limitations, activities of daily living, etc, resulting from stroke (SIPP).[69]
- On the basis of pooled data from the FHS, ARIC, and CHS studies of the NHLBI:
  - The percentages dead 1 year after a first stroke were as follows:
    - at ≥40 years of age, 21% of men and 24% of women.
    - at 40 to 69 years of age: 14% of white men, 20% of white women, 19% of black men, and 19% of black women.
    - at ≥70 years of age: 24% of white men, 27% of white women, 25% of black men, and 22% of black women.
  - The percentages dead within 5 years after a first stroke were as follows:
    - at ≥40 years of age: 47% of men and 51% of women.
    - at 40 to 69 years of age: 32% of white men, 32% of white women, 34% of black men, and 42% of black women.
    - at ≥70 years of age: 58% of white men, 58% of white women, 49% of black men, and 54% of black women.
  - Of those who have a first stroke, the percentages with a recurrent stroke in 5 years are as follows:
    - at 40 to 69 years of age: 13% of men and 22% of women.
    - at ≥70 years of age: 23% of men and 28% of women.
    - at 40 to 69 years of age: 15% of white men, 17% of white women, 10% of black men, and 27% of black women.

  - at ≥70 years of age: 23% of white men, 27% of white women, 16% of black men, and 32% of black women.
- The median survival times (in years) after a first stroke are:
  - at 60 to 69 years of age: 6.8 for men and 7.4 for women.
  - at 70 to 79 years of age: 5.4 for men and 6.4 for women.
  - at ≥80 years of age: 1.8 for men and 3.1 for women.

- The length of time to recover from a stroke depends on its severity. From 50% to 70% of stroke survivors regain functional independence, but 15% to 30% are permanently disabled, and 20% require institutional care at 3 months after onset.[71]
- In the NHLBI's FHS, among ischemic stroke survivors who were at least 65 years of age, these disabilities were observed at 6 months after stroke[72]:
  - 50% had some hemiparesis.
  - 30% were unable to walk without some assistance.
  - 26% were dependent in activities of daily living.
  - 19% had aphasia.
  - 35% had depressive symptoms.
  - 26% were institutionalized in a nursing home.
- Black stroke survivors had greater activity limitations than did white stroke survivors, according to data from the NHIS (2000–2001), as analyzed by the CDC.[73]
- Data from the Paul Coverdell National Acute Stroke Registry showed the majority of stroke admissions were ischemic strokes (52% to 70%), with TIA and intracerebral hemorrhage comprising the bulk of the remainder. Between 19% and 26% of admitted patients were under 60 years of age, and between 52% and 58% were female. Blacks constituted 7% to 31% of admitted patients, depending on state of residence. Between 20% and 25% of admitted patients arrived at the emergency department within 3 hours of onset. Treatment with recombinant tissue plasminogen activator (rtPA) was administered to 3% to 8.5% of those admitted for ischemic stroke. Of those treated with rtPA, fewer than 20% received it within 60 minutes of arrival. Compliance with secondary prevention practices was poorest for smoking cessation counseling and best for antithrombotics.[74]
- Of patients with ischemic stroke in the California Acute Stroke Pilot Registry, 23.5% arrived at the emergency department within 3 hours of symptom onset, and 4.3% received thrombolysis. If all patients had called 9-1-1 immediately, the expected overall rate of thrombolytic treatment within 3 hours would have increased to 28.6%. If all patients with known onset had arrived within 1 hour and had been optimally treated, 57% could have received thrombolytic treatment.[75]
- Patients with a discharge diagnosis of ischemic stroke were identified in 7 California hospitals participating in the California Acute Stroke Pilot Registry. Six points of care were tracked: thrombolysis, receipt of antithrombotic medications within 48 hours, prophylaxis for deep vein thrombosis, smoking cessation counseling, and prescription of lipid-lowering and antithrombotic medications at discharge. Overall, rates of optimal treatment improved for patients treated in year 2 versus year 1, with 63% receiving a perfect score in year 2 versus 44% in year 1. Rates significantly improved in 4 of the 6 hospitals and for 4 of the 6 interventions. A seventh hospital that participated in the registry but did not implement standardized orders showed no improvement in optimal treatment.[76]
- A population-based study performed in a biracial population of 1.3 million in Ohio in 1993 and 1994 showed that 8% of all ischemic stroke patients presented to an emergency department within 3 hours and met other eligibility criteria for rtPA. Even if time were not an exclusion criterion for rtPA, only 29% of all ischemic strokes in the population would have otherwise been eligible for rtPA.[77]

Hospital Discharges/Ambulatory Care Visits

- From 1979 to 2004, the number of inpatient discharges from short-stay hospitals with stroke as the first listed diagnosis increased 21% to 906 000 (NHDS, NCHS, AHA computation).
- From 1988 to 1997, the age-adjusted stroke hospitalization rate increased 18.6% (from 560 to 664 per 100 000), whereas total hospitalizations increased 38.6% (from 592 811 to 821 760). Hospitalization rates did not change for those 35 to 64 years of age but increased for persons age 65 and older. This increase was greater for men than for women. The average length of hospital stay fell from 11.1 to 6.2 days. Total person-days in hospital decreased 22%.[78] (Stroke in this study includes ICD-9 431–434 and 436–438. The AHA uses 430–438.)
- Between 1980 and 1999, hospital discharge rates for stroke increased for blacks and whites; the in-hospital mortality rates decreased for both black and white patients. Generally, the risk of a stroke hospitalization was more than 70% greater for blacks than for whites. Both groups were similar in terms of in-hospital mortality rates.[79] Note: Estimates by race, especially time trends, are affected by the increasing underreporting of race in the NHDS.[80]
- According to data from Ambulatory Care Visits to Physician Offices, Hospital Outpatient Departments, and Emergency Departments: US, 1999 to 2000, the number of visits for stroke was 3.0 million (NAMCS, NHAMCS).[81]

Cost

- The estimated direct and indirect cost of stroke for 2007 is $62.7 billion.
- In 2001, $3.7 billion ($6037 per discharge) was paid to Medicare beneficiaries discharged from short-stay hospitals for stroke.[82]
- The mean lifetime cost of ischemic stroke in the United States is estimated at $140 048. This includes inpatient care, rehabilitation, and follow-up care necessary for lasting deficits. (All numbers were converted to 1999 dollars by using the medical component of the Consumer Price Index.)[83]

- In a population study of stroke costs within 30 days of an acute event, the average cost was $13 019 for mild ischemic strokes and $20 346 for severe ischemic strokes (4 or 5 on the Rankin Disability Scale).[84]
- Inpatient hospital costs for an acute stroke event account for 70% of first-year poststroke costs.[83]
- The largest components of acute-care costs were room charges (50%), medical management (21%), and diagnostic costs (19%).[85]
- Death within 7 days, subarachnoid hemorrhage, and stroke while hospitalized for another condition are associated with higher costs in the first year. Conversely, lower costs are associated with mild cerebral infarctions or residence in a nursing home before the stroke.[84]
- Demographic variables (age, sex, and insurance status) are not associated with stroke cost. Severe strokes (NIHSS score greater than 20) cost twice as much as mild strokes, despite similar diagnostic testing. Comorbidities such as ischemic heart disease and AF predict higher costs.[85,86]

Operations and Procedures

In 2004, an estimated 98 000 inpatient endarterectomy procedures were performed in the United States. Carotid endarterectomy is the most frequently performed surgical procedure to prevent stroke (NHDS).

Stroke in Children

- Stroke in children peaks in the perinatal period. In the NHDS from 1980 to 1998, the rate of stroke for infants less than 30 days old (per 100 000 live births per year) was 26.4, with rates of 6.7 for hemorrhagic stroke and 17.8 for ischemic stroke.[87]
- A history of infertility, preeclampsia, prolonged rupture of membranes, and chorioamnionitis were found to be independent risk factors for radiologically confirmed perinatal arterial ischemic stroke in the Kaiser Permanente Medical Care Program. The risk of perinatal stroke increased approximately 25-fold, with an absolute risk of 1 per 200 deliveries when 3 or more of the following antenatally determined risk factors were present: infertility, preeclampsia, chorioamnionitis, prolonged rupture of membranes, primiparity, oligohydramnios, decreased fetal movement, prolonged second stage of labor, and fetal heart rate abnormalities.[88]
- The GCNKSS found the stroke rate per 100 000 for children 1 to 14 years of age was 2.7. The rates of ischemic stroke and intracerebral hemorrhage are similar in this age group.[89,90]
- Stroke in childhood and young adulthood has a disproportionate impact on the affected patients, their families, and society, as compared with stroke at older ages. Outcome of childhood stroke was a moderate or severe deficit in 42% of cases.[91]
- Compared with the stroke risk of white children, black children have a higher RR of 2.12, Hispanics have a lower RR of 0.76, and Asians have a similar risk. Boys have a 1.28-fold higher risk of stroke than girls. There are no ethnic differences in stroke severity or case-fatality, but boys have a higher case-fatality rate for ischemic stroke. The increased risk among blacks is not fully explained by the presence of sickle cell disease, nor is the excess risk among boys fully explained by trauma.[92]
- Despite current treatment, 1 of 10 children with ischemic stroke will have a recurrence within 5 years.[93]
- Cerebrovascular disorders are among the top 10 causes of death in children, with rates highest in the first year of life. Stroke mortality in children under 1 year of age has remained the same over the past 40 years.[87]
- From 1979 to 1998 in the United States, childhood mortality from stroke declined by 58% overall, with reductions in all major subtypes.[94]
  - Ischemic stroke decreased by 19%, subarachnoid hemorrhage by 79%, and intracerebral hemorrhage by 54%.
  - Black ethnicity was a risk factor for death from all stroke types.
  - Male sex was a risk factor for death from subarachnoid hemorrhage and intracerebral hemorrhage, but not from ischemic stroke.
- Sickle cell disease is the most important cause of ischemic stroke among African-American children. The Stroke Prevention Trial in Sickle Cell Anemia (STOP) demonstrated the efficacy of blood transfusions for primary stroke prevention in high-risk children with sickle cell disease in 1998. First-admission rates for stroke in California among persons under age 20 with sickle cell disease showed a dramatic decline subsequent to the publication of the STOP study. For the study years 1991 to 1998, 93 children with sickle cell disease were admitted to California hospitals with a first stroke; 92.5% were ischemic, and 7.5% were hemorrhagic. The first-stroke rate was 0.88 per 100 person-years during 1991 to 1998, compared with 0.50 in 1999 and 0.17 in 2000 ($P<0.005$ for trend).[95]

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TABLE 4-1. Stroke

Population Group	Prevalence 2004 Age 20+	New and Recurrent Attacks All Ages	Mortality 2004*	Hospital Discharges 2004 All Ages	Cost 2007
Both sexes	5 700 000 (2.6%)	700 000	150 147	906 000	$62.7 billion
Males	2 400 000 (2.6%)	327 000 (47%)†	58 660 (39.1%)†	416 000	...
Females	3 300 000 (2.8%)	373 000 (53%)†	91 487 (60.9%)†	490 000	...
NH white males	2.4%	277 000	49 258	...	...
NH white females	2.7%	312 000	78 845	...	...
NH black males	4.1%	50 000	7555	...	...
NH black females	4.1%	61 000	10 373	...	...
Mexican-American males	3.1%	...	...	...	...
Mexican-American females	1.9%	...	...	...	...
Hispanic or Latino‡ age 18+	2.8%	...	...	...	...
Asian‡ age 18+	2.4%	...	...	...	...
American Indian/Alaska Native‡ age 18+	5.1%§	...	...	...	...

Ellipses (...) indicate data not available.

*Mortality data are for whites and blacks.

†These percentages represent the portion of total stroke incidence or mortality that is for males vs females.

‡NHIS (2004)—data are weighted percentages for Americans age 18 and older.

§Estimates are considered unreliable.

Sources: Prevalence (total, males, females, whites, blacks, Mexican Americans) is based on NHLBI computations of NHANES 1999–2004 (age 20 and older). Rates are extrapolated to the US population, 2004. Prevalence in the Hispanic, Asian, and American Indian/Alaska Native populations, age 18 and older, is from NHIS.[2] Incidence: GCNKSS data compiled by NHLBI. See also Kissela et al.[1] Data include children. Mortality: NCHS. These data represent underlying cause of death only. Mortality data for white and black males and females include Hispanics; data for Mexican Americans are for 2003. Hospital discharges: NHDS, NCHS data include those inpatients discharged alive, dead, or status unknown. Cost: NHLBI. Data include estimated direct and indirect costs for 2007.

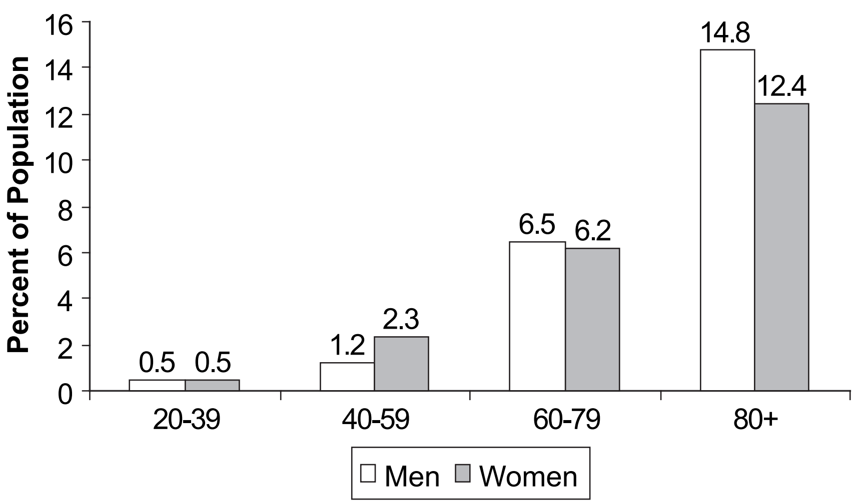


Chart 4-1. Prevalence of stroke by age and sex (NHANES: 1999–2004). Source: NCHS and personal communication with NHLBI.

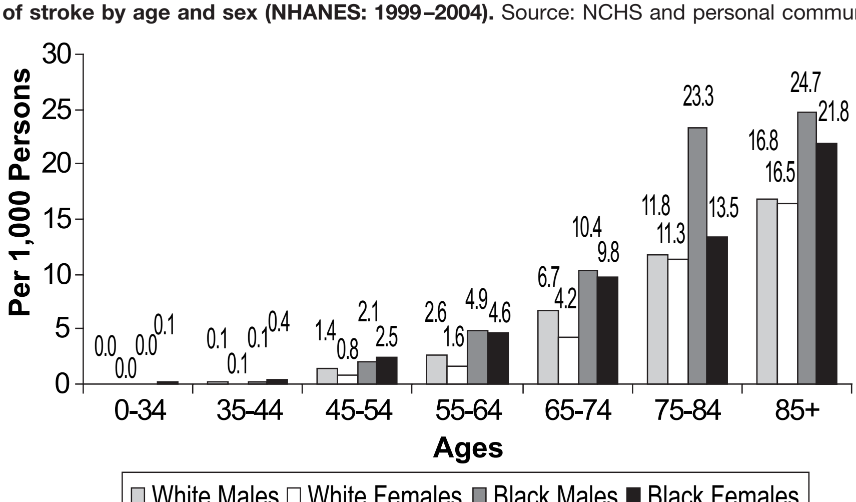


Chart 4-2. Annual rate of first cerebral infarction by age, sex, and race (GCNKSS: 1993–1994). Source: Kissela et al.[1]

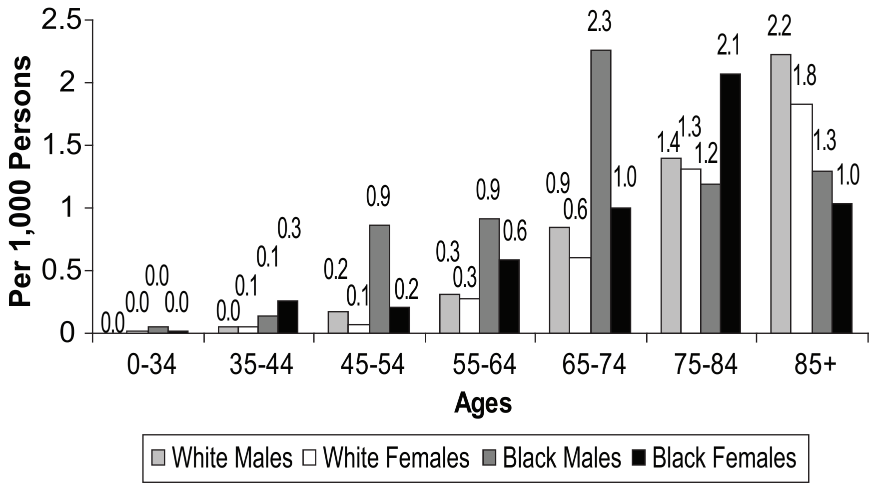
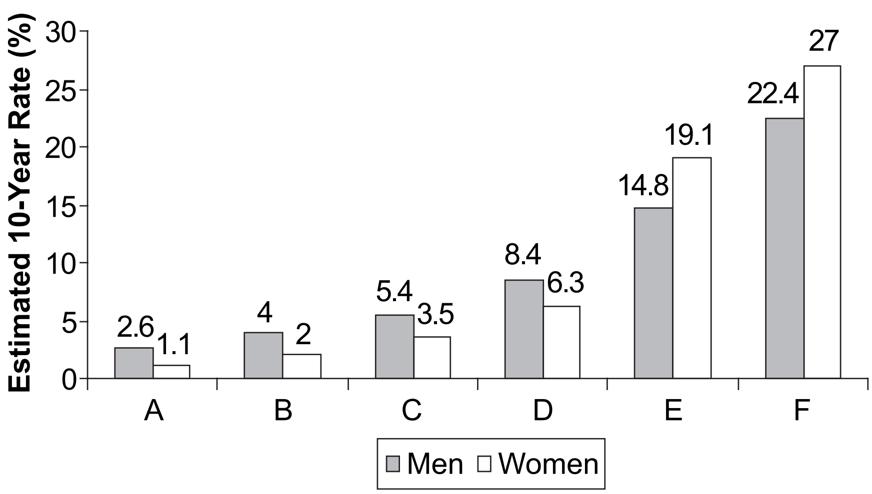


Chart 4-3. Annual rate of first intracerebral hemorrhage by age, sex, and race (GCNKSS: 1993–1994). Source: Kissela et al.[1]



	A	B	C	D	E	F
Systolic BP*	95–105	130–148	130–148	130–148	130–148	130–148
Diabetes	No	No	No	No	No	No
Cigarettes	No	No	No	Yes	Yes	Yes
Prior AF	No	No	No	No	Yes	Yes
Prior CVD	No	No	No	No	No	Yes

*BPs are provided in millimeters of Mercury (mm Hg).

Chart 4-4. Estimated 10-year stroke risk in 55-year-old adults according to levels of various risk factors (FHS). Source: Wolf et al.[96]

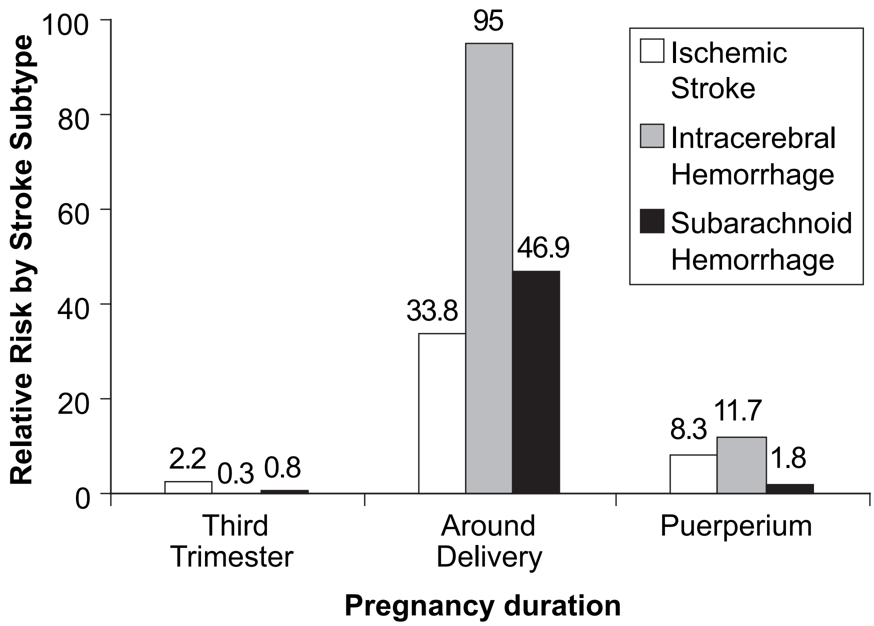


Chart 4-5. Risk of stroke in women in the third trimester and peri- and postpartum periods versus risk of nonpregnant women and women in the first 2 trimesters. Source: Salonen et al.[37]

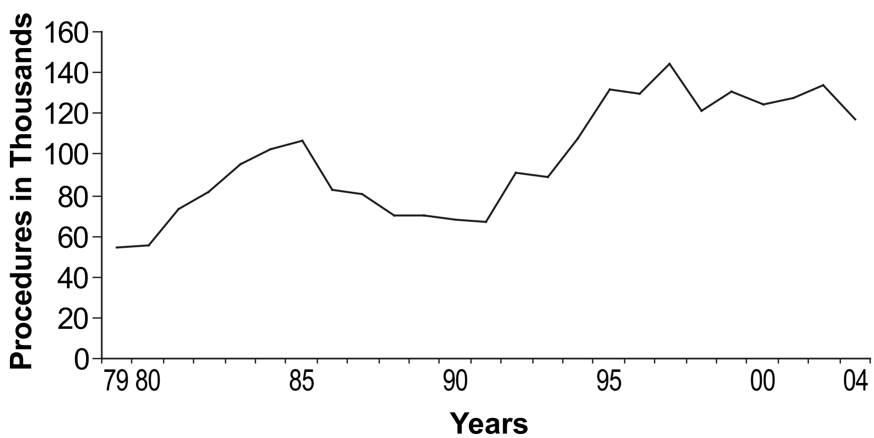


Chart 4-6. Trends in carotid endarterectomy procedures (United States: 1979–2004). Source: NCHS and personal communication with NHLBI.

5. High Blood Pressure

ICD-9 401–404, ICD-10 I10–I15. See Table 5-1 and Charts 5-1 through 5-4.

Prevalence

- HBP is defined as:
  - systolic BP of 140 mm Hg or higher or diastolic BP of 90 mm Hg or higher or taking antihypertensive medicine
  - or having been told at least twice by a physician or other health professional that one has HBP.
- Nearly 1 in 3 US adults has HBP.[1]
- In a study conducted in 1999–2000, 39% of persons were normotensive, 31% were prehypertensive, and 29% were hypertensive. The age-adjusted prevalence of prehypertension was greater in men (39%) than in women (23.1%). African Americans between the ages of 20 and 39 years had a higher prevalence of prehypertension (37.4%) than did whites (32.2%) and Mexican Americans (30.9%), but prevalence of prehypertension in African Americans was lower at older ages because of a higher prevalence of hypertension.[2]
- A higher percentage of men than women have HBP until age 45. From age 45 to age 54, the percentages of men and women with HBP are similar. After that, a much higher percentage of women have HBP than do men.[3]
- HBP is 2 to 3 times more common in women taking oral contraceptives, especially in obese and older women, than in women not taking them.[4]

Abbreviations Used in Chapter 5

AA	African American
ARIC	Atherosclerosis Risk in Communities study
BP	blood pressure
BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CHF	congestive heart failure
CHS	Cardiovascular Health Study
CVD	cardiovascular disease
FHS	Framingham Heart Study
HBP	high blood pressure
ICD	International Classification of Diseases
JNC	Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHDS	National Hospital Discharge Survey
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute
NINDS	National Institute of Neurological Disorders and Stroke
REGARDS	Reasons for Geographic and Racial Differences in Stroke
RR	relative risk

- Data from the BRFSS study of the CDC showed that in 2005, 25.5% of respondents had been told they had HBP (http://apps.nccd.cdc.gov/brfss/index.asp).

Race/Ethnicity and HBP

- The prevalence of hypertension in blacks in the United States is among the highest in the world, and it is increasing. From 1988–1994 to 1999–2002, the prevalence of HBP in adults increased from 35.8% to 41.4% among blacks, and it was particularly high among black women, at 44.0%. Prevalence among whites also increased, from 24.3% to 28.1%.[5]
- Compared with whites, blacks develop HBP earlier in life and their average BPs are much higher. As a result, compared with whites, blacks have a 1.3-times greater rate of nonfatal stroke, a 1.8-times greater rate of fatal stroke, a 1.5-times greater rate of heart disease death, and a 4.2-times greater rate of end-stage kidney disease (Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure [JNC] 5 and 6).
- Within the African-American community, rates of hypertension vary substantially.[5,6]
  - Those with the highest rates are more likely to be middle aged or older, less educated, overweight or obese, and physically inactive and are more likely to have diabetes.
  - Those with the lowest rates are more likely to be younger but also overweight or obese.
  - Those with uncontrolled HBP who are not on antihypertensive medication tend to be male, younger, and have infrequent contact with a physician.
- Compared with white women, black women have an 85% higher rate of ambulatory medical care visits for HBP.[7]
- Analysis from the REGARDS study (REasons for Geographic and Racial Differences in Stroke) of the NINDS suggests that efforts to raise awareness of prevalent hypertension among African Americans have apparently been successful (31% greater odds in African Americans relative to whites), and efforts to communicate the importance of receiving treatment for hypertension have been successful (69% greater odds among African Americans relative to whites); however, substantial racial disparities remain in the control of BP (systolic BP $<$140 mm Hg, diastolic BP $<$90 mm Hg) with the odds of control 27% lower in African Americans relative to whites. In contrast, geographic disparities in hypertension awareness, treatment, and control were minimal.[8]
- A study from 1988–1994 to 1999–2000 of children and adolescents 8 to 17 years of age showed that among non-Hispanic blacks, mean systolic BP levels increased 1.6 mm Hg among girls and 2.9 mm Hg among boys when compared with non-Hispanic whites. Among Mexican Americans, girls' systolic BP increased 1.0 mm Hg and boys' increased 2.7 mm Hg when compared with non-Hispanic whites.[9]
- Data from the 1999–2003 NHIS survey showed that American Indian/Alaska Native adults age 18 and older

were less likely (29.7%) than black adults (33.9%) and more likely than white adults (22.8%) and Asian adults (19.3%) to ever have been told they had hypertension.[10]

- The prevalence of HBP among blacks and whites in the southeastern United States is greater and death rates from stroke are higher than among those in other regions (JNC 5 and 6).
- Certain Hispanic subpopulations are characterized by low levels of hypertension awareness, treatment, and control. The CDC analyzed death certificate data from 1995 and 2002. The results indicated that Puerto Rican Americans had consistently higher hypertension-related mortality than all other Hispanic subpopulations and non-Hispanic whites. The age-standardized hypertension-related mortality rate was 127.2 per 100 000 population for all Hispanics, similar to that of non-Hispanic whites (135.9). The age-standardized rate for Hispanic women (118.3) was substantially lower than that observed for Hispanic men (135.9). Male hypertension-related mortality rates were higher than female rates for all Hispanic subpopulations. Puerto Rican Americans had the highest hypertension-related death rate among all Hispanic subpopulations (154.0), and Cuban Americans had the lowest (82.5).[11]
- Some studies suggest that Hispanic Americans have rates of HBP similar to or lower than non-Hispanic white Americans. Findings from a new analysis of combined data from the NHIS surveys of 2000–2002 point to a health disparity between black and white adults of Hispanic descent. Black Hispanics were at slightly greater risk than white Hispanics, although non-Hispanic black adults had by far the highest rate of HBP. The racial disparity among Hispanics was also evident in the fact that higher-income, better-educated black Hispanics still had a higher rate of HBP than lower-income, less-educated white Hispanics.[12]

Mortality

HBP total-mention mortality in 2002 was about 277 000.

- From 1994 to 2004, the age-adjusted death rate from HBP increased 25.2%, and the actual number of deaths rose 54.6% (NCHS and NHLBI).
- The 2004 overall death rate from HBP was 17.9. Death rates were 15.6 for white males, 49.9 for black males, 14.3 for white females, and 40.6 for black females (NCHS mortality data and NHLBI.)

Aftermath

- About 69% of people who have a first heart attack, 77% who have a first stroke, and 74% who have CHF have BP higher than 140/90 mm Hg (NHLBI unpublished estimates from ARIC, CHS, and FHS Cohort and Offspring Studies).
- People with systolic BP of 160 mm Hg or higher and/or diastolic BP of 95 mm Hg or higher have a RR for stroke about 4 times greater than that of those with normal BP.[13]
- Hypertension precedes the development of CHF in 91% of cases. HBP is associated with a 2 to 3 times higher risk for developing CHF (FHS, NHLBI, Levy et al[14]).
- Data from FHS indicate that recent (within the past 10 years) and remote antecedent BP levels may be an important determinant of risk over and above current BP level.[15]
- Data from the FHS indicate that hypertension is associated with shorter overall life expectancy as well as shorter life expectancy free of CVD and more years lived with CVD.[16]
  - Total life expectancy was 5.1 years longer for normotensive men and 4.9 years longer for normotensive women compared with hypertensives of the same sex at age 50.
  - Compared with hypertensive men at age 50, men with untreated BP $<$140/90 mm Hg survived on average 7.2 years longer without CVD and spent 2.1 fewer years of life with CVD. Similar results were observed for women.

Hospital Discharge/Ambulatory Care Visits

- Data from Ambulatory Care Visits to Physician Offices, Hospital Outpatient Departments, and Emergency Departments: US, 2001–2002, showed the number of visits for essential hypertension was 45.3 million.[17]

Awareness and Control

- Data from NHANES 1999–2004 showed that of those with hypertension age 18 and older, 71.8% were aware of their condition, 61.4% were under current treatment, 35.1% had it under control, and 64.9% did not have it controlled (NCHS and NHLBI).
- Data from the 2005 BRFSS survey indicate that overall, 25.5% of adults age 18 and older had been told that they have HBP. The highest percentage was in Mississippi (33.3%), and the lowest was in Utah (18.4%) (www.cdc.gov/brfss/).
- In NHANES 1999–2000, rates of control were lower in Mexican Americans (17.7%) than in non-Hispanic whites (33.4%) and non-Hispanic blacks (28.1%).[18]
- The awareness, treatment, and control of HBP among those in the CHS age 65 years and older improved during the 1990s. The percentages of those aware of and treated for HBP were higher among blacks than among whites. Prevalences with HBP under control were similar. For both groups combined, the control of BP to lower than 140/90 mm Hg increased from 37% in 1990 to 49% in 1999. Improved control was achieved by an increase in antihypertensive medications per person and by an increase in the proportion of the CHS population treated for hypertension from 34.5% to 51.1%.[19]
- Data from the FHS study of the NHLBI show that:
  - among those age 80 and older, only 38% of men and 23% of women had BPs that met targets set forth in the National High Blood Pressure Education Program's clinical guidelines. Control rates in men less than 60, 60 to 79, and 80 or more years of age were 38%, 36%, and 38%, respectively, and for women in the same age groups they were 38%, 28%, and 23%, respectively.[20]
- Data from the Women's Health Initiative Study of nearly 100 000 postmenopausal women across the country, enrolled between 1994 and 1998, indicate that although

prevalence rates ranged from 27% of women between ages 50 and 59 to 41% of women between ages 60 and 69 and 53% of women between ages 70 and 79, treatment rates were similar across age groups, being 64%, 65%, and 63%, respectively. In spite of similar treatment rates, hypertension control is especially poor in older women, with only 29% of hypertensive women 70 to 79 years of age having clinic BPs <140/90, compared with 41% and 37% of those 50 to 59 and 60 to 69 years old, respectively.[21]

Cost

- The estimated direct and indirect cost of HBP for 2007 is $66.4 billion.

Prehypertension

- "Prehypertension" is untreated systolic BP of 120 to 139 mm Hg or untreated diastolic BP of 80 to 89 mm Hg and not having been told on 2 occasions by a doctor or other health professional that one has hypertension.
- It is estimated that 37.4% of the US population 20 years of age and older has prehypertension, including 41 900 000 million men and 27 800 000 women.[22]
- Follow-up of 9845 men and women in the FHS who attended examinations from 1978 to 1994 revealed that, at 35 to 64 years of age, the 4-year incidence of hypertension was 5.3% for those with baseline BP <120/80 mm Hg, 17.6% for those with systolic BP 120 to 129 or diastolic BP 80 to 84 mm Hg, and 37.3% for those with systolic BP 130 to 139 or diastolic BP 85 to 89 mm Hg. At 65 to 94 years of age, the 4-year incidences of hypertension were 16.0%, 25.5%, and 49.5% for these BP categories, respectively.[23]
- Data from FHS also reveal that prehypertension is associated with elevated relative and absolute risks for CVD outcomes across the age spectrum. Compared with normal BP (<120/80 mm Hg), prehypertension was associated with a 1.5- to 2-fold risk for major CVD events in those less than 60, between 60 and 79, and 80 or more years of age. Absolute risks for major CVD associated with prehypertension increased markedly with age: Six-year event rates for major CVD were 1.5% in prehypertensives less than 60 years of age, 4.9% in those between the ages of 60 to 79, and 19.8% in those age 80 or older.[20]

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TABLE 5-1. High Blood Pressure

Population Group	Prevalence 2004 Age 20+	Mortality 2004* All Ages	Hospital Discharges 2004 All Ages	Cost 2007
Both sexes	72 000 000 (33.6%)	54 186	551 000	$66.4 billion
Males	33 000 000 (33.2%)	22 795 (42.1%)†	230 000	...
Females	39 000 000 (33.6%)	31 392 (57.9%)†	322 000	...
NH white males	32.5%	16 547	...	...
NH white females	31.9%	24 066	...	...
NH black males	42.6%	5602	...	...
NH black females	46.6%	6592	...	...
Mexican-American males	28.7%	...	...	...
Mexican-American females	31.4%	...	...	...
Hispanic or Latino‡ age 18+	19.0%	...	...	...
Asian‡ age 18+	16.1%	...	...	...
American Indians/Alaska Natives‡ age 18+	23.9%	...	...	...

Ellipses (...) indicate data not available.

*Mortality data are for whites and blacks.

†These percentages represent the portion of total HBP mortality that is for males vs females.

‡NHIS (2003), NCHS; data are weighted percentages for Americans age 18 and older. Mortality: NCHS. These data represent underlying cause of death only. Data for white and black males and females include Hispanics; data for Mexican Americans are for 2003. Hospital discharges: NHDS; data include those discharged alive, dead, or status unknown. Cost: NHLBI; data include estimated direct and indirect costs for 2007.

Sources: Hypertension is defined as systolic BP of 140 mm Hg or higher or diastolic BP of 90 mm Hg or higher, or taking antihypertensive medication, or being told twice by a physician or other professional that one has hypertension. That is the definition used for all age-adjusted prevalence percentages in this table and for the extrapolation of age- and sex-specific prevalence in NHANES 1999–2004 (NCHS) to the 2004 US population, resulting in the estimate of 72 million. The NHLBI computed the numbers and rates on the basis of NHANES 1999–2004. The total estimate is 7 million persons higher than the estimated 65 million in the 2006 Statistical Update. The definition of hypertension was the same, but the 65 million had been estimated by using the 1999–2000 NHANES data applied to the population of the average for those years, as reported in Fields et al.[1] The larger estimate for 2007 is due to population increase and aging between 1999–2000 and 1999–2004 and higher prevalence percentages in some age groups in NHANES 1999–2004 than NHANES 1999–2000. The NHANES exams and questionnaires enable the estimation of the prevalence of hypertension with this more complete definition. Many studies, however, define hypertension as BP of ≥140/90 mm Hg or taking antihypertensive medication. Under that definition, extrapolation of NHANES 1999–2004 data to the US population in 2004 gives an estimated prevalence of 63.4 million. That is 29.9% of the population age 20 and older, as compared with 33.8% according to the more complete definition—a difference of 8 300 000 persons and almost another 4% of the population.

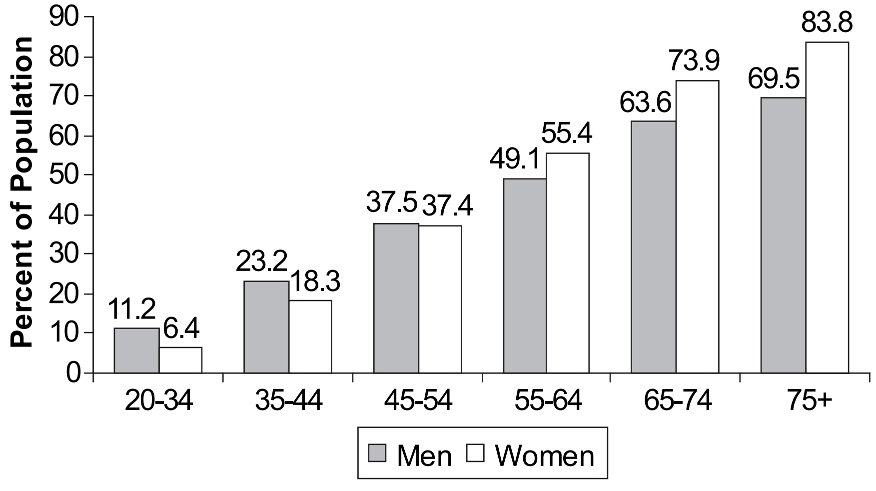

Chart 5-1. Prevalence of HBP in adults age 20 and older by age and sex (NHANES: 1999–2004). Source: NCHS and NHLBI.

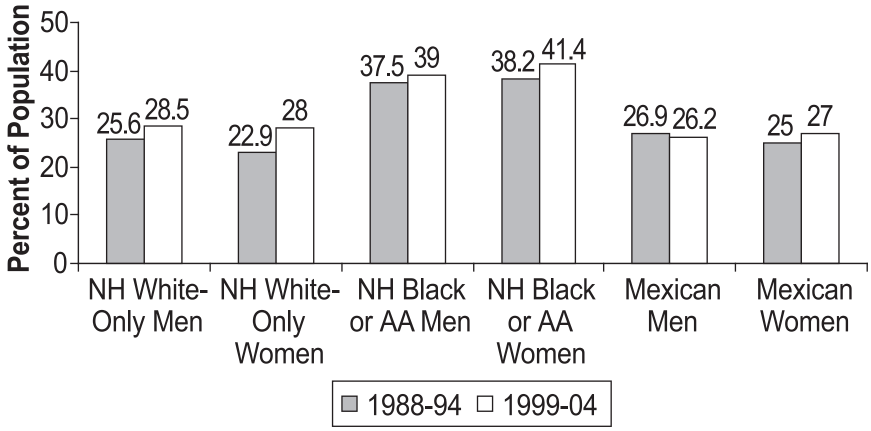

Chart 5-2. Age-adjusted prevalence trends for HBP in adults age 20 and older by race/ethnicity, sex, and survey (NHANES: 1988–1994 and 1999–2004). Source: NCHS and NHLBI. NH indicates non-Hispanic; AA, African American.[3]

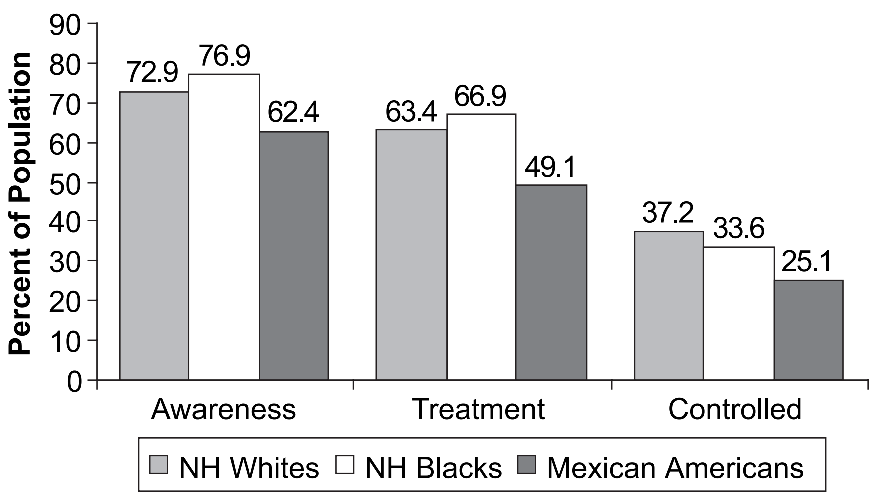

Chart 5-3. Extent of awareness, treatment, and control of HBP by race/ethnicity (NHANES: 1999–2004). Source: NCHS and NHLBI.

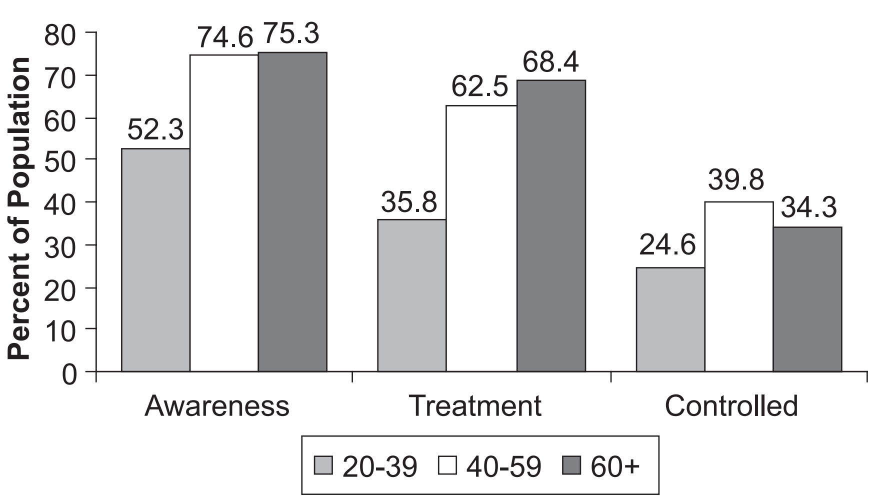

Chart 5-4. Extent of awareness, treatment, and control of HBP by age (NHANES: 1999–2004). Source: NCHS and NHLBI.

6. Congenital Cardiovascular Defects

ICD-9 745–747, ICD-10 Q20–Q28. See Tables 6-1 through 6-5.

Congenital cardiovascular defects, also known as congenital heart defects, are structural problems arising from abnormal formation of the heart or major blood vessels. At least 15 distinct types of congenital defects are recognized, with many additional anatomic variations.

Defects range in severity from tiny pinholes between chambers that are nearly irrelevant and often resolve spontaneously to major malformations that result in fetal loss or death in infancy or childhood. The common complex defects include:

- tetralogy of Fallot (9% to 14%)
- transposition of the great arteries (10% to 11%)
- atrioventricular septal defects (4% to 10%)
- coarctation of the aorta (8% to 11%)
- hypoplastic left heart syndrome (4% to 8%)
- ventricular septal defects (VSDs), the most common defect. Many close spontaneously, but VSDs still account for 14% to 16% of defects requiring an invasive procedure within the first year of life.[1]

Prevalence

As of 2002, the prevalence of congenital cardiovascular defects in the United States was estimated to range from 650 000 to 1.3 million.[2] Almost as many people with congenital cardiovascular defects are under age 25 years as over that age, but the proportions differ among disease types. Using available data to estimate the expected numbers of infants with each type of congenital cardiovascular defect at birth, the authors estimate their survival to 2002 assuming no treatment (the low estimate) and full treatment (the high estimate) of prevalence. Of the 1.3 million, 750 000 are simple lesions, 400 000 are moderate, and 180 000 are complex. There are an estimated 3 million more people with bicuspid aortic valve: 2 million adults and 1 million children. On the basis of the tabulations in Hoffman et al,[2] prevalence was calculated by type of lesion excluding bicuspid aortic valve (Table 6-3). We assumed that prevalence is two thirds of the way between the estimated high and low ranges, representing a total of about 1 million persons with congenital heart disease. The most common types are: VSD, 199 000 people; atrial septal defect, 187 000 people; patent ductus arteriosus, 144 000 people; and valvular pulmonary stenosis, 134 000 people.[2]

Abbreviations Used in Chapter 6

CDC	Centers for Disease Control and Prevention
ICD	International Classification of Diseases
NCHS	National Center for Health Statistics
NHDS	National Hospital Discharge Survey
NHLBI	National Heart, Lung, and Blood Institute
VSD	ventricular septal defect

Incidence

Major defects are usually apparent in the neonatal period, but minor defects may not be detected until adulthood. Thus, true measures of incidence for congenital heart disease would need to record new cases of defects presenting any time in fetal life through adulthood. However, estimates are only available for new cases detected between birth and 30 days of life, known as birth prevalence, or as new cases detected in the first year of life only. Both of these are typically reported as cases per 1000 live births per year and do not distinguish between tiny defects that resolve without treatment and major malformations. To distinguish more serious defects, some studies also report new cases of sufficient severity to require an invasive procedure or that result in death within the first year of life. Despite the absence of true incidence figures, some data are available and are shown in Table 6-2.

- According to the CDC, 1 in every 110 infants in the metropolitan Atlanta, Ga, area was born with a congenital heart defect, including some infants with tiny defects that resolved without treatment. Some defects occur more commonly in males or females or in whites or blacks.[3]
- Nine (9.0) defects per 1000 live births are expected, or 36 000 infants per year in the United States. Of these, several studies suggest that 9200, or 2.3 per 1000 live births, require invasive treatment or result in death in the first year of life.[4]
- Estimates are also available for bicuspid aortic valves, occurring in 13.7 per 1000 people; these defects may not require treatment in infancy but can cause problems later in adulthood.[5,6]
- Some studies suggest that as many as 5% of newborns, or 200 000 per year, are born with tiny muscular VSDs, almost all of which close spontaneously.[7,8] These defects nearly never require treatment, so they are not included in Table 6-2.
- Data collected by the National Birth Defects Prevention Network from 11 states from 1999 to 2001 showed the average prevalence of 18 selected major birth defects. These data indicated that there are more than 6500 estimated annual cases of 5 cardiovascular defects: truncus arteriosus, transposition of the great arteries, tetralogy of Fallot, atrioventricular septal defect, and hypoplastic left heart syndrome.[9]

Mortality

- Total-mention mortality from congenital cardiovascular defects in 2002 was 6110.
- Congenital cardiovascular defects are the most common cause of infant death from birth defects; 30% of infants who die from a birth defect have a heart defect (National Vital Statistics System Final Data for 2003).
- The 2003 overall death rate for congenital cardiovascular defects was 1.4. Death rates were 1.5 for white males, 1.8 for black males, 1.2 for white females, and 1.4 for black females. Crude infant death rates (under 1 year) were 39.5 for white infants and 52.3 for black infants. In 2000, 213 000 life-years were lost before age 65 because of deaths from congenital cardiovascular defects. This is nearly equivalent to the life-

years lost from leukemia, prostate cancer, and Alzheimer's disease combined (NCHS, NHLBI).

- Mortality from congenital defects has been declining. From 1979 to 1997, age-adjusted death rates from all defects declined 39%, and deaths tended to occur at progressively older ages. However, 43% of deaths still occurred in infants less than 1 year of age. Mortality varies considerably according to type of defect.[10]
- From 1993 to 2003, death rates for congenital cardiovascular defects declined 31%, while the actual number of deaths declined 26%.

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TABLE 6-1. Congenital Cardiovascular Defects

Population Group	Mortality 2003 All Ages	Hospital Discharges 2004 All Ages
Both sexes	3983	72 000
Males	2115 (53.1%)*	35 000
Females	1868 (46.9%)*	37 000
White males	1375	...
White females	1245	...
Black males	345	...
Black females	301	...

Ellipses (. . .) indicate data not available.

*These percentages represent the portion of total congenital cardiovascular mortality that is for males vs females.

Sources: Mortality: NCHS; these data represent underlying cause of death only; data for white and black males and females include Hispanics. Hospital discharges: NHDS, NCHS; data include those inpatients discharged alive, dead, or status unknown.

TABLE 6-2. Annual Incidence of Congenital Cardiovascular Defects

Type of Presentation	Rate per 1000 Live Births	No.
Fetal loss	Unknown	Unknown
Invasive procedure during the first year	2.3	9200
Detected during first year*	9.0	36 000
Bicuspid aortic valve	13.7	54 800
Other defects detected after first year	Unknown	Unknown
Total	Unknown	Unknown

Includes stillbirths and pregnancy termination at less than 20 weeks' gestation; includes some defects that resolve spontaneously or do not require treatment.

TABLE 6-3. Estimated Prevalence of Congenital Cardiovascular Defects and Percent Distribution by Type, United States 2002* (in Thousands)

	Prevalence			Percent of Total		
Type	Total	Children	Adults	Total	Children	Adults
Total	994	463	526	100	100	100
VSD†	199	93	106	20.1	20.1	20.1
Atrial septal defect	187	78	109	18.8	16.8	20.6
Patent ductus arteriosus	144	58	86	14.2	12.4	16.3
Valvular pulmonic stenosis	134	58	76	13.5	12.6	14.4
Coarctation of aorta	76	31	44	7.6	6.8	8.4
Valvular aortic stenosis	54	25	28	5.4	5.5	5.2
Tetralogy of Fallot	61	32	28	6.1	7.0	5.4
Atrioventricular septal defect	31	18	13	3.1	3.9	2.5
Transposition of great arteries	26	17	9	2.6	3.6	1.8
Hypoplastic right heart syndrome	22	12	10	2.2	2.5	1.9
Double-outlet right ventricle	9	9	0	0.9	1.9	0.1
Single ventricle	8	6	2	0.8	1.4	0.3
Anomalous pulmonary venous connection	9	5	3	0.9	1.2	0.6
Truncus arteriosus	9	6	2	0.7	1.3	0.5
Hypoplastic left heart syndrome	3	3	0	0.3	0.7	0.0
Other	22	12	10	2.1	2.6	1.9

*Excludes an estimated 3 million bicuspid aortic valve prevalence: 2 million in adults and 1 million in children.

†Small VSD, 117 000: 65 000 adults and 52 000 children. Large VSD, 82 000: 41 000 adults and 41 000 children. Source: Reprinted from Hoffman et al[2] with permission from Elsevier. Copyright 2004. Average of the low and high estimates, two thirds from low estimate.[2]

TABLE 6-4. Admission With Congenital Heart Disease

	Population, Weighted
Admissions for congenital heart disease*	142 991
Total cost for all congenital heart disease admissions, US dollars†	9.2 billion
Adjusting for missing cases	9.5 billion

In 2003, more than 140 000 hospitalizations for a congenital cardiovascular defect as a primary or secondary diagnosis occurred in infants and children; hospital charges were $9.5 billion.

*Any diagnosis and/or procedure for congenital heart disease.

†Total charges missing for 2172 cases.

TABLE 6-5. Surgery for Congenital Heart Disease

	Sample	Population, Weighted
Surgery for congenital heart disease	14 888	25 831
Deaths	736	1253
Mortality rate	4.9%	4.8%
By gender (81 missing in sample):		
Male	8127	14 109
Deaths	420	714
Mortality rate	5.2%	5.1%
Female	6680	11 592
Deaths	315	539
Mortality rate	4.7%	4.6%
By type of surgery:		
ASD secundum surgery	834	1448
Deaths	3	6
Mortality rate	0.4%	0.4%
Norwood for hypoplastic left heart syndrome	161	286
Deaths	42	72
Mortality rate	26.1%	25.2%

In 2003, more than 25 000 cardiovascular operations for congenital cardiovascular defects were performed on children under 20 years of age. Inpatient mortality rate after all types of cardiac surgery was 4.8%. However, mortality risk varies substantially for different defect types, from 0.4% for atrial septal defect repair to 25.2% for first-stage palliation for hypoplastic left heart syndrome. Fifty-five percent of operations were performed in males. In unadjusted analysis, mortality after cardiac surgery was somewhat higher for males than for females (5.1% vs 4.6%).

7. Heart Failure

ICD-9 428, ICD-10 I50. See Table 7-1 and Charts 7-1 through 7-3.

Prevalence

- In a cross-sectional study conducted among asymptomatic individuals in Olmsted County, Minn, the prevalence of left ventricular diastolic dysfunction was 21% for mild diastolic dysfunction and 7% for moderate or severe diastolic dysfunction. Altogether, 6% had moderate or severe diastolic dysfunction with normal ejection fraction. The prevalence of systolic dysfunction was 6% (moderate or severe systolic dysfunction was 2%). The presence of any left ventricular dysfunction (systolic or diastolic) was associated with an increased risk of HF, and diastolic dysfunction was predictive of all-cause mortality.[1]

Incidence

- On the basis of the 44-year follow-up of the NHLBI's FHS[2]:
  - HF incidence approaches 10 per 1000 population after age 65.
  - Seventy-five percent of HF cases have antecedent hypertension.
- On the basis of 1971–1996 data from the NHLBI's FHS[2]:
  - At age 40, the lifetime risk of developing CHF for both men and women is 1 in 5.
  - At age 40, the lifetime risk of CHF occurring without antecedent MI is 1 in 9 for men and 1 in 6 for women.
  - The lifetime risk doubles for people with BP greater than 160/90 mm Hg versus those with BP less than 140/90 mm Hg.
- The annual rates per 1000 population of new HF events for white men are 15.2 for those between ages 65 and 74 years, 31.7 for those between ages 75 and 84 years, and 65.2 for those age 85 and older. For white women in the same age groups the rates are 8.2, 19.8, and 45.6, respectively. For black men the rates are 16.9, 25.5, and 50.6*, and for black women the rates are 14.2, 25.5, and 44.0*, respectively (CHS, NHLBI). *Unreliable estimate.
- A community-based cohort study conducted in Olmsted County, Minn, showed that the incidence of HF (ICD-9 428) has not declined during 2 decades, but survival after onset has increased overall, with less improvement among women and elderly persons.[3]

Abbreviations Used in Chapter 7

AHA	American Heart Association
BMI	body mass index
BP	blood pressure
CHD	coronary heart disease
CHF	congestive heart failure
CHS	Cardiovascular Health Study
FHS	Framingham Heart Study
HF	heart failure
ICD	International Classification of Diseases
MI	myocardial infarction
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHDS	National Hospital Discharge Survey
NHLBI	National Heart, Lung, and Blood Institute

Risk Factors

- Data from the FHS indicate that hypertension is a very common risk factor for HF that contributed to a large proportion of HF cases in this study (FHS).[4]
- A study of the predictors of HF among women with CHD found that diabetes was the strongest risk factor. Diabetic women with elevated BMI or depressed creatinine clearance were at highest risk, with annual incidence rates of 7% and 13%, respectively. Among nondiabetic women with no risk factors, the annual incidence rate was 0.4%. The rate increases with each additional risk factor, and nondiabetic women with 3 or more risk factors had an annual incidence of 3.4%. Among diabetic participants with no additional risk factors, the annual incidence of HF was 3.0%, compared with 8.2% among diabetics with at least 3 additional risk factors. Diabetics with fasting glucose greater than 300 mg/dL had a 3-fold adjusted risk of developing HF, compared with diabetics with controlled fasting blood sugar levels.[5]
- The prevalence of diabetes is increasing among older persons with HF, and diabetes is a significant independent risk factor for death in these individuals. Researchers from the Mayo Clinic found that the prevalence of diabetes increased 3.8% every year. The odds of having diabetes for those first diagnosed with HF in 1999 were nearly 4 times higher than those diagnosed 20 years earlier. Five-year survival was 46% for those with HF alone but only 37% for those with HF and diabetes mellitus.[6]

Mortality

HF total-mention mortality in 2002 was 286 700.

- On the basis of the 44-year follow-up of the NHLBI's FHS:
  - Eighty percent of men and 70% of women under age 65 who have HF will die within 8 years.
  - After HF is diagnosed, survival is poorer in men than in women, but fewer than 15% of women survive more than 8 to 12 years. The 1-year mortality rate is high, with 1 in 5 dying.
  - In people diagnosed with HF, sudden cardiac death occurs at 6 to 9 times the rate of the general population.
- From 1994 to 2004, deaths from HF (ICD 428) increased 28%. In the same time period, the death rate declined 2.0% (NCHS, NHLBI).

- The 2004 overall death rate for HF was 19.1. Death rates were 20.3 for white males, 22.9 for black males, 18.3 for white females, and 19.0 for black females (NCHS, NHLBI).

Aftermath

- Further data from Olmsted County, Minn, indicate that the proportion of persons with HF and preserved ejection fraction increased over time. Survival improved over time among individuals with reduced ejection fraction but not among those with preserved ejection fraction.[7]

Hospital Discharges

- Hospital discharges for HF rose from 399 000 in 1979 to 1 099 000 in 2004, an increase of 175% (NHDS, NHLBI).
- Data from Ambulatory Care Visits to Physician Offices, Hospital Outpatient Departments, and Emergency Departments: US, 1999 to 2000, showed the number of visits for CHF was 3.4 million.[8]

Cost

- The estimated direct and indirect cost of HF in the United States for 2007 is $33.2 billion. (See Chapter 14.)
- In 2001, $4.0 billion ($5912 per discharge) was paid to Medicare beneficiaries for CHF.[9]

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TABLE 7-1. Heart Failure

Population Group	Prevalence 2004 Age 20+	Incidence (New Cases) Age 35+	Mortality 2004* All Ages	Hospital Discharges 2004 All Ages	Cost 2007
Both sexes	5 200 000 (2.5%)	550 000	57 700	1 099 000	$33.2 billion
Males	2 600 000 (2.8%)	...	22 501 (39.0%)†	524 000	...
Females	2 600 000 (2.2%)	...	35 199 (61.0%)†	575 000	...
NH white males	2.8%	...	20 040	...	...
NH white females	2.1%	...	31 785	...	...
NH black males	2.7%	...	2119	...	...
NH black females	3.3%	...	3017	...	...
Mexican-American males	2.1%	...	...	...	...
Mexican-American females	1.9%	...	...	...	...

Ellipses (...) indicate data not available.

*Mortality data are for whites and blacks.

†These percentages represent the portion of total HF mortality that is for males vs females.

Sources: Prevalence: NHANES (1999–2004), NCHS, and NHLBI; percentages are age adjusted for Americans age 20 and older. These data are based on self-reports. Estimates from NHANES 1999–2004 applied to 2004 population estimates. Incidence: FHS, NHLBI. Mortality: NCHS. These data represent underlying cause of death only. Data for white and black males and females include Hispanics; data for Mexican Americans are for 2003. Hospital discharges: NHDS, NCHS; data include those inpatients discharged alive, dead, or status unknown. Cost: NHLBI; data include estimated direct and indirect costs for 2007.

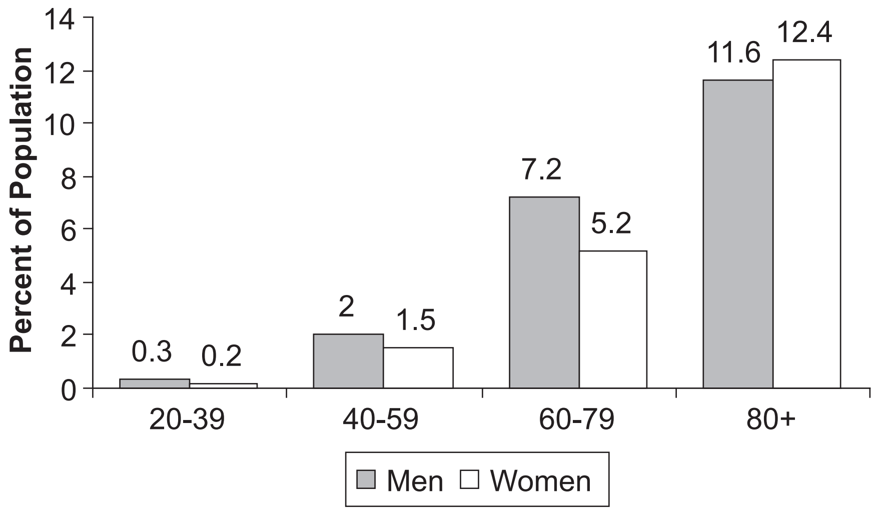

Chart 7-1. Prevalence of HF by sex and age (NHANES: 1999–2004). Source: NCHS and NHLBI.

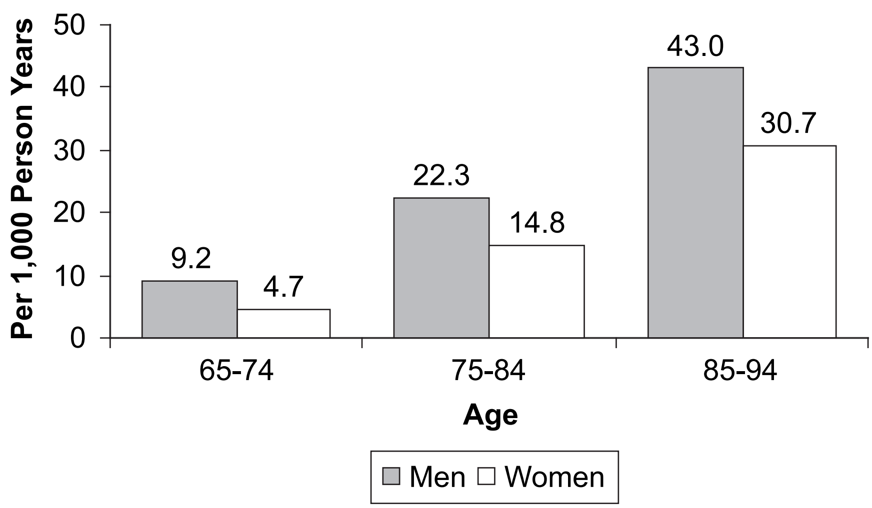

Chart 7-2. Incidence of HF* by age and sex (FHS 1980–2003). *HF based on physician review of medical records and strict diagnostic criteria. Source: NHLBI.[10]

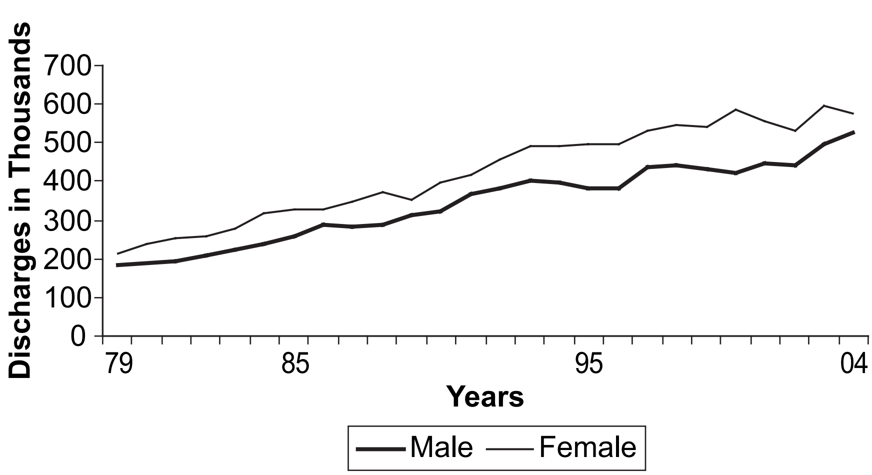

Chart 7-3. Hospital discharges for HF by sex (United States: 1979–2004). Note: Hospital discharges include those inpatients discharged alive, dead, or status unknown. Source: NHDS, NCHS, and NHLBI.

8. Other Cardiovascular Diseases

Mortality in this section is for 2003; except for total mentions, which are for 2002. Prevalence data are for 2003. Total-mention mortality is for 2002. Hospital discharge data are from the NHDS; data include inpatients discharged alive, dead, or status unknown. Hospital discharge data for 2004 are based on ICD-9 codes.

Arrhythmias (Disorders of Heart Rhythm)

ICD-9 426, 427; ICD-10 I46–I49.

Mortality—38 698. Total-mention mortality (2002)—479 700. Hospital discharges—817 000. In 2001, $2.7 billion ($6634 per discharge) was paid to Medicare beneficiaries for cardiac dysrhythmias.[1]

Atrial Fibrillation and Flutter

ICD-9 427.3; ICD-10 I48. Mortality—10 089. Total-mention mortality (2002)—77 800. Prevalence—>2 200 000.[2] Incidence—>75 000.[3] Hospital discharges—444 000.

- Participants in the FHS study of the NHLBI were followed up from 1968 to 1999. At age 40, remaining lifetime risks for AF were 26.0% for men and 23.0% for women. At 80 years, lifetime risks for AF were 22.7% for men and 21.6% for women. In further analysis, counting only those who had development of AF without prior or concurrent CHF or MI, lifetime risk for AF was approximately 16%.[4]
- Data from a large community-based population suggest that AF is less prevalent in blacks/African Americans than in whites, overall and in the setting of CHF.[2,5]

Abbreviations Used in Chapter 8

AAA	abdominal aortic aneurysm
AF	atrial fibrillation
ARIC	Atherosclerosis Risk in Communities study
BMI	body mass index
BP	blood pressure
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CHF	congestive heart failure
CHS	Cardiovascular Health Study
CVD	cardiovascular disease
DVT	deep vein thrombosis
FHS	Framingham Heart Study
HBP	high blood pressure
HF	heart failure
ICD	International Classification of Diseases
MI	myocardial infarction
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
NHDS	National Hospital Discharge Survey
NHLBI	National Heart, Lung, and Blood Institute
OR	odds ratio
PAD	peripheral arterial disease
PE	pulmonary embolism
RR	relative risk

- Data from the NHDS (1996–2001) on cases that included AF as a primary discharge diagnosis found that[6]:
  - About 44.8% of patients were men.
  - The mean age for men was 66.8 years, versus 74.6 for women.
  - The racial breakdown for admissions was 71.2% white, 5.6% black, and 2.0% other races (20.8% were not specified).
  - African-American patients were much younger than patients of other races.
  - The incidence in men ranged from 20.58/100 000 persons per year for patients between the ages of 15 and 44 years to 1077.39/100 000 persons per year for patients age 85 and older. In women, the incidence ranged from 6.64/100 000 persons per year for patients between the ages of 15 and 44 years to 1203.7/100 000 persons per year for those age 85 and older.
  - From 1996 to 2001, hospitalizations with AF as the first-listed diagnosis increased 34%.
- Age-adjusted death rates for AF were highest among whites (25.7) and blacks (16.4) and higher for men (34.7) than women (22.8).[7]
- In 1999, the CDC analyzed data from national and state multiple-cause mortality statistics and Medicare hospital claims for persons with AF. The most common disease listed as the primary diagnosis for persons hospitalized with AF was CHF (11.8%), followed by AF (10.9%), CHD (9.9%), and stroke (4.9%).[7]
- AF is an independent risk factor for ischemic stroke, increasing risk about 4- to 5-fold. AF can cause a stroke through formation of fibrin-rich clot in the left atrium (and particularly the left atrial appendage) that subsequently dislodges and embolizes into the cerebrovascular system. The risk for stroke attributable to AF increases with age.[8]
- Paroxysmal, persistent, and permanent AF all appear to increase the risk of stroke to a similar degree.[9]
- AF is responsible for about 15% to 20% of all strokes.[2]
- AF is also an independent risk factor for stroke recurrence and stroke severity. A recent report showed that people who had AF and were not treated with anticoagulants had a 2.1-fold increase in risk for recurrent stroke and a 2.4-fold increase in risk for recurrent severe stroke.[10]
- People who have strokes caused by AF have been reported as 2.23 times more likely to be bedridden than those who have strokes from other causes.[11]
- Data from participants in the FHS Offspring Study of the NHLBI examined between 1984 and 1987 and monitored for 10 years showed that symptoms of anger and hostility were predictive of 10-year incidence of AF in men.[12]
- In Olmsted County, Minn, the age-adjusted incidence of AF increased by 12.6% between 1980 and 2000.[13]
- The incidence of AF was greater in men (incidence ratio for men over women, 1.86) and increased markedly with age.[13]
- According to US population projections by the Census Bureau, the projected number of persons with AF may exceed 10 million by 2050.[13]

- Chronic atrial flutter is uncommon but is associated with a high risk of developing AF,[14] and data from a sample of 191 patients with chronic atrial flutter revealed a risk of stroke that was of similar magnitude to that seen for AF.[15]
- ***Tachycardia*** (ICD-9 427.0, 1, 2; ICD-10 I47.0, 1, 2, 9). Mortality—610. Total-mention mortality (2002)—7200. Hospital discharges—80 000.
- ***Paroxysmal supraventricular tachycardia*** (ICD-9 427.0; ICD-10 I47.1). Mortality—151. Total-mention mortality (2002)—1454. Hospital discharges—24 000.
- ***Ventricular fibrillation*** (ICD-9 427.4; ICD-10 I49.0). Mortality—1264. Total-mention mortality (2002)—13 100. Hospital discharges—6000. Ventricular fibrillation is listed as the cause of relatively few deaths, but the overwhelming majority of sudden cardiac deaths from coronary disease (estimated at about 325 000 per year) are thought to be from ventricular fibrillation.

Arteries, Diseases of

ICD-9 440–448; ICD-10 I70–I79. Includes peripheral arterial disease. Mortality—35 607. Total-mention mortality (2002)—115 400. Hospital discharges—278 000.

Aortic aneurysm (ICD-9 441; ICD-10 I71). Mortality—13 765. Total-mention mortality (2002)—20 800. Hospital discharges—61 000.

- Although the definition varies somewhat by age and body-surface area, generally, an abdominal aortic aneurysm (AAA) is considered to be present when the anteroposterior diameter of the aorta reaches 3.0 cm.[16]
- The prevalence of AAAs 2.9 to 4.9 cm in diameter ranges from 1.3% in men 45 to 54 years of age to 12.5% in men 75 to 84 years of age. For women, the prevalence ranges from 0% in the youngest to 5.2% in the oldest age groups.[16]
- Factors associated with increased prevalence of AAA include older age, male sex, family history, tobacco use, hypertension, dyslipidemia, and manifest atherosclerotic disease in other vascular beds.[16]
- Large AAAs tend to expand more rapidly than small AAAs, and large AAAs are at substantially higher risk for rupture.[16]
  - Average annual expansion rates are approximately 1 to 4 mm for aneurysms <4.0 cm in diameter, 4 to 5 mm for AAAs 4.0 to 6.0 cm in diameter, and as much as 7 to 8 mm for AAAs >6.0 cm in diameter.
  - Absolute risk for eventual rupture is approximately 20% for AAAs >5.0 cm, approximately 40% for AAAs >6.0 cm, and more than 50% for AAAs >7.0 cm in diameter.
  - Rupture of an AAA may be associated with mortality rates as high as 90%.

Atherosclerosis (ICD-9 440; ICD-10 I70) is a process that leads to a group of diseases characterized by a thickening of artery walls. Mortality—13 030. Total-mention mortality (2002)—66 000. Hospital discharges—123 000. Atherosclerosis causes many deaths from heart attack and stroke and accounts for nearly three fourths of all deaths from CVD (FHS, NHLBI).

Other diseases of arteries (ICD-9 442–448; ICD-10 I72-I78). Mortality—9862. Total-mention mortality (2002)—10 109. Hospital discharges—94 000.

Kawasaki disease (ICD-9 446.1; ICD-10 M30.3). Mortality—9. Total-mention mortality (2002)—14. Hospital discharges—5000, primary plus secondary diagnoses.

- About 76% of Kawasaki disease patients are under age 5.[17]
- Up to 2500 cases of Kawasaki disease are diagnosed yearly. Kawasaki disease occurs more often among boys (63%) and among those of Asian ancestry.[18]
- The highest incidence in the United States is in Hawaii. A hospitalization rate of 47.7 per 100 000 children under age 5 was reported during the mid-1990s. In the continental United States, the estimated incidence ranges from 9 to 19 per 100 000 children.[19]

Peripheral arterial disease (PAD) affects about 8 million Americans and is associated with significant morbidity and mortality.[20]

- A study from the NHANES 1999–2000 data found that PAD affects about 5 million adults. Prevalence increases dramatically with age and disproportionately affects blacks.[21] However, the measurement of systolic BP in the right arm only and the omission of queries for surgical procedures to correct PAD in this study led to an underestimate of the true PAD prevalence. Experts in the field generally agree that PAD affects about 8 million Americans.[20]
- PAD affects 12% to 20% of Americans age 65 and older. Despite its prevalence and cardiovascular risk implications, only 25% of PAD patients are undergoing treatment.[22]
- In the general population, only about 10% of persons with PAD have the classic symptoms of intermittent claudication. About 40% do not complain of leg pain, whereas the remaining 50% have a variety of leg symptoms different from classic claudication.[20,23] However, in an older, disabled population of women, as many as two thirds of individuals with PAD had no exertional leg symptoms.[24]
- Intermittent claudication is present in fewer than 1% of individuals under age 50 and approximately 5% or more of those older than age 80.[16]
- In the FHS, the incidence of PAD was based on symptoms of intermittent claudication in subjects 29 to 62 years of age. Annual incidence of intermittent claudication per 10 000 subjects at risk rose from 6 in men and 3 in women between the ages of 30 and 44 years to 61 in men and 54 in women between the ages of 65 and 74 years. Intermittent claudication incidence has declined since 1950, but mortality has remained high and unchanged.[25]
- The risk factors for PAD are similar to those for CHD, although diabetes and cigarette smoking are particularly strong risk factors for PAD.[16,26]
- Persons with PAD have impaired function and quality of life. This is true even for persons who do not report leg symptoms. Furthermore, PAD patients, including those who are asymptomatic, experience significant decline in lower-extremity functioning over time.[27,28]

- PAD is a marker for systemic atherosclerotic disease. Persons with PAD, compared with those without, have 4 to 5 times the risk of dying of a CVD event, resulting in a 2- to 3-times higher total mortality risk.[16,29]
- In the FHS, the annual mortality rate was almost 4 times greater in subjects with intermittent claudication. In a major cohort study, investigators observed a risk for all-cause mortality in these subjects that was 3.1 times higher than that for patients without PAD. In addition, PAD patients had a 5.9-times higher risk for death from CVD complications and a 6.6-times higher risk for death from CHD specifically.[16,30]
- African-American ethnicity was a strong and independent risk factor for PAD. PAD was not attributable to higher levels of diabetes, hypertension, or BMI. African Americans had a higher PAD prevalence than non-Hispanic whites (OR=2.3). There was no evidence that the reason for the higher PAD prevalence in African Americans was a greater susceptibility to CVD risk factors.[31]
- Data from NHANES 1999–2000 show that even low blood levels of lead and cadmium may increase the risk of PAD. Exposure to these 2 metals can occur through cigarette smoke. The risk was 2.8 for high levels of cadmium and 2.9 for high levels of lead. The OR of PAD for current smokers was 4.13, as compared with people who had never smoked.[32] Results from the NHANES 1999–2000 survey of the NCHS showed a remarkably high prevalence of PAD among patients with renal insufficiency. Accurate identification of patients with renal insufficiency, combined with routine ankle brachial index measurement in this group, would greatly enhance efforts to detect subclinical PAD.[33]
- Available evidence suggests that the prevalence of PAD in persons of Hispanic origin is similar to or slightly higher than that in Caucasians.[31]
- Recent studies indicate an association of elevated ankle brachial index levels with increased all-cause and cardiovascular mortality.[34]

Bacterial Endocarditis

ICD-9 421.0; ICD-10 I33.0. Total-mention mortality (2002)—2370. Hospital discharges—29 000, primary plus secondary diagnoses.

Cardiomyopathy

ICD-9 425; ICD-10 I42. Mortality—27 728. Total-mention mortality (2002)—54 700. Hospital discharges—33 000.

- Eighty-seven percent of cases are congestive or dilated cardiomyopathy. Of patients with dilated cardiomyopathy, 50% are alive 5 years after their initial diagnosis, and 25% are alive 10 years after the diagnosis.[34a]
- Mortality from cardiomyopathy is highest in older persons, men, and blacks (FHS, NHLBI).
- Tachycardia-induced cardiomyopathy develops slowly and appears reversible, but recurrent tachycardia causes rapid decline in left ventricular function and development of HF. Sudden death is possible.[35]
- Since 1996, the NHLBI's Pediatric Cardiomyopathy Registry has collected data on all children with newly diagnosed cardiomyopathy in New England and the Central Southwest (Texas, Oklahoma, and Arkansas).[36]
  - The overall incidence of cardiomyopathy is 1.13 cases per 100 000 in children under age 18.
  - In children under 1 year of age, the incidence is 8.34, and in children between 1 and 18 years of age it is 0.70 per 100 000.
  - The annual incidence is lower in white than in black children, higher in boys than in girls, and higher in New England (1.44 per 100 000) than in the Central Southwest (0.98 per 100 000).
- Studies show that 36% of young athletes who die suddenly have probable or definite hypertrophic cardiomyopathy.[37]
- Hypertrophic cardiomyopathy is the leading cause of sudden cardiac death in young people, including trained athletes. Hypertrophic cardiomyopathy is the most common inherited heart defect, occurring in 1 of 500 individuals. In the United States, some 500 000 people have hypertrophic cardiomyopathy, yet most are unaware they are affected.[38]

Rheumatic Fever/Rheumatic Heart Disease

ICD-9 390–398; ICD-10 I00–I09. See Table 8-1.

- Many operations on heart valves are related to rheumatic heart disease.
- The incidence of rheumatic fever remains higher in African Americans, Puerto Ricans, Mexican Americans, and American Indians.[39]
- Total-mention mortality (2002)—7440.
- In 1950, about 15 000 Americans (adjusted for changes in ICD codes) died of rheumatic fever/rheumatic heart disease, compared with about 3200 today.
- From 1994 to 2004, the death rate from rheumatic fever/rheumatic heart disease fell 50%, while actual deaths declined 40%.
- The 2004 overall death rate for rheumatic fever/rheumatic heart disease was 1.1. Death rates were 0.9 for white males, 0.6 for black males, 1.3 for white females, and 1.0 for black females.

Valvular Heart Disease

ICD-9 424; ICD-10 I34–I38. Mortality—20 056. Total-mention mortality (2002)—42 590. Hospital discharges—94 000.

- Aortic valve disorders (ICD-9 424.1; ICD-10 I35). Mortality—12 548. Total-mention mortality (2002)—26 336. Hospital discharges—48 000.
- Mitral valve disorders (ICD-9 424.0; ICD-10 I34). Mortality—2542. Total-mention mortality (2002)—about 6600. Hospital discharges—38 000.
  - The NHLBI's FHS reports that among people 26 to 84 years of age, prevalence is about 1% to 2% and equal between women and men.
- Pulmonary valve disorders (ICD-9 424.3; ICD-10 I37). Mortality—11. Total-mention mortality (2002)—35.

- Tricuspid valve disorders (ICD-9 424.2; ICD-10 I36). Mortality—16. Total-mention mortality (2002)—69.
- In 2004, an estimated 99 000 inpatient valve procedures were performed in the United States (NHDS, NCHS).

Venous Thromboembolism

- Venous thromboembolism occurs for the first time in about 100 per 100 000 persons each year in the United States. About one third of patients with symptomatic venous thromboembolism manifest pulmonary embolism (PE), whereas two thirds manifest deep vein thrombosis (DVT) alone.[40]
- Caucasians and African Americans have a significantly higher incidence than that of Hispanics and Asians or Pacific Islanders.[40]
- In studies conducted in Worcester, Mass, and Olmsted County, Minn, the incidence of venous thromboembolism was about 1 in 1000. In both studies, venous thromboembolism was more common in men; for each 10-year increase in age, the incidence doubled. By extrapolation, it is estimated that more than 250 000 patients are hospitalized annually with venous thromboembolism.[41]
- The crude incidence rate per 1000 person-years was 0.80 in the ARIC study, 2.15 in the CHS, and 1.08 in the combined cohort. Half of the participants who developed incident venous thromboembolism were women, and 72% were white.[42]
- More than 200 000 new cases of venous thromboembolism occur annually. Of these, 30% die within 30 days, one fifth suffer sudden death due to PE, and about 30% develop recurrent venous thromboembolism within 10 years. Independent predictors for recurrence include increasing age, obesity, malignant neoplasm, and extremity paresis.[43]
- Data from the ARIC study of the NHLBI showed that the 28-day fatality rate from DVT is 9%; from PE, 15%; from idiopathic DVT or PE, 5%; from secondary non–cancer-related DVT or PE, 7%; and from secondary cancer-related DVT or PE, 25%.[44]
- The RR of venous thromboembolism among pregnant or postpartum women was 4.29%, and the overall incidence of venous thromboembolism (absolute risk) was 199.7 per 100 000 woman-years. The annual incidence was 5 times higher among postpartum women than pregnant women, and the incidence of DVT was 3 times higher than that of PE. PE was relatively uncommon during pregnancy versus the postpartum period. Over the 30-year period, the incidence of venous thromboembolism during pregnancy remained relatively constant, whereas the postpartum incidence of PE decreased more than 2-fold.[45]
- ***DVT*** (ICD-9 451.1; ICD-10 I80.2). Mortality—2809. Total-mention mortality (2002)—10 530. Hospital discharges—9000.
  - A review of 9 studies conducted in the United States and Sweden showed that the mean incidence of first DVT in the general population was 5.04 per 10 000 person-years. The incidence was similar in males and females and increased dramatically with age from about 2 to 3 per 10 000 person-years at 30 to 49 years of age to 20 at 70 to 79 years of age.[46]
  - Death occurs in about 6% of DVT cases within 1 month of diagnosis.[40]
- ***PE*** (ICD-9 415.1; ICD-10 I26). Mortality—8702. Total-mention mortality (2002)—26 600. Hospital discharges—121 000.
  - In the Nurses' Health Study, nurses age 60 or older in the highest BMI quintile had the highest rates of PE. Heavy cigarette smoking and HBP were also identified as risk factors for PE.[41]
  - Death occurs in about 12% of PE cases within 1 month of diagnosis.[40]
  - A study of Medicare recipients age 65 and older reported 30-day case fatality rates in patients with PE. Overall, men had higher fatality rates than women (13.7% versus 12.8%), and blacks had higher fatality rates than whites (16.1% versus 12.9%).[41]
  - In the International Cooperative Pulmonary Embolism Registry, the 3-month mortality rate was 17.5%. In contrast, the overall 3-month mortality rate in the Prospective Investigation of Pulmonary Embolism Diagnosis was 15%, but only 10% of deaths during 1 year of follow-up were ascribed to PE.[41]
  - The age-adjusted rate of deaths from pulmonary thromboembolism decreased from 191 per million in 1979 to 94 per million in 1998 overall, decreasing 56% for men and 46% for women. During this time, the age-adjusted mortality rates for blacks were consistently 50% higher than those for whites, and those for whites were 50% higher than those for people of other races (Asian, American Indian, etc). Within racial strata, mortality rates were consistently 20% to 30% higher among men than among women.[47]

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TABLE 8-1. Rheumatic Fever/Rheumatic Heart Disease

Population Group	Mortality 2004 All Ages	Hospital Discharges 2004 All Ages
Both sexes	3248	57 000
Males	1022 (31.5%)*	18 000
Females	2226 (69.6%)*	39 000
White males	918	. . .
White females	1983	. . .
Black males	83	. . .
Black females	171	. . .

Ellipses (. . .) indicate data not available.

*These percentages represent the portion of total mortality that is for males vs females.

Sources: Mortality: NCHS; these data represent underlying cause of death only; data for white and black males and females include Hispanics. Hospital discharges: NHDS, NCHS; data include those inpatients discharged alive, dead, or of unknown status.

9. Risk Factor: Smoking/Tobacco Use

See Tables 9-1 and 9-2 and Charts 9-1 and 9-2.[1–3]

Prevalence

Youth

- In 2005, in grades 9 through 12, 31.7% of male students and 25.1% of female students reported current tobacco use, 19.2% of males and 8.7% of females reported current cigar use, and 13.6% of males and 2.2% of females reported current smokeless tobacco use.[4]
- From 1980 to 2004, the percentage of high school seniors who reported smoking in the previous month decreased 18%. This percentage decreased by 5.6% in males, 27.8% in females, 9% in whites, and 55.2% in blacks or African Americans (NCHS).[5]
- An estimated 150 000 to 300 000 children younger than 18 months of age have respiratory tract infections because of exposure to secondhand smoke (www.cdc.gov/tobacco/research_data/environmental/ets-fact.htm).
- Children's exposure to secondhand smoke, as indicated by cotinine levels, dropped between 1988–1994 and 1999–2002. Overall, 59% of children between the ages of 4 and 11 years had cotinine in their blood in 1999–2002, down from 88% in 1988–1994. From 1999 to 2002, 84% of non-Hispanic black children between the ages of 4 and 11 years had cotinine in their blood, compared with 58% of non-Hispanic white children and 47% of Mexican-American children. The percentage of homes with children under age 7 in which someone regularly smokes decreased from 29% in 1994 to 11% in 2003.[6]

Adults

- Since 1965, smoking in the United States has declined by 49% among people age 18 and older (NCHS).[5]
- Among Americans age 18 and older, 23.4% of men and 18.5% of women are smokers, putting them at increased risk of heart attack and stroke.[1]
- Use of any tobacco product in 2003 was 31.6% for whites only, 30.0% for blacks or African Americans only, 41.8% for American Indians or Alaska Natives only, 37.0% for Native Hawaiians or other Pacific Islanders only, 13.8% for Asians only, and 23.7% for Hispanics or Latinos of any race.[5]
- Data for 2004 (NHIS) showed that smoking prevalence is higher among those who had earned a GED diploma (39.6%) and those with 9 to 11 years of education (34.0%) than among those with more than 16 years of education (8.0%). It is highest among persons living below the poverty level (29.1%) compared with other income groups.[1]
- Compared with results from 1988 to 1991, median cotinine levels measured from 1999 to 2002 in nonsmokers have decreased 68% in children, 69% in adolescents, and about 75% in adults. Non-Hispanic blacks have levels more than twice as high as those of non-Hispanic whites and Mexican Americans. Children's levels are more than twice those of adults.[7]
- Data from the 2004 NHIS survey showed that American Indian or Alaska Native adults age 18 and older were more likely (33.4%) to be current smokers than were non-Hispanic white adults (22.2%), black adults (20.2%), and Asian adults (11.3%).[1]
- BRFSS 2005 prevalence data showed that overall, 20.6% of adults age 18 and older were current smokers. The highest percentage was in Kentucky (28.7%), and the lowest was in Utah (11.5%) (www.cdc.gov/brfss/).

Abbreviations Used in Chapter 9

AA	African American
BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CVD	cardiovascular disease
MI	myocardial infarction
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute
YRBS	Youth Risk Behavior Surveillance

Incidence

- Each day about 3900 people between the ages of 12 and 17 initiate cigarette smoking in the United States. In this age group, each day an estimated 1500 young people become daily smokers.[8]
- About 80% of people who use tobacco begin before age 18, according to a report from the Surgeon General, *Preventing Tobacco Use Among Young People, 1994*. The most common age of initiation is 14 to 15.[9]
- The CDC Health Effects of Cigarette Smoking Fact Sheet, February 2004, provides the following information:
  - Cigarette smokers are 2 to 4 times more likely to develop CHD than are nonsmokers.
  - Cigarette smoking approximately doubles a person's risk for stroke.
  - Cigarette smokers are more than 10 times as likely as nonsmokers to develop peripheral vascular disease.

Mortality

- From 1997 to 2001, an estimated 437 902 Americans died each year of smoking-related illnesses, and 34.7% of these deaths were related to CVD.[2]
- On average, male smokers die 13.2 years earlier than male nonsmokers and female smokers die 14.5 years earlier than female nonsmokers.[11]
- From 1997 to 2001, smoking annually caused 3.3 million years of potential life lost for men and 2.2 million years for women.[2]
- From 1997 to 2001, smoking during pregnancy resulted in an estimated 523 male and 387 female infant deaths annually.[2]

- Current cigarette smoking is a powerful independent predictor of sudden cardiac death in patients with CHD.[12]
- Cigarette smoking results in a 2- to 3-fold increased risk of dying from CHD.[13]
- After up to 14.5 years of follow-up of participants in the Lung Health Study of the NHLBI, all-cause mortality among participants in a smoking cessation intervention was significantly lower (15%) than all-cause mortality among those who received usual care.[14]
- An estimated 35 052 nonsmokers die from CHD each year as a result of exposure to environmental tobacco smoke.[2]

Aftermath

- *The Health Consequences of Smoking, 2004—A Report of the Surgeon General* (CDC) reports: A study of women below age 44 found there was a strong dose–response relationship for MI, with a risk of 2.5 for those smoking 1 to 5 cigarettes per day, rising to 74.6 for those smoking more than 40 cigarettes per day, compared with nonsmokers.
  - Another study on female smokers found the highest risk (6.8) for MI was in women younger than 55 years of age.
  - One third of those who receive percutaneous coronary artery vascularization are current smokers, and 50% to 60% continue to smoke after the procedure.
  - Cigarette smoking remains a major cause of stroke in the United States. The evidence is sufficient to infer a causal relationship between smoking and subclinical atherosclerosis.
  - *The Health Consequences of Smoking, 2004—A Report of the Surgeon General* states that the risk of stroke decreases steadily after smoking cessation. Former smokers have the same risk as nonsmokers after 5 to 15 years.[11]
  - Data from *The Health Consequences of Involuntary Exposure to Tobacco Smoke—A Report of the Surgeon General (2006)* indicate a 25% to 30% increase in risk of CHD from exposure to secondhand smoke.[16]

Smokeless Tobacco

- About 5 million American men and women use chewing tobacco (NHANES III [1988–1994], NCHS).
  - Rates are highest in the South and rural areas.
  - Men use chewing tobacco at 10 times the rate of women. The percentages of men who use chewing tobacco are 6.8 for whites, 3.1 for blacks, 1.5 for Hispanics, 1.2 for Asians or Pacific Islanders, and 7.8 for American Indians or Alaska Natives.
  - For women, the percentages are 0.3 for whites, 2.9 for blacks, 0.1 for Hispanics, almost none for Asians or Pacific Islanders, and 1.2 for American Indians or Alaska Natives.
  - Use rates increase as years of education decrease for both men and women.

An estimated 3% of adults are current smokeless tobacco users. About 6% of men and 0.3% of women use smokeless tobacco (http://www.cdc.gov/tobacco/factsheets/smokelesstobacco.htm).

Cost

- Direct medical costs ($75.5 billion) and lost productivity costs associated with smoking ($92 billion) total an estimated $167 billion per year.[2]

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TABLE 9-1. Cigarette Smoking

Population Group	Prevalence 2004* Age 18+	Cost[2] 1997 to 2001
Both sexes	46 000 000 (20.9%)	$167 billion per year
Males	25 100 000 (23.4%)	. . .
Females	20 900 000 (18.5%)	. . .
NH white males	24.1%	. . .
NH white females	20.4%	. . .
NH black males	23.9%	. . .
NH black females	17.2%	. . .
Hispanic males	18.9%	. . .
Hispanic females	10.9%	. . .
Asian only males	17.8%	. . .
Asian only females	4.8%	. . .
American Indian/Alaska Native males	37.3%	. . .
American Indian/Alaska Native females	28.5%	. . .

Ellipses (. . .) indicate data not available.

*Data are for 2004 for Americans age 18 and older. NHIS percentages applied to 2004 population estimates.[1]

TABLE 9-2. Cigarette Smoking in the Past Month by Race/Ethnicity, Age, and Sex in the United States, 2004

Demographic Characteristic	Ages 12–17	Age 18 and Older
Total	11.9%	26.4%
Male	11.3%	29.8%
Female	12.5%	23.3%
NH white	14.4%	27.6%
NH black or AA	6.0%	26.2%
NH American Indian or Alaska Native	17.9%	32.9%
NH Asian	5.4%	10.9%
Hispanic or Latino	9.1%	23.2%
NH white male	13.3%	NR
NH white female	15.7%	NR
NH black male	6.5%	NR
NH black female	5.5%	NR
Hispanic male	8.8%	NR
Hispanic female	9.4%	NR

NR indicates data not provided.

Source: Percentage of persons between the ages of 12 and 17 years and age 18 years and older reporting cigarette use during the past month, by race/ethnicity and sex.[3]

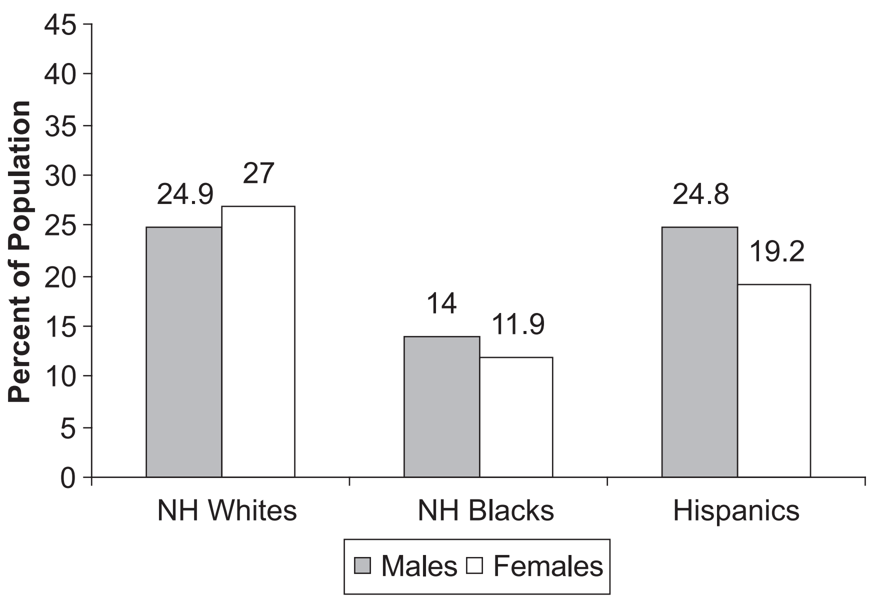

Chart 9-1. Prevalence of high school students in grades 9 through 12 reporting current cigarette use by sex and race/ethnicity (YRBS: 2005). Source: *MMWR*.[4] NH indicates non-Hispanic.

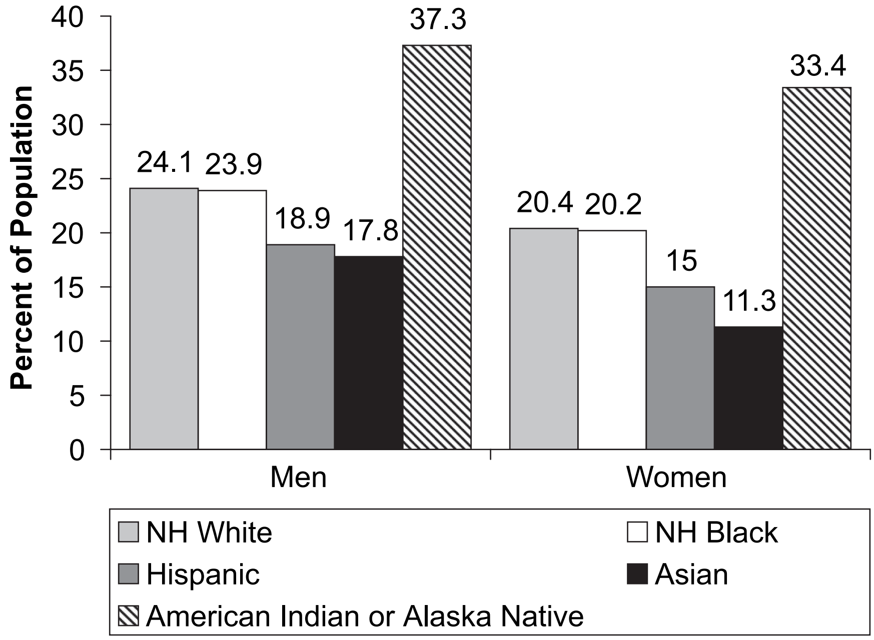

Chart 9-2. Prevalence of current smoking for adults age 18 and older by race/ethnicity and sex (NHIS: 2004). Source: *MMWR*.[1] NH indicates non-Hispanic.

10. Risk Factor: High Blood Cholesterol and Other Lipids

See Table 10-1 and Charts 10-1 through 10-4.[1]

Prevalence

For information on dietary cholesterol, total fat, saturated fat, and other factors that affect blood cholesterol levels, see Chapter 16 (Nutrition).

Youth

- Among children and adolescents between the ages of 4 and 19 years (NHANES III [1988–1994]):
  - Females have significantly higher average total cholesterol and LDL cholesterol (bad cholesterol) than do males.
  - Non-Hispanic black children and adolescents have significantly higher mean total cholesterol, LDL (bad) cholesterol, and HDL (good) cholesterol levels when compared with non-Hispanic white and Mexican-American children and adolescents.
- Among children and adolescents between the ages of 4 and 19 years, the mean total blood cholesterol level is 165 mg/dL. For boys, it is 163 mg/dL, and for girls, 167 mg/dL. The racial/ethnic breakdown is as follows (NHANES III [1988–1994], NCHS):
  - For non-Hispanic whites, 162 mg/dL for boys and 166 mg/dL for girls.
  - For non-Hispanic blacks, 168 mg/dL for boys and 171 mg/dL for girls.
  - For Mexican Americans, 163 mg/dL for boys and 165 mg/dL for girls.
- About 10% of adolescents between the ages of 12 and 19 years have total cholesterol levels exceeding 200 mg/dL (NHANES III [1988–1994], NCHS).

Adults

- Data from the BRFSS study of the CDC in 2005 showed that 73% of adults had been screened for high blood cholesterol in the preceding 5 years.[2]
- A 10% (population-wide) decrease in total cholesterol levels may result in an estimated 30% reduction in the incidence of CHD.[3]

Abbreviations Used in Chapter 10

BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
HDL	high-density lipoprotein
LDL	low-density lipoprotein
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHLBI	National Heart, Lung, and Blood Institute

- Data from NHANES 1999–2002 showed that overall, 63.3% of participants whose test results indicated high blood cholesterol or who were taking a cholesterol-lowering medication had been told by a professional that they had high cholesterol. Women were less likely than men to be aware of their condition; blacks and Mexican Americans were less likely to be aware of their condition than were whites. Fewer than half of Mexican Americans with high cholesterol were aware of their condition.[4]
- Between 1988–1994 and 1999–2002, the age-adjusted mean total serum cholesterol level of adults age 20 and older decreased from 206 mg/dL to 203 mg/dL, and LDL cholesterol levels decreased from 129 mg/dL to 123 mg/dL.[5]
- Data from the Minnesota Heart Survey, 1980–1982 to 2000–2002, showed a decline in age-adjusted mean total cholesterol concentrations from 5.49 and 5.38 mmol/L for men and women, respectively, in 1980–1982, to 5.16 and 5.09, respectively, in 2000–2002. However, the decline was not uniform across all age groups. Middle-aged to older people have shown substantial decreases, but younger people have shown little overall change and recently had increased total cholesterol values. Lipid-lowering drug use rose significantly for both sexes between the ages of 35 and 74 years. Awareness, treatment, and control of hypercholesterolemia have increased; however, more than half of those at borderline-high risk remain unaware of their condition.[6]
- Data from the BRFSS survey in 2005 showed that overall, 35.6% of adults age 18 and older had been told that they have high blood cholesterol. The highest percentage was in West Virginia (39.9%), and the lowest was in Louisiana (30.3%) (www.cdc.gov/brfss/).

Adherence

On the basis of data from the Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults[7]:

- Fewer than half of persons who qualify for any kind of lipid-modifying treatment for CHD risk reduction are receiving it.
- Fewer than half of even the highest-risk persons (those with symptomatic CHD) are receiving lipid-lowering treatment.
- Only about one third of treated patients are achieving their LDL goal; fewer than 20% of CHD patients are at their LDL goal.

LDL (Bad) Cholesterol

Youth

- Mean LDL cholesterol levels among children and adolescents between the ages of 12 and 19 years are as follows (NHANES III [1988–1994], NCHS):
  - Among non-Hispanic whites, 91 mg/dL for boys and 100 mg/dL for girls.
  - Among non-Hispanic blacks, 99 mg/dL for boys and 102 mg/dL for girls.

- Among Mexican Americans, 93 mg/dL for boys and 92 mg/dL for girls.

Adults

- The mean level of LDL cholesterol for American adults, age 20 and older, is 123 mg/dL. Levels of 130 to 159 mg/dL are considered borderline high. Levels of 160 to 189 mg/dL are classified as high, and levels of 190 mg/dL and higher are considered very high.[5]
- According to NHANES 1999–2002 (NCHS):
  - Among non-Hispanic whites, mean LDL cholesterol levels were 126 mg/dL for men and 121 mg/dL for women.
  - Among non-Hispanic blacks, the mean LDL cholesterol level was 121 mg/dL for both men and women.
  - Among Mexican Americans, mean LDL cholesterol levels were 125 mg/dL for men and 117 mg/dL for women.

HDL (Good) Cholesterol

The higher a person's HDL cholesterol level is, the better. A level less than 40 mg/dL in adults is considered low HDL cholesterol, which is a risk factor for heart disease and stroke.

Youth

- Mean HDL cholesterol levels among children and adolescents between the ages of 4 and 19 years are as follows (NHANES III [1988–1994], NCHS):
  - Among non-Hispanic whites, 48 mg/dL for boys and 50 mg/dL for girls.
  - Among non-Hispanic blacks, 55 mg/dL for boys and 56 mg/dL for girls.
  - Among Mexican Americans, 51 mg/dL for boys and 52 mg/dL for girls.

Adults

- The mean level of HDL cholesterol for American adults age 20 and older is 51.3 mg/dL.[5]
- According to NHANES 1999–2002 (NCHS):
  - Among non-Hispanic whites, mean HDL cholesterol levels were 45.5 mg/dL for men and 52.9 for women.
  - Among non-Hispanic blacks, mean HDL cholesterol levels were 51.0 mg/dL for men and 57.3 for women.
  - Among Mexican Americans, mean HDL cholesterol levels were 45.0 mg/dL for men and 52.9 for women.

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TABLE 10-1. High Blood Cholesterol and Other Lipids

Population Group	Prevalence of Total Cholesterol 200 mg/dL or Higher 2004 Age 20+	Prevalence of Total Cholesterol 240 mg/dL or Higher 2004 Age 20+	Prevalence of LDL Cholesterol 130 mg/dL or Higher 2004 Age 20+	Prevalence of HDL Cholesterol Less Than 40 mg/dL 2004 Age 20+
Both sexes*	105 200 000 (48.4%)	36 600 000 (16.8%)	79 300 000 (32.5%)	44 100 000 (16.7%)
Males*	50 100 000 (47.8%)	17 000 000 (16.2%)	40 800 000 (32.2%)	31 700 000 (25.1%)
Females*	55 200 000 (48.6%)	19 700 000 (17.1%)	38 600 000 (32.4%)	12 300 000 (9.1%)
NH white males	47.9%	16.1%	31.7%	26.2%
NH white females	49.7%	18.2%	33.8%	8.8%
NH black males	44.8%	14.1%	32.4%	15.5%
NH black females	42.1%	12.5%	29.8%	6.9%
Mexican-American males	49.9%	16.0%	39.0%	27.7%
Mexican-American females	50.0%	14.2%	30.7%	13.0%
Total Hispanics† age 18+	...	25.6%	...	...
Total Asian/Pacific Islanders† age 18+	...	27.3%	...	...
Total American Indians/Alaska Natives, Alaska† age 18+	...	26.0%	...	...
Total American Indians/Alaska Natives, Oklahoma† age 18+	...	28.6%	...	...
Total American Indians/Alaska Natives, Washington† age 18+	...	26.5%	...	...

Ellipses (. . .) indicate data not available; mg/dL, milligrams per deciliter of blood. Prevalence of total cholesterol 200 mg/dL or higher includes people with total cholesterol of 240 mg/dL or higher. In adults, levels of 200 to 239 mg/dL are considered borderline-high cholesterol. Levels of 240 mg/dL or higher are considered high cholesterol.

*Total data for total cholesterol are for Americans age 20 and older. Data for LDL cholesterol, HDL cholesterol, and all racial/ethnic groups are age adjusted for age 20 and older.

†BRFSS (1997), MMWR[1]; data are self-reported data for Americans age 18 and older.

Source for total cholesterol 200 mg/dL or higher, 240 mg/dL or higher, LDL, and HDL: NHANES (1999–2004), NCHS, and NHLBI. Estimates from NHANES 1999–2004 applied to 2004 population estimates.

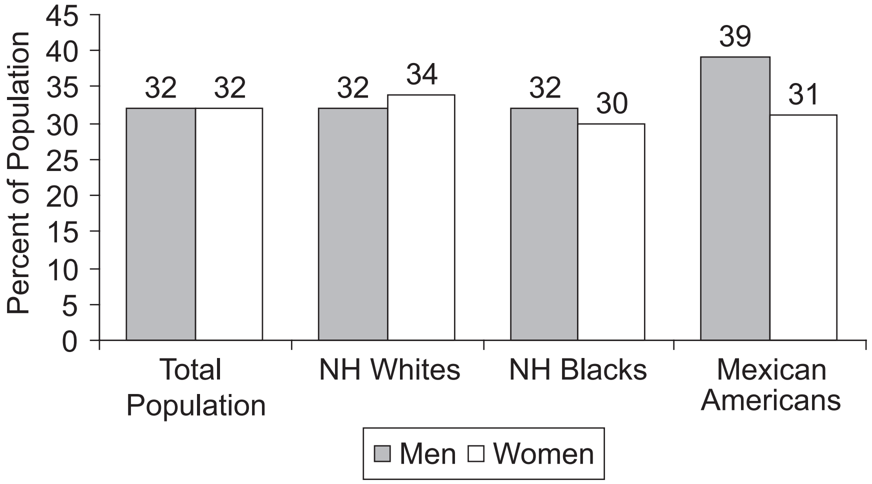

Chart 10-1. Age-adjusted prevalence of adults age 20 and older with LDL cholesterol of 130 mg/dL or higher by race/ethnicity and sex (NHANES: 2003–2004). Source: NCHS and NHLBI.

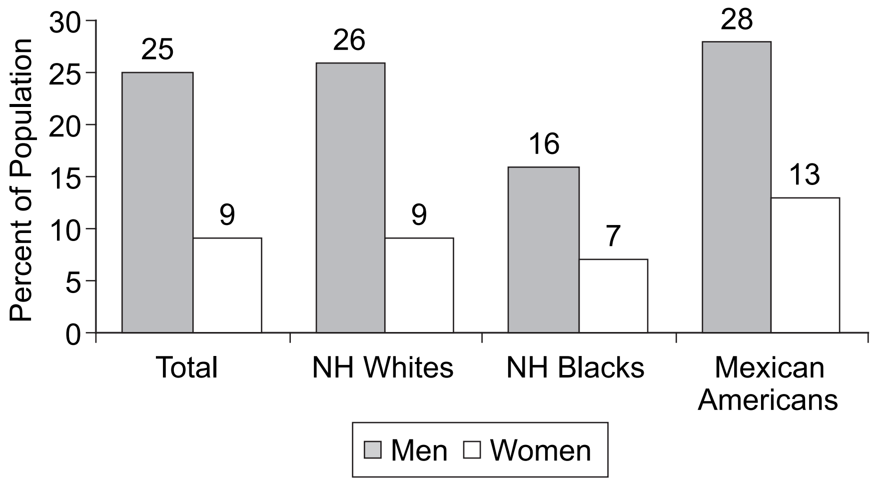

Chart 10-2. Age-adjusted prevalence of adults age 20 and older with HDL cholesterol under 40 mg/dL by race/ethnicity and sex (NHANES: 2003–2004). Source: NCHS and NHLBI.

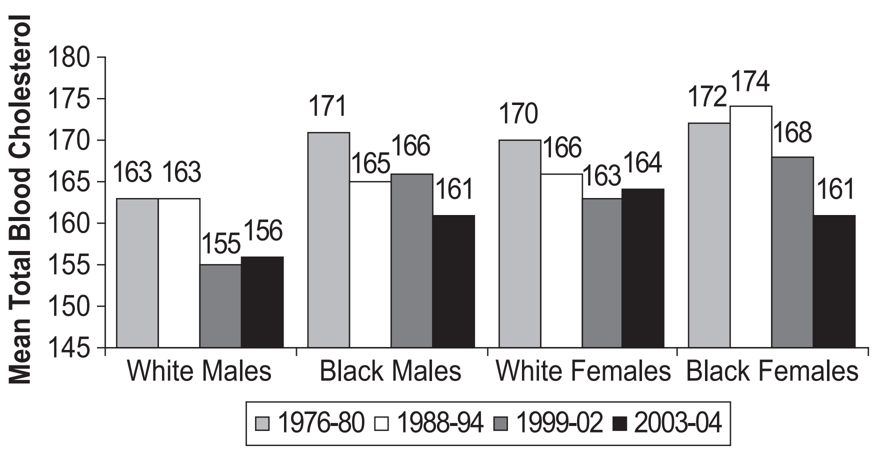

Chart 10-3. Trends in mean total serum cholesterol among adolescents between the ages of 12 and 17 years by race, sex, and survey (NHANES: 1976–1980, 1988–1994, 1999–2002, and 2003–2004). Source: NCHS and NHLBI.

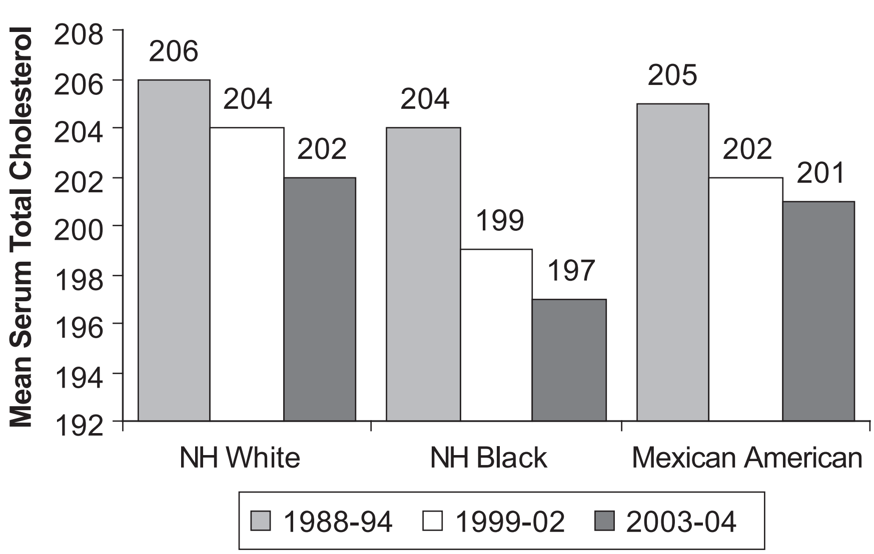

Chart 10-4. Trends in mean total serum cholesterol among adults by race, sex, and survey (NHANES: 1988–1994, 1999–2002, and 2003–2004). Source: NCHS and NHLBI.

11. Risk Factor: Physical Inactivity

See Tables 11-1 and 11-2 and Charts 11-1 and 11-2.

Prevalence

Youth

- In 2005, 43.8% of male and 27.8% of female high school students in grades 9 through 12 met currently recommended levels of PA. Among these students, 37.1% of males and 29.0% of females attended physical education classes daily, and 87.2 of males and 80.3 of females exercised or played sports for more than 20 minutes during an average physical education class.[1]
- Among children between the ages of 9 and 13 years, 61.5% do not participate in any organized PA during their nonschool hours, and 22.6% do not engage in any free-time PA, according to 2002 data from the Youth Media Campaign Longitudinal Study (YMCLS) of the CDC. Non-Hispanic black and Hispanic children are significantly less likely than non-Hispanic white children to report involvement in organized activities, as are children whose parents have lower incomes and education levels.[2]
- By the age of 16 or 17, 31% of white girls and 56% of black girls report no habitual leisure-time PA.[3]
  - Lower levels of parental education are associated with greater decline in PA for white girls at both younger and older ages. For black girls, this association is seen only at older ages.
  - Cigarette smoking is associated with decline in PA among white girls. Pregnancy is associated with decline in PA among black girls but not among white girls.
  - A higher BMI is associated with greater decline in PA among girls of both races.
- The prevalence of high school students who played video or computer games or used a computer for something that was not schoolwork for 3 or more hours a day was 21.1%, according to data from the CDC's YRBS 2005 survey. The prevalence of computer use was higher among male (27.4%) than female (14.8%) students; specifically, it was higher among non-Hispanic white male (25.4%), non-Hispanic black male (34.9%), and Hispanic male (24.4%) than non-Hispanic white female (13.7%), non-Hispanic black female (16.1%), and Hispanic female (14.9%) students, respectively.[1]
- According to data from the CDC's YRBS 2005 survey, 37.2% of students watched television 3 or more hours on an average school day. The prevalence was higher among non-Hispanic black (64.1%) than non-Hispanic white (29.2%) and Hispanic (45.8%) students; higher among Hispanic (45.8%) than non-Hispanic white (29.2%) students; higher among non-Hispanic black female (64.5%) than non-Hispanic white female (28.1%) and Hispanic female (45.8%) students; higher among Hispanic females (45.8%) than non-Hispanic white female (28.1%) students; higher among non-Hispanic black male (63.5%) than non-Hispanic white male (30.2%) and Hispanic male (45.8%) students; and higher among Hispanic male (45.8%) than non-Hispanic white male (30.2%) students.[1]

Abbreviations Used in Chapter 11

BMI	body mass index
BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
HBP	high blood pressure
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHIS	National Health Interview Survey
PA	physical activity
RR	relative risk
YRBS	Youth Risk Behavior Surveillance

Adults

- Among Asians and Native Hawaiians or other Pacific Islanders, 21.2% of men and 27.0% of women reported no leisure-time PA, according to 2001–2003 data from the BRFSS surveys. Of these, 21.5% were overweight (BMI 25.0 to 29.9), and 23.8% were obese (BMI 30.0 and higher).[4]
- According to 2005 data from the BRFSS survey (CDC), 76.2% of respondents age 18 and older had participated in any PA in the past month. The highest percentage was in Minnesota (83.8%), and the lowest was in Louisiana (66.6%). Overall, the percentage of adults with at least 20 minutes of PA at least 3 days per week was 72.5%. The highest percentage was in Kentucky (83.2%), and the lowest was in California (63.8%). Overall, the percentage of adults with at least 30 minutes of moderate PA at least 5 days per week or at least 20 minutes of vigorous PA at least 3 days per week was 50.9%. The highest percentage was in Kentucky (65.3%), and the lowest was in Alaska (40.8%) (www.cdc.gov/brfss/).
- On the basis of data from the 1999–2001 NHIS surveys[5]:
  - Among US adults age 18 and older, 31.3% engage in any regular leisure-time PA.
  - Men (64.2%) were more likely than women (59.0%) to engage in at least some leisure-time PA.
  - Engaging in any PA declined steadily with age, from 39.7% of adults between the ages of 18 and 24 to 15.6% of those age 75 and older.
  - Engaging in any regular leisure-time PA was more prevalent among white adults (32.7%) than among Asian adults (27.8%) and black adults (23.9%).
  - Non-Hispanic white adults (65.7%) were more likely than non-Hispanic black adults (49.3%) and Hispanic adults (45.0%) to engage in at least some leisure-time PA.
  - Adults with a graduate degree (80.6%) were about twice as likely as adults with less than a high school diploma (41.0%) to engage in at least some leisure-time PA.
  - Adults who had incomes at least 4 times the poverty level (39.9%) were about twice as likely as adults with incomes below the poverty level (22.6%) to engage in any regular PA.
  - Widowed adults (23.6%) were less likely than never-married adults (33.0%), married adults (31.1%), and divorced or separated adults (29.1%) to engage in regular PA.

- Adults living in the West (65.3%) were more likely than adults living in the South (56.4%) to engage in at least some leisure-time PA.

- The RR of CHD associated with physical inactivity ranges from 1.5 to 2.4, an increase in risk comparable to that observed for high blood cholesterol, HBP, or cigarette smoking.[6]
- A study of more than 72 000 female nurses indicated that moderate-intensity PA, such as walking, is associated with a substantial reduction in risk of total and ischemic stroke.[7]
- The prevalence of physical inactivity during leisure time among Mexican Americans is higher than in the general population.[8]
  - The prevalence of physical inactivity among those whose main language is English is 15% of men and 28% of women. This is similar to that of the general population (17% of men and 27% of women).
  - Those whose main language is Spanish have the highest prevalence of physical inactivity (38% of men and 58% of women).
- Data from the 1999–2003 NHIS survey of the NCHS showed that American Indian or Alaska Native adults age 18 and older were as likely (50.3%) as black adults (49.9%) and more likely than Asian adults (38.1%) and white adults (36.6%) to never engage in any leisure-time PA.[9]

Cost

- The annual estimated direct medical cost of physical inactivity in 2000 was $76.6 billion.[10]

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TABLE 11-1. Regular Leisure-Time PA

Population Group	Prevalence 2004 Age 18+
Both sexes	30.1%
Males	31.4%
Females	29.0%
NH white males	33.4%
NH white females	31.8%
NH black males	29.5%
NH black females	19.6%
Hispanic or Latino males	24.9%
Hispanic or Latino females	21.8%

Regular leisure-time PA is defined as light–moderate activity for ≥30 minutes, ≥5 times per week, or vigorous activity for ≥20 minutes, ≥3 times per week (Early Release of Selected Estimates on Data from the 2004 NHIS, NCHS).

Data are age adjusted for adults age 18 and older.

Source: NHIS 2004 (personal communication, NCHS).

TABLE 11-2. Leisure-Time Physical Inactivity

Population Group	Prevalence 2004 Age 18+	2000 Cost[10]
Both sexes	23.7%	$76.6 billion
Males	21.4%	...
Females	25.9%	...
NH white males	18.4%	...
NH white females	21.6%	...
NH black males	27.0%	...
NH black females	33.9%	...
American Indian/Alaska Native males	23.8%	...
American Indian/Alaska Native females	31.8%	...
Hispanic males	32.5%	...
Hispanic females	39.6%	...
Asian/Pacific Islander males	20.4%	...
Asian/Pacific Islander females	24.0%	...

Ellipses (...) indicate data not available.

Prevalence is the percentage of population that reports no leisure-time PA.

Source: CDC.[11]

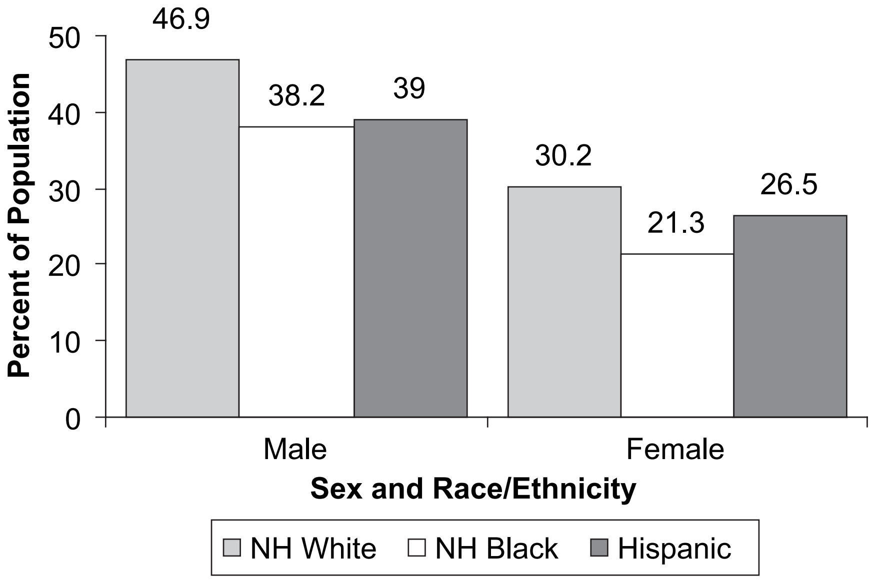

Chart 11-1. Prevalence of students in grades 9 through 12 who met currently recommended levels of PA during the previous 7 days by race/ethnicity and sex (YRBS: 2005). "Currently recommended levels" are defined as activity that increased students' heart rates and made them breathe hard some of the time for a total of at least 60 minutes/day on at least 5 of the 7 days preceding the survey. Source: YRBS and *MMWR*.[14]

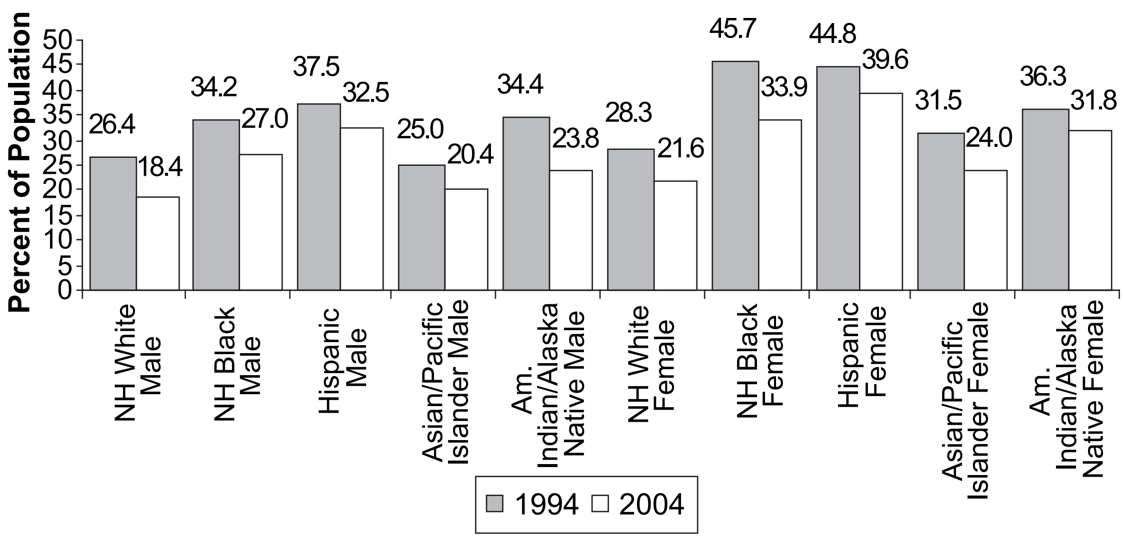

Chart 11-2. Prevalence of leisure-time physical inactivity among adults age 18 and older by race/ethnicity and sex (BRFSS: 1994 and 2004). Source: *MMWR*.[11]

12. Risk Factor: Overweight and Obesity

See Table 12-1 and Charts 12-1 through 12-3.

Prevalence

Youth

- More than 9 million children and adolescents between the ages of 6 and 19 years are considered overweight on the basis of being in the 95th percentile or higher of BMI values in the 2000 CDC growth chart for the United States (NHANES [2003–2004], NCHS).[1]
- On the basis of data from NHANES, the prevalence of overweight in children between the ages of 6 and 11 years increased from 4.0% in 1971–1974 to 17.5% in 2001–2004. The prevalence of overweight in adolescents between the ages of 12 and 19 increased from 6.1% to 17.0% (Health, United States, 2006, NCHS [prepublication]).
- Nearly 14% of preschool children between the ages of 2 and 5 years were overweight in 2003–2004, up from 10.3% in 1999–2000.[1]
  - Among preschool children, the following are overweight: 11.5% of non-Hispanic whites, 13.0% of non-Hispanic blacks, and 19.2% of Mexican Americans.
  - Among children between the ages of 6 and 11, the following are overweight: 17.7% of non-Hispanic whites, 22.0% of non-Hispanic blacks, and 22.5% of Mexican Americans.
  - Among adolescents between the ages of 12 and 19, the following are overweight: 17.3% of non-Hispanic whites, 21.8% of non-Hispanic blacks, and 16.3% of Mexican Americans.
  - In addition, the data show that another 16.5% of children and teens between the ages of 2 and 19 are considered at risk of being overweight (BMI from the 85th to 95th percentile).
- Overweight adolescents have a 70% chance of becoming overweight adults. This increases to 80% if one or both parents are overweight or obese (www.surgeongeneral.gov/topics/obesity/calltoaction/fact_adolescents.htm).
- Data from the CDC's YRBS 2005 survey showed that the prevalence of being overweight was higher among non-Hispanic black (16.0%) and Hispanic (16.8%) than non-Hispanic white (11.8%) students; higher among non-Hispanic black female (16.1%) and Hispanic female (12.1%) than non-Hispanic white female (8.2%) students; and higher among non-Hispanic black male (15.9%) and Hispanic male (21.3%) than non-Hispanic white male (15.2%) students. The prevalence of being at risk for overweight was higher among non-Hispanic black (19.8%) and Hispanic (16.7%) than non-Hispanic white (14.5%) students; higher among non-Hispanic black female (22.6%) than non-Hispanic white female (13.8%) and Hispanic female (16.8%) students; and higher among Hispanic male (16.5%) and non-Hispanic black male (16.7%) than non-Hispanic white male (15.2%) students.[2]
- Data from NHANES 1999–2002 showed that among all overweight children and teens between the ages of 2 and 19 (or their parents), 36.7% reported ever having been told by a doctor or healthcare professional that they were overweight. For those between the ages of 2 and 5, this percentage was 17.4%; for those between the ages of 6 and 11, 32.6%; for those between the ages of 12 and 15, 39.6%; and for those between the ages of 16 and 19, 51.6%. Similar trends were seen for males and females. Among racial/ethnic populations, overweight non-Hispanic black females were significantly more likely to be told that they were overweight than were non-Hispanic white females (47.4% versus 31.0%). Among those informed of overweight status, 39% of non-Hispanic black females were severely overweight, compared with 17% of non-Hispanic white females.[3]

Adults

- Analysis of the FHS, 1971 to 2001, showed that among normal-weight white adults between the ages of 30 and 59, the 4-year rates of developing overweight varied from 14% to 19% in women and 26% to 30% in men. The 30-year risk was similar for both sexes, with some variation by age. Overall, the 30-year risk exceeded 1 in 2 persons for "overweight or more," 1 in 4 for obesity, and 1 in 10 for stage II obesity (BMI $\geq$35) across different age groups. The 30-year estimates correspond to the lifetime risk for overweight or more or obesity for participants 50 years of age.[4]
- The age-adjusted prevalence of overweight and obesity (BMI $\geq$25) increased from 64.5% in NHANES (1999–2000) to 66.3% in NHANES (2003–2004, NCHS). The prevalence of obesity (BMI $\geq$30) increased during this period from 30.5% to 32.2%. Extreme obesity (BMI $\geq$40.0) increased from 4.7% to 4.8%.[1]
- According to 2005 data from the BRFSS survey based on self-reported height and weight, 24.4% of adults are obese. By state, the highest prevalences of obesity were seen in Louisiana, Mississippi, and West Virginia. The lowest prevalences were seen in Colorado and Hawaii (http://apps.nccd.cdc.gov/brfss/index.asp).

Abbreviations Used in Chapter 12

BMI	body mass index
BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CI	confidence interval
CVD	cardiovascular disease
FHS	Framingham Heart Study
HHP	Honolulu Heart Program
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHIS	National Health Interview Survey
NOMAS	Northern Manhattan Study
YRBS	Youth Risk Behavior Surveillance
OR	odds ratio

- Abdominal obesity is an independent risk factor for ischemic stroke in all race/ethnic groups, with an OR about 3 times greater when comparing the first and fourth quartiles. This effect was larger for those under age 65 (OR=4.4) than those over age 65 (OR=2.2) (NOMAS).[5]
- A recent comparison of risk factors in both the HHP and FHS showed that a BMI increase of around 3 kg/m^2 raised the risk of hospitalized thromboembolic stroke by 10% to 30%.[6]
- In 1998 and 1999, surveys of people in 8 states and the District of Columbia by the BRFSS study of the CDC indicated that obesity rates are significantly higher among people with disabilities, especially blacks and those between the ages of 45 and 64.[7]
- Analysis of data (FHS, NHLBI) showed that overweight and obesity were associated with large decreases in life expectancy. Forty-year-old female nonsmokers lost 3.3 years and 40-year-old male nonsmokers lost 3.1 years of life expectancy because of overweight. In 40-year-old nonsmokers, females lost 7.1 years and males lost 5.8 years because of obesity. Obese female smokers lost 7.2 years and obese male smokers lost 6.7 years when compared with normal-weight nonsmokers.[8]
- Data from the 1999–2003 NHIS study of the NCHS showed that American-Indian or Alaska Native adults age 18 and older were as likely (30.4%) as black adults (30.8%) and less likely than white adults (40.9%) and Asian adults (62.8%) to be at a healthy weight.[9]
- Data from the 1999–2003 NHIS study of the NCHS showed that American-Indian or Alaska Native women age 18 and older were less likely (29.4%) than black women (36.6%) and more likely than white women (20.3%) and Asian women (5.8%) to be obese.[9]
- According to the World Health Organization, the number of overweight and obese people worldwide is set to increase to 1.5 billion by 2015 if current trends continue. Excessive weight and obesity are major risk factors for CVD, the No. 1 cause of death worldwide, claiming more than 17 million lives a year.[10]
- On the basis of data from NHANES 2001–2002 (NCHS), racial disparities were observed among women, not among men: 68.6% of black women were overweight or obese compared with 56.0% of white women and 54.5% of Hispanic women. The racial differences among women were more pronounced when comparing the rates of obesity: 41.5% of black women were obese compared with 19.3% of white women and 26.2% of Hispanic women.[11]

Mortality

Among adults, obesity was associated with nearly 112 000 excess deaths (95% CI 53 754 to 170 064) relative to normal weight in 2000. Of these, grade 1 obesity (BMI 30 to <35) was associated with almost 30 000 excess deaths (95% CI 8534 to 68 220) and Grade II–III obesity (BMI ≥35) with more than 82 000 excess deaths (95% CI 44 843 to 119 289). Underweight was associated with nearly 34 000 excess deaths (95% CI 15 726 to 51 766). Overweight (BMI 25 to <30) was not associated with excess mortality.[12]

Cost

- Among children and adolescents, annual hospital costs related to obesity were $127 million between 1997 and 1999.[13]
- The estimated cost of overweight and obesity, in 2001 dollars, is $117 billion. Direct cost is $61 billion, and indirect cost is $56 billion. The cost of lost productivity related to obesity (BMI >30) among Americans between the ages of 17 and 64 is $3.9 billion (www.win.niddk.nih.gov/statistics/).

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TABLE 12-1. Overweight and Obesity

Population Group	Prevalence of Overweight and Obesity in Adults 2004 Age 20+	Prevalence of Obesity in Adults 2004 Age 20+	Prevalence of Overweight in Children 2004 Ages 6–11	Prevalence of Overweight in Adolescents 2004 Ages 12–19	Cost* 2001
Both sexes	140 000 000 (66.0%)	66 000 000 (31.4%)	4 200 000 (17.5%)	5 700 000 (17.0%)	$117 billion
Males	72 000 000 (70.5%)	30 000 000 (29.5%)	2 300 000 (18.7%)	3 100 000 (17.9%)	...
Females	68 000 000 (61.6%)	36 000 000 (33.2%)	1 900 000 (16.3%)	2 600 000 (16.0%)	...
NH white males	71.0%	30.2%	16.9%	17.9%	...
NH white females	57.6%	30.7%	15.6%	14.6%	...
NH black males	67.0%	30.8%	17.2%	17.7%	...
NH black females	79.6%	51.1%	24.8%	23.8%	...
Mexican-American males	74.6%	29.1%	25.6%	20.0%	...
Mexican-American females	73.0%	39.4%	16.6%	17.1%	...
Hispanic or Latino† age 18+	38.9%	24.7%	...	...	...
Asian only† age 18+	25.1%	6.0%	...	...	...
American Indian/Alaska Native† age 18+	33.5%	32.9%	...	...	...

Ellipses (. . .) indicate data not available. BMI is weight in kilograms divided by height in meters squared (kg/m^2).

Data for white, black or African-American, and Asian or Pacific Islander males and females are for non-Hispanics.

Overweight and obesity in adults is BMI 25 and higher. Obesity in adults is BMI 30 or higher. Overweight in children and adolescents was defined as being at or above the 95th percentile of the sex-specific BMI-for-age CDC 2000 growth chart.

*www.win.niddk.nih.gov/statistics/.

†NHIS (2003), NCHS; data are weighted percentages for Americans age 18 and older.

Sources: NHANES (2001–2004), NCHS. Health, United States, 2006. Unpublished data. Data in adults are for age 20 and older. Estimates from NHANES 2001–2004 applied to 2004 population estimates.

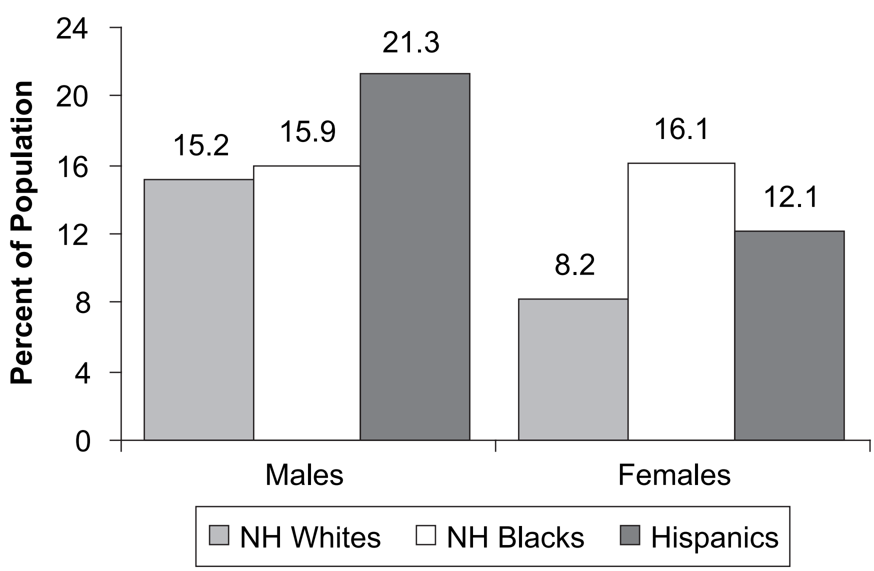

Chart 12-1. Prevalence of overweight among students in grades 9 through 12 by sex and race/ethnicity (YRBS: 2005). Source: BMI 95th percentile or higher by age and sex of the CDC 2000 growth chart. *MMWR*.[2]

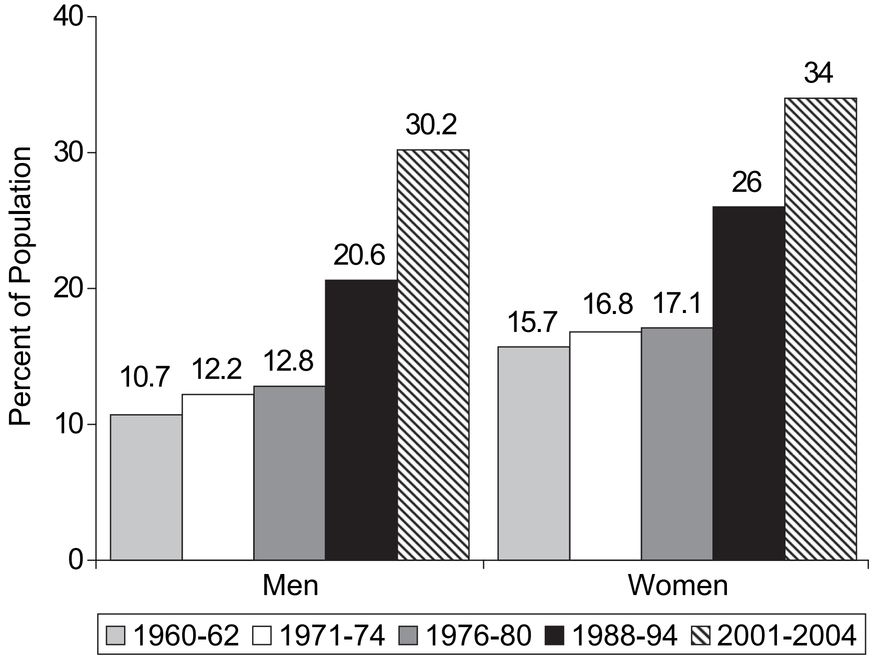

Chart 12-2. Age-adjusted prevalence of obesity in adults between the ages of 20 and 74 by sex and survey (National Health Examination Survey 1960–1962; NHANES: 1971–1974, 1976–1980, 1988–1994, and 2001–2004). Obesity is defined as a BMI of 30.0 or higher. Source: Health, United States, 2006; unpublished data, NCHS.

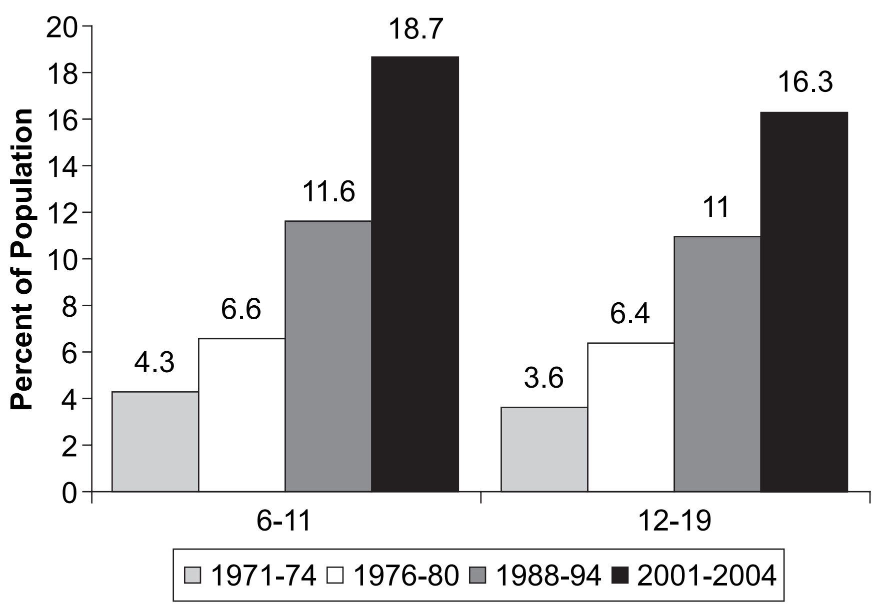

Chart 12-3. Trends in the prevalence of overweight among US children and adolescents by age and survey (NHANES: 1971–1974, 1976–1980, 1988–1994, and 2001–2004). Source: Health, United States, 2006; unpublished data, NCHS.

13. Risk Factor: Diabetes Mellitus

ICD-9 250; ICD-10 E10–E14. See Table 13-1 and Charts 13-1 and 13-2.

Prevalence

- The National Institute of Diabetes and Digestive and Kidney Diseases estimates that 20.8 million Americans (7% of the population) have diabetes and that about 30% are unaware of the diagnosis. Among Americans age 20 and older, 9.6% have diabetes, and among those 60 and older, 21% have diabetes. Men age 20 and older have a slightly higher prevalence (11%) than women (9%). Among non-Hispanic whites age 20 and older, 9% have diabetes; the prevalence of diabetes among non-Hispanic blacks of a similar age is 1.8 times higher; among Mexican Americans, 1.7 times higher; and among American Indians and Alaska Natives, 1.5 to 2.2 times higher.[1]
- About 176 500 people age 20 or younger have diabetes (0.22% of all people in this age group). About 1 in every 400 to 600 children and adolescents has type 1 diabetes. Although type 2 diabetes can occur among youth, the nationally representative data that would be needed to monitor diabetes trends in youth by type are not yet available.[1]
- The prevalence of diabetes increased by 8.2% from 2000–2001. Since 1990, the prevalence of those diagnosed with diabetes increased 61%.[2] On the basis of 2004 BRFSS data, the median prevalence of adults who reported ever having been told by a doctor that they have diabetes was 7.1%. West Virginia had the highest prevalence (11.0%), and Alaska had the lowest (4.2%).[3]

Abbreviations Used in Chapter 13

AHRQ	Agency for Healthcare Research and Quality
BMI	body mass index
BP	blood pressure
BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CHD	coronary heart disease
CI	confidence interval
CVD	cardiovascular disease
FHS	Framingham Heart Study
HbA_{1c}	glycosylated hemoglobin
HBP	high blood pressure
ICD	International Classification of Diseases
LDL	low-density lipoprotein
MI	myocardial infarction
NCHS	National Center for Health Statistics
NH	non-Hispanic
NHANES	National Health and Nutrition Examination Survey
NHDS	National Hospital Discharge Survey
OR	odds ratio
RR	relative risk

- From 1994 to 2002, the age-adjusted prevalence of diabetes increased 54.0% for US adults overall (from 4.8% to 7.3%) and increased 33.2% (from 11.5% to 15.3%) among American Indian or Alaska Native adults. The overall age-adjusted prevalence for American Indian or Alaska Native adults was more than twice that of US adults overall.[4]
- In 1976–1980, total diabetes prevalence in African Americans 40 to 74 years of age was 8.9%, according to NHANES (NCHS) data; in 1988 to 1994, the rate was 18.2%—a doubling of the rate in just 12 years. In 1988 to 1994, among people 40 to 74 years of age, the prevalence rate was 18.2% for African Americans, compared with 11.2% for whites.[5]
- Data from the NHANES 1999–2002 (NCHS) showed a disproportionately high prevalence of diabetes in non-Hispanic blacks and Mexican Americans when compared with non-Hispanic whites. For previously diagnosed diabetes, the percentages were 11.0% for non-Hispanic blacks and 10.4% for Mexican Americans, compared with 5.2% for non-Hispanic whites. For undiagnosed diabetes, the percentages were 3.6%, 3.0%, and 2.7%, respectively. For impaired fasting glucose (100 to <126 mg/dL), the percentages were 17.7%, 31.6%, and 26.1%, respectively.[6]
- BRFSS (CDC) data from 1998–2002 in selected areas showed that diabetes disproportionately affects Hispanics in the United States and Puerto Rico. Hispanics were twice as likely to have diabetes as were non-Hispanic whites of similar age (9.8% versus 5.0%). This disparity, however, varied by geographic location—it was lowest in Florida and higher in California, Texas, and Puerto Rico. Among Hispanic adults in California, Florida, Illinois, New York/New Jersey, Puerto Rico, and Texas, the overall prevalence of diabetes was 7.4%; it ranged from 6.2% in Illinois and New York/New Jersey to 9.3% in Puerto Rico.[7]
- The prevalence of diabetes for all age groups worldwide was estimated to be 2.8% in 2000 and is projected to be 4.4% in 2030. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030.[8]
- Type 2 diabetes may account for 90% to 95% of all diagnosed cases of diabetes (diabetes.niddk.nih.gov/dm/pubs/statistics/index.htm). In Framingham, Mass, 99% of diabetes is type 2.[9]

Incidence

- One and a half million new cases of diabetes were diagnosed in people age 20 or older in 2005.[1]
- Data from Framingham, Mass, indicate a doubling in the incidence of diabetes over the past 30 years, most dramatically during the 1990s. FHS participants who attended a routine examination in the 1970s, 1980s, or 1990s were followed up for the 8-year incidence of diabetes across decades for participants 40 to 55 years of age in each decade. The age-adjusted 8-year incidence rates of diabetes were 2.0%, 3.0%, and 3.7% among women and 2.7%, 3.6%, and 5.8% among men in the 1970s, 1980s, and 1990s, respectively. Compared with the 1970s, the age- and sex-adjusted ORs for diabetes were 1.40 (95% CI 0.89–

2.22) in the 1980s and 2.05 (95% CI 1.33–3.14) in the 1990s (*P* for trend 0.0006). Among women, the ORs were 1.50 (95% CI 0.75–2.98) in the 1980s and 1.84 (95% CI 0.95–3.55) in the 1990s (*P* for trend 0.07) compared with the 1970s, whereas among men, the ORs were 1.33 (95% CI 0.72–2.47) in the 1980s and 2.21 (95% CI 1.25–3.90) in the 1990s (*P* for trend 0.003). Most of the increase in absolute incidence of diabetes occurred in individuals with BMI ≥30 kg/m^2 (*P* for trend 0.03).[10]

Mortality

Total-mention mortality (2002)—224 100.

- The 2004 overall death rate from diabetes was 24.4. Death rates were 26.1 for white males, 50.5 for black males, 19.2 for white females, and 44.9 for black females.
- At least 65% of people with diabetes mellitus die of some form of heart disease and stroke.[11]
- Heart disease death rates among adults with diabetes are 2 to 4 times higher than the rates for adults without diabetes (diabetes.niddk.nih.gov).

Aftermath

- A population-based study of more than 13 000 men and women in Denmark showed that in people with type 2 diabetes, the RR of first MI, incident MI, and admission for MI was increased 1.5- to 4.5-fold in women and 1.5- to 2-fold in men. The RR of first stroke, incident stroke, and admission for stroke was increased 2- to 6.5-fold in women and 1.5- to 2-fold in men, with a significant difference between the sexes. In both men and women the RR of death was increased 1.5 to 2 times.[12]
- Data from Canada demonstrate that diabetes confers an equivalent risk to aging 15 years. However, people age 40 or younger with diabetes did not seem to be at increased risk of CVD if they had an event rate equivalent to a 10-year risk of 20% or more or an event rate equivalent to that associated with previous MI. On the basis of healthcare insurance claims of more than 10 million people for acute MI, stroke, or death from any cause, on average, diabetic men and women entered the high-risk category at ages 47.9 and 54.3 years, respectively. The transition to a high-risk category occurred at a younger age for men and women with diabetes than for those without diabetes (mean difference, 14.6 years). The data suggest that age is a key factor to consider in targeting risk reduction in people with diabetes.[13]
- Although the exact date of diabetes onset can be difficult to determine, duration of diabetes appears to affect CVD risk. Longitudinal data from Framingham, Mass, suggest that the risk factor–adjusted relative risk of CHD was 1.38 (95% CI 0.99 to 1.92) times higher for each 10-year increase in duration of diabetes (defined as fasting glucose ≥126 mg/dL, random glucose ≥200 mg/dL, or use of an oral hypoglycemic agent or insulin), and the risk for CHD death was 1.86 times higher (1.17 to 2.93) for the same increase in duration of diabetes.[14]
- Diabetes increases the risk of stroke, with the RR ranging from 1.8 to almost 6.0.[15]
- Ischemic stroke patients with diabetes are younger, more likely to be African American, and more likely to have hypertension, MI, and high cholesterol than are nondiabetic patients. Diabetes increases ischemic stroke incidence at all ages, but this risk is most prominent before age 55 in African Americans and before age 65 in whites.[16]
- On the basis of data from the CDC Diabetes Surveillance System, 1997–2000:
  - In 2000, the age-standardized prevalence of any self-reported cardiovascular condition among persons with diabetes age 35 and older was 37.5% for white men, 32.2% for white women, 31.4% for black men, 34.0% for black women, 23.9% for Hispanic men, and 22.9% for Hispanic women.
  - In 2000, the self-reported prevalence of any cardiovascular condition was 28.8 per 100 diabetic population among persons 35 to 64 years of age, 45.7 per 100 diabetic population among persons 65 to 74 years of age, and 53.5 per 100 diabetic population among persons age 75 and older.
  - In 2000, among persons with diabetes age 35 and older, 37.2% reported being diagnosed with a cardiovascular condition, (ie, CHD, stroke, or other cardiovascular condition).
  - In 2000, among persons with diabetes age 35 and older, the age-standardized prevalence of self-reported CHD, angina, or MI was almost 3 times that of self-reported stroke (22.1% versus 8.0%).
  - In 2000, 4.4 million persons age 35 and older with diabetes reported being diagnosed with a cardiovascular condition, 2.9 million were diagnosed with CHD (ie, self-reported CHD, angina, or MI), and 1.1 million reported being diagnosed with a stroke.
  - About one third of adults with diabetes received all 5 interventions recommended for comprehensive diabetes care in 2001. The proportion receiving all 5 interventions was lower among blacks compared with whites and lower among Hispanics compared with non-Hispanic whites (2004 National Healthcare Disparities Report, AHRQ, US Department of Health and Human Services).
  - The difference in hospital admissions for long-term complications between men and women is highly significant, with women 22% less likely than men to be admitted (2004 National Healthcare Disparities Report, AHRQ, US Department of Health and Human Services).
  - In multivariate models controlling for age, gender, income, education, insurance, and residence location, blacks were 38% less likely and Hispanics were 33% less likely than their respective comparison groups to receive all services in 2001 (2004 National Healthcare Disparities Report, AHRQ, US Department of Health and Human Services).
- Data from Framingham, Mass, also show that despite improvements in CVD morbidity and mortality, diabetes continues to elevate CVD risk. Participants between the ages of 45 and 64 years from the FHS original and offspring cohorts who attended examinations in 1950–1966 (“earlier” time period; 4118 participants, 113 with diabetes) and 1977–1995 (“later” time period; 4063 partic-

ipants, 317 with diabetes) were followed up for incident MI, CHD death, and stroke. Among participants with diabetes, the age- and sex-adjusted CVD incidence rate was 286.4 per 10 000 person-years in the earlier period and 146.9 per 10 000 person-years in the later period, a 35.4% (95% CI 25.3% to 45.4%) decline. Hazard ratios for diabetes as a predictor of incident CVD were not significantly different in the earlier (risk factor–adjusted hazard ratio 2.68, 95% CI 1.88 to 3.82) versus later (hazard ratio 1.96, 95% CI 1.44 to 2.66) periods. Thus, although there was a 50% reduction in the rate of incident CVD events among adults with diabetes, the absolute risk of CVD remained 2-fold greater than among persons without diabetes.[17]

- The increased prevalence of diabetes is being followed by an increasing prevalence of CVD morbidity and mortality. New York City death certificate data for 1989–1991 and 1999–2001 and hospital discharge data for 1988–2002 demonstrate alarming increases in all-cause and cause-specific mortality between 1990 and 2000, as well as annual hospitalization rates for diabetes and its complications among patients hospitalized with acute MI and/or diabetes. During this decade, all-cause and cause-specific mortality rates declined, with the striking exception of diabetes, which increased 61% and 52% for men and women, respectively, as did hospitalization rates for diabetes and its complications. The percentage of all acute MIs occurring in patients with diabetes increased from 21% to 36%, and the absolute number more than doubled, from 2951 to 6048. Although hospital days due to acute MI fell overall, for those with diabetes, they increased 51% (from 34 188 to 51 566). These data suggest that increases in diabetes rates threaten the long-established nationwide trend toward reduced coronary artery events.[18]

Risk Factors

- Among US adults with diabetes, data from the NHANES surveys from 1971–1974 to 1999–2000 showed that mean total cholesterol declined from 5.95 to 5.48 mmol/L. The proportion with high cholesterol decreased from 72% to 55%. Mean blood pressure declined from 146/86 to 134/72 mm Hg. The proportion with HBP decreased from 64% to 37%, and smoking prevalence decreased from 32% to 17%. Although these trends are encouraging, still 1 of 2 people with diabetes had high cholesterol, 1 of 3 had HBP, and 1 of 6 was a smoker.[19]
- A recent meta-analysis examined the effect of interventions to prevent CVD in patients with type 2 diabetes mellitus. Data from 7 serum cholesterol–lowering trials, 6 BP-lowering trials, and 5 blood glucose–lowering trials were pooled by using fixed-effects models. For aggregate cardiac events (CHD death and nonfatal MI), cholesterol lowering (rate ratio=0.75; 95% CI 0.61 to 0.93) and blood pressure lowering (rate ratio=0.73; 95% CI 0.57 to 0.94) produced large, significant effects, whereas intensive glucose lowering reduced events without reaching statistical significance (rate ratio=0.87; 95% CI 0.74 to 1.01). For cholesterol-lowering and BP-lowering therapy, 69 to 300 person-years of treatment were needed to prevent 1 cardiovascular event.[20]
- More recent observational data from follow-up of a randomized, controlled trial suggest that long-term intensive glycemic control may be associated with improved CVD event rates years after the end of the intervention, at least in type 1 diabetes.[21]
- Despite the efficacy of CVD risk factor reduction in diabetes, many patients do not receive optimal care. In data from NHANES 1999–2000 (NCHS) among adults age 20 and older with previously diagnosed diabetes, only 37.0% of participants achieved the target goal of glycosylated hemoglobin (HbA_{1c}) less than 7.0%, and 37.2% were above the recommended "take-action" HbA_{1c} level of greater than 8.0%; these percentages did not change significantly from NHANES III 1988–1994 (P=0.11 and P=0.87, respectively). Only 35.8% of participants achieved the target of systolic BP less than 130 mm Hg and diastolic BP less than 80 mm Hg, 40.4% had hypertensive BP levels (systolic BP ≥140 or diastolic BP <80 mm Hg), and 40.4% had hypertensive BP levels (systolic BP ≥140 or diastolic BP ≥90 mm Hg). These percentages did not change significantly from NHANES III (P=0.10 and P=0.56, respectively). More than half (51.8%) of the participants in NHANES 1999–2000 had total cholesterol levels of 200 mg/dL or greater (versus 66.1% in NHANES III; P<0.001). In total, only 7.3% (95% CI 2.8% to 11.9%) of adults with diabetes in NHANES 1999–2000 attained recommended goals of HbA_{1c} level less than 7%.[22]
- In one large academic medical center, outpatients with type 2 diabetes were observed during an 18-month period for proportions of patients who had HbA_{1c} levels, BP, or total cholesterol levels measured; who had been prescribed any drug therapy if HbA_{1c} levels, systolic BP, or LDL cholesterol levels exceeded recommended treatment goals; and who had been prescribed greater-than-starting-dose therapy if these values were above those of treatment goals. Patients were less likely to have cholesterol levels (76%) measured than HbA_{1c} levels (92%) or BP (99%; P<0.0001 for either comparison). The proportion of patients that received any drug therapy was greater for above-goal HbA_{1c} (92%) than for above-goal systolic BP (78%) or LDL cholesterol (38% P<0.0001 for each comparison). Similarly, patients whose HbA_{1c} levels were above the treatment goal (80%) were more likely to receive greater-than-starting-dose therapy, compared with those who had above-goal systolic BP (62%) and LDL cholesterol levels (13%; P<0.0001).[23]
- Data from the same academic medical center also showed that CVD risk factors among women with diabetes were managed less aggressively than among men with diabetes. Women were less likely than men to have HbA_{1c} <7% (without CHD: adjusted OR 0.84 [95% CI 0.75 to 0.95], P=0.005; with CHD: 0.63 [0.53 to 0.75], P<0.0001). Women without CHD were less likely than men to be treated with lipid-lowering medication (0.82 [0.71 to 0.96], P=0.01) or, when treated, to have LDL cholesterol levels <100 mg/dL (0.75 [0.62 to 0.93], P=0.004) and were less likely than men to be prescribed aspirin (0.63 [0.55 to

0.72], $P<0.0001$). Women with diabetes and CHD were less likely than men to be prescribed aspirin (0.70 [0.69 to 0.83], $P<0.0001$) or, when treated for hypertension or hyperlipidemia, were less likely to have BP levels <130/80 mm Hg (0.75 [0.69 to 0.82], $P<0.0001$) or LDL cholesterol levels <100 mg/dL (0.80 [0.68 to 0.94], $P=0.006$).[24]

- Between NHANES III 1988–1994 (NCHS) and NHANES 1999–2002, considerable differences were found among ethnic groups in glycemic control rates among adults with type 2 diabetes. Among non-Hispanic whites, the controlled rates were 43.8 in 1988–1994 and 48.4 in 1999–2002. For non-Hispanic blacks the rates were 41.2 and 36.5. For Mexican Americans the rates were 34.5 and 34.2.[25]

Cost

In 2002, the direct and indirect cost attributable to diabetes was $132 billion.[26] In one managed healthcare system, more than 25% of the excess costs of diabetes were due to CVD complications.[27]

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TABLE 13-1. Diabetes

Population Group	Prevalence of Physician-Diagnosed Diabetes 2004 Age 18+	Prevalence of Undiagnosed Diabetes 2004 Age 18+	Prevalence of Prediabetes 2004 Age 18+	Incidence of Diagnosed Diabetes	Mortality (Diabetes) 2004‡ All Ages	Hospital Discharges 2004 All Ages	Cost 2002§
Both sexes	15 180 000 (7.1%)	5 000 000 (2.4%)	56 500 000 (27.6%)	1 500 000	72 815	599 000	$132 billion
Males	7 280 000 (7.4%)	2 880 000 (2.9%)	32 340 000 (33.8%)	...	35 043 (48.1%)*	299 000	...
Females	7 900 000 (6.9%)	2 120 000 (1.9%)	24 160 000 (21.7%)	...	37 771 (51.9%)*	300 000	...
NH white males	6.7%	3.2%	34.3%	...	28 545	...	...
NH white females	5.6%	1.7%	21.6%	...	29 439	...	...
NH black males	10.7%	1.7%	23.1%	...	5460	...	...
NH black females	13.2%	2.3%	20.5%	...	7187	...	...
Mexican-American males	11.0%	1.1%	37.5%	...	...	...	...
Mexican-American females	10.9%	3.1%	22.6%	...	...	...	...
Hispanic or Latino† age 18+	10.4%	...	...	...	...	...	...
Asian† age 18+	7.5%	...	...	...	...	...	...
American Indians/Alaska Natives† age 18+	15.8%	...	...	...	...	...	...

Ellipses (. . .) indicate data not available. Undiagnosed diabetes is defined here for those whose fasting glucose is 126 mg/dL or higher but who did not report being told they had diabetes by a healthcare provider. Prediabetes is a fasting blood glucose of 100 to less than 126 mg/dL (impaired fasting glucose). Prediabetes also includes impaired glucose tolerance.

*These percentages represent the portion of total diabetes mellitus mortality that is for males vs females.

†Lethbridge-Cejku M, Rose D, Vickerie J. Summary of health statistics for US adults: National Health Interview Survey, 2004. National Center for Health Statistics. *Vital Health Stat 10*. 2006;(228). Data are age-adjusted estimates for Americans age 18 and older.

‡Mortality data are for whites and blacks.

§CDC; National Diabetes Fact Sheet.

Sources: Prevalence: NHANES 1999–2002, NCHS and NHLBI; percentages for racial/ethnic groups are age standardized for Americans age 20 and older. Estimates from NHANES 1999–2004 applied to 2004 population estimates. Mortality: NCHS. These data represent underlying cause of death only. Data for white and black males and females include Hispanics. Hospital discharges: NHDS, NCHS; data include those inpatients discharged alive, dead, or status unknown.

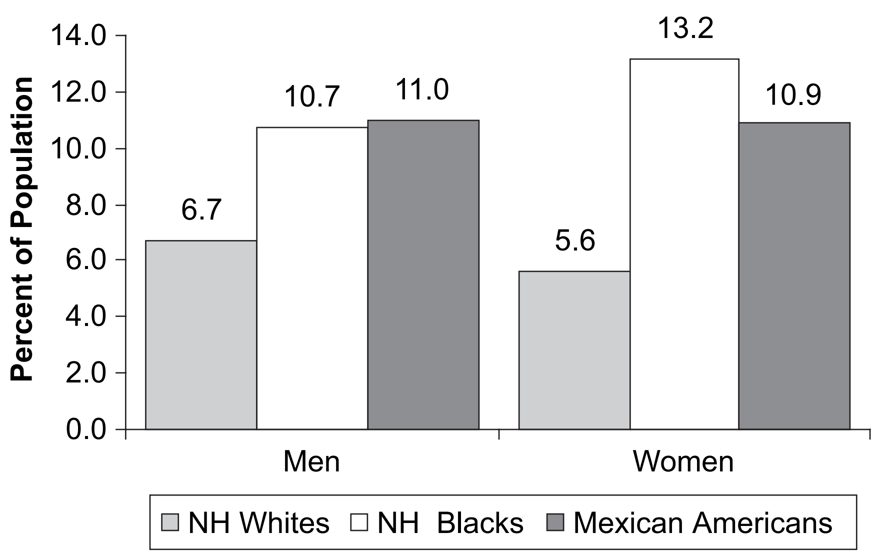

Chart 13-1. Prevalence of physician-diagnosed diabetes in adults age 20 and older by race/ethnicity and sex (NHANES: 1999–2004). Source: NCHS and NHLBI.

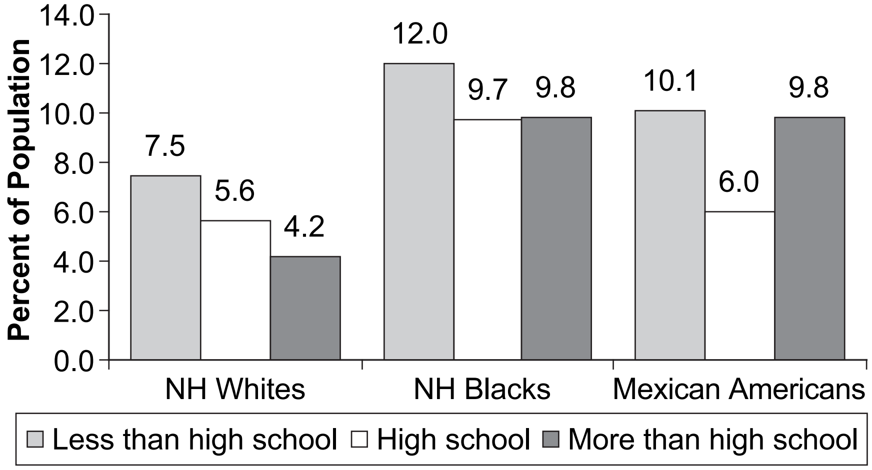

Chart 13-2. Prevalence of non–insulin-dependent (type 2) diabetes in adults age 18 and older by race/ethnicity and years of education (NHANES: 1999–2004). Source: NCHS and NHLBI.

14. End-Stage Renal Disease and Chronic Kidney Disease

ICD-10 N18.0. See Tables 14-1 and 14-2.

End-stage renal disease (ESRD) is a condition that is most commonly associated with diabetes or HBP and occurs when the kidneys can no longer function normally on their own. When this happens, patients are required to undergo treatment such as hemodialysis, peritoneal dialysis, or kidney transplantation. ESRD morbidity rates vary dramatically among different age, race, ethnicity, and sex population groups. Morbidity rates tend to increase with age and then fall off for the oldest age group. The age group with the highest incidence rate is 75 to 79 years old; the age group with the highest prevalence rate is 70 to 74 years old.

Chronic kidney disease not yet requiring dialysis or kidney transplantation is categorized in stages by level of estimated glomerular filtration rate (an indicator of kidney function) and amount of urine protein and is also a substantial public health burden in the United States. A persistent estimated glomerular filtration rate less than 60 mL/min per 1.73 m^2 or proteinuria at any level of glomerular filtration rate defines chronic kidney disease.[1] Although many patients with chronic kidney disease will progress to ESRD, the risk of CVD is substantially higher than the risk of ESRD. The excess CVD risk in people with chronic kidney disease is caused at least in part by a higher prevalence of traditional CVD risk factors in this group than in the general population. The main factors include older age, HBP, high blood cholesterol and lipids, and diabetes. An independent, graded association was observed between a reduced estimated glomerular filtration rate and the risk of death, cardiovascular events, and hospitalization in a large, community-based population of more than 1 million men and women.[2]

Abbreviations Used in Chapter 14

AHRQ	Agency for Healthcare Research and Quality
BMI	body mass index
BP	blood pressure
CDC	Centers for Disease Control and Prevention
CVD	cardiovascular disease
CI	confidence interval
HBP	high blood pressure
JNC	Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
NHANES	National Health and Nutrition Examination Survey
RR	relative risk
ESRD	end-stage renal disease
USDHHS	United States Department of Health and Human Services

- The incidence of reported ESRD has almost doubled in the past 10 years.[3]
- In 2003, 102 567 new cases of ESRD were reported.[3]
- Nearly 453 000 patients were being treated for ESRD by the end of 2003.[3]
- In 2003, 82 588 patients died from ESRD.[3]
- More than 15 700 kidney transplantations were performed in 2003.[3]
- Diabetes continues to be the most common reported cause of ESRD.[3]
- The CDC analyzed 1990–2002 data from the United States Renal Data System, which showed that diabetes is the leading cause of ESRD, accounting for 44% of new cases in 2002. Although the new cases of ESRD–diabetes mellitus increased overall, the incidence of ESRD–diabetes mellitus among persons with diabetes is not increasing among blacks, Hispanics, men, and persons between the ages of 65 and 74, and it is declining among persons under 65, women, and whites.[4]
- Data from NHANES 1999–2000 showed that 19.0 million American adults (or 9.4% of US adults) had stage 1 to 4 chronic kidney disease in 2000.[5]
- Between 1996 and 1997, 3.2% of the Medicare population had a diagnosis of chronic kidney disease, representing 63.6% of persons who progressed to ESRD after 1 year.[6]
- Data from a large HMO population reveal that among adults with a glomerular filtration rate more than 60 mL/min per 1.73 m^2 and no evidence of proteinuria or hematuria at baseline, risks for ESRD increased dramatically with higher baseline BP level, and BP-associated risks were greater in men than women and in blacks than whites.[7] (Also see Table 14-1.)
- Results from a large, community-based population showed that higher BMI also independently increased the risk of ESRD. The higher risk of ESRD with overweight and obesity was consistent across age, sex, race, and the presence or absence of diabetes, hypertension, or known baseline kidney disease.[8] (Also see Table 14-2.)

Age, Sex, Race, and Ethnicity

- The average incidence rates for pediatric ESRD are more than twice as high among children between the ages of 15 and 19 years as among children between the ages of 10 and 14 years. The rates are more than 3 times higher than those for children between 0 and 4 years old and between 5 and 9 years old.
- Children with pediatric ESRD have high transplantation rates. More than 44% of children starting therapy received a transplant during the first year of therapy, compared with 10% of patients between the ages of 20 and 64 at ESRD incidence.
- The median age of the prevalent population is 58.1 years (59.2 for whites, 56.1 for blacks, 56.7 for Hispanics, 58.9 for Asians, and 57.5 for Native Americans) (United States Renal Data System 2004 Annual Data Report, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases).

- Treatment of ESRD is more common in men than in women.
- Blacks and Native Americans have much higher rates of ESRD than do whites and Asians. Blacks represent 29% of treated ESRD patients.
- Without treatment, ESRD is fatal. Even with dialysis treatment, 20% of ESRD patients die yearly (2004 National Healthcare Disparities Report, AHRQ, United States Department of Health and Human Services [USDHHS]).
- Expenditures for ESRD totaled almost $23 billion in 2001 (2004 National Healthcare Disparities Report, AHRQ, USDHHS).
- Performance for urea reduction ratio of 65 or greater in hemodialysis patients increased from 74% in 1996 to 90% in 2002 (2004 National Healthcare Disparities Report, AHRQ, USDHHS).
- In both 2001 and 2002, the proportion of adult hemodialysis patients who received adequate dialysis was lower among blacks and higher among Asians, as compared with whites. The proportion who received adequate dialysis was similar among Hispanics and non-Hispanic whites.

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TABLE 14-1. BP and the Adjusted Risk of ESRD Among 316 675 Adults Without Evidence of Baseline Kidney Disease

JNC V BP Category	Adjusted RR (95% CI)
Optimal	Reference
Normal, not optimal	1.62 (1.27–2.07)
High normal	1.98 (1.55–2.52)
Hypertension:	
Stage 1	2.59 (2.07–3.25)
Stage 2	3.86 (3.00–4.96)
Stage 3	3.88 (2.82–5.34)
Stage 4	4.25 (2.63–6.86)

TABLE 14-2. Multivariable Association Between BMI and Risk of ESRD Among 320 252 Adults

BMI, kg/m^2	Adjusted RR (95% CI)
	Reference
18.5–24.9 (normal weight)	1.00
25.0–29.9 (overweight)	1.87 (1.64–2.14)
30.0–34.9 (class I obesity)	3.57 (3.05–4.18)
35.0–39.9 (class II obesity)	6.12 (4.97–7.54)
≥40.0 (extreme obesity)	7.07 (5.37–9.31)

15. Metabolic Syndrome

See Chart 15-1.

- The term *metabolic syndrome* (MetS) refers to the clustering of risk factors for CVD and type 2 diabetes mellitus. Several different definitions for MetS are in use; in the United States, the National Cholesterol Education Program Adult Treatment Panel III definition is most commonly used. By this definition, MetS is diagnosed when 3 or more of the following 5 risk factors are present[1]:
- Fasting plasma glucose ≥100 mg/dL
- HDL cholesterol <40 mg/dL in men or <50 mg/dL in women
- Triglycerides ≥150 mg/dL
- Waist circumference ≥102 cm in men or ≥88 cm in women
- BP ≥130 mm Hg systolic or 85 mm Hg diastolic or drug treatment for hypertension

On the basis of National Cholesterol Education Program Adult Treatment Panel III criteria:

- An estimated 47 million US residents have MetS.[2]
- The age-adjusted prevalence of MetS for adults is 23.7%.[2]
  - The prevalence ranges from 6.7% among people between 20 and 29 years old to 43.5% for people between 60 and 69 years old and 42.0% for those age 70 and older.
  - The age-adjusted prevalence is similar for men (24.0%) and women (23.4%).
  - Mexican Americans have the highest age-adjusted prevalence of MetS (31.9%). The lowest prevalence is among whites (23.8%), African Americans (21.6%), and people reporting as "other" race or ethnicity (20.3%).
  - Among African Americans, women had a prevalence about 57% higher than that of men. Among Mexican Americans, women had a prevalence about 26% higher than that of men.

- The prevalences of people with MetS are 24.3%, 13.9%, and 20.8 for white, black, and Mexican-American men, respectively. For women, the percentages are 22.9%, 20.9%, and 27.2% respectively.[3]
- Using a pediatric definition based closely on Adult Treatment Panel III (ATP III), an estimated 1 in 10 (9.2%) US adolescents between the ages of 12 and 19 years has MetS. The prevalence for boys is 9.5%, and for girls it is 8.9%.[4]
  - Among overweight or obese adolescents, 1 in 3 has MetS. Two thirds of all adolescents have at least 1 metabolic abnormality.[4]
- Among a sample of adolescents from NHANES III, the overall prevalence of MetS was 38.7% in moderately obese subjects and 49.7% in severely obese subjects. The prevalence of MetS in severely obese black subjects was 39%.[5]
- People with MetS are at increased risk for developing diabetes and CVD as well as increased risk of mortality from CVD and all causes.
- According to NHANES data, people who did not have MetS had the lowest risk for CVD events, those with MetS had an intermediate level of risk, and those with diabetes had the highest level of risk.
- In the ARIC study of 12 089 black and white middle-aged individuals, Adult Treatment Panel III MetS was present in approximately 23% of individuals without diabetes or prevalent CVD at baseline. Over an average of 11 years of follow-up, 879 incident CHD and 216 ischemic stroke events occurred. Men and women with the MetS were approximately 1.5 and 2 times more likely to develop CHD after adjustment for age, smoking, LDL cholesterol, and race or ARIC center.[6]
- In the FHS, 3323 middle-aged adults (who were free of CVD at baseline in 1989–1993) were followed up for 8 years for the development of new CVD, CHD, and type 2 diabetes. In persons without CVD or diabetes at baseline, the prevalence of Adult Treatment Panel III MetS was 26.8% in men and 16.6% in women. Among men with a mean age of 50 years at baseline, MetS prevalence was 21.4%, and at the end of follow-up it was 38.8% (or 33.9% after direct adjustment to the baseline age), demonstrating an adjusted increase of 56% over the baseline rate. For women with a mean age of 51 years at baseline, the prevalence was 12.5%, and 8 years later, it was 30.6% (age adjusted, 23.6%), representing an increase in prevalence of 47%. In men, the MetS age-adjusted RRs and 95% CIs were as follows: RR=2.88, 95% CI 1.99 to 4.16 for CVD; RR=2.54, 95% CI 1.62 to 3.98 for CHD; and RR=6.92, 95% CI 4.47 to 10.81 for diabetes. Event rates and RRs were lower in women for CVD (RR=2.25, 95% CI 1.31 to 3.88) and CHD (RR=1.54, 95% CI 0.68 to 3.53), but they were similar for diabetes (RR=6.90, 95% CI 4.34 to 10.94). Population-attributable risk estimates associated with MetS for CVD, CHD, and diabetes were 34%, 29%, and 62% in men and 16%, 8%, and 47% in women. The range of risk associated with all possible trait combinations was 3.5 to 12.1 for diabetes and 1.8 to 2.5 for CVD. MetS trait combinations that included elevated fasting glucose increased the RR of diabetes by 11-fold and that of CVD by 2.5-fold; trait combinations not including hyperglycemia increased risk for diabetes by 5-fold and that of CVD by 2.1-fold. There was a strong positive association between the number of MetS traits and risk of subsequent CHD, CVD, and diabetes. The data show that MetS is a far stronger risk factor for diabetes than for CVD.[7]
- Despite increased risk associated with MetS, data from the ARIC study showed that, by comparison of receiver operating characteristic curves, a diagnosis of MetS did

Abbreviations Used in Chapter 15

ARIC	Atherosclerosis Risk in Communities study
BP	blood pressure
CHD	coronary heart disease
CI	confidence interval
CVD	cardiovascular disease
FHS	Framingham Heart Study
HDL	high-density lipoprotein
LDL	low-density lipoprotein
MetS	metabolic syndrome
NHANES	National Health and Nutrition Examination Survey
RR	relative risk

not materially improve CHD risk prediction beyond the level achieved by the Framingham Risk Score.[6]

- Population-based data from the United Kingdom compared Adult Treatment Panel III MetS with the Framingham Risk Score as predictors of CHD, stroke, and type 2 diabetes in men between the ages of 40 and 59 years with no history of CHD, stroke, or diabetes, followed up over 20 years. Men with MetS at baseline (26%) showed significantly higher RR than that of men without MetS of developing CHD (RR=1.64, 95% CI 1.41 to 1.90), stroke (RR=1.61, 95% CI 1.26 to 2.06), and diabetes (RR=3.57, 95% CI 2.83 to 4.50). The probability of developing CVD or diabetes over 20 years increased from 11.9% in those with no MetS traits to 31.2% in those with 3 traits to 40.8% in those with 4 or 5 traits. The Framingham Risk Score was a better predictor of CHD and stroke than MetS but was less predictive of diabetes. Areas under the receiver-operating characteristic curves for FHS versus the number of MetS traits were 0.68 versus 0.59 for CHD, 0.60 versus 0.70 for diabetes, and 0.66 versus 0.55 for stroke ($P<0.001$ for all). Thus, although the presence of MetS was a significant predictor of CVD and diabetes, it was a stronger predictor of diabetes than of CHD, and the Framingham Risk Score was superior to MetS for prediction of CVD. Data from the San Antonio Heart Study also demonstrated that dedicated risk engines perform better than MetS for prediction of diabetes or CVD. Whether the simple clinical "pattern recognition" afforded by a diagnosis of MetS will lead to better clinical or population health outcomes remains to be determined.[8,9]

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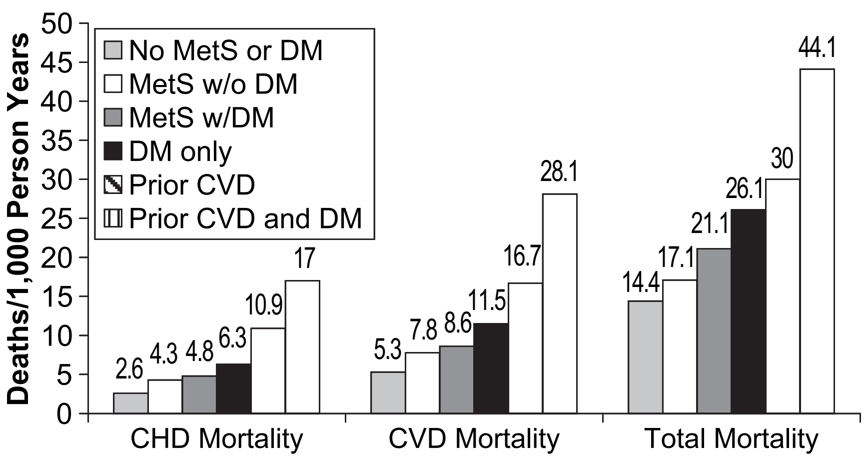

Chart 15-1. Total mortality rates in US adults between the ages of 30 and 75 years with MetS, with and without diabetes mellitus and preexisting CVD (NHANES II 1976–1980 Follow-Up Study*). Source: Malik et al.[10] *Average of 13 years of follow-up. DM indicates diabetes mellitus.

16. Nutrition

See Table 16-1.

- The Economic Research Service of the US Department of Agriculture suggests that average daily calorie consumption in the United States increased 16% between 1970 and 2003, or 523 calories. Of that increase, grains (mainly refined grains) accounted for 43%; fats and oils, 63%; sugars and sweeteners, 19%; fruits, 12%; vegetables, 24%; meat, eggs, and nuts, 7%; and dairy groups, 5%.[1]
- Between 1971–1974 and 1999–2000, age-adjusted total daily calories for people between the ages of 20 and 74 years increased from 2450 to 2618 for men and from 1542 to 1877 for women.[2]
- In 1999–2000, among children between the ages of 2 and 6 years, 20% had a good diet, 74% had a diet that needed improvement, and 6% had a poor diet. For those between the ages of 7 and 12 years, 8% had a good diet, 79% had a diet that needed improvement, and 13% had a poor diet.[3]
- Mean energy intake for children between the ages of 1 and 19 years changed little from the surveys in the 1970s to 1999–2000, except for an increase among adolescent females.[2]
- Between 1977 and 1996, portion sizes for key food groups grew markedly in the United States, not only at fast-food outlets but also in homes and at conventional restaurants. One study of portion sizes for typical items showed that:

  -Salty snacks increased from 132 calories to 225 calories.
  -Soft drinks increased from 144 calories to 193 calories.
  -French fries increased from 188 calories to 256 calories.
  -Hamburgers increased from 389 calories to 486 calories.[4]

Fat/Meat

- The average daily intake of total fat in the United States is 79 g (91 g for males and 67 g for females) (NHANES 1999–2000).
- The average daily intake of saturated fat in the United States is 27 g (31 g for males and 23 g for females) (NHANES 1999–2000).
- The proportion of fat calories from beef, pork, dairy products, and eggs fell from 50% in 1965 to 33% in 1994–1996. The proportion of fat calories from poultry increased from 4% to 7%. Calories from fruits and vegetables rose from 8% to 13%.[5]
- In 1994–1996, pizza, Mexican food, Chinese food, hamburgers, French fries, and cheeseburgers accounted for 10.8% of total fat intake. These 6 foods accounted for only 1.9% of fat intake in 1965.[5]

Abbreviations Used in Chapter 16

BRFSS	Behavioral Risk Factor Surveillance Survey
CDC	Centers for Disease Control and Prevention
CHS	Cardiovascular Health Study
CVD	cardiovascular disease
NCHS	National Center for Health Statistics
NHANES	National Health and Nutrition Examination Survey
PA	physical activity

- The major sources of saturated fat in the diet are red meat, butter, whole milk, and eggs. Intake of these foods has fallen markedly since 1965. The decline in whole milk consumption from 21.3 gallons in 1972–1976 to 8.2 gallons in 1997 accounts for most of the reduction in saturated fat.[5]
- According to US Department of Agriculture data, in 2001 total meat consumption (red meat, poultry, and fish) amounted to 194 pounds per person, 16 pounds higher than the level in 1970. Each American consumed an average of 21 pounds less red meat (mostly beef) than in 1970, 34 pounds more poultry, and 3.4 pounds more fish.[1]
- Data from NHANES 1999–2000 (NCHS) showed the mean percentage of calories from total fat was 32.7% for both sexes: 32.7% for males and 32.6% for females.[6]
- Data from NHANES 1999–2000 (NCHS) showed the mean percentage of calories from saturated fat was 11.2% for both sexes: 11.2% for males and 11.1% for females.[6]

Cholesterol

- The average daily intake of dietary cholesterol in the United States is 265 milligrams (mg). For males the average is 307 mg, and for females the average is 225 mg (NHANES 1999–2000 [NCHS]).[7]

Fiber

- The recommended daily intake of dietary fiber is 25 g or more. Americans consume a daily average of 15.6 g of dietary fiber (17.8 g for males and 13.6 g for females) (NHANES III [NCHS]).

  - For non-Hispanic whites, the average is 15.8 g (18.1 g for males and 13.7 g for females).
  - For non-Hispanic blacks the average is 13.4 g (15.0 g for males and 12.0 g for females).
  - For Mexican Americans the average is 18.5 g (21.0 g for males and 15.9 g for females).

- Analysis of participants in the CHS showed that cereal fiber consumption late in life was associated with lower risk of incident CVD, which supports recommendations for elderly people to increase consumption of dietary cereal fiber.[8]
- Despite US Department of Agriculture Food Pyramid recommendations to consume several daily servings of whole grains, in 1994–1996, intake of whole grains for children was 1 serving or less.[9]
- Most Americans consume less than 1 serving of whole grains a day, but between the early 1980s and 2000, consumption of refined grains increased. (Refined grains include white, whole-wheat, and durum flour, all of which have less nutritional value than whole grains.)[10]

Fruits/Vegetables

- In 2005, 76.8% of adults age 18 and older reported eating fewer than 5 servings of fruits and vegetables a day (www.cdc.gov/brfss/).
- More than 60% of young people eat too much fat, and fewer than 20% eat the recommended 5 or more servings of fruits and vegetables each day (BRFSS, 2000).
- Only 22.7% of adults consumed fruits and vegetables at least 5 times a day in 1996. This was an increase from 19.0% in 1990 (BRFSS [1990–1996], CDC).

- The highest proportion of adults who consumed fruits and vegetables at least 5 times a day were those age 65 and older, whites, college graduates, those actively engaged in leisure-time PA, and nonsmokers.[5]
- The percentage of males who consumed fruits and vegetables at least 5 times a day was 17.7% in 2003. For females, the percentage was 27.0 (BRFSS 2003, CDC).
- From 1990 to 1996, the percentage of obese adults who consumed at least 5 servings of fruits and vegetables a day dropped from 16.8% to 15.4%.[5]
- Recent studies support the intake of up to 9 servings of fruits and vegetables per day.[11]
- In 2005, the percentages of students in grades 9 through 12 who reported eating fruits and vegetables 5 or more times per day were 21.4% for males and 18.7% for females.

  - Black students (22.1%) and Hispanic students (23.2%) were more likely than non-Hispanic white (18.6%) students to have eaten 5 or more servings per day. The percentage was higher among Hispanic female students (21.8%) than white female (17.4%) students and higher among black male (24.3%) and Hispanic male (24.5%) than white male (19.7%) students.[12]

- From 1994 to 1996, only 14% of children between the ages of 6 and 19 years met then-current US Department of Agriculture Food Pyramid recommendations for daily fruit intake (2 to 4 servings per day). Only 20% got enough vegetables (3 to 5 servings per day).[13]
- In 1980, about 50% of high school seniors reported eating green vegetables "nearly every day or more." By 2003 that figure had dropped to about 30%.[14]

Costs

Each year more than $33 billion in medical costs and $9 billion in lost productivity due to heart disease, cancer, stroke, and diabetes are attributed to poor nutrition.[15,16]

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TABLE 16-1. Nutrition: Mean Dietary Intake of Energy and 10 Key Nutrients for Public Health

	Total Population	Males	Females
Energy, kcal	2146	2475	1833
Protein, % of calories	14.7%	14.9%	14.6%
Carbohydrate, % of calories	51.9%	50.9%	52.8%
Total fat, % of calories	32.7%	32.7%	32.6%
Saturated fat, % of calories	11.2%	11.2%	11.1%
Cholesterol, mg	265	307	225
Calcium, mg	863	966	765
Folate, μg	361	405	319
Iron, mg	15.2	17.2	13.4
Zinc, mg	11.4	13.3	9.7
Sodium, mg	3375	3877	2896

Source: NHANES (1999–2000), NCHS 2003. (Advance data from *Vital and Health Statistics*, No. 334, 2003.)

17. Quality of Care

See Tables 17-1 through 17-9.

The Institute of Medicine defines quality of care as "the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge."[1]

This chapter of the Update highlights national data on quality of care for several cardiovascular conditions. It is intended to serve as a benchmark for current care and to stimulate efforts to improve the quality of cardiovascular care nationally. Where possible, data are reported from standardized quality indicators (ie, those consistent with the methods for quality performance measures endorsed by the American College of Cardiology and the AHA.[2] Additional data on aspects of quality of care, such as compliance with American College of Cardiology/AHA clinical practice guidelines, are also included to provide a spectrum of quality-of-care data.

Abbreviations Used in Chapter 17

ACE	angiotensin-converting enzyme
AF	atrial fibrillation
AHA	American Heart Association
ARB	angiotensin receptor blocker
BMI	body mass index
BP	blood pressure
CHF	congestive heart failure
CVD	cardiovascular disease
DVT	deep vein thrombosis
GWTG	Get With The Guidelines
HF	heart failure
LDL	low-density lipoprotein
MI	myocardial infarction
NCHS	National Center for Health Statistics
PCI	percutaneous coronary intervention
tPA	tissue plasminogen activator
TIA	transient ischemic attack

Care Centers/Personnel

- On the basis of data from the American Board of Psychiatry and Neurology, there are 240 board-certified vascular neurologists (August 2005).
- In 2002, there were 17 301 doctors of medicine with a specialty of CVDs (Health, United States, 2005, NCHS).
- As of September 28, 2005, there were 175 total certified primary stroke centers by Joint Commission on Accreditation of Health Care Organizations standards.

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TABLE 17-1. Joint Commission on Accreditation of Health Care Organizations Standardized Measures

	Percentage of Inpatients/Time
Acute MI	
Aspirin at admission	95%
Aspirin at discharge	95%
ACE inhibitor for left ventricular systolic dysfunction	80%
Smoking cessation counseling	84%
β-Blocker at admission	91%
β-Blocker at discharge	93%
Mean time to thrombolysis	54 min
Mean time to PCI	293 min
Inpatient death	8%
HF	
Discharge instructions	55%
Assessment of left ventricular function	88%
ACE inhibitor for left ventricular systolic dysfunction	77%
Smoking cessation counseling	72%

Data were recently published on Joint Commission on Accreditation of Healthcare Organization (JCAHO) standardized "core" quality measures.[3] The table provides summary data on inpatient measures for acute MI and HF from the second quarter of 2004 from 3377 hospitals nationally.

ACE indicates angiotensin-converting enzyme.

Mean rates for rate-based measures are based on aggregate calculations (dividing all patients who met the criterion by the total number of patients). Mean values for continuous variables are based on aggregated mean rates for each participating hospital weighted by the total number of patients included by each hospital. The average number of patients per hospital per quarter on which the summary data above were based ranged from 4 (for mean time to thrombolysis for acute MI) to 69 (for assessment of left ventricular function for HF).

TABLE 17-2. National Medicare and Medicaid Data

	Percentage of Inpatients
Acute MI	
Aspirin at arrival	94.7%
β-Blocker at arrival	90.8%
Thrombolytic therapy within 30 min of hospital arrival	38.0%
PCI within 120 min of hospital arrival	65.9%
Smoking cessation advice/counseling	88.6%
Aspirin at discharge	94.9%
β-Blocker at discharge	93.5%
ACE inhibitor or ARB for left ventricular dysfunction at discharge	82.4%
HF	
Assessment of left ventricular function	88.4%
ACE inhibitor or ARB for left ventricular dysfunction at discharge	81.7%
Smoking cessation advice/counseling	77.2%
Discharge instructions	54.2%

As part of the Hospital Quality Alliance Program, data are collected by the Centers for Medicare and Medicaid Services on quality-of-care indicators for conditions including acute MI and HF. The data were collected from eligible patients for hospital admissions between July 2004 and June 2005.

ARB indicates angiotensin receptor blocker.

*Data obtained from United States Department of Health & Human Services Hospital Compare Web site: http://www.hospitalcompare.hhs.gov/hospital/home2.asp.

TABLE 17-3. National Veterans Health Administration Data

	Percentage of Inpatients
Acute MI	
Aspirin within 24 h of admission	97%
Aspirin at discharge	98%
β-Blocker within 24 h of admission	96%
β-Blocker at discharge	99%
ARB/ACE inhibitor for patients with left ventricular ejection fraction <40%	89%
Smoking cessation advice given	95%
HF	
Documentation of left ventricular ejection fraction	98%
ARB/ACE inhibitor for patients with left ventricular ejection fraction <40%	87%
Complete discharge instructions	98%
Smoking cessation advice given	92%
Hypertension	
BP at goal (<140/90 mm Hg)	74%
Cholesterol	
Cholesterol screening in all patients	94%
Cholesterol measured after acute MI	95%
LDL cholesterol <100 mg/dL after acute MI	66%

The Veterans Administration collects national quality performance data related to CVD. Aggregate data from 158 Veterans Administration hospitals for the period between January 2005 and December 2005 are listed (Office of Quality and Performance, Veterans Health Administration). Only patients who were candidates for each quality indicator were considered (ie, patients with contraindications to a given therapy were not considered).

TABLE 17-4. AHA Get With The Guidelines—Coronary Artery Disease Program

Performance Indicator	Percentage of Inpatients
Aspirin within 24 h of admission	94.6%
Aspirin at discharge*	94.2%
β-Blocker at discharge*	90.5%
ACE inhibitor at discharge	66.0%
ACE inhibitor at discharge for acute MI patients*	68.2%
ACE inhibitor in left ventricular systolic dysfunction patients	79.2%
Lipid therapy at discharge	72.1%
Lipid therapy at discharge if LDL >100 mg/dL*	78.1%
BP control (to <140/90 mm Hg) at discharge	78.8%
Smoking cessation counseling*	90.0%
Referral to cardiac rehabilitation	70.3%
Composite quality-of-care measure†	86.3%

Get With The Guidelines (GWTG)—Coronary Artery Disease is an AHA program for the improvement of quality of care. Participating hospitals are involved in initiatives specifically designed to increase adherence to key quality indicators in patients admitted with a cardiovascular event. The table summarizes performance on the selected quality-of-care indicators. These were collected from 74 143 patients who were admitted to 376 hospitals participating in the GWTG–Coronary Artery Disease program from January 1, 2005, through December 31, 2005.

In-hospital mortality was 4.7%, and mean length of hospital stay 5.3 days (median 4.0 days). (Note: This excludes transfer-out patients. If discharge status is missing, "no" is assumed.)

*Indicates the 5 key performance measures targeted in GWTG–Coronary Artery Disease.

†The composite quality-of-care measure indicates performance on the provision of several elements of care. It is computed by summing the numerators for each key performance measure across the population of interest to create a composite numerator (all the care that was given), summing the denominators for each measure to form a composite denominator (all the care that should have been given), and reporting the ratio (the percentage of all the needed care that was given).

TABLE 17-5. AHA/American Stroke Association Get With The Guidelines—Stroke Program

Performance Indicator	Percentage of Inpatients
Intravenous tPA in patients who arrived <2 h after symptom onset*	55.8%
Intravenous tPA in patients who arrived <3 h after symptom onset	46.1%
Documentation of ineligibility (why no tPA)	89.3%
Rate of symptomatic brain hemorrhage after tPA†	5.6%
Antithrombotics <48 h after admission*	93.9%
DVT prophylaxis by second hospital day*	79.8%
Antithrombotics at discharge*	97.3%
Anticoagulation for AF at discharge*	97.3%
Therapy at discharge if LDL >100 mg/dL or on therapy at admission*	78.6%
Counseling for smoking cessation*	75.9%
Lifestyle changes recommended for BMI >25 kg/m^2	38.0%
Composite quality-of-care measure	88.0%

GWTG-Stroke is an AHA/American Stroke Association program for the improvement of quality of care. Participating hospitals are involved in initiatives specifically designed to increase adherence to key quality indicators in patients admitted with an ischemic stroke or TIA. The table summarizes performance on the selected treatment and quality-of-care indicators for acute stroke and secondary prevention. There were 93 722 clinically identified patients who were admitted to 587 hospitals participating in the GWTG-Stroke program from January 1, 2005, through December 31, 2005.

*Indicates the 7 key performance measures targeted in GWTG-Stroke.

A smaller denominator for intravenous tPA measures in the study population.

In-hospital mortality was 7.1%, and mean length of hospital stay 5.6 days (median 4.0 days).

TABLE 17-6. AHA Get With the Guidelines—Heart Failure Program

Performance Indicators	Percentage of Inpatients
Complete set of discharge instructions*	71.9%
Measure of left ventricular function*	90.0%
ACE or ARB at discharge for patients with left ventricular systolic dysfunction, no contraindications*	81.2%
Smoking cessation counseling, current smokers*	79.2%
β-Blockers at discharge for patients with left ventricular systolic dysfunction, no contraindications*	85.9%
Anticoagulation for AF or atrial flutter, no contraindications	62.7%
Composite quality-of-care measure	82.5%

GWTG-HF is an AHA program for the improvement of quality of care. Participating hospitals are involved in initiatives specifically designed to increase adherence to key quality indicators in patients admitted with HF. The table summarizes performance on the selected quality-of-care indicators. These were collected from 17 941 patients who were admitted to 144 hospitals participating in the GWTG-HF program from January 1, 2005, through December 31, 2005.

Mechanical ventilation was required in 1.9% of patients. In-hospital mortality was 3.8%, and mean length of stay 6.1 days (median 4.0 days).

*Indicates the 5 key performance measures targeted in GWTG-HF.

TABLE 17-7. ACS Registry Data

	Overall	"Leading" Centers (Top 25%)	"Lagging" Centers (Bottom 25%)
Acute medications* (within 24 h)			
Aspirin	96%	98%	91%
β-Blocker	91%	96%	82%
Heparin, any	87%	94%	76%
Glycoprotein IIb/IIIa inhibitor, any	47%	65%	27%
Discharge medications†			
Aspirin	95%	98%	87%
Clopidogrel	74%	82%	62%
β-Blocker	93%	97%	84%
ACE inhibitors, overall	63%	71%	53%
ACE inhibitors, among recommended‡	65%	74%	55%
Lipid-lowering agent, overall	84%	90%	71%
Lipid-lowering agent, recommended§	90%	94%	80%
Procedures‖			
Cardiac catheterization, overall	83%	94%	65%
Cardiac catheterization, within 48 h of presentation	66%	78%	48%

CRUSADE (Can Rapid Stratification of Unstable Angina Patients Suppress ADverse Outcomes with Early Implementation of the ACC/AHA Guidelines) is a national quality-improvement initiative designed to increase adherence to guideline-recommended care for patients hospitalized with non–ST-segment–elevation MI or unstable angina (www.CRUSADEQI.com). Data on treatment measures from the CRUSADE registry on 41 952 patients from 370 hospitals from January 1, 2005, through March 31, 2005, are listed.

*Excluding patients with contraindications to these therapies.

†Excluding patients with contraindications, transfers out, and deaths.

‡Including only patients with history of hypertension, diabetes, CHF, and left ventricular ejection fraction <40%.

§Including only patients with history of hyperlipidemia or LDL >100 mg/dL.

‖Excluding patients with contraindications to cardiac catheterization.

Note that not all of the treatment measures reported above are established quality indicators. Further information on the CRUSADE registry can be found at its Web site (www.CRUSADEQI.com).

TABLE 17-8. American College of Cardiology—National Cardiovascular Data Registry Cardiac Catheterization and PCI Data

Diagnostic Cardiac Catheterization	Overall Mean	"Leading" Centers (Mean Top 25%)	"Lagging" Centers (Mean Bottom 25%)
In-laboratory mortality*	0.06%	0.00%	0.08%
Major complications†	1.87%	0.24%	1.98%
PCI			
Major complications‡	2.31%	90.96%	3.21%
Vascular complications§	1.73%	0.83%	2.34%
Antiplatelet drug administration‖	95.81%	98.09%	94.80%
Emergency coronary artery bypass surgery¶	0.39%	0.00%	0.56%
Average door-to-balloon time#	142.88 min	92.00 min	144.12 min
Percentage patients with door-to-balloon time <90 min**	50.66%	64.28%	37.15%
Percentage patients with door-to-balloon time <120 min††	73.33%	85.70%	65.90%
Risk-adjusted mortality‡‡	1.14%	0.77%	1.44%

The American College of Cardiology maintains a number of clinical data registries as part of the American College of Cardiology–National Cardiovascular Data Registry. Among them is the CathPCI Registry, which is composed of diagnostic cardiac catheterizations and interventional (PCI) procedures harvested from participating facilities across the nation. Listed in the table are aggregated data of 604 042 diagnostic cardiac catheterizations and 293 773 PCI procedures performed on patients discharged in 2005 from 462 participating facilities. Only records with valid responses to indicators were considered, and not all procedures qualify for every indicator. For more information, visit www.acc.org or call 1-800-253-4636, ext 451.

*Mortality in laboratory.

†‡Contrast media reaction, cardiogenic shock, cerebrovascular accident, CHF, cardiac tamponade, renal failure.

§Bleeding at entry site (femoral approach), vascular access occlusion at entry site, peripheral embolization, vascular dissection, psuedoaneurysm, arteriovenous fistula.

‖Percentage of patients receiving antiplatelet therapy, such as clopidogrel or ticlopidine, during admission.

¶Percentage of PCI patients requiring emergency or coronary artery bypass surgery.

#Often called "door-to-balloon time," this is the elapsed time between entry to facility and reperfusion of the affected coronary vessel for patients with acute MI treated with primary PCI.

**Percentage of primary PCI patients with coronary reperfusion within 90 min of entry to facility.

††Percentage of primary PCI patients with coronary reperfusion within 120 min of entry to facility.

‡‡PCI mortality rate adjusted by American College of Cardiology–National Cardiovascular Data Registry Risk Adjustment Algorithm.

TABLE 17-9. Society of Thoracic Cardiac Surgery Registry Data

Measure	STS 2005 Data
No. of isolated coronary artery bypass procedures	145 333
No. of aortic valve procedures	13 836
No. of mitral valve procedures	3948
Unadjusted isolated coronary artery bypass operative mortality	2.2%
Unadjusted aortic valve operative mortality	2.8%
Unadjusted mitral valve operative mortality	5.2%
Mean postprocedure length of stay isolated coronary artery bypass procedures	6.9 days
Mean postprocedure length of stay for aortic valve procedures	7.8 days
Mean postprocedure length of stay for mitral valve procedures	10.4 days

The STS National Database is a national quality-improvement initiative of the Society of Thoracic Surgeons designed to improve the quality of care for patients undergoing cardiothoracic surgery. The table summarizes aggregate data for 234 532 procedures performed at 654 participating sites in 2005.

18. Medical Procedures

See Tables 18-1 and 18-2 and Charts 18-1 and 18-2.

From 1979 to 2004, the total number of inpatient cardiovascular operations and procedures increased 432% (AHA computation).

- Data from men and women enrolled in Medicare from 1992–2001 suggest changes in the difference between blacks and whites in the age-standardized rates of angioplasty, coronary artery bypass grafting, and carotid endarterectomy.[1]

  - Among women, the rates of angioplasty were 11.68 per 1000 enrollees for whites and 10.07 per 1000 enrollees for blacks. By 2002, the rates were 16.83 per 1000 enrollees among white women and 17.35 per 1000 enrollees among black women. For men, the difference in rates between whites and blacks remained. In 1992, the rates were 21.34 per 1000 enrollees for white men and 11.86 per 1000 enrollees for black men. In 2001, the rates were 28.18 and 19.67, respectively.
  - Among women, the rates of carotid endarterectomy were 1.59 per 1000 enrollees for whites and 0.64 per 1000 enrollees for blacks. By 2002, the rates were 2.42 per 1000 enrollees among white women and 1.15 per 1000 enrollees among black women. For men, the difference in rates between whites and blacks remained. In 1992, the rates were 3.13 per 1000 enrollees among white men and 0.82 per 1000 enrollees among black men. In 2001, the rates were 4.42 and 1.44, respectively.
  - For women, the rates of coronary artery bypass grafting were 3.14 per 1000 enrollees for whites and 1.80 per 1000 enrollees for blacks. By 2002, the rates were 3.70 per 1000 enrollees among whites and 2.82 per 1000 enrollees among blacks. For men, the difference in rates between whites and blacks remained. In 1992, the rates were 9.01 per 1000 enrollees for white men and 2.72 per 1000 enrollees for black men. In 2001, the rates were 9.8 and 4.11, respectively.

Cardiac Catheterization

- From 1979 to 2004, the number of cardiac catheterizations increased 334% (AHA computation).
- An estimated 1 297 000 inpatient cardiac catheterizations were performed in 2004.
- The mean charge for patients hospitalized for diagnostic cardiac catheterization increased from $11 611 in 1993 to $24 893 in 2003. The total number of patients increased from 628 962 to 728 786, whereas the average length of stay decreased from 4.9 days to 3.7 days.[2]

Abbreviations Used in Chapter 18

AHA	American Heart Association
CDC	Centers for Disease Control and Prevention
ICD	International Classification of Diseases
NCHS	National Center for Health Statistics
NHDS	National Hospital Discharge Survey
NHLBI	National Heart, Lung, and Blood Institute
PCI	percutaneous coronary intervention

Coronary Artery Bypass Surgery

In the United States in 2004, the NCHS estimates that 427 000 of these procedures were performed on 249 000 patients.

- Compared with Canadian patients, US patients were older, more likely to be female, and discharged from the hospital sooner. In-hospital costs of treatment were substantially higher in the United States than in Canada. After controlling for demographic and clinical differences, length of stay in Canada was 16.8% longer than in the United States; there was no difference in in-hospital mortality; and the cost in the United States was 82.5% higher than that in Canada.[3]

Heart Transplantations

In 2005, 2125 heart transplantations were performed in the United States. There are 309 organ transplantation centers in the United States, 186 of which perform heart transplantations (http://www.unos.org/).

- In the United States, 72.4% of heart transplantation patients are male, 70.0% are white, 19.1% are between the ages of 35 and 49 years, and 45.0% are between the ages of 50 and 64 years.
- As of August 11, 2006, the 1-year survival rate for males was 86.1%, and for females it was 83.9%; the 3-year rates were 78.3% for males and 74.9% for females; and the 5-year rates were 71.2% for males and 66.9% for females.
- As of August 11, 2006, there were 2871 heart patients on the transplant waiting list.

Percutaneous Coronary Intervention

- An estimated 664 000 PCI (previously referred to as percutaneous transluminal coronary angioplasty or PTCA) procedures were performed on 658 000 patients in 2004 in the United States. From 1987 to 2004, the number of procedures increased 326% (AHA computation).
- In 2004, 66.7% of PCI procedures were performed on men, and 52% were performed on people age 65 and older.
- The rate of coronary stent insertion increased 147% between 1996 and 2000. Among the elderly, this procedure increased 168% during the same period. The rate of stent insertion also more than doubled for the population between the ages of 45 and 64 years, increasing from 157 to 318 per 100 000.[4]
- In 2003, approximately 84% of 660 000 hospitalized patients who underwent a coronary angioplasty received a stent. Black and white patients were equally likely to receive a stent. However, white patients were more likely than black patients to receive a drug-eluting stent.[5]

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TABLE 18-1. 2003 National Healthcare Cost and Utilization Project Statistics: Mean Charges and In-Hospital Death Rates for Various Procedures

Procedure	Mean Charges	In-Hospital Death Rate
Coronary artery bypass grafting	$ 83 919	2.2%
PCI	$ 38 203	0.8%
Diagnostic cardiac catheterization	$ 24 893	1.0%
Cardiac pacemaker	$ 41 075	1.1%
Implantable defibrillator	$103 680	1.0%
Endarterectomy	$ 21 742	0.6%
Valves	$118 656	5.6%

Source: hcup.ahrq.gov.

Data from the latest Healthcare Cost and Utilization Project provide the mean charges and in-hospital death rates for the procedures listed in the table.

TABLE 18-2. Estimated* Inpatient Cardiovascular Operations, Procedures, and Patient Data by Sex, Age, and Region—United States: 2004 (in Thousands)

			Sex		Age				Region†			
Operations/Procedures/Patients (ICD-9 Code[s])		Total	M	F	<15	15-44	45-64	≥65	Northeast	Midwest	South	West
Angioplasty (36.0)	Procedures	1285	853	432	. . .	72	550	663	227	333	634	350
PCI (36.01, .02, .05)[a,f,g]	Procedures	664	448	226	. . .	35	284	342	118	167	242	128
	Patients[g]	658	435	223	. . .	36	282	339	118	168	240	132
Stenting (36.06, .07)	Procedures	615	412	203	. . .	35	264	316	105	163	219	129
Cardiac revascularization (bypass) (36.1–36.3)[b]												
	Procedures	427	303	124	. . .	17	195	215	81	89	170	87
	Patients	249	174	76	. . .	9	111	129	47	52	100	50
Diagnostic cardiac catheterizations (37.2)[a]												
	Procedures	1297	771	526	11	101	547	638	268	89	170	87
Endarterectomy (38.12)	Procedures	98	60	38	. . .	. . .	19	78	19	21	43	15
Implantable defibrillators (37.94–.99)	Procedures	68	48	20	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Open-heart surgery[c]	Procedures	646	426	223	33	41	256	329	158	129	242	135
Pacemakers (37.7–.8)[d]	Procedures	170	85	85	. . .	. . .	22	144	51	29	59	31
Valves (35.1, .2, .99)[e]	Procedures	99	52	47	. . .	10	25	58	25	17	33	20
Total vascular and cardiac surgery and procedures (35–39)‡		**6993**	**3985**	**3009**	**226**	**675**	**2511**	**3581**	**1388**	**1440**	**2731**	**1434**

Ellipses (. . .) indicate data not available.

*Breakdowns are not available for some procedures, so entries for some categories do not add to totals. These data include codes where the estimated number of procedures is fewer than 5000. Categories of such small numbers are considered unreliable by NCHS and in some cases may have been omitted.

†Regions: Northeast—Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont; Midwest—Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin; South—Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia; and West—Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming.

‡Totals include procedures not shown here.

[a] Does not include procedures in the outpatient or other nonhospitalized setting; thus, excludes some cardiac catheterizations and PCIs.

[b] Because 1 or more procedure codes are required to describe the specific bypass procedure performed, it is impossible from this (mixed) data to determine the average number of grafts per patient.

[c] Includes valves, bypass, and 104 000 "other" open-heart procedures (codes 35 [less 35.1–35.2, 35.4, 35.96, 35.99]; 36 [less 36.0–36.1]; and 37.1, 37.3–37.5).

[d] There are additional insertions, revisions, and replacements of pacemaker leads, including those associated with temporary (external) pacemakers.

[e] Open-heart valvuloplasty without replacement; replacement of heart valve; other operations on heart valves.

[f] Previously referred to as percutaneous transluminal coronary angioplasty or PTCA.

[g] Data are for patients with a PCI listed anywhere on their medical record, but patients with a PCI listed were only counted once, even if they also had a code for insertion of stent. In 2003, 84% of patients with PCI were reported to have a stent inserted. Code 36.06 "insertion of non–drug-eluting stents" and 36.07 "insertion of drug-eluting stents."

Source: Health Care Statistics Branch, NCHS. Estimates are based on a sample of inpatient records from short-stay hospitals in the United States (NHDS, NCHS).

Note: These data do not reflect any procedures performed on an outpatient basis. Many more procedures are being performed on an outpatient basis. Some of the lower numbers in the table probably reflect this trend. Outpatient procedure data are not available at this time.

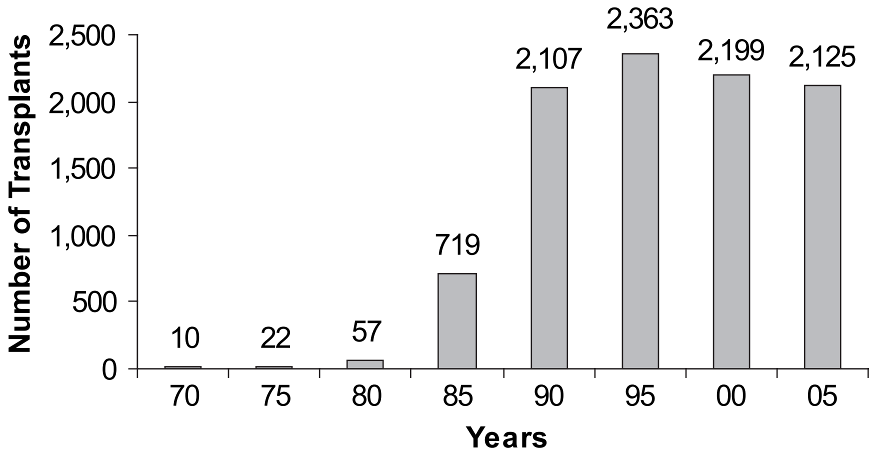

Chart 18-1. Trends in heart transplantations (United Network for Organ Sharing: 1970–2005). Source: United Network for Organ Sharing, scientific registry data.

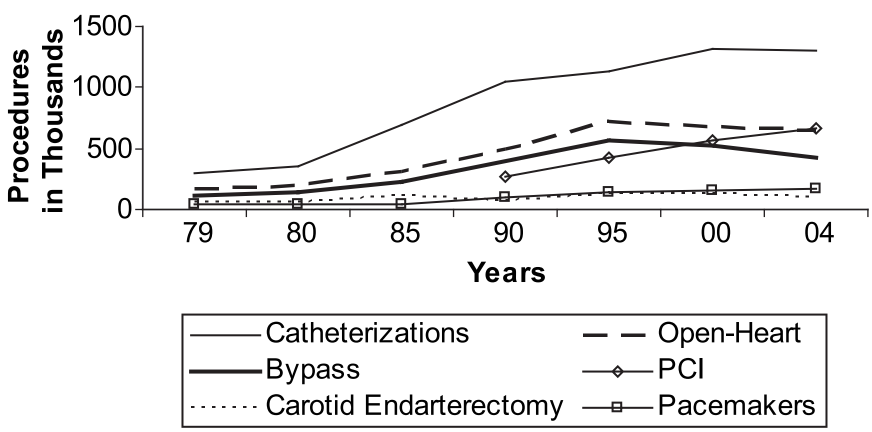

Chart 18-2. Trends in cardiovascular inpatient operations and procedures (United States: 1979–2004). Source: NHDS. NCHS and NHLBI. Note: In-hospital procedures only.

19. Economic Cost of Cardiovascular Diseases

See Chart 19-1 and Table 19-1.[1–5]

The cost of CVD and stroke in the United States for 2007 is estimated at $431.8 billion. This figure includes health expenditures (direct costs, which include the cost of physicians and other professionals, hospital and nursing home services, medications, home health care, and other medical durables) and lost productivity resulting from morbidity and mortality (indirect costs). By comparison, in 2004 the estimated cost of all cancers was $190 billion ($69 billion in direct costs, $17 billion in morbidity indirect costs, and $104 billion in mortality indirect costs). In 1999, the estimated cost of HIV infections was $28.9 billion ($13.4 billion direct and $15.5 billion indirect).

Abbreviations Used in Chapter 19

CHD	coronary heart disease
CHF	congestive heart failure
CVD	cardiovascular disease
HF	heart failure
NCHS	National Center for Health Statistics
NHLBI	National Heart, Lung, and Blood Institute

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TABLE 19-1. Estimated Direct and Indirect Costs (in Billions of Dollars) of CVD and Stroke: United States: 2007

	Heart Diseases*	CHD	Stroke	Hypertensive Disease	HF	Total CVD†
Direct costs						
Hospital	$94.2	$48.4	$17.9	$7.2	$17.8	$133.0
Nursing home	$22.0	$11.6	$15.2	$4.5	$4.2	$45.3
Physicians/other professionals	$22.2	$12.5	$3.5	$12.5	$2.3	$43.3
Drugs/other						
Medical durables	$20.0	$9.2	$1.2	$23.0	$3.0	$47.2
Home health care	$6.4	$1.9	$3.8	$2.1	$2.9	$14.4
Total expenditures†	$164.9	$83.6	$41.6	$49.3	$30.2	$283.2
Indirect costs						
Lost productivity/morbidity	$22.3	$9.8	$6.5	$7.8	...	$36.3
Lost productivity/mortality‡	$89.9	$58.2	$14.6	$9.3	$3.0	$112.3
Grand totals†	$277.1	$151.6	$62.7	$66.4	$33.2	$431.8

Ellipses (...) indicate data not available.

†Totals do not add up because of rounding and overlap.

*This category includes CHD, CHF, part of hypertensive disease, cardiac dysrhythmias, rheumatic heart disease, cardiomyopathy, pulmonary heart disease, and other or ill-defined "heart" diseases.

‡Lost future earnings of persons who will die in 2007, discounted at 3%.

Sources: Direct costs: Extrapolation from 1995 cost estimates for CVDs in Hodgson and Cohen[1] to the 2007 national health expenditure projections by the Centers for Medicare and Medicaid Services[2]; indirect morbidity costs extrapolated to 2007 from indirect cost estimates by disease in 1980 by Rice, Hodgson, and Kopstein[3] after applying a 1980–2007 inflation factor[4]; indirect mortality costs estimated by multiplying the numbers of deaths by age, sex, and cause in 2003[5] (NCHS mortality statistics) times estimates of the present value of lifetime earnings for 2002 by age and sex (unpublished estimates) furnished by Rice, Max, Michel, and Sung (University of California, San Francisco, 2005).

All estimates prepared by Thomas Thom, NHLBI.

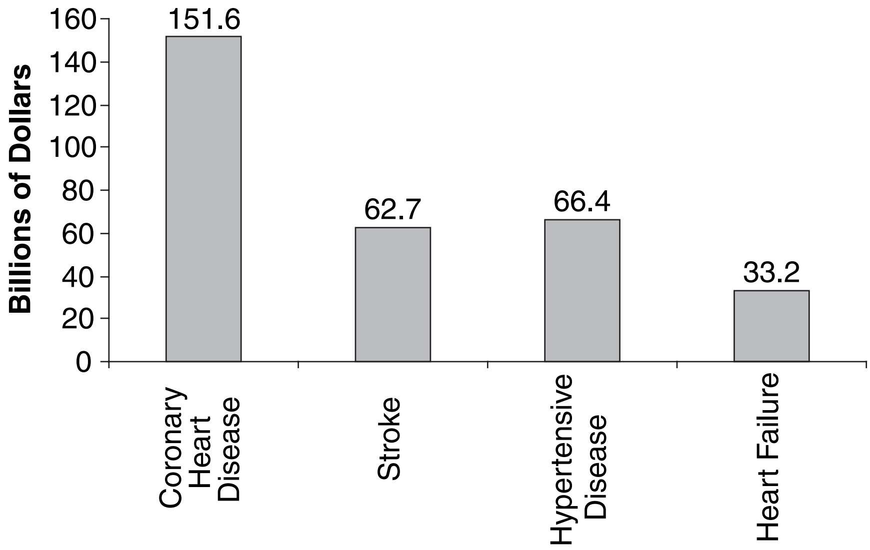

Chart 19-1. Estimated direct and indirect costs (in billions of dollars) of major CVD and stroke (United States: 2007). Source: NHLBI.

20. At-a-Glance Summary Tables

See Tables 20-1 through 20-4.

TABLE 20-1. Males and CVD: At-a-Glance Table

Diseases and Risk Factors	Both Sexes	Total Males	White Males	Black Males	Mexican-American Males
Total CVD					
Prevalence 2004†	79.4 M (37.1%)	37.3 M (37.5%)	37.2%	44.6%	31.6%
Mortality 2004§	871.5 K	410.4 K	353.5 K‖	47.5 K‖	. . .
CHD					
Prevalence 2004 CHD†	15.8 M (7.3%)	8.5 M (8.9%)	9.4%	7.1%	5.6%
Prevalence 2004 MI†	7.9 M (3.7%)	4.9 M (5.1%)	5.4%	3.9%	3.1%
Prevalence 2004 AP†	8.9 M (4.1%)	4.3 M (4.4%)	4.8%	3.4%	2.3%
New and recurrent CHD*¶	1.2 M	715.0 K	650.0 K	65.0 K	. . .
New and recurrent MI¶	865.0 K	520.0 K	. . .	. . .	. . .
Incidence AP (stable angina)¶	400.0 K	. . .	. . .	. . .	. . .
Mortality 2004 CHD§	452.3 K	233.3 K	205.5 K	22.9 K	. . .
Mortality 2004 MI§	157.6 K	83.1 K	73.6 K	7.8 K	. . .
Stroke					
Prevalence 2004†	5.7 M (2.6%)	2.4 M (2.6%)	2.4%	4.1%	3.1%
New and recurrent strokes§	700.0 K	327.0 K	277.0 K	50.0 K	. . .
Mortality 2004§	150.1 K	58.7 K	49.3 K	7.6 K	. . .
HBP					
Prevalence 2004†	72.0 M (33.6%)	33.0 M	32.5%	42.6%	28.7%
Mortality 2004§	54.2 K	22.8 K	16.5 K	5.6 K	. . .
HF					
Prevalence 2004†	5.2 M (2.5%)	2.6 M (2.8%)	2.8%	2.7%	2.1%
Mortality 2004§	57.7 K	22.5 K	20.0 K	2.1 K	. . .
Tobacco					
Prevalence 2004‡	46.0 M (20.9%)	25.1 M (23.4%)	24.1%	23.9%	18.9%#
Blood cholesterol					
Prevalence 2004:					
Total cholesterol ≥200 mg/dL†	105.2 M (48.4%)	50.1 M (47.8%)	47.9%	44.8%	49.9%
Total cholesterol ≥240 mg/dL†	36.6 M (16.8%)	17.0 M (16.2%)	16.1%	14.1%	16.0%
LDL cholesterol ≥130 mg/dL†	79.3 M (32.5%)	40.8 M (32.2%)	31.7%	32.4%	39.0%
HDL cholesterol <40 mg/dL†	44.1 M (16.7%)	31.7 M (25.1%)	26.2%	15.5%	27.7%
PA**					
Prevalence 2004‡	30.1%	31.4%	33.4%	29.5%	24.9%#
Overweight and obesity					
Prevalence 2004:					
Overweight BMI 25.0 or higher†	140.0 M (66.0%)	72.0 M (70.5%)	71.0%	67.0%	74.6%
Obesity BMI 30.0 or higher†	66.0 M (31.4%)	30.0 M (29.5%)	30.2%	30.8%	29.1%
Diabetes mellitus					
Prevalence 2004:					
Physician-diagnosed diabetes‡	15.2 M (7.1%)	7.3 M (7.4%)	6.7%	10.7%	11.0%
Undiagnosed diabetes‡	5.0 M (2.4%)	2.9 M (2.9%)	3.2%	17.0%	1.1%
Prediabetes‡	56.5 M (27.6%)	32.3 M (33.8%)	34.3%	23.1%	37.5%
Incidence, diagnosed diabetes†	1.5 M	. . .	. . .	. . .	. . .
Mortality 2004§	72.8 K	35.0 K	28.5 K	5.5 K	. . .

CHD includes MI, AP, or both. K indicates thousands; M, millions; mg/dL, milligrams per deciliter; and ellipses (. . .), data not available.

*New and recurrent MIs and fatal CHD.

†Age 20+.

‡Age 18+.

§All ages.

‖2003.

¶Age 35+.

#Hispanic.

**Regular leisure-time PA.

Sources: See summary tables for each chapter in this update. For data on men in other ethnic groups, see other chapters and Statistical Fact Sheets (http://www.americanheart.org/presenter.jhtml?identifier=2007).

TABLE 20-2. Females and CVD: At-a-Glance Table

Diseases and Risk Factors	Both Sexes	Total Females	White Females	Black Females	Mexican-American Females
Total CVD					
Prevalence 2004†	79.4 M (37.1%)	42.1 M (36.6%)	35.0%	49.0%	34.4%
Mortality 2004§	871.5 K	461.2 K	398.8 K	53.5 K	...
CHD					
Prevalence 2004 CHD†	15.8 M (7.3%)	7.2 M (6.1%)	6.0%	7.8%	5.3%
Prevalence 2004 MI†	7.9 M (3.7%)	3.0 M (2.5%)	2.5%	3.3%	2.1%
Prevalence 2004 AP†	8.9 M (4.1%)	4.6 M (3.9%)	3.9%	4.3%	3.3%
New and recurrent CHD*¶	1.2 M	485.0 K	425.0 K	60.0 K	...
New and recurrent MI¶	865.0 K	345.0 K	...	...	...
Incidence AP (stable angina)¶	400.0 K	...	...	...	...
Mortality 2004 CHD§	452.3 K	219.1 K	191.5 K	23.6 K	...
Mortality 2004 MI§	157.6 K	74.5 K	64.7 K	8.4 K	...
Stroke					
Prevalence 2004†	5.7 M (2.6%)	3.3 M (2.8%)	2.7%	4.1%	1.9%
New and recurrent strokes§	700.0 K	373.0 K	312.0 K	61.0 K	...
Mortality 2004§	150.1 K	91.5 K	78.8 K	10.4 K	...
HBP					
Prevalence 2004†	72.0 M (33.6%)	39.0 M	31.9%	46.6%	31.4%
Mortality 2004§	54.2 K	31.4 K	24.1 K	6.6 K	...
HF					
Prevalence 2004†	5.2 M (2.5%)	2.6 M (2.2%)	2.1%	3.3%	1.9%
Mortality 2004§	57.7 K	35.2 K	31.8 K	3.0 K	...
Tobacco					
Prevalence 2004‡	46.0 M (20.9%)	20.9 M (18.5%)	20.4%	17.2%	10.9%#
Blood cholesterol					
Prevalence 2004:					
Total cholesterol ≥200 mg/dL†	105.2 M (48.4%)	55.2 M (48.6%)	49.7%	42.1%	50.0%
Total cholesterol ≥240 mg/dL†	36.6 M (16.8%)	19.7 M (17.1%)	18.2%	12.5%	14.2%
LDL cholesterol ≥130 mg/dL†	79.3 M (32.5%)	38.6 M (32.4%)	33.8%	29.8%	30.7%
HDL cholesterol <40 mg/dL†	44.1 M (16.7%)	12.3 M (9.1%)	8.8%	6.9%	13.0%
PA**					
Prevalence 2004‡	30.1%	29.0%	31.8%	19.6%	21.8%#
Overweight and obesity					
Prevalence 2004:					
Overweight BMI 25.0 or higher†	140.0 M (66.0%)	60.8 M (61.6%)	57.6%	79.6%	73.0%
Obesity BMI 30.0 or higher†	66.0 M (31.4%)	36.0 M (33.2%)	30.7%	51.1%	39.4%
Diabetes mellitus					
Prevalence 2004:					
Physician-diagnosed diabetes‡	15.2 M (7.1%)	7.9 M (6.9%)	5.6%	13.2%	10.9%
Undiagnosed diabetes‡	5.0 M (2.4%)	2.1 M (1.9%)	1.7%	2.3%	3.1%
Prediabetes‡	66.5 M (27.6%)	22.2 M (21.7%)	21.6%	20.5%	22.6%
Incidence, diagnosed diabetes†	1.5 M	...	...	...	...
Mortality 2004§	72.8 K	37.8 K	29.4 K	7.2 K	...

CHD includes MI, AP, or both. K indicates thousands; M, millions; mg/dL, milligrams per deciliter; and ellipses (. . .), data not available.
*New and recurrent MIs and fatal CHD.
†Age 20+.
‡Age 18+.
§All ages.
||2003.
¶Age 35+.
#Hispanic.
**Regular leisure-time PA.
Sources: See summary tables for each chapter in this update. For data on women in other ethnic groups, see other chapters and Statistical Fact Sheets (http://www.americanheart.org/presenter.jhtml?identifier=2007).

TABLE 20-3. Ethnic Groups and CVD: At-a-Glance Table

		Whites		Blacks		Mexican Americans		Hispanics/Latinos	
Diseases and Risk Factors	Both Sexes	Males	Females	Males	Females	Males	Females	Males	Females
Total CVD									
Prevalence 2004†	79.4 M (37.1%)	37.2%	35.0%	44.6%	49.0%	31.6%	34.4%	. . .	. . .
Mortality 2004§	871.5 K	353.5 K	398.8 K	47.5 K	53.5 K	. . .	. . .	. . .	. . .
CHD									
Prevalence 2004 CHD†	15.8 M (7.3%)	9.4%	6.0%	7.1%	7.8%	5.6%	5.3%	6.0%	
Prevalence 2004 MI†	7.9 M (3.7%)	5.4%	2.5%	3.9%	3.3%	3.1%	2.1%	. . .	. . .
Prevalence 2004 AP†	8.9 M (4.1%)	4.8%	3.9%	3.4%	4.3%	2.3%	3.3%	. . .	. . .
New and recurrent CHD*‖	1.2 M	650.0 K	425.0 K	65.0 K	60.0 K	. . .	. . .	. . .	. . .
Mortality 2004 CHD§	452.3 K	205.5 K	191.5 K	22.9 K	23.6 K	. . .	. . .	. . .	. . .
Mortality 2004 MI§	157.6 K	73.6 K	64.7 K	7.8 K	8.4 K	. . .	. . .	. . .	. . .
Stroke									
Prevalence 2004†	5.7 M (2.6%)	2.4%	2.7%	4.1%	4.1%	3.1%	1.9%	2.8%‡	
New and recurrent strokes§	700.0 K	277.0 K	312.0 K	50.0 K	61.0 K	. . .	. . .	. . .	. . .
Mortality 2004§	150.1 K	49.3 K	78.8 K	7.6 K	10.4 K	. . .	. . .	. . .	. . .
HBP									
Prevalence 2004†	72.0 M (33.6%)	32.5%	31.9%	42.6%	46.6%	28.7%	31.4%	19.0%	
Mortality 2004§	54.2 K	16.5 K	24.1 K	5.6 K	6.6 K	. . .	. . .	. . .	. . .
HF									
Prevalence 2004†	5.2 M (2.5%)	2.8%	2.1%	2.7%	3.3%	2.1%	1.9%	. . .	. . .
Mortality 2004§	57.7 K	20.0 K	31.8 K	2.1 K	3.0 K	. . .	. . .	. . .	. . .
Tobacco									
Prevalence 2004‡	46.0 M (20.9%)	24.1%	20.4%	23.9%	17.2%	. . .	. . .	18.9%	10.9%
Blood cholesterol									
Prevalence 2004†:									
Total cholesterol ≥200 mg/dL†	105.2 M (48.4%)	47.9%	49.7%	44.8%	42.1%	49.9%	50.0%	. . .	. . .
Total cholesterol ≥240 mg/dL†	36.6 M (16.8%)	16.1%	18.2%	14.1%	12.5%	16.0%	14.2%	25.6%¶	
LDL cholesterol ≥130 mg/dL†	79.3 M (32.5%)	31.7%	33.8%	32.4%	29.8%	39.0%	30.7%	. . .	. . .
HDL cholesterol <40 mg/dL†	44.1 M (16.7%)	26.2%	8.8%	15.5%	6.9%	27.7%	13.0%	. . .	. . .
PA#									
Prevalence 2004‡	30.1%	33.4%	31.8%	29.5%	19.6%	. . .	. . .	24.9%	21.8%
Overweight and obesity									
Prevalence 2004:									
Overweight BMI 25.0 or higher†	140.0 M (66.0%)	71.0%	57.6%	67.0%	79.6%	74.6%	73.0%	38.9%‡	
Obesity BMI 30.0 or higher†	66.0 M (31.4%)	30.2%	30.7%	30.8%	51.1%	29.1%	39.4%	24.7%‡	
Diabetes mellitus									
Prevalence 2004:									
Physician-diagnosed diabetes‡	15.2 M (7.1%)	6.7%	5.6%	10.7%	13.2%	11.0%	10.9%	10.4%	
Undiagnosed diabetes‡	5.0 M (2.4%)	3.2%	1.7%	1.7%	2.3%	1.1%	3.1%	. . .	. . .
Prediabetes‡	56.5 M (27.6%)	34.3%	21.6%	23.1%	20.5%	37.5%	22.6%	. . .	. . .
Incidence, diagnosed diabetes†	1.5 M	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .
Mortality 2004§	72.8 K	28.5 K	29.4 K	5.5 K	7.2 K	. . .	. . .	. . .	. . .

CHD includes MI, AP, or both. K indicates thousands; M, millions; mg/dL, milligrams per deciliter; and ellipses (. . .), data not available.
*New and recurrent MIs and fatal CHD.
†Age 20+.
‡Age 18+.
§All ages.
‖Age 35+.
¶BRFSS (1997). *MMWR*, Vol. 49, No. SS-2, March 24, 2000.
#Regular leisure-time PA.
Sources: See summary tables for each chapter in this update. For data on other ethnic groups, see other chapters and Statistical Fact Sheets (http://www.americanheart.org/presenter.jhtml?identifier=2007).

TABLE 20-4. Children, Youth, and CVD: At-a-Glance Table

				Whites		Blacks		Mexican Americans	
Diseases and Risk Factors	Both Sexes	Total Males	Total Females	Males	Females	Males	Females	Males	Females
Congenital cardiovascular defects									
Mortality 2003 (all ages)	4.0 K	2.1 K	1.9 K	1.4 K	1.2 K	0.3 K	0.3 K	...	...
Mortality 2003 (age <15)	2.1 K	1.2 K	0.9 K	0.6 K	0.5 K	0.2 K	0.2 K	...	...
Tobacco									
Prevalence ages 12–17:									
Current cigarette use 2004	11.9%	11.3%	12.5%	13.3%	15.7%	6.5%	5.5%	8.8%*	9.4%*
High school students grades 9–12§:									
Current cigarette smoking 2005	23.0%	22.9%	23.0%	24.9%	27.0%	14.0%	11.9%	24.8%*	19.2%*
Current cigar smoking 2005	14.0%	19.2%	8.7%	21.0%	8.6%	12.3%	8.3%	20.0%*	9.1%*
Smokeless tobacco use 2005	8.0%	13.6%	2.2%	17.6%	2.7%	3.0%	0.4%	8.6%*	1.5%*
Blood cholesterol									
Ages 4–19									
Mean total cholesterol mg/dL	165	163	167	162	166	168	171	163	165
Mean HDL cholesterol mg/dL	...	...	...	48	50	55	56	51	52
Ages 12–19									
Mean LDL cholesterol mg/dL	...	...	...	91	100	99	102	93	92
PA†									
Prevalence 2003 grades 9–12§:									
Met currently recommended levels of PA on ≥5 of past 7 days	35.8%	43.8%	27.8%	46.9%	30.2%	38.2%	21.3%	39.0%*	26.5%*
Met previously recommended levels of PA on ≥3 of past 7 days	68.7%	75.8%	61.5%	77.0%	63.3%	71.7%	53.1%	76.0%*	62.6%*
Overweight									
Prevalence 2003:									
Preschool children ages 2–5‡	14%	...	...	11.5%		13.0%		19.2%	
Children ages 6–11‖	4.2 M (17.5%)	2.3 M (18.7%)	1.9 M (16.3%)	16.9%	15.6%	17.2%	24.8%	25.6%	16.6%
Adolescents ages 12–19‖	5.7 M (17.0%)	3.1 M (17.9%)	2.6 M (16.0%)	17.9%	14.6%	17.7%	23.8%	20.0%	17.1%
Students grades 9–12§	13.1%	16.0%	10.0%	15.2%	8.2%	15.9%	16.1%	21.3%*	12.1%*

K indicates thousands; M, millions; mg/dL, milligrams per deciliter; and ellipses (...), data not available. Overweight in children is BMI 95th percentile of the CDC 2000 growth chart.

*Hispanic.

†Regular leisure-time PA.

‡2003–2004.

§CDC. Youth Risk Behavior Surveillance, U.S., 2005. Surveillance Summaries, June 9, 2006. *MMWR.* 2006;55(SS-5).

‖2004.

Sources: See summary tables for related chapters in this update. For more data on congenital defects, see Chapter 6, and our Statistical Fact Sheet, Congenital Cardiovascular Defects (http://www.americanheart.org/presenter.jhtml).

Abbreviations Used in Chapter 20

AP	angina pectoris
BMI	body mass index
BRFSS	Behavioral Risk Factor Surveillance Survey
CHD	coronary heart disease
CVD	cardiovascular disease
HBP	high blood pressure
HDL	high-density lipoprotein
HF	heart failure
LDL	low-density lipoprotein
MI	myocardial infarction
PA	physical activity

21. Glossary

- *Age-adjusted rates*—Used mainly to compare the rates of 2 or more communities or population groups or the nation as a whole over time. The AHA uses a standard population (2000) so these rates are not affected by changes or differences in the age composition of the population.
- *Agency for Healthcare Research and Quality (AHRQ)*—A part of the US Department of Health and Human Services, this is the lead agency charged with supporting research designed to improve the quality of health care, reduce its cost, improve patient safety, decrease medical errors, and broaden access to essential services. AHRQ sponsors and conducts research that provides evidence-based information on healthcare outcomes, quality, cost, use, and access. The information helps healthcare decision makers—patients, clinicians, health system leaders, and policy makers—make more informed decisions and improve the quality of healthcare services.
- *Bacterial endocarditis*—An infection of the heart's inner lining (endocardium) or the heart valves. The bacteria that most often cause endocarditis are streptococci, staphylococci, and enterococci.
- *Body mass index (BMI)*—A mathematical formula to assess body weight relative to height. The measure correlates highly with body fat. Calculated as weight in kilograms divided by the square of the height in meters (kg/m^2).
- *Centers for Disease Control and Prevention/National Center for Health Statistics (CDC/NCHS)*—An agency within the US Department of Health and Human Services (USDHHS). The CDC conducts the Behavioral Risk Factor Surveillance System (BRFSS), an ongoing study. The NCHS also conducts or has conducted these studies (among others):

  - National Health Examination Survey (ongoing)
  - National Health and Nutrition Examination Survey I (NHANES I, 1971 to 1974)
  - National Health and Nutrition Examination Survey II (NHANES II, 1976 to 1980)
  - National Health and Nutrition Examination Survey III (NHANES III, 1988 to 1994)
  - National Health and Nutrition Examination Survey (NHANES, 1999–. . . .) (ongoing)
  - National Health Interview Survey (NHIS) (ongoing)
  - National Home and Hospice Care Survey (ongoing)
  - National Hospital Discharge Survey (NHDS) (ongoing)

- *Centers for Medicare and Medicaid Services (CMS), formerly Health Care Financing Administration (HCFA)*—The federal agency that administers the Medicare, Medicaid, and Child Health Insurance Programs, which provide health insurance for more than 74 million Americans.
- *Comparability ratio*—Provided by the NCHS to allow time-trend analysis from one ICD revision to another. It compensates for the "shifting" of deaths from one causal code number to another. Its application to mortality based on one ICD revision means that mortality is "comparability modified" to be more comparable to mortality coded to the other ICD revision.
- *Coronary heart disease (CHD) (ICD-10 codes I20–I25)*—This category includes acute myocardial infarction (I21–I22); other acute ischemic (coronary) heart disease (I24); angina pectoris (I20); atherosclerotic cardiovascular disease (I25.0); and all other forms of chronic ischemic coronary heart disease (I25.1–I25.9).
- *Death rate*—The relative frequency with which death occurs within some specified interval of time in a population. National death rates are computed per 100 000 population. Dividing the mortality by the population gives a crude death rate. It is restricted because it does not reflect a population's composition with respect to such characteristics as age, sex, race, or ethnicity. Thus, rates calculated within specific subgroups, such as age-specific or sex-specific rates, are often more meaningful and informative. They allow well-defined subgroups of the total population to be examined.
- *Diseases of the circulatory system (ICD codes I00–I99)*—Included as part of what the American Heart Association calls "cardiovascular disease." Mortality data for states can be obtained from cdc.gov/nchs, by direct communication with the CDC/NCHS, or from our National Center Biostatistics Program Coordinator on request. (See "Total cardiovascular disease" in this Glossary.)
- *Diseases of the heart*—Classification the NCHS uses in compiling the leading causes of death. Includes acute rheumatic fever/chronic rheumatic heart diseases (I00–I09); hypertensive heart disease (I11) and hypertensive heart and renal disease (I13); coronary heart disease (I20–I25); pulmonary heart disease and diseases of pulmonary circulation (I26–I28); heart failure (I50); and other forms of heart disease (I29–I49, I50.1–I51). "Diseases of the heart" are not equivalent to "total cardiovascular disease," which the American Heart Association prefers to use to describe the leading causes of death.
- *Health Care Financing Administration (HCFA)*—See Centers for Medicare and Medicaid Services (CMS).
- *Hispanic origin*—In US government statistics, "Hispanic" includes persons who trace their ancestry to Mexico, Puerto Rico, Cuba, Spain, the Spanish-speaking countries of Central or South America, the Dominican Republic, or other Spanish cultures, regardless of race. It does not include people from Brazil, Guyana, Suriname, Trinidad, Belize, or Portugal because Spanish is not the first language in those countries. Much of our data are for Mexican Americans or Mexicans, as reported by government agencies or specific studies. In many cases, data for all Hispanics are more difficult to obtain.
- *Hospital discharges*—The number of inpatients discharged from short-stay hospitals where some type of disease was the first-listed diagnosis. Discharges include those discharged alive, dead, or status unknown.
- *International Classification of Diseases (ICD) codes*—A classification system in standard use in the United States. The *International Classification of Diseases* is published by the World Health Organization. This system is reviewed and

revised about every 10 to 20 years to ensure its continued flexibility and feasibility. The tenth revision (ICD-10) began with the release of 1999 final mortality data. The ICD revisions can cause considerable change in the number of deaths reported for a given disease. The NCHS provides "comparability ratios" to compensate for the "shifting" of deaths from one ICD code to another. To compare the number or rate of deaths with that of an earlier year, the "comparability-modified" number or rate is used.

- *Incidence*—An estimate of the number of new cases of a disease that develop in a population, usually in a 1-year period. For some statistics, new and recurrent attacks, or cases, are combined. The incidence of a specific disease is estimated by multiplying the incidence rates reported in community- or hospital-based studies by the US population. The rates in this report change only when new data are available; they are not computed annually.
- *Major cardiovascular diseases*—Disease classification commonly reported by the NCHS; represents ICD codes I00–I78. The American Heart Association does not use "major cardiovascular diseases" for any calculations. See "Total cardiovascular disease" in this Glossary.
- *Metabolic syndrome*—The metabolic syndrome is defined* as the presence of any 3 of the following 5 diagnostic measures: elevated waist circumference (≥102 cm in men or ≥88 cm in women); elevated triglycerides (≥150 mg/dL [1.7 mmol/L] or drug treatment for elevated triglycerides); reduced HDL (high-density lipoprotein) cholesterol (<40 mg/dL [0.9 mmol/L] in men or <50 mg/dL [1.1 mmol/L] in women or drug treatment for reduced HDL cholesterol); elevated blood pressure (≥130 mm Hg systolic blood pressure or ≥85 mm Hg diastolic blood pressure or drug treatment for hypertension); and elevated fasting glucose (≥100 mg/dL or drug treatment for elevated glucose).
- *Morbidity*—Incidence and prevalence rates are both measures of morbidity—that is, measures of various effects of disease on a population.
- *Mortality*—The total number of deaths from a given disease in a population during a specific interval of time, usually a year. These data are compiled from death certificates and sent by state health agencies to the NCHS. The process of verifying and tabulating the data takes about 2 years. For example, 2004 mortality statistics, the latest available, did not become available until late 2006. Mortality is "hard" data, so it is possible to do time-trend analysis and compute percentage changes over time.
- *National Heart, Lung, and Blood Institute (NHLBI)*—An institute in the National Institutes of Health in the US Department of Health and Human Services. The NHLBI conducts such studies as the:
  - Framingham Heart Study (FHS) (1948 to date).
  - Honolulu Heart Program (HHP) (1965–1997).
  - Cardiovascular Health Study (CHS) (1988 to date).
  - Atherosclerosis Risk in Communities (ARIC) study (1985 to date).
  - Strong Heart Study (SHS) (1989 to 1992; 1991 to 1998).
  - The NHLBI also published reports of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure and the Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III, or ATP III.)
- *National Institute of Neurological Disorders and Stroke (NINDS)*—An institute in the National Institutes of Health in the US Department of Health and Human Services. The NINDS sponsors and conducts research studies such as these:
  - Greater Cincinnati/Northern Kentucky Stroke Study (GCNKSS)
  - Rochester (Minnesota) Stroke Epidemiology Project
  - Northern Manhattan Study (NOMAS)
  - Brain Attack Surveillance in Corpus Christi (BASIC) Project

Prevalence—An estimate of the total number of cases of a disease existing in a population during a specified period. Prevalence is sometimes expressed as a percentage of population. Rates for specific diseases are calculated from periodic health examination surveys that government agencies conduct. Annual changes in prevalence as reported in this booklet only reflect changes in the population; rates do not change until there is a new survey. Changes in rates can only be evaluated with data from new surveys. Estimates from NHANES 1999–2004 applied to 2004 population estimates.

Note

In the data tables, which are located in the different disease and risk factor categories, if the percentages shown are age adjusted, they will not add to the total.

- *Race and Hispanic origin*—Race and Hispanic origin are reported separately on death certificates. In this publication, unless otherwise specified, deaths of persons of Hispanic origin are included in the totals for whites, blacks, American Indians or Alaska Natives, and Asian or Pacific Islanders, according to the race listed on the decedent's death certificate. Data for Hispanic persons include all persons of Hispanic origin of any race. See "Hispanic origin" in this Glossary.
- *Stroke (ICD-10 codes I60–I69)*—This category includes: subarachnoid hemorrhage (I60); intracerebral hemorrhage (I61); other nontraumatic intracranial hemorrhage (I62); cerebral infarction (I63); stroke, not specified as hemorrhage or infarction (I64); occlusion and stenosis of precerebral arteries not resulting in cerebral infarction (I65); occlusion and stenosis of cerebral arteries not resulting in cerebral infarction (I66); other cerebrovascular diseases (I67); cerebrovascular disorders in diseases classified elsewhere (I68), and sequelae of cerebrovascular disease (I69).
- *Total cardiovascular disease (ICD-10 codes I00–I99, Q20-Q28)*—This category includes: rheumatic fever/rheumatic heart disease (I00–I09); hypertensive diseases (I10–I15); ischemic (coronary) heart disease (I20–I25); pulmonary heart disease and diseases of pulmonary circulation (I26–I28); other forms of heart disease (I30–I52); cerebrovas-

*According to criteria established by the American Heart Association and National Heart, Lung, and Blood Institute, in "Diagnosis and Management of the Metabolic Syndrome: An American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement," published in *Circulation* (*Circulation*. 2005;112:2735–2752).

cular disease (stroke) (I60–I69); atherosclerosis (I70); other diseases of arteries, arterioles and capillaries (I71–I79); diseases of veins, lymphatics and lymph nodes not classified elsewhere (I80–I89); and other and unspecified disorders of the circulatory system (I95–I99). When data are available, we include congenital cardiovascular defects (Q20–Q28).

- *Underlying or contributing cause of death*—These terms are used by the NCHS when defining mortality. Underlying mortality is defined by World Health Organization as "the disease or injury which initiated the train of events leading directly to death, or the circumstances of the accident or violence which produced the fatal injury." Contributing mortality would be any other disease or condition which the decedent may have also had.

Abbreviation Guide

AA—African American
AAA—abdominal aortic aneurysm
ACE—angiotensin-converting enzyme
ACS—acute coronary syndrome
AF—atrial fibrillation
AHA—American Heart Association
AHRQ—Agency for Healthcare Research and Quality
AP—angina pectoris
ARB—angiotensin receptor blocker
ARIC—Atherosclerosis Risk in Communities study
BASIC—Brain Attack Surveillance in Corpus Christi
BMI—body mass index
BP—blood pressure
BRFSS—Behavioral Risk Factor Surveillance Survey
CDC—Centers for Disease Control and Prevention
CHD—coronary heart disease
CHF—congestive heart failure
CHS—Cardiovascular Health Study
CI—confidence interval
CLRD—chronic lower respiratory disease
CVD—cardiovascular disease
DVT—deep vein thrombosis
EMS—emergency medical services
ESRD—end-stage renal disease
FHS—Framingham Heart Study
GCNKSS—Greater Cincinnati/Northern Kentucky Stroke Study
GWTG—Get With The Guidelines^{SM}
HbA_{1c}—glycosylated hemoglobin
HBP—high blood pressure
HDL—high-density lipoprotein
HERS—Heart and Estrogen/progestin Replacement Study
HF—heart failure
HHP—Honolulu Heart Program
ICD—International Classification of Diseases
JNC—Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure
LDL—low-density lipoprotein
MET—metabolic equivalent
MetS—metabolic syndrome
MI—myocardial infarction
NAMCS—National Ambulatory Medical Care Survey
NASCET—North American Symptomatic Carotid Endarterectomy
NCHS—National Center for Health Statistics
NH—non-Hispanic
NHAMCS—National Hospital Ambulatory Medical Care Survey
NHANES—National Health and Nutrition Examination Survey
NHDS—National Hospital Discharge Survey
NHIS—National Health Interview Survey
NHLBI—National Heart, Lung, and Blood Institute
NINDS—National Institute of Neurological Disorders and Stroke
NNHS—National Nursing Home Survey
NOMAS—Northern Manhattan Study
OR—odds ratio
PA—physical activity
PAD—peripheral arterial disease
PCI—percutaneous coronary intervention
PE—pulmonary embolism
REGARDS—Reasons for Geographic and Racial Differences in Stroke
RR—relative risk
rtPA—recombinant tissue plasminogen activator
SHS—Strong Heart Study
SIPP—Survey of Income and Program Participation
STOP—Stroke Prevention Trial in Sickle Cell Anemia
STS—Society of Thoracic Physicians
TIA—transient ischemic attack
USDHHS—United States Department of Health and Human Services
VSD—ventricular septal defect
WEST—Women's Estrogen for Stroke Trial
YMCLS—Youth Media Campaign Longitudinal Study
YRBS—Youth Risk Behavior Surveillance span

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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (1) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (2) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.